

CSP Questions and Answers- Part-II

Question #: 744- Of all occupational diseases occurring in industry, the most common is?

- 1) Lead poisoning 2) Silicosis 3) Mercurialism **4) Dermatitis**

Answer:- Dermatitis is the most common of all occupational diseases.

Question #: 745- Dermatitis tends to be **most severe** in which of the following industries?

- 1) Silver** 2) Meat packing 3) Lead battery 4) Concrete products

Answer:- Using lost work day rates as a measure of severity, dermatitis is the most severe in the silver industry, followed by the meat packing industry, then the lead battery industry and finally the concrete production industry.

Question #: 746- Overexertion injuries associated with manual materials handling jobs account for at least _____ of all occupational injuries:

- 1) 15% 2) 20% **3) 25%** 4) 30%

Answer:- The National Safety Council reports that at least 25% of all occupational injuries resulted from overexertion associated with manual materials handling work consisting of lifting, lowering, pushing, and pulling operations.

Question #: 747- Carpal tunnel syndrome occurs more frequently in:

- 1) Men **2) Women** 3) Approximate equal distribution 4) Depends on body weight

Answer:- Statistics indicate that more women get carpal tunnel syndrome than men.

Question #: 748- When is the highest incidence of sharp object injuries from a medical device?

- 1) During use 2) Pre-use 3) During disposal **4) After use, pre-disposal**

Answer:- The highest incidence of sharp object injuries from medical devices occur after use, prior to disposal. This is the most dangerous time, since the object is contaminated with potential infectious agents from blood.

Question #: 749- Atoms of the same element with different atomic weights are called:

- 1) Electrons **2) Isotopes** 3) Inert elements 4) Matter

Answer:- An isotope is one or more atomic species of an element differing in atomic weight, but having the same atomic number. Each contains the same number of protons, but a different number of neutrons.

Question #: 750- The force of attraction between molecules of the same kind is called:

1) Cohesion 2) Adhesion 3) Malleability 4) Ductility

Answer:- Molecules have an affinity for each other. The force of attraction between molecules of the same kind is called cohesion. The force of attraction between molecules of different kinds is called adhesion.

Question #: 751- Which of the following chemicals is not combustible?

1) Carbon black 2) Sulfur 3) Lamp black **4) Sodium chloride**

Answer:- Most organic chemicals (those with carbon atoms) are combustible, while most inorganic chemicals (those without carbon atoms) are non-combustible.

Question #: 752- The ability of a material to be beaten or rolled into thin sheets is called:

1) Hardness 2) Ductility **3) Malleability** 4) Tenacity

Answer:- The ability of a material to be beaten or rolled into thin sheets is called malleability. Gold is among the most malleable substances. Others include iron, copper, tin and aluminum.

Question #: 753- 10 ml of 10 molar HCl contains _____ moles of HCl. This amount of HCl will neutralize _____ ml of 0.1 normal HNO₃.

1) 0.1, 0.1 2) 0.1, 0.05 3) 0.05, 0.1 **4) HCl will not neutralize HNO₃**

Answer:- Since both are strong acids, no neutralization will take place. Neutralization is a reaction between an acid and a base. Since both are very strong acids they will be nearly 100% ionized in solution; both will use water as their proton acceptor.

Question #: 754- A radioisotope has a half life of 1 year. How many years will it take to reduce the initial activity to less than 10%?

1) 1 year 2) 2 years 3) 3 years **4) 4 years**

Answer:- After 1 year, the activity will be 50%. After two years, the activity will be half of 50%, or 25%. The activity after three years will be 12.5% of the initial activity. After 4 years the activity will be 6.25% of the initial activity. This is less than 10%.

Question #: 755- A solution contains 10^{-1} moles of HYDROGEN ions per liter. The solution is:

1) A strong base **2) A strong acid** 3) A weak base 4) A weak acid

Answer:- 10^{-1} moles of H⁺ ions is equal to a pH of 1. This is a strong acid solution.
 $\text{pH} = -\log (\text{concentration of hydrogen ions/liter}) = -\log (10^{-1}) = 1$

Question #: 756- A tank of helium contains 150 l of gas at a pressure of 110 atm. What volume would the gas occupy at 1 atm assuming the temperature remains unchanged?

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- 1) **16,500 liters** 2) 1.36 liters 3) 0.73 liters 4) 6.06×10^{-5} liters

Answer:- Use Boyle's law ($P_1 V_1 = P_2 V_2$) and solve for V_2

$$V_2 = (P_1 V_1) / P_2 = (110 \text{ atm} * 150 \text{ liters}) / 1 \text{ atm} = 16,500 \text{ liters}$$

Question #: 757- A tank truck has been involved in a fire. By the time you arrive, the label on the truck only indicates that the material has a pH of 12. What does this tell you?

- 1) Material is flammable 2) Material is acidic **3) Material is basic** 4) Material is neutral

Answer:- A pH of 12 is a basic solution. A pH less than 7 is acidic, a pH equal to 7 is neutral, and a pH greater than 7 is basic.

Question #: 758- Tuberculosis is spread by:

- 1) Intimate sexual contact 2) Contaminated blood **3) Airborne droplet nuclei** 4) Fomites

Answer:- Tuberculosis (TB) is a bacterial disease which is spread by airborne droplet nuclei containing the infectious bacteria in closed air spaces. TB is not spread by sexual contact or contaminated blood or blood products.

Question #: 759- A person infected with tuberculosis:

- 1) Always shows symptoms 2) Not always tests positive
3) Can spread disease with no symptoms **4) May never show symptoms**

Answer:- People infected with tuberculosis may never develop active TB. 5-15% develop active disease within the first 2 years of primary infection. Therefore, the symptoms may never be evident. When the infected person is not showing symptoms, they are not infectious and cannot spread the disease. TB infected people always test positive for TB.

Question #: 760- Tuberculosis outbreaks have increased in recent years because of all of the following EXCEPT:

- 1) Non-compliance with drug therapy **2) Contaminated blood supply**
3) Multi-drug resistant bacteria 4) Human immunodeficiency virus

Answer:- Tuberculosis is not transmitted by contaminated blood. Infected people who do not comply with the proper drug therapy cause an increase in drug resistant bacteria. Many HIV infected patients develop TB due to their reduced immune competence.

Question #: 761- Disinfection means:

- 1) Killing/removing all organisms

2) Reducing the number of organisms so there is no threat of disease

- 3) Removing microorganisms from skin or living tissue
- 4) Stopping the growth of microorganisms

Answer:- Disinfection is used on inanimate objects to reduce the number of pathogens to such a low concentration that there is no threat of disease. Sterilization is the killing and removing of all organisms from a surface. Antisepsis is the removal of microbes from the skin or living tissue. Bacteriostatic agents stop bacterial growth.

Question #: 762- The phenol coefficient is:

- 1) A measure of microbial resistance to phenol disinfectant
- 2) A measure of microbial resistance to disinfectants
- 3) A measure of phenol in a disinfectant
- 4) **A measure of the effectiveness of a disinfectant**

Answer:- The phenol coefficient is the ratio of the smallest concentration of a disinfectant that will kill a certain percentage of organisms in 5-10 minutes to the smallest concentration of phenol that will kill in the same time period. It measures the effectiveness of the disinfectant.

Question #: 763- Bacterial and viral disinfectants work in all of the following ways EXCEPT:

- 1) Alteration of protein structure
- 2) Disruption of lipids in cell membrane
- 3) ~~Destruction of nuclear membrane~~
- 4) Nucleic acid destruction

Answer:- Viruses and bacteria have no nucleus or nuclear membrane to disrupt. Disinfectants work through action on proteins, cell membranes, and viral nucleic acid.

Question #: 764- What biosafety level should be used when working with blood and blood products?

- 1) 1
- 2) **2**
- 3) 3
- 4) 4

Answer:- Biosafety level 2 is recommended by the Centers for Disease Control for working with human-derived blood, body fluids, or tissues where the presence of an infectious agent may be unknown.

Question #: 765- What is the function of the ear's eustachian tube?

- 1) **Pressure equalization**
- 2) Transmission of sound waves
- 3) Collect dirt
- 4) Prevent infection

Answer:- The eustachian tube serves to equalize pressure in the middle ear with the external atmospheric pressure. It opens during swallowing and yawning.

Question #: 766- Which of the following chemicals is least likely to produce kidney damage in humans?

- 1) Chlorinated hydrocarbons
- 2) Chromium
- 3) ~~Benzene~~
- 4) Carbon disulfide

Answer: Chlorinated hydrocarbons, carbon disulfide, chromium, and other heavy metals such as uranium, lead, and mercury are nephrotoxins - chemicals that produce kidney damage in humans. Benzene is toxic primarily to the hematopoietic systems.

Question #: 767- Which of the following is the most hazardous to your health if ingested?

- 1) **Wood alcohol** 2) Isopropyl alcohol 3) Glyceryl alcohol 4) Grain alcohol

Answer:- Wood alcohol is methyl alcohol (methanol), which is toxic when ingested; drinking it may cause blindness. Isopropyl alcohol is rubbing alcohol, glyceryl alcohol is an industrial solvent, and flavored diluted grain alcohol is a beverage.

Question #: 768- Carpal tunnel syndrome involves an injury to the median nerve. The nerve is compressed due to inflammation in the carpal tunnel. Carpal tunnel syndrome will NOT result in:

- 1) **Numbness in the little finger** 2) Pain in the wrist upon exertion
3) Pain in the second and third fingers 4) Numbness in the thumb

Answer:- The little finger is not served by the median nerve, therefore the little finger is not affected by compression of the median nerve in the carpal tunnel.

Question #: 769- In heat stroke, the:

- 1) Body temperature is lowered 2) **Body temperature is elevated**
3) Body temperature is normal 4) Patient sweats profusely

Answer:2- In heat stroke the patient has an elevated temperature and does not sweat.

Question #: 770- In which part of the ear is mechanical energy converted to electrical energy?

- 1) Outer ear 2) Middle ear 3) **Inner ear** 4) Outer ossicular area

Answer:3- In the cochlea the energy is changed from mechanical (fluid waves) to electrical (nerve impulses).

Question #: 771- Melanoma is a serious type of skin cancer. Which of the following is the most common occupational cause of melanoma?

- 1) Asphalt tar 2) Ultraviolet light from black lights 3) **Sunlight** 4) Nitrosoamines

Answer:3- Sunlight is the most common occupational cause of melanoma skin cancer in caucasian workers.

Question #: 772- Numbness of the fingers is associated with:

- 1) Siderosis 2) **Raynaud's Phenomenon** 3) Lead poisoning 4) Tetanus

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Answer:2- Raynaud's Phenomenon is a disorder associated with the use of hand held vibrating tools. It results in a loss of feeling and is characterized by white spots on the fingers and hands.

Question #: 773- The cochlea is essentially a coiled tube. At one end of the tube is the oval window. The function of the oval window is to:

1) **Receive the vibrations from the eardrum** 2) Shield the semicircular canals from interference 3) Protect the auditory canal 4) Receive neural input from the auditory nerve

Answer:1- The oval window is the entry point for the vibrations coming from the eardrum via the ossicles. The vibrations enter the cochlea, move through the fluid and stimulate hair-like cells. Stimulation of these cells sends an impulse to the brain for analysis.

Question #: 774- The greenhouse effect is due to a disruption in which geochemical cycle?

1) Nitrogen 2) Sulfur 3) **Carbon** 4) Oxygen

Answer:3- The greenhouse effect is caused by a disruption in the global carbon cycle.

Question #: 775- What is the most serious heat related disease?

1) **Heat stroke** 2) Heat neurosis 3) Acute heat exhaustion 4) Heat syncope

Answer:1- In heat stroke the body temperature rises to dangerous levels and the heat control mechanisms are shut down.

Question #: 776- Which of the following is likely to increase proneness to skin problems?

1) Dry skin 2) Oily skin 3) Fair skin 4) **All of the above**

Answer:4- Dry, oily, or fair skin makes the individual more susceptible to one form or another of skin disorders.

Question #: 777- For indoor air quality investigations, carbon dioxide concentrations above _____ppm indicate inadequate ventilation.

1) 350 ppm 2) 600 ppm 3) 700 ppm 4) **1,000 ppm**

Answer:4- NIOSH guidelines specify that CO₂ concentrations of 1,000 ppm or greater indicate inadequate ventilation. The number may even be less than 1,000 ppm (e.g., in the 750-800 ppm range).

Question #: 778- You are asked to inspect a 10 psi(g) unfired pressure vessel. What do you already know about it?

1) Safety professionals do not perform pressure vessel inspections
2) No formal inspection criteria exist

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3) Unfired pressure vessel regulations do apply

4) Unfired pressure vessel regulations do not apply

Answer:4- Unfired pressure vessel regulations do not apply to unfired pressure vessels which operate at pressures below 15 psi(g).

Question #: 779- A static coefficient of friction (SCOF) of ____ or higher is considered the minimum for pedestrian safety under most conditions.

- 1) 0.10 2) 0.30 **3) 0.50** 4) 0.70

Answer:3- Although there is no regulation setting this as the minimum SCOF, most authorities agree that 0.50 is the minimum acceptable SCOF. A SCOF of 0.50 or greater is required by UL 410 for a floor product to be listed under that consensus standard.

Question #: 780- When a crane is repaired or extensively overhauled, how much load must be placed on the crane to test it prior to returning it to service?

- 1) 100% of rated capacity **2) 125% of rated capacity**
3) 150% of rated capacity 4) 200% of rated capacity

Answer:2- The standard load test requirement is 125% of the rated capacity of the crane. This is the same load that is used when the unit is new from the manufacturer.

Question #: 781- Electrical fires are one of the most common types of building fires in the United States. What is the most common type of electrical equipment involved in electrical fires?

- 1) Heating equipment 2) Cooking equipment
3) Electrical distribution equipment 4) Air conditioning and refrigeration equipment

Answer:3- Distribution equipment is the primary cause of most electrical fires since it is often hidden and it is usually energized constantly.

Question #: 782- If an employee is exposed to continuous noise at the level of 90 dBA averaged over the eight hour work day, the employer must do all of the following EXCEPT:

- 1) Implement feasible engineering or administrative controls
2) Include the employee in a Hearing Conservation Program
3) Establish a Hearing Conservation Program 4) Isolate the noise source

Answer:4- OSHA's Hearing Conservation Standard requires that feasible administrative or engineering controls be implemented if exposure is greater than or equal to 90 dBA. If the noise exposure is greater than or equal to 85 dBA, a hearing conservation program must be established and any exposed employees must be enrolled in it.

Question #: 783- What is the total resistance of three 30 W devices connected in series?

- 1) 10 W 2) 30 W **3) 90 W** 4) 27,000 W

Answer:3- For a series circuit: $RT = 30\text{ W} + 30\text{ W} + 30\text{ W}$; $RT = 90\text{ W}$

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Question #: 784 -What is total resistance of three 30 W devices connected in parallel?

- 1) **10 W** 2) 30 W 3) 90 W 4) 27,000 W

Answer:1- For a parallel circuit: $1/RT = 1/30\text{ W} + 1/30\text{ W} + 1/30\text{ W}$ $RT = 10\text{ W}$

Question #: 785 - What is the **total power** of a **parallel 110 V circuit** where the current flow through the branches is 12.3 A, 8.5 A and 4.2 A?

- 1) 1,265 W **2) 2,750 W** 3) 3,552 W 4) 4,321 W

Answer:2- For a parallel circuit, the total current is the sum of the branch currents (opposite from calculating resistances).

$$IT = 12.3\text{ A} + 8.5\text{ A} + 4.2\text{ A} \quad IT = 25\text{ A} \quad P = E * I \quad P = 110\text{ V} * 25\text{ A} = 2,750\text{ W}$$

Question #: 786 - In one type of explosimeter, a series of resistors is balanced and a portion of the circuit is exposed to air containing a combustible gas. The combustion causes an imbalance. The circuit is called a:

- 1) Combustible resistor circuit (CRC) **2) Wheatstone bridge**
3) Combustible balancing circuit (CBC) 4) Combustible ampere circuit (CAC)

Answer:2- A common circuit used to measure differences in current flow and hence resistance is the Wheatstone bridge. In this circuit the resistances are balanced, then one part of the circuit is exposed to an external atmosphere containing flammable gases. This unbalances the circuit because the heat of combustion from the hot wire interacting with the flammable gas results in a measurably higher resistance.

Question #: 787 - What is the maximum number of lighting and appliance circuits permitted in any one circuit breaker cabinet?

- 1) 22 **2) 42** 3) 100 4) No limit, cabinets can be sized to hold additional circuits

Answer:2- 42 circuits permitted in a circuit breaker cabinet. NFPA 70 Article 384-15 (NEC).

Question #: 788 - Equipment connected by cord and plug shall be grounded for any of the following **EXCEPT** when:

- 1) The equipment is used by persons standing on metal floors
2) The equipment operates at 220 V to ground
3) The equipment is used by persons working inside a metal tank
4) ~~The equipment operates at 120 V to ground~~

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Answer:4- Equipment connected by cord and plug shall be grounded if it is used in a hazardous location, if it operates at more than 150 V to ground, if it is used in a damp or wet location, if it is used by persons standing on the ground, or on metal floors, or working inside metal tanks or boilers, or if it is likely to be used in wet and conductive locations. 29 CFR 1910.305 (g)

Question #: 789- The voltage on the secondary side of a step-down transformer is _____ the voltage on the primary side.

- 1) Lower than 2) Higher than 3) Equal to 4) Not related to

Answer:1- The secondary side of a step-down transformer side features the "stepped down" voltages, therefore the secondary side is of lower voltage.

Question #: 790- As a safety professional, you are notified that some rigid metal conduit is warm to the touch. What is your suspicion?

- 1) Short in system 2) Transformer is undersized
3) Aluminum wire 4) Current flow is too high

Answer:4- This would probably indicate that current flow is too high in the conduit. Further investigation and corrective action should also take place.

Question #: 791- Electric power tools which do not have separate grounding conductors must:

- 1) Never be used 2) Have three-wire systems
3) Have grounding straps attached to the chassis 4) Be double insulated

Answer:4- Double insulated tools do not require separate grounding conductors.

Question #: 792- In an industrial transformer, the "primary" side is generally recognized by any of the following **EXCEPT**:

- 1) Direct feed from power lines 2) ~~Last part of transformer to see current~~
3) Higher voltages than the secondary side 4) First part of transformer to see current

Answer:2 - The "primary" side of a conventional industrial transformer receives the highest voltage from the electrical service and then steps down the voltage.

Question #: 793- A megohm meter is used to:

- 1) Measure large voltages 2) Measure large resistances
3) Measure earth faults 4) Measure large currents

Answer:2- A megohm meter measures large resistances.

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Question #: 794- With what instrument can the continuity of a ground be tested in an electrical hand tool?

- 1) Voltmeter 2) X-Ray 3) Tester with light **4) Ohmmeter**

Answer:4- An ohmmeter can test the continuity of a ground in an electrical hand tool.

Question #: 795- When does the Corona Effect occur?

- 1) Upon electromagnetic radiation effects
2) Upon low voltage current from which a spark occurs
3) Upon a partial breakdown of a gap between two conductors in a high voltage circuit
4) Upon the breakdown of the insulation in a high voltage conductor

Answer:3- Corona occurs in high voltage circuits when breakdown of a gap between two conductors is partial.

Question #: 796- Which is not an acceptable grounding means?

- 1) Open switch ground** 2) Resistance ground
3) Reactance ground 4) Resonance ground

Answer:1- Open switch ground is not an acceptable grounding means.

Question #: 797- For Class I locations Groups A, B, C and D, the classifications involve determinations of:

- 1) Minimum explosion pressure, minimum safe clearance between parts of a clamped joint in an enclosure, and the maximum auto-ignition temperature of the atmospheric mixture
2) Maximum explosion pressure, maximum safe clearance between parts of a clamped point in an enclosure, and the minimum auto-ignition temperature of the atmospheric mixture
3) The chemical mixture and explosive pressure
4) The ignition temperature of the gas only

Answer:2- Maximum explosion pressure and maximum safe clearance between joints in the enclosure are the critical issues. NFPA 70 Article 500-3 (National Electric Code)

Question #: 798- A 10 part block and tackle is used to lift a load of 3 tons. Neglecting shear friction, what is the force required?

- 1) 100 lb 2) 200 lb 3) 300 lb **4) 600 lb**

Answer:4- 600 lb is required. $3 \text{ ton} \times 2,000 \text{ lb/ton} = 6,000 \text{ lb}$ $6,000 \text{ lb} / 10 \text{ parts} = 600 \text{ lb}$

Question #: 799- All circular table saws must have:

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- 1) A hood which encloses that portion of a saw above the material being cut
2) A spreader to prevent material from squeezing the saw blade
3) Anti-kickback fingers to prevent material from being thrown back at the operator
4) Both 1 and 3

Answer:1- OSHA requires that all circular table saws shall have a hood over the portion of the saw above the table, so mounted that the hood will automatically adjust itself to the thickness of, and remain in contact with, the material being cut. Spreaders and anti-kickback fingers apply to special applications, such as ripping. 29 CFR 1910.213 (a) and (c)

Question #: 800- A punch press guard normally consists of:

- 1) Barrier **2) Remote controls** 3) Sensing 4) Locks

Answer:2- Remote controls are the most common guard on punch presses.

Question #: 801- A wheelbarrow contains a load of 216 lb at an average distance of 1.50 ft from the axle. If the shaft of the wheelbarrow is 4 ft long, what is the force exerted upward by the fulcrum?

- 1) 45.0 lb 2) 67.5 lb 3) 135 lb 4) 180 lb

Answer:3 - Since the wheelbarrow is in equilibrium, the forces pulling it upward are equal to the sum of the forces pulling it downward.

The downward force = load = 216 lb

The upward force = $(216 \text{ lb} \times 1.50 \text{ ft}) / 4 \text{ ft} = 81 \text{ lb}$

Therefore the fulcrum must exert an upward force of: $216 \text{ lb} - 81 \text{ lb} = 135 \text{ lb}$



Question #: 802- If water weighs 8.34 lb/gal, what work is required to move 300 gal of water from a mine 400 ft deep?

- 1) 1,000,200 ft-lb 2) 1,000,400 ft-lb 3) 1,000,600 ft-lb **4) 1,000,800 ft-lb**

Answer:4- Use the formula $W = F D$, where W = Work, F = Force, D = Distance

$W = (8.34 \text{ lb/gal} \times 300 \text{ gal})(400 \text{ ft})$ $W = 1,000,800 \text{ ft-lb}$

Question #: 803- The ASME code requires pressure vessel hydrostatic testing to 150% of the:

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- 1) Design pressure 2) Pressure relief limit
3) Maximum operating pressure (MOP) 4) Burst pressure

Answer:3- The ASME code calls for 150% of the maximum operating pressure.

Question #: 804- To what percentage of the rated load must a crane be tested?

- 1) 75% 2) 100% **3) 125%** 4) 150%

Answer:3- Cranes must be proof-tested to 125% of the rated load.

Question #: 805- What predominant frequency can be expected from a fan which is direct driven at 3,600 rpm to deliver 2,400 cfm at 0.5 in. of water? The fan has 60 backward curved blades.

- 1) 1,200 Hz 2) 1,800 Hz **3) 3,600 Hz** 4) 5,400 Hz

Answer:3- The frequency is determined by how many times the blades pass a fixed point.
3,600 rpm = 60 revolutions per second (rps) . 60 blades turning at 60 rps = 3,600 passes of a blade past the point. This is 3,600 Hz.

Question #: 806- A two piece block and tackle with 5 parts of rope to lift a weight of 3,000 pounds requires how much force for lift (neglecting friction)?

- 1) 500 lb **2) 600 lb** 3) 750 lb 4) 1,000 lb

Answer:2- To determine the lifting force without friction, divide the total load by the number of rope parts. $3,000 \text{ lb} / 5 = 600 \text{ lb}$

Question #: 807 - In any man-machine system, humans serve three functions: sensor, controller and:

- 1) Information seeker **2) Information processor**
3) Stimulus responder 4) Information controller

Answer:2- The purpose of human factors engineering is to minimize errors in using displays and controls by designing systems that will be compatible with both the human and machine components. It is assumed that humans will serve as one or all of their functions, namely, sensing, controlling, and information processing. In the role of an information processor, humans are required to make judgements.

Question #: 808 -The Steiner Tunnel Test is used to determine:

- 1) Sprinkler head RTI values
2) Dust deflagration (explosion) venting values
3) Extinguishing agent effectiveness
4) Material flame spread/smoke development rating

Answer:4- The Steiner Tunnel Test is the test for flame spread and smoke developed for interior finishes such as carpeting and wall coverings.

Question #: 809- Vapors of flammable and combustible liquids are:

1) Generally heavier than air

2) Generally lighter than air

3) Normally liquid at room temperature and have molecular weights lower than those which are gases

4) Unstable and unpredictable

Answer:1- The vapors of flammable liquids are generally heavier than air. Examples are alcohol, naphtha, gasoline, kerosene, and carbon disulfide. This is logical because gas or vapor density is proportional to molecular weight, and the compounds which are normally liquids at room temperature have higher molecular weights than those which are gases. Note that because vapors of flammable and combustible liquids are heavier than air, they tend to settle in lower areas and the trail of vapors can spread far from the liquid itself. **If this vapor trail contacts a source of ignition, the resulting fire can FLASHBACK to the source of the vapors.**

Question #: 810- Increasing the temperature or pressure will have the following effect on the LEL and UEL:

1) Raise the LEL and lower the UEL

2) Lower the LEL and raise the UEL

3) Raise the LEL and raise the UEL

4) Lower the LEL and lower the UEL

Answer:2- Flammable or explosive limits are concentrations of a vapor or gas in air below or above which propagation of a flame does not occur on contact with a source of ignition. The lower explosive limit (LEL) is the minimum vapor concentration below which the vapor-air mixture is too lean to burn or explode. The upper explosive limit (UEL) is the maximum vapor concentration above which the mixture is too rich to burn or explode. Increasing the temperature or pressure lowers the LEL and raises the UEL.

Question #: 811- Decreasing the temperature or pressure will have the following effect on the LEL and UEL:

1) Raise the LEL and lower the UEL

2) Lower the LEL and raise the UEL

3) Raise the LEL and raise the UEL

4) Lower the LEL and lower the UEL

Answer:1- Flammable or explosive limits are concentrations of a vapor or gas in air below or above which propagation of a flame does not occur on contact with a source of ignition. The lower explosive limit (LEL) is the minimum vapor concentration below which the vapor-air mixture is too lean to burn or explode. The upper explosive limit (UEL) is the maximum vapor concentration above which the vapor-air mixture is too rich to burn or explode. Decreasing the temperature or pressure raises the (LEL) and lowers the (UEL).

Question #: 812- An MFL wall is:

1) An interior partition that acts as a barrier to the spread of fire

2) A fire resistant wall designed to prevent the horizontal spread of fire

3) A self-supporting wall designed to maintain its integrity if the structure on either side completely collapses

4) A concrete block, floor to ceiling, wall that protects one fire zone from the other

Answer:3 - **A maximum foreseeable loss (MFL) wall** is a fire resistant wall designed to prevent the horizontal spread of fire into adjacent areas and by insurance carrier decree, must be self-supporting and designed to maintain its integrity if the structure on either side completely collapses. The MFL wall ensures that a total fire loss would not extend beyond the wall.

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Question #: 813- If the flowing pressure at a fire extinguishing nozzle is 75 psi, what is the velocity discharge in ft/sec?

- 1) 90 **2) 105** 3) 210 4) 4,680

Answer:2- The solution involves two pressure formulas: - Torricelli's Law for efflux from a container and $P = 0.433 * h$

V = velocity in ft/sec (unknown)

g = acceleration due to gravity (32 ft/sec²)

P = 75 psi

Solving for "h" (head in feet). $75 \text{ psi} = (0.433)h$ $173.2 \text{ feet} = h$ $V = 105.3 \text{ ft/sec}$

Question #: 814- Which of the following has the most potential for fire and explosion?

- 1) Acetone **2) Acetylene** 3) Gasoline 4) Hydrogen

Answer:2- The range of flammable limits for acetylene (2.5% to 81% acetylene in air) is greater than that of other commonly used gases, with consequently greater hazard.

Question #: 815- Means of egress components in a two-story office building include one 34 in. wide door, a 44 in. wide stairway and a 44 in. wide door. What is the capacity of this exit?

- 1) 130 persons **2) 147 persons** 3) 170 persons 4) 220 persons

Answer:2- The most restrictive egress component is the 44" wide stairway. The component with the least capacity determines the egress capacity.

COMPONENT	CAPACITY FACTOR	CAPACITY
Door 34 in.	0.2 in/person	170 persons
Stair 44 in.	0.3 in/person	147 persons
Door 44 in.	0.2 in/person	220 persons

Question #: 816 - If the public water supply at street level is 95 psi(g), what is the gauge pressure at a hose outlet located on the roof of a 50 ft high office building?

- 1) 33 psi 2) 45 psi **3) 73 psi** 4) 145 psi

Answer:3 - The pressure exerted by a 50 ft high column:

$P = 62.4 \text{ lb/ft}^3 * 50 \text{ ft} = 3,120 \text{ lb/ft}^2$

Converting to lb/ft² to psi: $P = 3,120 \text{ lb/ft}^2 * (1 \text{ ft} / 12 \text{ in})^2 = 21.7 \text{ psi}$

Subtract this from supply pressure at street level $\text{Pressure} = 95 \text{ psi} - 21.7 \text{ psi} = 73.3 \text{ psi}$

NOTE: These are gauge pressures.

Question #: 817- Class C fires involve _____.

- 1) Ordinary combustibles **2) Live electrical equipment**
3) Combustible metals 4) Flammable liquids

Answer:2 -Class A fires involve ordinary combustibles such as paper and cardboard. Class B fires involve flammable or combustible liquids. Class C fires involve live electrical equipment. Class D fires involve combustible metals.

Question #: 818- A motor rated to operate in a flammable/explosive atmosphere is explosion proof due to:

- 1) It's ability to contain internal explosions**
2) It's being constructed exclusively of bronze
3) It's ability to eliminate arcs
4) It's ability to operate at the non-sparking point of the fan curve

Answer:1- Explosion proof motors are designed to prevent explosions occurring inside the motor from propagating to the external environment.

Question #: 819- At a construction site, an approved/rated storage cabinet may hold no more than _____ gal of flammable materials or _____ gal of combustible materials.

- 1) 30, 60 **2) 60, 120** 3) 120, 240 4) 5, 10

Answer:2- An approved/rated cabinet may hold up to 60 gal of flammable materials or 120 gal of combustible materials. No more than **three** such cabinets may be located in a single storage area. 29 CFR 1926.152 (b)(3)

Question #: 820- Chlorinated hydrocarbon solvents involved in a fire may generate:

- 1) Arsine 2) Phosphine 3) Phosgene 4) Styrene

Answer:3- Phosgene (COCl_2) may be generated during the thermal decomposition of chlorinated hydrocarbons.

Question #: 821- Indicate the flammable solvent:

- 1) Mono-chlorobenzene** 2) Freon TF 3) Trichloroethylene 4) 1,1,1-trichloroethane

Answer:1- Chlorobenzene is a flammable solvent. The other solvents are chain hydrocarbons with chlorine substitution. Normally, this indicates a tendency towards non-flammability, but in this case a chlorinated solvent is also a flammable solvent.

Question #: 822- One class of organic chemicals that form potentially explosive peroxides is:

- 1) Ethers** 2) Ketones 3) Alkyls 4) Anilines

Answer:1- Aged ethers can form explosive peroxides. These peroxides may frequently occur as **visible crystal growths** in the ether solution.

Question #: 823- Which of these metals is combustible?

- 1) Nickel **2) Magnesium** 3) Molybdenum 4) Iron

Answer:2- Examples of metals which are considered combustible other than magnesium include titanium, zirconium, sodium, and potassium. Fires involving these metals are Class D fires.

Question #: 824- A fire protection standpipe 110 ft high is filled with water. What is the gauge pressure at the bottom of the pipe?

- 1) 33 psig 2) 38 psig **3) 48 psig** 4) 62 psig

Answer:3- To determine the pressure at the bottom of the pipe, obtain the density of water from the OHST/CHST Examination Reference Handout and multiply it by the height of the standpipe. Convert the units to obtain pounds per square inch (psi).

Water has a density of 62.4 lbs./ft³.

So 110 ft (62.4 lbs./ft³)(1 ft/12 in.)² = 47.67 psi

To obtain the absolute pressure, add 14.7 psi to the gauge pressure.

Question #: 825- Fire loads depend on the occupancy and the materials used in their operations. An occupancy that contains mostly paper and wood, such as an office, would have a heat of combustion of:

- 1) 8-10,000 Btu/lb **2) 7-8,000 Btu/lb** 3) 5-8,000 Btu/lb 4) 1-5,000 Btu/lb

Answer:2- A fire load of 7,000 to 8,000 Btu/lb can be expected in this environment.

Question #: 826- If a fire pump is to obtain water by the suction process, how far can the pump be expected to raise the water from its source to the pump?

- 1) 10 ft **2) 25 ft** 3) 40 ft 4) 50 ft

Answer:2- Regardless of pump size, 25 ft is about the limit a pump can raise water by the suction process.

Question #: 827- When reviewing the effectiveness of compartmentalization as a delay or prevention of the propagation of fire from one area to another, you must consider inherent fire resistance, the details of construction, and _____.

- 1) The alarm system in use 2) The speed of reaction of the suppression system
3) The fire codes **4) The penetrations of the walls and floors**

Answer: 4- One of the major causes of propagation from one area to another are the penetration of walls and floor such as doors, ducts, stairs, utility chases, etc.

Question #: 828 -The fire point is the lowest temperature at which a liquid in an open container will evolve vapors fast enough to support continuous combustion. That temperature is usually:

- 1) The flash point 2) A few degrees below the flash point
3) A few degrees above the flash point 4) The ignition temperature

Answer:3- The fire point is usually slightly above the flash point in order to create a mixture between the lean limit and the rich limit thereby creating a flammable mixture.

Question #: 829- A **catastrophic hazard** in large steel foundries that utilize below the floor casting **pits** is:

- 1) Loss of power in the electrical system during a pour
- 2) Explosions from water in the pit that turns to steam when molten metal is poured into the mold**
- 3) Pouring metal into a collapsed mold
- 4) Cracked ladles

Answer:2- While all are significant hazards, water in a mold cavity can cause a significant explosion when the molten metal is poured into the mold cavity.

Question #: 830- A water tank used as a secondary water supply in a small manufacturing plant is 15 ft in diameter and is 35 ft tall. The supply line has a diameter of 6 in. There is 1 ft of air space at the top of the tank when full. Two 4 in. diameter vents are located on the top of the tank to supply make up air as the tank is drained. What is the **gauge pressure** in the supply line (located 1 ft from the bottom of the tank)?

- 1) 1.9 psi
- 2) 14.3 psi**
- 3) 272 psi
- 4) 2,059 psi

Answer:2 - $P = 33 \text{ ft} * 62.4 \text{ lb/ft}^3 = 2,059 \text{ lb/ft}^2$ Convert lb/ft² to psi...
 $P = 2,059 \text{ lb/ft}^2 (1 \text{ ft} / 12 \text{ in.})^2 = 14.3 \text{ lb/in}^2 = 14.3 \text{ psi}$ NOTE: This is a gauge pressure

Question #: 831- The most common method for measuring flow from an open stream discharging from an orifice, nozzle, or open pipe is by direct measurement of the velocity head of the stream. This is measured by:

- 1) A pressure gauge
- 2) A pitot tube and pressure gauge**
- 3) A pitot tube
- 4) A play pipe

Answer:2- Pitot tubes in combination with pressure gauges are used to measure pressure which can then be converted into flow rates.

Question #: 832- A Pitot tube reading of 30 psi was measured on an open 2.5 in. smooth rounded hydrant butt. The coefficient of friction is 0.90. The theoretical flow rate for a 30 psi velocity head is 990 gpm. What is the actual discharge in gpm?

- 1) 330 gpm
- 2) 891 gpm**
- 3) 990 gpm
- 4) 1,089 gpm

Answer:2- $Q = \text{flow in gpm} = \text{theoretical discharge} * \text{discharge coeff.}$
 $= 990 \text{ gpm} * 0.90 = 891 \text{ gpm}$

Question #: 833- The number of hours during which the required fire water flow should be available varies from:

- 1) 1 - 4 hr
- 2) 2 - 4 hr
- 3) 2 - 10 hr**
- 4) 3 - 8 hr

Answer:3- The time varies from 2 to 10 hr, although most water authorities place an upper limit of 2 to 4 hr on water supply duration because of economics.

Question #: 834 - You have a need to determine the rate of flow of water from hydrants in the area of your building. You have been told by the water department that the pressure, or velocity head, of the hydrant in front of your building is 49 psi when measured at the 2.5 inch hydrant butt with a pitot tube and gauge. The k factor for this type of hydrant is 167.8. What is the water volume?

- 1) 834 gpm **2) 1,175 gpm** 3) 1,468 gpm 4) 1,600 gpm

Answer:2-

$$Q = k * \sqrt{\text{Pressure or Velocity Head}} = 167.8 * \sqrt{49} = 167.8 * 7 = 1,174.6 \text{ gpm}$$

Question #: 835- An alarm system that transmits water flow alarms from sprinklers and supervisory signals to a central system that is constantly staffed by the owner's security force is the description of a:

- 1) Proprietary system** 2) Central station system
3) Auxiliary system 4) Remote station system

Answer:1- A proprietary system is a normally closed-circuit system with electromechanical devices used to transmit signals to the central supervisory station located in or near the building or groups of buildings being protected. The central supervisory station is constantly staffed by qualified personnel hired by the building owner or occupant.

Question #: 836- Smoke detectors work best where:

- 1) Smoke generation will be difficult to detect **2) Smoke will be generated by the products of combustion**
3) There is the potential for substantial fumes to be generated
4) The products of combustion generated by fire are invisible

Answer:2- Smoke detectors respond to the particles of combustion that occur in the second fire phase. Smoke detectors operate on lighting principles. When smoke enters a light beam, it triggers a reaction; the more smoke that enters, the faster the response.

Question #: 837- The main disadvantage of most heat detectors is:

- 1) Their false alarm rate is high 2) They are costly to install
3) They are slow in detecting fire 4) They have limited application

Answer:3- Of the four kinds of fire detectors in use, heat detectors are the slowest in detecting fires. They are widely used because they are the least expensive fire detector and have the **lowest false alarm** rate.

Question #: 838- Which of the following smoke detectors will accurately detect most fires more rapidly than the others?

- 1) Rate-of-rise thermal **2) Ionizing**
3) Reflected beam photoelectric 4) Bulb detection system

Answer:2- Ionizing detectors sense fire at the earliest practical detection stage. They sense both visible and invisible products of combustion which enters a chamber containing positive

and negative plates and a very minute amount of radioactive material that ionizes the air in the chamber. The movement of ions between plates sets up a small current that triggers an alarm.

Question #: 839- Smoke detectors which detect the products of combustion are known as what type of detector?

- 1) Non-ionizing **2) Ionizing** 3) Photo-electric 4) Combustion

Answer:2- Combustion produces products that can be detected by the ionizing detector before smoke is visible.

Question #: 840- Smoke detectors which react to light reflected off smoke from a fire are known as what type of detector?

- 1) Non-ionizing 2) Ionizing **3) Photo-electric** 4) Combustion

Answer:3- Photo-electric detectors essentially work when smoke passes through the detector and light is reflected back into the photo cell of the detector.

Question #: 841- A water motor gong is powered by:

- 1) Domestic water lines opened electrically by a smoke detector 2) Electrical power
3) A fire pump **4) Water flowing through the sprinkler system**

Answer:4- Water flowing through a sprinkler system will power the gong, whether the sprinkler is actuated by a fire or has a substantial leak.

Question #: 842- The oldest type of automatic fire detection device in use today is the:

- 1) Eutectic metal heat detector** 2) Ionizing smoke detector
3) Dissimilar metal heat detector 4) Photo-electric smoke detector

Answer:1- Eutectic metals are designed to melt (fuse) at a specific temperature. A fusible link is one of the oldest types of heat detectors, and the heat detector is the oldest type of automatic fire detection device. It is the type of fire detection used in most sprinkler heads, auto-closing fire doors, automatic lid closers, and some alarms. The development of sprinklers began in the 1860's.

Question #: 843-Eutectic metals are used in:

- 1) Smoke detectors 2) Metal flues **3) Heat detectors**
4) Hazardous environments requiring non-sparking tools

CSP Questions and Answers- Part-II

Answer:3- Eutectic metals are metal alloys designed to melt at a specific temperature. They are usually made from tin, lead, cadmium, or bismuth, and melt rapidly at a predetermined temperature.

Question #: 844- The type of smoke detector that contains a small amount of radioactive material as part of its operating mechanism is the:

- 1) Light obscuring detector
- 2) Cloud chamber detector
- 3) Ionizing detector**
- 4) Light scattering type

Answer:3- Ionizing detectors use radiation to ionize smoke particles so that the particles conduct electrical current, thus operating the alarm. The other types listed are photo-electric smoke detectors that use light as the basis of their operation.

Question #: 845- In a pre-action sprinkler system, the water is:

- 1) Admitted to the piping by the use of a pressure actuated valve
- 2) Contained in the piping system similar to that of a wet system
- 3) Admitted to the piping through an automatic water control valve that has been activated by a zoned heat or smoke detector**
- 4) Held back from the sprinkler piping by a deluge valve

Answer:3- Pre-action systems are designed to protect properties where there is danger of serious water damage as a result of damaged automatic sprinkler heads or piping. The pre-action system is similar to a standard dry-pipe system. To it is added a water supply valve that is opened by the operation of an automatic fire detection system (smoke or heat detectors).

Question #: 846- What fire extinguishing agent contains halogenated hydrocarbons?

- 1) Halon**
- 2) Carbon dioxide
- 3) Dry powder
- 4) Foam

Answer:1- Halon is composed of halogenated hydrocarbons (CFC's) which react with stratospheric ozone.

Question #: 847- What type of closed-head sprinkler system requires a fire detection device in the affected area to activate?

- 1) Dry-pipe system
- 2) Pre-action system**
- 3) Deluge system
- 4) Wet pipe system

Answer:2- The best answer is a pre-action system. A dry-pipe system relies on sprinkler head operation to trigger water flow. A deluge system uses a fire detection device but the heads are already open.

Question #: 848- The flowing pressure at a fire extinguishing nozzle is 50 psi. What is the velocity of discharge in ft/sec?

- 1) 8.5 ft/sec
- 2) 50.5 ft/sec
- 3) 85.5 ft/sec**
- 4) 650 ft/sec

Answer:3- Use the formula $Q = K \sqrt{P}$ or $V = K \sqrt{P}$
 $K = 12.1$
 $= 12.1 \times 7.07 = 85.5 \text{ ft/sec}$

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Question #: 849- All of the following are decomposition products of Halon 1301 EXCEPT:

- 1) Hydrogen fluoride 2) Hydrogen bromide 3) Bromine **4) Ethylene**

Answer:4- Ethylene is a gaseous olefin compound resulting from the cracking of either selected petroleum fractions or natural gas.

Question #: 850- All the following secondary hazards should be considered as a result of discharge of Halon 1301 EXCEPT:

- 1) Noise 2) Dislodgment of objects 3) Frostbite burns to skin **4) Heat**

Answer:4- Heat is not a secondary hazard as a result of discharge of Halon 1301.

Question #: 851- What is one of the major decomposition products produced when Halon is used as an extinguishing agent.

- 1) Carbon monoxide **2) Hydrogen fluoride** 3) Hydrogen chloride 4) Chlorine gas

Answer:2- Hydrogen fluoride is produced when Halon (BrCF_3) is exposed to temperatures over 900°F.

Question #: 852- Halogenated hydrocarbons appear to be effective in suppressing fires by:

- 1) Excluding heat from the fire
2) Producing free radicals that consume free radicals that the fire is producing
3) Cooling the fire
4) Suppressing the production of free radicals by the heat of the fire

Answer:2- These seem to work by producing free radicals that then combine with free radicals being produced by the fire. The elimination of these free radicals then starve the fire.

Question #: 853- Water is a particularly effective extinguishing agent because:

- 1) Water is the cheapest of the extinguishing agents available
2) Water can be used universally
3) Water has a high latent heat and expands 1,700 times when vaporized thereby excluding oxygen
4) Water acts faster than other extinguishing agents

Answer:3 - Both of these characteristics make water effective in fighting most fires.

Question #: 854- Which of the following extinguishing systems or extinguishing agents are frequently used in areas with electrical hazards (such as switch rooms in manufacturing plants)?

- 1) Foam Systems 2) Halon systems 3) Dry pipe systems **4) Carbon dioxide systems**

Answer:4- Carbon dioxide (CO_2) systems are primarily used because they will not create additional fire hazards or damage the electrical equipment.

CSP Questions and Answers- Part-II

Question #: 855- A fire emanating from a compressed gas cylinder can be effectively halted

- 1) With a handheld extinguisher
- 2) With a water cannon
- 3) By shutting off the flow**
- 4) With freon injection

Answer:3- The only way to really halt a compressed gas fire is to shut off gas flow. Temporarily extinguishing the fire may be dangerous if flow is not stopped. The unburned gas can then accumulate and possibly explode.

Question #: 856- The handling of ethyl ether involves severe explosion hazards because of its:

- 1) High flash point
- 2) Low vapor pressure
- 3) Ability to form peroxides**
- 4) Both 1 and 2

Answer:3- Ethyl ether has a LOW flash point and a HIGH vapor pressure. Ethyl ether has a dangerous propensity to form highly unstable explosive peroxides when in contact with air.

Question #: 857- Why should acetylene cylinders be stored in an upright position?

- 1) To prevent liquid acetone from escaping**
- 2) For proper securing**
- 3) In order for the acetylene to dispense properly
- 4) Both 1 and 2**

Answer:4- Acetylene cylinders must always be stored in an upright position to allow proper securing and to prevent the liquid acetone solvent from escaping.

Question #: 858- Acetylene must not be used at a pressure in excess of:

- 1) 5 psi(g)
- 2) 10 psi(g)
- 3) 15 psi(g)**
- 4) 20 psi(g)

Answer:3- Acetylene must not be used at a pressure in excess of 15 psi(g), or 30 psi(a). Above this pressure, acetylene may become unstable and explode.

Question #: 859- The most common cause of indoor air quality problems is:

- 1) Off-gassing from building materials/furnishings
- 2) Cigarette smoking
- 3) Processes using volatile chemicals
- 4) Poor ventilation**

Answer:4- Poor ventilation is the most common cause of indoor air quality problems because air contaminants from sources such as cigarette smoke, processes, and off-gassing build-up can cause hypersensitivity in people. The other answers contribute to the cause, but poor ventilation is usually the root of the problem.

Question #: 860- What is the common terminology for paint that does not hit the part in painting operations?

1) Overspray 2) Sludge 3) Drag out 4) Blowdown

Answer:1- Overspray is the terminology for the wasted paint. Water curtain paint booths or dry filter paint booths are then necessary to capture the wasted paint solids, each resulting in a difficult to manage waste. Paint booth filters that are auto-ignitable are especially difficult and expensive to manage.

Question #: 861- The primary hazard operating gasoline-powered industrial trucks in an unventilated space is:

1) Human exposure to explosions 2) Human exposure to carbon dioxide (CO₂)
3) Human exposure to carbon monoxide (CO) 4) Human exposure to nitrogen oxides (NO_x)

Answer:3- Carbon monoxide is the primary human exposure hazard when operating gasoline-powered trucks within an enclosed space.

Question #: 862- A sound absorption coefficient of 0.6 means that _____ of the sound energy in a wave will be reflected.

1) 40% 2) 60% 3) $10(\log 0.6/0.4)\%$ 4) $(0.6 \log 10)\%$

Answer:1- A sound absorption coefficient of 0.6 means that 40% of the sound energy in the wave will be reflected and 60% absorbed. The key word in the question was reflected, NOT absorbed.

Question #: 863- If a material has a sound absorption coefficient of 0.8 that means that _____ percent of the sound energy in the wave will be _____.

1) 20, absorbed 2) $10 * \log (0.20/0.80)$, reflected **3) 80, absorbed** 4) 80, reflected

Answer:3- A sound absorption coefficient of 0.8 means that 80 % of the sound energy in the wave will be absorbed and 20% will be reflected.

Question #: 864- In a work area the noise levels are 95 dBA for 2 hr, 90 dBA for 4 hr and 85 dBA for 2 hr. Does this exceed the OSHA limits?

1) Yes 2) No 3) Can't determine from information given 4) Borderline exposure

Answer:1 - Using OSHA Allowable 90 dBA for an 8 hour period:

Allowable exposure time, $T = 8/2^{(L-90)/5}$

Therefore:

For 95 dBA, $T = 4$

For 90 dBA, $T = 8$

For 85 dBA, $T = 16$

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Noise dose (%), $D = 100 [\sum C1/T1]$

$D = 100 [2/4 + 4/8 + 2/16] = 100 [1.125] = 112.5\%$

This exceeds the allowable daily exposure by more than 12%.

Question #: 865- The LEAST critical factor in the analysis of noise exposure is:

- 1) A-weighted sound pressure level 2) Frequency spectrum of the noise
3) Duration of noise exposure **4) ~~C-weighted sound pressure level~~**

Answer:4- It is important to use the A-weighted sound level, frequency duration, distribution as well as the type of noise (impact vs. continuous) in the analysis of noise exposures. In addition, you must also know the duration of exposure.

Question #: 866- What is the **overall noise level** to be expected when two machines are operating simultaneously in a room if the SPL due to machine X is 95 dB and the SPL due to machine Y is 99 dB ?

- 1) 95 dB 2) 97 dB 3) 99 dB 4) 100 dB

Answer:3- (Total Sound Pressure = 10 times the log of the sum of the 10 to the power of the individual sound pressure divided by 10)

$$\begin{aligned} L_{Pt} &= 10 \log [10 (P1/10) + 10 (P2/10)] & L_{Pt} &= 10 \log [10^{95/10} + 10^{99/10}] \\ &= 10 \log [3.2 * 10^9 + 7.9 * 10^9] & &= 10 \log [1.1106 * 10^{10}] & &= 100.45 \text{ dB} \end{aligned}$$

Rule of Thumb- If the difference between two noise levels is between 4-9 then add 1 to higher noise level.

Question #: 867- What is the permissible noise exposure in duration per hour of a 97 dBA exposure?

- 1) 4 hours **2) 3 hours** 3) 2 hours 4) 1.5 hours

Answer:2- 3 hours is the permissible noise exposure in duration per hour of a 97 dBA exposure.

Question #: 868- The following noise exposures were recorded:

92 dBA - 3 hours 95 dBA - 3 hours 90 dBA - 2 hours **What is the total exposure?**

- 1) 80 dBA 2) 85 dBA 3) 90 dBA **4) 93 dBA**

Answer:4

Add all the exposure times and divide by 8 hours. We are using units of dBA.

$$\begin{aligned} Ex &= [(92 \text{ dB} * 3 \text{ hr}) + (95 \text{ dB} * 3 \text{ hr}) + (90 \text{ dB} * 2 \text{ hr})] / 8 \\ &= (276 \text{ dB-hr} + 285 \text{ dB-hr} + 180 \text{ dB-hr}) / 8 \text{ hr} & &= 92.8 \text{ dBA} \end{aligned}$$

Question #: 869- The following noise exposures were recorded:

92 dBA - 3 hours 95 dBA - 3 hours 90 dBA - 2 hours

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Is there an over exposure to noise?

- 1) **Yes** 2) No 3) Just at level 4) Slightly below

Answer:1 - Add all the exposure times and divide by 8 hours. We are using units of dBA.

$$\begin{aligned} \text{Ex} &= [(92 \text{ dB} * 3 \text{ hr}) + (95 \text{ dB} * 3 \text{ hr}) + (90 \text{ dB} * 2 \text{ hr})] / 8 \\ &= (276 \text{ dB-hr} + 285 \text{ dB-hr} + 180 \text{ dB-hr}) / 8 \text{ hr} \\ &= 92.8 \text{ dBA} \end{aligned}$$

The calculated exposure of 92.6 dBA is higher than the allowable 90 dBA.

Question #: 870 - The following noise exposures were recorded:

#	dBA	Time in hours
1	110	0.5
2	90	2.0
3	80	3.0
4	85	2.5

Was the permissible noise exposure exceeded for an 8 hour period?

- 1) No (just under the limit) 2) Yes (just over the limit)
3) **Yes (over the limit by 50%)** 4) At limit

Answer:3 - Exposure = S [(Measured dB * Exposure Time) / (Measured dB / Allowable Exposure Time)]

$$\begin{aligned} \text{Exposure} &= [(110 \text{ dB} * 0.5 \text{ hr}) / (110 \text{ dB} * 0.5 \text{ hr})] + [(90 \text{ dB} * 2 \text{ hr}) / (90 \text{ dB} * 8 \text{ hr})] \\ &+ [(80 \text{ dB} * 3 \text{ hr}) / (80 \text{ dB} * 32 \text{ hr})] + [(85 \text{ dB} * 2.5 \text{ hr}) / (85 \text{ dB} * 16 \text{ hr})] = 1.496 \end{aligned}$$

The total allowable exposure should be kept at 1.0 or lower. This one exceeds the limit by nearly 50%.

Question #: 871- If the variations in sound level oscillate with an interval of 1 second or less, the sound is considered:

- 1) Impact noise 2) Non-continuous noise 3) **Continuous noise** 4) An overexposure

Answer:3 - Continuous noise involves sound levels oscillating with an interval of 1 second or less.

Question #: 872- Calculate the estimated near field power density on a microwave beam axis emitted from a large circular antenna with an effective diameter of 3 m and an average power output of 200 W.

- 1) **11.3 mW/cm²** 2) 42.5 mW/cm² 3) 200 mW/cm² 4) 200 W/cm²

Answer:1 - To solve this problem, use the near field power density formula where W is power density, P is average power, and D is the antenna diameter in centimeters. The formula is:

$$\begin{aligned} W &= (16 P) / (\pi * D^2) \quad 3 \text{ m} = 300 \text{ cm} \\ W &= (16 * 200 \text{ W}) / [\pi (300)^2] = 3,200 \text{ W} / 282,743 \text{ cm}^2 = 0.0113 \text{ W/cm}^2 = 11.3 \text{ mW/cm}^2 \end{aligned}$$

Question #: 873- Calculate the estimated far field power density 6 m from a 900 MHz microwave antenna with an effective diameter of 3 m and an average power output of 200 W?

- 1) 0.35 mW/cm² 2) 1.25 mW/cm² 3) 5.40 mW/cm² 4) 11.3 mW/cm²

Answer:1- To solve this problem, use the far field equation. $W = (A P) / (\lambda^2 r^2)$, where r is the distance from the antenna, A is the antenna effective area, P is the power output of the antenna, and λ is the wavelength. First, calculate the wavelength using the following formula. $[\lambda = c / f]$ f is the frequency and c is the speed of light = $(3 * 10^8 / (900 * 10^6)) = 1 / (300 * 10^{-2}) = 1/3 \text{ m} = 100/3 \text{ cm}$
 $A = r^2 = (150 \text{ cm})^2 = 70,686 \text{ cm}^2$
 $W = (70,686 \text{ cm}^2 * 200 \text{ W}) / [(100/3 \text{ cm})^2 (600 \text{ cm})^2] = 0.0353 \text{ W/cm}^2 = 35.34 \text{ mW/cm}^2$

Question #: 874- Which type of ionizing radiation, sometimes used in manufacturing operations, is the least penetrating?

- 1) Alpha 2) Beta 3) Gamma 4) X-ray

Answer:1- Of the five kinds of radioactivity that are of general concern (e.g., alpha, beta, gamma, x-ray, and neutrons), alpha particles are the least penetrating. They will not penetrate thin barriers. For example, paper, cellophane, and even skin, will shield alpha particles.

Question #: 875- Which kind of radioactivity is considered to be a critical internal hazard?

- 1) Alpha 2) Beta 3) Gamma 4) X-ray

Answer:1-Alpha particles may be inadvertently ingested, inhaled, or absorbed into the body as a result of improper handling. Internally, alpha particles are acutely hazardous because of their ionizing ability through very short distances in soft tissue. Depending on the chemical and physical form of the radioactive material, alpha particles may deposit in specific organs and produce acute radiation doses in those organs.

Question #: 876- The preferred choice of shielding material for beta radiation is:

- 1) Lead 2) Concrete 3) Plastic 4) Paper

Answer:3- Beta particles are readily stopped in relatively small thicknesses of materials. The preferred choice for beta sources is low density plastic materials such as plexiglass or lucite. High density materials, like lead, are less effective because of the production of secondary X-rays when the beta particles strike lead atoms.

Question #: 877- A glass container of radium iodate powder shatters when accidentally dropped on the quarry tile floor of an experimental laboratory. What is the first action that should be taken?

- 1) Call the spill team for assistance
2) Vacuum the powder up off the floor quickly, using a vacuum with a HEPA filter
3) Notify the NRC
4) Evacuate the laboratory

Answer:4- The first action to be taken following the spill of a powdered radium substance is to evacuate the area. Radium sources emit alpha particles which are easy to spread over large areas. Airborne, they present a major hazard to personnel by route of inhalation, thereby necessitating rapid evacuation from the scene of a spill.

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Question #: 878- In a single year, ACGIH recommends that the occupational exposure of radiation to the whole body of non-pregnant individuals not exceed:

- 1) 10 mSv per calendar quarter
- 2) 20 mSv per calendar quarter
- 3) 25 mSv per calendar year
- 4) 50 mSv per calendar year

Answer:4- This is the effective dose averaged over the year. The average effective dose averaged over five years should not exceed 20 mSv per year. ACGIH TLVs and BEIs (1999)

Question #: 879- On pressure demand SCBA's there is an alarm to let the wearer know that the air supply has decreased to _____ of full.

- 1) 10%
- 2) 20% - 25%
- 3) 30%
- 4) 50%

Answer:2- All pressure demand units are required by NIOSH-MSHA to have an alarm to alert the user that the air supply has decreased to 20-25% of full.

Question #: 880- If you were milling asbestos, what effect would this have on the fibers?

- 1) Nothing
- 2) Reduce diameter
- 3) Reduce diameter and shorten length
- 4) Increase length

Answer:3 - Milling will tend to break up the fibers, resulting in both shorter and narrower fibers.

Question #: 881- In the cyanide electroplating of brass, which of the following components is frequently used?

- 1) Hydrogen cyanide
- 2) MFG
- 3) Cyanide salts
- 4) Zn salts

Answer:3- Cyanide salts are commonly used in electroplating.

Question #: 882- Which of the following is ~~not~~ a primary irritant?

- 1) NH₃
- 2) HCl
- 3) H₂SO₄
- 4) H₂S

Answer:4- H₂S, or hydrogen sulfide, is a secondary irritant since it does produce irritation, but that effect is overshadowed by its systemic effect on the body. Other secondary irritants include: ketones, esters, alcohols, and ethers. A primary irritant's action is limited to irritation.

Question #: 883- The category A1 carcinogen is:

- 1) Suspected human carcinogen
- 2) Probable human carcinogen
- 3) Confirmed human carcinogen
- 4) Not suspected as a human carcinogen

Answer:3- Carcinogen category A1 is a confirmed human carcinogen, which means the agent is carcinogenic to humans based on the weight of evidence from epidemiological studies of, or convincing clinical evidence in, exposed humans. Category A2 is suspected human carcinogen

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and A5 is not suspected as a human carcinogen. Probable human carcinogen is not a carcinogen category.

Question #: 884- Acute poisoning refers to:

- 1) Low dose exposure over many years
- 2) Rapid absorption in a short period**
- 3) Exposure to highly toxic materials over a month or less
- 4) Low dose exposures over a short period

Answer:2- Acute exposures are the result of a single rapid exposure to a high dose of a material over a very short time period. Low or high doses to a toxic material over a period of days or weeks is not an acute exposure, it is a chronic exposure. Low doses over a short period do not constitute an acute exposure. **An acute exposure results in immediate effects.**

Question #: 885- Pneumoconiosis is a disease of the lungs that is caused by inhalation of:

- 1) Dusts**
- 2) Fumes
- 3) Gases and vapors
- 4) Smoke

Answer:1- Pneumoconiosis are a group of diseases of the lung that are caused by inhalation of dusts, such as asbestos, cotton dust, coal dust, crystalline silica, and others. Smoke, fumes, gases, and vapors can cause other diseases and effects, depending on the toxicology of the substance.

Question #: 886 - Byssinosis is associated with exposure to:

- 1) Asbestos
- 2) Cotton dust**
- 3) Ferric oxide
- 4) Crystalline silica

Answer:2- Byssinosis is caused by **long term exposure** to cotton dust. Asbestos exposure can cause asbestosis and potentially mesothelioma (a form of lung cancer). Exposure to ferric oxide can cause **siderosis**. Exposure to crystalline silica can cause **silicosis**.

Question #: 887- Chemicals with a "C" notation with their TLV's:

- 1) Are carcinogenic
- 2) Are listed in Appendix C of the MSDS
- 3) Are either suspect or confirmed carcinogens
- 4) Have ceiling TLV limits assigned to them**

Answer:4- A "C" notation denotes that the TLV is the ceiling limit for the chemical listed. This means that the assigned TLV is a maximum level that should not be exceeded at any time during the workday.

Question #: 888- The **minimum** lethal dosage (MLD) is defined as:

- 1) The largest amount that will kill the most susceptible of a group of test animals
- 2) The largest amount that will kill the most susceptible of a group of test people
- 3) The smallest amount that will kill the most susceptible of a group of test animals**

4) The smallest amount that will kill the most susceptible of a group of test people

Answer:3- The MLD is the smallest amount that will kill the most susceptible of a group of test animals.

Question #: 889- Which one of the following statements is NOT true?

~~1) Fog - small gas-borne particles resulting from incomplete combustion and consisting predominantly of carbon and other combustible materials~~

2) Mist - a term loosely applied to the dispersion of liquid particles, many of which are large enough to be individually visible without visual aid

3) Smog - a term derived from "smoke" and "fog" and applied to extensive atmospheric contamination by aerosols arising from a combination of natural and man-made sources

4) Dust - solid particles predominantly larger than colloidal and capable of temporary suspension in air or other gases

Answer:1- Fog is a term loosely applied to visible aerosols in which the dispersed phase is liquid. Formation by condensation is implied. The definition given in Answer 1 applies to smoke.

Question #: 890- Which of the following statements is true?

1) Gas - a substance below its critical temperature

2) Vapor - the gaseous phase of a substance above its critical temperature

3) Aerosol - a dispersion of gaseous particles of microscopic size in a liquid medium

4) Mist - dispersion of liquid particles, many of which are large enough to be individually visible without visual aid

Answer:4- The definition of "mist" is correct. Gas - a substance above its critical temperature
Vapor - the gaseous phase of a substance below its critical temperature. Aerosol - a dispersion of solid or liquid particles of microscopic size in a gaseous medium for instance, smoke, fog, and mist

Question #: 891- Which one of the following statements is NOT true?

1) Smoke - small gas-borne particles resulting from incomplete combustion and consisting predominantly of carbon and other combustible materials. 2) Fog - a term loosely applied to visible aerosols in which the dispersed phase is liquid. 3) Fume - solid particles generated by condensation from the gaseous state, generally after volatilization from melted substances and often accompanied by a chemical reaction, such as oxidation

4) Smog - a term loosely applied to solid particles predominantly larger than colloidal and capable of temporary suspension in air or other gases

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Answer:4 -Smog is a term derived from "smoke" and "fog" and is applied to extensive atmospheric contamination by aerosols arising from a combination of natural and man-made sources. The definition given in Answer 4 applies to dust.

Question #: 892- Liquid droplets or solid particles dispersed in air, that are fine enough particle size to remain so dispersed for a period of time, are called:

- 1) Smoke **2) Aerosols** 3) Vapors 4) Dusts

Answer:2- Aerosols are liquid droplets or solid particles dispersed in air, that are fine enough particle size to remain so dispersed for a period of time.

Question #: 893- Suspended liquid droplets generated by condensation from the gaseous to liquid state are called:

- 1) Mists** 2) Aerosols 3) Dusts 4) Vapors

Answer:1- Mists are suspended liquid droplets generated by condensation from the gaseous to liquid state.

Question #: 894- A material that causes visible destruction or irreversible alterations in living tissue by chemical action at the site of contact is defined as:

- 1) Acidophilic **2) Corrosive** 3) Reactive 4) Toxic

Answer:2- A corrosive chemical causes visible destruction or irreversible alterations in living tissue by chemical action at the site of contact.

Question #: 895- Toxic effects may be broken down into the following major classifications:

- 1) Light exposure 2) Moderate exposure
3) Acute, chronic, narcosis, discomfort 4) Acute or chronic

Answer:3- Toxic effects may be broken down into the following major classifications: acute, chronic, narcosis, and discomfort.

Question #: 896- A worker is exposed to a level of a chemical above its TLV-TWA but lower than its STEL. What is the minimum period required before the next STEL level exposure if the TLV-TWA is not violated?

- 1) None required
2) None required but only 4 such exposures per day
3) 60 minutes
4) 4 STEL exposure per day with each exposure separated by 60 minutes

Answer:4- Up to four STEL exposures may occur each workday with each STEL exposure separated by at least 60 minutes. ACGIH TLVs and BEIs

Question #: 897 - You are monitoring a worker's exposure to a substance with a TLV-TWA but no published TLV-STEL or TLV-C. What is the maximal exposure allowed even with no indication of TLV-TWA violation?

1) 5 times the TLV-TWA

3) 2 times the TLV-TWA

2) 3 times the TLV-TWA

4) 1.5 times the TLV-TWA

Answer:1- Under no circumstances should exposures exceed 5 times the TLV-TWA, provided that the TLV-TWA is not exceeded.

Question #: 898- What do the following chemicals have in common: acetone, carbon disulfide, cresol, gasoline, mercury-aryl, and inorganic compounds?

1) No TLV-TWA's 2) Designated as "A2" carcinogens 3) There is a skin notation

4) TLV-TWA is higher than either the OSHA PEL and/or the NIOSH Recommended Exposure Level (REL)

Answer:4- All of the above chemicals have TLV-TWA's above either the OSHA PEL and/or the NIOSH REL. Apply the most conservative allowable exposure.

Question #: 899 - The analog to the breathing air exposure level TLV-TWA, is the biological monitoring level _____.

1) BEI

2) TLV

3) PD

4) BIO

Answer:1- The biological monitoring level utilized by the ACGIH to assess worker exposure is termed a Biological Exposure Index (BEI). ACGIH has established dozens of BEI's for various hazardous chemicals.

Question #: 900 - An operator of a degreaser tank noticed that the tank solvent (trichloroethylene) was leaking onto a flame under the tank. As the plant safety professional, what is your main concern of exposure?

1) Trichloroethylene **2) Phosgene** 3) Flammability/explosion 4) Chlorine

Answer:2- Trichloroethylene upon exposure to a flame, decomposes to form phosgene, a highly toxic gas. Trichloroethylene is not flammable.

Question #: 901- What is the primary hazard(s) of ethylene oxide?

1) Toxicity

2) Fire/explosion hazard

3) Carcinogen

4) 1, 2, and possibly 3

Answer:4- Ethylene oxide is toxic and has a low flash point. **Additionally it is an IARC Group 2A carcinogen (i.e., it is probably carcinogenic to humans).**

Question #: 902 - Which of the following does NOT carry a TLV "skin" notation?

1) Toluidine

2) 2,4,6-Trinitrotoluene (TNT)

3) Hydrazine

4) Lead

Answer:4- All of the above chemicals, with the exception of lead, carry the "skin" notation.

Question #: 903- Fatalities among workers performing quenching operations on metal drosses have been caused by:

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1) **Arsine** 2) Nitrous fumes 3) Beryllium 4) Vanadium pentoxide

Answer:1- Most cases of arsine poisoning occur after the accidental generation of the gas in the workplace. During recent years many incidents have involved a reaction between arsenic and aluminum, with the subsequent release of hydrogen in the presence of water to permit the formation of arsine gas. Arsine usually evolves when nascent hydrogen is generated in the presence of arsenical compounds or by the hydrolysis of a metallic arsenide in contact with water. Invariably, there is an acid medium where metal is present (e.g., dross residues, galvanized implements, aluminum tanks or implements) thereby creating the key ingredients necessary for arsine formation. Arsine generation is a concern of metal pickling operations.

Question #: 904- Which form of silica has the lowest TLV?

1) Quartz 2) **Cristobalite** 3) Silica, fused 4) Chrysotile

Answer:2- The TLV for quartz and fused silica is 0.1 mg/m³. The TLV for cristobalite is 0.05 mg/m³. Chrysotile is a form of asbestos.

Question #: 905 - Which of the following irritants is not considered a primary irritant?

1) HCl 2) **NO₂** 3) SO₂ 4) NH₃

Answer:2- NO₂ is a secondary irritant in that it produces toxic system effects upon absorption on the lung tissue. The other chemicals are primary irritants in that they form non-toxic end products and primarily cause irritation.

Question #: 906- Which of the following chemicals are sensitizers?

1) **TDI** 2) **MDI** 3) HCl 4) **Both 1 and 2**

Answer:4- Both TDI and MDI are strong sensitizers. Sensitizers cause a strong allergic reaction in sensitized individuals after initial exposure. An individual who is sensitized responds to extremely small concentrations.

Question #: 907- Which of the following gases is not a simple asphyxiant?

1) **Carbon monoxide** 2) Nitrogen 3) Methane 4) Argon

Answer:1- Carbon monoxide binds with the body's hemoglobin tightly so that oxygen cannot be transported. Because of this it is considered a chemical Asphyxiant.

Question #: 908- Of the following, which is FALSE?

- 1) **A "skin" notation means that the chemical causes dermatitis**
2) A mixture calculation may be used when toxic effects are similar
3) The term TWA implies that the exposure limit may be exceeded for short periods
4) A ceiling notation means that the level may not be exceeded at any time

Answer:1- A skin notation means that is substance in question has the ability to penetrate the skin thus making the skin an entry route.

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Question #: 909- Where the "skin" notation follows a substance TLV, it refers to all of the following, EXCEPT:

- 1) Exposure via eyes
- 2) **Exposure via intestinal absorption**
- 3) Exposure via mucous membranes
- 4) Exposure via cutaneous route

Answer:2- The "skin" notation refers to the potential significant contribution to exposure by the cutaneous route, including mucous membranes and the eyes. While some are capable of causing irritation, dermatitis, and sensitization, these properties are not considered relevant when assigning a skin notation.

Question #: 910- Glacial acetic acid should be stored with:

- 1) Nitric acid
- 2) Flammable materials
- 3) Acids and bases
- 4) Sodium hydroxide

Answer:2- Acetic acid has a flash point of 109°F. This makes it a combustible liquid. Therefore the most appropriate storage area is FLAMMABLE.

Question #: 911- The "hot zone" is:

- 1) The area closest to a radiation leak
- 2) **The area around a spill/release into which untrained personnel may not enter**
- 3) The area where responders and most equipment are decontaminated before entering the "cold zone"
- 4) The area where only firefighters can enter

Answer:2- The "hot zone" (exclusion zone), is that area around a spill/release into which untrained, unequipped individuals may not enter.

Question #: 912- In responding to a spill of a material that is labeled "ORM-A ", what would be your main concern?

- 1) Asphyxiation
- 2) Fire/explosion
- 3) **Toxicity**
- 4) Dust

Answer:3- ORM-A refers to a Department of Transportation (DOT) classification of **"Other Regulated Materials"** that do not meet the definition of other DOT hazard classes. ORM-A materials have anesthetic, irritating, noxious, toxic, or other similar properties that can cause extreme annoyance or discomfort to passengers or crew in the event of leakage during transportation.

Question #: 913- Storing chemicals according to their compatibility is an important factor in reducing risks. Which of the following groups of chemicals cannot be stored safely together?

- 1) Methyl ethyl ketone, toluene
- 2) **Nitric acid, oils**
- 3) Sodium hydroxide, sodium cyanide
- 4) 1,1,1-trichloroethane, paint thinners

Answer:2- Nitric acid will oxidize oils and potentially cause a fire.

Question #: 914- A basic safeguard involving the storage of hazardous chemicals is:

- | | |
|-----------------------------------|-------------------------------|
| 1) Automatic sprinkler protection | 2) Segregation |
| 3) Grounding and bonding | 4) Class I, Division 2 wiring |

Answer:2- Non-compatible chemicals, such as those that may react violently on mixing (such as acids with organic solvents or oxidizers with organic solvents) should be separated by a solid partition in major storage areas, or by a distance of not less than 20 feet .

Question #: 915- A worker's hand has been exposed to liquid nitrogen. What is the correct first aid?

- | | |
|------------------------------|--------------------------------------|
| 1) Immerse hand in ice water | 2) Immerse hand in warm water |
| 3) Immerse hand in hot water | 4) Keep hand in ice |

Answer:2 - Per the "Accident Prevention Manual for Industrial Operations", the hand should be placed in warm water

Question #: 916- In preparing the battery for a powered lifter, one must always:

- | | |
|-----------------------------|------------------------|
| 1) Add acid to water | 2) Add water to acid |
| 3) Ground the lifter | 4) Check tire pressure |

Answer:1 - To prepare a battery "AAA" - always add acid to water to prevent splattering.

Question #: 917- Typically, if a compound is not very soluble in water, but is soluble in octanol, which of the following statements would be expected to be accurate?

- 1) The compound is very mobile in soil
- 2) The compound is not very mobile in soil**
- 3) The compound should exhibit moderate to high toxicity
- 4) None of the above

Answer:2- The octanol-water partition coefficient is sometimes used to approximate the degree to which a chemical, when released, will **tend to migrate (partition) between soil and water**.

Question #: 918- In assessing mobility and persistence of hazardous constituents upon release to the environment, the following factors are of interest EXCEPT:

- 1) Physical state of the matrix
- 2) Water solubility
- 3) Octanol-water partition coefficient (Kow) and soil-sorption coefficient (Koc)
- 4) Electrofluorescence**

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Answer:4 - Answers 1, 2, and 3 are of value in predicting the fate, transport, and persistence of chemicals released to the environment. Answer 4 is not a factor considered in mobility and persistence.

Question #: 919- A tank farm is being designed and will be located in a geographical location that receives extensive rainfall. The tank farm will house four hazardous materials: fuel oil, ethanol, acetone, and sulfuric acid. To ensure that corporate safety and environmental protection policies are followed, you have been asked to provide input on the layout of the containment dikes. Because of the soil, no dike can be higher than 4.5 ft. Due to the potential for heavy rains, company policy requires a 25% overage be designed into the capacity of any given diked volume. What are the minimum dimensions of the diked area necessary to protect acetone tanks C and D?

- 1) 145 ft * 145 ft 2) 130 ft * 160 ft 3) 138 ft * 160 ft 4) 138 ft * 138 ft

Answer:2- Answer this question one step at a time.

Step 1: Find the capacity of the larger tank. Dikes must be able to fully contain a release of the largest tank in the diked area. Tank C is the larger tank. Assume that its capacity is the same as the volume of a cylinder. The diameter of Tank C is 60 ft and its height is 24 ft. Its volume is therefore

$$V = \pi r^2 * h = 3.14 * 30^2 * 24 \\ = 67,858 \text{ ft}^3$$

Step 2: The next step is to determine the required capacity of the diked area. The dike must contain a complete loss of the largest tank plus a rainfall overage of 25%. Therefore, the actual capacity of the dike is 25% higher than the volume of the largest tank.

$$\text{Total Volume} = 1.25 * 67,858 \text{ ft}^3 \\ = 84,823 \text{ ft}^3$$

Step 3: Unfortunately, we cannot use the volume occupied by the other tank in the diked area (Tank D). We DO assume that the volume occupied by Tank C is available, though. To calculate the unavailable dike volume occupied by Tank D, simply assume that Tank D is a cylinder of 4.5 ft high (the height of the dike) and calculate the volume of this 4.5 ft high cylinder. Volume Tank D =

$$V = \pi r^2 * h = 3.14 * 25^2 * 4.5 \\ = 8,836 \text{ ft}^3$$

Step 4: Calculate the Net Volume. This is the Total Volume plus the Volume of Tank D.

$$\text{Net Volume} = 84,823 \text{ ft}^3 + 8,836 \text{ ft}^3 \\ = 93,659 \text{ ft}^3$$

Step 5: Calculate the required surface area necessary to cover this volume. We are allowed a dike height of 4.5 ft; therefore, the required surface area is the Net Volume divided by the dike height.

$$\text{Surface Area} = 93,659 \text{ ft}^3 / 4.5 \text{ ft} \\ = 20,813 \text{ ft}^2$$

Step 6: To calculate the preliminary minimum dimensions, simply take the square root of the Surface Area. This will give us the preliminary minimum dimensions in the form of a square.

$$\text{Minimum Dimension} = \text{ft}^2 \\ = 144.3 \text{ ft} * 144.3 \text{ ft}$$

Step 7: Verify that these dimensions are compatible with tank separation requirements. Tank C must be at least 50 ft from Tank D. Assume that all other tanks in this tank farm can be placed sufficiently far away from Tank C in their own diked areas to meet minimum separation requirements. Tank C has a diameter of 60 ft, and Tank D has a diameter of 50 ft. The minimum separation distance is 50 ft. Therefore, when adding these gross dimensions, you find that the vertical dimension (with respect to the graphic) of 144.3 ft is insufficient. If the two tanks were built right on the upper and lower dikes, they would only be separated by 34.3 ft. An additional 15.7 ft in the vertical dimension is required to account for minimum separation.

144.3 feet – 60 feet Diameter of Tank C = 84.3 feet – 50 feet separation distance = 34.3

Step 8: The minimum vertical dimension is therefore
Vertical Dimension = 144.3 ft + 15.7 ft = 160 ft

Step 9: Calculate the new horizontal dimension (with respect to the graphic). The Net Volume is still 93,659 ft³. The new horizontal dimension is therefore
Horizontal Dimension = 93,659 ft³ / 160 ft / 4.5 ft = 130 ft

Finally, the minimum dimensions of this diked area are 160 ft vertically * 130 ft horizontally.

NOTE: Always go through the process of determining the preliminary minimum dimensions. If Tank C and Tank D contained fuel oil instead of acetone, for example, the preliminary minimum dimensions would have been the actual minimum dimensions.

Question #: 920- A tank farm is being designed and will be located in a geographical location that receives extensive rainfall. The tank farm will house four hazardous materials: fuel oil, ethanol, acetone, and sulfuric acid. To ensure that corporate safety and environmental protection policies are followed, you have been asked to provide input on the layout of the containment dikes. Because of the soil, no dike can be higher than 4.5 ft. Due to the potential for heavy rains, company policy requires a 25% overage be designed into the capacity of any given diked volume. Because of piping layout requirements, the edge of Tank F will be located 1 ft from the dike it shares with Tank G. The same piping issues require the centerlines of Tank F and Tank G to line up. What are the minimum dimensions of the other three dikes containing Tank G? Assume that the diked area for Tank G is rectangular.

- 1) 85 ft * 85 ft 2) 105 ft * 85 ft 3) 105 ft * 105 ft 4) 129 ft * 85 ft

Answer: 4- Answer this question one step at a time.

Step 1: Find the capacity of Tank G. Assume that its capacity is the same as the volume of a cylinder. The diameter of Tank G is 50 ft and its height is 20 ft. The volume is therefore
 $V = \pi [(50 \text{ ft})^2 / 4] 20 \text{ ft}$
= 39,270 ft³

Step 2: The next step is to determine the required capacity of the diked area. The dike must contain a complete loss of Tank G plus a rainfall overage of 25%. Therefore, the actual capacity of the dike is 25% higher than the volume of Tank G.
Total Volume = 1.25 * 39,270 ft³
= 49,087 ft³

Step 3: Since there are no other tanks in this diked area, we can immediately calculate the required surface area to cover this volume by dividing the volume by the dike height of 4.5 ft.
Surface Area = 49,087 ft³ / 4.5 ft

= 10,908 ft²

Step 4: To calculate the preliminary minimum dimensions, simply take the square root of the Surface Area. This will give us the preliminary minimum dimensions in the form of a square.

Minimum Dimension = ft²

= 104.4 ft * 104.4 ft

Step 5: Verify that these dimensions are compatible with the tank separation requirements.

Tank G must be at least 80 ft from Tank F. Assume that Tank E is sufficiently far away from Tank G to meet minimum separation requirements. Tank G has a diameter of 50 ft. If it were placed at the far end of its diked area, it would still be too close to Tank F by 24.6 ft (104.4 ft - 50 ft - 80 ft + 1 ft). (The 1 ft dimension is the distance of Tank F from the shared dike.)

Therefore, the minimum horizontal dimension (with respect to the graphic) is

Minimum Horizontal Dim. = 104.4 + 24.6 ft = 129 ft

Step 6: Calculate the new minimum vertical dimension (with respect to the graphic) based on the minimum horizontal dimension of 129 ft using the Total Volume.

Minimum Vertical Dim. = 49,087 ft³ / 129 ft / 4.5 ft = 84.6 ft

NOTE: Always go through the process of determining the preliminary minimum dimensions. If Tank G contained any of the other three materials in this exercise, the preliminary minimum dimensions would have been the actual minimum dimensions.

Question #: 921- Apocrine and eccrine relate to what gland?

- 1) Sebaceous **2) Sweat** 3) Thyroid 4) Liver

Answer:2- Skin is equipped with upward of two million tiny glands that produce sweat. There are two kinds of sweat glands. Apocrine sweat glands open into hair follicles and are limited to the underarm and genital area. Eccrine, the other type of sweat gland, is present almost everywhere in the skin. Its function is to help the body dissipate excessive internal heat through evaporation of sweat from the surface of the skin. Sebaceous glands are the skin's oil-making glands.

Question #: 922- Most people, especially the young, can hear sounds between:

- 1) 10 Hz and 12,000 Hz 2) 10 Hz and 50,000 Hz
3) 16 Hz and 20,000 Hz 4) 150 Hz and 30,000 Hz

Answer:3- Most people, especially the young, can hear tones within a range of 16 Hz (cycles per second), up to 20,000 Hz. A steady loss of hearing occurs as people grow older (e.g., a 60-year-old person often cannot hear sounds with frequencies above 12,000 Hz). This phenomenon is known as Presbycusis.

Question #: 923- What classification level is the most hazardous for flammable aerosols?

- 1) Level 1 2) Level 2 **3) Level 3** 4) Level 4

Answer:3- Level 1 aerosols are defined as producing less than 8,600 Btu/lb of aerosol. Level 2 aerosols produce 8,600-13,000 Btu/lb and Level 3 aerosols produce more than 13,000 Btu/lb. Level 4 aerosols do not exist.

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Question #: 924- In the identification of fire class occupancies, Class II indicates the presence of:

- 1) **Combustible dusts**
- 2) Flammable vapors
- 3) Ordinary combustibles
- 4) Ignitable fibers

Answer:1- Class II occupancies are locations where combustible dust is, or may be, in suspension in the air continuously, intermittently, or periodically. Hazardous dusts are separated into groups: Group E for metal dust, Group F for carbon black, coal or coke dust, and Group G for flour, starch, or grain dust. NFPA 70 Article 500-3 (National Electric Code)

Question #: 925- The exit design requirements in the NFPA 101 Life Safety Code are based on classification of the occupancy. These classifications are dependent on the burning characteristics of:

- 1) **Contents of the building**
- 2) Quantity of combustible materials
- 3) Type of building construction
- 4) The type of flooring materials

Answer:1- The contents are evaluated to determine the rate of fire spread, development of products of combustion, and components that affect the time available for evacuating the building. NFPA 101 6.2 (Life Safety Code)

Question #: 926- A Class I, Division I hazard includes all of the following EXCEPT?

- 1) ~~A closed-loop system containing a flammable solvent~~
- 2) An open vat containing a flammable solvent
- 3) A cleaning operation involving a flammable solvent
- 4) A degreasing tank with a flammable solvent

Answer:1- Class I, Division I systems involve operations where flammable solvent vapors would **generally be present**. One would not expect flammable vapors to be normally present in a closed-loop system. NFPA 70 Article 500-5 (National Electric Code)

Question #: 927- A Division 2 location is one where:

- 1) Combustible materials are always present
- 2) **Combustible materials are not normally present**
- 3) Combustible materials are never present
- 4) Combustible materials are stored near an ignition source

Answer:2- A Division 1 location is expected to have combustible materials present while a Division 2 location should only have such materials present in emergencies or other unusual circumstances. NFPA 70 Article 500-5 (National Electric Code)

Question #: 928- A flammable liquid with a flash point of 72°F and a boiling point below 100°F would be classified by the NFPA as a:

- 1) Class I liquid
- 2) **Class IA liquid**
- 3) Class IB liquid
- 4) Class II liquid

Answer:2- A Class I liquid refers to any flammable with a flashpoint below 100°F. A Class IA liquid has a flashpoint below 73°F and a boiling point below 100°F. A Class IB liquid has a flash point below 73°F and a boiling point at or above 100°F. A Class II liquid has a flash point at or

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above 100°F and a boiling point below 140°F. NFPA 30 Flammable and Combustible Liquids Code

Question #: 929- "Means of Egress" as defined in the NFPA Life Safety Code includes all of the following EXCEPT:

- 1) Exit access **2) Exit doorway** 3) Exit discharge 4) Exit

Answer:2- NFPA 101 (Life Safety Code) states that a means of egress involves the exit access, exit, and exit discharge. These components of the means of egress are further defined in NFPA's Life Safety Code Handbook. NFPA 101 3.3.121 (Life Safety Code)

Question #: 930- Which of the following is among NFPA's classifications of hazard of contents for a building?

- 1) Conventional hazard **2) Ordinary hazard** 3) Nominal hazard 4) Minimal hazard

Answer:2- Of these, NFPA defines "Ordinary Hazard" as one of the classifications of the hazard of contents in a building. The other two classifications are **"Low Hazard" and "High Hazard."** NFPA 101 6.2.2 (Life Safety Code)

Question #: 931- The National Electrical Code utilizes a Class I, II, and III hazard identification system. Class II hazards involve:

- 1) Flammable liquids **2) Combustible dusts** 3) Combustible fibers 4) Combustible powders

Answer:2- The NEC Class I hazard category includes flammable liquids or gases, Class II includes combustible dusts, Class III involves fibers. NFPA 70 Article 500-6 (National Electric Code)

Question #: 932- Approved for hazardous (classified) location means?

- 1) Equipment is approved for the class, division, and group of location**
2) There are four types of equipment specifically designed for hazardous (classified) locations
3) There are three types of equipment specifically designed for hazardous (classified) locations
4) Equipment need not be approved for the class, division and group of location

Answer:1- Equipment must be approved for the class, division, and group of location. There are two types of equipment specifically designed for hazardous (classified) locations – explosion proof and dust-ignition-proof. NFPA 70 Article 500-2 (National Electric Code)

Question #: 933- Consider the following floor plan, and estimate the common path of travel from Room A (assume that Room A is essentially empty)?

- 1) 0 feet** 2) 50 feet 3) 100 feet 4) 250 feet

Answer:1- The common path of travel is the **maximum distance** one has to travel in order to have **access to two or more exits**. In this case, Room A already has two valid exits; therefore, the common path of travel is 0 feet.

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Question #: 934- Consider the following floor plan, and estimate the common path of travel from Point X.

- 1) 0 feet **2) 50 feet** 3) 100 feet 4) 250 feet

Answer:2- The common path of travel is the **maximum distance one has to travel** in order to have **access to two or more exits**. In this case, one has to travel the length of this dead-end corridor in order to have access to two different exits.

Question #: 935- Consider the following floor plan, and estimate the maximum travel distance in this floor plan (assume that all of the rooms are essentially empty).

- 1) 50 feet 2) 100 feet 3) 250 feet 4) 450 feet

Answer:3- The maximum travel distance is the maximum distance one could travel to pass through the nearest exit discharging to a public way. In this case, the worst-case scenario is in the back of Room B. Assume that the furthest point is near the upper right corner of Room B. An estimate of the travel distance is 100 feet (to the door from Room B) plus about 50 feet to the corner of the corridor plus 100 feet to the exit.

Question #: 936- What is an example of an unfired pressure vessel?

- 1) Boiler **2) Steam jacketed kettle** 3) Any vessel directly experiencing flame
4) Copper jacketed reactor

Answer:2- An unfired pressure vessel does not have a direct flame impacting it. A steam jacketed kettle is one example.

Question #: 937- Which floor surface presents the most resistance to a slip/fall accident?

- 1) Steel 2) Granite **3) Creosote wood** 4) Tile

Answer:3- Creosote wood flooring would provide the most resistance to a slip/fall accident.

Question #: 938- Which natural fiber makes the safest rope?

- 1) Manila** 2) Sisal 3) Cotton 4) Jute

Answer:1- Per the "Accident Prevention Manual", manila rope is the best suited natural fiber rope for slings and capstans.

Question #: 939- Use the following data: 8 ft deep, unshored trench; floor of trench is 6 ft wide; Type A soil (sloping requirement for Type A soil is 3/4 horizontal to 1 vertical). What is the minimum acceptable width of the trench at grade level if the trench is properly sloped?

- 1) 12 ft **2) 18 ft** 3) 21 ft 4) 24 ft

Answer:2- Draw a sketch. For every foot in depth, the slope must be cut 3/4 ft horizontally. That means for 8 ft in depth, the slope must be cut 6 ft wide. Since this has to be done for both sides of the trench, the width must be 18 ft; (6 ft + 6 ft + 6 ft).

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Question #: 940- What is not an acceptable method of controlling static discharge?

- 1) Grounding 2) Bonding 3) Conductive flooring **4) Open circuits**

Answer:4- Open circuits are not an acceptable method of controlling static discharge.

Question #: 941- If a wire is 200 ft long and has a resistance of 1.5 W and a diameter of 2 mm, what will the **resistance** be if the length is 140 ft and the diameter is 2.5 mm?

- 1) 0.233 W 2) 0.323 W **3) 0.672 W** 4) 0.840 W

Answer:3- Use the formula: $R2 = R1(L2 / L1) (D1^2 / D2^2)$

$$R2 = R1 (140 \text{ ft}/200 \text{ ft}) [(2 \text{ mm})^2/(2.5 \text{ mm})^2]$$

$$R2 = 1.5 \text{ W} * 0.7 * 0.64$$

$$R2 = 0.672 \text{ W}$$

Remember that the cross-sectional area of a round conductor changes with the square of the diameter.

Question #: 942- Which of the following substances is the best conductor?

- 1) Aluminum 2) Copper **3) Silver** 4) Nickel

Answer:3- Silver has the lowest resistivity at 1.47×10^{-8} ohm-m.

Question #: 943- The resistance of a wire varies with all of the following EXCEPT:

- 1) Temperature 2) Length 3) Diameter **4) Nuclear orientation**

Answer:4- The resistance of a material varies with its temperature, length and diameter. Nuclear orientation has no effect on resistance.

Question #: 944- As the diameter of a wire increases, the resistance of the wire:

- 1) Increases **2) Decreases** 3) Stays the same
4) Increases as the square of the cross-sectional area

Answer:2- As the diameter of a wire increases, its resistance decreases.

Question #: 945- What size solid copper and aluminum conductors are used with a 110 V, 20 A electrical circuit?

- 1) 12 gauge for both 2) 14 gauge for both
3) 14 gauge for copper, aluminum cannot be used
4) 14 gauge for copper, 12 gauge for aluminum

Answer:4- Aluminum conductors are not as efficient as copper so they must be larger. NFPA 70 Article 310-5 (National Electric Code)

Question #: 946- Class III, Division 1 electrical protection is provided in a plant processing:

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- 1) Sugar **2) Cotton** 3) Starch 4) Paint

Answer:2- Class III, Division 1 locations are hazardous because of the presence of easily ignitable fibers or flyings in processing cotton. NFPA 70 Article 500-7 (National Electric Code)

Question #: 947- A hazardous location, because of the presence of combustible dust requires electrical protection that meets the requirements of:

- 1) Class I locations **2) Class II locations** 3) Class III locations 4) Class IV locations

Answer:2- Class II locations are those in which suspended combustible dust may be present in quantities sufficient to produce explosive or ignitable mixtures; or be electrically conductive; or be ignitable by a malfunction of electrical equipment. NFPA 70 Article 500-6 (National Electric Code)

Question #: 948- When applied to electrical apparatus, the term "explosion proof" means:

- 1) Capable of withstanding external explosions
2) Capable of excluding the intrusion of explosive gas or vapor
3) Capable of containing an internal explosion
4) Both 1 and 2

Answer:3- NFPA 70 (National Electric Code) defines "explosion proof apparatus" as, "Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes, or explosion of the gas or vapor within, and that operates at such an external temperature that a surrounding flammable atmosphere will not be ignited thereby." NFPA 70 Article 100-A (National Electric Code).

Question #: 949- Any of the following are major cause(s) of electrical shock EXCEPT:

- 1) Ungrounded frames or inadequate grounding of frames on noncurrent-carrying parts of electrical machinery and tools
2) Inadequate protection of exposed current-carrying parts of electrical installations
3) Inadequate insulation of electrical conductors
4) GFCI devices

Answer:4- Answers 1, 2, and 3 are the three major causes of electrical shock as reported by OSHA in their student manual "Guide to Voluntary Compliance". GFCI stands for ground fault circuit interrupter. These devices prevent electrical shocks by opening the circuit upon detecting a fault in the circuit.

Question #: 950- What fundamental precaution should be taken during an electrical storm?

- 1) Stand perfectly still
2) Stand by a metal fence
3) Seek shelter within a grounded metal building
4) Seek shelter within a non-grounded non-metal building

Answer:3- Precautions should be taken during an electrical storm, including seeking shelter within a grounded metal building.

Question #: 951- To control static discharge the following should be performed:

- 1) Lower relative humidity below 65%
- 2) Raise relative humidity above 65%**
- 3) Lower relative humidity below 30%
- 4) Maintain relative humidity above between 10% and 60%

Answer:2- To control static discharge one should raise relative humidity above 65%.

Question #: 952- Assume a fan operates at 81% of maximum efficiency and delivers 6,000 cfm of air against a total pressure of 2 in. H₂O. What horsepower is delivered?

- 1) 0.47 hp 2) 0.94 hp 3) 1.06 hp **4) 1.62 hp**

Answer:4- $Q = \text{Flow (cfm)}$, $TPf = \text{Total pressure (in. H}_2\text{O)}$
 $\text{Max flow} = 6,000 \text{ cfm} / 0.81 = 7,407 \text{ cfm}$

$$\text{AHP} = Q (TPf/\text{Max Flow}) = 6,000 \text{ cfm}(2 \text{ in. H}_2\text{O} / 7,407 \text{ cfm}) = 1.62 \text{ hp}$$

Question #: 953- In the application of principles of guarding, what does zero mechanical state (ZMS) mean?

- 1) All energy sources neutralized**
- 2) All electrical energy off
- 3) Guards are not effective
- 4) All electrical energy locked and tagged out

Answer:1- ZMS is defined in ANSI Z-241.1 as the state with all energy sources neutralized.

Question #: 954- Gas supply hoses for temporary heaters should have a burst pressure of:

- 1) 500 psi(g) 2) 750 psi(g) 3) 1,000 psi(g) **4) 1,250 psi(g)**

Answer:4- The burst pressure rating is 1,250 psi(g).

Question #: 955- The work rest on a grinding wheel should be no more than _____ away from the wheel.

- 1) 1/8 in.** 2) 1/2 in. 3) 3/4 in. 4) 1 in.

Answer:1- A work rest should be, at most, 1/8 in. away from wheel. This is necessary to prevent the object being ground from being caught between the wheel, possibly injuring the operator. 29 CFR 1919.215 (a)(4)

Question #: 956- Which of the following is not a type of compressed gas cylinder relief device?

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- 1) Spring-loaded
3) Fusible metal

- 2) Frangible disc
(4) Spring-loaded backed up by fusible metal

Answer:4- All of the above are allowed except Answer 4). A frangible disc is the only relieving mechanism that is permitted to be backed up by a fusible metal device.

Question #: 957- Of the four gases shown below, which would cause the most problems with a cylinder valve assembly?

- 1) Nitrogen 2) Arsine **3) Hydrogen chloride** 4) Air

Answer:3- Hydrogen chloride (HCl) gas is highly corrosive and can cause problems with cylinder valves.

Question #: 958- How much horsepower is expended by a gasoline engine driving a winch used to raise a 2,200 lb fixture a distance of 20 ft in 10 sec?

- 1) 0.13 hp 2) 1.30 hp 3) 4.00 hp **4) 8.00 hp**

Answer:4- Horsepower is obtained from the formula: Work = Force * Distance

$$W = 2,200 \text{ lb} * 20 \text{ ft} = 44,000 \text{ ft-lb}, \text{ Power} = \text{Work}/\text{time}$$

$$P = 44,000 \text{ ft-lb} / 10 \text{ sec} , \quad P = 4,400 \text{ ft-lb/sec}$$

$$\text{Converting ft-lb/sec to hp: } P(\text{hp}) = (4,400 \text{ ft-lb/sec}) / [550(\text{ft-lb/sec})/\text{hp}] \quad P = 8.00 \text{ hp}$$

Question #: 959- What effort must be exerted by a material handler who is required to push a 200 lb barrel up a 10 ft long inclined plank on to a dock that is 2 ft above the ground? (Neglect friction.)

- 1) 40 lb** 2) 80 lb 3) 120 lb 4) 160 lb

Answer:1- The work done in pushing a barrel up an inclined plane is equal to the resistive load multiplied by the height of the plane:

$$\text{Length of Incline} * \text{Effort} = \text{Resistive Load} * \text{Height of Incline}$$

$$10 \text{ ft} * \text{Effort} = 200 \text{ lb} * 2 \text{ ft} \quad \text{Effort} = (200 \text{ lb} * 2 \text{ ft}) / 10 \text{ ft} = 40 \text{ lb}$$

Question #: 960- A wheelbarrow contains a load of 216 lb at an average distance of 1.50 ft from the axle. If the shaft of the wheelbarrow is 4 ft long, what force will be needed to raise the handles of the wheelbarrow?

- 1) 27 lb 2) 54 lb **3) 81 lb** 4) 108 lb

Answer:3- The moment of the 216 lb load is: $216 \text{ lb} * 1.50 \text{ ft} = 324 \text{ ft-lb}$. This force tends to turn the shaft in the clockwise direction. The unknown force (f) is applied to the handles 4 ft from the fulcrum. So $324 \text{ ft-lb} = 4 \text{ ft} * f$. So $f = 324 \text{ ft-lb} / 4 \text{ ft} = 81 \text{ lb}$

Question #: 961- Given a load of 2,000 lb and a two-leg sling making an angle of 30° with the horizontal, what is the tension of each leg in the sling?

- 1) 1,000 lb 2) 1,155 lb 3) 2,000 lb 4) 5,000 lb

Answer:3- Divide the total load by 2 because this is a two-leg sling. Use the trigonometric identity for sine. The hypotenuse leg represents the tension in the actual sling leg.
 $\sin 30^\circ = 1,000 \text{ lb} / \text{hypotenuse leg length} = 2,000 \text{ lb}$

Question #: 962- A box weighing 500 lb is to be pushed up a ramp with a 5% grade. If the coefficient of friction is 0.15, what is the force required to push the box up the ramp?

- 1) **100 lb** 2) 250 lb 3) 500 lb 4) 1,000 lb

Answer:1- 5% grade = $\tan^{-1} 0.05 = 2.86^\circ$ $\cos 2.86^\circ = \text{resultant force} / 500 \text{ lb}$
 $r = (0.9988) 500 \text{ lb} = 499.4 \text{ lb}$. Now Calculate the friction force component:
friction force = $f r = (0.15)(499.4 \text{ lb}) = 75 \text{ lb}$ Now Calculate the dynamic force component:
 $\sin 2.86^\circ = d / 500 \text{ lb}$ So $d = 0.0499 * 500 \text{ lb} = 25 \text{ lb}$.
Total force = dynamic force + friction force. So Total force = $25 \text{ lb} + 75 \text{ lb} = 100 \text{ lb}$.

Question #: 963- Hazardous chemical drums stacked 3-high, limit (i.e.restrict) response to a leak from one of the drums because of all of the following EXCEPT:

- 1) Leaks may not be accessible 2) Falling drums may aggravate the situation
3) Dispersion of sprinkler water to lower drums may be limited
4) **Containment of spill on the ground will be hampered**

Answer:4- Containment will not be a factor since any leaks will fall to the ground where they can ultimately be contained. Containment at the source of the leak will be a problem in this situation.

Question #: 964- Wire rope is used widely instead of fiber rope because:

- 1) **It has greater strength for the same diameter**
2) **Its strength is constant when wet or dry**
3) ~~It is not as durable~~
4) **Both 1 and 2**

Answer:4- Wire rope is composed of wires, strands, and core. The wires are drawn to a predetermined size and laid together in various arrangements helically formed around the core. In general, the greater the number of wires in a strand and the greater the number of strands, the more flexible the rope.

Question #: 965- Of the following, which is the best source of power for forklifts used in a warehouse operation?

- 1) **Electric** 2) LPG 3) Gasoline 4) Either 2 or 3

Answer: 1- An electric forklift produces **no emissions**. This is an important consideration in an enclosed warehouse.

Question #: 966- You are asked to **reduce the emissions** of gasoline-powered forklifts used in a warehouse. What is your best option given the fact that you cannot afford to purchase electrically-powered trucks?

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- 1) Convert the existing forklifts to diesel-power **2) Convert the existing forklifts to LP-gas-power**
3) Provide warehouse employees with air-purifying respirators
4) Increase the warehouse dilution ventilation

Answer:2- Of the above options, converting the gasoline-powered forklifts to LP-gas-power is the best. Conversions must be handled in accordance with the following standards: 29 CFR 1910.178 (d) 29 CFR 1910.178 (q)(12)

Question #: 967- Which of the following is **not** one of the common types of hitches used to secure a sling to a load?

- 1) Vertical **2) Horizontal** 3) Choker 4) Basket

Answer:2- Vertical, choker, and basket are types of hitches used to secure slings to loads lifted by hoists or cranes. There is no such thing as a horizontal hitch.

Question #: 968- A table of rated capacities for wire rope slings generally **lists** lifting capacities for different:

- 1) Sling lengths 2) Load angle factors 3) Sling ages **4) End fittings and hitch types**

Answer:4- Load rating tables for wire rope slings almost always list the weight which can be lifted for different diameter ropes by the end fittings and hitch type to be utilized. 29 CFR 1910.184 (f)

Question #: 969- Decreasing the angle between a sling and the load increases:

- 1) The weight which can be lifted **2) The effective weight of the load**
3) The time it takes to make the load 4) The system overburden

Answer:2- Decreasing the "load angle" increases the effective weight of the load, thereby increasing the capacity required to lift the load. For example, more weight can be lifted by a sling if the sling angle is 60° versus 45°. Refer to load angle factor tables, or perform the calculations yourself using trigonometry.

Question #: 970- If a uniformly distributed 5,000 lb load is to be lifted by a 2-leg bridle hitch with each leg forming an angle of 45° with the load, what is the load on each leg of the sling?

- 1) 1,768 lb 2) 2,500 lb **3) 3,535 lb** 4) 5,000 lb

Answer:3- First, divide the total weight to be lifted by the number of legs on the sling or hitch. If the load is not uniform, then the exact weight on the leg lifting more would have to be calculated. In this case the load is uniformly distributed so:

$5,000 \text{ lb} / 2$ (since there are two legs) = 2,500 lb

Then calculate the effective weight on each leg by multiplying the weight on each leg by the load angle factor. $2,500 \text{ lb} / \sin 45^\circ = 3,535 \text{ lb}$

Question #: 971- If an analytical procedure requires 4 mg of a substance having a TLV of 100 ppm and a molecular weight of 156, what is the minimum time required to collect one sample at the TLV if the sampling rate is 1.5 lpm?

- 1) 31.32 min 2) 10.59 min 3) 8.34 min **4) 4.17 min**

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Answer:4- First determine $\text{mg/m}^3 = (100 \text{ ppm} * 156)/24.45 = 638 \text{ mg/m}^3$ or 0.638 mg/l
 $0.638 \text{ mg/l} * 1.5 \text{ lpm} = 0.96 \text{ mg/min}$. Now $4 \text{ mg}/0.96 \text{ mg/min} = 4.17 \text{ min}$

Question #: 972- If 100 ml of methylene chloride is spilled into an unventilated room $4 \text{ m} * 4 \text{ m} * 10 \text{ m}$, what would the concentration be after it has all evaporated? (SG of methylene chloride is 1.336 and MW is 85)

- 1) 150 ppm 2) 100 ppm 3) 220 ppm 4) 240 ppm

Answer:4- Total volume of room = $4 \text{ m} * 4 \text{ m} * 10 \text{ m} = 160 \text{ m}^3$

$100 \text{ ml} * 1.336 \text{ g/ml} = 133.6 \text{ g} = 133,600 \text{ mg}$

$133,600 \text{ mg}/160 \text{ m}^3 = 835 \text{ mg/m}^3$

Converting mg/m^3 to ppm: $(835 \text{ mg/m}^3 * 24.45) / 85 = 240 \text{ ppm}$

Question #: 973- How much acetone would have to be evaporated into a room $15 \text{ ft} * 12 \text{ ft} * 10 \text{ ft}$ to give a final concentration of 10 ppm at STP? (SG of acetone is 0.79 and MW is 58)

- 1) **1.53 ml** 2) 1.01 ml 3) 1.95 ml 4) 1.33 ml

Answer:1- Volume of the room $15 \text{ ft} * 12 \text{ ft} * 10 \text{ ft} = 1,800 \text{ ft}^3$

Convert cubic feet to cubic meter $\rightarrow 1,800 \text{ ft}^3 / (35.3 \text{ ft}^3/\text{m}^3) = 51 \text{ m}^3$

$\text{mg/m}^3 = (\text{ppm} * \text{MW}) / 24.45 = (10 \text{ ppm} * 58) / 24.45 = 23.7 \text{ mg/m}^3$

$23.7 \text{ mg/m}^3 * 51 \text{ m}^3 = 1208.7 \text{ mg} = 1.21 \text{ g}$ $1.21 \text{ g}/0.79 \text{ g/ml} = 1.53 \text{ ml}$

Question #: 974- Workplace air at 120°F was sampled and 70 mg of methyl chloroform was found in an 850 liter sample. What would the concentration have been at normal temperature and pressure (NTP)? (MW of methyl chloroform is 133)

- 1) **16.3 ppm** 2) 21.4 ppm 3) 25.4 ppm 4) 30.1 ppm

Answer:1- $70 \text{ mg}/0.85 \text{ m}^3 = 82 \text{ mg/m}^3$

$\text{ppm} = [(82 \text{ mg/m}^3 * 24.45)/133] 322^\circ \text{ K}/298^\circ \text{ K} = 16.3 \text{ ppm}$

Remember, for this conversion: $T = 25^\circ\text{C} = 298^\circ \text{ K}$ $T = 120^\circ\text{F} = 322^\circ \text{ K}$

Question #: 975- Which of the following is not a chemical Asphyxiant?

- 1) Aniline 2) Sodium nitrite 3) Hydrogen cyanide 4) **Argon**

Answer:4- Argon is a simple Asphyxiant. The other chemicals are all chemical Asphyxiant.

Question #: 976- What would the resulting acetone vapor concentration be if 2 g of acetone were allowed to evaporate in a chamber $5 \text{ ft} * 10 \text{ ft} * 7 \text{ ft}$? (MW of acetone is 58)

- 1) 55 ppm 2) 65 ppm 3) 75 ppm 4) **85 ppm**

Answer:4- Volume of chamber $\rightarrow 5 \text{ ft} * 10 \text{ ft} * 7 \text{ ft} = 350 \text{ ft}^3$

Convert cubic feet to cubic meters $\rightarrow 350 \text{ ft}^3/35.3 \text{ ft}^3/\text{m}^3 = 9.92 \text{ m}^3$

$2 \text{ g} = 2,000 \text{ mg}$ $2,000 \text{ mg}/9.92 \text{ m}^3 = 201.6 \text{ mg/m}^3$

Converting mg/m^3 to ppm $\text{ppm} = (201.6 \text{ mg/m}^3 * 24.45) / 58 = 85 \text{ ppm}$

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Question #: 977- What volume would 100 cm³ of carbon monoxide occupy at 70°F and 1 atm if the temperature and pressure were changed to 150°F and 2 atm?

- 1) 100 cm³ 2) 65 cm³ **3) 57.7 cm³** 4) 52.9 cm³

Answer:3- This is the equation we will use. $(P_1V_1) / T_1 = (P_2V_2) / T_2$

Perform these temperature conversions first.

$$70^{\circ}\text{F} = 21^{\circ}\text{C} = 294^{\circ}\text{K}$$

$$150^{\circ}\text{F} = 66^{\circ}\text{C} = 339^{\circ}\text{K}$$

Once the conversions are performed, rearrange the equation above to solve for V₁.

$$V_1 = (P_2V_2T_1) / (P_1T_2)$$

$$= (1 \text{ atm} * 100 \text{ cm}^3 * 339^{\circ}\text{K}) / (2 \text{ atm} * 294^{\circ}\text{K})$$

$$= 57.7 \text{ cm}^3$$

Question #: 978 - A worker is exposed to xylene during her 8-hr work day in the following concentrations: 2 hr at 100 ppm; 2 hr at 150 ppm; and 4 hr at 50 ppm. What is her time-weighted-average (TWA) exposure? (MW of xylene is 106)

- 1) 50 ppm 2) 56 ppm 3) 77 ppm **4) 88 ppm**

Answer:4- $\text{TWA} = [(2 \text{ hr} * 100 \text{ ppm}) + (2 \text{ hr} * 150 \text{ ppm}) + (4 \text{ hr} * 50 \text{ ppm})] / 8 \text{ hr}$

$$\text{TWA} = (200 \text{ hr-ppm} + 300 \text{ hr-ppm} + 200 \text{ hr-ppm}) / 8 \text{ hr} \quad \text{TWA} = 87.5 \text{ ppm}$$

Question #: 979- What volume of phosphorus oxychloride would be needed to attain a concentration of 25 ppm in a 50 ft³ container? (SG of phosphorus oxychloride is 1.675 and MW is 153)

- 1) 2.9 ml **2) 0.13 ml** 3) 1.3 ml 4) 117 ml

Answer:2 - First convert ft³ to m³ → $50 \text{ ft}^3 / 35.3 \text{ ft}^3/\text{m}^3 = 1.4 \text{ m}^3$

Determine mg/m³ by converting from ppm → $\text{mg}/\text{m}^3 = (25 \text{ ppm} * 153) / 24.45 = 156.4 \text{ mg}/\text{m}^3$

$$156.4 \text{ mg}/\text{m}^3 * 1.4 \text{ m}^3 = 219 \text{ mg} = 0.219 \text{ g}$$

$$\text{Divide by specific gravity to get volume.} \rightarrow 0.219 \text{ g} / 1.675 \text{ g}/\text{ml} = 0.13 \text{ ml}$$

Question #: 980- What concentration of xylene would be produced using a permeation tube if the tube weighed 114.123 g at the start and 113.997 g after 5.8 hr if the flow rate over the tube was 92.3 lpm?

- 1) 3.92 mg/m³** 2) 30.9 mg/m³ 3) 100 mg/m³ 4) 4.5 mg/m³

Answer:1- Determine total grams collected: $114.123 \text{ g} - 113.997 \text{ g} = 0.126 \text{ g} = 126 \text{ mg}$

$$\text{Total sample: } 5.8 \text{ hr} * 92.3 \text{ lpm} * 60 \text{ min}/\text{hr} = 32,120 \text{ l or } 32.1 \text{ m}^3$$

$$126 \text{ mg} / 32.1 \text{ m}^3 = 3.92 \text{ mg}/\text{m}^3$$

Question #: 981- How much acetone would have to be evaporated in a room 25 ft x 25 ft x 25 ft to give a final concentration of 25 ppm at STP? (SG of acetone is 0.79 and MW is 58)

- 1) 25.6 ml 2) 27.9 ml **3) 33.2 ml** 4) 45.7 ml

Answer:3

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First determine room volume:

$$25 \text{ ft} \times 25 \text{ ft} \times 25 \text{ ft} = 15,625 \text{ ft}^3$$

$$15,625 \text{ ft}^3 / 35.3 \text{ ft}^3/\text{m}^3 = 442.6 \text{ m}^3$$

Determine mg/m³ equivalent of 25 ppm

$$\text{mg}/\text{m}^3 = (25 \text{ ppm} \times 58) / 24.45 = 59.3 \text{ mg}/\text{m}^3$$

$$59.3 \text{ mg}/\text{m}^3 \times 442.6 \text{ m}^3 = 26,246 \text{ mg} = 26.246 \text{ g}$$

Divide by the specific gravity to obtain volume.

$$26.246 \text{ g} / 0.79 \text{ g}/\text{ml} = 33.2 \text{ ml}$$

Question #: 982- Assuming perfect mixing of dilution air with contaminated air, how long will it take to dilute 500 ppm of contaminant to 1 ppm assuming a dilution rate of 230 cfm and a room size of 1,000 ft³?

- 1) 40 min 2) 36 min 3) 35 min **4) 27 min**

Answer:4- Using the equation from the BCSP Examination Reference Handout:

$$\ln (C_2/C_1) = -Q/V (t_2-t_1) \text{ then, } t = -V/Q [\ln (C_2/C_1)]$$

t = time to dilution (min), C₂= Concentration after t min (ppm), C₁= Initial concentration (ppm), Q = dilution rate (cfm), and V = Room volume (ft³)

$$t = -1000/230 [\ln (1/500)] \quad t = -4.35 [-6.21] \quad t = 27.02$$

Question #: 983- Assuming perfect mixing of dilution air with contaminated air, how long will it take to dilute 10,000 ppm of contaminated air to 1 ppm assuming a dilution rate of 230 cfm and a small office with dimensions of 10 ft³ x 10 ft³ x 10 ft³?

- 1) 27 min 2) 33 min **3) 40 min** 4) 47 min

Answer:3 - Using the equation $t = [\ln (C_0/C)] / (Q/V)$

where t = time to dilution (min), C = Concentration after t min (ppm), C₀ = Initial concentration (ppm), Q = dilution rate (cfm), and V = Room volume (ft³)

$$t = [\ln (10,000 \text{ ppm}/1 \text{ ppm})]/(230 \text{ cfm}/1000 \text{ ft}^3) \quad t = 9.21/.23 \text{ min} \quad t = 40 \text{ min}$$

Question #: 984- What gas concentration results when 5 ml of dry phosphorus pentafluoride is injected by gas syringe into a 13 gallon glass carboy filled with air? (MW of dry phosphorus pentafluoride is 126).

- 1) 50 ppm 2) 100 ppm **3) 102 ppm** 4) 107 ppm

Answer:3- Use the gas laws. $126 \text{ g} / 24.45 \text{ l} = 5.15 \text{ g}/\text{l} = 5.15 \text{ mg}/\text{ml}$

Concentration * volume = amount

$$5.15 \text{ mg}/\text{ml} \times 5 \text{ ml} = 25.75 \text{ mg}$$

Next convert gallons to m³

$$13 \text{ gal} \times 3.785 \text{ l}/\text{gal} = 49.205 \text{ l} = 0.049205 \text{ m}^3$$

Then convert mg/m³ to ppm

$(25.75 \text{ mg}/0.049205 \text{ m}^3) 24.45) / 126 = 102 \text{ ppm}$

Question #: 985- A welder was exposed to airborne lead at a concentration of 270 mg/m³ for 75 min while burning bolts, 40 mg/m³ for 3 hr 19 min when welding painted steel, and 600 mg/m³ for 30 min when using an abrasive blaster to remove lead-containing paint. The balance of his 8-hour day was spent in an environment with an airborne lead concentration of 1.5 mg/m³. What was his TWA exposure to lead?

- 1) 43.4 mg/m³ 2) 47.9 mg/m³ **3) 96.8 mg/m³** 4) 100.5 mg/m³

Answer:3-

JOB	C * t = TWA
Burning	270.0 * 75 = 20,250
Welding	40.0 * 199 = 7,960
Blasting	600.00 * 30 = 18,000
Other	1.5 * 176 = 264
Total	46,474

8 hr = 480 min $\text{TWA} = (46,474 \text{ (mg/m}^3\text{)(min)} / 480 \text{ min} = 96.8 \text{ mg/m}^3$

Question #: 986- A gas mixture is 75% methane and 25% propane by volume. The respective LEL's are 5% and 2.1%. What is the LEL (in air) for the gas mixture?

- 1) 2.5% 2) 3.2% 3) 4.5% **4) 3.7%**

Answer:4- Use LeChatelier's Law. $\text{LEL}(\text{mixture}) = 100 / [(75/5) + (25/2.1)] = 3.7\%$
Think of this as a weighted average of the LEL's.

Question #: 987- A gas mixture is 75% methane and 25% propane by volume. The respective UEL's are 15% and 9.5%. What is the UEL (in air) for the mixture?

- 1) 10.7% 2) 11.5% 3) 12.3% 4) 13.2%

Answer:4- Use LeChatelier's Law. $\text{UEL}(\text{mixture}) = 100 / [(75/15) + (25/9.5)] = 13.2\%$
Think of this as a weighted average of the UEL's.

Question #: 988- Most asbestos work involves which type of fiber?

- 1) **Chrysotile** 2) Amosite 3) Crocidolite 4) Cristobalite

Answer:1- Chrysotile is the most common form of asbestos.

Question #: 989- In the scrubbing of a biosafety cabinet effluent, what is the most **universal scrubbing technology** utilized?

- 1) Entry of effluent into chemical scrubber **2) HEPA filtration**
3) Incineration 4) Chemical sanitation

Answer:2- HEPA filtration of biosafety cabinet effluent is the most common technology utilized. Chemical scrubbing may be required if chemicals are used in the cabinet. Incineration is used only for the most toxic pathogens.

Question #: 990- You are a safety professional in a plant that manufactures a flammable, solvent based ink. The wiring in the processing area should be:

- 1) **Class I, Division 1** 2) Class I, Division 2
3) Class II, Division 1 4) Class II, Division 2

Answer:1- Wiring complying with Class I, Division 1 is required. This high level of protection is required because flammable solvents are used. The vapors can travel and find a source of ignition when inadequate protection is installed. NFPA 70 Article 500-5 (National Electric Code)

Question #: 991- What is the recommended safety factor for manila rope in a block and tackle assembly?

- 1) 1 2) 5 **3) 10** 4) 20

Answer:3- Per the "Accident Prevention Manual for Industrial Operation" the safety factor is 10 due to the potential for shock.

Question #: 992- What is the most appropriate coding method when identifying 15 items, from a human engineering view?

- 1) Color coding **2) Geometric shapes** 3) Stereoscopic depth 4) Standard color coding chart

Answer:2- Geometric shapes is the most appropriate coding method when identifying 15 items from a human engineering view.

Question #: 993- When designing a task that will be repeated throughout a shift, it should be designed so that it does not consume more than what percent of a person's maximum physical capacity?

- 1) 25% **2) 40%** 3) 50% 4) 70%

Answer:2- 40% capacity is the acceptable limit on the design of a long-term task.

Question #: 994- Human factors engineers' work to change tasks to improve efficiency. When applying these principles to reduce accidents or injuries, the hardest item to change through HFE principals is:

- 1) Displays 2) Controls 3) Human parameters 4) Task functions and order

Answer:3- Humans are the hardest part of the system to change. Therefore, the engineer attempts to improve efficiency or safety by working on the other parameters or sub-systems.

Question #: 995- A pistol grip power tool is best suited for:

- 1) Application on a vertical plane** 2) Application on a horizontal plane
3) Assembly with screws 4) Assembly of small parts

Answer:1- A pistol grip used on a vertical plane, such as a wall, allows the wrist to remain in the neutral position.

Question #: 996- Which of the following engineering controls would be the most appropriate for a worker exposed in a steel mill to air temperatures exceeding 105°F?

- 1) Use of increased general ventilation
2) Use of cooling fans
3) Provision of cooling fans
4) Application of radiant heat shielding

Answer:4- Although increasing general ventilation, using cooling fans, or providing spot cooling would result in some improvement, the application of radiant heat shielding is more appropriate. A steel mill (or forge shop, foundry, glass manufacturing plant) is a hot-dry industry, where the thermal load on the worker is increased by the sensible heat given off by the process equipment. The major heat source is **radiant heat from molten metals and cherry red ingots**, while that of the surrounding hot air is secondary. Radiant heat has no appreciable heating effect on the air it passes through, but its energy is absorbed by any object it strikes. Therefore, the application of a shield to either absorb or reflect the radiation from the heat source would be appropriate.

Question #: 997- When designing an ergonomically desirable work place, which of the following is a good design practice?

- 1) Allow room for employees to lean forward or to the side to reach objects
2) Design the work so that employees can move about and use different muscle groups
3) Place objects within close reach to discourage excessive movement
4) Design work which requires the arms to be held up or out

Answer:2- Allowing employees freedom of movement and the use of different muscle groups helps prevent overuse of any one muscle group. Leaning, restricted movement, and extension of arms all can cause injury over the long-term.

Question #: 998- Work surface height for standing work places should be designed as follows for precision work:

- 1) Below wrist height with padded rests for elbows
- 2) Shoulder height with a back rest
- 3) Above elbow height with padded forearm rests**
- 4) Standing work places should be discouraged

Answer:3- The work should be placed above elbow height for best posture and provide padded forearm rests to allow resting of arms on surface. Work surfaces below elbow height may cause arm fatigue, and shoulder height work will cause back and shoulder fatigue. Standing work places can be well-designed to allow for low stress work with low fatigue. Adjustability will allow the employees to determine the best height for their needs.

Question #: 999- Manipulative tasks are highly repetitive and can cause an overload of muscles and joints. All of the following are **good design guidelines** for manipulative arm and hand work **EXCEPT**:

- 1) Keep movements of arms and hands well within the full range of motion of body joints
- 2) Prevent body joints from exercising the extremes of their ranges of motion
- 3) Keep elbows at an angle of 60° at or above mid-torso height**
- 4) Keep wrists straight

Answer:3- Elbows should be kept at 90° and below mid-torso height for maximum comfort and least strain on the muscles and tendons. Keeping body joints within the range of motion and away from extremes reduces potential for strains and sprains. Straight wrists will prevent repetitive motion injuries.

Question #: 1000- Methods of minimizing rates of repetition in jobs include the following **EXCEPT**:

- 1) Dividing jobs to reduce the number of job elements**
- 2) Allowing alternate use of limbs
- 3) Allowing self-pacing
- 4) Allowing frequent rotation between jobs which use different postures and muscles

Answer:1- The goal is to increase the number of job elements to reduce the repetitiveness of the task. This can only be done by combining jobs, not dividing them. The other answers help to reduce repetition through allowing change and alternatives to using the same muscles continuously.

Question #: 1001- Manual materials handling tasks can be designed to avoid injuries. Modifications to the object to be handled may include all of the following **EXCEPT**:

1) Designing objects so the arms can be easily extended around it

- 2) Installing handles or hand holds wherever possible
- 3) Avoiding lopsided weights and loose contents
- 4) Using hoists or other lift assists when object weight is excessive

Answer:1- Extension of the arms around objects should be avoided. Alternatively, use handles, lifting devices, and even weighting to improve the task.

Question #: 1002- Manual materials handling tasks can be designed to avoid injuries. Modifications to the task may include all of the following **EXCEPT**:

- 1) Keeping loads as close to the body as possible during lifting
- 2) Keeping loads off the floor by using platforms or stands
- 3) Keeping all repetitive lifts between knee and waist height**
- 4) Avoiding twisting, stretching, or leaning with the load

Answer:3- Repetitive lifts should be kept between knuckle and shoulder height to reduce bending and reaching for the load. Keeping the loads close to the body, off the floor, and avoiding twisting, stretching, or leaning will help avoid the musculoskeletal, crushing, or falling injuries frequently caused by manual materials handling.

Question #: 1003- When attempting to reduce ergonomic injuries, which of the following actions is the most **proactive**?

- 1) Design reviews**
- 2) Injury/illness data reviews
- 3) Medical surveillance
- 4) Audits/assessments

Answer:1- Design reviews allow for ergonomic issues to be identified and eliminated before workers are exposed, which is the most proactive step. Reviewing injury/illness data, conducting medical surveillance, and performing audits are actions that find the problem once it has occurred or is occurring.

Question #: 1004- All of the following are administrative controls that could be considered for the reduction or prevention of ergonomic injuries **EXCEPT**:

- 1) Job expansion
- 2) Tool changes**
- 3) Job rotation
- 4) Rest periods

Answer:2- Tool changes are an engineering control while job expansion, job rotation, and rest periods are administrative controls.

Question #: 1005- Common job risk factors for the development of cumulative trauma disorder (CTD) include all of the following **EXCEPT**:

- 1) Excessive force
- 2) Abnormal postures
- 3) Mechanical compression
- 4) Simple repetition**

Answer:4- The accumulation of micro-injuries related to the risk factors (e.g., excessive force, abnormal postures, mechanical compression) eventually causes the injury. If the risk factors are not present, simple repetition will not contribute to the risk for developing CTD. On the other hand, if the risk factors ARE present, repetition will compound the effect and hasten the development of CTD.

Question #: 1006- A construction worker operating a jackhammer would be most affected by which of the following hazards?

- 1) Vibrations of 1 to 125 Hz
- 2) Dust hazards
- 3) Sparks
- 4) Eye hazards

Answer:1- The use of jackhammers without protective gloves can lead to "white finger disease", a deadening of the nerves due to the vibration from the jackhammer. The vibration frequency that is most hazardous is between 1 to 125 Hz.

Question #: 1007- When safety nets are necessary, the safety nets are required to extend _____ ft beyond the edge of the work surface.

- 1) 4
- 2) 6
- 3) 8
- 4) 25

Answer:3- Safety nets shall be provided when workplaces are more than 25 ft above the ground or other surfaces where the use of ladders, scaffolds, catch platforms, temporary floors, safety lines, or safety belts is impractical. Nets shall extend 8 ft beyond the edge of the work surface where employees are exposed and shall be installed as close under the work surface as practical, but in no case more than 25 ft below such work surface. 29 CFR 1926.105 (c)

Question #: 1008- Quality of illumination pertains to the:

- 1) Distribution of brightness in the visual environment
- 2) Desirable number of footcandles that satisfies environmental needs
- 3) Illumination ratio between surfaces
- 4) Differences in the ratio between the light source and the reflected surface

Answer:1- The factors to be considered for good illumination are quantity, the amount of illumination that produces brightness on the task and its surroundings, and quality, which pertains to the distribution of brightness in a visual environment and includes the color of light, its direction, diffusion, and degree of glare. In a positive sense, quality of illumination implies that all brightnesses contribute favorably to visual performance, visual comfort, ease of seeing, safety, and esthetics for the specific task involved.

Question #: 1009- Ventilation systems are designed for any of the following **EXCEPT**:

- 1) Supply oxygen
- 2) Remove contaminants
- 3) Provide comfort
- 4) Supply carbon dioxide

Answer:4- The purpose of ventilation includes dilution of contaminants and supplying make up air.

Question #: 1010- Canopy hoods can best be used when:

- 1) High toxicity materials are used
- 2) Thermal currents can be taken advantage of**
- 3) Energy costs are a concern
- 4) Canopy hoods should never be used

Answer:2- Canopy hoods are best used where heated materials give off contaminants that tend to rise which the canopy hood can capture and remove. The toxicity of the material is less of an issue if the canopy hood is able to keep the concentration below hazardous levels. Canopy hoods do tend to draw a high volume of air, which can lead to higher makeup air and energy costs.

Question #: 1011- In determining the volume of dilution air needed in a room, you need to know:

- 1) TLV of the contaminant**
- 2) Rate of generation of the contaminant**
- 3) Size of room
- 4) Both 1 and 2**

Answer:4- All that is needed for determining the volume of dilution air needed is the specific gravity and molecular weight of the contaminant, the TLV, and generation rate. A "K" value needs to be determined, based on the safety factor and mixing characteristics of the room. The size of the room is not a factor in this calculation.

Question #: 1012- As a rule of thumb, what percentage of the exhaust face velocity of an unflanged open duct is present at 1 duct diameter from the duct?

- 1) 5%
- 2) 10%**
- 3) 25%
- 4) 50%

Answer:2- At one duct diameter from an unflanged open duct exhaust, there is only 10% of the initial face velocity available for capture of contaminants. Conversely, at 30 duct diameters from the source of a blowing airstream, there is still 10% of the velocity measured at the source.

Question #: 1013- Of the following, which is the appropriate type of hood for a welding operation?

- 1) Side hood
- 2) Canopy
- 3) Downdraft bench booth**
- 4) Wind tunnel

Answer:3- Downdraft bench booth is an appropriate type of hood for a welding operation.

Question #: 1014- The blowing range of a fan is about _____ times greater than the suction range.

- 1) 2
- 2) 30**
- 3) 60
- 4) 10

Answer:2- The blowing range is about 30 times greater. This is why capture velocity near the contaminant is very critical.

Question #: 1015- A fan exhausting a paint spray booth is required to be nonferrous or non-sparking.

1) True

2) False

3) Depends on the occupancy of the building

4) Depends upon the training of the users

Answer:1- The fan rotating element or the casing must be nonferrous or non-sparking. 29 CFR 1910.107 (c)(6)

Question #: 1016- What is the acceptable ventilation rate for a flammable liquid storage room inside a building?

1) 2 air changes/hr 2) 6 air changes/hr 3) 10 air changes/hr 4) 25 air changes/hr

Answer:2- OSHA requires 6 air changes/hr for an interior flammable liquid storage room. 29 CFR 1910.106 (d)(4)(iv)

Question #: 1017- If a spill occurs in an enclosed space, and the maximum airborne concentration of the spilled material reaches 18,000 ppm, how many room air changes would be needed to drop the airborne concentration of the spilled material to its TLV-C of 1.0 ppm?

1) 4.3 air changes 2) 9.8 air changes 3) 15 air changes 4) 19 air changes

Answer:2 - $C = C_i (-V_w/V_i)$ $V_w/V_i = \ln [C_i / C]$ $C_i = 18,000 \text{ ppm}$ $C = 1.0 \text{ ppm}$
 $V_w/V_i = \ln [18,000 / 1]$ $= 9.8$

Question #: 1018- Baffles are put on the canopy of a shake out hood to:

1) Channel dust to the hopper

2) Prevent plugging of shaker grid

3) Provide better air distribution

4) Lower the noise level

Answer:3- The function of the baffles is to provide for better air distribution and hence better control of the air contaminant from this foundry operation.

Question #: 1019- Blast gates are used to:

1) Generate proper capture velocities

2) Balance the resistance to air flow

3) Properly vent sudden overpressures

4) Reduce energy loss when VP changes to SP

Answer:2- Blast gates are used to balance the resistance to air flow in different ducts.

Question #: 1020- Flexible ducting used for movable exhaust systems has the following advantage over conventional galvanized ducts:

1) Decreased resistance

2) Maneuverability of hood

3) Availability of hood shapes

4) Increased static pressure

Answer:2- The principle advantage of flexible ducting is its maneuverability. The hood should be located as close as possible to the contaminant source. Once galvanized ducts are installed they are difficult and expensive to move.

Question #: 1021- From an aerosol generation standpoint, which of the following housekeeping techniques is most preferable?

- 1) Dry sweeping 2) Wet scrubbing **3) Vacuuming** 4) Air blowing

Answer:3- All mechanical cleaning techniques generate significant amounts of aerosols. Vacuuming removes material from the area.

Question #: 1022- A key **disadvantage** of canopy hoods is that:

- 1) More material is needed to construct the system 2) Larger fans are needed
3) Contaminants are drawn through the breathing zone
4) Contaminants are converted into aerosols

Answer:3- Since canopies are above the worker, the contaminant must travel very close to, and most of the time through, the worker's breathing zone.

Question #: 1023- Round ducts are better than square ducts because round ducts:

- 1) Can be made air tight easier 2) Use less material for same size
3) Are stronger 4) Have less friction

Answer:3- In industrial applications, high velocities, and therefore high SP's are normally used. This condition results in duct collapses. Circular ducts are more able to withstand this stress.

Question #: 1024- All of the following agents can contribute to indoor air pollution **EXCEPT**:

- 1) Carbon dioxide 2) Formaldehyde 3) Asbestos **4) PCB's**

Answer:4- Although PCB's have caused problems in building contamination, they have a low vapor pressure and do not cause indoor air quality problems, unless burned. Carbon dioxide, formaldehyde, and asbestos are common indoor air pollutants that are caused by building materials and occupants.

Question #: 1025- Which of the following sources of indoor air pollution in an office environment can be lethal?

- 1) Microorganisms** 2) Formaldehyde 3) Carbon dioxide 4) Poor ventilation

Answer:1- Airborne microorganisms circulated from water-cooling systems (Legionella Pneumophila) have caused Legionnaires Disease from acute exposures. Formaldehyde and carbon dioxide require concentrations well beyond those found in offices to be lethal. Poor ventilation would require reductions in oxygen level below 19.5%, which is unlikely in an office environment.

Question #: 1026- Methods to control Legionnaires disease include the following **EXCEPT** :

1) Continuous feed biocide

- 2) Locate make-up air intakes upwind from cooling towers
- 3) Periodic cleaning of cooling water systems
- 4) Sampling to ensure bacterial control

Answer:1- Continuous feed biocides can cause resistant strains of bacteria in the cooling system. It is best to alternate biocides to prevent resistance. Prevention of cooling tower aerosols into the building makeup air will prevent bacteria from entering the ventilation system. Complete periodic cleaning and sampling of the cooling water systems have proven effective.

Question #: 1027- What capacity of outdoor (fresh) air does the American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE) recommend in its 62-1989 Standard for an office environment?

- 1) 10 cfm/person
- 2) 20 cfm/person**
- 3) 10 cfm/room
- 4) 20 cfm/room

Answer:2- ASHRAE, in its 62-1989 Standard, recommends 20 cfm/person of outdoor air for acceptable indoor air quality in an office environment. This value has been chosen to control carbon dioxide and other contaminants with an adequate margin of safety and to account for health variations among people, varied activity levels, and a moderate amount of smoking.

Question #: 1028- What is the length of time permissible for an exposure to noise of 94 dB?

- 1) 1.6 hrs
- 2) 2.3 hrs
- 3) 4.0 hrs
- 4) 4.6 hrs**

Answer:4 - Use the formula for calculating the time weighted average for exposure:

$$T = 8 / 2^{[(L-90)/5]}$$

where L is measured exposure, and 90 is the permissible exposure

$$T = 8 / 2^{[4/5]} = 8 / 1.74 = 4.6 \text{ hr}$$

Question #: 1029- For employees with a significant threshold shift, hearing protector attenuation must be sufficient to reduce exposure to a time-weighted average of:

- 1) 75 dB
- 2) 80 dB
- 3) 85 dB**
- 4) 90 dB

Answer:3- For employees with a significant threshold shift, hearing protector attenuation must be sufficient to reduce exposure to a time-weighted average of 85 dB. 29 CFR 1910.95 (i)(2)

Question #: 1030- One of the problems with the old method of using cotton earplugs was the cerumen. Cerumen is also detrimental to some of the modern earplugs. What is cerumen?

- 1) Ear canal hair cells
- 2) Earwax**
- 3) Fluids secreted by the cochlea
- 4) Secretions of the hypothalamus

Answer:2- Cerumen is earwax. If cotton earplugs were used, the earwax would bind the cotton together, negating any protective effect.

Question #: 1031- The correct term for hearing loss that can be induced by **occupational exposure** to noise is:

- 1) Presbycusis 2) Socioculus **3) Sensorineural** 4) Conductive

Answer:3- Presbycusis is hearing loss due to age. Socioculus is loss due to background noise. Conductive loss is a loss between the outer ear and the cochlea.

Question #: 1032- The damaging effect of noise on hearing depends on:

- 1) The sound pressure level of the noise 2) The frequency distribution of the noise**
3) The transmission/frequency lapse rate **4) Both 1 and 2**

Answer:4- The sound pressure level and the frequency distribution of the noise along with the length of exposure will determine the effect on the ear. The transmission/frequency lapse rate is fictitious.

Question #: 1033- What is the **most expedient** method of protecting a worker from noise?

- 1) Ear protection** 2) Limited exposure time
3) Engineering controls 4) Administrative controls

Answer:1- The quickest way is to provide hearing protection. The most effective long term solution is to engineer out the source of the noise, if feasible.

Question #: 1034- When incurring a Temporary Threshold Shift due to a noisy workplace, most of the TTS occurs:

- 1) Right before the end of the exposure period **2) In the first few hours of exposure**
3) Towards the end of the first week of exposure 4) Occurs within minutes of entering the area

Answer:2- Most of the TTS incurred is incurred within the first 1-2 hours of the exposure. Aram Glorig, 1961

Question #: 1035- When controlling noise, the following are all proven techniques EXCEPT:

- 1) Substituting the process 2) Minimizing sound emitting areas
3) Providing **adsorption** panels 4) Eliminating leakage paths

Answer:3- The panels need to absorb the sound waves, not adsorb them. Process substitution can provide alternative technologies that are less noisy. Reducing the areas that radiate noise will also reduce exposure.

Question #: 1036- When hazards from operating machinery cannot be eliminated, _____ provides protection to the employee from inadvertent contact with a moving or dangerous part.

- 1) Training **2) Guarding** 3) Personal protective equipment 4) Administrative controls

Answer:2- Where hazards cannot be eliminated, guarding provides protection against potential failure of people to utilize equipment correctly. Both safe design and guarding minimize the effect of individual differences on accident frequency or severity.

Question #: 1037- Which of the following is a manner by which sound may reach the inner ear even when hearing protectors are employed?

- 1) Use of foam rubber plugs **2) Hearing protective device vibration**
3) Conduction through bone and tissue **4) Both 2 and 3**

Answer:4- The effectiveness of hearing protective devices depends on the manner in which the sound energy is transmitted through or around the device. Therefore, if the device does not fit properly there will be leakage. Sound can also travel by conduction.

Question #: 1038- A condition which is caused by a very loud impulsive sound which can cause a ringing in the ear and an immediate loss of hearing is called:

- 1) Anacusis 2) Mastoidectomy 3) Lateral semicircular canal **4) Tinnitus**

Answer:4- Tinnitus is a condition which is caused by a very loud impulsive sound which can cause a ringing in the ear and an immediate loss of hearing.

Question #: 1039- If an estimated near field power density of a microwave antenna is calculated as 14 mW/cm², what is your conclusion?

- 1) There is no hazard 2) There is a hazard
3) Further investigation is necessary to determine if there is a hazard 4) No conclusions

Answer:3- Since the result is greater than the OSHA exposure guide for microwaves of 10 mW/cm², further investigation is necessary. Consideration must be given to the distance from the antenna at which a worker may be exposed and the length of time they may be exposed. 29 CFR 1910.97 (a)(2)(i)

Question #: 1040- When making a final assessment of the **potential hazard from electromagnetic waves** based on calculations, what other **factors** need to be considered?

- 1) The possibility of reflections from the ground or surfaces**
2) The length of time of the exposure
3) Both 1 and 2
4) None of the above

Answer:3- When making an assessment of the potential hazard of electromagnetic waves, the possibility of reflections and the length of exposure need to be considered.

Question #: 1041- What type of ionizing radiation is the greatest external hazard?

- 1) Alpha 2) Beta **3) Gamma** 4) Delta

Answer:3 - Gamma rays are the most penetrating of all radiation and have the ability to penetrate the skin.

Question #: 1042 - Which of the following is most vulnerable to damage/injury precipitated by exposure to electromagnetic radiation:

- 1) Eye** 2) Liver 3) Lung 4) Kidney

Answer:1- Of the above choices, the eye is the most vulnerable part of the body to electromagnetic radiation. The skin is also vulnerable - particularly to ultraviolet radiation exposure (sunburn). The susceptibility of the eye is partially due to its receiving radiations not entirely limited to the visible portion of the electromagnetic spectrum. The function of certain portions of the ocular apparatus may be most easily impaired by minimal or threshold damage because of the delicate functional balance of component parts.

Question #: 1043- A Class II laser:

1) Does not have enough power to injure a person accidentally when viewed for less than 1/4 sec

- 2) Does not have enough power to injure person accidentally when viewed for less than 1/2 sec
3) Cannot produce accidental injury if viewed directly for more than 1/2 sec
4) Produces a hazardous direct or specularly reflected beam

Answer:1- To provide guidance on the evolution and control of laser radiation hazards, a classification scheme was established (ANSI Z-136.1, Standard for the Safe Use of Lasers). This scheme is based only on the ability of the laser to produce injury, which in **five classes, range from safe to very hazardous**. **Class II, or "low-power" devices**, are those **visible lasers** which do not have enough power to injure a person accidentally, but which may produce retinal injury when viewed directly for more than 1/4 sec.

Question #: 1044- A Class IIIb laser:

- 1) Does not have enough power to injure a person accidentally
2) Cannot induce injury when viewed within the beam with the unaided eye
3) Can produce accidental injury if viewed directly
4) Produces a hazardous direct or specularly reflected beam

Answer:3- To provide guidance on the evaluation and control of laser radiation hazards, a classification scheme was established (ANSI Z-136.1, Standard for the Safe Use of Lasers). This scheme is based only on the ability of the laser to produce injury, which in five classes, range from **safe to very hazardous**. A Class IIIb consists of lasers which can produce accidental injury if viewed directly. Intrabeam viewing of either the direct beam or a mirror-like (specular) reflection of the beam should also be considered hazardous.

Question #: 1045- Carbon dioxide lasers are particularly hazardous because:

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- 1) They are Q-switched 2) They produce a continuous beam
3) They are invisible to the human eye 4) They are difficult to control

Answer:3- Laser light formed in carbon dioxide lasers is invisible to the human eye.

Question #: 1046- Current X-ray machines feature the greatest danger from:

- 1) Beta 2) Gamma 3) Radiofrequency **4) High voltage**

Answer:4- X-ray machines have numerous levels of safety design incorporated into them. The highest risk now is from the high voltages required to generate X-rays.

Question #: 1047- If a curie represents 3.7×10^{10} disintegrations per second, how many disintegrations per second in a microcurie?

- 1) 3.7×10^{10} 2) 3.7×10^7 **3) 3.7×10^4** 4) 3.7×10^6

Answer:3 - A microcurie has 10^{-6} activity of a curie.

$$\text{Conv} = (3.7 \times 10^{10} \text{ dps/curie}) / 10^6 \text{ microcurie/curie} = 3.7 \times 10^4 \text{ dps/microcurie}$$

Question #: 1048- All of the following are non-ionizing radiation sources EXCEPT:

- 1) Radiofrequency 2) Ultraviolet 3) Infrared 4) X-ray

Answer:4- All of the above radiation forms are considered non-ionizing except for X-rays.

Question #: 1049- The dose rate at 2 m from a particular gamma source is 50 mrem/hr. At what distance will it give a dose rate of 2.0 mrem/hr?

- 1) 0.5 m 2) 5 m **3) 10 m** 4) 20 m

Answer:3- Use the inverse square law for radiation distance.

$$D1 R1^2 = D2 R2^2 \quad 50 * 2^2 = 2R2^2 \quad R2^2 = 100 \text{ m}^2 \quad R2 = 10 \text{ m}$$

Question #: 1050- Radon produces particulate _____ products.

- 1) Decay** 2) Industrial 3) Radioactive 4) Both 1 and 3

Answer:4- Radon gas decays to form radioactive particulates which can be collected on a high volume sampler.

Question #: 1051- Which laser forms are considered intrinsically the most dangerous?

- 1) Ruby 2) Visible **3) Invisible** 4) Gas

Answer:3- Invisible laser radiation requires the most safeguards as it cannot be seen by the human eye.

Question #: 1052- Excessive exposure to ultraviolet (UV) radiation for a short period of time can result in:

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- 1) **Welder's flash** 2) Stoker's syndrome 3) Hyperthermia 4) Pyrogenic response

Answer:1- Acute UV exposure in a short time can result in welder's flash. Symptoms are: red eyes, foreign body sensation, gritty feeling in the eye, and excessive tears. The condition is usually temporary and rarely causes permanent damage.

Question #: 1053- One problem associated with flux-cored arc welding of stainless steel is the production of aerosols containing:

- 1) Nickel and Chromium 2) Carbon and Nickel
3) **Fluorides, Nickel and Chromium** 4) Copper, Nickel and Acid gases

Answer:3- Welding fumes can contain constituents of the material being welded and the consumable materials (e.g. flux). Stainless steel welding results in fumes containing nickel and chromium. Often flux is used which contain fluorides. These fluorides are also released into the air during the welding process.

Question #: 1054- Sources of ozone include any of the following EXCEPT:

- 1) Arc welders 2) Office photocopying machines 3) Ultraviolet quartz lamps 4) **VDT monitors**

Answer:4- Ozone can be produced by the interaction of ultraviolet light, electric arcs, and oxygen. Sources of ultraviolet light include electric arcs such as those produced during arc welding, photocopy machines, laser printers, and ultraviolet lamps. VDT monitors do not produce ozone.

Question #: 1055- The room designed to recharge and replace acid batteries for forklifts requires the following EXCEPT:

- 1) Eyewash/safety shower 2) Ventilation
3) Facilities to neutralize electrolytes 4) **Blow-out construction**

Answer:4- All of the above except blow-out construction are required. 29 CFR 1910.178 (g)(2)

Question #: 1056- Which of the following types of welding produces ozone?

- 1) **Gas Metal Arc Welding** 2) Sweating Carbon Rod
3) Brazing 4) Oxyacetylene welding

Answer:1- Ozone is produced in greater quantities by gas metal arc welding (GMAW or short-arc), gas tungsten arc welding (GTAW or heli-arc), and plasma arc cutting. Arc welding produces intense ultraviolet light that can create ozone from oxygen.

Question #: 1057- Secondary containment should be considered for all EXCEPT:

- 1) 90-day container accumulation areas
2) Chemical and waste loading and unloading areas

3) Virgin product storage areas and tanks

4) Immersion heaters

Answer:4- Secondary containment of chemical and waste storage and transfer areas is a best management practice and should be seriously evaluated even where not currently required by federal, state, or local regulations. Immersion heaters present a fire hazard in electroplating operations but do not require secondary containment.

Question #: 1058- Secondary containment is considered:

1) A best management practice

2) Necessary to effective wastewater treatment

3) Provided by compacted soil barriers

4) Unnecessary if hazardous waste tanks and containers are frequently inspected and when releases are directed away from storm sewers

Answer:1- Regardless of regulatory requirements, secondary containment is recommended as a best management practice. Secondary containment manages the risks and costs associated with chemical releases. Requirements for secondary containment can be found in both RCRA and CWA regulations. The fines, clean up costs, and litigation expenses associated with oil and chemical releases indicate the necessity for secondary containment.

Question #: 1059- How is asbestos disposed of?

1) Landfill

2) Incinerated

3) Chemically dissolved

4) Deep well injection

Answer:1- Asbestos waste is commonly landfilled.

Question #: 1060- What type of facility would be **least** likely to generate lab packs?

1) University

2) Semiconductor manufacturing facility

3) Chemistry lab

4) Hospital

Answer:2 - Except for Answer 2, all of the above facilities would use a wide variety of small quantities of chemicals and would then require lab packs.

Question #: 1061- Why are temperature inversions important in air pollution?

1) They serve to disperse pollutants

2) They serve to concentrate pollutants

3) They are not important

4) They increase reaction of the chemicals with ozone

Answer:2- Temperature inversions serve to concentrate air pollutants near the ground.

Question #: 1062- The level of radon exposure in a home considered by the EPA to be the maximum acceptable level is:

1) 0.4 picocuries/m³ 2) 4.0 picocuries/m³ 3) 0.4 picocuries/l

4) 4.0 picocuries/l

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Answer:4- The EPA has recommended the level of 4.0 picocuries/l air as a maximum safe level of exposure to radon in the home environment.

Question #: 1063- Maximum contaminant levels (MCL's) are regulatory thresholds for:

- 1) Effluent quality under the Clean Water Act
- 2) Air emissions under the Clean Air Act
- 3) Heavy metal contamination under RCRA
- 4) Allowable drinking water pollutant concentrations under the Safe Drinking Water Act**

Answer:4- MCL's represent maximum permissible levels of specified contaminants in water which is delivered to any user of a public water supply system.

Question #: 1064- Primary MCL's refer to:

- 1) Concentrations of regulated drinking water contaminants that are protective of human health with a margin of safety
- 2) Groundwater quality standards
- 3) Maximum levels of contaminants allowable in public water systems**
- 4) Workplace exposure limits for airborne contaminants

Answer:3 - Primary maximum contaminant levels (MCL's) are the maximum permissible levels of specific contaminants in water which is delivered to any user of a public water supply system. Answer 1 refers to maximum contaminant level goals (MCLG's). MCL's are sometimes used as groundwater cleanup goals in the RCRA and CERCLA programs.

Question #: 1065- MCLG's refer to:

- 1) Enforceable drinking water quality standards
- 2) Non-enforceable concentrations of drinking water contaminants that are protective of health with a margin of safety**
- 3) Non-enforceable standards addressing the aesthetic qualities of drinking water, such as appearance, odor, and taste
- 4) Regulatory standards for small public water supply systems

Answer:2- Maximum contaminant level **goals** (MCLG's) under the Safe Drinking Water Act (SDWA) are non-enforceable health-based standards, and are used in developing legally enforceable MCL's. Aesthetic qualities of drinking water are addressed by non-enforceable secondary MCL's.

Question #: 1066- Industrial dischargers to a POTW should be concerned when a POTW **violates** its NPDES permit because:

- 1) Potential bans on new sewer connections
- 2) Potential additional or more stringent retreatment requirements
- 3) Potential liability for contamination of sewage treatment plant sludge

4) All of the above

Answer:4-Industrial dischargers to the sewer to a publicly owned treatment works (sewage treatment plant) should be very concerned when the POTW violates its NPDES permit for all of the above listed reasons, as well as for the real potential for increased scrutiny of its own operations by federal, state, and local officials, and environmental groups. Increased enforcement activity and citizen suits are likely to follow.

Question #: 1067- Chemical analysis of the products of **combustion** will almost always show the presence of what element in the molecules?

- 1) Silica 2) Hydrogen 3) Carbon **4) Oxygen**

Answer:4- Since oxygen is required to support normal combustion, the products of combustion would contain oxygen in combination with other elements.

Question #: 1068- If a bar magnet were to be pulverized into dust, the particles would:

- 1) Become unmagnetized **2) Become tiny bar magnets** 3) Neutralize each other 4) 1 and 3

Answer:2- In a magnetized body, a large number of tiny molecular magnets are arranged so that their north poles face one end of the body, while their south poles face the opposite end. If the bar magnet were broken in two, each piece would be found to be a complete magnet having a north and south pole. Breaking these pieces into smaller fragments, no matter how small, they will be bar magnets. This fact suggests that pieces, the size of molecules, would be bar magnets having a north and south pole.

Question #: 1069- What horizontal force is necessary to slide a 50 lb wooden crate on a level wooden floor? (assume the coefficient of static friction for wood on wood is 0.40)

- 1) 20 lb** 2) 30 lb 3) 50 lb 4) 125 lb

Answer:1 - $F_f = \mu F_n$, where F_f is final force, μ is the coefficient of static friction and F_n is the weight of the object being pushed or pulled. $F_f = 0.4 * 50 \text{ lb} = 20 \text{ lb}$

Question #: 1070- Solid particles generated by condensation from the gaseous state, generally after volatilization from molten metals, are called:

- 1) Smokes 2) Mists 3) Gases **4) Fumes**

Answer:4- Fumes are solid particles generated by condensation from the gaseous state, generally after volatilization from molten metals.

Question #: 1071- Determine the wavelength of a low frequency sound of 100 Hz, which is traveling through steel at 16,400 ft/sec.

- 1) 200 ft 2) 200 in. **3) 164 ft** 4) 164 m

Answer:3- Use the formula: $C = \lambda f$ $C = \text{Speed} = 16,400 \text{ ft/sec}$
 $\lambda = \text{Wavelength}$ $f = \text{Frequency in Hz} = 100 \text{ Hz}$

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$$C = \lambda f \quad \lambda = C / f \quad = (16,400 \text{ ft/sec}) / 100 \text{ Hz} \quad = 164 \text{ ft}$$

Question #: 1072- The decay rate of radium is 1.36×10^{-11} per sec. What is its half life?

- 1) 0.0059×10^{10} sec 2) 0.5095×10^{10} sec **3) 5.0955×10^{10} sec** 4) 5.0955 sec

Answer:3- Use the formula: Decay Rate = $0.693 / \text{Half Life}$
Half life = $0.693 / 1.36 \times 10^{-11}$ per sec = 5.0955×10^{10} sec

Question #: 1073- What is a "photon"?

- 1) Electromagnetic radiation** 2) Alpha particle 3) Nucleon 4) Sound wave

Answer:1- A photon is any item on the electromagnetic (EM) spectrum. An ionizing photon can be an x-ray, gamma, or cosmic ray. Do not confuse "phonon", a sound wave, with "photon." A nucleon is a particle in the nucleus, either a proton or a neutron. Non-ionizing electromagnetic (EM) radiation types would include infrared and visible light.

Question #: 1074- Define non-ionizing radiation.

- 1) Radiation reduced in energy from ionizing
2) The visible portion of the electromagnetic spectrum
3) Radiofrequency (RF)
4) EM radiation less than 10 keV

Answer:4 - Particles are not considered in the discussion of non-ionizing radiation. The non-ionizing portion of the spectrum begins at 10 keV and below. This roughly corresponds to the area of soft x-rays and high energy ultraviolet light.

Question #: 1075- Which is the LEAST likely definition of a neutron?

- 1) An effective neutral component of the nucleus
2) A nucleon
3) A particle with 1 amu
4) The opposite of proton

Answer:4- Neutrons are not fundamental particles like electrons and protons. They will decay when separated from the nuclear force into a positive and negative component and, therefore, are considered to have an effective charge of zero. Neutrons, like protons, have an amu about equal to 1 and are considered to be a nucleon.

Question #: 1076- What is the general formula in standardized notation for Newton's second law?

- 1) $E = mc^2$ **2) $F = ma$** 3) $E = I R$ 4) $c = \text{wavelength} * \text{frequency}$

Answer:2- Each of the above formulae are fundamental. The first is Einstein's equivalent of mass and energy; the second, is Newton's second law, with force being equal to mass times

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acceleration; the third, is Ohm's Law, with voltage being equal to current times resistance. The last equation identifies that the speed of light is a constant.

Question #: 1077- What is the mathematical relationship of the wavelength of a photon to its frequency?

- 1) Direct **2) Inverse** 3) Independent 4) Depends on the energy

Answer:2- The wave equation: speed of light = frequency * wavelength. The speed of light is a constant; therefore, the relationship is inverse. In other words, as the wavelength decreases the frequency will increase. Conversely, if the wavelength increases the frequency will decrease.

Question #: 1078- What is the "half-life" of a radionuclide?

- 1) Amount of time to eliminate $\frac{1}{2}$ the dosage
2) Average time that the average radionuclide exists
3) Time required for a radionuclide to decay to $\frac{1}{2}$ activity
4) Amount of time for the body to eliminate $\frac{1}{2}$ the dose

Answer:3- The "half-life" is also known as the physical half-life. One half-life is the time it takes for a given amount of a radioactive material to decrease in activity by 50%.

Question #: 1079- A carbon dioxide laser has a wavelength in the _____ region.

- 1) Green 2) Red 3) Ultraviolet **4) Infrared**

Answer:4- Wavelength = 10^{-6} mm. CO₂ lasers are invisible and can cause retinal damage. This wavelength is in the infrared region of the electromagnetic (EM) spectrum.

Question #: 1080- The range of a beta particle is any of the following EXCEPT:

- 1) Finite
2) Varies from zero to a maximum
3) Depends on the radionuclide
4) Does not depend on transmission medium

Answer:4- Beta radiation is not monoenergetic as is an alpha emission. A particular beta particle can have a range from zero to a maximum depending on the particular radionuclide. The range of particles IS dependent on the medium of transmission.

Question #: 1081- What does an "alpha" emission consist of?

- 1) An electron 2) An electromagnetic wave
3) 2 neutrons and 2 protons 4) 1 neutron and 1 proton

Answer:3 - An "alpha" emission consists of 2 neutrons and 2 protons (a helium nucleus). This type of ionizing radiation is easily shielded so it is considered an internal radiation hazard as it can cause heavy damage in tissue.

Question #: 1082- In the alpha decay of radium to radon, the following occurs: --> alpha particle + What is the value of "X" in this decay equation?

- 1) 222 2) 223 3) 224 4) 226

Answer:1- An alpha particle is a helium nucleus. It contains 2 neutrons and 2 protons. Losing 4 atomic mass units converts radium 226 to radon 222.

Question #: 1083- In the alpha decay of radium to radon, the following occurs: --> alpha particle + . What is the value of "Z" in this decay equation?

- 1) 85 2) 86 3) 87 4) 88

Answer:2- An alpha particle contains 2 neutrons and 2 protons. Therefore, the release of one alpha particle decreases the element's atomic number by 2 (protons are counted for the atomic number).

Question #: 1084- Which of the following forms of ionizing radiation are considered electromagnetic?

- 1) Beta 2) Gamma 3) X-ray 4) Both 2 and 3

Answer:4- Beta and alpha radiation is considered particulate, as sub-atomic particles are involved. X-ray and gamma radiation are electromagnetic radiation.

Question #: 1085- What does MeV stand for?

- 1) 10^1 electron volts 2) 10^3 electron volts 3) 10^6 electron volts 4) 10^9 electron volts

Answer:3- Some people confuse this nomenclature with KeV. 1 KeV is 10^3 electron volts, and 1 MeV is 10^6 electron volts.

Question #: 1086- In the beta decay of strontium to yttrium, the following occurs: --> beta particle + . What is the value of "X" in this decay equation?

- 1) 89 2) 90 3) 91 4) 92

Answer:2 - The "X" refers to the mass number for yttrium. As beta decay causes no change in the mass number, the mass number remains 90 for yttrium.

Question #: 1087- In the beta decay of strontium to yttrium, the following occurs: --> beta particle + . What is the value of "Z" in this decay equation?

- 1) 37 2) 38 3) 39 4) 42

Answer:3- Beta decay causes an increase of +1 in the atomic number as a negative charge is leaving the atom. A +1 increase in the atomic number increases the atom's ranking on the periodic table to the next higher element. Therefore "Z" is 39.

Question #: 1088- At what speed does electromagnetic radiation (X-ray, cosmic, gamma, etc.) travel?

1) The speed of light 2) $\frac{1}{2}$ the speed of light 3) $\frac{2}{3}$ the speed of light 4) $\frac{3}{4}$ the speed of light

Answer:1- All forms of electromagnetic radiation travel at the speed of light.

Question #: 1089- Recently, health physicists have been switching from curies to becquerels. A curie is 3.7×10^{10} disintegrations per second (dps). What is a becquerel (Bq)?

1) 1.0×10^{10} dps 2) 3.7×10^{10} dps 3) 0.5×10^{10} dps **4) 1 dps**

Answer:4- Becquerels (Bq) are based upon the relationship that 1 Bq is 1 dps. A curie is equivalent to 3.7×10^{10} Bq.

Question #: 1090- What is a roentgen?

1) The amount of X-ray or gamma radiation that produces ionization resulting in 1 electrostatic unit of change in 1 cm³ of dry air at STP

2) The absorption of 100 ergs of energy from any radiation in 1 g of any material
3) The "biological" dose to living tissue
4) The same as a rem

Answer:1- A roentgen is a measurement of exposure whose definition is given in Answer 1. The measurement of an absorbed dose, or a rad, is defined in Answer 2. A rem is a biological dose.

Question #: 1091- The following are components of bacteria, EXCEPT:

1) Cell wall 2) Cell membrane 3) Flagella **4) Mitochondria**

Answer:4- Mitochondria are structures found in eukaryotic cells, not bacteria. A bacterium does have a cell wall that provides shape and prevents ruptures, a cell membrane that regulates the transport of materials in and out of the cell, and external structures, such as flagella, which aid in motility.

Question #: 1092- Which of the following is NOT true about viruses?

1) Contain both RNA and DNA as their genetic material

2) Always intracellular parasites 3) Non-cellular 4) Submicroscopic

Answer:1- Viruses contain either DNA or RNA, not both. They are obligate intracellular parasites and are not considered cellular, since they do not contain cellular structures. They cannot be seen with optical microscopes.

Question #: 1093- Voluntary muscle is controlled at will and comprises what percentage of body weight?

- 1) 10% 2) 20% 3) 30% **4) 40%**

Answer:4- Voluntary muscle is controlled at will and comprises of 40% of body weight.

Question #: 1094- How do you define a persons maximum heart rate?

- 1) The point at which the person no longer feels like performing work
2) The point when increasing workload no longer increases the heart rate
3) The point at which a person has achieved 75% of their maximum aerobic capacity
4) The point at which a person has achieved 100% of their maximum aerobic capacity

Answer:2- The point when increasing workload no longer increases the heart rate is a person's maximum heart rate. It is **estimated by subtracting a person's age from 220 +/- 10 beats per minute.**

Question #: 1095- Which of the following is not a symptom of carpal tunnel syndrome?

- 1) Numbness 2) Loss of feeling in grip 3) Loss of hand use and function 4) All above

Answer:4- Answer 3 can occur in the most extreme cases. Carpal tunnel syndrome is caused by serious degradation of the median nerve. Phalen in the 1960's described a condition called "ape hand" caused by atrophy of the large muscle of the thumb.

Question #: 1096- When the wrist is bent toward the thumb side of the hand, this is known as a(n)_____ deviation.

- 1) Ulnar **2) Radial** 3) Palmar 4) Dorsi

Answer:2- Ulnar deviation is a bend toward the little finger. A palmar flexion is a bend toward the palm, and a dorsiflexion is an extension of the wrist towards the back part of the hand.

Question #: 1097- Hot dry skin, dizziness, nausea, rapid weak pulse, and rapid shallow breathing are symptoms of _____?

- 1) Insulin shock 2) Myocardial infarction **3) Heat stroke** 4) Stroke

Answer:3 - Heat stroke is a serious medical emergency caused by a failure of the central nervous system sweat control, thus leading to loss of evaporative cooling. This process leads to confusion, collapse, delirium, and coma. Cooling of the body must be started immediately if vital organ damage or death is to be averted.

Question #: 1098- Evidence suggests that short term occupational exposure to vibration causes:

- 1) Severe physiological effects on the body
- 2) Moderate physiological effects on the body
- 3) Increased risk to the spine and the peripheral nervous system, the digestive system, and the reproductive system
- 4) Only small physiological effects which are reversible**

Answer:4 - In most occupational settings, the damage from vibration is thought to occur from the micro-trauma induced by vibration exposure over a long period of time, usually years. In the initial stages, vibration injury is reversible if the worker is removed from the exposure or the exposure is eliminated from the job.

Question #: 1099- The most important factor that causes carpal tunnel syndrome is:

- 1) Impact of the hand against blunt objects
- 2) Swelling of the transverse carpal ligament
- 3) Compression of the median nerve brought on by swelling of the tendons passing through the wrist**
- 4) Swelling of the radial artery, which passes through the transverse carpal ligament

Answer:3- Answer 1 is considered incorrect although blunt trauma to the wrist could produce symptoms of CTS caused by swelling and edema.

Question #: 1100- Tenosynovitis can best be described as:

- 1) Inflammation of the tendon and the synovial sheath**
- 2) Inflammation of the tendons
- 3) A sore elbow
- 4) A torn ligament

Answer:1- Tendons pass through synovial sheaths or membranes. Synovial membranes help lubricate tendons to facilitate movement. Repetitive use can irritate the sheath, the tendon, or both, causing a potential build-up of synovial fluid and possible inflammation.

Question #: 1101- _____ is an inflammation of the tendons and their sheath and is commonly associated with the clothes wringing motion.

- 1) Tendonitis **2) Tenosynovitis** 3) Epicondylitis 4) Trigger finger

Answer:2- This is a commonly accepted definition of a CTD. Washer Woman's Sprain is an older name for De Quervain's Syndrome and is caused by inflammation of the abductor and extensor tendons of the thumb and top of the wrist.

Question #: 1102- The minimum distance that combustibles should be moved away from welding and cutting operations is:

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- 1) 10 ft 2) 25 ft **3) 35 ft** 4) 50 ft

Answer:3- The recommended distance of 35 ft is found in NFPA, FM, and most fire prevention codes.

Question #: 1103- The minimum width of any exit access for **new** construction shall be no less than:

- 1) 28 in. 2) 30 in. 3) 32 in. **4) 36 in.**

Answer:4- The NFPA Life Safety Code (NFPA 101) states that the minimum width of any exit access shall be as specified for individual occupancies, but in no case shall such width be less than 36 inches (91 cm). In existing buildings, the minimum width shall not be less than 28 inches. NFPA 101 7.3.4.1 (Life Safety Code)

Question #: 1104- An area where flammable solvents are transferred and stored should be wired as:

- 1) Class I, Division 1** 2) Class I, Division 2 3) Class II, Division 1 4) Class II, Division 2

Answer:1- A Class I, Division 1 rating is required for all electrical wiring (as well as electrical equipment) due to the expectation that a flammable atmosphere may be present at some time from operations. NFPA 70 Article 500-5 (National Electric Code)

Question #: 1105- Fire safety relief devices are required on all compressed gas cylinders.

- 1) True
2) False
3) Depends upon building occupancy
4) Depends upon cylinder construction

Answer:2- Cylinders containing toxic or poisonous gases are not required to have relief devices. Other classes of compressed gases have frangible disks, fusible disks, etc.

Question #: 1106- A flammable liquid with a flash point of 63°F and a boiling point of 110°F would be classified by the NFPA as a:

- 1) Class I liquid 2) Class IA liquid **3) Class IB liquid** 4) Class II liquid

Answer:3- Class IB liquid is a flammable liquid with a flash point of 63°F and a boiling point of 110°F. NFPA 30 - Flammable and Combustible Liquids Code

Question #: 1107- Which of the following temperature ranges concerning fire sprinkler heads color coding is correct?

- 1) 100°F Ceiling Temperature - Orange **2) 150°F Ceiling Temperature - White**

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3) 375°F Ceiling Temperature - Blue

4) 475°F Ceiling Temperature - Uncolored

Answer:2- Use the following table: NFPA 13 2-2.3.2 - Standard for the Installation of Sprinkler Systems

Ceiling Temperature (°F)	Rating	Class	Color
100	135-170	Ordinary	Uncolored
150	175-225	Intermediate	White
225	250-300	High	Blue
300	325-375	Extra High	Red
375	400-475	Very Ex. High	Green
475	500-575	Ultra High	Orange

Question #: 1108- Design and layout requirements for emergency lighting in health care occupancies are outlined in:

1) NFPA 70 - National Electric Code

2) NFPA 72 - Fire Alarm Code

3) NFPA 99 - Health Care Facilities

4) NFPA 101 - Life Safety Code

Answer:3- NFPA 99, Chapter 8, specifies the design and layout of emergency lighting for health care facilities. NFPA 101 (Life Safety Code) specifies how they are powered.

Question #: 1109- General purpose electrical equipment can cause explosions and fires in areas where flammable vapors, liquids, and gases, and combustible dusts or fibers are present. Which of the following is NOT an example of **special purpose** electrical equipment?

1) Non-sparking equipment

2) Motors and lighting fixtures

3) Intrinsically safe electrical equipment

4) Pressurized equipment

Answer:2- Motors and lighting fixtures are examples of equipment that may heat up. These energy sources can produce temperatures high enough to cause ignition.

Question #: 1110- Which of the following is NOT true?

1) Equipment and wiring approved as intrinsically safe is acceptable in any hazardous (classified) location for which it is designed

2) All interconnections between circuits must be evaluated to be sure that an unexpected source of ignition is not introduced through other non-intrinsically safe equipment

3) Intrinsically safe equipment is not capable of releasing sufficient electrical or thermal energy under normal or abnormal conditions to cause ignition of specific flammable or combustible atmospheric mixtures in their most easily ignitable concentrations

4) Separation of intrinsically safe and non-intrinsically safe wiring is not necessary to ensure that the circuits in hazardous (classified) locations remain safe

Answer:4- Separation of intrinsically safe and non-intrinsically safe wiring IS necessary to ensure that the circuits in hazardous (classified) locations remain safe. NFPA 70 Article 504-30 (National Electric Code)

Question #: 1111- Which one of the following statement is NOT true?

1) Generally, equipment installed in Class I locations need not be approved as explosion proof

- 2) Since it is impractical to keep flammable gases outside of enclosures, arcing equipment must be installed in enclosures that are designed to withstand an explosion
- 3) The equipment must not only be strong enough to withstand an internal explosion, but the enclosures must be designed to vent the resulting explosive gases
- 4) Venting must ensure that the gases are cooled to a temperature below the ignition temperature of the hazardous substance involved before being released into the hazardous atmosphere

Answer:1- Generally, equipment installed in Class I locations must be approved as explosion proof. NFPA 70 Article 500-2 (National Electric Code)

Question #: 1112- Which of the following organizations promulgates the primary safety standard for boilers?

- 1) ANSI
- 2) ASME**
- 3) BOCA
- 4) NFPA

Answer:2- The American Society of Mechanical Engineers (ASME) promulgates the "Boiler and Pressure Vessel Code."

Question #: 1113- The procurement/acquisition process is frequently overlooked as a stakeholder in the design of systems. At which point in the design process should representatives from procurement be integrated into the design team?

- 1) At the very beginning
- 2) When the system's design intents are well understood (preliminary design review is complete)**
- 3) When the system's component specifications are established (critical design review is complete)
- 4) When the system is ready to be released for bid or fulfillment

Answer:2- Though bringing in representatives from procurement at the very beginning may provide some design insight, the best time to integrate procurement into the design process is when the actual design intent of the system is well understood. At this point, procurement can provide insight on specific component specifications and vendors that can provide the required components and services.

Question #: 1114- The TLV-STEL refers to a concentration:

- 1) That should never be exceeded
- 2) Average permitted for a 30 minute period
- 3) That is an emergency exposure level
- 4) Average permitted for a 15 minute period**

Answer:4- The threshold limit value-short term exposure limit (TLV-STEL) is an average concentration over a 15 minute period, that should not be exceeded at any time during an 8

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hour workday. The concentration may momentarily exceed the STEL, only if the 15 minute average is at or below the STEL.

Question #: 1115- Shortly following a gas manifold cleaning operation in which alcohol was used, an explosion, followed by fire occurred. A contributing factor could probably be traced to the presence of which of the following materials (besides the alcohol)?

- 1) Hydrogen **2) Oxygen** 3) Nitrogen 4) Phosgene

Answer:2- Oxygen is the oxidizer and it participates in the combustion with the alcohol.

Question #: 1116- When a vacuum cleaner is used to clean up asbestos containing wastes, it must have _____ exhaust ports.

- 1) Well maintained **2) HEPA filtered** 3) Pressure demand 4) Demand only

Answer:2- All vacuum cleaners used for asbestos-containing material (ACM), MUST have HEPA filtered exhausts. 29 CFR 1910.1001 (k)(4)

Question #: 1117- Which of the following general classes of insecticides is the most persistent in the environment?

- 1) Carbamate **2) Organochlorine** 3) Organophosphate 4) Pyrethrins

Answer:2- The carbamate and organophosphate insecticides are degraded relatively rapidly in both the environment and the mammalian body compared to the organochlorine insecticides. Organochlorine pesticides are relatively persistent in the environment. DDT was an organochlorine pesticide

Question #: 1118- What type of emergencies would you expect to find at a TSD site?

- 1) Those involving hazardous substances** 2) Those involving trash or rubbish
3) Those dealing with fire and similar life threatening conditions
4) Those involving gas cylinders

Answer:1- Treatment, storage, and disposal (TSD) sites are required by OSHA, TSCA, and CERCLA to have an emergency response plan for all emergencies involving hazardous substances. OSHA's HAZWOPER Standard, 29 CFR 1910.120, is the standard that details program requirements.

Question #: 1119- According to NFPA, water fire extinguishers require periodic hydrostatic testing:

- 1) Annually 2) Every 3 years **3) Every 5 years** 4) Every 7 years

Answer:3- NFPA requires hydrostatic testing of water extinguishers every 5 years. The NFPA Fire Protection Handbook is a comprehensive reference covering all aspects of fire extinguishers. NFPA 10 - Standard for Portable Fire Extinguishers

Question #: 1120- During a power failure, the NFPA Life Safety Code (NFPA 101) requires that power-operated doors:

- 1) Operate automatically **2) Operate manually** 3) Lock 4) Remain motionless

Answer:2- The NFPA Life Safety Code requires that power-operated doors are capable of being operated manually during a power failure. NFPA 101 7.2.1.9.1 (Life Safety Code)

Question #: 1121- The ACGIH classifies carcinogens into two categories. The category corresponding to Confirmed Human Carcinogens is:

- 1) A1** 2) A2 3) A3 4) A4

Answer:1-

A1 is the category for Confirmed Human Carcinogens.

A2 is the category for Suspected Human Carcinogens.

A3 is the category for Confirmed Animal Carcinogen with Unknown Relevance to Humans.

A4 is the category for Not Classifiable as a Human Carcinogen.

A5 is the category for Not Suspected as a Human Carcinogen.

Substances for which no human or experimental animal carcinogenic data have been reported are assigned no carcinogenicity designation.

Question #: 1122- The major cause of fire-related deaths is attributed to:

- 1) Inhalation of smoke 2) Seared lungs **3) Carbon monoxide** 4) Burn trauma

Answer:3- Statistics maintained by the National Safety Council (NSC) and the National Fire Protection Association (NFPA) show carbon monoxide to be the leading cause of fire-related deaths. Carbon monoxide, a gas, inhibits blood cells from carrying oxygen to the body tissues.

Question #: 1123- What is the leading source of industrial fires?

- 1) Smoking 2) Lightning **3) Electrical malfunctions** 4) Hot surfaces

Answer:3- In an analysis of 25,000 industrial fires reported to FM from 1968-77, electrical malfunctions were the leading cause of industrial fire.

Question #: 1124- System safety and occupational safety considerations are frequently not considered early in a system's design process. Why is this?

1) Some design engineers and project managers do not consider system safety and occupational safety issues as design engineering components (i.e., design intent and how to achieve design intent do not require input from system safety and occupational safety professionals).

2) Some design engineers and project managers believe that system safety and occupational safety considerations can be addressed once the system is in operation.

3) All of the above

Answer:4- Unfortunately, many project managers and design engineers have no formal training in system safety and occupational safety and are unaware of the value (and ultimate savings) that can be realized by integrating such considerations.

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Question #: 1125- TLV's (Threshold Limit Values) are based on all of the following EXCEPT:

- 1) Industrial experience 2) Human studies 3) Animal studies **4) Referrals**

Answer:4- TLV's are based on the best available information from industrial experience, from human and animal studies, and when possible, from a combination of the three.

Question #: 1126- When analyzing air sampling concentration data, the data are assumed to be _____ distributed.

- 1) Exponentially 2) Normally 3) Gaussian **4) Log normally**

Answer:4- Air sampling data are assumed to be log normally distributed. If there is some question about the distribution one should perform one of a variety of statistical tests to determine which distribution the data fits best.

Question #: 1127- The major cause of on-the-job fatalities in the United States is:

- 1) Employee slips, trips, and falls **2) Employee motor vehicle use**
3) Logging 4) Machinery

Answer:2- The single largest cause of on-the-job fatalities is from motor vehicles. They account for about a third of all deaths.

Question #: 1128- Shock mounts are responsible for reducing especially which of the following frequency ranges?

- 1) less than 500 Hz** 2) less than 1,000 Hz 3) 1,000 - 2,000 Hz 4) 2,000 - 4,000 Hz

Answer:1- Shock mounts and other vibration isolation techniques are useful in the low frequency ranges (i.e., less than 500 Hz).

Question #: 1129- For the purpose of protecting workers in trenches, the type of soil is required to assess risk. A primary factor in differing types of soil is:

- 1) Depth **2) Cohesiveness** 3) Width 4) Soil weight

Answer:2- A soil's cohesiveness is critical to its stability in a trench or excavation. 29 CFR 1926 Subpart P, Appendix A

Question #: 1130- In addition to shoring and shielding, what basic type of protective method is permitted to protect workers from a trench cave-in?

- 1) Sloping** 2) Limiting the workers' exposure times in the trench
3) Posting a competent person as a safety observer outside the trench 4) Training

Answer:1- Other accepted methods of protection include sloping or benching. Sloping and benching decrease the effective depth of the trench. 29 CFR 1926.652 (b)

Question #: 1131- The point of operation for any machine tool is:

- 1) The place where a guard is usually placed
- 2) Where one moving part passes another
- 3) **The place where work is done on material**
- 4) Both 1 and 2

Answer:3- Point of operation is the area on a machine where work is actually performed upon the material being processed. This is generally an area where injury can occur. 29 CFR 1910.212 (a)(3)

Question #: 1132- The primary reason for enclosing a grinding wheel is:

- 1) Collect dust
- 2) **Contain wheel breakage**
- 3) Easier to use
- 4) Prevent wheel from breaking

Answer:2- An enclosure will prevent wheel fragments from entering the work area if the grinding wheel breaks.

Question #: 1133- The method of guarding by fixed physical barriers that are mounted on a machine to prevent access to the moving parts is called guarding by:

- 1) **Enclosure**
- 2) Interlock
- 3) Fixed guard
- 4) Barriers

Answer:1- Enclosure is the method of guarding by fixed physical barriers that are mounted on a machine to prevent access to the moving parts.

Question #: 1134- Which activity requires the higher level of personal protection?

- 1) Spill containment
- 2) **Spill stoppage**
- 3) Decontamination
- 4) Spill clean-up

Answer:2- The potential exposure during spill stoppage is greater since the situation is not controlled and the responder has to go to the source of the spill, which may have the greatest exposure potential.

Question #: 1135- EPA specifies levels of protection for chemical protective clothing. One ensemble includes liquid-splash protective suit, pressure-demand full face piece SCBA, inner chemical resistant gloves, chemical resistant safety boots, two-way radio, hard hat. This is an example of what level?

- 1) A
- 2) **B**
- 3) C
- 4) D

Answer:2- Level A is more stringent than Level B in that a vapor protective suit is required instead of a liquid-splash protective suit.

Question #: 1136- The difference between a mock-up and a breadboard model is:

- 1) The mock up is operational but not the same size as a full scale model. The breadboard is also operational but does not resemble the product
- 2) **A breadboard functions and a mock-up does not**
- 3) There are no differences
- 4) One is used to simulate a failure and one to simulate a product design

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Answer:2- A mock-up looks like the product but does not function. A breadboard works but does not resemble the final product.

Question #: 1137- Which of the following is most appropriate in the routine occupational health examination of a machinist?

- 1) Exercise stress test
- 2) Serum protease inhibitor level
- 3) Allergy history assessment
- 4) **Audiometric testing**

Answer:4- Machinists are likely to be exposed to noise that may produce hearing loss. The best answer is audiometric testing.

Question #: 1138- Which of the following is NOT considered an engineering control method for noise?

- 1) Absorption devices installed inside the machine
- 2) Substituting a quieter machine for the loud machine
- 3) Enclosing the loud machine in a sound-dampening box
- 4) **Donning ear muffs with inserts when using the machine**

Answer:4- Absorption, substitution, enclosure, and isolation are all considered engineering control measures for noise.

Question #: 1139- A primary reason for conducting an accident investigation is to:

- 1) Reduce the cost for workers' compensation
- 2) Find and fix the blame
- 3) **Identify the cause and take actions to prevent recurrence**
- 4) Prepare reports needed for litigation

Answer:3- Although there are a variety of accident investigations and analysis techniques, they all serve to identify root cause (or multiple root causes) and identify countermeasures that will prevent accident recurrence.

Question #: 1140- The LEAST likely root cause of accidents generally is a result of:

- 1) Management system failures
- 2) Environmental factors
- 3) Physical limitations
- 4) **Lack of a safety policy or program**

Answer:4- Accident causation is very diverse, but generally each accident is a result of a combination of factors. The lack of a safety program, per se, is not a root cause. The management system allowing no safety program, though, is a primary root cause of accidents.

Question #: 1141- Safety professionals use accident investigations to:

- 1) Prepare for OSHA inspections
- 2) Collect accident performance data
- 3) **Identify the hazards that caused the accident**
- 4) Prepare defense for litigation

Answer:3- Accident investigations are used to determine the root cause(s) of an accident, so that issues can be corrected. Although the information in the other answer selections obtained during accident investigations may be useful, these are not the primary reasons for conducting investigations.

Question #: 1142- In business terminology, what is a tall organization?

- 1) A company with well-developed management systems
- 2) A company with many levels of management**
- 3) A company with broad market diversification
- 4) A company with extensive vertical market mobility

Answer:2- A tall organization has many levels of management and a narrow span of control at each level. In the United States, the tall organization is being displaced by flatter organizational structures.

Question #: 1143- What is a DISADVANTAGE of having an external group evaluate the company's safety program?

- 1) More objective
- 2) Fresh perspective
- 3) Image as "critics"**
- 4) Non-prejudicial

Answer:3- A real problem with having external groups evaluate the safety program is that they may be perceived as "critics" rather than as teammates.

Question #: 1144- What is a DISADVANTAGE of having an internal group evaluate the company's safety program?

- 1) Evaluation staff knows plant workers
- 2) Less obtrusive audit
- 3) Potentially less objective**
- 4) Harder to work with

Answer:3- One main drawback of an internal safety program audit group is that they are less likely to be totally objective due to personal friendships and "closeness" to issues.

Question #: 1145- Currently the term sievert (Sv) is becoming widely used in health physics. What is 1 sievert equivalent to?

- 1) 1 rem
- 2) 10 rems
- 3) 100 rems**
- 4) 1,000 rems

Answer:3- 1 sievert (Sv) = 100 rems

Question #: 1146- At what dose of ionizing radiation does nausea, vomiting, and reduced white blood cell count occur?

- 1) 0-25 rad
- 2) 25-50 rad
- 3) 50-150 rad**
- 4) 150-300 rad

Answer:3- For exposure to ionizing radiation the following dose-response relationships exists:

DOSE (rad)	EFFECT
0 - 25	No observable effect
25 - 50	Minor temporary blood changes

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50 - 150	Nausea, vomiting, reduced white blood cell count
150 - 300	Increased severity of above symptoms plus diarrhea, malaise, loss of appetite - some death

Question #: 1147- A pattern of behavior associated with a distinctive social position is commonly referred to as a:

- 1) Status **2) Role** 3) Class 4) Caste

Answer:2- Each society has many social categories which are referred to as roles, of which, each is associated with a particular behavioral pattern.

Question #: 1148- The theory on human motivation which declares that workers are uninterested and unmotivated toward work, and to motivate them to work, a system of rewards and punishment is necessary, applies to:

- 1) McGregor's Theory Y **2) McGregor's Theory X**
3) Herzberg's Job-Enrichment Theory 4) Likert's Theory

Answer:2- In an attempt to analyze how management personnel view human motivation, McGregor evolved the notion that there are two basic ways in which management can view the worker: Theory X assumes the worker is essentially uninterested and unmotivated to work. Theory Y assumes the worker is basically interested and motivated to work.

Question #: 1149- In occupational safety, _____ are particularly important from the point of view of hazard identification and recognition through various warning systems:

- 1) Anthropometric considerations 2) Visual displays
3) Population stereotypes 4) Codings

Answer:3- In the man-machine system, man functions as a controller. For many situations, a generalized response is given, like expecting a light switch to be turned on with an upward movement and off with a downward movement, or turning a dial clockwise to obtain an increase. Such responses are called population stereotypes, a behavioral response common to nearly everyone in a certain population.

Question #: 1150- Maslow's Hierarchy of Needs: Biological - security - social - ego/status - self-realization. Once a lower need is met, a person seeks the next higher need. All of the following factors complicate hierarchical motivation EXCEPT:

- 1) Multiple Motivation - People are often motivated by more than one need, for example, seeking recognition from fellow workers and supervisor
2) Psychosocial Needs - These are continuing needs such as recognition and affection

3) Conflicting Motives - Some motives can cause conflict, for example, desiring a promotion but fearing responsibilities

4) Withdrawal Needs – Removes self from the situation, physically or psychologically

Answer:4- Withdrawal needs is not one of the factors complicating hierarchical motivation.

Question #: 1151- Normal air contains approximately ____ of oxygen by volume.

- 1) 16% 2) 18% 3) 19% **4) 21%**

Answer:4- Normal air contains approximately 21% oxygen by volume.

Question #: 1152- Concentration of gases and vapors may be reported as:

- 1) Parts per million by weight 2) Particles per million by volume
3) Parts per million by volume 4) Particles per million by weight

Answer:3- Gas and vapor concentrations in air are expressed in a volume/volume ratio. Based on toxicity, irritation, and other factors, the volume of gas or vapor is compared to one million parts of air. Particulates are used for solid contaminants. Weight/volume ratios are used for particulates.

Question #: 1153- Which of the following technical departments or functions normally perform an FMEA?

- 1) Safety Engineering **2) Reliability Engineering**
3) Quality Assurance Engineering 4) Production Engineering

Answer:2- Reliability engineers are often tasked to perform a failure modes and effects analysis (FMEA).

Question #: 1154- Of the following, which is an alcohol?

- 1) $C_3H_6O_3$ 2) CH_4 3) $CH_2-CH_3-NH_2$ **4) CH_3-CH_2-OH**

Answer:4- Alcohols are a class of organic compounds which can be represented by the shorthand notation ROH. R stands for the hydrocarbon residue that is attached to the OH functional group. The identity of the hydrocarbon residue fixes the specific name of the compound. CH_3OH - methanol CH_3CH_2OH - ethanol

Question #: 1155- The function of a catalyst is to:

- 1) Change the ratio of products in the reaction
2) Alter the ratio of products as well as the rate of the reaction
3) Change the rate of the chemical reaction
4) Modify the products forthcoming from the reaction

Answer:3- The function of a catalyst is to change the rate of a reaction. Usually, catalysts greatly increase the reaction rate, but undergo no permanent chemical changes themselves.

Question #: 1156- If the atomic numbers of four different elements total 102, one can conclude that:

- 1) The elements are members of the same family 2) There are a total of 102 neutrons
3) There are a total of 102 electrons 4) The elements are capable of reacting with each other

Answer:3- The atomic number of an element represents the number of protons (positively charged particles) found in the nucleus of an atom. Since elements are electrically balanced, the atomic number also represents the number of electrons in the atom. There are 102 electrons, equal to the number of protons contained in the four elements.

Question #: 1157- The products produced when water is electrolyzed are:

- 1) H_2O_2 **2) H_2 and O_2** 3) H^+ and OH^- 4) H_2O_2 and H^+

Answer:2- A controlled electrical charge on a container of water will convert the water to hydrogen gas (H_2) and oxygen gas (O_2).

Question #: 1158- Materials which cannot be divided into simpler chemical entities are called:

- 1) Elements** 2) Atoms 3) Molecules 4) Compounds

Answer:1- Elementary solids, liquids, or gaseous matter which cannot be further decomposed into simpler substances by chemical means are called elements.

Question #: 1159- The number of protons in the nucleus of an atom defines the atom's:

- 1) Neutrons 2) Atomic weight 3) Avogadro number **4) Atomic number**

Answer:4- The number of protons in the nucleus defines the atomic number. This is also the elemental identity of the atom.

Question #: 1160- The number of protons combined with the number of neutrons approximates the:

- 1) Avogadro's number **2) Atomic weight** 3) Gram-molecular weight 4) Atomic number

Answer:2- The number of protons combined with the number of neutrons approximates the atomic weight. The atomic weight of an atom is proportional to its physical mass.

Question #: 1161- The particle whose mass is closest to that of the electron is the:

- 1) Neutron 2) Neutrino 3) Proton **4) Positron**

Answer:4- A positron is a particle which has the same weight as an electron, but is electrically positive rather than negative. It is not stable in matter because it reacts readily with an electron to produce gamma radiation.

Question #: 1162- The term "anhydrous" in anhydrous ammonia means:

- 1) Ultra-pure **2) Having no water** 3) Having no salt 4) Having no ammonia

Answer:2- Anhydrous refers to the fact that no water is present.

Question #: 1163- One gram molecular weight of a gaseous substance occupies what amount of space at STP?

- 1) 20.0 liters **2) 22.4 liters** 3) 24.5 liters 4) 32.3 liters

Answer:2- An ideal gas occupies 22.4 liters at STP. This is derived from the ideal gas law ($PV = nRT$) where n is defined as 1 mol and the conditions are standard temperature and pressure (STP = 1 atm and 0°C). R is chosen as 0.082 l-atm / K-mol since we are interested in liters. $PV = nRT$ $V = nRT/P = [1 \text{ mol} * (0.082 \text{ l-atm/K-mol}) * 273 \text{ K}] / 1 \text{ atm} = 22.4 \text{ liters}$

Question #: 1164- Specific gravity of a liquid is defined as:

- 1) The density 2) The mass per unit volume of substance
3) The ratio of weight of volume to weight of an equal volume of water 4) The mass

Answer:3- Specific gravity is the ratio of the mass of one volume of a substance to that of a similar volume of water. Therefore, if a liquid has a specific gravity of 1.2, it is 1.2 times more dense than water.

Question #: 1165- When a chemical reaction takes place, an initial energy is needed to move the reaction up an energy "hill". This energy that is needed to get the reaction going is called:

- 1) Enthalpy 2) Entropy **3) Energy of activation** 4) Excitation energy

Answer:3- Activation energy is the energy that is needed to overcome the energy "hill" and allow the reaction to proceed. Catalysts speed up reactions by lowering the activation energy.

Question #: 1166- When a liquid changes to a gas, the liquid evaporates. When a solid changes to a gas, the solid:

- 1) Evaporates 2) Evolves **3) Sublimes** 4) Undergoes redox

Answer:3- Sublimation is the process of changing a solid directly to a gas. A common example of sublimation is the changing of carbon dioxide from a solid (dry ice) to a gas.

Question #: 1167- Which of the following describes the diffusion of ammonia in air?

- 1) Beer's law **2) Fick's law** 3) Henry's law 4) Boyle's law

Answer:2- Fick's law of diffusion describes the relationship between molecular weight, diffusion coefficient, etc., and the rate of diffusion. Henry's law covers solubilities of gases in water. Beer's law covers the absorption of EM radiation and its relation to concentration, and Boyle's law addresses the relationship of pressure and volume at constant temperature.

Question #: 1168- Which of the following is a strong oxidizing agent?

- 1) Hydrogen peroxide** 2) Helium 3) Iron 4) Chromium

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Answer:1- Hydrogen peroxide (H₂O₂) is a very strong oxidizing agent sometimes used as an oxidizer for rocket fuel.

Question #: 1169- Solve for x in the following equation: $2x^2 - 3x - 4 = 0$

1) $x = 2$ 2) $x = 2$ and $x = -1$ 3) $x = 2.48$ and $x = -0.64$ 4) $x = 2.35$ and $x = -0.85$

Answer:4- Use the algebraic formula to solve for a quadratic equation where "a" is 2, "b" is -3, and "c" is -4.

Question #: 1170- If two legs of a triangle have lengths of 15 feet and 25 feet, and the included angle is 135°, how long is the third side?

1) 29.2 ft 2) 30.0 ft 3) 34.6 ft 4) 37.2 ft

Answer:4- Use the Law of Cosines.

$$c^2 = a^2 + b^2 - 2 * a * b * \cos$$

$$c = (15 \text{ ft})^2 + (25 \text{ ft})^2 - 2 \text{ ft} * 15 \text{ ft} * 25 \text{ ft} * \cos$$

$$135 = 225 \text{ ft}^2 + 625 \text{ ft}^2 - 750 \text{ ft}^2 * -0.7071 = 1380.325 \text{ ft}^2 \quad c = 37.15 \text{ ft}$$

Question #: 1171- Raynaud's Phenomenon can be caused by:

1) Repetitive motion stresses 2) Improper lifting
3) Improper posture 4) Hand-arm vibration

Answer:4- Raynaud's Phenomenon (or Syndrome), also known as vibration white-finger disease, is caused by repeated exposure to hand-arm vibration in the 500 - 1,200 Hz range. Repetitive motion, improper lifting, and posture cause other types of ergonomic diseases.

Question #: 1172- A unit of radiation reflecting the biological effects resulting from exposure of X or gamma radiation is called a:

1) Becquerel 2) Roentgen 3) Curie 4) Red

Answer:2- A unit of radiation reflecting the biological effects resulting from exposure of X-ray or gamma radiation is called a roentgen.

Question #: 1173- The primary red blood cell (erythrocyte, RBC) producing organ is the _____.

1) Bone marrow 2) Spleen 3) Liver 4) Thymus

Answer:1- Up until the age of 4 or 5 years, the spleen and liver can produce RBC's in response to normal growth demands, but after this period, production of RBC's in extramedullary sites occurs only under pathologic conditions. Bone marrow is also the site for production of leukocytes (white blood cells) and thrombocytes (platelets).

Question #: 1174- In the treatment of cyanide poisoning which of the following is administered first?

1) Sodium thiosulfate 2) Sodium nitrite 3) Sulfur 4) Hyperbaric oxygen

Answer:2- Administration of sodium nitrite results in the formation of methemoglobin, which acts as a competitor of cytochrome a3 for cyanide. Since the affinity of methemoglobin for cyanide is greater than for cytochrome a3, the result is dissociation of the cyanide-cytochrome complex and resumption of oxidative metabolism. Sodium thiosulfate converts cyanide to thiocyanate.

Question #: 1175- To convert rads to rems, a multiplier is used that quantifies the radiation damage to biological systems based upon the specific radiation in question. What is the multiplier called?

1) Quality factor 2) Conversion factor 3) Roentgen equivalent man 4) X factor

Answer:1- The multiplier used to convert rads to rems is termed the quality factor or QF.
QF (X, gamma, beta) = 1, QF (neutrons of unknown strength) = 10, QF (alpha) = 20
The relationship is: **1 rem = dose in rads * QF**
Nuclear Regulatory Commission, Code of Federal Regulations, Title 10, 20.1004

Question #: 1176- All of the following EXCEPT _____ are components of photochemical air pollution.

1) Ozone **2) Sulfur dioxide** 3) Hydrocarbons 4) Oxides of nitrogen

Answer:2- Photochemical air pollution arises from a series of atmospheric reactions - NO₂ absorbs UV light giving rise to NO and O radicals which in turn react to produce O₃ (ozone). Ozone and NO can react to regenerate NO₂. Thus the reaction is cyclic. Sulfur dioxide is not part of the photochemical smog problem.

Question #: 1177- The primary purpose of a safety inspection is to:

1) Determine if compliance with governmental codes and regulations are being met
2) Find out if safety rules are being obeyed 3) Look for unsafe conditions and practices
4) Discover and correct hazards

Answer:4- The primary purpose of a safety inspection is to locate hazards and quickly follow up with actions to correct them.

Question #: 1178- Of the following, the least likely reason to perform a health and safety audit is to:

1) Determine if codes, laws, and regulations are being complied with
2) Assess the over-all program and its conformance to accepted safety and health practices
3) Determine if company policies, procedures, and standards are being met
4) Make sure the company is prepared for an OSHA inspection

Answer:4- The purpose of an effective health and safety audit is to conduct a systematic, objective analysis of a company's health and safety practices that is directed toward well defined goals, namely: regulatory compliance, accident/injury/illness risk control, program activities, records analysis and company policies. Following the audit, a report is prepared in which a written assessment is made along with recommendations to improve health and safety management of any significant risks that were identified.

Question #: 1179- Environmental health and safety audits are a means to:

- 1) Identify weak performers in plant manager roles
- 2) **Ensure legal and corporate program compliance**
- 3) **Advise top management of compliance status**
- 4) **Both 2 and 3**

Answer:4- A well run audit program will ensure compliance with corporate and legal requirements and advise top management of the situation at the plant. The goal is not to identify weak plant managers but rather to identify strengths and weaknesses of the EH&S program and to assess the level of compliance. In addition, a compliance assurance plan is generated.

Question #: 1180- A safety program evaluation can be defined as:

- 1) An exercise designed to placate management
- 2) An audit to highlight deficiencies
- 3) **A measure of the effectiveness of safety programs**
- 4) A method to get rid of unsafe supervisors

Answer:3- A safety program evaluation is defined as a systematic method of measuring the effectiveness of a planned group of activities aimed at improving workplace safety. It is important to note that most program evaluations look at both the good and bad aspects of the program; in other words, a properly conducted safety program evaluation is a balanced evaluation.

Question #: 1181- The main reason for safety inspections is to:

- 1) Identify unsafe acts
- 2) Determine compliance with OSHA standards
- 3) Prepare for insurance audits
- 4) **Identify and correct workplace hazards**

Answer:4- The main purpose of safety inspections is to identify hazards and to correct them.

Question #: 1182- An in-depth method that may be used to evaluate a safety program is a:

- 1) **Safety program audit**
- 2) Safety inspection
- 3) Job-Task survey
- 4) Safety check

Answer:1- A safety audit is a comprehensive examination of the safety program. The audit should provide insight into the effectiveness of the program and identify where improvements can be made. The American Society of Safety Engineers (ASSE) publicizes a comprehensive safety audit process to evaluate and rate a safety program by considering Organization and Administration, Industrial Hazard Control, Fire Control and Industrial Hygiene, Supervisory Participation, Motivation and Training, Accident Investigation, and Statistics and Reporting Procedures.

Question #: 1183- Nearly all inorganic compounds do NOT contain:

- 1) **Carbon**
- 2) Nitrogen
- 3) Oxygen
- 4) Hydrogen

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Answer:1- "Inorganic" is the term used to designate compounds that generally do not contain carbon. Exceptions are carbon monoxide and carbon dioxide. These are considered inorganic molecules.

Question #: 1184- 1 g-mole of an ideal gas at 0°C and 760 mm Hg occupies:

- 1) **22.40 liters** 2) 23.40 liters 3) 24.45 liters 4) 28.65 liters

Answer:1- The molar volume of an ideal gas at STP is 22.4 liters. STP (Standard Temperature and Pressure) is 0°C and 1 atm (760 mm Hg).

The Ideal Gas Law is: $PV = nRT$ where:

P = Pressure

V = Volume

n = number of mass-moles of gas

R = the appropriate gas constant

T = Temperature (absolute scale)

In this case, P = 760 mm Hg, n = 1 g-mole, T = 273° K, and we will want V in liters. We then select the gas constant, R, as 62.4 (liter-mm Hg/g-mol-K) because we want to match the other units we already have, and we want the volume in liters. Therefore, substitute these numbers into the Ideal Gas Law equation and solve for V.

$$PV = nRT$$

$$V = (nRT/P)$$

$$= (1 \text{ g-mol} * 62.4 \text{ liter-mm Hg/g-mol-K} * 273^\circ \text{ K}) / 760 \text{ mm Hg}$$

$$= 22.41 \text{ liters}$$

(NOTE: When performing these gas calculations, take care to ensure that the units cancel appropriately.)

Question #: 1185- A _____ is a material that increases the rate of a chemical reaction without being used up in the chemical reaction.

- 1) Buffer 2) **Catalyst** 3) Redox agent 4) Solute

Answer:2- A catalyst is a material that participates in, and speeds up, a chemical reaction but is not used up in the reaction. Catalysts act by lowering the energy of activation for the reaction.

Question #: 1186- A critical orifice is dependent on which of the following?

- 1) Humidity 2) Humidity/pressure 3) Temperature/pressure 4) **Density/humidity**

Answer:4- Density effects air flow because of the change in mass per unit volume. Since humidity effects density and since the critical orifice is dependent on air flow, the critical orifice must therefore be dependent on both humidity and density.

Question #: 1187- A cylinder contains 1,000.0 psi(g). What is its absolute pressure?

- 1) **1,014.7 psi(a)** 2) 1,000.0 psi(a) 3) 985.3 psi(a) 4) 900.0 psi(a)

Answer:1- Psi(g) (pounds per square inch gauge) = psi(a) (pounds per square inch absolute) - atmospheric pressure (14.7 psi)

$$\text{psi(g)} = \text{psi(a)} - 14.7 \text{ psi} \text{ So } \text{psia} = \text{psig} + 14.7 \text{ psi} = 1000.0 \text{ psig} + 14.7 \text{ psi} = 1,014.7.$$

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Question #: 1188- A gas inside a sealed drum exerts 15.3 psi(g) at 25°C. What is the pressure inside the drum when the temperature is 40°C?

- 1) 16.1 psi(g) 2) 14.6 psi(g) 3) Molecular weight of material must be known
4) Volume of drum must be known

Answer:1- $(P_1 V_1) / T_1 = (P_2 V_2) / T_2$ $15.3 \text{ psi(g)} / 298^\circ \text{ K} = P_2 / 313^\circ \text{ K}$
 $P_2 = 16.1 \text{ psi(g)}$ Where : P_1 = Initial pressure , P_2 = Final pressure , T_1 = Initial temperature (absolute) , T_2 = Final temperature (absolute) , V_1 = Initial volume , V_2 = Final volume
NOTE: Assume that the volume = 1. The volume does not change.

Question #: 1189- A gas occupies a volume of 2.75 liters at 87°C and 150 torr. What volume will the gas occupy at 25°C and 745 torr?

- 1) 0 liters 2) 0.13 liters 3) 0.23 liters 4) 0.46 liters

Answer:4 - Use the combined Ideal Gas Law equation. $(P_1 V_1) / T_1 = (P_2 V_2) / T_2$
Remember to convert all temperatures to absolute.
($T_a = ^\circ\text{C} + 273$)
 $V_2 = (P_1 V_1 T_2) / (P_2 T_1)$
 $= (150 \text{ torr} * 2.75 \text{ l} * 298^\circ \text{ K}) / (745 \text{ torr} * 360^\circ \text{ K})$
 $= 0.46 \text{ liters}$
NOTE: 1 torr is also equal to 1 mm Hg

Question #: 1190- A mixture of gases at 1 atm contains 66.0% N₂, 14% O₂ and 20% CO₂ by volume. What is the partial pressure of each gas in mm Hg?

- 1) N₂ = 501.6, O₂ = 106.4, CO₂ = 152.0 2) N₂ = 501.6, O₂ = 152.0, CO₂ = 106.4
3) N₂ = 217.1, O₂ = 152.0, CO₂ = 106.4 4) N₂ = 217.1, O₂ = 106.4, CO₂ = 152.0

Answer:1- $P(\text{total}) = P(\text{N}_2) + P(\text{O}_2) + P(\text{CO}_2) = 1 \text{ atm} = 760 \text{ torr} = 760 \text{ mm Hg}$
 $P(\text{N}_2) = 0.66 * 760 \text{ mm Hg} = 501.6 \text{ mm Hg}$ $P(\text{O}_2) = 0.14 * 760 \text{ mm Hg} = 106.4 \text{ mm Hg}$
 $P(\text{CO}_2) = 0.20 * 760 \text{ mm Hg} = 152.0 \text{ mm Hg}$

Question #: 1191- When an atom absorbs energy from a source such as ultraviolet light, it often releases that energy in several smaller packets of energy. Which of the following is NOT correct?

- 1) The released energy is used for analytical purposes
2) The released energy is of a longer wavelength than the ultraviolet light
3) The released energy is a type of fluorescence
4) The released energy is usually X-rays

Answer:4- The process of absorbing energy moves electrons to a higher energy. When the electrons revert back to a lower energy level, the excess energy may be released as light. This release usually takes place in two or three smaller releases, dividing the original energy into pieces, resulting in the longer wavelength. The science of spectrofluorometry is the analysis of this light.

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Question #: 1192- Beer's Law refers to:

1) Spectrophotometry 2) Chromatography 3) Dosimetry 4) Fluorescence

Answer:1- Beer's Law is $A = kC$, where A is the absorbance of a solution, C is the concentration of analyte, and k is a constant whose value depends on the wavelength of the radiation, the nature of absorbing system, and the optical path length, or cell thickness.

Question #: 1193- What is the wavelength of 100 Hz sound traveling through steel (if the velocity of sound in steel is 16,400 ft/sec)?

1) 164 ft 2) 1,640 ft 3) 16,400 ft 4) 1,640,000 ft

Answer:1- $V = LF$, where , V = velocity, F = frequency, L = wavelength
 $L = V/F = (16,400 \text{ ft/sec}) / 100 \text{ Hz} = 164 \text{ ft}$

Question #: 1194- The 4th ring (energy level) of an atom can contain up to how many electrons?

1) 8 2) 16 3) 32 4) 64

Answer:3- Rule: Energy Level = $2 (\text{ring number})^2$
Electrons = $2 * 4^2 = 2 * 16 = 32$

Question #: 1195- How much energy is required to raise the temperature of 1 lb of water from 32°F to 212°F?

1) 180 Btu 2) 242 Btu 3) 444 Btu 4) 132 Btu

Answer:1- 1 Btu is the heat required to raise 1 lb of water 1°F (assuming that the heat capacity of water remains constant throughout the temperature range) Energy = $180^\circ\text{F} * 1 \text{ Btu}/^\circ\text{F} = 180 \text{ Btu}$

Question #: 1196- At a distance of 5 miles, an office building has an angle of elevation of 2° (neglecting the curvature of the earth). Find the height of the building.

1) 922 ft 2) 561 ft 3) 434 ft 4) 4,340 ft

Answer:1- 5 miles is equal to 26,400 ft. Draw a right triangle. $\tan 2^\circ = \text{Opposite side} / \text{Adjacent side}$. So = Opp / 26,400 ft Opposite side = $\tan 2^\circ * 26,400 \text{ ft} = 922 \text{ ft}$

Question #: 1197- A rock weighs 250 lb. When it is placed in water it weighs 100 lb. What is its specific gravity?

1) 2.5 2) 2.0 **3) 1.7** 4) 0.4

Answer:3- When something is placed in water it displaces its volume of water. Specific gravity is the weight of a given volume of a material relative to that same amount of water. Use the formula: Specific Gravity = Weight in air / Weight of displaced water The weight of the displaced

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water necessarily is the "underwater" weight of the rock subtracted from the "in air" weight of the rock. $SG = 250 \text{ lb} / (250 \text{ lb} - 100 \text{ lb}) = 1.7$

Question #: 1198- To what pressure can a man weighing 150 lb inflate a tire if he uses a single pump with a cross section of 3 in²?

- 1) 25 psi **2) 50 psi** 3) 100 psi 4) 150 psi

Answer:2- The force the man can apply is 150 lb. This force is distributed over 3 in². Therefore, divide 150 lb by 3 in². This results in a pressure of 50 psi.

Question #: 1199- Which one of the following statements is not correct?

- 1) $A^2 = B^2 + C^2 - 2 * B * C * \cos A$ 2) $B^2 = A^2 + C^2 - 2 * A * C * \cos B$
3) $C^2 = A^2 + B^2 - 2 * A * B * \cos C$ **4) $B^2 = B^2 + A^2 - 2 * A * B * \cos B$**

Answer:4- All but Answer 4 represent the Law of Cosines.

Question #: 1200- If a force acting on a surface is applied in a direction perpendicular to that surface then the force is called a:

- 1) Uni-directional force **2) Normal force** 3) Perpendicular force 4) Friction force

Answer:2- If a force acting on a surface is applied in a direction perpendicular to that surface then the force is called normal force.

Question #: 1201- A system of forces is ____ if the lines of action of the forces have a common point of intersection.

- 1) Combined 2) Normal 3) Non-concurrent **4) Concurrent**

Answer:4- A system of forces is concurrent if the lines of action of the forces have a common point of intersection.

Question #: 1202- A system of forces is said to be ____ if all the forces are acting on a two-dimensional surface.

- 1) Coplanar forces** 2) Concurrent forces 3) Tangential force 4) Normal force

Answer:1- A system of forces is said to be coplanar forces if all the forces are acting on a two-dimensional surface.

Question #: 1203- A system of forces is ____ if all the forces have a common line of action.

- 1) Concurrent 2) Tangential 3) Coplanar **4) Collinear**

Answer:4- A system of forces is collinear if all the forces have a common line of action.

Question #: 1204- A force applied on a body that will tend to elongate the body is called:

- 1) Applied 2) Tangential **3) Tensile** 4) Normal

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Answer:3- A force applied on a body that will tend to elongate the body is called tensile.

Question #: 1205- A force that will tend to shrink the body in the direction that it is applied is called:

- 1) Non-tensile 2) Tensile **3) Compressive** 4) Coplanar

Answer:3- A force that will tend to shrink the body in the direction that it is applied is called compressive.

Question #: 1206- What is the speed in feet per minute of a 24 in. diameter pulley turning at 1,000 rpm?

- 1) 628 ft/min 2) 2,000 ft/min 3) 2,400 ft/min 4) 6,280 ft/min

Answer:4- Speed = c (rpm) $c = \pi d$ $d = 24 \text{ in} / (12 \text{ in/ft}) = 2 \text{ ft}$
Speed = $3.14 * 2 \text{ ft} * (1,000 \text{ rpm}) = 6,280 \text{ ft/min}$

Question #: 1207- One foot candle is equivalent to:

- 1) 1 lux 2) 1.076 lux **3) 10.76 lux** 4) 2 foot-lamberts

Answer:3- One foot candle converts to 10.76 lux.

Question #: 1208- Reflectance is:

- 1) A unit of light output 2) Amount of light emitted **3) The quantity of light reflected from a surface** 4) The quantity of light absorbed on a black surface

Answer:3- Reflectance is the quantity of light reflected from a surface.

Question #: 1209- Find the distance between these two graphed points: (6, 34) and (80, 37)

- 1) 59 2) 69 3) 71 **4) 74**

Answer:4- Use the formula: $D = 74$

Question #: 1210- Convert 0.200 m/sec to miles per hour.

- 1) 0.0447 mph **2) 0.447 mph** 3) 4.47 mph 4) 44.7 mph

Answer:2- $= (0.200 \text{ m/sec})(3.281 \text{ ft/m})(1 \text{ mi}/5,280 \text{ ft})(60 \text{ sec/min})60 \text{ min/hr} = 0.447 \text{ mi/hr}$

Question #: 1211- What is the appropriate formula to determine the kinetic energy of a rotating body?

- 1) $A = W^2 R$ 2) $W = \text{Radians} / \text{Time}$ **3) $E = \frac{1}{2} I W^2$** 4) $E = \frac{1}{4} I W^2$

Answer:3- The formula for the kinetic energy of a rotating body is: $E = \frac{1}{2} I W^2$

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Question #: 1212- If a weight is dropped from an altitude of 1,300 feet, how much time is needed for the weight to strike the ground?

- 1) 4.5 sec 2) 7.0 sec 3) 8.0 sec **4) 9.0 sec**

Answer:4- Use the formula: Distance (S) = $a t^2 / 2$. So $1300 = 32.2 t^2 / 2$ So $2600/32.2 = t^2$
So $80.74 = t^2$ So $t = \sqrt{80.74} = 8.9$ seconds.

Question #: 1213 - What is the weight of a solid cylinder of aluminum having a diameter of 3 feet and a length of 4 feet? (Aluminum weighs 165 lb/ft³.)

- 1) 19,000 lb 2) 9,300 lb **3) 4,700 lb** 4) Not enough information provided

Answer:3 - First calculate the volume of the cylinder (or any object) and then multiply the volume times the weight of the material per unit of volume. The formula for calculating the volume of a cylinder is $3.14 * \text{radius}^2 * \text{the length of the cylinder}$

$$V = 3.14 r^2 * \text{length} = 3.14(1.5 \text{ ft})^2 4 \text{ ft} = 28.26 \text{ ft}^3$$

The weight of the object is determined by multiplying the volume of the object times the weight per unit of volume.

$$\text{Weight} = 165 \text{ lb/ft}^3(28.26 \text{ ft}^3) = 4,663 \text{ lb}$$

Question #: 1214- The components of a virus include all of the following EXCEPT:

- 1) Nucleic acid **2) Cell wall** 3) Capsid 4) Envelope

Answer:2 - Viruses do not contain a cell wall; viruses are non-cellular and contain only nucleic acids (DNA or RNA), a capsid, which encloses the nucleic acid and determines the shape of the virus, and the envelope, which comes from the host cell.

Question #: 1215- Antigens are made of all of the following EXCEPT:

- 1) Protein **2) Lipid** 3) Polysaccharide 4) Glycoprotein

Answer:2- Antigens are not made of lipids. They are either proteins, polysaccharides, glycoproteins, or nucleoproteins. Antigens are substances foreign to the body that stimulate the production of antibodies. Antigens are found on the surfaces of microbes.

Question #: 1216- Which of the following is not a type of immunoglobulin?

- 1) IgG 2) IgA **3) IgB** 4) IgE

Answer:3- There are five classes of immunoglobulins - IgG, IgA, IgM, IgD, and IgE. They are produced by lymphocytes in the lymph nodes, spleen, tonsils, and adenoids. These are also called antibodies that are proteins produced in response to an antigen.

Question #: 1217- Tuberculosis is caused by which of the following?

- 1) Virus **2) Bacteria** 3) Protozoa 4) Spirochete

Answer:2- Tuberculosis is caused by mycobacterium tuberculosis, which is a bacillus bacteria. Viruses and protozoa are not bacteria and do not cause tuberculosis. Spirochetes are bacteria, but of a different type and shape than the bacteria that causes tuberculosis.

Question #: 1218- Ultrasonic noise cannot be heard by the human ear. What does the ear hear during ultrasonic operation?

- 1) Ultrasonic noise **2) Subharmonic noise** 3) ELF noise 4) Nothing

Answer:2- You actually hear subharmonics of the ultrasonic noise which are generated in your hearing range. An ultrasonic welder emitting noise at 20 KHz (human limit) will be heard at 10 kHz, the first subharmonic.

Question #: 1219- In which part of the ear is mechanical energy translated to electrical energy?

- 1) Outer ear 2) Middle ear **3) Inner ear** 4) Ear drum

Answer:3- The inner ear contains the cochlea, which has tiny hair cells that vibrate when exposed to sound waves. These hairs then transmit electrical impulses to the brain along nerves attached to the hair cells.

Question #: 1220- Most muscles are joined by hundreds or even thousands of nerve fibers of the efferent (motor) nervous system. The contact between the end point of the axon of one motor-neuron and the sarcolemma of the muscle is called:

- 1) Reticulum switches 2) Cross bridges **3) Motor endplate** 4) Motor muscle

Answer:3- Most muscles are joined by hundreds or even thousands of nerve fibers of the efferent (motor) nervous system. The contact between the end point of the axon of the motor-neuron and the sarcolemma of the muscle is called the motor endplate.

Question #: 1221- The sacrum is located:

- 1) Along the upper spinal column **2) Below the lumbar vertebrae**
3) Above the cervical vertebrae 4) Within the thoracic cavity

Answer:2- The sacrum is located below the lumbar vertebrae.

Question #: 1222- The carpus is defined as:

- 1) The collection of bones in the hand **2) The wrist bones, collectively**
3) The bony eminence at the distal end of the elbow 4) Pertaining to the palm of the hand

Answer:2- The carpus is defined as the wrist bones, collectively.

Question #: 1223- The metacarpal is defined as:

- 1) The center point of the hand 2) The most distal point of the hand
3) Pertaining to the long bones of the hand between the carpus and phalanges.

4) The muscle of the posterior lower arm

Answer:3- The metacarpal is defined as pertaining to the long bones of the hand between the carpus and phalanges.

Question #: 1224- The term which defines the torque that a given muscle (or group of muscles) can develop voluntarily around a skeletal articulation which is spanned by the muscle(s) is called:

1) Muscle span 2) Muscle torque **3) Voluntary muscle strength** 4) Involuntary muscle strength

Answer:3- The term which defines the torque that a given muscle (or group of muscles) can develop voluntarily around a skeletal articulation which is spanned by the muscle(s) is called voluntary muscle strength.

Question #: 1225- The term which describes a subdivision of dynamics that deals with the motions of bodies, but not the causing forces is:

1) Mechanics 2) Free dynamics 3) Sometric **4) Kinematics**

Answer:4- The term which describes a subdivision of dynamics that deals with the motions of bodies, but not the causing forces, is kinematics.

Question #: 1226- The term that describes muscle fiber elements (polymerized protein molecules) capable of **sliding along each other**, thus shortening the muscle and, if doing so against resistance, generating tension is called:

1) Muscle contraction 2) Kinetics 3) Free dynamics **4) Muscle filaments**

Answer:4- The term that describes muscle fiber elements (polymerized protein molecules) capable of sliding along each other, thus shorting the muscle and, if doing so against resistance, generating tension, is called muscle filaments.

Question #: 1227- The nerve cells in the eyes, ears, skin, and the rest of the body that receive information about the body and the world around it are called:

1) Receptor cells 2) Processing cells 3) Motor neurons 4) Neuro-muscular

Answer:1- Receptor cells are the nerve cells in the eyes, ears, skin and the rest of the body that receive information about the body and the world around it.

Question #: 1228 - The incus is part of:

1) Cochlea 2) Inner ear **3) Middle ear** 4) Outer ear

Answer:3- The incus is part of the middle ear.

Question #: 1229- The flexing of the elbow, the biceps, and the brachialis on the front of the upper arm are the:

1) Non-fixation muscles **2) Prime movers** 3) Ergon muscle 4) Anti-fixation muscles

Answer:2- The flexing of the elbow, the biceps, and the brachialis on the front of the upper arm are the prime movers.

Question #: 1230- What do asbestos, silicon dioxide, metal fumes, nitrogen dioxide, and beryllium have in common?

- 1) They are carcinogens
- 2) They are lung damaging agents
- 3) They are nephrotoxins
- 4) They are nerve damaging agents

Answer:2- Asbestos, silicon dioxide, metal fumes (iron, cadmium, zinc oxides) and beryllium are lung damaging agents. In order for a harmful agent to exert its toxic effect, it must come into contact with a body cell. To make that contact, entry into the body is made as a result of the inhalation of the foregoing in the form of dusts, fibers, or particles which are deposited and retained in the lungs, where they (depending on dose response) have the potential to produce signs, symptoms, and findings of pulmonary disease. (Asbestos and beryllium are also carcinogenic.)

Question #: 1231- What fundamental concept in toxicology is used to determine the safety or hazard of chemical substances?

- 1) Assessment of the hazard and its impact on the population
- 2) Defining safety and health limits of chemical agents
- 3) Establishing that a relationship exists between the dose of an agent and the response that it produced in a biologic system
- 4) Identifying mechanisms by which noxious substances gain access to the biological system

Answer:3- Toxicology is the study of noxious effects of chemical and physical agents. The most fundamental concept in toxicology states that a relationship exists between the dose of an agent and the response that it produces in a biologic system. The first toxicity data on an uncharacterized agent are usually obtained using test animals. A range of doses is found where at the upper end all animals die, and at the lower end, they survive.

Question #: 1232- At a given intensity, sound in which frequency is most likely to result in permanent hearing damage?

- 1) 37.5 - 500 Hz
- 2) 1,000 - 4,000 Hz
- 3) 8,000 - 16,000 Hz
- 4) 16,000 - 32,000 Hz

Answer:2- The ear is most susceptible to noise in the range that it is most sensitive. The ear is most sensitive in the range 1,000 - 4,000 Hz.

Question #: 1233- At what frequency does noise induced hearing loss first show up on an audiogram?

- 1) 250 - 1,000 Hz
- 2) 3,000 - 6,000 Hz
- 3) 250 - 500 Hz
- 4) 250 - 8,000 Hz

Answer:2- The first sign of noise induced hearing loss is usually seen in the higher frequencies.

Question #: 1234- The main part of the body involved in maintaining the body's heat balance is:

- 1) **Skin** 2) Heart 3) Lungs 4) Hair

Answer:1- The skin is responsible for dissipating heat load through the blood flow of the capillaries. The capillaries expand and contract depending on the load.

Question #: 1235- The middle ear contains a group of bones called the:

- 1) Stapes 2) **Ossicles** 3) Incus 4) Eustachian tubes

Answer:2- The middle ear consists of the eustachian tubes, the mastoid air cell system, and the sound conducting mechanism composed of the incus, malleus, and the stapes. These three small bones are called the ossicles.

Question #: 1236 - The part of the ear which contains the hair-like cells that detect sounds is the:

- 1) Semicircular canals 2) **Cochlea** 3) Stapes 4) Anvil

Answer:2 - The cochlea is the organ which contains these hair cells. The sound waves move the hairs at specific locations in the cochlea. The sites of hair movement correspond to the sounds' frequencies.

Question #: 1237- The phenomena of bio magnification of heavy metals is due to the:

- 1) Second Law of Thermodynamics 2) Lead pipes 3) Collapsed sewer mains 4) **Food chain**

Answer:4- The food chain serves to concentrate heavy metals in the uppermost predators as the lower forms add to their heavy metal loading.

Question #: 1238- What does BOD stand for?

- 1) Biological Organic Demand 2) Basic Oxygen Demand
3) **Biochemical Oxygen Demand** 4) Biological Oxidation Demand

Answer:3- BOD stands for Biochemical Oxygen Demand. This is the quantity of oxygen used in the aerobic stabilization of wastewaters.

Question #: 1239- What factor LEAST influences the interchange of heat between man and his environment?

- 1) Moisture content of the air 2) Air velocity 3) **Air density** 4) Air temperature

Answer:3- The density of the air is not one of the major influencing factors in heat exchange between man and the environment.

Question #: 1240- What part of the body is most **acutely** damaged by ultraviolet radiation?

- 1) **Cornea** 2) Skin 3) Kidneys 4) Lung

Answer:1- Ultraviolet light can cause the most acute damage to the eye's cornea. Factors which influence the damage include: exposure time, distance, wavelength, sensitivity of the individual, and presence of sensitizing agents.

Question #: 1241- Which frequency of vibration most adversely affects humans?

- 1) **1 - 125 Hz** 2) 140 - 250 Hz 3) 275 - 500 Hz 4) 500 - 1,000 Hz

Answer:1- The 1 - 125 Hz band has been shown to be the most effective in affecting humans.

Question #: 1242- What size of particles are removed by the mouth and nasal passages?

- 1) Greater than 1 micron 2) Greater than 5 microns
3) **Greater than 10 microns** 4) Greater than 20 microns

Answer:3- The mouth and nasal passages can remove particles greater than 10 microns in diameter from impaction on the wet surfaces of the nose and mouth.

Question #: 1243- Deposition of **liquid particles** in the respiratory system is dependent on:

- 1) Particle size 2) Specific gravity 3) Viscosity 4) **Solubility in water**

Answer:4- A liquid's solubility in water and its reactivity are the determining factors in the deposition of liquid particles in the respiratory system, as compared with solid particles, which depend on specific gravity and particle diameter.

Question #: 1244- MIG (metal inert gas) welding is commonly used when working with:

- 1) Aluminum 2) Stainless Steel 3) **Mild Steel** 4) Titanium

Answer:3- While MIG (metal inert gas) welding is capable of being used for all the listed metals, it is most effective for mild steels. TIG (tungsten inert gas) welding is more effective for aluminum, stainless steel and titanium. Fumes are a concern with both MIG and TIG welding, but MIG welding tends to produce more fumes. All forms of arc welding produce potentially hazardous Ultraviolet (UV) light.

Question #: 1245- The primary machine shop tool used in the cold forming of metals is the:

- 1) Drill 2) Turning machine 3) Lathe 4) **Power press**

Answer:4- Power press is a versatile tool used in a number of operations to cold form metals.

CSP Questions and Answers- Part-II

Question #: 1246- A cyclone scrubber is put on-line with an Electrostatic Precipitator (ESP). The efficiency of the cyclone is 80% while the ESP is 95%. Assuming the cyclone is last, what is the overall system efficiency?

- 1) 99% 2) 99.9% 3) 99.99% 4) 99.999%

Answer:1- Efficiency = $95\% + (80 \times 5\%) = 99\%$ efficiency

Question #: 1247- An 8.0 ft steel ladder is placed against a building. The top of the ladder is 7.6 ft up the building wall then slips 1.0 ft down. How far did the bottom of the ladder move?

- 1) 1.0 ft 2) 2.0 ft 3) 2.5 ft 4) 4.5 ft

Answer:2- After the ladder slips 1 foot it is 6.6 ft up on the house. Using the Pythagorean Theorem for right triangles (i.e., $a^2 + b^2 = c^2$ where a and b are sides of a right triangle, and c is the hypotenuse.)

Solving for the new base: $(8.0 \text{ ft})^2 - (6.6 \text{ ft})^2 = (\text{new base})^2$

$64 \text{ ft}^2 - 43.6 \text{ ft}^2 = (\text{new base})^2$

$20.4 \text{ ft}^2 = (\text{new base})^2$

$\text{ft}^2 = \text{new base}$

New base = 4.5 ft

Solving for the original base: $(8.0 \text{ ft})^2 - (7.6 \text{ ft})^2 = (\text{original base})^2$

Original base = 2.5 ft. Therefore the base changed from 2.5 ft to 4.5 ft, a change of 2.0 ft.

Question #: 1248- A fluid system with a Reynolds number significantly below 2,000 implies what about a fluid system's flow characteristics?

- 1) **Laminar flow** 2) Turbulent flow 3) Too fast for dust transport 4) Too slow for dust transport

Answer:1- The Reynolds number is a dimensionless number used to model whether the flow is turbulent or laminar. If the Reynolds number is less than 2,000 the flow will have laminar characteristics. If it is greater than 2,000 the fluid system is considered turbulent.

Question #: 1249- A ladder leans against the side of a building and makes an angle of 70° with the ground. The foot of the ladder is 30 ft from the building. What is the length of the ladder?

- 1) 11 ft 2) 32 ft **3) 88 ft** 4) 92 ft

Answer:3- $\text{Cosine of Angle} = \text{Adjacent Leg Length} / \text{Hypotenuse Leg Length}$

$\text{Cos } 70^\circ = 30 \text{ ft} / \text{Hypotenuse Leg Length}$ $\text{Hypotenuse Leg Length} = 30 \text{ ft} / \text{cos } 70^\circ$

$= 30 \text{ ft} / 0.3420 = 88 \text{ ft}$

CSP Questions and Answers- Part-II

Question #: 1250- If a 220 lb man runs up a 10 ft flight of stairs in 4 sec, how much horsepower does he develop?

- 1) **1.0 hp** 2) 4.0 hp 3) 5.5 hp 4) 16 hp

Answer:1- $1 \text{ hp} = 550 \text{ ft-lb/sec}$ $\text{Power} = (10 \text{ ft} * 220 \text{ lb}) / 4 \text{ sec} = 2,200 \text{ ft-lb} / 4 \text{ sec}$
 $= 550 \text{ ft-lb/sec} = 1.0 \text{ hp}$

Question #: 1251- What is the absolute pressure at the bottom of an open-air tank filled with sea water to a depth of 10 ft with an average density of 64 lb/ft³?

- 1) 4.44 psi(a) 2) **19.3 psi(a)** 3) 640 psi(a) 4) 655 psi(a)

Answer:2- Use the formula: Pressure = Height * Density

$$P = 10 \text{ ft} * 64 \text{ lb/ft}^3 \quad P = 640 \text{ lb/ft}^2 \quad \text{There are 144 in}^2 \text{ in a ft}^2$$

$$640 \text{ lb/ft}^2 / 144 \text{ in}^2/\text{ft}^2 = 4.44 \text{ psi}$$

Adding standard atmospheric pressure to the head pressure calculated above, the total absolute pressure at the bottom of the sea water tank is: $4.44 \text{ psi} + 14.9 \text{ psi} = 19.3 \text{ psi(a)}$

Question #: 1252- To secure a roof antenna three guy wires are required. The wires will make an angle of 35° with respect to the roof. How much guy wire is needed if the antenna is 10 ft high?

- 1) 13 ft 2) 18 ft 3) 37 ft 4) **52 ft**

Answer:4- Use the sine trigonometric identity.

Sine of Angle = Opposite Leg Length / Hypotenuse Leg Length

$$\sin 35^\circ = 10 \text{ ft} / \text{Hypotenuse Leg Length}$$

$$\text{Hypotenuse Leg Length} = 10 \text{ ft} / \sin 35^\circ = 10 \text{ ft} / 0.5736 = 17.4 \text{ ft}$$

$$\text{Total for 3 guy wires} = 3 * 17.4 \text{ ft} = 52.2 \text{ ft.}$$

Question #: 1253- A 4 ft high by 8 ft wide panel is submerged such that the top of the panel is located 18 ft below the water line. What total force is experienced by the panel?

- 1) 100,000 lb 2) 80,000 lb 3) 60,000 lb 4) **40,000 lb**

Answer:4- Use the following formulas: Area = Length * Width = $8 \text{ ft} * 4 \text{ ft} = 32 \text{ ft}^2$

$$\text{Pressure} = \text{Weight} * \text{depth at VERTICAL CENTER of panel} = 62.4 \text{ lb/ft}^3 * 20 \text{ ft} = 1,248 \text{ lb/ft}^2$$

$$\text{Total Force} = \text{Area} * \text{Pressure} = 32 \text{ ft}^2 * 1,248 \text{ lb/ft}^2 = 39,936 \text{ lb}$$

Question #: 1254- What is the axial tensile stress on this cross support (neglecting the effects of beam weight)?

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- 1) 18 lb **2) 36 lb** 3) 48 lb 4) 96 lb

Answer:2- Use the tangent trigonometric identity. Since the load is supported by 2 diagonal beams, divide the load by 2 and calculate the vertical component for each side. The vertical component is:

$$100 \text{ lb} / 2 = 50 \text{ lb}$$

tangent of angle = opposite length / adjacent length

$$\tan 70^\circ = 50 \text{ lb} / \text{adjacent length}$$

$$= 50 \text{ lb} / \tan 70^\circ$$

$$= 50 \text{ lb} / 2.75$$

$$= 18.2 \text{ lb}$$

The other diagonal support beam is contributing the same stress.

Therefore, the total stress on the cross support is $18.2 \text{ lb} + 18.2 \text{ lb} = 36.4 \text{ lb}$

Question #: 1255- A sled and passenger weigh 86 lb. The coefficient of friction of steel runners on snow is 0.07. What force is needed to get the sled moving?

- 1) 5.1 lb **2) 6.0 lb** 3) 6.7 lb 4) 8.5 lb

Answer:2- Force = $f \times \text{weight}$ = $0.07 (86 \text{ lb})$ = 6.02 lb

Question #: 1256- If water weighs 8.34 lb / gal and 100 gal are moved up from the bottom to the top of a 100 ft tank, what work is done?

- 1) 385 ft-lb 2) 4,932 ft-lb 3) 8,340 ft-lb **4) 83,400 ft-lb**

Answer:4- Use the formula: $W = F D$ (where W = work, F = force and D = distance)

$$\text{Weight of water} = 8.34 \text{ lb} / \text{gal} \times 100 \text{ gal} = 834 \text{ lb} \quad W = 834 \text{ lb} \times 100 \text{ ft} = 83,400 \text{ ft-lb}$$

Question #: 1257- What size of motor on a hoist rated at 2,000 lb is required if the motor were required to raise a rated load of 25 ft in no longer than 3 sec?

- 1) 20 hp 2) 25 hp **3) 30 hp** 4) 35 hp

Answer:3- Use the formula: $\text{Power} = (F D) / t$ (where F = force, D = distance, t = time)

$$P = 2,000 \text{ lb} \times 25 \text{ ft} / 3 \text{ sec} = 16,667 \text{ ft-lb/sec}$$

$$= (16,667 \text{ ft-lb/sec}) / (550 \text{ ft-lb/sec per hp}) = 30.3 \text{ hp}$$

Question #: 1258- A three-leg sling is supported from a single point and attaches to a 1,000 lb steel cylindrical object at three equidistant points along the cylinder's circumference (i.e., the attachment points on the steel cylinder are 120° apart). The center of gravity of the cylinder runs through its center. When attached to this steel cylinder, each leg of the sling creates a 30° angle with respect to the load. What is the tension in each leg of the sling?

- 1) 333 lb 2) 385 lb 3) 577 lb **4) 667 lb**

Answer:4-Since the center of gravity of the load is through its center, and since each leg of the sling attaches to the load equidistant from its adjacent legs, each leg will carry exactly $1/3$ of the load. The angle each leg of the sling makes with the load is measured as 30° . Therefore, the tension in each leg of the sling is equal to $1/3$ of the total load (1,000 lb) divided the sine of 30° .

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Tension (one leg) = $1/3$ of 1,000 lbs/sin 30° Tension (one leg) = $333.3/0.5 = 667$ lbs
When you have the angle of each leg of the sling with respect to the load (or with respect to the horizontal), divide the load by the sine of the angle.

Question #: 1259- Determine the horsepower required to lift a 120 lb weight to a height of 40 ft in 65 sec.

- 1) **0.134 hp** 2) 0.268 hp 3) 1.340 hp 4) 2.680 hp

Answer:1- Use the formula: Power = Work / Time (Note: Work = Force * Distance)
Power = Force * Distance / Time = $120 \text{ lb} * 40 \text{ ft} / 65 \text{ sec} = 73.8 \text{ ft-lb/sec}$
 $1 \text{ hp} = 550 \text{ ft-lb/sec}$ Power = $(73.8 \text{ ft-lb/sec}) / (550 \text{ ft-lb/sec}) / \text{hp} = 0.134 \text{ hp}$

Question #: 1260- Which of the following correlates the parts of an overhead crane with the correct direction of travel?

- 1) **Bridge: Horizontal, Trolley: Horizontal, Hoist: Vertical**
2) Bridge: Vertical, Trolley: Horizontal, Hoist: Horizontal
3) Bridge: Horizontal, Trolley: Vertical, Hoist: Vertical
4) Bridge: Horizontal, Trolley: N/A, Hoist: Vertical

Answer:1- The trolley and hoist move horizontally along the bridge rails. The trolley is connected to the bridge and moves at right angles to it. The hoist is connected to the trolley and does the lifting. Combined, the trolley and the bridge travel at right angles to each other and enable the crane to reach any point under the bridge rails, limited only by the travel limits.

Question #: 1261-The purpose of an upper limit switch on a hoist is to:

- 1) Shut down the hoist when the load is too heavy
2) **Prevent the load block from being raised too high**
3) Prevent the running rope from coming off the hoist drum
4) To ensure that the load is centered over the hoist

Answer:2- The purpose of an upper limit switch is to prevent the load block from being raised into the hoist mechanism (sheave). When the upper limit switch is near contact by the load block, the crane upward movement is automatically shut down in order to keep the load block from contacting the sheave.

Question #: 1262- An instantaneous exposure excursion to ammonia ranging up to 250 ppm should:

- 1) Be of no concern
2) Not be considered when the TWA is calculated
3) **Be considered an unacceptable event**
4) Be regarded as a measurement artifact

Answer:3- An excursion of this magnitude for a fast acting irritant would be considered unacceptable. For more information see the ACGIH TLVs and BEIs publication.

Question #: 1263- Given a challenge atmosphere of 150 ppm and a quantitative fit test result of 3 ppm measured inside the respirator, what is the protection factor (PF) for that respirator?

- 1) 0.02 2) 3 3) 50 4) 147

Answer:3- To calculate the PF:

PF = outside concentration / inside concentration

PF = 150 ppm / 3 ppm

= 50

Question #: 1264- If an employee works in an area for 2.5 hours, what is his/her maximum permissible exposure to noise?

- 1) 96 dB 2) 97 dB **3) 98 dB** 4) 100 dB

Answer:3- Using $T = 8 / 2[(L-90)/5]$ where L is the measured exposure, 90 is the permissible exposure, and T is the exposure time

$T = 8 / 2[(L-90)/5]$ $2.5 = 8/x$ $x = 3.2$

Substituting, $3.2 = 2[(L-90)/5]$ or $3.2 = 2y$ $y = 1.59$

Substituting, $1.59 = (L-90)/5$, $L = 98$ dB

Question #: 1265- In auditing plant operations, you find a machine operator being exposed to a high noise level (determined through sampling). What is the most **expedient method** that should be taken to protect the machine operator?

- 1) Stop the operation
2) Equip the operator with personal protective equipment
3) Engineer control measures
4) Limit the operator's time of exposure

Answer:2- For expedience and until such time as engineering or administrative controls can be implemented, personal protective equipment must be provided and used to reduce the noise to an acceptable level.

Question #: 1266- The average person contains about 0.1 microcuries of K-40 (half life = 1.27×10^6 years). How many dps is this?

- 1) 3.7×10^4 dps **2) 3.7×10^3 dps** 3) 4.6×10^6 dps 4) 2.6×10^3 dps

Answer:2- By definition 1 microcurie = 3.7×10^4 dps; therefore, 0.1 microcurie = 3.7×10^3 dps

Question #: 1267- What material should be used to provide shielding against gamma rays?

- 1) Aluminum sheet 2) Paper 3) Pyrex **4) Lead**

Answer:4- Gamma rays must be shielded by dense materials such as lead. The thicker and denser the material the better.

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Question #: 1268- A gamma radiation source reads 500 milliroentgens/hr at a distance of 1 m. How far away must a worker be so that the level does not exceed 25 milliroentgens/hr?

- 1) 3.25 m **2) 4.47 m** 3) 5.42 m 4) 6.23 m

Answer:2- $I_2 = (I_1 D_1^2) / D_2^2$

I = Intensity and D = Distance

$$25 \text{ mRoent/hr} = [500 \text{ mRoent/hr} (1 \text{ m})^2] / D_2^2$$

$$25 \text{ mRoent/hr} * D_2^2 = 500 \text{ m}^2\text{-mRoent/hr}$$

$$D = 4.47 \text{ m}$$

Question #: 1269- Bone marrow and the eyes are very sensitive to radiation. Damage to the body may be permanent. What other tissue or organ is most sensitive to radiation?

- 1) Skin 2) Hair **3) Blood** 4) Reproductive organs

Answer:3- White blood cells are the most sensitive to radiation, which reduces their number, leaving the body open to infection. Skin is easily damaged; however, the skin has great recuperative powers. Radiation will lead to loss of hair. This effect is generally temporary after exposure stops; however, the new hair may be of a new color or have other characteristics different from the original. To produce sterility in a person would require almost a fatal dose. Genetic effects produced by radiation to reproductive cells can only be surmised, and would not be known for several generations after exposure.

Question #: 1270- Which type of ionizing radiation is penetrating; whole-body exposure?

- 1) Alpha 2) Beta **3) Gamma** 4) Microwave

Answer:3- Gamma - Penetrating; whole-body exposure , Beta - Primarily skin exposure
Alpha - Will not penetrate dead cells on surface of skin, Microwave - Ionizing radiation

Question #: 1271- Which type of ionizing radiation is primarily a skin penetrating exposure hazard?

- 1) Alpha **2) Beta** 3) Gamma 4) Infrared

Answer:2- Beta - Primarily skin exposure , Gamma - Penetrating; whole-body exposure
Alpha - Will not penetrate dead cells on surface of skin, Infrared - Non-ionizing radiation

Question #: 1272- Which type of ionizing radiation will not penetrate the dead skin cells on the surface of the skin?

- 1) Alpha** 2) Beta 3) Gamma 4) Ultraviolet

Answer:1- Alpha - Will not penetrate dead cells on surface of skin , Beta - Primarily skin exposure , Gamma - Penetrating, whole-body exposure, Ultraviolet - Non-ionizing radiation

Question #: 1273- Alpha emitters are:

- 1) Noted for long half lives 2) External hazards **3) Internal hazards** 4) Non-hazardous

Answer:3- Alpha emitters are internal hazards.

Question #: 1274- What is a beta particle?

- 1) Helium nucleus component with a double charge **2) High-speed electron**
3) X-rays from a nucleus 4) Unknown radiation component in a calibration

Answer:2- A beta particle is usually a high speed electron created in isobaric decay. If the high speed electron is positively charged the particle is a positron.

Question #: 1275- Electric fields of a high voltage may accelerate electrons to a high enough speed whereby they can escape their orbitals and induce X-rays. What is the magnitude of this high voltage?

- 1) Greater than 10 kV** 2) Greater than 5 kV 3) Greater than 2 kV 4) Greater than 1 kV

Answer:1- Electric fields of greater than 10 kV can cause ionizing radiation to be generated.

Question #: 1276- What is the maximal whole body lifetime dose of ionizing radiation to a 50 year old U.S. worker allowable under current OSHA and NRC guidelines?

- 1) 5 rem 2) 10 rem 3) 100 rem **4) 160 rem**

Answer:4- Utilizing the total dose accumulation equation:

Total Dose Accumulation = 5 (N-18) rem; where N = age = 5 (50-18) = 5 * 32 = 160 rem
29 CFR 1910.1096 (b)(2)(ii)

Question #: 1277- A liquid with a pH of 1 is:

- 1) Basic **2) Acidic** 3) Neutral 4) Alkaline

Answer:2- A liquid with a pH of 1 is highly acidic. Basic and alkaline are synonyms of a liquid with a pH greater than 7. A liquid with a pH of 7 is neutral.

Question #: 1278- A chemical compound capable of forming multiple chemical bonds to a metal ion is called a:

- 1) Chelating agent** 2) Reactive agent 3) Catalyst 4) Reactive ion

Answer:1- A chelating agent is a chemical compound capable of forming multiple chemical bonds to a metal ion.

Question #: 1279- A substance that affects the change in hydrogen ion concentration (pH) otherwise produced by adding acids or bases to a solution is called a:

- 1) Buffer** 2) Bonding agent 3) Catalyst 4) Chloracne agent

Answer:1- A buffer is a substance that reduces the change in hydrogen ion concentration (pH) otherwise produced by adding acids or bases to a solution.

CSP Questions and Answers- Part-II

Question #: 1280- Which one of the following correctly balances the following reaction: $\text{NaOH} + \text{H}_2\text{SO}_4$?

- 1) $\text{Na}_2\text{SO}_5 + \text{H}_2\text{O}$ 2) $\text{SO}_5\text{H}_2\text{O} + \text{Na}_2$ 3) $\text{Na}_2\text{SO}_3 + \text{H}_2\text{O}_2$ **4) $\text{Na}_2\text{SO}_4 + 2 (\text{H}_2\text{O})$**

Answer:4- This is an example of an acid base neutralization reaction. The resulting salt from this reaction is sodium sulfate. To properly balance the full reaction equation, two sodium hydroxide molecules react with one sulfuric acid molecule to yield Answer 4.

Question #: 1281- All the following are true about ketones EXCEPT:

- 1) Ketones have one or more carbonyl groups ($\text{C}=\text{O}$)
2) Methanol, a small chain ketone, can cause blindness
3) Long term exposure to ketones can adversely affect the brain and nervous system
4) Ketones are commonly used as solvents

Answer:2- Methanol is not a ketone; it is an alcohol.

Question #: 1282- Which one of the following equations is NOT balanced?

- 1) $2 (\text{Mg}) + \text{O}_2 \rightarrow 2 (\text{MgO})$ 2) $4 (\text{Fe}) + 3 (\text{O}_2) \rightarrow 2 (\text{Fe}_2\text{O}_3)$
3) $\text{H}_2\text{O} + \text{N}_2\text{O}_3 \rightarrow 2 (\text{HNO}_2)$ **4) $2 (\text{Na}_2\text{O}) + \text{H}_2\text{O} \rightarrow 2 (\text{NaOH})$**

Answer:4- Only one molecule of Na_2O reacts with one molecule of water to produce 2 molecules of NaOH .

Question #: 1283- 25 grams of H_2O is equivalent to how many moles of H_2O ?

- 1) 0.72 mol 2) 1.00 mol **3) 1.39 mol** 4) 25.0 mol

Answer:3- A mole is the equivalent of one gram-molecular weight. Since the molecular weight of water is 18 g/mol, 25 grams is equivalent to $25 \text{ g} / (18 \text{ g/mol}) = 1.39 \text{ mol}$

Question #: 1284- What volume will 38 g of oxygen occupy at 1 atm and 20°C ?

- 1) 22.4 liters **2) 28.5 liters** 3) 29.3 liters 4) 32.6 liters

Answer:2- $PV = nRT$

$R = 0.08205 \text{ l-atm/mol-K}$ because we are interested in liters with pressure in atm and temperature in K. Remember to use absolute temperatures. The gram-molecular weight of oxygen (O_2) is 32 g/mol. $V = nRT / P = [(38 \text{ g}/32 \text{ g/mol})0.08205 \text{ l-atm/mol-K} * 293^\circ \text{ K}] / 1 \text{ atm} = 28.5 \text{ liters}$

Question #: 1285- What volume does 1 mole of ANY gas occupy at 1 atm and 0°C ?

- 1) 22.4 liters** 2) 1 liter 3) 24.45 liters 4) 1 ft³

Answer:1- $PV = nRT$ $V = nRT / P = (1 \text{ mol} * 0.08205 \text{ l-atm/mol-K} * 273^\circ \text{ K}) = 22.4 \text{ liters}$

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Question #: 1286- A closed 500 l cylinder holds a gas at 200 psi(a) at 20°C. If the cylinder is involved in a fire and increases in temperature to 260°C, what is the gas pressure in the cylinder assuming an ideal gas?

- 1) 213 psi **2) 364 psi** 3) 465 psi 4) 2,600 psi

Answer:2- $(P_1 V_1) / T_1 = (P_2 V_2) / T_2$ Remember to use absolute temperatures.
 $(200 \text{ psi} * 500 \text{ l}) / 293^\circ\text{K} = (P_2 * 500 \text{ l}) / 533^\circ\text{K}$ $P_2 = 364 \text{ psi}$

Question #: 1287- One atmosphere is equivalent to how many pounds per square inch pressure?

- 1) 1 psi **2) 14.7 psi** 3) 29.92 psi 4) 760 psi

Answer:2- One atmosphere is equivalent to 14.7 pounds per square inch pressure.

Question #: 1288- What is the partial pressure of a vapor with an airborne concentration of 150 ppm (assume barometric pressure of 1 atmosphere)?

- 1) $150 \times 10^{-4} \text{ atm}$ **2) $1.5 \times 10^{-4} \text{ atm}$** 3) $0.15 \times 10^{-4} \text{ atm}$ 4) $1.5 \times 10^{-3} \text{ atm}$

Answer:2- Use the formula to calculate the concentration of a vapor and solve for the partial pressure.
 $C = (P_v \times 10^6) / P_b$ $150\text{ppm} = (P_v \times 10^6) / 1 \text{ atm}$ $P_v = 1.5 \times 10^{-4} \text{ atm}$

Question #: 1289- Convert a partial pressure of $1.5 \times 10^{-4} \text{ atm}$ to mm Hg.

- 1) $4.5 \times 10^{-3} \text{ mm Hg}$ 2) 0.114 mm Hg 3) $5.1 \times 10^{-3} \text{ mm Hg}$ 4) $0.45 \times 10^{-3} \text{ mm Hg}$

Answer:2- $1 \text{ atm} = 760 \text{ mm Hg}$ $\text{mm Hg} = 1.5 \times 10^{-4} \text{ atm} (760 \text{ mm Hg} / 1 \text{ atm}) = 0.114 \text{ mm Hg}$

Question #: 1290- The most prevalent all-around solvent is:

- 1) Alcohol 2) Aliphatic hydrocarbons 3) Halogenated hydrocarbons **4) Water**

Answer:4- Water is the most prevalent all-around solvent. It is nontoxic, nonflammable, and with proper additives, forms a solvent system that works well even with many organic materials.

Question #: 1291- A fiber is defined as having an aspect ratio (length to diameter) greater than:

- 1) 5 to 1 2) 2 to 1 **3) 3 to 1** 4) 10 to 1

Answer:3- Fibers are particles which have a length that is at least three times its width.

Question #: 1292- Gas chromatography (GC) is an excellent separation technique for many organic compounds found in the industrial environment. Which of the following is often performed after GC to identify the compound?

- 1) Infrared spectrophotometry **2) Mass spectrometry (MS)**
3) High performance liquid chromatography (HPLC) 4) Atomic absorption

Answer:2- GC/MS is commonly performed to separate and identify the compound of interest. GC separates a mixture based on differences in boiling point and solubility. Differences in these properties produce differences in retention times in the GC column separating the mixture. MS fractures and ionizes each compound into a recognizable pattern.

Question #: 1293 - The conversion of ammoniacal nitrogen to nitrate ion through the aeration of activated sludge is called:

- 1) Nitrogen fixation **2) Nitrification** 3) Nitrate reduction 4) Denitrification

Answer:2- In the sewage treatment process, nitrification converts ammoniacal nitrogen to nitrate ion during the aeration of waste water.

Question #: 1294- Two nuclei of the same element that have the same charge but different masses are called:

- 1) Neutrons 2) Reactions 3) Protons **4) Isotopes**

Answer:4- Isotopes of the same element have the same charge but different nuclear masses.

Question #: 1295- Normally formless fluids that occupy the space of enclosure and which can be changed to the liquid or solid state by increased pressure and decreased temperature are called:

- 1) Smoke 2) Mists **3) Gases** 4) Vapors

Answer:3 - Gases are normally formless fluids that occupy the space of enclosure and can be changed to the liquid or solid state by increased pressure and decreased temperature.

Question #: 1296- Emission of light during a noncombustible chemical reaction is called:

- 1) Leomens 2) Reactive luminescence 3) Illuminescence **4) Chemiluminescence**

Answer:4- Chemiluminescence is the emission of light during a noncombustible chemical reaction.

Question #: 1297- What is the atomic weight printed on periodic tables?

- 1) Number of protons 2) Number of neutrons 3) Number of protons and neutrons
4) Average mass value of naturally occurring elements

Answer:4- The total number of protons and neutrons is an element's mass number. The atomic weight is used in chemistry and involves the average of the nuclear masses of the element's isotopes found in nature.

Question #: 1298 - The periodic table lists:

- 1) All elements 2) All nuclides 3) All radionuclides 4) All naturally occurring elements

Answer:1- The periodic table is a list of elements (by atomic number) and electron structure. It also lists man-made elements.

Question #: 1299- What is an isotope of an element?

1) Matter which has the same number of protons but a different number of neutrons

2) Matter which has the same number of neutrons but a different number of protons

3) Matter with the same number of protons and neutrons as the given element

4) Matter with the same number of neutrons and electrons as the given element

Answer:1- Isotopes of an element have the same number of protons but a different number of neutrons. Radioisotopes are isotopes that are radioactive.

Question #: 1300- What is the chemical symbol for radon?

- 1) Ra 2) Rd 3) Ro 4) Rn

Answer:4- Radon is represented on the periodic table by the symbol "Rn". "Ra" denotes radium.

Question #: 1301- Which aliphatic hydrocarbon features double carbon bonds?

- 1) Alkanes 2) Alkenes 3) Alkynes 4) Paraffins

Answer:2- Alkenes (olefins) are unsaturated hydrocarbons with one or more double bonds. Alkanes are unsaturated hydrocarbons with only single carbon bonds. Alkynes are unsaturated hydrocarbons with one or more triple bonds.

Question #: 1302- The tendency of a liquid to vaporize at room temperature is its:

- 1) Rate of evaporation 2) Vapor pressure 3) Volatility 4) Flammable range

Answer:3- Volatility is the tendency or ability of a liquid to vaporize. Ethanol and gasoline are examples of volatile liquids because of their tendency to evaporate rapidly.

Question #: 1303- A chemical with a molecular weight of 88 evaporates from a chemical process. Where would it most likely accumulate?

- 1) Floor 2) Ceiling 3) Neither; it will mix uniformly 4) Insufficient information

Answer:1- For gases, density is proportional to molecular weight. Air has an approximate molecular weight of 29. Therefore the gas should sink.

Question #: 1304- The reaction of oxygen and organic compounds yielding sudden and rapid combustion is known as a:

- 1) Detonation 2) Deflagration **3) Hypergolic reaction** 4) Misanthropic reaction

Answer:3- A hypergolic reaction is a violent reaction occurring when a fuel and oxidizer are mixed. The mixing of liquid hydrogen and liquid oxygen is also an example of this reaction.

Question #: 1305 - If the velocity of a reaction through the reacting material reaches sonic or supersonic speed, the reaction is called a:

- 1) Low order explosion 2) Low explosive 3) Deflagration **4) Detonation**

Answer:4- The explosion that results when the velocity of reaction through the reacting material reaches sonic or supersonic speed is called a detonation.

Question #: 1306 - A sudden and violent release of large amounts of gas is called a(n):

- 1) Detonation 2) Hazardous reaction 3) Deflagration **4) Explosion**

Answer:4- An explosion is the sudden and violent release of large amounts of gas.

Question #: 1307- Which hydrocarbon has the lowest auto-ignition temperature?

- 1) Methane 2) Butane 3) Ethane **4) Decane**

Answer:4- Decane is the hydrocarbon with the lowest auto-ignition temperature.

Question #: 1308- Flammable limits and range is defined as:

- 1) The range in which flammable liquids cannot ignite 2) The range in which flammable liquids can auto-ignite 3) The range in which liquids form flammable mixtures with maximum concentrations of vapor in air or oxygen

4) The range in which gases or vapors form flammable mixtures with air or oxygen

Answer:4- Flammable limits and range is defined as the range in which gases or vapors form flammable mixtures with air or oxygen. There is a minimum concentration of vapor in air or oxygen below which propagation of flame does not occur on contact with a source of ignition.

Question #: 1309- The vapor-air density is defined as:

1) The weight of a vapor-air mixture resulting from the vaporization of a flammable liquid at equilibrium temperature and pressure conditions as compared with the weight of an equal volume of air under the same conditions

2) The weight of a volume of a pure gas compared to the weight of an equal volume of dry air at the same temperature and pressure

3) The density of a solid or liquid substance is the ratio of the weight of the substance to the weight of the same volume of another substance

4) A hazard which exists wherever material that will burn or oxidize readily is available

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Answer:1- The vapor-air density is defined as the weight of a vapor-air mixture resulting from the vaporization of a flammable liquid at equilibrium temperature and pressure conditions as compared with the weight of an equal volume of air under the same conditions.

Question #: 1310- The latent heat of vaporization of water is:

- 1) 1,200 Btu/lb **2) 970 Btu/lb** 3) 560 Btu/gal 4) 600 Btu/gal

Answer:2- 970 Btu/lb is the latent heat of vaporization of water. It takes a relatively large amount of heat to vaporize water.

Question #: 1311- A chemical breakdown due to heat is known as a:

- 1) Chain reaction 2) Decomposition reaction **3) Pyrolysis reaction** 4) Pyrotechnic reaction

Answer:3- Pyrolysis is the breakdown of materials due to heat.

Question #: 1312- Methane (CH₄) is composed of carbon (atomic weight of 12.011 g/mol) and hydrogen (atomic weight of 1.008 g/mol).What is the molecular weight of methane?

- 1) 4.032 g/mol 2) 12.011 g/mol 3) 13.019 g/mol **4) 16.043 g/mol**

Answer:4- One carbon atom (12.011 g/mol * 1) + four hydrogen atoms (1.008 g/mol * 4) = a molecular weight of 16.043 g/mol.

Question #: 1313- Methane (CH₄) is composed of carbon (atomic weight of 12.011 g/mol) and hydrogen (atomic weight of 1.008 g/mol).What is the specific gravity of methane?

- 1) 0.41 2) 0.45 3) 0.55 4) 16.04

Answer:3- Molecular weight of methane is:

$$MW = (1 * 12.011 \text{ g/mol}) + (4 * 1.008 \text{ g/mol}) = 16.043 \text{ g/mol}$$

$$SG = MW \text{ of substance} / MW \text{ of air} = (16.043 \text{ g/mol}) / (29 \text{ g/mol}) = 0.5532$$

(A molecular weight of 29 is used for air. This is the weighted average of the gaseous components of air.)

Question #: 1314- Methane (CH₄) is composed of carbon (atomic weight of 12.011 g/mol) and hydrogen (atomic weight of 1.008 g/mol).What is a primary concern, from a fire safety viewpoint, in large spills of liquid methane?

- 1) The gas has a specific gravity of less than 1.0 which will cause it to rise rapidly **2) The gas will spread over a wide area with little dilution** 3) The gas has no odor 4) The gas will dilute quickly to reach its explosive concentration

Answer:2- Even though the specific gravity is less than one, when spilled in large quantities, the gas is cryogenic (cold) making it heavier than air. As the gas warms, it will spread over a wide area with little dilution.

Question #: 1315- The pressure at which a vapor is at equilibrium is called the:

- 1) Specific gravity 2) Molecular weight 3) Boiling point **4) Vapor pressure**

Answer:4- Vapor pressure is the pressure at which molecules escaping from a liquid are equal to the number of molecules returning to the liquid from the vapor.

Question #: 1316- Find the vapor-specific gravity at 100°F and atmospheric pressure for a flammable liquid which has a specific gravity of 2.3, and has a vapor pressure at 100°F of 3.0 in Hg.

- 1) 1.1** 2) 1.3 3) 1.5 4) 3.0

Answer:1- $V_{\text{asg}} = (p_s)/P + (P - p)/P$ Where: p = vapor pressure of the liquid, s = specific gravity of the liquid, P = the pressure of one atmosphere in the same units as " p " 1 atm = 29.92 in Hg
 $V_{\text{asg}} = [(3.0 \text{ in Hg} \times 2.3) / 29.92 \text{ in Hg}] + [(29.92 \text{ in Hg} - 3.0 \text{ in Hg}) / 29.92 \text{ in Hg}] = 0.2306 + 0.8997 = 1.1303$

Question #: 1317- How many kilowatts are required to raise 1 lb of water 1°F in 1 sec?

- 1) 1,054 kW 2) 105.4 kW 3) 10.54 kW 4) 1.054 kW

Answer:4- 1 Btu is the heat required to raise 1 lb of water 1°F.
1 Btu = 2.930×10^{-4} kW-hr There are 3,600 seconds in an hour.
 $(2.930 \times 10^{-4} \text{ kW-hr})(3,600 \text{ sec/hr}) = 1.054 \text{ kW}$

Question #: 1318- An explosion of hydrogen in a battery recharging area is an example of a propagating reaction. Such a reaction is always:

- 1) Slow to grow 2) Endothermic **3) Exothermic** 4) Spontaneous

Answer:3- Propagating reactions always require a source of ignition and are therefore exothermic.

Question #: 1319- The term combustion usually refers to an exothermic, or heat producing, chemical reaction of a substance and:

- 1) Hydrogen **2) Oxygen**
3) A substance with a similar molecular weight 4) An inert substance

Answer:2- Oxygen is required to support conventional combustion.

Question #: 1320- Water reactive materials are:

1) Materials that are chemically reactive with water

- 2) Materials that are chemically reactive with water while being heated
3) Materials that are chemically reactive with water under pressure
4) Materials that are chemically reactive with water while being heated under pressure

Answer:1- Water reactivity describes the sensitivity of materials to water without requiring heat or confinement.

Question #: 1321- One of the laws governing ideal gas behavior that industrial hygienists must account for when conducting air sampling is Charles' Law. This law describes the relationship of:

- 1) Volume with pressure and temperature 2) Pressure with noise level and temperature
3) Temperature with pressure and enthalpy **4) Volume with absolute temperature**

Answer:4- Charles' Law states that the volume of a gas sample varies directly with absolute temperature (e.g., temperature in Kelvin or Rankine). To determine the volume of an ideal gas at a new temperature, use Charles' Law.

$$\text{New Volume (V2)} = \text{Starting Volume (V1)}(T2/T1) \quad V2 = V1 (T2/T1)$$

Question #: 1322- Within normal limits of use, if a 10 lb object stretches a coil spring 1.5 in., a 20 lb object will stretch the spring:

- 1) $1.5 * 3$ **2) $1.5 * 2$** 3) $1.5 * 1.5$ 4) $1.5 (1.5)^2$

Answer:2- According to Hooke's Law, the amount of deformation experienced by a body under stress is proportional to the distorting force. Since the distorting force is doubled, the distortion is also doubled.

Question #: 1323- Disregarding the coefficients of friction, what is the expression for the work needed to move weight W up an incline through a distance d when the height of the plane is h and the angle of incline is x?

- 1) $Wd \cos x$ **2) $Wd \sin x$** 3) $W \sin/d x$ 4) $Wh \cos x$

Answer:2- Forming a right triangle you will see that the work needed to move the weight W through distance d along the plane is equal to Wh. Also, $\sin x = h/d$ or $h = d \sin x$, hence, work needed is $= Wh = Wd \sin x$.

Question #: 1324- If the speed of an object is doubled, its kinetic energy is:

- 1) Halved 2) Doubled **3) Quadrupled** 4) Increased by a factor of 8

Answer:3-Kinetic energy $= 1/2 mv^2$. From the formula, the kinetic energy of an object is proportional to the square of its speed. When the speed is multiplied by 2, the kinetic energy is multiplied by 2^2 , or quadrupled.

Question #: 1325- Decontamination procedures include all of the following EXCEPT:

- 1) Incineration** 2) Chemical removal 3) Physical removal 4) Combination removal

Answer:1- Incineration is a form of disposal, not decontamination.

Question #: 1326- The decontamination stations should be set up in:

- 1) The hot zone
- 2) The warm zone**
- 3) The cold zone
- 4) Between the warm zone and the hot zone

Answer:2- Decontamination stations should be set up in the warm zone, which is the area between the contaminated area (hot zone) and the cold zone, where contamination should not occur. The decontamination line is the last point where decontamination will occur, at the entrance to the cold zone from the warm zone.

Question #: 1327- In responding to a spill of hazardous materials, which of the following is NOT a good source of information for prompt hazard recognition?

- 1) MSDS
- 2) Hazardous waste manifest**
- 3) Manufacturer label
- 4) Symbolic labels

Answer:2- The hazardous waste manifest does not contain hazard information.

Question #: 1328- If the identity of the material in a pipe were unknown, one could determine the hazard of the pipe material by referring to all of the following EXCEPT:

- 1) MSDS**
- 2) Process diagrams
- 3) Standard operating procedures
- 4) Other employees familiar with the processes

Answer:1- The MSDS can only be used if the identity is already known.

Question #: 1329- The skill of prompt hazard recognition is so important because:

- 1) It allows quick spill clean-up
- 2) The responders can protect themselves and others**
- 3) It allows plant management to understand the situation
- 4) Communication with the media is most efficient

Answer:2- The first concern is the health and safety of the responder.

Question #: 1330- Under what circumstances would you want to designate a decontamination team for a spill response?

- 1) Only with spills greater than 55 gallons
- 2) Only with spills greater than 25 gallons
- 3) In practically every spill situation**
- 4) Only in catastrophic spills greater than 1,000 gallons

Answer:3- In very simple defensive measures, decontamination may not be necessary, but typically at least one person should be assigned this responsibility for spill response situations.

Question #: 1331- Occupational Health and Safety Management Systems standard 18001 is a produced by:

- 1) ANSI 2) ISO 3) ASSE **4) BSI**

Answer:4- Occupational Health and Safety Management Systems standard 18001 is a produced by BSI. The British Standards Institute led the development of 18001 as a health and safety management system standard that is compatible with ISO 9001 and ISO 14001.
BS OHSAS 18001:2007

Question #: 1332- The British Standards Institute (BSI) developed and published the Occupational Health and Safety Management Systems standard 18001 because:

1) Of 'customer' requests for a management standard that addresses occupational health and safety

- 2) Of 'customer' concerns that the ISO management system standards were inadequate
3) BSI is responsible for assuring that United Kingdom has business standards necessary for global competition
4) ANSI/AIHA had developed an American standard (ANSI/AIHA Z10)

Answer:1-The British Standards Institute (BSI) developed and published the Occupational Health and Safety Management Systems standard 18001 because of 'customer' requests for a management standard that addresses occupational health and safety. BSI has stated its intention to withdraw the standard if an Internal Standard is published covering the subject matter. Occupational Health and Safety Management Systems standard 18001 is produced by BSI. The British Standards Institute led the development of 18001 as a health and safety management system standard that is compatible with ISO 9001 and ISO 14001.
BS OHSAS 18001:2007

Question #: 1333- The British Standards Institute (BSI) developed and published the Occupational Health and Safety Management Systems standard 18001 to provide for:

1) Organizations to fill a gap, thus providing additional revenue streams to BSI, through the sales of the standard. This will be successful until ISO publishes a similar standard.

2) A structure for an organization to incorporate occupational safety and health into the organizational management process. The standard is designed to work in conjunction with ISO 14001 and ISO 9001.

3) An organizational structure to incorporate occupational safety and health into the organizational management process. The standard was necessary because occupational safety and health program needs are not compatible with ISO 14001 and ISO 9001.

4) A management structure for an organization to accomplish occupational safety and health, providing an independent verification of organizational safety programs that is not negatively influenced by the quality management system objectives.

Answer:2- The British Standards Institute (BSI) developed and published the Occupational Health and Safety Management Systems standard 18001 to provide for a structure for an

organization to incorporate occupational safety and health into the organizational management process. The standard is designed to work in conjunction with ISO 14001 and ISO 9001. BS OHSAS 18001:2007

Question #: 1334- The Occupational Health and Safety Management Systems standard 18001 concept is based on the recognized quality concept of:

- 1) Verification and validation 2) Process documentation **3) Plan, do, check, act** 4) Six sigma

Answer:3- The Occupational Health and Safety Management Systems standard 18001 concept is based on the recognized quality concept of plan, do, check, act. BS OHSAS 18001:2007

Question #: 1335- The planning process of the Occupational Health and Safety Management Systems standard 18001 requires that:

- 1) An organization or company completes a planning activity on a recurring basis with the organization or company's board of directors
2) An organization assures daily planning of work activities to assure safe practices are reviewed and implemented
3) An organization or company to establish processes, implement and monitor all procedures and processes and take corrective action when problems occur
4) An organization establishes objectives and processes supporting the organizations' occupational health and safety policy

Answer:4- The planning process of the Occupational Health and Safety Management Systems standard 18001 requires that an organization establishes objectives and processes supporting the organizations' occupational health and safety policy. BS OHSAS 18001:2007

Question #: 1336- The Occupational Health and Safety Management Systems standard 18001 is a management system standard that is directed at reducing risk through a process of continual improvement. The standard is not a regulation or law. As such:

1) Compliance with OH&S legal requirements is only a piece of an OH&S management system conforming to the Occupational Health and Safety Management Systems standard 18001

2) Compliance with OH&S legal requirements is only the key factor of an OH&S management system conforming to the Occupational Health and Safety Management Systems standard 18001

3) Compliance with OH&S legal requirements is irrelevant to an OH&S management system conforming to the Occupational Health and Safety Management Systems standard 18001

4) Compliance with OH&S legal requirements is generally part of, but not required for an OH&S management system conforming to the Occupational Health and Safety Management Systems standard 18001

Answer:1- The Occupational Health and Safety Management Systems standard 18001 is a management system standard that is directed at reducing risk through a process of continual improvement. The standard is not a regulation or law. As such, compliance with OH&S legal requirements is only a piece of an OH&S management system conforming to the Occupational Health and Safety Management Systems standard 18001. Section 4.3.2, of the standard requires that legal and other requirements be continually identified and taken into account when establishing processes, procedures and running an OH&S management system.

BS OHSAS 18001:2007

Question #: 1337- The ANSI/ASSE Z490.1 standard:

- 1) Provides the additional depth necessary to integrate the ANSI/AIHA Z10-2005, American National Standard for Occupational Health and Safety Management Systems into quality and environmental management systems
- 2) Is a standard that covers the areas of accomplishing training, including design, development, delivery and evaluation of training.**
- 3) Is the American Society of Safety Engineers' alternative to the American Industrial Hygiene Association's standard on safety management systems
- 4) Provides a basis for training that assures compliance with laws and regulations

Answer:2- The ANSI/ASSE Z490.1 standard is a standard that covers the areas of accomplishing training including design, development, delivery and evaluation of training. ANSI/ASSE Z490.1-2001

Question #: 1338- ASSE is the:

- 1) Association of System Safety Engineers
- 2) Association for Safe and Secure Environments
- 3) American Society of Safety Engineers**
- 4) American Safety and Security Engineers

Answer:3- ASSE is the American Society of Safety Engineers. ASSE is an organization serving its members and the public by providing information and action on occupational safety, health and environmental issues and practices. ASSE membership is made up of professionals that work to prevent workplace injuries and illnesses, to create safer work and leisure environments and to develop safer products to enhancing the quality of life.

Question #: 1339- The ANSI/ASSE Z490.1, American National Standard, Criteria for Accepted Practices in Safety, Health and Environmental Training should be applied to:

- 1) Organizational safety, health and environmental management organizations
- 2) Any training that has the potential to create a hazardous environmental for the students
- 3) Organizational safety, health and environmental training plans to assure compliance with laws and regulations
- 4) Safety, health and environmental training providers**

Answer:4- The ANSI/ASSE Z490.1, American National Standard, Criteria for Accepted Practices in Safety, Health and Environmental Training should be applied to safety, health and environmental training providers. As with all ANSI standards, Z490.1 is voluntary and does not guarantee regulatory compliance. ANSI/ASSE Z490.1-2001

Question #: 1340- The International Organization for Standardization is:

- 1) A worldwide federation of national standards bodies**
- 2) An organization created by the European Union to advance the business needs of the EU
- 3) A federation of international government appointed representatives that develop consensus standards for application on a worldwide basis
- 4) A federation of government representatives that develop unilateral agreements for the application of business practices across international borders

Answer:1- The International Organization for Standardization is a worldwide federation of national standards bodies. ISO WWW1

Question #: 1341- ISO 19011:2002, Guidelines for quality and/or environmental management systems auditing is designed for:

1) Use by organizations wanting to get independent certification of its management system. ISO 19011 is a requirement for quality management systems under ISO 9001 and recommended for environmental management systems under ISO 14001.

2) Use as guidance for audit programs whether those programs are for internal or external audits

3) Use as guidance for audits conducted by third party certification organizations to assure valid management system certification

4) Use by regulators, providing a guide to the application of management system audits to compliance inspections

Answer:2- ISO 19011:2002, Guidelines for quality and/or environmental management systems auditing is designed for use as guidance for audit programs whether those programs are for internal or external audits. ISO 19011:2002

Question #: 1342- The ISO 19011:2002, Guidelines for quality and/or environmental management systems auditing provides:

1) Guidelines that are statutory in nature and are not necessarily applicable in all circumstances
2) Guidelines that, when adopted, need to be applied as specifically designated in order to claim conformance with the standard

3) Guidelines that should be used differently based on the nature, size and complexity of an organization that is being audited

4) Guidelines to be applied when conducting combined quality and environmental management system audits

Answer:3- The ISO 19011:2002, Guidelines for quality and/or environmental management systems auditing provides guidelines that should be used differently based on the nature, size and complexity of an organization that is being audited. The guidelines may be applied to quality management system audits, environmental management system audits or combined management system audits. There is no specific requirement for the guidelines to be implemented in order to have a conforming management system. ISO 19011:2002

Question #: 1343- ANSI/ISO/ASQ QE 19011S-2004, American National Standard, Guidelines for quality and/or environmental management systems auditing was developed by the ASQ to:

1) Provide for the special needs of the U.S. business community in maximizing U.S. international competition

2) Assure U.S. business competitiveness with the European Union

3) Provide U.S. corporations with an auditing program that would accomplish regulatory compliance requirements, as well as management system audits

4) Provide additional guidance to the International Standard for application to the full range of audit activities

Answer:4- ANSI/ISO/ASQ QE 19011S-2004, American National Standard, Guidelines for quality and/or environmental management systems auditing was developed by the ASQ to

provide additional guidance to the International Standard for application to the full range of audit activities. ANSI/ISO/ASQ QE 19011S-2004

Question #: 1344- Which of the following is not an indicator of the variability of observations in an experiment?

- 1) **Mean** 2) Standard deviation 3) Range 4) Upper and lower confidence limits

Answer:1- The mean is the arithmetic average of the observations; it tells you nothing of the spread of the data. The standard deviation is a measure of how the data points differ from the average. The range is the high and low limits of the observations, and the confidence interval incorporates a probability as well as a measure of variability.

Question #: 1345- Quality control has been labeled as the science and art of identifying and controlling variability. One measure of variability as used in this context is:

- 1) The arithmetic mean 2) The size of a lot 3) The mode 4) **The variance**

Answer:4- The variance is a measure of the average squared difference between the mean and the individual items in either a sample or a population. Squaring these distances gives weight to the variation in distance from the mean and eliminates the negative sign.

Question #: 1346- Which of the following measures of variability is **not dependent on** the exact value of every measurement?

- 1) Mean deviation 2) Variance 3) **Range** 4) Standard deviation

Answer:3- The range is the difference between the largest and smallest value in a group of data. It ignores the data between these values.

Question #: 1347- A major objective of safety analysis programs is to:

- 1) Determine cause from past accidents 2) **Determine foreseeable accidents**
3) Determine fault 4) Analyze all accidents including non-injury accidents

Answer:2- Safety analysis programs have as their chief objective, the determination of possible accidents from systems. They do not rely on past accidents to determine cause. Analyses do not determine fault. Analyses are performed on systems, not past accidents or incidents.

Question #: 1348- When designing a safety program for an organization, it is necessary to consider the psychological factors that influence success, such as motivation, emotion, individual differences, and attitudes.

- 1) **True** 2) False 3) Not enough information
4) Safety programs are not designed for organizations

Answer:1- To work effectively with people, it is necessary to understand them. Much of the success of a safety program depends upon its acceptance by those to whom it is directed. Conversely, program acceptance is dependent upon an understanding of psychological factors which influence program success. These have been identified as being: individual differences, motivation, emotion, attitudes, and learning processes.

Question #: 1349- One of the primary reasons for the loss of buildings to fire has been an inadequate chain of events for notifying the fire department. Which element of the chain is often at fault in this chain?

- 1) Detecting the fire
- 2) Deciding to inform the fire department
- 3) Sending the message
- 4) The correct receipt of the message by the fire department

Answer:3- Buildings have been lost because of insufficient attention to the method of notifying the fire department.

Question #: 1350- A manufacturing process can be laid out according to the product being produced or according to the process that is used to make several products. An advantage of process layout vs. product layout is:

- 1) Accounting costs are easier to track
- 2) Material handling costs are lower
- 3) Hazardous processes can be isolated
- 4) Product production scheduling is easier

Answer:2- These costs are lower because there is less need to transport materials during the process.

Question #: 1351- A job safety analysis is a technique to:

- 1) Establish safety procedures for each job
- 2) Determine physical demands of each job
- 3) Identify hazards associated with each step of the job
- 4) Improve the workplace environment

Answer:3- A job safety analysis is a procedure to make the job safer by identifying the hazards or potential injuries/illnesses associated with each step of the job, in addition to developing a solution for each hazard that will eliminate or control the exposure.

Question #: 1352- Approximately ____% of the MALE population has some form of color blindness.

- 1) 1
- 2) 2
- 3) 4
- 4) 8

Answer:4- About 8% of men and 1% of women are color deficient. Color deficiency is a difficulty distinguishing color hue, especially under dim light. Color blindness is the inability to discriminate between certain colors, usually red, green, and gray. Very few people (about 3 in 100,000) are actually totally color blind (see everything as one color in different intensities).

Question #: 1353- Common carriers (e.g., airlines, bus companies, and railroads) must exercise a high degree of care (care that a very prudent and cautious person would undertake for the safety of others). This principle is called:

- 1) Slight care
- 2) Reasonable care
- 3) Care and great care
- 4) Exercise of due care

Answer:3- Care and great care is the principle behind a high degree of care: that a very prudent and cautious person would undertake for the safety of others. Common carriers must exercise a high degree of care.

Question #: 1354- A master is liable for any negligence of his servant acting within the scope of employment. This concept is called:

- 1) Master negligence
- 2) Strict liability
- 3) **Master-servant relationship**
- 4) Master-employee liability

Answer:3- Master-servant relationship is the concept that a master is liable for any negligence of his servant acting within the scope of employment.

Question #: 1355- Historically, under common law, an employer is obligated to provide employees with all BUT:

- 1) A safe place to work
- 2) Safe tools to work with
- 3) **Semi-competent supervisors**
- 4) Knowledge of any hazards

Answer:3- Under common law an employer has been obligated to provide employees with competent (not semi-competent) supervisors.

Question #: 1356- Under the doctrine of comparative negligence:

- 1) Damage is based on the party that was most at fault
- 2) Damage is awarded to the party that was least at fault
- 3) Damage is awarded only if a party is not at fault
- 4) **Damage is apportioned according to the degree of fault of the various parties**

Answer:4- Damages are awarded and apportioned to the degree of fault of each party in the law suit.

Question #: 1357- Failure to exercise a degree of care that an ordinarily careful and prudent person (reasonable man) would exercise is the definition of:

- 1) A tort
- 2) **Negligence**
- 3) Degree of care theory
- 4) Common law

Answer:2- This is the classic definition of negligence. There must be a legal duty to use care. A breach of that duty and injury or damage is negligence.

Question #: 1358- Manual materials handling injuries include all of the following EXCEPT:

- 1) Musculoskeletal disorders
- 2) **Carpal tunnel syndrome**
- 3) Crushing of hands and fingers
- 4) Dropping of objects on feet/toes

Answer:2- Carpal tunnel syndrome is a repetitive motion injury, not a materials handling injury. Materials handling injuries are from overexerting muscles, tendons, and ligaments, that result in musculoskeletal injuries or trauma from falling objects or being caught between objects.

CSP Questions and Answers- Part-II

Question #: 1359- With repeated exposure to noise of sufficient intensity, a permanent threshold shift (PTS) will gradually appear first at _____ Hz.

- 1) 200 Hz 2) 1,500 Hz 3) 2,000 Hz **4) 4,000 Hz**

Answer:4- As the number of years of noise exposure increases, the hearing loss between 3,000 Hz and 6,000 Hz becomes more pronounced.

Question #: 1360- A temporary depression of the hearing is called a:

- 1) Noise Induced Hearing Reduction (NIHR) **2) Temporary Threshold Shift (TTS)**
3) Permanent Threshold Shift (PTS) 4) Temporary Auditory Depression (TAD)

Answer:2- A temporary depression of the hearing is called a temporary threshold shift, or TTS.

Question #: 1361- Which of the following best describes the type of health hazard produced by noise?

- 1) Hearing changes correctable by surgery **2) Permanent damage to the hair cells of inner ear**
3) Reversible damage to the ear drum 4) Damage to the outer ear

Answer:2- Damage to the hair cells of the inner ear may occur. Bald spots may form and hearing is impaired at the frequencies corresponding to the location of the bald spot.

Question #: 1362- Administrative work practice controls for heat stress include acclimatization. This requires exposing the worker to the work environment for how long?

- 1) Two hours per day for 1 to 2 weeks** 2) Four hours per day for 1 week
3) One full week 4) Two full days

Answer:1- Experience has shown that workers do not tolerate a hot job very well initially, but develop tolerance rapidly, and full endurance by working in the heat for about two hours per day for a period of one to two weeks. A worker acclimatized to heat will have a lower heart rate, a lower body temperature, a higher sweat rate, and more dilute sweat.

Question #: 1363- One of the most helpful groups to determine potential product problems with an existing product is:

- 1) The sales force **2) The service department** 3) The manufacturing department
4) The quality assurance department

Answer:2- The service department is often the first group to know about emerging problems, especially with new products.

CSP Questions and Answers- Part-II

Question #: 1364- An employee has suffered a noise induced hearing loss. In which frequency range would you expect to see the loss on the employee's audiogram?

- 1) 500 Hz 2) 750 Hz 3) 1,000 Hz **4) 4,000 Hz**

Answer:4- Noise induced hearing loss affects the higher frequencies. This may be referred to as the 4,000 Hz notch in an audiogram.

Question #: 1365- Hearing loss attributed to listening to loud music from portable music players is called:

- 1) Psychogenic **2) Socioculus** 3) Sensorineural 4) Conductive

Answer:2- Hearing loss due to social habits is called socioculus.

Question #: 1366- The ossicles are located in the:

- 1) External ear **2) Middle ear** 3) Inner ear 4) Ear drum

Answer:2- The ossicles is located in the middle ear.

Question #: 1367- Heat energy of the body is primarily lost by:

- 1) Radiation 2) Convection 3) Conduction **4) Evaporation**

Answer:4- Evaporation is the primary mechanism by which the body loses heat to the surrounding environment.

Question #: 1368- The first physiological signs of exposure to an oxygen-deficient atmosphere are increased rate and depth of breathing. This condition is called:

- 1) Anoxia **2) Hypoxia** 3) Oxygen starvation 4) Decompression illness

Answer:2- Hypoxia, the first physiologic sign of an oxygen deficiency, is characterized by an increased rate and depth of breathing.

Question #: 1369- The process of eliminating unsafe acts is referred to as:

- 1) Positive reinforcement 2) Feedback **3) Extinction** 4) Discipline

Answer:3- Extinction is the process of eliminating a behavior, including unsafe acts.
Dan Petersen, Safety Management: A Human Approach

Question #: 1370- In the last 15 years, air pollution emissions have:

- 1) Increased slightly 2) Doubled 3) Stayed the same **4) Decreased**

Answer:4- In the last 15 years many air pollutants, like automobile emissions, have been substantially reduced. For example, an automobile purchased in 1990 emitted approximately 4% of that of a similar 1970 model. Another example is sulfur dioxide, the main ingredient of acid rain that is emitted from coal-burning electric utilities. Compared with 1977, the emitted rate of SO₂ is now 20% lower. Much of this can be attributed to regulations that require controls like after-burners and scrubbers.

Question #: 1371- The greatest single contributor to urban air pollution is:

- 1) Electric utilities burning oil 2) Electric utilities burning coal
3) Automobiles 4) Process manufacturing plants

Answer:3- Cars and trucks are major sources of carbon monoxide, nitrogen oxides, and volatile organic compounds that interact in the presence of sunlight to produce ground-level ozone pollution commonly referred to as smog. Researchers allege the automobile is responsible for approximately 40% of urban smog nationally and a great deal more in some areas of California.

Question #: 1372- What kind of industrial hazard can lead to an accident resulting in either death OR an accident with no severe lasting effects?

- 1) Chemical 2) Mechanical **3) Electrical** 4) Ionizing radiation

Answer:3- Depending on a number of conditions (e.g., skin thickness, surface moisture, part of body involved, duration of current flow through the victim, etc.), an electric shock can result in either death or no lasting effect except for body burns that generally heal.

Question #: 1373- The degree of safety achieved in a system depends directly on:

- 1) Good design practices 2) Employing systems safety techniques
3) Management emphasis 4) Meeting set objectives

Answer:3- The degree of safety achieved in a system depends directly on management emphasis. Government and contractors will apply management emphasis to safety during the system acquisition process and throughout the life cycle of each system, making sure mishap risk is understood and risk reduction is always considered in the management review process.

Question #: 1374- The most critical step in any safety program evaluation is:

- 1) The development of the evaluation protocol checklist** 2) Spending "quality" time with line employees 3) Walking-through the survey with the responsible supervisor before formally conducting the evaluation 4) Appointing a competent evaluation team leader

Answer:1- A safety program evaluation will fail or succeed based on the quality of the evaluation protocol/checklist. The protocol determines the areas to be examined, the level of detail, and the questions to be asked.

Question #: 1375- Which of the following diseases would be least likely classified as an occupational hazard?

- 1) Yellow fever** 2) Q fever 3) Brucellosis 4) Ringworm

Answer:1- Pet shop salesmen, stockmen, and breeders of cats and dogs are occupations that may encounter ringworm. Slaughterhouse workers, farmers, and veterinary surgeons are occupations having potential to be infected with Q fever, a rickettsial organism. Workers with cattle and pigs, beef and pork handlers in slaughterhouses, and farmers can contract brucellosis (undulant fever). Yellow fever is caused by a mosquito bite.

Question #: 1376- Which of the following is the least likely occupational disease?

CSP Questions and Answers- Part-II

- 1) Asbestosis **2) Emphysema** 3) Siderosis 4) Glanders

Answer:2- Asbestosis and siderosis are a kind of pneumoconiosis involving specific lung changes caused by the inhalation of dust or fumes. In the past, asbestos was widely used in construction materials (roofing, siding, wallboard, floor tiles, insulation); textiles (fireproof clothing, blankets); shipbuilding materials (pipe insulation); and automotive parts (brake shoes and clutch pads). Excessive fumes (iron oxide) from welding operations may produce siderosis with a pigmentation of the lungs without disability (black in welders lungs and red in iron ore miners). Glanders is a bacterial disease that may be contracted by horse trainers, veterinary surgeons or anyone having contact with sick horses or mules. Emphysema is most commonly associated with cigarette smoking.

Question #: 1377- At 10°C and 4.0 atm, a sample of gas occupies 1,000 liters. If the gas is reduced in volume to 300 liters and the temperature remains constant, what will the pressure be?

- 1) 10 atm 2) 13 atm 3) 14 atm 4) 23 atm

Answer:2 - Boyle's law states that at constant temperature, pressure and volume are inversely related - as the pressure increases the volume decreases.

$$P \text{ (atm)} = 4.0 \text{ atm} (1,000 \text{ liters} / 300 \text{ liters}) = 4.0 \text{ atm} (3.333) = 13.33 \text{ atm}$$

Question #: 1378- The atomic number of an element indicates:

- 1) The total number of neutrons **2) The total number of protons**
3) The total number of protons and neutrons 4) The total number of protons minus neutrons

Answer:2- The atomic number refers to the total number of protons in the nucleus.

Question #: 1379- Bonds formed between two different atoms often result in the electrons not being shared equally between them. This unequal sharing is a function of how _____ one atom is, relative to the other.

- 1) Polar 2) Covalent **3) Electronegative** 4) Energetic

Answer:3- Electronegativity is the property associated with the unequal sharing of electrons during bonding. One atom has a greater ability to attract electrons. When the bond is formed, the electrons spend more time near one atom. Large differences in electronegativity will cause a transfer of electrons (i.e., an ionic bond).

Question #: 1380- Carbon monoxide is formed by:

- 1) Degradation of carbon dioxide 2) High temperature combustion greater than 700°C
3) Incomplete combustion 4) Chlorofluorocarbon interaction

Answer:3- Carbon monoxide is an intermediate oxidation product of carbon. If enough oxygen were present the carbon would have been oxidized to carbon dioxide. When there is insufficient oxygen to fully oxidize the carbon to carbon dioxide, carbon monoxide is formed.

Question #: 1381- Concentrations of gases and vapors are commonly expressed as:

- 1) Parts per million by weight **2) Parts per million by volume**
-

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- 3) Millions of particles per cubic foot (MPPCF) 4) Particles per million

Answer:2- Gases and vapors are not particles and therefore cannot be measured in units of MPPCF or "particles per million."

Question #: 1382- Convert 0°C to Kelvin:

- 1) 32° K 2) 100° K **3) 273° K** 4) 0° K

Answer:3- Ideal Gas Law equations must have relative temperatures (such as degrees Celsius or degrees Fahrenheit) converted to absolute temperatures. Degrees Kelvin (K) is the absolute temperature scale for SI units, while degrees Rankine is the absolute temperature scale for English units. The conversion rule for Kelvin is: $K = ^\circ C + 273.15$.

Question #: 1383- The chemical symbol represents the isotope:

- 1) Phosphorus, 15 protons, 13 neutrons** 2) Phosphorus, 28 protons, 15 neutrons
3) Phosphorus, 14 protons, 15 neutrons 4) Phosphorus, 15 protons, 28 neutrons

Answer:1- This symbol indicates a phosphorus isotope with an atomic weight of 28, and an atomic number of 15.

Question #: 1384- A newspaper recently reported that a man who worked from 1981 to 1984 has now filed for worker's compensation because he is plagued with muscular tremors, memory loss, wasted limbs, and bleeding gums. These are all classic symptoms of what kind of poisoning?

- 1) Lead 2) Beryllium **3) Mercury** 4) Chromium

Answer:3- The newspaper article (July 5, 1991) reported the victim worked in a sealed-off basement room at a thermometer factory in New York. He was one of many workers who made new thermometers and reclaimed mercury from old ones. Muscular tremors, memory loss, wasted limbs, and bleeding gums are the classic symptoms of mercury poisoning.

Question #: 1385- The least likely outcome of exposure to asbestos fibers is:

- 1) Asbestosis **2) Skin cancer** 3) Mesothelioma 4) Lung cancer

Answer:2- Asbestos is a generic term applied to a number of hydrated mineral silicates, including chrysotile, amosite, crocidolite, tremolite, and anthophyllite. Asbestos causes asbestosis, cancer of the lungs and digestive tract, and mesothelioma. Asbestosis and asbestos cancer are the long term effects of inhaling asbestos fibers (they do not become clinically evident until more than 20 years have passed from onset of exposure) whereas, mesotheliomas result from a short term exposure and are diffuse and spread rapidly. Death usually results within one year of diagnosis. Skin cancer is not a likely outcome of asbestos exposure.

Question #: 1386- A common injury to the wrist involving the median nerve which produces tingling and numbness is:

- 1) Wrist drop **2) Carpal tunnel syndrome** 3) Raynaud's syndrome 4) White finger

Answer:2- Carpal tunnel syndrome is an injury/inflammation of the carpal tunnel of the wrist. The median nerve is compressed resulting in numbness and tingling in areas served by the median nerve. Other symptoms are also common, i.e., pain and sometimes muscle atrophy.

Question #: 1387- A condition which results from exposure to welding fumes that is characterized by accumulation of metal oxides in the lung without apparent physical symptoms is called:

- 1) Pulmonary atresia **2) Siderosis** 3) Idiopathic pulmonary distress 4) Byssinosis

Answer:2- Siderosis is a pigmentation of the lung due to iron oxide exposure. The pigmentation can be marked but there seems to be no physical detriment. However, some siderosis patients present with chronic bronchitis and dyspnea. Differential diagnosis is difficult.

Question #: 1388- Metal fume fever is a delayed type of disease with flu-like symptoms. It has been associated with exposure to all of the following EXCEPT:

- 1) Magnesium oxide fumes 2) Nascent zinc oxide fumes 3) Zinc oxide fumes **4) Thorium oxide fumes**

Answer:4- Metal fume fever has been shown to be caused by exposure to freshly generated (nascent) fumes of zinc and magnesium and their oxides. Although zinc and magnesium are the most common causes, copper has been known to cause metal fume fever also.

Question #: 1389- As one ages there is a vascular and neural degeneration of the inner ear. This results in a decrease in hearing ability. This condition is called:

- 1) Temporary Threshold Shift (TTS) 2) Permanent Threshold Shift (PTS)
3) Presbycusis 4) Auditory Threshold Reduction (ATR)

Answer:3- Presbycusis is the decrease in hearing that is associated with aging.

Question #: 1390- To assess your company's loss control performance, several statistics are captured and analyzed. One of these is "Number of lost time cases experienced during the past year." This statistic is an example of a(n):

- 1) Leading indicator **2) Lagging indicator** 3) Optional indicator 4) Occupational indicator

Answer:2- Lagging indicators (such as historical statistics) provide data on how well the loss control system has performed and is useful for understanding how well a management system change affected loss control performance. However, lagging indicators are not as useful for predicting future loss control performance.

Question #: 1391- The first consideration when you are the first person approaching an active spill is:

- 1) Stop the spill 2) Contain the spill 3) Move the drum **4) Personnel safety**

Answer:4- The first consideration for first responders is their own safety and that of others. They are to determine what needs to be done to protect people.

Question #: 1392- Which of the following ergonomically related orthopedic problems leads to the greatest cost?

- 1) Carpal tunnel syndrome
- 2) Lower back syndrome
- 3) Ganglion formation
- 4) Trigger finger

Answer:2- Statistics indicate that low back pain is responsible for more lost time than any other ergonomically related problem. About one third of all disabling injuries are due to manual handling of objects.

Question #: 1393- In injury epidemiology, the term incidence rate is often used. Incidence rate is the number of _____ that occurred in a given period of time divided by the sum of the exposed time.

- 1) New cases
- 2) Prevalent cases
- 3) All cases
- 4) Specific cases

Answer:1- Incidence rate is the rate of development of new cases of a specific disease over a given time period. The denominator is normally person-hours worked or some other similar measure such as person-years, etc.

Question #: 1394- In worker's compensation cases involving hearing loss, the term low fence is often heard. Low fence also varies by state. What is the meaning of this term?

- 1) Minimum noise level the worker must be able to hear
- 2) Hearing threshold level at which impairment begins
- 3) Minimum acceptable dollar value related to the loss
- 4) Maximum acceptable dollar value related to the loss

Answer:2- Low fence is the minimum threshold level at which hearing impairment begins (in that particular state).

Question #: 1395- In workers compensation cases for hearing loss, the term high fence is often used. High fence also varies by state. What is the meaning of the term high fence?

- 1) Point at which the worker is subject to annual audiometric testing
- 2) Point of 100% hearing impairment
- 3) Point of 50% hearing impairment
- 4) Point just before measurable hearing impairment

Answer:2- High fence is a term that describes the point of 100% hearing loss. High fence varies according to state law.

Question #: 1396- State compensation boards use a formally designated low fence for hearing loss disability claims because:

- 1) Of inaccuracies in audiograms
- 2) Small hearing losses are not necessarily disabling
- 3) Litigation can be avoided later

4) This allows reduced workers' compensation costs

Answer:2- The low fence is the minimum dB loss at which a worker is eligible for compensation. This is set to account for presbycusis (the natural loss of hearing due to aging).

Question #: 1397- Suppose a company operating as a machine shop doing contract jobs for their customers is in worker's compensation Class 3652. In the company's current state, this worker's compensation Class has a manual rate of \$10.50. The company employs 55 people and the average salary per person is \$35,000. The company has an adequate safety program and has a current experience modification factor on workers' compensation insurance of 1.1. Next year, it will drop to 0.90. What is the firm's estimated worker's compensation premium for the next year?

1) \$181,912.50 2) \$222,337.50 3) \$17,500 4) \$21,388.89

Answer:1- Estimated premium is calculated in this case by determining the estimated payroll, dividing the estimated payroll by \$100 (since rates are based on \$100 of payroll), multiplying that number by the rate for machine shops and the experience modifier for the new year.

Estimated Premium = $[(\# \text{ Emp} * \text{Avg Sal} / \text{Empl}) / \$100] * \text{Manual Rate} * \text{Experience Modifier}$
EP = $[(55 * \$35,000) / \$100] * \$10.50 * 0.90$ EP = $19,250 * \$10.50 * 0.90 = \$181,912.50$

Question #: 1398- Exclusive remedy in workers' compensation means that:

1) Employers are protected from suits by non-employees on their premises since they are covered by their own worker's compensation coverage

2) Employees may not sue employers for on-the-job injuries

3) Employers and employees agree to binding arbitration to settle grievances arising out of on-the-job accidents

4) Employers may not impose a specific treatment method for an employee who is injured

Answer:2- One of the primary reasons for the creation of workers' compensation in the early 1900's was to protect the injured employee from financial loss and to protect the employer from lawsuits. Therefore, one of the keys of most state based worker's compensation systems is that worker's compensation insurance is the exclusive remedy that an employee may use to recover from loss due to on-the-job injuries.

Question #: 1399- Background concentrations in contaminated soil investigations refer to:

1) Constituent concentrations in samples from areas not affected by the activity being monitored

2) The maximum allowable incremental contamination allowed by EPA

3) Clean-up standards necessary to protect public health and environmental quality

4) Statistical evaluation of data from the potentially contaminated area

Answer:1- Background concentrations typically are of concern only with respect to those constituents naturally occurring in soil. Many regulatory officials believe Answers 2 and 3 to be true. However, background concentrations of a variety of chemical constituents vary widely even in uncontaminated soils. Background concentrations are often used in statistical comparisons of levels in areas under investigation to those that are presumably uncontaminated.

Question #: 1400- There are a number of management standards published by ISO. ISO is an acronym for:

- 1) **International Organization for Standardization** 2) International Standards Organization 3) Identifying Standardization Organization 4) Organization de Standards International

Answer:1- ISO is an acronym for the International Organization for Standardization. ISO is a non-governmental organization. ISO World Wide Web

Question #: 1401- The ISO Quality Management Standards are found in which series of standards?

- 1) The 6000 series 2) **The 9000 series** 3) The 14000 series 4) The 18000 series

Answer:2- The ISO Quality Management Standards are found in the ISO 9000 series. ISO 9001, Quality Management Systems - Requirements is the best known. The ISO 14000 series covers Environmental Management. 18000 series is not in the ISO standards. OHSAS 18001 and 18002 are Occupational Safety and Health Management Standards generally considered to have originated from England. ISO World Wide Web

Question #: 1402- An EMS, referred to in ISO 14004, is a system for:

- 1) Emergency Medical 2) Energy Management
3) **Environmental Management** 4) Emergency Management

Answer:3- ISO 14004 discusses guidelines for an Environmental Management System (EMS). ISO World Wide Web

Question #: 1403- The ISO 9000 series of standards set forth and describe:

- 1) A regulatory framework that assures a corporation has a valid quality management system
2) A standardized list of expectations of high quality companies for use by governing bodies
3) A simple set of rules that can be followed by company officials to assure that employees accomplish quality work
4) **A set of management practices recognized by international consensus**

Answer:4- The ISO 9000 series of standards sets forth an internationally recognized series of standards that have been developed through a consensus process. The ISO 9000 series specifically identifies good quality management practices. ISO World Wide Web

Question #: 1404- The ISO 9001:2008 standard provides:

1) A set of management system requirements that can be achieved and measured

- 2) A set of specific operating methodologies that companies must implement
- 3) A model organizational structure that will assure quality products and services
- 4) A method for auditing organizations to measure the organizational quality level

Answer:1- ISO 9001:2008 sets forth a system of requirements that an organization must achieve to be considered conformant with the standard. The standard does not specify how the organization must achieve the requirements or what the organizational structure must be. ISO World Wide Web

Question #: 1405- The American National Standards Institute (ANSI) is:

- 1) The United States Government representative to international boards of inquiry and regulation
- 2) A United States non-profit organization**
- 3) A United States industry advocate
- 4) A United States government organization that certifies standards

Answer:2- The American National Standards Institute (ANSI) is a 501(c)3 private, not-for-profit organization in the United States. ANSI oversees the creation, promulgation and use of standards and guidelines that impact every sector of businesses. ANSI is also involved in accreditation programs related to conformance to standards - including globally-recognized programs like the ISO 9000 (quality) and ISO 14000 (environmental) management systems. ANSI World Wide Web

Question #: 1406- The American National Standards Institute (ANSI) oversees the development of national standards affecting businesses in the United States. ANSI's standards development process focuses on:

- 1) The selection of key experts for standards committees to assure scientifically sound standards are promulgated
- 2) The use of European Union approved methods to achieve global dominance of key industries
- 3) The use of consensus and broad based public involvement to achieve balanced and high quality standards**
- 4) The use of standards to further the business interests of ANSI member companies

Answer:3- The American National Standards Institute (ANSI) oversees the development of standards affecting businesses in the United States. ANSI's standards development process focuses on the use of consensus and broad based public involvement to achieve balanced and high quality standards. The ANSI standards development process is designed to withstand scrutiny. ANSI World Wide Web

Question #: 1407- The American National Standards Institute (ANSI):

- 1) Serves as the Head of ISO and chairs the IEC

- 2) Is not involved in international standards, as it is a United States based organization
- 3) Provides oversight for all ISO standards development
- 4) Is the US representative to ISO and IEC**

Answer:4- The American National Standards Institute (ANSI) is the U.S. representative to ISO and IEC. ANSI is the U.S. representative of the two major non-treaty international standards organizations, the International Organization for Standardization (ISO), and the International Electrotechnical Commission (IEC) [via the U.S. National Committee USNC].ANSI World Wide Web

Question #: 1408- AIHA is the:

- 1) American Industrial Hygiene Association**
- 2) American International Hygiene Agency
- 3) Agency International for Hygiene and Assessment
- 4) Agency Industrial and Health Audits (from ISO)

Answer:1- AIHA is the American Industrial Hygiene Association. AIHA is an international, membership organization serving professionals that practice industrial hygiene. AIHA is the sponsor of the ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems. AIHA World Wide Web

Question #: 1409- The ANSI Z10 **standard is:**

- 1) The American National Standard Criteria for Accepted Practices in Safety, Health, and Environmental Training
- 2) The American National Standard for Occupational Health and Safety Management Systems**
- 3) The American National Standard version of the ISO 140001, Environmental Management Systems
- 4) The American National Standard equivalent of the ISO 9001, Quality Management Systems

Answer:2- The ANSI Z10 standard is the American National Standard for Occupational Health and Safety Management Systems. Z10 is the equivalent to the British Standards Institute, BS OHSAS 18001. AIHA World Wide Web

Question #: 1410- The **objective** of the ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems is which of the following?

- 1) Provide a framework of auditing tools to measure the level of success of an organizations occupation safety and health programs.
- 2) Set forth a strict set of practices and processes that must be implemented that will allow an organization to be certified as having an occupation safety and health management system.
- 3) Provide organizations with a model to allow them to integrate occupational health and safety management into their overall business management system.**
- 4) Establish a framework for organizations to manage occupational health and safety irrespective of the success or failure of the business.

Answer:3- The objective of the ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems is to provide organizations with a model to allow them to integrate occupational health and safety management into their overall business management system. AIHA World Wide Web

Question #: 1411- The ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems provides a **system** of:

- 1) Detailed specifications to be implemented in each organization adopting the standard
- 2) Strict auditing specifications for management system certifications
- 3) A template for occupational safety and health consultants to use in establishing consulting businesses
- 4) Principles with broad applicability to different organizations**

Answer:4- The ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems provides a system of principles with broad applicability to different organizations. Management system standards must be capable of being used by a wide variety of different organizations, as such, they are performance based, not prescriptive. AIHA World Wide Web

Question #: 1412- ANSI, or the American National Standards Institute:

- 1) Approves standards developed sponsors, granting approval once specific standards development criteria are verified**
- 2) Promulgates and publishes standards that are intended to be used by local governments in the development of regulations
- 3) Promulgates and publishes standards that are developed in cooperation with various sponsoring organizations
- 4) Works closely with the American National Standards Verification Board to assure the standards that it develops meet the specific criteria required of ANSI standards

Answer:1- ANSI, or the American National Standards Institute, approves standards developed sponsors, granting approval once specific standards development criteria are verified. ANSI does not develop standards and does not provide interpretations. **Standards are developed under the direction of sponsors.** Standards may be approved by ANSI only after ANSI has **verified** that the requirements for due process, consensus and other criteria have been met in the development process. ANSI World Wide Web

Question #: 1413- The ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems **purpose** is to:

- 1) Establish performance criteria for management acceptance of risk to employees and the public
- 2) Establish a tool for continual improvement of occupational safety and health performance**
- 3) Establish a tool to assist organizations with regulatory compliance
- 4) Establish a minimum level of performance for organization health and safety programs in the international environment

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Answer:2- The ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems purpose is to establish a tool for continual improvement of occupational safety and health performance. ANSI/AIHA Z10-2005

Question #: 1414- The ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems **concept** is based on the recognized quality concept of:

- 1) Verification and validation
- 2) Process documentation
- 3) Plan, do, check, act**
- 4) Six sigma

Answer:3- The ANSI/AIHA Z10, American National Standard for Occupational Health and Safety Management Systems concept is based on the recognized quality concept of plan, do, check, act. ANSI/AIHA Z10-2005

Question #: 1415 - There are 10 plants in a manufacturing company. Four are to be picked at **random** to send a representative to safety planning meetings. How many different combinations of plant representation are possible at the meeting?

- 1) 210**
- 2) 440
- 3) 720
- 4) 5,040

Answer:1- Because order is NOT important, this is a combination (instead of a permutation).
Combinations = $N! / [X! (N-X)!]$
(where N is the total number of plants and X is the number of plants chosen for representation at the safety planning meetings)
Combinations = $10! / [4! (10-4)!] = 3,628,800 / (24 * 720) = 210$

Question #: 1416- In manual materials handling, methods for eliminating the need to bend include all of the following EXCEPT:

- 1) Using lift tables, work dispensers, and other mechanical aids
- 2) Raising the work level to an appropriate height
- 3) Providing materials and tools in front of the worker**
- 4) Lowering the worker

Answer:3- Although providing materials and tools in front of the worker helps to prevent twisting motions, to avoid bending motions the work needs to be at the proper height. This can be accomplished through mechanical means (lift tables), raising the work level, or lowering the worker to the level of the work.

Question #: 1417- Human factors engineering or ergonomics is concerned with fitting the worker to a task or the task to the worker. A man/machine system is considered a closed loop system. Which one of the following does NOT make up the closed loop system?

- 1) Reactions
- 2) Data input
- 3) Senses of man
- 4) Size of material**

Answer:4- The closed loop system is made up of reactions, machine, data input, and senses of man.

Question #: 1418- Human factors engineering is fitting the worker to the task or the task to the worker. Man is better at all of the following EXCEPT:

- 1) Exerting large forces smoothly**
- 2) Handling the unexpected

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- 3) Sensitive to a wide variety of stimuli 4) Flexibility

Answer:1- Machines are better at exerting large forces smoothly.

Question #: 1419- Human factors engineering is a technical discipline which concerns any of the following EXCEPT:

- 1) **Interrelationships between people** 2) Design of the workplace to reduce mistakes and accidents
3) Design of tools to promote comfort 4) Reduction of injuries

Answer:1- Human factors, also referred to as ergonomics, human engineering, bioengineering, and biomedics is a technical discipline mainly concerned with optimizing the relationship between people AND their work environment.

Question #: 1420- Supplied air respirators (SAR's) can be used in IDLH atmospheres under any of the listed conditions EXCEPT:

- 1) Employee is equipped with auxiliary escape air
2) Supply line are less than 300 ft in length
3) Maximum inlet air pressure is less than 125 psi(g)
4) **Airflow into the face piece is 3 cfm**

Answer:4- NIOSH respirator requirements require a face piece air flow rate of 4 cfm.

Question #: 1421- A respirator that uses various chemical substances to purify inhaled air which contains certain contaminant gases and vapors is defined as a:

- 1) Chemically reactive air-purifying respirator 2) CHP respirator
3) **Chemical cartridge air-purifying respirator** 4) Chemical air-purifying respirator

Answer:3- A chemical cartridge air-purifying respirator is a respirator that uses various chemical substances to purify inhaled air which contains certain contaminant gases and vapors.

Question #: 1422- Protective garment materials have all of the following general considerations EXCEPT:

- 1) They are permeable to some degree 2) **They are resistant to all chemicals** 3) Some chemicals have no acceptable garment
4) No single material is resistant to all chemicals.

Answer:2- There is no material that can protect against all chemicals due to the many different chemical forms that are used in today's manufacturing. All materials have some level of permeation.

Question #: 1423- What is permeation?

- 1) A chemical's ability to dissipate 2) **A chemical's ability to pass through a material** 3) A chemical's ability to dissolve another material
4) A chemical's ability to pass through living tissue

Answer:2- Permeation is a chemical's ability to pass through a material.

Question #: 1424- Chemical protective clothing (CPC) can introduce all of the following hazards to an emergency responder EXCEPT:

- 1) Heat stress 2) Visual limitations 3) Physical limitations 4) **Carbon monoxide**

Answer:4- CPC can cause discomfort to the wearer, especially heat stress, and many physiological stresses during use. An SCBA is worn which supplies Grade D breathing air.

Question #: 1425- A safety program begins by:

- 1) **Developing a policy statement** 2) Assuring compliance with all OSHA standards 3) Soliciting support of the facilities department 4) Training all employees

Answer:1- Management must develop a policy statement that clearly defines management's support for safety and the safety-related roles of each member of the organization.

Question #: 1426- When an employee's exposure to an airborne, breathable chemical cannot be reduced to permissible safe levels through engineering controls, then the LEAST acceptable exposure control alternative is:

- 1) Administrative controls 2) Job rotation
3) Changing production schedules 4) **Wearing a respirator**

Answer:4- Administrative controls are methods for controlling employee exposures to contaminants or excess noise by limiting the duration of an individual's exposure by job rotation, work assignment, or time periods away from the contaminant or noise source. Personal protective equipment, such as a respirator, is the last alternative that should be considered to reduce exposures.

Question #: 1427- In Escola v. Coca Cola Bottling Company of Fresno, Justice Traynor pointed out that a manufacturer must know that its product is "fit". Fitness can be determined by the manufacturer by analysis and by:

- 1) Examination 2) Demonstration 3) Test 4) **All of the above**

Answer:4- In addition to analysis, examination, demonstration, and test can be used independently or together in any combination to determine "fitness" of the product and that safeguards are verified.

Question #: 1428- Safety directors should _____ as many levels of management as possible.

- 1) Report to 2) **Have access to** 3) Have citation powers for 4) Have budget approved by

Answer:2- The fact that the safety director's manager is interested in safety and supportive of the director is more important than the level he/she reports at. It is important that the company's upper management support safety and encourage safety. If the safety function reports at a high level in a company that does not value safety, the level of reporting will not matter. Access to managers throughout an organization will assist the safety director in developing an accepted, consistent, effective safety program.

Question #: 1429- Typically, the product safety engineer is a separate entity of which organization?

- 1) Operations/Engineering 2) **Risk Management**

3) Quality Assurance

4) Manufacturing

Answer:2- Generally the product safety engineer is a separate entity or of the risk management department organization. For a simple product or process, the product safety engineering organization may be one person. If the organization is large or complex, several people may be needed, even with specializations.

Question #: 1430- The system safety responsibility in many company organizations is placed in the:

1) Engineering department

2) Product assurance department

3) Human factors engineering department

4) Manufacturing department

Answer:2- The system safety responsibility in many company organizations is placed in the product assurance department because it is an organizational method of establishing a close relationship among common disciplines such as reliability, maintainability, quality assurance, and human factors engineering.

Question #: 1431- Ozone has a propensity to form free radicals in the body. A toxicologic phrase utilized to describe this phenomena is:

1) Radiomimetic

2) Reactive

3) Chelator

4) Irritant

Answer:1- Ozone's propensity to form free radicals is termed radiomimetic. Webster's 3rd New International Dictionary defines radiomimetic as "producing, especially, biological effects similar to those produced by radiation."

Question #: 1432- Which of the following chemical asphyxiants **inhibits** cytochrome oxidase and is rapidly fatal?

1) Carbon monoxide

2) Hydrogen sulfide

3) Hydrogen cyanide

4) Both 2 and 3

Answer:4- Both hydrogen cyanide and hydrogen sulfide inhibit the enzyme cytochrome oxidase, which is essential for tissue respiration. Tissue hypoxia and death may occur rapidly. Carbon monoxide interacts with the hemoglobin molecule to produce asphyxia.

Question #: 1433- Which of the following chemicals is NOT a hepatotoxic agent?

1) Carbon tetrachloride

2) Nitrosoamines

3) Tetrachloroethane

4) Arsine

Answer:4- Arsine is a gas whose primary effect upon inhalation is hemolysis (break down of red blood cells). All of the other chemicals are severe hepatotoxic agents. Carbon tetrachloride produces severe diffuse central necrosis of the liver, tetrachloroethane produces yellow atrophy of the liver, and nitrosoamines and aflatoxins cause severe liver damage.

Question #: 1434- Insoluble uranium is well known for its radioactive risks. What organ system is potentially impacted by its non-radioactive, toxic properties?

1) Eyes

2) Kidneys

3) Liver

4) Olfactory

Answer:2- Insoluble and soluble uranium are potent kidney toxins which also can affect the skin, lungs, bone marrow, and lymphatics.

Question #: 1435- Which chemical is characteristically related to oat cell carcinoma of the lung?

- 1) Asbestos 2) Vinyl chloride 3) Chromium 4) Bis-chloromethyl ether

Answer:4- Prolonged exposure to bis-chloromethyl ether has been shown to cause oat cell carcinoma of the lung. The other characteristic cancers are listed below:

Asbestos - Mesothelioma

Vinyl chloride - Angiosarcoma

Nickel, wood dust, chromium - Adenocarcinoma of the nasal cavity

Question #: 1436- What was the characteristic cancer exhibited by the radium dial painters earlier in this century?

- 1) Osteogenic sarcoma 2) Mesothelioma
3) Angiosarcoma 4) Oat cell carcinoma of the lung

Answer:1- Radium dial painters were afflicted with osteogenic sarcoma from radium exposure. Osteogenic means "originating in bone." Sarcoma means "a malignant neoplasm arising in connective tissue and especially in bone, muscle, or cartilage."

Question #: 1437- Thalidomide is a classic example of what type of agent?

- 1) Mutagenic 2) Teratogenic 3) Toxic 4) Radioactive

Answer:2- The two potential answers were "mutagenic" and "teratogenic". Thalidomide is a classic teratogen. Thalidomide babies were born without limbs because the drug's effect acted on the developing fetus. Teratogens have an adverse effect upon the developing fetus. Mutagens modify the actual genetic material.

Question #: 1438- Benzene is metabolized by the body to form which metabolite?

- 1) Urea 2) Phenol 3) Cyclohexane 4) Hexane

Answer:2- Phenol is the classic metabolic product of benzene. Total urinary phenols is the method of choice for benzene exposure biological monitoring.

Question #: 1439- Methylene chloride is a mild toxicant whose primary metabolite is:

- 1) Phenol 2) Carbon monoxide 3) Methyl chloroform 4) Benzene

Answer:2- Methylene chloride is metabolized by the body to form carbon monoxide. Due to this fact, combined exposure to this solvent and carbon monoxide must be taken into account and is considered by both the ACGIH and NIOSH safe exposure level recommendations.

Question #: 1440- An oil refinery worker was attempting to repair a pipe from which gas had been escaping. He became dizzy, noticed a pressure in his head, and then passed out. A fellow worker who went to his aid was also rendered unconscious. Both victims began convulsing and

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were hospitalized. The first victim appeared to be recovering but at approximately 72 hours after the exposure, developed severe pulmonary edema and died. The second victim recovered completely within 36 hours and was back at work within a week without lasting effect. What is the most logical chemical agent to cause this?

- 1) **Hydrogen sulfide** 2) Volatile organics 3) Carbon monoxide 4) Arsine

Answer:1- The most logical choice, given the fact that the incident takes place in an oil refinery, is hydrogen sulfide poisoning. Hydrogen sulfide interferes with cytochrome oxidase leading to tissue hypoxia.

Question #: 1441- A **semiconductor operator** is exposed to a variety of agents when a diffusion furnace tube explodes during a process step. Upon admittance to the emergency room, the unconscious worker is found to have a bronze hue to his skin. Subsequent lab test indicate a number of lysed red blood cells. What is the causative agent?

- 1) Volatile organics **2) Arsine** 3) Phosphine 4) Hydrogen chloride

Answer:2- The lysed red blood cells and bronze hue of the skin is highly indicative of arsine poisoning. This gas breaks apart the red blood cell. It is an extremely toxic chemical.

Question #: 1442- Several young male agriculture pesticide formulation workers complained to the company physician about an inability to have children. Medical examination revealed little or no sperm and the decrease or loss of spermatogenic cells. What is the likely chemical cause?

- 1) Warfarin 2) DDT **3) DBCP** 4) Aldrin

Answer:3- 1,2-dibromo-3-chloropropane (DBCP) is a potent male reproductive toxin. It is also a suspect human carcinogen.

Question #: 1443- A **biotechnology technician** dropped a bottle of compound X and saturated his right leg, the right side of his stomach and his chest. Fellow employees removed his shirt and washed his upper body. The technician then walked across the street to a physician's office. However within 15 minutes of arriving, the technician collapsed and died. Subsequent autopsy revealed first and **second degree burns** on his body's right side. There was **edema of both lungs, kidneys, pancreas, and spleen**. What was the agent?

- 1) Hydrochloric acid **2) Phenol** 3) Trichlorethylene 4) Deionized water

Answer:2- Phenol is a systemic poison absorbed through the skin. The removal of the shirt and subsequent washing of the chest did not remove the phenol from the victim's lower body and a subsequent acute poisoning occurred.

Question #: 1444- How long should eyes or skin be flushed immediately after exposure to a hazardous chemical?

- 1) 3 min 2) 5 min 3) 10 min **4) 15 min**

Answer:4- A general rule is to wash with copious amounts of water for at least 15 minutes.

Question #: 1445- A physician that specializes in **hearing disorders** is an:

- 1) Audiologist 2) Audiothamologist **3) Otolaryngologist** 4) Ear, nose, and throat specialist

Answer:3- An audiologist conducts and reads audiograms. An ear, nose, and throat specialist will diagnose hearing problems, but does not specialize in hearing disorders as an otolaryngologist does.

Question #: 1446- Cumulative trauma disorder (CTD) is:

- 1) An acute injury caused by repetitive motion
2) A chronic illness caused by exposure to extremes in temperature
3) A chronic injury caused by an accumulation of micro-injuries
4) An acute form of carpal tunnel syndrome

Answer:3- Cumulative trauma disorder is a type of chronic musculoskeletal injury that is caused by an accumulation of many micro-injuries over a period of time. Acute or macro-injuries cause immediate pain and damage from sudden or extreme force, while micro-injuries are from low-intensity stresses that accumulate over a long period of time.

Question #: 1447- Which of the following is NOT a **cumulative** trauma disorder?

- 1) Thoracic Outlet Syndrome 2) Tenosynovitis **3) Raynaud's Phenomenon**
4) De Quervain's Disease

Answer:3- Raynaud's Phenomenon (or Syndrome) is a disorder of the hand and arm sometimes resulting from excessive vibration exposure, but not as a result of cumulative trauma. Raynaud's Phenomenon can develop from the single use of a vibrating tool, though it typically comes from long-term use. In addition, it can be caused by exposure to certain chemicals, exposure to cold, and excessive emotional stress. While doctors can diagnose and treat the signs and symptoms of Raynaud's Phenomenon, they are still not sure what causes it. Thoracic Outlet Syndrome is due to repetitive compression of nerves and blood vessels in the neck and shoulder. Tenosynovitis is due to repetitive compression of nerves and blood vessels in the wrist. De Quervain's Disease is due to repetitive compression of nerves and blood vessels in the thumb.

Question #: 1448- The **primary factors** that affect development of cumulative trauma disorder (CTD) include all of the following EXCEPT the:

- 1) Age of the worker** 2) Intensity of force applied
3) Frequency of repetition of high risk tasks between high risk tasks
4) Lack of a proper rest period

Answer:1- The age of a worker has little effect on the development of CTD. The accumulation of micro-injuries from excessive force is compounded by the frequency of repetition of such high risk tasks. (This takes into account the lack of rest between tasks).

Question #: 1449- Which of the following is NOT a symptom of carpal tunnel syndrome?

- 1) Cannot tell hot from cold **2) Excessive sweating of hand and wrist**

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3) Lack of strength

4) Trouble performing simple manipulative tasks

Answer:2- Carpal tunnel syndrome patients often develop autonomic nerve damage which results in loss of the sweat function, leaving dry, shiny skin. The remainder of the answers are common symptoms of carpal tunnel syndrome.

Question #: 1450- Under the citizen suit provisions of RCRA, citizens are directly allowed to:

1) Sue for punitive damages

2) File suit in federal district court to enforce RCRA waste management regulations

3) Intervene in the siting of new treatment, storage, and disposal (TSD) facilities

4) Both 1 and 3

Answer:2- The citizen suit provisions of RCRA, found at Section 7002, are limited to the enforcement of the regulations. Punitive damages are not specifically allowed. Intervention in siting would be allowed indirectly through the mandatory public participation in the RCRA permitting process.

Question #: 1451- The "cradle-to-grave" aspects of the RCRA program refer to:

1) Regulation of hazardous wastes from the point of generation through their ultimate disposal

2) An extensive network of government-owned and operated treatment facilities

3) Requirements to pay federal environmental taxes on the purchase of hazardous chemicals and the land disposal of hazardous wastes

4) Extensive requirements for health and safety, including medical monitoring, of those employees handling hazardous chemicals and/or hazardous wastes

Answer:1- The RCRA regulations establishing "cradle-to-grave" control of hazardous wastes are found at **40 CFR 260-271**.

Question #: 1452- The so-called "rebuttable presumption" in the RCRA program is:

1) The burden of proof imposed on the generator in delisting previously listed hazardous wastes

2) The legal term for the principle that the accused is considered guilty until proven innocent

3) The requirement to list wastes with over 1,000 ppm of chlorinated solvents as hazardous

4) None of the above

Answer:4- The rebuttable presumption under RCRA **applies to certain used oils** that are to be recycled under the limited provisions of 40 CFR 279. Used oils that contain over 1,000 ppm of total halogens (TX) are presumed to be hazardous by virtue of mixing with listed spent chlorinated solvents. This presumption of "hazardousness" can be rebutted by showing that the halogens are from unregulated sources, such as additives put in the virgin oils. The EPA would like the oil to be analyzed by GC/MS, and that no halogenated hazardous constituent be present in concentrations greater than 100 ppm. The regulatory provisions dealing with the rebuttable presumption are found at 40 CFR 279.10; 279.21; 279.44; and 279.53 for the various parties regulated under 40 CFR 279.

Question #: 1453- The term for the interaction of two toxins where the combined effect is greater than the sum is:

1) Additive

2) Synergistic

3) Potentiation

4) Antagonistic

Answer:2- Synergistic effects occur when two substances act together to produce a toxic effect greater than the sum of each. For example, asbestos exposure and cigarette smoking produce a cancer risk that is much greater than the sum of each risk. Additive effects are the sum of each substance on the body. Potentiation is where one substance has no effect unless combined with a second substance, and antagonistic effects occur when two substances interfere with each others effects, giving an overall lesser effect.

Question #: 1454- Which of the following is the **second most plentiful element** in the earth's crust:

- 1) Aluminum 2) Oxygen 3) Iron **4) Silicon**

Answer:4- The second most plentiful element in the earth's crust is silicon.

Question #: 1455- The decibel is the commonly used unit for expressing sound pressure. Decibels must be calculated as compared to a reference level. The reference level for sound pressure is 2×10^{-5} newtons per square meter (or 2×10^{-5} pascals). Why was this level selected?

- 1) It is the lowest sound pressure which can be measured
2) It approximates the threshold of hearing
3) It simplifies the calculations
4) It approximates the pain threshold

Answer:2- The reference level for sound pressure of 2×10^{-5} was chosen because it approximates the threshold of human hearing at 1,000 Hz.

Question #: 1456- A sound pressure level of 3 N/m² corresponds to how many decibels?

- 1) 101.3 dB 2) 78.6 dB **3) 103.5 dB** 4) 85.9 dB

Answer:3- $L_p = 20\log (P/P_o)$, where L_p = pressure level, P = the measured pressure, and P_o is the reference sound pressure of 2×10^{-5} Pa. So $L_p = 20\log (3/0.00002)$
 $= 20\log (150,000)$ $= 103.5$ dB

Question #: 1457- If the sound pressure of 3 N/m² is reduced in half to 1.5 N/m², what is the new sound pressure level in decibels?

- 1) 100.5 dB 2) 51.75 dB 3) 85.5 dB **4) 97.5 dB**

Answer:4- Use the formula $L_p = 20\log (P/P_o)$ where L_p is the pressure level, P is the measured pressure and P_o is the reference pressure of 2×10^{-5} Pa. So $L_p = 20\log (1.5/0.00002)$
 $= 20\log (75,000)$ $= 20 * 4.8751$ $= 97.5$ dB

Question #: 1458- Sound **power** is used to describe:

- 1) The sound source **2) Amount of acoustical energy produced over time**
3) The amplitude of a sound source normalized to a frequency of 10,000 Hz 4) Both 2 and 3

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Answer:2- Sound power is used to describe the acoustical energy produced over time from a sound source.

Question #: 1459- A unit used to describe sound power is:

- 1) **Watts** 2) Joules 3) Ergs 4) Lamberts

Answer:1- Sound power is measured in watts.

Question #: 1460- To **express** sound power (in watts) as decibels, what is required?

- 1) This is not possible 2) A sound level meter
3) **A reference level** 4) Knowledge of the sound intensity

Answer:3- Decibels require a reference level. For sound power, the reference level is 10^{-12} W.

Question #: 1461- What is the sound power in decibels of a machine with a sound power of 1,000 W?

- 1) 100 dB 2) 120 dB 3) 140 dB 4) **150 dB**

Answer:4- Use sound power formula, $L_p = 10 \log I/I_0$ where I is the measured pressure and I_0 is the reference pressure of 10^{-12} Pa.

$$\text{So } L_p = 10 \log (1,000/10^{-12}) = 10 \log (1 \times 10^{15}) = 150 \text{ db}$$

Question #: 1462- A machine normally produces 1,000 watts of sound power. What is the sound power (in decibels) of the machine if its sound power is reduced by a factor of 10?

- 1) 15 dB 2) **140 dB** 3) 100 dB 4) 135 db

Answer:2- One thousand (1,000) watts reduced by a factor of 10 is **100 watts**. Use the formula for sound power: $L_p = 10 \log I/I_0$ db where I is the measured pressure and I_0 is 10^{-12} Pa

$$L_p = 10 \log (100/10^{-12}) = 10 \log (1 \times 10^{14}) = 140 \text{ db}$$

Question #: 1463- Sound intensity is defined as:

- 1) The loudest octave band 2) Total acoustic power
3) **The sound power per unit area** 4) The sound pressure level actually heard

Answer:3- Sound intensity is defined as the sound power per unit area.

Question #: 1464- A **unit** used to describe sound intensity is:

- 1) **Watts per square meter** 2) Joules per second
3) Ergs per liter 4) Feet per second

Answer:1- Sound intensity is described by watts (power) per square meter (area).

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Question #: 1465-When calculating estimated sound pressure levels within a room, Q refers to:

- 1) The size of the noise source
- 2) The type of room where the noise source is located
- 3) The directivity factor associated with the sound**
- 4) The octave band with the largest sound pressure

Answer:3- Q is a dimensionless quantity that is a measure of the degree to which sound emitted by a source is concentrated in a certain direction rather than radiated spherically.

Question #: 1466- A 500 gram piece of iron cools from 400°C to 20°C. How much heat is given up by the iron? (The specific heat of iron is 0.113 cal/g-°C)

- 1) 18,300 cal
- 2) 19,600 cal
- 3) 21,500 cal**
- 4) 24,800 cal

Answer:3- Use the formula: $Q = c m(T_2 - T_1)$, where c is the specific heat, m is the mass, T₂ is the final temperature, and T₁ is the beginning temperature.

$$Q = 0.113 \text{ cal/g-}^\circ\text{C} (500 \text{ g})(400-20)^\circ\text{C} = 21,470 \text{ cal}$$

Question #: 1467- If a 500 gram piece of iron at 400 °C is plunged into 13,600 g of mercury at 20 °C, what is the final temperature? (The specific heat of mercury is 0.033 cal/g-°C and the specific heat of iron is 0.113 cal/g-°C)

- 1) 62.5°C
- 2) 93.6°C
- 3) 112°C
- 4) 188°C

Answer:1 $Q = c m(T_1 - T_2)$, where c = specific heat, m is the mass, T₂ is the ending temperature, and T₁ is the beginning temperature. Since the final temperature will be the same for both the mercury and the iron and the calories lost by the iron will be the same as gained by the mercury, set the two materials equal and solve for X (X will be T₂ for the iron and T₂ for the mercury, but T₂ is subtracted from the beginning temperature of the iron and the beginning temperature of the mercury is subtracted from T₂ in setting the two sides of the equation equal).

$$\begin{aligned} 500 \text{ g} (0.113 \text{ cal/g-}^\circ\text{C})(400^\circ\text{C} - X) &= (13,600 \text{ g})(0.033 \text{ cal/g-}^\circ\text{C})(X - 20^\circ\text{C}) \\ (56.5 \text{ cal/}^\circ\text{C})(400^\circ\text{C} - X) &= (448.8 \text{ cal/}^\circ\text{C})(X - 20^\circ\text{C}) \\ 22,600 - 56.5 X &= 448.8 X - 8,976 \\ 31,576 &= 505.3X \\ 62.5^\circ\text{C} &= X \end{aligned}$$

Question #: 1468- Which of the following statements is true?

- 1) For any two surfaces, the coefficient of static friction is less than the coefficient of dynamic friction
- 2) The coefficient of dynamic friction applies when objects are in motion**
- 3) Both 1 and 2
- 4) None of the above

Answer:2- The coefficient of dynamic friction applies to an object in motion.

Question #: 1469- Which is true about the coefficient of dynamic friction?

- 1) It can range in value from 0.0 - 10.0
- 2) It is about 25% less than the coefficient of static friction for any two objects**
- 3) Both 1 and 2
- 4) None of the above

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Answer:4- Weight is equal to the mass of the object times the effect of gravity or:

$$W = m * g \quad 200 \text{ lb} = m(32.2 \text{ ft/sec}^2) \quad m = 6.21 \text{ lb-sec}^2/\text{ft}$$

Question #: 1474- An automobile is traveling at 30 mph. If the automobile is accelerated at a rate of 2 ft/sec^2 , what is the velocity after 10 sec?

- 1) 64 mph **2) 44 mph** 3) 50 mph 4) 44 ft/sec

Answer:2- First, convert mph to ft/sec, $30 \text{ mi/hr} * 5,280 \text{ ft/mi} * 1 \text{ hr}/3,600 \text{ sec} = 44 \text{ ft/sec}$
Then using $v = v_o + at$, where v = ending velocity, v_o = beginning velocity and at = acceleration and time. $v = 44 \text{ ft/sec} + (2 \text{ ft/sec}^2 * 10 \text{ sec}) = 64 \text{ ft/sec}$. Convert to mph. $64 \text{ ft/sec} = 43.6 \text{ mph}$

Question #: 1475- An automobile is traveling at 60 mph. If the driver brakes at a rate of 10 ft/sec^2 , how long will it take the automobile to stop?

- 1) 9 sec 2) 6 sec 3) 4 sec 4) 2 sec

Answer:1- Convert mph to ft/sec. $60 \text{ mph} = 88 \text{ ft/sec}$ $v = v_o + at$, where v = ending velocity, v_o = beginning velocity and at = acceleration and time.

$$0 = 88 \text{ ft/sec} + (-10 \text{ ft/sec}^2) t \quad t = (-88 \text{ ft/sec}) / (-10 \text{ ft/sec}^2) = 8.8 \text{ sec}$$

Question #: 1476- A vehicle is travelling at a constant speed of 45 mph. On average, the vehicle accelerates at a rate of 1 ft/sec^2 four times per hour for 30 seconds to pass other vehicles. How far does the vehicle travel in one hour?

- 1) 46.1 miles 2) 49.0 miles **3) 46.4 miles** 4) 47.3 miles

Answer:3- In 58 minutes the vehicle goes $45 \text{ mph} * (58 \text{ min} / 60 \text{ min/hr}) = 43.5 \text{ miles}$.
To determine the distance traveled in the remaining two minutes of acceleration, use $s = v_o t + at^2/2$.

Convert 45 mph to 66 ft/sec $t = 120 \text{ seconds (2 minutes)}$

$$s = (66 \text{ ft/sec})(120 \text{ sec}) + (1 \text{ ft/sec}^2)(120 \text{ sec})^2 / 2$$

$$= 7,920 \text{ ft} + 7200 \text{ ft} = 15,120 \text{ ft} = 2.9 \text{ miles} \quad 43.5 \text{ miles} + 2.9 \text{ miles} = 46.4 \text{ miles}$$

Question #: 1477- If a drag racer has a terminal velocity of 200 mph after a $\frac{1}{4}$ mile race, what has been the average acceleration?

- 1) 50 ft/sec^2 **2) 32.5 ft/sec^2** 3) 18 ft/sec^2 4) 23.4 ft/sec^2

Answer:2- $200 \text{ mph} = 293 \text{ ft/sec}$; $\frac{1}{4} \text{ mile} = 1,320 \text{ ft}$

$v^2 = v_o^2 + 2as$, where v = ending velocity, v_o = beginning velocity, a = acceleration, and s = distance. $(293 \text{ ft/sec})^2 = 0 + 2a(1,320 \text{ ft}) \quad a = 85,849 \text{ ft}^2/\text{sec}^2 / 2,640 \text{ ft} = 32.5 \text{ ft/sec}^2$

Question #: 1478- If a man applies a force in a horizontal direction to slide an 80 lb crate 10 ft, how much work did he perform? (Assume the coefficient of static friction is 0.40 between the crate and the floor.)

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1) 320 ft-lb 2) 610 ft-lb 3) 800 ft-lb 4) 1,120 ft-lb

Answer:1- Since the force is being applied in the horizontal direction, the only force to be overcome is the friction between the crate and the floor.

$$F = \mu N = (0.40)(80 \text{ lb}) = 32 \text{ lb} \quad \text{Work} = Fs = (32 \text{ lb})(10 \text{ ft}) = 320 \text{ ft-lb}$$

Question #: 1479- If a man lifts a 90 lb crate 3 ft, how much work did he perform?

1) 3 ft-lb 2) 30 ft-lb 3) 90 ft-lb 4) 270 ft-lb

Answer:4- Since the force is being applied in the vertical direction, the only force to be overcome is the weight. $\text{Work} = Fs$ $\text{Work} = 90 \text{ lb} * 3 \text{ ft} = 270 \text{ ft-lb}$

Question #: 1480- A man pushes a 30 lb object for 8 ft on a 15° inclined plane. If the dynamic coefficient of friction is 0.40, how much work did he perform?

1) 155 ft-lb 2) 240 ft-lb 3) 92.8 ft-lb 4) 62.4 ft-lb

Answer:1- Draw a picture. The 30 lb object exerts forces perpendicular to the plane and in the direction of the plane, forming a vector triangle. The force from the weight in the direction of the plane can be determined by: $\cos 75 = F_p / 30 \text{ lb}$ $F_p = 7.8 \text{ lb}$

The force perpendicular to the plane. $F_n = \sin 75 * 30 \text{ lb} = 28.9 \text{ lb}$ Dynamic friction force to be overcome is: $F_f = 0.4 * 28.9 \text{ lb} = 11.6 \text{ lb}$ The man has to overcome both forces.

$$F_t = 11.6 \text{ lb} + 7.8 \text{ lb} = 19.4 \text{ lb} \quad \text{Work performed} = 19.4 \text{ lb} * 8 \text{ ft} = 155.2 \text{ ft-lb}$$

Question #: 1481- How much kinetic energy is required to bring a 3,000 lb automobile to a speed of 45 mph?

1) 3,000 ft-lb 2) 135,000 ft-lb 3) 188,000 ft-lb 4) 203,000 ft-lb

Answer:4- Use the formula for calculating kinetic energy: $KE = (mv^2) / 2$
 $= W/g = 3,000 \text{ lb} / (32.2 \text{ ft/sec}^2) = 93.2 \text{ lb-sec}^2/\text{ft}$ $v = 45 \text{ mph} = 66 \text{ ft/sec}^2$
 $KE = [(93.2 \text{ lb-sec}^2/\text{ft})(66 \text{ ft/sec}^2)^2] / 2 = 202,990 \text{ ft-lb}$

Question #: 1482- How much kinetic energy is required to stop a 4,000 lb automobile travelling at 60 mph?

1) 353,000 ft-lb 2) 481,000 ft-lb 3) 4,000 ft-lb 4) 240,000 ft-lb

Answer:2- $KE = (mv^2) / 2$ $m = W/g$ $m = 4,000 \text{ lb} / 32.2 \text{ ft/sec}^2$
 $= 124.2 \text{ lb-sec}^2/\text{ft}$ $v = 60 \text{ mph} = 88 \text{ ft/sec}^2$
 $KE = [(124.2 \text{ lb-sec}^2/\text{ft})(88 \text{ ft/sec}^2)^2] / 2 = 480,902 \text{ ft-lb}$

Question #: 1483- If 300,000 ft-lb of kinetic energy is required to bring a moving automobile to a stop, and the total braking power transmitted to the road is 1,500 lb, how far did the vehicle go before it came to a stop?

1) 3,000 ft 2) 200 ft 3) 150 ft 4) 300 ft

Answer:2- The difference in kinetic energy of two states is equivalent to the work performed.
 $300,000 \text{ ft-lb} = 1,500 * d$ $d = 200 \text{ ft}$

Question #: 1484- What is the potential energy with respect to gravity of a 10 lb steel ball at a height of 12 ft from the surface of the earth?

- 1) **120 ft-lb** 2) 1.2 ft-lb 3) 0.875 ft-lb 4) 322 ft-lb

Answer:1- $PE = mgh$ $W = mg$ $PE = Wh$ $= (10 \text{ lb})(12 \text{ ft})$ $= 120 \text{ ft-lb}$

Question #: 1485- The factor which is primarily responsible for dust gaining entrance to the alveolar regions of the lung is:

- 1) Composition of the dust 2) Concentration
3) **Particle size** 4) Condition of the mucociliary system

Answer:3- Particle size is the most important factor in determining respirability. It is the ability of the smaller particles to negotiate the turns and twists of the respiratory tract that allows them to gain access to the lower portions of the respiratory system. The composition and concentration are important once the deposition of the particle has occurred; that may cause the biological response to the substance. The condition of the mucociliary system affects the clearance of particles from the lung, once deposited.

Question #: 1486- The size particle which has the greatest retention in the lung is:

- 1) 0.05 to 1.0 micron 2) 0.5 to 0.75 microns 3) **1.0 to 5.0 microns** 4) 5.0 to 10.0 microns

Answer:3- Particles in the size range of 1.0 to 5.0 microns penetrate the lungs into the alveolar area where they have less of a chance of being cleared from the lung. Particles less than 1.0 micron tend to stay in the airstream and are breathed back out, while particles greater than 5.0 microns are captured in the upper respiratory tract and do not get to the lower portions of the lungs.

Question #: 1487- An irreversible diseased lung condition in which the alveolar walls have lost their resiliency resulting in an excessive reduction in the lung capacity is called:

- 1) Eclema 2) Dipuria 3) **Emphysema** 4) Physema

Answer:3- Emphysema is an irreversible lung condition in which the alveolar walls have lost their resiliency, resulting in an excessive reduction in the lung capacity.

Question #: 1488- A dark-blue to purplish coloration of the skin and the mucous membranes caused by lack of oxygen utilization by the body is defined as a:

- 1) Toxemic effect 2) Canasine effect 3) **Cyanotic effect** 4) Cryogenic effect

Answer:3- The cyanotic effect causes a dark-blue to purplish coloration of the skin and the mucous membranes caused by lack of oxygen utilization by the body.

Question #: 1489- The effect of local or generalized grey-blue colored impregnation of the skin tissue with silver is called:

- 1) Asphyxia **2) Argyria** 3) Atrophy 4) Diaphoresis

Answer:2- Argyria is the effect of local or generalized grey-blue colored impregnation of the skin tissue with silver.

Question #: 1490- What part of the eye is acutely damaged by the welders flash of ultraviolet rays?

- 1) Pupil 2) Sclera **3) Cornea** 4) Retina

Answer:3- The cornea is acutely damaged by the welders flash of ultraviolet rays.

Question #: 1491- Activation-dependent carcinogens are those which require bioactivation of the parent molecule to an ultimate carcinogen. Synonyms for this term include _____.

- 1) Primary carcinogens **2) Procarcinogens** 3) Direct-acting carcinogens 4) Cocarcinogens

Answer:2-Procarcinogen, precarcinogen, secondary carcinogen, and indirect-acting carcinogens are all terms implying activation-dependence. Activation- independent, direct-acting, or primary carcinogens are those in which the parent molecule is the ultimate carcinogen.

Question #: 1492- Carcinogens that interact with DNA are _____ carcinogens.

- 1) Activation-dependent **2) Genotoxic** 3) Epigenetic 4) Unclassified

Answer:2- Activation-dependent carcinogens are one type of genotoxic carcinogens. Epigenetic carcinogens are basically those for which no evidence of DNA reactivity has been found.

Question #: 1493- Chemical carcinogens are defined operationally by their ability to cause neoplasms. Which of the following is NOT acceptable evidence for a carcinogenic effect?

- 1) Earlier development of tumors 2) Increase in benign tumors
3) Greater multiplicity of tumors **4) Presence of chemical DNA adducts**

Answer:4- The presence of chemical DNA adducts is indicative of a genetic lesion, not a tumor.

Question #: 1494- The uncertainty factor approach (i.e., derivation of a risk reference dose or RFD) is used to derive guidelines for exposure to _____ agents.

- 1) Carcinogenic **2) Noncarcinogenic** 3) Toxicologic 4) Pharmacologic

Answer:2- Use of the RFD is based on the presumed threshold nature of these effects and uses uncertainty factors to attempt to account for intraspecies and interspecies variation.

Question #: 1495- Children are generally _____ susceptible to the effects of a number of heavy metals as compared to adults.

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- 1) Less **2) More** 3) Equally 4) Variably

Answer:2- Children have an **immature blood-to-brain (BTB) barrier**. Mature BTB's are effective at preventing lead and other heavy metals from reaching the brain and spinal areas.

Question #: 1496- A type of toxic reaction common in acute exposure to solvents is _____.

- 1) Spontaneous aborted pregnancy **2) Narcosis** 3) Anemia 4) Pneumonitis

Answer:2- Acute exposure to a variety of solvents produces disturbances including disorientation, euphoria, giddiness, confusion, and eventually unconsciousness, paralysis, convulsions, and death if the exposure is not discontinued.

Question #: 1497- The primary target tissue in methanol toxicity is the _____.

- 1) Cornea 2) Cerebellum 3) Nasal epithelium **4) Retina**

Answer:4- Methanol intoxication is characterized by initial mild inebriation followed by an asymptomatic period of 12 to 24 hours after which metabolic acidosis develops. Visual problems include eye pain, blurred vision, reduced visual fields, and blindness (due to damage to the retinal tissue).

Question #: 1498- The most common type of cancer produced by ionizing radiation in children under 10 years of age is:

- 1) Osteogenic sarcoma **2) Myeloid leukemia** 3) Chronic lymphatic leukemia 4) Thyroid cancer

Answer:2- Myeloid and acute leukemias are the most readily induced of the radiation-caused cancers; however, the incidence of chronic lymphatic leukemia does not appear to be affected by radiation.

Question #: 1499- The agent responsible for paralytic shellfish poisoning is:

- 1) Curare **2) Saxitoxin** 3) Tetrodotoxin 4) Ciguateratoxin

Answer:2- Saxitoxin is actually a complex of toxins produced by the Gonyaulax species dinoflagellates (kingdom Protista). Humans develop paralytic shellfish poisoning as a consequence of **ingesting filter feeding mollusks** which have **accumulated the dino-flagellates**. Paralytic shellfish poisoning is associated with algal blooms.

Question #: 1500- _____ is the neurotoxin found in the liver of the pufferfish.

- 1) Tetrodotoxin** 2) Saxitoxin 3) Batrachotoxin 4) Curare

Answer:1- In pufferfish poisoning, death is due to skeletal muscle paralysis. Both saxitoxin and tetrodotoxin have applications in mechanistic toxicity studies because they **selectively block the sodium channels** along the axons, preventing the inward sodium current while leaving the outward potassium current unaffected.

Question #: 1501- Botulinum toxin interferes with the propagation of nerve impulses by preventing the release of _____ from the axon terminal.

- 1) **Acetylcholine** 2) Norepinephrine 3) Adrenaline 4) Gaba

Answer:1- Botulinum toxin, produced by the bacterium *Clostridium botulinum*, binds irreversibly to the axon terminal preventing the development of the end plate potential on the muscle side of the synapse. The muscle behaves as if it were denervated. The result is the paralysis characteristic of botulism.

Question #: 1502- The principle effects of sulfur dioxide on uncompromised human subjects are:

- 1) Carcinogenic effects 2) **Irritant properties** 3) Teratogenic potential 4) Pulmonary toxicity

Answer:2- Sulfur dioxide (SO₂), a major form of air pollution, causes reflex bronchoconstriction and increases in resistance to pulmonary flow. These are mainly a consequence of irritant properties. Atmospheric particulates (e.g., particulate sulfates) can enhance the effects of SO₂ on the body.

Question #: 1503- Numerous LIFESTYLE factors have been shown to impact the toxicity of chemicals. For example, _____ is known to potentiate both the carcinogenic and non-carcinogenic effects of asbestos.

- 1) **Smoking** 2) Ethanol consumption 3) Coffee consumption 4) Obesity

Answer:1- Epidemiologic studies have shown that smoking dramatically increases the risk of developing fibrotic lung disease (asbestosis and bronchiogenic carcinoma). Mesothelioma, another tumor type associated with asbestos exposure, has an uncertain relationship to cigarette smoking.

Question #: 1504- Most snake venoms are:

- 1) **Complex mixtures** 2) Rapidly fatal at small doses 3) Neurotoxic 4) Produced by pit vipers

Answer:1- Snake venoms are complex mixtures containing numerous proteins as well as small amounts of metals, glycoproteins, lipids, biogenic amines, and inorganics such as sodium, calcium, and potassium. Many of the proteins have enzymatic activity (e.g., hyaluronidase, collagenase, proteolytic enzymes) which are thought to facilitate the venoms toxicity.

Question #: 1505- Failure to adequately clean-up chemical releases can result in:

- 1) The spill area being considered an unpermitted land disposal unit 2) Extensive soil and ground water contamination 3) Enforcement actions 4) **All of the above**

Answer:4- All of the above listed consequences can result from the failure to adequately remediate chemical releases. Another impact is a potential decrease in property value.

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Question #: 1506- All of the following are natural sources of air pollution EXCEPT:

- 1) Volcanoes 2) Soil 3) Vegetation **4) Fossil fuels**

Answer:4- Fossil fuel is a component of the global carbon cycle that man mines and combusts; therefore, it is a man-made pollution source.

Question #: 1507- Diesel engines produce ____ pollutants than do gasoline engines:

- 1) Less **2) More** 3) Same amount 4) Less if compression ratios are higher than gasoline engines

Answer:2- Diesel engines produce more pollutants than do comparable gasoline engines. Compression ratios are necessarily higher in diesel engines.

Question #: 1508- Viable reasons for incineration of air pollutants include all of the following EXCEPT:

- 1) Odor control 2) Reduce VOC emissions 3) Reduce explosion hazard **4) Reduce ozone emissions**

Answer:4- Incineration reduces odors, effectively removes most VOC's, and reduces explosion hazards at plants by not allowing build up of flammables.

Question #: 1509- Based on the tonnage of material emitted annually, which of the following sources accounts for the most air pollution in the United States?

- 1) Industry 2) Electric power generation 3) Refuse disposal **4) Transportation**

Answer:4- Transportation, including private automobiles, accounts for approximately 60% of the air pollution in the United States.

Question #: 1510- Atomic absorption is distinctly good for what type of analysis?

- 1) Metals 2) Solvents 3) Aromatic hydrocarbons 4) Aliphatic hydrocarbons

Answer:1- Atomic absorption is an analytical technique which takes advantage of the characteristic **absorption by metals of certain wavelengths of light**.

Question #: 1511- Convert 12 mg/m³ of phosgene gas to ppm. Formula for phosgene is COCl₂
Atomic weights: Cl = 35.5, O = 16, C = 12

- 1) 0.003 ppm 2) 0.05 ppm 3) 3.00 ppm 4) 30.0 ppm

Answer:1- The general formula for conversion is given below: ppm = [(mg/m³) 24.4] / MW
There are 1,000 mg in 1 g ppm = 0.012 mg/m³ * 24.4 / 99 = 0.003 ppm

Question #: 1512- Convert 400 ppm of sulfur dioxide vapors to percent by volume.
The molecular weight of SO₂ is 64:

- 1) 4% 2) 0.4% **3) 0.04%** 4) 0.004%

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Answer:3- 400 ppm means that there are 400 parts of sulfur dioxide for every million parts of the gas. $(400 \text{ parts} / 1,000,000 \text{ parts}) \times 100\% = 0.04\%$

Question #: 1513- If a vessel contains 80% air and 20% hydrocarbons, what is the oxygen content of the vessel?

- 1) 21.9% 2) 16.8% 3) 15.5% 4) 14.0%

Answer:2 Normal air contains 21% oxygen by volume, and the vessel contains 80% normal air.
Oxygen content = $0.80 \times 0.21 = 0.168 = 16.8\%$

Question #: 1514- In a gaseous mixture at 20°C, the partial pressure of the component gases are: H₂ = 200 mm Hg, CO₂ = 135 mm Hg, N₂ = 320 mm Hg, Ar = 105 mm Hg. What is the volume percent of H₂?

- 1) 20.0% 2) 23.6% 3) 26.3% 4) 95.0%

Answer:3- $P(\text{total}) = (200 + 135 + 320 + 105) \text{ mm Hg} = 760 \text{ mm Hg}$
Fractional volume of H₂ = $P(\text{H}_2) / P(\text{total}) = 200 \text{ mm Hg} / 760 \text{ mm Hg} = 0.263 = 26.3\%$

Question #: 1515- In gas chromatography, the separation of sample components is determined primarily by what physical property of substances?

- 1) Number of carbon atoms 2) Boiling point 3) Heat of vaporization 4) Ability to absorb UV

Answer:2- The boiling point is the determining factor within a group of compounds. Physical properties will effect the separability of the compounds.

Question #: 1516- Spectrophotometry uses absorption in the ultraviolet, infrared, and visible wavelengths.

- 1) True 2) False 3) Depends upon water content of substance
4) Depends upon hydrocarbon content of substance

Answer:1- Spectrophotometry is a group of analytical techniques which utilize electromagnetic radiation to conduct qualitative or quantitative analysis of various substances.

Question #: 1517- Strong oxidizing agents:

- 1) React violently with bases 2) Can cause serious burns
3) Shall be stored in steel containers 4) React violently in air

Answer:2- Oxidizers do not always react violently with bases nor can they be stored safely in steel containers. They can however produce severe burns.

Question #: 1518- The density of an unknown ideal gas at 85°C and 720 mm Hg pressure is 2.75 g/l. What is the gram molecular weight of this gas?

- 1) 0.32 g/mol 2) 3.08 g/mol 3) 30.8 g/mol 4) 85.4 g/mol

Answer:4-Temperature is 358° K. Pressure is 720 mm Hg/760 mm Hg/atm = 0.947 atm
 Calculate the number of moles in 1 liter. $PV = nRT$ $n/V = P/RT = 0.947 \text{ atm} / (0.082 \text{ l-atm/K-mol} * 358^\circ \text{ K}) = 0.0322 \text{ mol/l}$ Since 0.0322 mole weighs 2.75 g, 1 mole weighs: Weight = $(2.75 \text{ g/l}) / (0.0322 \text{ mol/l}) = 85.4 \text{ g/mol}$

Question #: 1519- The elements of silane include:

- 1) Si, H 2) Cl, H, C, O 3) As, H 4) S, H

Answer:1- The molecular formula for silane, or silicon tetrahydride, is SiH₄. Therefore silicon and hydrogen are its elemental constituents.

Question #: 1520- The pressure in a closed gas cylinder is doubled as a result of heating. If the original ambient temperature was 25°C, what is the new temperature?

- 1) 50°C 2) 149°C 3) 323°C 4) 596°C

Answer:3- $25^\circ \text{ C} = 298^\circ \text{ K}$ $(P_1 V_1) / T_1 = (P_2 V_2) / T_2$ $(P_1 V_1) / 298 = 2 (P_2 V_2) / T_2$ $P_2 = 2(P_1 V_2) = V_1$ (it is a closed container) $T_2 = (2 * P_1)(V_1)(298) / P_1 V_1 = 596^\circ \text{ K} = 323^\circ \text{ C}$. (P₁ and V₁ are algebraically eliminated. Convert Kelvin back into Celsius.)

Question #: 1521- What is the molar volume at 300°C and 0.95 atm for an ideal gas?

- 1) 49.5 liters 2) 40.9 liters 3) 49.5 m³ 4) 33.3 ft³

Answer:1- Molar volume at STP is 22.4 liters.

For 300°C and 0.95 atm... Molar volume = $22.4 \text{ liters}(T_1 / T_2)(P_1 / P_2)$
 $= 22.4 \text{ liters} (573^\circ \text{ K} / 273^\circ \text{ K})(1 \text{ atm} / 0.95 \text{ atm}) = 49.5 \text{ liters}$

Question #: 1522- What is the volume of 1 gal of water when it is fully converted to water vapor at 230°F, at a pressure of one atmosphere? Assume that water vapor acts as an ideal gas.

- 1) 3,500 liters 2) 4,600 liters 3) 5,500 liters 4) 6,600 liters

Answer:4- How many moles of water in 1 gallon? Once you determine that, use the ideal gas law to determine the volume at the new temperature and pressure.

Molecular weight of water is 18 g/mol $230^\circ \text{ F} = 110^\circ \text{ C} = 383^\circ \text{ K}$

Weight of gallon of water: $W = 1 \text{ gal} * 62.4 \text{ lb/ft}^3 * 454 \text{ g/lb} * 1 \text{ ft}^3 / 7.505 \text{ gal} = 3,775 \text{ g}$

Number of moles = $3,775 \text{ g} / (18 \text{ g/mol}) = 210 \text{ moles}$

$PV = nRT$ $V = nRT/P = (210 \text{ mol} * 0.08205 \text{ l-atm/mol-K} * 383^\circ \text{ K}) / 1 \text{ atm} = 6,600 \text{ liters}$

Question #: 1523- What is the predominant frequency to be expected from a fan which is direct driven at 3,600 rpm, and delivers 2,400 cfm at ½ in. H₂O? The fan has 60 backward curved blades.

- 1) 3,500 Hz 2) 3,600 Hz 3) 2,400 Hz 4) 900 Hz

Answer:2- The frequency is calculated from the number of times/second the blades pass a fixed point. Therefore, Frequency = $3,600 \text{ rev/min}(1 \text{ min} / 60 \text{ sec})60 \text{ blades} = 3,600 \text{ Hz}$

CSP Questions and Answers- Part-II

Question #: 1524- What mathematical formula best describes the decay of a radioactive material?

- 1) **$N = N_0 e^{kt}$** 2) $I \propto r^2$ 3) $N = 4/3 I \propto r^2$ 4) $E = mc^2$

Answer:1- Radioactive materials, and some other substances, decompose according to a formula for exponential decay. That is, the amount of radioactive material N present at time is given by the formula: $N = N_0 e^{kt}$ where k is less than 0.

A radioactive substance is often described in terms of its half-life, which is the time required for half the material to decompose.

Question #: 1525- The speed of sound is medium-dependent. In which media does sound travel fastest?

- 1) Air 2) Water 3) Wood 4) **Steel**

Answer:4- The speed of sound increases as the medium becomes more dense and less compressible.

MEDIUM	AIR	WATER	WOOD	STEEL
SPEED	344m/sec	1,433 m/sec	3,962 m/sec	5,029 m/sec

Question #: 1526- In which media does sound travel at the slowest speed?

- 1) **Air** 2) Water 3) Wood 4) Steel

Answer:1- The speed of sound is directly related to the density of the media it travels through. In this case, air is the least dense media, and sound travels at 1,130 ft/sec. In steel, sound travels at 16,500 ft/sec.

Question #: 1527- A sound is considered ultrasonic if it has a frequency in excess of:

- 1) 5,000 Hz 2) **20,000 Hz** 3) 200 Hz 4) 10,000 Hz

Answer:2- The frequency of human hearing is from 20 - 20,000 Hz; anything above 20,000 Hz is considered ultrasonic.

Question #: 1528- Sound can be transmitted through all of the following EXCEPT:

- 1) Water 2) Steel 3) Lead 4) **Vacuums**

Answer:4- Sound can be transmitted through all of the other media. Vacuum is an absence of a medium; therefore, sound cannot be transmitted through it.

Question #: 1529- Which characteristic of quantifying vibration levels does not take into account the time history of the wave?

- 1) Velocity 2) **Peak to peak** 3) Average 4) None of the above

Answer:2- A peak to peak does not take into account the time history of the wave.

CSP Questions and Answers- Part-II

Question #: 1530- The minimum amount of electric current passing through the body to produce a fatality is:

- 1) 7 A 2) 2 A 3) 500 - 750 mA **4) 70 - 100 mA**

Answer:4- The National Safety Council publicizes that 70 - 100 mA (milliamperes) is enough current to be fatal.

Question #: 1531- Accidental contact with 60 Hz current of 5 to 25 mA can cause the following:

- 1) Death in most adults 2) Cardiac fibrillation **3) Paralysis** 4) No effect

Answer:3- Victims may become paralyzed.

Question #: 1532- Electrical shock intensity and effects will depend on the:

- 1) Age of the conductor 2) Length of the conductor
3) Current path, frequency, and duration 4) Voltage drop across the conductor

Answer:3- Electrical shock intensity and effects depends on the current path, frequency, and duration.

Question #: 1533- Special hazard terminology has been developed for cranes and derricks. What is the correct term for an undetected hazard, created as a result of the **crane's design or by the crane's use**?

- 1) Dormant** 2) Armed 3) Active 4) Either 2 or 3

Answer:1- A dormant hazard is an undetected hazard created either by the crane's design or crane use. Armed and active are other types of crane and derrick hazards.

Question #: 1534- Which of the following are safety devices installed in boilers to relieve pressure?

- 1) Blow down pipes 2) Blow down valves
3) Fusible plugs and safety valves 4) Pressure relief pumps

Answer:3- Fusible plugs are designed to relieve pressure and to indicate certain conditions that contribute to low water (which causes pressure build-up). Safety valves will automatically relieve excess pressure or vacuum, that would otherwise damage equipment or result in injury to personnel. The selection, fabrication, installation, testing, and replacement of safety valves and fusible plugs should be in accordance with the ASME code.

Question #: 1535- Which is the **preferred guard** for power presses performing piercing, blanking, and stamping operations?

- 1) Fixed 2) Interlocked 3) Adjustable 4) Self-adjusting

Answer:1- The fixed guard is considered preferable to all other types and should be used in every case unless it has been definitely determined that this type is not at all practical. The fixed guard at all times prevents access to the dangerous parts of the machine. Besides power

presses, fixed guards are also on guillotine cutters, drilling machines, gear trains, milling machines, and sheet flattening machines.

Question #: 1536- Guarding by means of a rail enclosure which restricts access to a machine is called:

- 1) Point of operation protection 2) Fixed guard 3) Enclosure guarding **4) Fencing**

Answer:4- Guarding by means of a rail enclosure which restricts access to a machine is called fencing.

Question #: 1537- Which of the following statements describes ergonomics/HFE?

I. Engineering something for the population that will use it. **II.** Designing a system so that machines, human tasks, and the environment are compatible with the capabilities and limitations of people. **III.** Designing the system to fit the characteristics of people rather than retrofitting people into the system- All of these.

Answer:4-Ergonomics/HFE is a multidisciplinary activity dealing with interactions between man and his total working environment plus stresses related to such environmental elements as atmosphere, heat, light, and sound, as well as workplace tools and equipment.

Question #: 1538- Placing importance on individual differences, a work station or system should be designed to fit _____ % of the population:

- 1) 50 **2) 90** 3) 95 4) 99.7

Answer:2- When a system is designed which is directed at the average individual, much of the population will not be able to use the system efficiently because each person differs from the other; in other words, there is variability in the population. A better approach when designing a system is, instead of setting the standards to fit the average, design it to fit all but the upper 5% and the lower 5%. The system will then fit 90% of the population.

Question #: 1539- Anthropometry provides the safety engineer with data about:

- 1) Lifting capabilities of males and females **2) Dimensions of human body members**
3) Historical data about accidents 4) Energy required to perform tasks

Answer:2- Anthropometric data provided specific data about the dimensions of the human body.

Question #: 1540-The most effective time to apply the principles of ergonomics is:

- 1) In accident investigations 2) During plant inspections
3) When planning a new operation 4) During special hazard evaluations

Answer:3- The most effective use of the principles of ergonomics is when planning a new operation or planning changes to an existing operation.

Question #: 1541- Ergonomics attempts to:

- 1) Redesign the product to be made more efficiently 2) Redesign tasks to fit the capabilities of males
3) Redesign tasks to fit the capabilities of humans
4) Redesign jobs to reduce the number of tasks required

Answer:3- The engineer attempts to redesign individual tasks in jobs so that a higher percentage of the human population can safely perform the tasks.

Question #: 1542- It is widely recognized that an important aspect of hand tool use is often overlooked. This aspect is:

- 1) Training 2) Tool repair 3) Tool design and selection 4) Tool labeling

Answer:1- Tenosynovitis is often called a "training" disease. Inexperienced or new workers often exert more force than necessary when using certain hand and power tools. Training in proper methods of tool use and encouraging workers to alternate hands when using selected hand tools (a design consideration, too) is encouraged.

Question #: 1543- What three concepts characterize ergonomics?

- 1) Human performance, ergonomic design, systems integration 2) Lifting, frequency, reach
3) Physical demands, mental demands, emotional demands
4) Academic, practitioner, integration

Answer:1- These concepts can be rephrased as work, engineering, and technology management.

Question #: 1544- Good engineering controls for manual materials handling tasks are based on which of the following principles?

- 1) Anthropometry 2) Epidemiology 3) Ergonomics 4) Physiology

Answer:3- Good engineering controls involve designing the workplace to fit the worker, one of the definitions for ergonomics. The key scientific areas that have been studied for the purpose of developing ergonomic guidelines for workplace design include: anthropometry, biomechanics, epidemiology, and physiology.

Question #: 1545- Work operations, reach, operator's position, and posture are all best analyzed by:

- 1) Civil engineers 2) Human factor engineers 3) Safety engineers 4) Environmental engineers

Answer:2- A human factors engineer would utilize these variables to conduct studies.

Question #: 1546- Which of the following is correct when isolating equipment through lockout/tagout?

- 1) Pulling a fuse on electrical equipment to guarantee a dead circuit

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- 2) Disconnecting the main power source to fully disable most machines
- 3) Tightly shutting a high pressure valve before starting maintenance work
- 4) **Physically locking the main power source and labeling it**

Answer:4- Answers 1, 2, and 3 fail to adequately eliminate the hazard. Additional actions require physically "locking out" the energy source(s) and labeling it with a warning tag.
29 CFR 1910.147

Question #: 1547- Which group of specially trained employees, who have been delegated by their employer, are most qualified to respond to an emergency in which a drum of hazardous substance has ruptured?

- 1) Paramedics
- 2) Nurses
- 3) **HAZMAT team**
- 4) First aid team

Answer:3- The HAZMAT team has been given the proper training that covers the necessary information to control and handle chemical substances, spills, and leaks safely, including information on the proper personal protective equipment and procedures that safeguard employees against hazards and toxic substances exposure. In this example, the only choice that explicitly has the required knowledge would be the HAZMAT team - hazardous materials response team.

Question #: 1548- What is a worker's daily 8 hour exposure to trichloroethylene if he spends 90 min at 300 ppm, 4.5 hr at 200 ppm, and 2.0 hr at 20 ppm?

- 1) 17.4 ppm
- 2) 65.2 ppm
- 3) 114 ppm
- 4) **174 ppm**

Answer:4- $TWA = [(1.5 \text{ hr} * 300 \text{ ppm}) + (4.5 \text{ hr} * 200 \text{ ppm}) + (2.0 \text{ hr} * 20 \text{ ppm})] / (1.5 \text{ hr} + 4.5 \text{ hr} + 2.0 \text{ hr}) = 174 \text{ ppm}$

Question #: 1549- When irritant smoke is used to test the fit of a respirator, the smoke is an aerosol of the following chemical.

- 1) **Stannic chloride**
- 2) **Titanium tetrachloride**
- 3) DEHP (Diethylhexylphthalate)
- 4) Either 1 or 2

Answer:4- In the irritant smoke test, either stannic chloride or titanium tetrachloride can be used.

Question #: 1550- Good ergonomic design for standing workstations would include all of the following EXCEPT:

- 1) Opportunity for frequent adjustments in posture
- 2) Anti-fatigue floor mats
- 3) Foot rests or a bar rail
- 4) **Foot controls for adjustments of work**

Answer:4- Foot controls should be avoided for standing workstations, since this can cause shifting of weight to one leg and abnormal postures. Frequent adjustments, floor mats, and foot rests allow the employee to pick and choose the most comfortable positions as needed.

Question #: 1551- Which is the intensity of illumination of a warehouse floor at a distance of 20 ft from a 1,000 candle power source?

- 1) **2.5 footcandle**
- 2) 5.0 footcandle
- 3) 10 footcandle
- 4) 20 footcandle

Answer:1- The intensity of illumination of a surface is inversely proportional to the square of its distance from the light source. Expressed as a formula: Intensity of illumination = Power of source/distance² = 1,000 candle/(20 ft)² = 2.5 footcandle

Question #: 1552- If the distance between a point source of light and a surface is doubled, the intensity of illumination on the surface will be:

- 1) The same
- 2) Reduced to 1/2 of the intensity
- 3) Reduced to 1/4 of the intensity**
- 4) Reduced to 1/8 of the intensity

Answer:3- The intensity of illumination from a point source varies inversely as the square of the distance. As the distance from the light source increases, the illumination decreases. When the distance is 2 times as great, the illumination is (1/2)² or 1/4 as much as it was before.

Question #: 1553- What is the intensity of illumination of the top of a bench at a distance of 4 ft from a 150 candlepower light source?

- 1) 9.4 footcandle**
- 2) 25 footcandle
- 3) 37 footcandle
- 4) 75 footcandle

Answer:1- Intensity of illumination of a surface is inversely proportional to the square of the distance from a light source.

Expressed as a formula: Intensity of illumination = Power of source/distance²
= 150 candle/(4 ft)² = 150 candle/16 ft² = 9.4 footcandle

Question #: 1554- The inverse square law as applied to illumination states:

- 1) The light source as received varies inversely as the square of the power
- 2) The light intensity of the source varies inversely as the distance in lumens
- 3) Light intensity on a surface varies inversely with the square of the distance between source and surface**
- 4) Surface illumination varies directly with the inverse square of the distance

Answer:3- Light intensity on a surface varies inversely with the square of the distance between source and surface.

Question #: 1555- Brightness ratio may be defined as:

- 1) Ratio of illumination between surfaces
- 2) Ratio of difference between light source and reflected surface**
- 3) Ratio of square of distance between illumination surfaces
- 4) Ratio of distance between source and surface

Answer:2- The brightness ratio of is the ratio of difference between light source and reflected surface.

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Question #: 1556- What would be the effect on illumination if a light source 1 ft from a worker is moved 10 ft further away?

- 1) The light illumination is halved 2) The light illumination is doubled 3) The light illumination is reduced by a factor of 10 **4) The light illumination is reduced by a factor of 100**

Answer:4- Like other forms of radiation, light obeys the inverse square law. In other words, if you move away 10 ft, the light will decrease by a factor of $(10 \text{ ft})^2$, or 100.

Question #: 1557- Which one of the following is NOT correct?

- 1) Intensity - How much light a source gives off in a given direction
2) Lumen - Unit of light output from a light source
3) Foot candle - Quantity of light falling on a surface
4) Footlambert - Percentage of light that is reflected from a surface

Answer:4- Footlambert is a unit of luminance. A surface emitting one lumen per square foot of surface has a luminance (brightness) of one footlambert. Reflectance describes how much light is reflected from a surface. A perfectly white surface has a reflectance of one or 100%.

Question #: 1558- The unit used as the unit of illumination equivalent to a lumen/ft² is which of the following:

- 1) Foot candle** 2) Lumen 3) Candela 4) LUX

Answer:1- The classic unit of illumination is the foot candle, which is equivalent to one lumen/ft²

Question #: 1559- What is the intensity of illumination on top of an assembly bench at a distance of 2 ft from a 200 candlepower light?

- 1) 400 foot candle 2) 200 foot candle 3) 100 foot candle **4) 50 foot candle**

Answer:4- The intensity of illumination of a surface is inversely proportional to the square of its distance from the light source. Expressed as a formula: Intensity of illumination = Power of source/distance² = 200 candle/(4 ft)² = 50 footcandle

Question #: 1560-The proper slant for a portable straight ladder is _____ ft vertical to _____ ft horizontal.

- 1) 1, 4 2) 1, 5 **3) 4, 1** 4) 4, 2

Answer:3- The proper slant is 4 ft vertical to 1 ft horizontal. 29 CFR 1910.25 (d)(2) 29 CFR 1910.26 (c)(3)

Question #: 1561- An electrician assures you that the standard duplex wall receptacle is wired correctly. She shows you on her multimeter (properly set for AC voltage) that the voltage across the brass-colored terminal and the terminal labeled with a "W" is 115 V. Do you agree with her assurance that the receptacle is wired correctly?

- 1) Yes 2) No. Ask her to test the voltage across the brass-colored terminal and the green-colored terminal. If it reads 115 V, then agree with her assurance. 3) No. Ask her to test the voltage across the "W"-labeled terminal and the green-colored terminal. If it reads 115 V,

then agree with her assurance. **4) No. Ask her to test the voltage across the "W"-labeled terminal and the green-colored terminal. If it reads 0 V, then agree.**

Answer:4- There should be no voltage across the grounded conductor ("W"-labeled terminal) and the ground wire (green-colored terminal). If there is voltage, then the white wire and the black wire (hot wire) are reversed. NFPA 70 Article 200-10 (National Electric Code) describes the identification of terminals.

Question #: 1562- How does a ground fault circuit interrupter work?

- | | |
|--|---------------------------------|
| 1) Senses small amount of current | 2) Senses small amount of heat |
| 3) Senses dampness | 4) Senses unexpected resistance |

Answer:1- The GFCI operates by sensing small amounts of current going to ground. There are various types of GFCI's with different tripping currents.

Question #: 1563, 1564, 1565 are deleted as the diagram is missing.

Question #: 1566- The basic purpose of local exhaust ventilation is to:

- | | |
|--|---|
| 1) Prevent re-entrance of air contaminants | 2) Remove contaminants at their source |
| 3) Provide dilution ventilation | 4) Both 1 and 3 |

Answer:2- The purpose of local exhaust ventilation is to remove the air contaminants at the source, not to dilute them.

Question #: 1567- The maximum permissible occupational exposure to **incident electromagnetic energy** of frequencies of 10 MHz to 100 GHz averaged over any possible 0.1 hr period is:

- | | | | |
|---------------------------|---------------------------|--------------------------------|--------------------------|
| 1) 0.5 mW/cm ² | 2) 1.0 mW/cm ² | 3) 10 mW/cm² | 4) 1.0 W/cm ² |
|---------------------------|---------------------------|--------------------------------|--------------------------|

Answer:3- According to the OSHA radiation protection guide for normal environmental conditions for incident electromagnetic energy of frequencies from 10 MHz to 100 GHz, the maximum permissible exposure is 10 mW/cm² as averaged over any possible 0.1 hr period. This standard also applies to microwave cooking ovens which usually operate at 915 or 2,450 MHz. 29 CFR 1910.97 (a)(2)(i)

Question #: 1568- Radon 222 has a half life of 3.8 days. What will the activity be of 1.0 microcurie of radon 222 after 15.2 days?

- | | | | |
|--------------------|--------------------|--------------------|----------------------------|
| 1) 0.05 microcurie | 2) 0.50 microcurie | 3) 0.62 microcurie | 4) 0.062 microcurie |
|--------------------|--------------------|--------------------|----------------------------|

Answer:4- One half life results in a decrease of 1/2 of the activity of the radon 222. How many half lives is 15.2 days?

$$15.2 / 3.8 = 4 \text{ half lives} \quad 4 \text{ half lives} = (1/2)^4 = 1/16$$

$$1/16 \text{ of the original activity will remain.} \quad 1/16 \times 1.0 \text{ microcurie} = 0.062 \text{ microcurie}$$

Question #: 1569- Video display terminals have received much attention recently for their possible association with reproductive effects. The reproductive effects have been attributed to ionizing radiation and:

- 1) **Low frequency pulsed magnetic fields** 2) Thermal stress
3) Microwave emissions 4) Extremely low frequency (ELF) electric fields

Answer:1- The main area of discussion has been the possible effects of low level pulsed magnetic fields. There have been several animal studies that have shown the waves to have potential teratogenic effects. The results have been difficult to replicate and some other exposures were not accounted for in the studies. This area will continue to be controversial.

Question #: 1570- What is an alpha particle?

- 1) **Helium nucleus component with a double positive charge** 2) High-speed electron
3) X-rays from a nucleus 4) Unknown radiation component in a calibration

Answer:1- Alpha rays are doubly ionized particles, not electromagnetic radiation. They are composed of two protons and two neutrons. An alpha particle is a helium nucleus.

Question #: 1571- What type of canister respirator would you use if you were working in a parking garage with a gas fired engine?

- 1) **Blue** 2) Black 3) Green 4) Red

Answer:1- Gas fired engines emit carbon monoxide as a by-product; the correct canister color for carbon monoxide is blue. Black is for organic vapors, green is for ammonia, and red is for all types of contaminants.

Question #: 1572- The movement of liquids or vapors through a garment material that occurs on a molecular level is called:

- 1) Penetration 2) Osmosis 3) Convection 4) **Permeation**

Answer:4- Permeation involves sorption of the chemical into the surface of the material, diffusion through the material, and desorption on the opposite side. Answer 1, penetration, is the passage of vapors or liquids through zippers, seams, holes, etc.

Question #: 1573- Airborne zinc oxide resulting from welding galvanized iron would be classified as:

- 1) Dust 2) Smoke 3) **Fume** 4) Mist

Answer:3- Fumes are produced from materials which are solid at room temperature, are vaporized, and then condense. They often are metal oxides. The zinc oxide would therefore be classified as a fume.

Question #: 1574- An atmosphere-supplying respirator must supply a quality of breathing air which contains the normal amount of oxygen, no more than 5 mg/m³ of condensed hydrocarbons, no more than 10 ppm of carbon monoxide, and other requirements. What Grade of air does this describe?

- 1) Grade A 2) Grade B 3) Grade C 4) **Grade D**

Answer:4- Grade D breathing air is required by OSHA and its quality is specified by the ANSI/CGA Commodity Specification for Air and re-stated by OSHA in the Respiratory Protection Standard. In addition to those requirements listed above, the air must also have no pronounced odor and have no more than 1,000 ppm of carbon dioxide. The oxygen concentration must be between 19.5% and 23.5% by volume. ANSI/CGA G-7.1-1989. 29 CFR 1910.134 (i)(1)(ii)

Question #: 1575- An air-purifying, half-face piece respirator has a protection factor of:

- 1) 1 2) 5 **3) 10** 4) 50

Answer:3- The half-face piece air purifying respirator has a protection factor of 10.

Question #: 1576- Pressure demand units are approved for use in IDLH atmospheres. The approvals are for units that last 15, 30, and 60 minutes. There are also approved units with times of 3, 5, 10 minutes. These latter units are approved for:

- 1) Escape only** 2) Escape and entry 3) Entry only 4) Not for industrial applications

Answer:1- The short duration pressure demand units having use times of 3, 5, and 10 minutes have been approved for escape only. They are not approved for entry into non-respirable atmospheres.

Question #: 1577- The following are true regarding the TLV's for simple asphyxiants, EXCEPT:

- 1) They are inert gases and vapors without significant physiological effects
2) Employees should not be exposed above 5,000 ppm
3) Most do not have TLV's
4) Exposure limit is based on % of available oxygen

Answer:2- Simple asphyxiants are inert gases and vapors that, when present in high concentrations in air, act primarily by displacing available oxygen. 5,000 ppm is a high concentration that could be dangerous for flammable asphyxiants such as methane, but is not high enough to reduce the oxygen level from 20.5% to the minimal oxygen level of 18%.

Question #: 1578- A disposable dust mask has a protection factor of approximately:

- 1) 2 **2) 5** 3) 10 4) 50

Answer:2- Disposable respirators such as dust masks have protection factors of 5. The protection factor is the ratio of the concentration outside the mask compared to the concentration inside the mask. Two (2) is less than most respirators, 10 is the protection factor for half mask cartridge respirators and 50 is the protection factor of demand supplied air respirators.

Question #: 1579- Pressure demand SCBA's have a protection factor of:

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- 1) 10 2) 100 3) 1,000 **4) 10,000**

Answer:4- A pressure demand self-contained breathing apparatus has a protection factor of 10,000. The protection factor is the ratio of the concentration outside the mask compared to the concentration inside the mask.

Question #: 1580- The least important consideration in **evaluating the length of time** an air-purifying respirator can be used is the:

- 1) Concentration of the contaminant 2) Duration of exposure
3) Type of cartridge used **4) Toxicity of the contaminant**

Answer:4- Although the toxicity of the contaminant is an important consideration when selecting a respirator, the length of time the respirator can be used is determined by the concentration, duration, and type of cartridge.

Question #: 1581- How many minutes of air do you have in SCBA emergency conditions?

- 1) 60 2) 30 3) Between 15 and 45
4) Significantly less than the rated number of minutes for the cylinder

Answer:4- Due to physical exertion, air is used very quickly in an emergency, significantly reducing the number of minutes of air delivered from an SCBA.

Question #: 1582- Which of the following is correct? Compressed air _____.

- 1) Must never be used for cleaning purposes
2) Must never be used to blow debris from a person
3) May be used for cleaning purposes when the pressure is reduced to below 50 psi
4) May be used to blow debris from a person when the pressure is reduced to below 30 psi

Answer:2- Compressed air must never be used to blow debris from a person. In fact, compressed air shall not be used for cleaning purposes except where reduced to less than 30 psi, and then only with effective chip guarding and personal protective equipment. 29 CFR 1910.242 (b)

Question #: 1583- The lenses in an arc welder's helmet are NOT required to:

- 1) Protect against metal spatter 2) Protect the eyes against ultraviolet radiation 3) Not degenerate from exposure to ultraviolet radiation **4) Protect the eyes against infrared radiation**

Answer:4- The welding helmet contains two lenses. The outer lens is clear glass. It functions to protect the welder from molten metal spatter. The inner lens is tinted and is capable of screening ultraviolet radiation. It will not degenerate from exposure to ultraviolet radiation. It is not designed to protect the eyes from heat (i.e., infrared radiation). ANSI Z87.1 29 CFR 1910.252 (b)(2)

Question #: 1584- A metatarsal guard provides the following protection:

- 1) Toe 2) Toe to insole **3) Toe to ankle** 4) Toe to knee

Answer:3- A metatarsal guard provides toe to ankle protection. The metatarsal guards are commonly used in foundries to protect employees from crushing injuries to the foot.

Question #: 1585- A one pound cylinder of Cl₂ (chlorine) fell off a lab bench and broke. The contents leaked into a sealed room of 60 ft x 30 ft x 15 ft. What is the concentration if the lab is at STP?

- 1) 20.5 ppm **2) 187.5 ppm** 3) 2,050 ppm 4) 20,500 ppm

Answer:2- Volume of the room = 27,000 ft³ (one ft³ is equal to 28.3 l) = 764,640 l

Next calculate the mass of chlorine released. 1 lb Cl₂ = 454.5 g Cl₂

The molecular weight of Cl₂ is 71 g/mol 454.5 g(1 mol/71 g) = 6.4 mol

6.4 moles(22.4 l/mole) = 143.4 l Cl₂

ppm = $V_a/V_b \times 10^6$ (gives the concentration in ppm where V_b is the volume of the room)

= (143.4 l Cl₂ / 764,640 l) x 10⁶ ppm/l = 187.5 ppm Cl₂

Question #: 1586- The vapor pressure of benzene at 25°C is 97 mm Hg. What is the maximum concentration of benzene vapor in air that can be obtained at 25°C at a total pressure of 760 mm Hg?

- 1) 0.127 ppm 2) 1.27 ppm 3) 1,270 ppm 4) 127,000 ppm

Answer:4- $C_{ppm} = (P_{vapor} / P_{total}) \times 10^6 \text{ ppm}$

= (97 mm Hg / 760 mm Hg) x 10⁶ ppm = 127,000 ppm

Question #: 1587- Reactive metals are usually arc welded under a shield of inert gas such as argon. Metals that are welded in this manner include aluminum and titanium. The major pollutants from this operation is (are):

- 1) Phosgene **2) Ozone** **3) Ultraviolet light** **4) Both 2 and 3**

Answer:4- Metal inert gas (MIG) welding produces relatively little metal fumes. It does however, produce significant amounts of ultraviolet radiation and, as a secondary pollutant, ozone.

Question #: 1588- What is the concentration of a chemical called that will kill 100% of the test animals?

- 1) LD50 **2) LD100** 3) LED100 4) LET100

Answer:2- The common terminology for this chemical concentration is LD100 (i.e., the lethal dose for 100% of animals tested).

Question #: 1589- Why is 1,1,1-trichloroethane sometimes substituted for trichloroethylene?

- 1) Lower flash point 2) Less volatile 3) Higher boiling point **4) TLV is higher**

Answer:4- The TLV is higher for 1,1,1-trichloroethane. Also trichloroethylene is suspected of having carcinogenic activity. NOTE: These materials are not in frequent use due to the environmental elimination of CFC's from the work place.

Question #: 1590- Disregarding the exceptions, in a single quarter, what is the maximum allowable whole body occupational exposure to ionizing radiation?

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- 1) 1 rem **2) 1 1/4 rem** 3) 1 1/2 rem 4) 2 rem

Answer:2-There are exceptions allowing whole body exposure up to 3 rem per calendar quarter based on the age of the employee, and the type of other exposures the employee has received. 29 CFR 1910.1096 (b)(1)

Question #: 1591- All of the following standards call for the use of respirators in the event of an over-exposure EXCEPT:

- 1) Lead 2) Asbestos 3) Benzene **4) Carbon dioxide**

Answer:4-Lead, asbestos, and benzene have an OSHA standard associated with their use. In each standard there is mention of respiratory protection. There is no standard for carbon dioxide.

Question #: 1592- What would be the best way to reduce radiant heat emissions in an industrial furnace?

- 1) Use shielding** 2) Employ blowing cool air
3) Lower the furnace temperature 4) Use modern heat absorption chemicals in the furnace

Answer:1- Radiant heat is best controlled by shielding.

Question #: 1593- After a recent hazardous materials spill of hydrochloric acid, you have been asked to analyze the contents of a catch basin in which some of the spilled acid was collected. After collecting a 65 mL sample from the catch basin, you precisely separate the samples into two 30.0 mL pipettes. Next, you test the remaining 5 mL with PH paper and see that it clearly indicates a pH of around 1. You decide to perform an acid/base titration to determine the precise molarity, or molar concentration of the material in the catch basin. You prepare a 0.100 Molar solution of sodium hydroxide and titrate both of your 30.0 mL samples. The first sample requires 50.55 mL of sodium hydroxide for neutralization, and the second sample requires 50.45 mL. What is the molarity of the hydrochloric acid in the catch basin?

- 1) the pH paper indicated that the material in the catch basin is actually basic
2) 0.59 Molar **3) 0.17 Molar** 4) 0.059 Molar

Answer:3- First of all, the indication of 2 on the pH paper implies an acidic liquid; therefore, an acid/base titration using sodium hydrochloric acid is appropriate. Sodium hydroxide and hydrochloric acid neutralize one another on a one-to-one basis (the one H⁺ ion from HCl reacts with the one OH⁻ ion in NaOH, and the one Na⁺ ion in NaOH reacts with the one Cl⁻ ion in HCL). Because of this one-to-one relationship, we can determine the molarity by using this simple identity: $M_1V_1 = M_2V_2$. M_1 is 0.100 M of which 50.5 mL (average) was used to neutralize 30.0 mL (V_2) of acid of unknown molarity (M_2). $(M_1V_1)/V_2 = M_2$ $(0.100 \text{ M} * 50.5 \text{ mL})/30.0 \text{ mL} = M_2 = 0.168 \text{ M}$

Question #: 1594- Which of the following designs will NOT allow equipment to operate:

- 1) Fail-active **2) Fail-passive** 3) Fail-safe 4) Fail-operational

Answer:2- A fail-passive system shuts down the equipment.

Question #: 1595- Which system design is intrinsically safe?

- 1) A non-redundant system **2) Double parallel system**
3) Cost effective system 4) Single parallel system

Answer:2- The only intrinsically safe system listed is a double parallel system.

Question #: 1596- In system safety design, which design philosophy is the closest to "perfect" safety?

- 1) Intrinsically safe** 2) Fail-safe 3) Fail-passive 4) Fail-operational

Answer:1- The design philosophy which is closest to "perfect" safety is intrinsic safety. This design philosophy seeks to limit failures to an extremely small percentage. All of the others allow failure, but seek to engineer out the hazard a failure would bring.

Question #: 1597- This system safety design reduces the system to its lowest energy level given a failure:

- 1) Intrinsically safe **2) Fail-passive** 3) Fail-active 4) Fail-operational

Answer:2- In fail-passive designs, the system is brought to its lowest energy level, given a component failure. The other options do not reduce the system energy level to its lowest potential.

Question #: 1598- Which of the following designs are NOT examples of fail-safe design philosophy:

- 1) Fail-passive 2) Fail-active 3) Fail-operational **4) All are fail-safe designs**

Answer:4- Fail-safe designs include all of the above as design philosophies.

Question #: 1599- All of the following are examples of malfunctions which impact a system EXCEPT:

- 1) Structural 2) Mechanical 3) Power **4) Human**

Answer:4- The potential malfunctions in any system include structural failure, mechanical malfunctions, power failures, and electrical malfunctions. The human component, though critical, is not considered to be a malfunction.

Question #: 1600- A design that automatically reduces the system to its lowest energy level is considered:

- 1) Fail-active **2) Fail-passive** 3) Fail-ceased 4) Fail-non-operational

Answer:2- Fail-passive is a design that automatically reduces the system to its lowest level.

Question #: 1601- A design which allows the system to function safely until corrective action is possible is called:

- 1) Fail-corrective 2) Fail-passive **3) Fail-operational** 4) Fail-non-operational

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Answer:3- Fail-operational is a design which allows the system to function safely until corrective action is possible.

Question #: 1602- When derating an electronic part, which of the following techniques is not appropriate:

- 1) **Decreasing MTBF** 2) Derating for temperature 3) Derating for stress 4) Lower the power dissipation

Answer:1- Decreasing the MTBF is not an appropriate technique for derating an electronic part.

Question #: 1603- A typical hydrocarbon emission rate for a stationary source coal combustion unit is 0.4 pounds hydrocarbon per ton of coal. What is the annual hydrocarbon emission rate from a power plant burning 300 tons of coal per day?

- 1) 15.7 tons 2) 17.9 tons 3) **21.9 tons** 4) 34.3 tons

Answer:3- $0.4 \text{ lbs/ton HC} \times 300 \text{ ton/day} = 120 \text{ lbs/day}$
 $120 \text{ lbs/day} \times 365 \text{ days/yr} = 43,800 \text{ lbs/yr}$
 $\text{HC } 43,800 \text{ lbs/yr} / 2000 \text{ lbs/ton} = 21.9 \text{ tons/yr HC}$

Question #: 1604- A point source produces 1 pound of pollutant every hour. How many tons will be produced in one year assuming continuous 24-hour operation?

- 1) 2.2 tons 2) 2.4 tons 3) 3.6 tons 4) **4.4 tons**

Answer:4- $\text{Total} = 1 \text{ lb/hr} \times 24 \text{ hr/day} \times 7 \text{ days/wk} \times 52 \text{ wk/yr} = 8,736 \text{ lb/yr} \times 1 \text{ ton}/2,000 \text{ lb} = 4.4 \text{ tons/yr}$

Question #: 1605- Catalytic combustion of pollutants implies a _____ burn temperature.

- 1) **Lower** 2) Similar 3) Higher 4) Lower (if molecular weight is high)

Answer:1- Catalytic combustion technology was introduced to lower the temperature required to oxidize pollutants.

Question #: 1606- What is the most important potential consequence of mixing different waste materials together?

- 1) Unexpected/unwanted chemical reactions
2) Increased cost and difficulty of waste characterization and treatment/disposal arrangements
3) Decreased feasibility of reuse or recycling
4) **Injuries**

Answer:4- The consequences of mixing incompatible chemicals together is severe from a health and safety perspective. From a disposal perspective, mixing of wastes can have a severe cost impact resulting from the Land Disposal Restrictions. Mixed wastes can require sequential treatment using different technologies at different facilities.

Question #: 1607- The indicator organism used to measure water quality is:

1) Coliform bacteria 2) Hepatitis B 3) Polio virus 4) Streptococcus

Answer:1- The EPA Drinking Water Standard uses coliform bacteria as an indicator of microbial contamination.

Question #: 1608- Equipment that monitors leachate is used with:

1) Air scrubbers **2) Hazardous waste disposal** 3) Incinerators 4) Gas fired boilers

Answer:2 -Leachate is a combination of groundwater or surface water that has infiltrated the hazardous solid waste and suspended solid matter, microbial waste products, heavy metals, and other chemical substances in a hazardous waste landfill. Leachate comes to the surface or percolates down to the groundwater. Analysis equipment is used to determine the types of heavy metals, chemicals, or biological agents found in the leachate.

Question #: 1609- In waste parlance, the term "rubbish" and "garbage" have different meanings. Rubbish is that portion of waste not containing:

1) Cloth 2) Paper 3) Wood **4) Food**

Answer:4- "Garbage" refers to food waste while rubbish refers to non-hazardous non-food waste.

Question #: 1610- Critical orifice flow is dependent upon upstream pressure:

1) Directly 2) Indirectly 3) As the square 4) Square root

Answer:1- The mass flow rate in a critical orifice is directly proportional to the upstream pressure.

Question #: 1611- Critical pressure is defined as the:

1) Point where temperature inversion occurs 2) Absolute pressure at 473° K
3) Point where no liquid-vapor phase transition occurs 4) Pressure of freezing water

Answer:3- The critical pressure of a substance is that pressure at which no liquid-vapor phase transition occurs for any temperature.

Question #: 1612- Find the density of carbon disulfide if its specific gravity is 1.26.

1) 1.3 lb/gal 2) 1.6 lb/gal 3) 6.6 lb/gal **4) 10.5 lb/gal**

Answer:4- Specific gravity is the ratio of the density of the material to that of water. Since water has a density of 8.33 lb/gal, the carbon disulfide must have a density of 1.26 times that of water.

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$$\text{Density} = 1.26 \times 8.33 \text{ lb/gal} = 10.5 \text{ lb/gal}$$

Question #: 1613- For the following decomposition reaction, how many liters of hydrogen would be released if 17 g of ammonia were decomposed? Assume ideal gas behavior at STP. $2 \text{ (NH}_3\text{)} \rightarrow \text{N}_2 + 3 \text{ (H}_2\text{)}$

- 1) 3.4 liters 2) 16.3 liters **3) 33.6 liters** 4) 36.7 liters

Answer:3-One mole of a gas at STP occupies 22.4 liters. For every mole of ammonia, $3/2$ or 1.5 moles, of hydrogen is released. 17 g of ammonia (NH_3) equals one mole, therefore, hydrogen = $22.4 \text{ l} \times 1.5 = 33.6 \text{ liters}$

Question #: 1614- Given that the volume of a gas at 45°C is 79.5 ml., what would the volume be at 0°C ? Use Charles' Law to determine the new volume.

- 1) 6.83 ml **2) 68.3 ml** 3) 78.3 ml 4) 88.5 ml

Answer:2- Charles' law states that volume is proportional to absolute temperature (i.e., $V_2 = V_1(T_2 / T_1)$). In this way if the temperature rises volume increases. If temperature decreases the volume will decrease. Remember to always use absolute temperatures. $V_2 = V_1 (T_2 / T_1)$
 $= 79.5 \text{ ml} (273^\circ \text{ K} / 318^\circ \text{ K}) = 68.3 \text{ ml}$

Question #: 1615- The atomic weight of carbon is 12, oxygen is 16, and chlorine is 35. What is the atomic weight of a molecule of phosgene (COCl_2)?

- 1) 98** 2) 63 3) 105 4) 89

Answer:1- $12 + 16 + 35 + 35 = 98$

Question #: 1616- Given the following meter readings in gallons per minute, what is the total number of gallons discharged in 6 hours?

0 - 3 hrs 12 gpm
3 - 6 hrs 15 gpm

- 1) 3,000 gal 2) 3,460 gal 3) 4,550 gal **4) 4,860 gal**

Answer:4- You must convert the gpm reading to gallons per hour.

$$(12 \text{ gal/min} \times 60 \text{ min/1 hr}) = 720 \text{ gal/hr}$$

$$12 \text{ gpm} = 720 \text{ gal/hr}$$

$$15 \text{ gpm} = 900 \text{ gal/hr}$$

$$\text{Total} = 3 \text{ hrs at } 900 \text{ gal/hr} + 3 \text{ hrs at } 720 \text{ gal/hr}$$

$$= (3 \text{ hr} \times 900 \text{ gal/hr}) + (3 \text{ hr} \times 720 \text{ gal/hr})$$

$$= 2,700 \text{ gal} + 2,160 \text{ gal}$$

$$= 4,860 \text{ gal}$$

Question #: 1617-How many carbon atoms does a benzene ring have?

- 1) 4 2) 5 **3) 6** 4) 8

Answer:3- A benzene ring has 6 carbon atoms.

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Question #: 1618- How many moles of sulfur are there in 10 g of the element? The atomic weight of sulfur is 32.

- 1) **0.3 mol** 2) 3.0 mol 3) 30.0 mol 4) 32.0 mol

Answer:1- Knowing the atomic weight of sulfur you know that one mole weighs 32 grams (atomic weights have units of grams/mole). Moles = $10 \text{ g} / (32 \text{ g/mol}) = 0.3 \text{ mol}$

Question #: 1619- If a material is contaminated with impurities, the melting point will be _____ than that of the pure material. This property is often used to assess purity in the laboratory.

- 1) Higher 2) Lower 3) Same 4) **Lower and broader**

Answer:4- Impurities will lower AND broaden the melting point of a material. Melting points are often used in the laboratory as an easy method to roughly assess purity.

Question #: 1620- Which of these conversions is NOT true?

- 1) 1 liter H₂O = 1,000 g H₂O at STP
2) **1 m³ = 10,000 liters**
3) 14.7 psi = 760 mm Hg = 760 torr
4) 1 liter= 0.001 m³

Answer:2- To succeed on the examination, one must be very comfortable with unit conversions. Frequently, problems on the examination will be in various non- related units. 1 m³ = 1,000 liters

Question #: 1621- Why does water pressure increase with depth?

- 1) Water becomes more dense with depth
2) **Water exerts more force per unit area with depth**
3) The force of gravity increases with depth
4) Unit mass of water changes with depth

Answer:2-Pressure is defined as a force per unit area. As the weight of water increases with increasing depth, the pressure or force per unit area increases.

Question #: 1622- Why would a lead oxide particle settle faster than a silica particle?

- 1) Shape 2) Size 3) **Density** 4) Diffusion

Answer:3- Settling velocity is directly proportional to particle density; hence, the lead particle will settle faster because it has a higher density.

Question #: 1623- There is a piston with an outside force of 4,000 psi acting on a volume. Keeping all other factors constant, how will the volume change if the piston force is increased to 8,000 psi? Assume that the volume contains an ideal gas.

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1) Decreases by a factor of 10

2) Decreases by a factor of 4

3) Decreases by a factor of 2

4) Increases by a factor of 2

Answer:3- Use the ideal gas laws (knowing that T is constant). $P_1V_1 = P_2V_2$

If the pressure is increased by a factor of 2, the volume must decrease in the same proportion.

$$V_2 = (V_1P_1) / P_2 = (V_1P_1) / (2 P_1) = (V_1 / 2)$$

Question #: 1624- What is atomic mass?

1) Proton number

2) Neutron number

3) Total number of neutrons plus protons

4) Average mass of naturally occurring isotopes

Answer:3- The atomic mass is the sum of the number of protons and the number of neutrons in a particular isotope of an element to yield its atomic mass. Atomic weight, which is a non-integer number (usually), is obtained by averaging the masses of the naturally occurring isotopes of the element.

Question #: 1625- Which of the following compounds is not a member of the chemical class of alkyl benzenes?

1) Toluene

2) Xylene

3) Benzo(a) pyrene

4) Cumene

Answer:3- Benzo(a) pyrene is poly aromatic hydrocarbon (PAH) consisting of several fused benzene rings. The acute inhalation toxicity of alkyl benzenes is sometimes manifested as depression. Unlike benzene, there is no substantiated data indicating that these compounds cause hematologic effects such as anemias or leukemias.

Question #: 1626- A chemical has a vapor pressure of 0.50 mm Hg at 25°C. What is the chemical's concentration (ppm) in air saturated with its vapor at 25°C?

1) 10 ppm

2) 300 ppm

3) 660 ppm

4) 1,520 ppm

Answer:3- $PPM = (0.50 \text{ mm Hg} / 760 \text{ mm Hg}) \times 10^6$

So ppm = 658 ppm

The concentration of a vapor is simply its partial pressure multiplied by a conversion of 10^6 ppm.

Question #: 1627- How much benzene would have to be evaporated in a room 10 m * 10 m * 8 m to give a final concentration of 10 ppm at STP? (The specific gravity of benzene is 0.879. Its molecular weight is 78.)

1) 15.5 ml

2) 25.5 ml

3) 29.0 ml

4) 31.9 ml

Answer:3- Determine total volume of room: $V = 10 \text{ m} \times 10 \text{ m} \times 8 \text{ m} = 800 \text{ m}^3$

Determine the mg/m^3 equivalent to 10 ppm: $\text{mg}/\text{m}^3 = (\text{ppm} \times \text{MW}) / 24.45$

$$= (10 \times 78) / 24.45 = 31.9 \text{ mg}/\text{m}^3$$

Determine the mass of benzene in the room:

$$\text{Mass} = 31.9 \text{ mg}/\text{m}^3 \times 800 \text{ m}^3 = 25,520 \text{ mg} = 25.52 \text{ g}$$

Determine the volume associated with a mass of 25.52 g:

$$\text{Volume} = 25.52 \text{ g} / 0.879 \text{ g}/\text{ml} = 29.03 \text{ ml}$$

Question #: 1628- Which of the following equations is CORRECT?

- 1) $V_1T_1 = V_2T_2$ 2) $V_1/P_1 = V_2/P_2$ 3) $PT = nRV$
4) $\text{ppm} = (\text{mg}/\text{m}^3 * 24.45) / \text{MW (at } 25^\circ\text{C and 1 atm)}$

Answer:4- Only Answer 4 is correct. This is the formula for converting mg/m^3 to ppm.

Question #: 1629- Convert $(100 \text{ oz}/1,000 \text{ ft}^3)$ to mg/l :

- 1) 0.1 mg/l 2) 10 mg/l 3) 100 mg/l 4) 1,000 mg/l

Answer:3- $100 \text{ oz} / 1,000 \text{ ft}^3 = 0.1 \text{ oz}/\text{ft}^3$

Perform a dimensional conversion:

$$\text{Conv} = 0.1 \text{ oz}/\text{ft}^3 * 1 \text{ lb}/16 \text{ oz} * 454 \text{ g}/\text{lb} * 1,000 \text{ mg}/\text{g} * 0.03531 \text{ ft}^3/\text{l} = 100 \text{ mg}/\text{l}$$

Question #: 1630- Given one mole of an ideal gas at a temperature of 0°C , and at a pressure of 1 atm, calculate the molar volume that this gas will occupy:

- 1) 22.4 l/mol 2) 24.2 l/mol 3) 24.4 l/mol 4) 28.8 l/mol

Answer:1- $PV = nRT$ $V = nRT / P = (1 \text{ mol} * 0.08205 \text{ l-atm}/\text{mol-K} * 273^\circ \text{ K}) / 1 \text{ atm} = 22.4 \text{ l}/\text{mol}$

Question #: 1631- Given one mole of an ideal gas at a temperature of 25°C , and a pressure of 1 atm, calculate the volume occupied by the gas:

- 1) 22.4 l/mol 2) 24.5 l/mol 3) 25.4 l/mol 4) 24.5 ml/mol

Answer:2- $PV = nRT$ $V = nRT / P = (1 \text{ mol} * 0.08205 \text{ l-atm}/\text{mol-K} * 298^\circ \text{ K}) / 1 \text{ atm} = 24.46 \text{ l}/\text{mol}$

Question #: 1632- What is the total pressure of a gaseous mixture with partial pressures of 75 mm Hg of SF_6 , 45 mm Hg CH_4 , 50 mm Hg CO , and 120 mm Hg of N_2 ?

- 1) 200 mm Hg 2) 400 mm Hg 3) 300 atm 4) 290 torr

Answer:4- The total pressure is a sum of all of the partial pressures.

$$P = 75 \text{ mm Hg} + 120 \text{ mm Hg} + 45 \text{ mm Hg} + 50 \text{ mm Hg} = 290 \text{ mm Hg} = 290 \text{ torr}$$

(1 torr=1 mm Hg).

Question #: 1633- What is the specific gravity of mercury, which is a liquid at 25°C ? (The density of mercury is 13.534 g/ml , and the density of water is 0.997 g/ml .)

- 1) 13.57 kg/m^3 2) 13.57 3) 13.57 mg/m^3 4) 13.57 g/ml

Answer:2- Specific gravity is the ratio of the density of a substance to that of a reference material. In the case of a liquid, the reference material is water.

$$\text{SG (Hg)} = r \text{ Hg} / r \text{ H}_2\text{O} = (13.534 \text{ g}/\text{ml}) / (0.997 \text{ g}/\text{ml}) = 13.57 \text{ (Note-SG does not have unit.)}$$

CSP Questions and Answers- Part-II

Question #: 1634- Ethyl alcohol has a molecular weight of 46.07 g/mol and a density of 0.785 g/ml at 25°C. What is the volume occupied by 1 mole of ethanol at NTP?

- 1) 58.5 liters **2) 58.5 ml** 3) 50 liters 4) 50 ml

Answer:2- $\text{ml/mol} = 46.07 \text{ g/mol} \times 1 \text{ ml}/0.785 \text{ g} = 58.5 \text{ ml/mol}$
 $\text{ml} = \text{ml/mol} \times \text{number of moles} = 58.5 \text{ ml/mol} \times 1 \text{ mol} = 58.5 \text{ ml}$

Question #: 1635- What is the volume of a 0.76 meter high column of mercury if the cross-sectional area of the column is 1 square meter?

- 1) 0.076 m³ 2) 0.76 m³ 3) 1.14 m³ 4) 1.32 m³

Answer:2- $V = hA$ h is the height and A is the cross-sectional area
 $V = 0.76 \text{ m}(1 \text{ m}^2) = 0.76 \text{ m}^3$

Question #: 1636- A Btu is defined as:

- 1) The amount of energy required to raise 1 kg of water 1°F
2) 1/180 of the amount of energy required to raise the temperature of one pound of water from 32°F to 212°F
3) The amount of energy needed to metabolize 1 lb of fat
4) The amount of heat needed to raise the temperature of 1 lb of water from 32°F to 212°F

Answer:2- The amount of heat required to raise water is a specific amount and varies with temperature. Answer 2 accounts for the change of the heat capacity of water as its temperature changes, giving the average over the whole range of temperatures at which water is a liquid at 1 atm. The more common definition of a Btu is defined as the heat necessary to raise 1 lb of water 1°F.

Question #: 1637- Physical adsorption is characterized by:

- 1) Electromagnetic forces on media surface
2) Reaction with a media to form new compounds
3) Chemical reaction on the surface of a media
4) Penetration of a media by a chemical

Answer:1- Physical adsorption is characterized by electromagnetic forces attracting a chemical to a media. Answer 3 is the mechanism for chemical adsorption. Answer 4 is the mechanism for physical absorption.

Question #: 1638- The volume of a gas at 45°C is 79.5 ml. What is the volume at 0°C? Use Charles' Law to determine the new volume.

- 1) 6.83 ml **2) 68.3 ml** 3) 78.3 ml 4) 88.5 ml

Answer:2- Charles' Law: volume is proportional to absolute temperature, i.e., $V_2 = V_1 (T_2/T_1)$. Remember to use absolute temperatures. $V_2 = 79.5 \text{ ml}(273^\circ \text{ K}/318^\circ \text{ K}) = 68.3 \text{ ml}$

Question #: 1639- When the temperature is raised, the rate of reaction increases. What happens to endothermic reactions when the temperature is raised?

1) Increases 2) Decreases 3) No effect

4) Minor decrease as long as pressure is above atmospheric pressure

Answer:1- Increasing the temperature will increase the rate of any reaction, whether it is exothermic or endothermic because increasing temperature increases the movement of atoms/molecules. Increased movement means increased collisions, increased collisions means increased reactions.

Question #: 1640- The major law of chemistry upon which visible and ultraviolet spectrophotometry is based is:

1) Fick's Law **2) Beer's Law** 3) $PV = nRT$ 4) $P_1 V_1 = P_2 V_2$

Answer:2- Spectrophotometry is based upon Beer's Law. Beer's Law states that $A = a * b * c$, where A is absorption, a is absorptivity, b is cell thickness, and c is concentration.

Question #: 1641- How many moles are in 90 g of acetic acid? (The formula for acetic acid is CH_3CO-OH . The atomic weight of carbon is 12, oxygen is 16, and hydrogen is 1.)

1) 1.5 mol 2) 15 mol 3) 6.02×10^{23} 4) 9.03×10^{23}

Answer:1- Molecular weight of acetic acid: $12 * 2 = 24$ from carbon, $1 * 4 = 4$ from hydrogen $16 * 2 = 32$ from oxygen, So Total $24 + 4 + 32 = 60$

This indicates that acetic acid has a gram-molecular weight of 60 g/mol.

Moles = $90 \text{ g} / (60 \text{ g/mol}) = 1.5 \text{ mol}$

Question #: 1642- 50 g of chlorine contains how many chlorine molecules? (The atomic weight of chlorine is 35.5 g/mol.)

1) 4.24×10^{23} molecules 2) 42.4×10^{23} molecules
3) 8.48×10^{23} molecules 4) 84.8×10^{23} molecules

Answer:1- Molecular weight of $Cl_2 = 35.5 \text{ g/mol} * 2 = 71 \text{ g/mol}$. This indicates that each mole of chlorine has a gram-molecular weight of 71 g/mol. The number of molecules in one mole of ANYTHING is 6.02×10^{23} . Therefore, Molecules = $50 \text{ g} / (71 \text{ g/mol}) * 6.02 \times 10^{23} \text{ molecules/mol} = 4.24 \times 10^{23} \text{ molecules}$

Question #: 1643- Molality refers to:

1) Number of moles of solute per liter of solution

2) Number of moles solute per 1,000 grams of solvent

3) Numbers of moles per gram of molecular weight

4) Number of grams of solute per mole of solution

Answer:2- Molality refers to the number of moles of a solute dissolved per 1,000 grams of a solvent. Answer 1 is molarity.

Question #: 1644- 100 mg/m³ of HCl equals how many ppm at 25°C and 760 mm Hg?

1) 61 ppm **2) 67 ppm** 3) 69 ppm 4) 76 ppm

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Answer:2- The molecular weight of HCL is 36.5 (1 chlorine atom at 35.5 plus 1 hydrogen atom at 1). $PPM = (mg/m^3 * 24.45) / MW$ $PPM = 100 mg/m^3 * 24.5 / 36.5 = 67 ppm$

Question #: 1645- What is the correct way to convert mg/m^3 to g/l ?

- 1) Multiply mg/m^3 by 1,000 g/l per mg/m^3 2) Multiply mg/m^3 by 1 g/l per mg/m^3
3) Multiply mg/m^3 by 10 g/l per mg/m^3 **4) Multiply mg/m^3 by 10^{-6} g/l per mg/m^3**

Answer:4- Since there are 1,000 milligrams in a gram and 1,000 liters in a cubic meter, the conversion is: $mg/m^3 = mg/m^3(1 g / 1,000 mg)(1 m^3 / 1,000 liters) = 10^{-6} g/l$

Question #: 1646- In a titration, 30 ml of a base was used to neutralize 25 ml of a 2.0 N acid. What is the normality of the base?

- 1) 1.67** 2) 2.00 3) 2.33 4) 3.00

Answer:1- Volume acid * Normality acid = Volume base * Normality base
 $25 ml * 2.0 = 30 ml * Normality base$ Normality base = 1.67

Question #: 1647- The volatility of a chemical refers to the:

- 1) Capacity of a liquid to form vapors** 2) Degree of flammability of a chemical
3) Exothermic reaction of a liquid 4) Endothermic reaction of a liquid

Answer:1- Volatility refers to the capacity of a liquid to form vapors, which can be measured through its vapor pressure. Flammability of a liquid is increased if it is more volatile, but non-flammable liquids can be volatile also. Exothermic and endothermic reactions are not related to volatility.

Question #: 1648- The equilibrium between molecules of gas in the atmosphere and molecules of the same gas in solution is defined by:

- 1) Faraday's Law **2) Henry's Law** 3) Friedel-Crafts reaction 4) Plank's Law

Answer:2- Henry's Law states that the solubility of a gas in a liquid is proportional to the partial pressure of that gas-liquid interface.

Question #: 1649- In the Ideal Gas Law, $PV = nRT$, T is expressed in:

- 1) Fahrenheit 2) Celsius 3) Centigrade **4) Kelvin or Rankine**

Answer:4- In the Ideal Gas Law, the temperature is expressed in absolute temperature. The Kelvin scale and Rankine scale are absolute temperature scales.

Question #: 1650- A container holds 50 ml of toluene with a specific gravity is 0.87 g/ml. What is the mass of toluene?

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- 1) 13.2 g 2) 23.5 g **3) 43.5 g** 4) 66.6 g

Answer:3-Specific gravity denotes the ratio of the mass of a substance to that of an equal volume of a reference substance. Specific gravity calculations are used to determine the mass of a volume of liquid. $50 \text{ ml of toluene} \times 0.87 \text{ g/ml} = 43.5 \text{ g toluene}$

Question #: 1651- How many grams of acid are in 500 ml of a 3 molar sulfuric acid solution?

- 1) 47 g 2) 98 g **3) 147 g** 4) 196 g

Answer:3- Molar solution means mol/l. A 3 molar solution of sulfuric acid therefore contains 3 moles of sulfuric acid per liter.

Molecular weight of $\text{H}_2\text{SO}_4 = 98 \text{ g/mol}$ Grams $= 98 \text{ g/mol} \times 3 \text{ mol/l} \times 0.5 \text{ l} = 147 \text{ g}$

Question #: 1652- How many moles of acid are in 500 ml of a 3 molar sulfuric acid solution?

- 1) 1.5 mol** 2) 2.0 mol 3) 2.5 mol 4) 3.0 mol

Answer:1- Molar solution means mol/l. A 3 molar solution of sulfuric acid therefore contains 3 moles of sulfuric acid per liter. $500 \text{ ml} = 0.5 \text{ liters}$ Moles $= 3 \text{ mol/l} \times 0.5 \text{ liters} = 1.5 \text{ mol}$

Question #: 1653- An oxygen tank is filled with oxygen at an absolute pressure of 1,000 pounds per square inch at 17°C . The internal volume of the tank is 1 cubic foot. The oxygen is used in high-altitude safety simulations at an absolute pressure of 10 pounds per square inch at -27°C . How many cubic feet of oxygen can be supplied by the tank under these conditions?

- 1) 70 ft³ 2) 75 ft³ 3) 80 ft³ **4) 85 ft³**

Answer:4- Use the Ideal Gas Law: $(P_1 V_1) / T_1 = (P_2 V_2) / T_2$

Remember to use absolute temperatures.

$(1,000 \text{ psi} \times 1 \text{ ft}^3) / 290^\circ \text{ K} = (10 \text{ psi} \times V_2) / 246^\circ \text{ K}$ $V_2 = 84.8 \text{ ft}^3$

Question #: 1654- What is the pH of a solution with a concentration of 10^{-4} mol/l of hydrogen ions?

- 1) 3 **2) 4** 3) 9 4) 10

Answer:2- Use the formula: $\text{pH} = -\log [\text{hydrogen ion concentration}]$

$\text{pH} = -\log [1 \times 10^{-4}]$ $\text{pH} = -(-4) \log 1$ $\text{pH} = 4$

Question #: 1655- A liquid with a pH of 7 is:

- 1) Basic 2) Acidic **3) Neutral** 4) Alkaline

Answer:3- A liquid with a pH of 7 is neutral.

Question #: 1656- What is the wavelength of the sound emitted by a guitar string that vibrates 452 times per second in a room where the temperature is 20°C ? (Velocity of sound at $20^\circ\text{C} = 1,130 \text{ ft/sec}$)

- 1) 0.4 ft 2) 0.8 ft 3) 1.2 ft **4) 2.5 ft**

Answer:4- If the frequency of a vibrating object is known, the wavelength of the sound it emits bears the following relationship: $\text{Wavelength} = \text{Velocity of sound} / \text{Frequency}$
 $= (1,130 \text{ ft/sec}) / (452 \text{ cycles/sec}) = 2.5 \text{ ft}$

Question #: 1657-The explosion of an atomic bomb exemplifies the conservation of energy principle in which:

- 1) Energy is converted into matter
- 2) Energy is converted into an explosion
- 3) Energy begets more energy by means of a nuclear explosion

4) Matter is converted into energy

Answer:4- The explosion of an atomic bomb involves the conversion of uranium atoms to other atoms with the evolution of energy in the process. The energy is generated from the conversion of a given mass of the starting atoms into energy.

Question #: 1658-The image formed by a convex mirror, when compared to the actual object, is:

- 1) Upright and smaller
- 2) Upright and larger
- 3) Inverted and smaller
- 4) Inverted and larger

Answer:1- The convex mirror is commonly used as a rear-view mirror for motor vehicles because the objects always appear upright and smaller. They are able to provide a wider view of the roadway behind a driver than could be obtained from a plane mirror.

Question #: 1659- $12! / 9!$ Equals:

- 1) $1/3$
- 2) 3
- 3) $12 * 11 * 10$
- 4) $12! 3!$

Answer:3- The factorial of 12 divided by the factorial of 9 is:

Question #: 1660- $y = (x+5) / (x-5)$. If $x = 6$, then y equals:

- 1) 11
- 2) 9
- 3) 7
- 4) 4

Answer:1- The solution when $x = 6$ is: $(x+5) / (x-5) = y$ $(6+5) / (6-5) = y$ $11 = y$

Question #: 1661- One square has a side 3 ft longer than the side of a second square. If the area of the larger square is 4 times as great as the area of the smaller square, find the length of the side of each square.

- 1) 1 ft and 4 ft
- 2) 2 ft and 5 ft
- 3) 3 ft and 6 ft
- 4) 4 ft and 7 ft

Answer:3- The solution is as follows:

Area of small square = S^2

Area of large square = $(S+3)^2$

As the area of the large square is 4 times as great as that of the small square:

$$(S+3)^2 = 4S^2$$

SOLVING BY USE OF FACTORING

$$(S+3)^2 = 4S^2$$

$$S^2 + 6S + 9 = 4S^2$$

$$-3S^2 + 6S + 9 = 0$$

$$3S^2 - 6S - 9 = 0$$

$$3(S^2 - 2S - 3) = 0$$

$$3(S - 3)(S + 1) = 0$$

(To get to this step you, must factor the equation in the previous step.) Knowing that if the product of two numbers is zero, one or both of the numbers must be zero.

$$S - 3 = 0$$

$$S + 1 = 0$$

$$\text{Small square } 3 = 3$$

$$S = -1$$

$$\text{Large square } S + 3 = 6$$

(-1 cannot be a solution)

Question #: 1662- If the circumference of a circle is 8.0 in., its area is:

- 1) **5.1 in²** 2) 8.0 in² 3) 16 in² 4) 32 in²

Answer:1- The circumference of a circle with radius r is $2\pi r$. A circle having a circumference of 8.0 in. must then have a radius $= 4/\pi$ in. The area of a circle $= \pi r^2$. Substituting $4/\pi$ for r , we get Area $= \pi (4/\pi)^2$, which is equal to $16/\pi = 5.1 \text{ in}^2$.

Question #: 1663- The number $1.33 \times 10^4 + 1.33 \times 10^5$ equals:

- 1) 1.33×10^9 2) 1.33×10^1 3) 14.33×10^4 4) **14.63×10^4**

Answer:4- Numbers expressed with power of 10 cannot be added or subtracted directly unless the powers of 10 are the same:

$$1.33 \times 10^4 + 1.33 \times 10^5 = 1.33 \times 10^4 + 13.3 \times 10^4 = 14.63 \times 10^4$$

Question #: 1664- $\log(27X) = 2.38$ equals:

- 1) **8.9** 2) 18 3) 36 4) 45

Answer:1- In solving for X , it is necessary to convert from logarithmic form to that of exponential.

$$\log(27X) = \log(27) + \log(X) = 2.38 \quad 1.431 + \log(X) = 2.38$$

$$\log(X) = 2.38 - 1.431 = 0.949 \quad \text{antilog}(0.949) = 8.9$$

Question #: 1665- The product of (3.1×10^5) and (0.2×10^2) is:

- 1) **6.2×10^6** 2) 6.2×10^7 3) 6.2×10^8 4) 6.2×10^{10}

Answer:1- The product of $(3.1 \times 10^5)(0.2 \times 10^2) = (3.1 \times 0.2)(10^5 \times 10^2) = 0.62 \times 10^7 = 6.2 \times 10^6$

Question #: 1666- Radiation is the primary way in which energy is transferred:

- 1) From a beverage to the ice cubes floating in it 2) From a soldering iron to copper wires being soldered 3) **From the sun to an earth satellite** 4) From a gas stove flame to a pan of water

Answer:3- As the space between the sun and an earth satellite is an almost perfect vacuum and conduction and convection cannot transfer energy in a vacuum, radiation becomes the main source of energy transfer.

Question #: 1667- A temperature of 120°C is equivalent to a temperature of:

- 1) 35°K 2) 153°K 3) 248°K **4) 393°K**

Answer:4- Kelvin scale is an absolute thermodynamic scale on which the temperature measured is based on the average kinetic energy per molecule of a perfect gas. The zero on the Kelvin scale is $-273.18^{\circ}\text{Celsius}$. The size of each Kelvin degree is the same as the Celsius degree. Thus, by adding 273.18 to any Celsius temperature, we obtain the corresponding temperature on the absolute scale or $(120 + 273.18)\text{K} = 393.18^{\circ}\text{K}$.

Question #: 1668- On the Fahrenheit scale, a temperature of 55°C is recorded as:

- 1) 87°F 2) 119°F **3) 131°F** 4) 99°F

Answer:3- Combining the facts that 180 divisions on the Fahrenheit scale are equal to 100 divisions on the Celsius scale (making each Fahrenheit degree $5/9$ as large as a Celsius degree) and 0°C is the equivalent of 32°F derive the following relationships:

$$F = 9/5C + 32 \text{ and } C = 5/9 (F - 32) \quad \text{Therefore, } F = 9/5 (55) + 32 = 131^{\circ}\text{F}$$

Question #: 1669- What would be the effect on a magnet if it were heated with a soldering iron?

- 1) No effect 2) It would strengthen it **3) It would weaken it** 4) It would reverse the polarity

Answer:3- Heating increases the random motion of the particles in the magnet. The arrangement of molecular magnets becomes less orderly, making the magnet weaker.

Question #: 1670- In a light wave:

- 1) The vibrations of the electric field are transverse and those of the magnetic field are longitudinal
2) The vibrations of the electric and magnetic fields are transverse
3) All vibrations are longitudinal
4) The vibrations of the magnetic field are transverse and those of the electric field are longitudinal

Answer:2- Light is an electromagnetic wave. In all electromagnetic waves, the electric and magnetic fields vibrate at right angles (transverse) to the direction in which the wave is traveling.

Question #: 1671- A trait of alpha particles, which are emitted from radioactive nuclei, is that they:

- 1) Usually consist of protons 2) Usually consist of electrons
3) Are helium nuclei 4) Are hydrogen nuclei

Answer:3- Alpha particles emitted from radioactive sources are helium nuclei. These particles consist of a cluster of two protons and two neutrons (giving a mass number of four, being structurally the same as the nucleus of a helium atom). Alpha particles, on slowing down,

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combine with electrons from the material through which they are passing and thus become helium atoms.

Question #: 1672- An automobile traveling 55 mi/hr is slowing up at the rate of 5 mi/hr per second. How many seconds will it take to stop?

- 1) 0.09 sec 2) 0.40 sec 3) 6.00 sec **4) 11.0 sec**

Answer:4- Newton's Law: V (velocity) = a (acceleration) * t (time) applies.
Initial velocity is substituted for final velocity when a moving body is being negatively accelerated. $V = a t$, or rearranging, $t = V/a$ $t = 55 \text{ mi/hr} / (5 \text{ mi/hr/sec}) = 11 \text{ sec}$

Question #: 1673- A light meter used to measure the intensity of surface illumination provides readings measured in:

- 1) Lumens 2) Watts per foot **3) Foot candles** 4) Candlepower

Answer:3- A light meter is the instrument used to measure the intensity of surface illuminations. Readings are measured in foot candles. By definition, a foot candle is the illumination at a point of a surface which is one foot, and perpendicular to a uniform point source of one candle. More briefly, a foot candle is a unit of illumination.

Question #: 1674- Neutrons are known to penetrate matter readily mainly because:

- 1) They are much smaller in size than electrons or protons
2) They have less mass than either electrons or protons
3) They are electrically neutral
4) They possess more energy than electrons or protons

Answer:3- Neutrons are electrically neutral. Compared with electrons and protons their volume is almost the same. The mass of a neutron is slightly more than that of a proton. Characteristically, atoms contain much **empty space which neutrons can travel through** without experiencing electric forces from electrons and nuclei because they are electrically neutral.

Question #: 1675- The greater the frequency of sound waves:

- 1) The lower the pitch of the sound 2) The louder the sound
3) The softer the sound **4) The higher the pitch of the sound**

Answer:4- Frequency is directly related to pitch. The higher pitched a sound is, the higher is its frequency, conversely, low pitched sounds have low frequencies.

Question #: 1676- An experiment involving sound requires the use of an oscilloscope. On the screen, the loudness of sound should be viewed as a function of:

- 1) Wavelength 2) Frequency **3) Amplitude** 4) Weighted sound level

Answer:3- The intensity of sound is characterized by its loudness, e.g., the louder the sound, the greater the amplitude of its wave motion. On the oscilloscope, the sound wave would appear as an alternating wave motion whose amplitude adjusts to the sound volume.

Question #: 1677- If a maintenance person moves at a speed of 0.5 times that of sound in a direction away from a noise source producing a sound frequency of f , he would probably hear a sound frequency:

- 1) Less than f 2) Equal to f 3) 1.5 times greater than f 4) Twice that of f

Answer:1- This is an example of the Doppler effect. Since the maintenance person is moving away from the source of the sound, successive compressions will reach him at the same rate as when he is stationary. Because his rate of speed is less than sound, the compressions don't catch up with him until the amplitude is too small to have any effect hence, the frequency he hears is less than f .

Question #: 1678- Which of the following types of electromagnetic radiation has the shortest wavelength?

- 1) Infrared light 2) Ultraviolet light 3) Visible light 4) Gamma waves

Answer:4- Gamma rays have the shortest wavelength. This is followed by ultraviolet light, visible light, and infrared light.

Question #: 1679- A 6 in. diameter grinding wheel rotating at 500 rpm has a surface speed of?

- 1) 556 ft/min 2) 690 ft/min 3) 785 ft/min 4) 970 ft/min

Answer:3- You first must calculate the circumference of the wheel.

$$C = \pi d = 3.14 * 0.5 \text{ ft} = 1.57 \text{ ft} \quad \text{Speed} = C * \text{rpm} = 1.57 \text{ ft} * 500 \text{ rpm} = 785 \text{ ft/min}$$

Question #: 1680- One of the most fundamental relationships in the field of acoustics is the relationship between wavelength, velocity, and frequency. Wavelength (λ) =

- 1) f/c 2) c/f 3) Force * mass 4) Force * g

Answer:2- Wavelength is equal to the velocity divided by the frequency. This implies that wavelength is inversely proportional to frequency and directly proportional to velocity.

Question #: 1681- Solve the following problem: $(6! \ 6!) / (3! \ 2!)$

- 1) 47 2) 4,320 3) 43,200 4) 432,000

Answer:3- The factorial (!) notation indicates that you multiply all numbers less than or equal to the number, e.g., $6! = 6 * 5 * 4 * 3 * 2 * 1 = 720$
The problem then becomes: Answer = $(720 * 720) / (6 * 2) = 43,200$

Question #: 1682- The time that it takes to complete one wave cycle (peak to peak) is called the:

- 1) Wavelength 2) Period 3) Frequency 4) Q factor

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Answer:2- The period is the TIME it takes to complete one wave cycle. It is measured in seconds. The distance between the peaks is the wavelength.

Question #: 1683- Transmission loss is:

- 1) Frequency dependent
- 2) Amplitude dependent
- 3) Different for different substances
- 4) Both 1 and 3

Answer:4- Transmission loss is frequency dependent and changes depending on the substance. For example, oak doors have a different transmission loss than do concrete blocks.

Question #: 1684- Transmittance and absorbance in spectrophotometry are:

- 1) Inverses of one another
- 2) Always 180° out of phase to one another
- 3) Synonyms
- 4) Not related in any way

Answer:1- Transmittance and absorbance are simple inverses of one another. The amount of light absorbed is absorbance and transmittance is the amount of light that is not absorbed.

Question #: 1685- Which of the following is a root of the equation? $6x^2 + 16x + 8 = 0$

- 1) -2
- 2) 0
- 3) -1
- 4) 1

Answer:1- Substituting $x = -2$ into the equation you find it yields 0, therefore $x = -2$ is a root.

Question #: 1686- A 10 lb steel ball is dropped from a height of 12 ft. What are the potential and kinetic energies of the ball when it reaches a height of 8 ft?

- 1) PE = 80 ft-lb, KE = 40 ft-lb
- 2) PE = 80 ft-lb, KE = 80 ft-lb
- 3) PE = 40 ft-lb, KE = 80 ft-lb
- 4) PE = 40 ft-lb, KE = 40 ft-lb

Answer:1- $PE = m * g * h$ (at 8 ft)
 $PE = (10 \text{ lb} / 32.2 \text{ ft/sec}^2) 32.2 \text{ ft/sec}^2 * 8 \text{ ft} = 80 \text{ ft-lb}$
KE represents the work performed from 12 ft to 8 ft
 $KE = 10 \text{ lb} (12 \text{ ft} - 8 \text{ ft}) = 40 \text{ ft-lb}$

Question #: 1687- A 10 lb steel ball is dropped from a height of 12 ft. What is the speed of the ball after it has fallen 4 ft?

- 1) 16 ft/sec
- 2) 18 ft/sec
- 3) 20 ft/sec
- 4) 22 ft/sec

Answer:1-KE represents the work performed during the 4 ft part of the fall.
 $KE = 10 \text{ lb} * 4 \text{ ft} = 40 \text{ ft-lb}$ KE also is equal to $\frac{1}{2} * m * V^2$
 $m = 10 \text{ lb} / 32.2 \text{ ft/sec}^2 = 0.3106 \text{ lb-sec}^2/\text{ft}$ $40 \text{ ft-lb} = (0.3106 \text{ lb-sec}^2/\text{ft} * V^2) / 2$ $V = 16 \text{ ft/sec}$

Question #: 1688- What is the potential energy with respect to the elastic force of a ball pulled 6 in. in a horizontal direction from the un deformed position?(Assume a spring constant of 8 lb/in.)

- 1) 196 in.-lb
- 2) 144 in.-lb
- 3) 48 in.-lb
- 4) 6 in.-lb

Answer:2- $PE = ks^2 / 2 = 8 \text{ lb/in.} (6 \text{ in})^2 / 2 = 144 \text{ in.-lb}$

Question #: 1689- At what frequency are the A, B, and C acoustic scales equal?

- 1) 250 Hz **2) 1,000 Hz** 3) 500 Hz 4) 2,000 Hz

Answer:2- The response curves for the three scales listed all cross at 1,000 Hz.

Question #: 1690- Relative humidity is determined by:

- 1) Wet bulb temperature alone 2) Vane anemometer
3) Impinger sample **4) WBGT and DBT with psychrometric chart**

Answer:4- Relative humidity is the ratio of the amount of water the air has to the amount of water it can hold.

Question #: 1691- Sound is a pressure phenomenon. If the sound pressure is doubled, how is the sound level (in decibels) affected?

- 1) Increases by approximately 6 units** 2) Doubles
3) Halved 4) Increases exponentially

Answer:1- Number of dB = $20 \log (P_1/P_2)$ $P_2 = 2P_1$ $\text{dB} = 20 \log (2/1) = 6$
 P_1 and P_2 are the two sound pressure levels.

Question #: 1692- The average power density one meter from a microwave antenna is 160 mW/cm². What is the power density at 2 meters?

- 1) 160 mW/cm² 2) 80 mW/cm² 3) 60 mW/cm² **4) 40 mW/cm²**

Answer:4- Use the inverse square law. $\text{PWD} = 160 \text{ mW/cm}^2 (1 \text{ m} / 2 \text{ m})^2 = 40 \text{ mW/cm}^2$

Question #: 1693- Transmission loss (TL) is defined by any of the following EXCEPT:

- 1) Energy lost as sound travels through a material 2) Is a ratio of two numbers
3) Affected by openings in an acoustical barrier **4) Reflective property of a material**

Answer:4- Transmission loss is defined as 10 times the log of the ratio of the acoustic energy transmitted through a barrier to the incident acoustic energy. It is a physical property of the material used for a given construction.

Question #: 1694- What is the smallest particle size that can be seen with the unaided eye?

- 1) 1 - 10 mm 2) 10 - 50 mm **3) 50 - 100 mm** 4) 100 - 200 mm

Answer:3- 50 - 100 mm is the smallest particle size that can be seen unaided by the human eye.

Question #: 1695- The most common source of radon gas is:

- 1) Soil 2) Building materials 3) Well water 4) Carpeting

Answer:1- Soil and bedrock that is rich in uranium or radium will off-gas radon, which can enter a home basement through cracks or other openings. Building materials only rarely contribute to radon gas in a home, unless made with contaminated materials. Well water can contribute to radon gas exposure, but only at very high water concentrations. Carpeting is not a source of radon.

Question #: 1696- The half-life of radon is:

- 1) 1 year 2) 38 days 3) 3.8 days 4) 1 day

Answer:3- The half-life of radon gas is 3.8 days.

Question #: 1697- Radon emits what type(s) of radiation when it decays?

- 1) Alpha 2) Beta 3) Gamma 4) Alpha and gamma

Answer:4- Radon 222 produces alpha particles and gamma radiation when it decays to polonium 218.

Question #: 1698- Radon is a hazard for all of the following reasons EXCEPT:

- 1) Potential for lung cancer
2) Birth defects from exposure of pregnant women in first trimester
3) Exposure to decay products from inhalation of dust
4) Decay products trapped in lung decay and damage lung tissue

Answer:2- Radon is not known to cause birth defects. It is known to cause lung cancer from inhalation of dust particles contaminated with radon decay products, which further decay and can cause lung damage.

Question #: 1699- The disintegration rate of 1 gram of radium is 3.7×10^{10} d/s. This rate of decay has units of:

- 1) Half-life 2) Fuel-life 3) Average rate 4) Curie

Answer:4- A curie is a unit of rate of decay.

Question #: 1700- Biohazards can be transmitted to a person by:

- 1) Inhalation or accidental injection 2) Inhalation, ingestion, or absorption
3) Physical contact 4) All of the above

Answer:4- Biohazards can be transmitted to a person through inhalation of airborne agents, injection (usually accidental), ingestion through contaminated food or water, and absorption by physical contact with contaminated surfaces or clothing.

Question #: 1701- Blood is carried to the heart by the:

- 1) Arteries 2) Capillaries 3) Spleen 4) Veins

Answer:4- The veins carry blood to the heart. Arteries carry blood away. (The pulmonary artery and pulmonary vein are exceptions to this).

Question #: 1702- Light passes through the crystalline lens in the eye and focuses on the:

- 1) Cornea 2) Iris 3) Pupil 4) Retina

Answer:4- Light enters the eye through the pupil, travels through the transparent crystalline lens, then travels through the vitreous humor (eyeball), and finally focuses on the retina.

Question #: 1703- Carbon monoxide is particularly dangerous because:

- 1) It inhibits blood cells from carrying oxygen
2) It is not easily transferred in cellular respiration
3) It is a systemic poison that inhibits enzyme generation
4) It paralyzes the respiratory center of the brain

Answer:1- Of all the gases that have poisonous effects upon man and animals, carbon monoxide is the most widely encountered. It exerts its effects by combining with the hemoglobin of the blood and interrupting the normal oxygen supply to the body tissues.

Question #: 1704- Fats, oils, and waxes are identified with:

- 1) Carbohydrates 2) Proteins 3) Lipids 4) Glucose

Answer:3- Lipids are one of the four main classes of biological molecules that all living cells contain. Lipids include fat, waxes, and oils. Their primary functions include storing energy and making up a major part of cell membranes.

Question #: 1705- There are four main classes of complex biological molecules that are contained in all living cells. Which of the following is NOT one of them?

- 1) Carbohydrates 2) Proteins 3) Hormones 4) Lipids

Answer:3- Hormones are not one of the main classes of complex biological molecules. The four main classes of complex biological molecules that all living cells contain include carbohydrates, proteins, lipids, and nucleic acid.

Question #: 1706- AIDS is caused by a:

- 1) Protozoa 2) Rickettsia 3) Bacteria 4) Virus

Answer:4- The human immunodeficiency virus (HIV) is the infectious etiologic agent causing AIDS.

Question #: 1707- The genetic code is best described as:

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- 1) Uncomplicated 2) Detached 3) Degenerate 4) Variable between species

Answer:3- The genetic code is degenerate. That is, an amino acid may be coded by more than one codon. (A codon is a sequence of three adjacent nucleotides that specifies the insertion of an amino acid in a specific structural position during protein synthesis).

Question #: 1708- Nature tends to maintain a balanced and symmetrical state for all organisms to exist. In a normal healthy person this is called:

- 1) State of balance 2) Positive feed-back mechanism
3) Anthropometry 4) Homeostasis

Answer:4- Homeostasis is a state of physiological equilibrium produced by a balance of functions and chemical composition within an organism.

Question #: 1709- The three parts of a human cell consist of the nucleus and:

- 1) Protoplasm and cytoplasm 2) Membrane and cytoplasm
3) Chromosomes and membrane 4) DNA and RNA

Answer:2- A cell is a structural unit of which tissues are made. The cell is the basic building block of life. It is a living thing which grows and reproduces itself. It has three basic parts: the nucleus, cytoplasm, and membrane.

Question #: 1710- The basic material from which all tissue is made is called:

- 1) Plasma 2) Cytoplasm 3) Protoplasm 4) Nucleus

Answer:3- Protoplasm is the basic material from which all living tissue is made. Physically, it is a viscous, translucent, semifluid colloid composed mainly of proteins, carbohydrates, fats, salts, and water.

Question #: 1711- Each human cell has a fixed number of chromosomes. How many does each parent contribute?

- 1) 22 2) 23 3) 44 4) 46

Answer:2- The nucleus of the cell contains chromosomes which are comprised of genes or heredity-determining units. Each cell has a fixed number of chromosomes, 46 in all, of which, half come from each parent. The 46 chromosomes contain 22 pairs of non-sexual autosomes and one pair of sex chromosomes.

Question #: 1712- In toxicology, we show concern for the inhalation of dust particles measured in microns. What is the size of a micron?

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- 1) Approximately 1/25,000 of an inch
- 2) 0.0001 millimeters
- 3) 10^{-4} centimeters
- 4) Both 1 and 3

Answer:4- A micron is defined as a unit of length, the thousandth part of a millimeter (0.001 mm) or the millionth part of a meter (10^{-6} m or 10^{-4} cm) which is approximately 1/25,000 of an inch.

Question #: 1713- The scientific study of how, when, where, and why an illness distributes itself over time in a population describes:

- 1) Biogenetics
- 2) Epidemiology
- 3) Etiology
- 4) Health physics

Answer:2- Epidemiology is a science that investigates the distribution and causes of disease. Epidemiologists study the interplay between the physical environment, biological effects, and social phenomena that relate to human health and illness in the workplace.

Question #: 1714- Epidemiological studies are either descriptive or experimental. Descriptive epidemiology helps in preventing disease by:

- 1) Observing outcomes among study groups not created experimentally
- 2) Observing outcomes among study groups created experimentally
- 3) Examining dose response relationships in terms of time, place, and exposed individuals
- 4) Both 1 and 3

Answer:4- Descriptive epidemiology is the observation of outcomes among study groups not created experimentally followed by an examination of dose response relationships. The key concept is that the epidemiologist observes existing groups of people and obtains observation data. No hypothesis is being tested as in an experimental study.

Question #: 1715- In determining the probability of a cause/effect relationship between an illness and an agent in the workplace, the first consideration must be to:

- 1) Examine the interplay between the physical environment and biological effects
- 2) Examine dose relationships in terms of time and place
- 3) Establish that a disease condition does exist
- 4) Determine toxicity of the chemical agent

Answer:3- The first consideration in determining the probability of a cause/effect relationship between an illness and an agent in the workplace is to establish that a disease condition actually exists or that the particular manifestations of the disease are the result of exposure to a specific harmful agent.

Question #: 1716- Which factor will **LEAST** likely determine whether or not an individual exposed to a biohazard will actually contract the disease?

- 1) The number of organisms in the work environment

2) The exposed individual's blood type

3) The resistance of the workers to the organism(s)

4) The virulence of the organism(s)

Answer:2- The combination of the number of organisms in the environment, the virulence of these organisms, the resistance of the workers to the organisms, and the presence of other chemical or physical stresses in the environment ultimately determines whether or not a person exposed to a biohazard will actually contract the disease. Blood type is the least likely factor.

Question #: 1717- Anthropometric data are widely used in:

1) Epidemiology 2) Ergonomics/human factors engineering 3) Biomechanics 4) Both 2 and 3

Answer:4- Anthropometry is concerned with measurement of the human body. Included in these measurements are body dimensions, range of body members, and muscle strength. Also considered are dimensions taken statically and dynamically. Viewed in physical terms, the body is a complex system of levers and motors attached to a frame. Biomechanics deals with the study and function of the body in relation to dynamics of men-machine systems. Ergonomics/HFE professionals use anthropometric data to design and construct equipment, tools, etc., that work safely and efficiently with humans.

Question #: 1718- The three primary methods, or types, of epidemiology studies are retrospective studies, prospective studies, and:

1) Case control studies 2) Cross-sectional studies 3) Cohort studies 4) Incident studies

Answer:2- Cross-sectional studies are, by definition, conducted on a sample which is drawn from one point in time (e.g., the population currently working in a manufacturing plant). The association between an exposure and effect at one specific point in time is studied. Employees that are no longer working within the subject area are not considered in the analysis. Therefore, since this type of study is based on a sample of subjects from one point in time, its ability to identify cause-effect relationships is very limited. These studies are quick and inexpensive, however, and can provide hypotheses for later comprehensive studies.

Question #: 1719- All hoist way openings are required to be protected by double doors or gates that:

1) Are interlocked with the controls 2) Can be easily opened 3) Cannot be opened when the car is not at the landing 4) Both 1 and 3

Answer:4- "All hoist way openings shall be protected by double doors or gates that are interlocked with controls, so that the car cannot be started until all gates or doors are closed, and so that gates or doors cannot be opened when the car is not at the landing." ANSI Z-17.2

Question #: 1720- ANSI recommends the lighting level for corridors in industrial facilities have a minimum of _____ foot candles.

1) 10 2) 20 3) 30 4) 40

Answer:2- The American National Standards Institute (ANSI) Standard Practice for Industrial Lighting (ANSI A22.2-1984) provides minimum lighting levels for safety purposes. The minimum they recommend for corridors in industrial facilities is 20 foot candles. The Illuminating Engineering Society (IES) publishes a Lighting Handbook which recommends higher illumination levels to maximize productivity.

Question #: 1721- Aisles that are utilized by both powered industrial trucks and pedestrians should be at least:

- 1) 2 ft wider than the widest load
- 2) 3 ft wider than the widest load
- 3) 4 ft wider than the widest load
- 4) 5 ft wider than the widest load

Answer:2- The aisle width requirement is 3 ft wider than the widest load of the powered industrial truck.

Question #: 1722- The building type least likely to survive an earthquake is:

- 1) Wood
- 2) Steel
- 3) Masonry
- 4) Both 2 and 3

Answer:3- Masonry, due to its characteristics, is most adversely affected by earthquakes.

Question #: 1723- The minimum temperature at which a liquid gives off sufficient vapor to form an ignitable mixture with air near the surface of the liquid is called the:

- 1) Auto ignition temperature
- 2) Flash point
- 3) Ignition point
- 4) Fire point

Answer:2- The auto ignition temperature is the temperature at which the liquid will self-ignite with no external spark, and is used to determine the flash point. The ignition point is not a "defined" fire term. The fire point is similar to the flash point except that the flammable substance is able to sustain self-burning without a continued spark or ignition source.

Question #: 1724- Reducing the oxygen concentration and raising the heat capacity of the atmosphere is the primary extinguishing mechanism of:

- 1) Inert agents
- 2) Halocarbon agents
- 3) Halon agents
- 4) Wet chemical agents

Answer:1- Carbon dioxide also works like inert agents to extinguish a fire. Halocarbons work through inhibiting the chain reaction of the fire process. Halon is banned for new installations. Wet chemicals inhibit the chain reaction of a fire and produce an emulsion effect that smothers the fire.

Question #: 1725- Inside a flammable liquid storage room, the minimum portable fire extinguisher requirement is:

- 1) A 20 lb carbon dioxide adjacent to any dispensing station within the room
- 2) A multipurpose ABC dry chemical, located inside the room, adjacent to the entrance door
- 3) A fire hose, with fog nozzle, mounted on a column, inside the room

4) The fire extinguisher must be located outside the room

Answer:4- In a hazardous location of this nature, the recommended practice is for the fire extinguishing equipment to be located outside the room.

Question #: 1726- The maximum travel distance in an industrial occupancy fully protected with automatic sprinklers is:

- 1) 50 ft 2) 150 ft 3) 200 ft 4) 250 ft

Answer:4- The travel distance to at least one exit shall not exceed 200 ft in industrial occupancies NOT equipped with a sprinkler system or exceed 250 ft in industrial occupancies protected throughout by an approved, supervised sprinkler system. NFPA 101 40.2.6.1 (Life Safety Code)

Question #: 1727- For a dust explosion to occur in a storage silo, which of the following conditions must be met:

- 1) Oxygen must be present in a concentration that will sustain rapid combustion
2) The dust must be well mixed with the oxygen at a concentration above the LEL
3) An ignition source must be present
4) All of above conditions must be met

Answer:4- A dust explosion compares with a deflagration in which gases spread through the burning material by conduction, convection, and radiation at a rate less than the velocity of sound. For it to occur, all conditions, including enclosed space, must be met.

Question #: 1728- Class "B" fire doors are used to protect openings in:

- 1) Corridor walls 2) Stairwells 3) Fire walls 4) Exterior walls

Answer:2- Class B openings are in enclosures of vertical communication through buildings, such as stairs and elevators. Doors for protection of these openings have a fire protection rating of 1 to 1.5 hours.

Question #: 1729- "Bonding" a flammable liquid dispensing can refers to the process of:

- 1) Connecting it to the earth 2) Attaching it to a grounding strap
3) Gluing it to the floor 4) Connecting it to other conductive objects

Answer:4- "Bonding" refers to the connection of conductive objects by means of a conductor to minimize potential electrical differences between the objects. "Grounding" is the process of connecting the conductive objective to the ground. In flammable liquid dispensing, both "Bonding" and "Grounding" are important.

Question #: 1730- A detonation has the following features EXCEPT:

- 1) Pressure front moves supersonically 2) Potential for extreme destruction exists
3) Blowout panels and rupture disks can vent explosion
4) Blowout panels and rupture disks are useless

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Answer:3- Due to the supersonic nature of the pressure front after a detonation, blowout panels and rupture disks are useless. When materials explode they usually propagate as a deflagration of a detonation. A deflagration is a low speed propagation and is effectively an expansion of gases. An expansion or flow of gases can be directed through venting and thus serious damage can be prevented through adequate venting. A detonation, on the other hand, results in a shock wave that cannot be redirected. The shock wave will impart its energy on any surface that is in its path, thus venting is practically useless for protection against damage from a detonation. National Fire Protection Association, Fire Protective Handbook, (15th ed.) Section 3/Chapter 2 subparagraph A.

Question #: 1731- You are a safety professional for a company that occupies several three-floor office buildings at its corporate headquarters location. Life safety is a concern, and the company insists that recognized life safety standards are not only enforced at its high-hazard plants, but also deployed across all corporate headquarters facilities. What is the **minimum width** permitted for the common corridors and passageways that lead to exits in the corporate headquarters buildings?

- 1) 28 in. 2) 30 in. 3) 36 in. **4) 44 in.**

Answer:4- 44 in. is the minimum permitted width of corridors and passageways that lead to means of egress. NFPA 101 39.2.3.2 (Life Safety Code)

Question #: 1732- Your office area in your building is about 10,000 ft². During an office inspection, someone asks you how many fire extinguishers are needed. The current extinguishers in place are class 2A extinguishers. What is your answer?

- 1) 1 2) 2 **3) 4** 4) 6

Answer:3- Four are needed, since each one can **cover 3,000 ft²** in an office occupancy.

Question #: 1733- There are different types of standpipe systems in buildings. **Type I** systems are meant to be used by:

- 1) Sprinkler systems **2) Fire department personnel** 3) Building occupants 4) Fire brigades

Answer:2- These systems are for use by the fire department personnel.

Question #: 1734- One of the **specific concerns** for fighting fires where **oxidizing agents** are present is that these agents:

- 1) Inhibit chemical reactions **2) Provide oxygen for the fire** 3) Limit the use of water as an extinguishing agent 4) Are highly combustible

Answer:2- These agents provide the fire with a source of oxygen even when extinguishing agents are used.

Question #: 1735- Assume you are building **a five-story building** and will place the heating unit in the basement. If the vent is to pass through the floors and roof, what must you do to the vent?

- 1) Install fire suppression equipment in the vent 2) Increase the size of the vent by a factor of 1.2 3) Install the vent in one-hour rated fire resistive walls **4) Install the vent in two-hour rated fire resistive walls**

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Answer:4- Two hour walls are needed when the building is **four stories or more** in height.

Question #: 1736- When water supply pipes **change direction** due to installation requirements, the installer must often use what technique to prevent damage to the system when in use?

- 1) Use of plastic or rubber pipe
- 2) **The installation of thrust block**
- 3) Shear plates
- 4) Shock absorber pistons

Answer:2-Thrust blocks are used at tees, plugs, and bends to absorb loads imposed by water moving in the pipe.

Question #: 1737- In normal areas the **spacing** between fire hydrants should not exceed:

- 1) 500 ft
- 2) **800 ft**
- 3) 1,000 ft
- 4) 1,600 ft

Answer:2- In normal areas, 800 ft is the normal spacing. In congested areas, 500 ft may be used. NFPA Fire Protection Handbook

Question #: 1738- **How often** should private hydrants be opened and closed to ensure proper water flow and drainage?

- 1) Monthly
- 2) Semi-annually (twice per year)
- 3) **Annually**
- 4) Bi-annually (once every two years)

Answer:3- Annual flow testing is recommended for private hydrants. NFPA 25 - Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems

Question #: 1739- Your company is planning a new corporate office and training center. This center will include a large meeting room that can be subdivided into smaller meeting rooms with movable walls. What is one of the commonly overlooked items when designing such facilities?

- 1) The facility needs to be classified as a place of assembly
- 2) **Emergency exit provisions must be made for each area subdivided by movable walls**
- 3) The facility may be used by the public
- 4) Generally these facilities have cooking facilities that must be treated as a restaurant

Answer:2- Often overlooked is the need to provide emergency egress from areas subdivided by movable walls, particularly when several scenarios of subdivision are possible.

Question #: 1740- All of the following statements are true EXCEPT:

- 1) Dust-ignition proof equipment is designed to keep ignitable amounts of dust from entering the enclosure
- 2) Dust may accumulate on electrical equipment, causing overheating of the equipment, as well as the dehydration and gradual carbonization of organic dust deposits
- 3) Overheated equipment may malfunction and cause a fire

4) Equipment must be designed to operate at the ignition temperature of the specific dust involved even when blanketed

Answer:4 Equipment must be designed to operate below the ignition temperature of the specific dust involved even when blanketed.

Question #: 1741- Ignition of flammable vapors, dusts, or fibers by discharge of static electricity can be prevented by any of the following EXCEPT:

- 1) Grounding and bonding 2) **Insulation** 3) Humidification 4) Ionization

Answer:2- Static electricity is non-flowing electricity commonly generated by friction and the effects of the positive and negative charges which have the potential to spark. The static charge which already exists can be removed or allowed to dissipate itself. The acts or conditions which can accomplish this are the same as those which permit the separation of charges to occur. Ignition is prevented by the actions employing humidification, ionization, grounding, and bonding. Flammable vapors, dusts, or fibers cannot be insulated.

Question #: 1742- In Class II hazardous locations there are three groups: E, F, and G. Special designs are required to prevent dust from entering into the electrical equipment enclosure. All of the following are true EXCEPT:

- 1) Assembly joints and motor shaft openings must be tight enough to prevent dust from entering the enclosure
2) The design must take into account the insulating effects of dust layers on equipment and must ensure that the equipment will operate below the ignition temperature of the dust involved
3) If conductive combustible dusts are present, the design of equipment must take the special nature of these dusts into account
4) **Equipment that is dust-ignition proof is generally not acceptable for use in Class III locations**

Answer:4- Equipment that is dust-ignition proof is generally acceptable for use in Class III locations, since the same design considerations are involved. NFPA 70 Article 500-3 (National Electric Code)

Question #: 1743- As a safety professional, you are asked to recommend a fire detector for use in a Class I, Division 2 work area. Which of the following would you select?

- 1) Fixed temperature 2) Rate compensated thermal
3) Rate-of-rise thermal 4) **Bulb detection system**

Answer:4- The bulb detection system is completely mechanical thereby avoiding the use of electricity and a potential source of ignition in an area where volatile flammable liquids or gases are used.

Question #: 1744- An average of one gallon of toluene is evaporated every hour in a continuous process drying oven operating at sea level. Assuming that the toluene completely mixes throughout the oven, what is the minimum exhaust ventilation rate required by code to prevent an explosive concentration? The code does not permit the concentration of flammable vapors in the oven to exceed 25% of the LEL at any time.

The LEL for toluene is 1.1% at the oven's operating temperature

The specific gravity of toluene is 0.87 (water is 1.0)

The specific vapor density of toluene is 3.1 (dry air is 1.0)

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The density of water at STP is 8.328 lb/gal
The density of air at STP is 0.075lb/ft³

The basic equation to determine the required ventilation to maintain a system at a discrete LEL is:

Ventilation Rate = (Density of Water at STP)/(Density of Air at STP)(Specific Gravity of Solvent)/[(100% - LEL)/LEL] Solvent Evaporation Rate

- 1) 31 SCFM 2) 47 SCFM 3) 187 SCFM 4) 2,802 SCFM

Answer:3- First, realize that the given equation gives you the required ventilation to MAINTAIN the LEL. We need to know the required ventilation rate at 25% of the LEL. Therefore, we will have to multiply the result from the given equation by a factor of 4 (100% of LEL/25% of LEL = 4). Also note that we require the answer in standard cubic feet per MINUTE. Since the evaporation rate is gallons per hour, we will have to convert to gallons per minute. Carefully track the units when solving this equation, and remember that specific gravity and specific vapor density have no units.

Minimum Rate = $4(8.328 \text{ lb/gal} / 0.075 \text{ lb/ft}^3)(0.87 / 3.1) [(100\% - 1.1\%) / 1.1\%]$ (1 gal/hr) (1 hr/60 min)

Minimum Rate = $4 * 111.04 \text{ ft}^3/\text{gal} * 0.281 * 89.91 * 0.0167 \text{ gal/min}$

Minimum Rate = 187 ft³/min

NFPA 86 Section 7 - Standards for Ovens and Furnaces

Question #: 1745- The water level of a rectangular fire pond, 75 ft * 42 ft, is to be raised 4 inch. How many gallons are needed?

- 1) 7,875 gal 2) 15,750 gal 3) 23,625 gal 4) 31,500 gal

Answer:1- $V = 75 \text{ ft} * 42 \text{ ft} [4 \text{ in} / (12 \text{ in} / 1 \text{ ft})] = 1,050 \text{ ft}^3$

There are 7.5 gallons in 1 cubic foot (ft³) $V = 1,050 \text{ ft}^3 * 7.5 \text{ gal/ft}^3 = 7,875 \text{ gal}$

Question #: 1746- Due to environmental concerns, what major type of fire suppression agent has been removed from production and replaced with halocarbon and inert gas agents?

- 1) Halon 2) Carbon dioxide 3) Dry chemical 4) Nitrogen

Answer:1- Halon is an ozone depleting agent that was banned by the Montreal Protocol. Carbon dioxide, dry chemicals, and nitrogen are currently used for fire suppression. Nitrogen is used as an inerting or suppression agent over oil baths.

Question #: 1747- ESFR sprinkler technology is most often used to protect:

- 1) Residential buildings 2) High rise buildings
3) Heat treating processes 4) Rack storage

Answer:4- ESFR (early suppression fast response) sprinklers are designed to fight high challenge, fast developing fires, often found in rack storage systems. ESFR sprinklers are also used in flammable liquid storage areas. The ESFR sprinkler is designed to extinguish the fire, rather than just control a fire, like other sprinkler heads.

Question #: 1748- A sprinkler system employing automatic sprinklers attached to a piping system containing air and a supplemental detection system installed in the same areas as the sprinklers; where the actuation of the detection system opens a valve that permits water flow into the sprinkler piping system and to be discharged from any sprinklers that are open is called a(n):

- 1) Dry system 2) Pre-action system 3) Deluge system 4) ESFR system

Answer:2- Pre-action and deluge systems are similar in design except that a pre-action system has closed sprinkler heads, whereas a deluge system has open heads. A pre-action system is often used to protect computer rooms or other areas with high value contents.

Question #: 1749- Open sprinklers are used in what type of sprinkler system?

- 1) Dry system 2) Pre-action system 3) Deluge system 4) Wet system

Answer:3- Deluge systems are designed to discharge water through every head when activated for rapid spreading fires, such as flammable liquid storage areas and aircraft hangars with jet fuel.

Question #: 1750- Water spray is an acceptable extinguishing method for all of the following EXCEPT:

- 1) Alcohol liquid fires 2) Sodium fires 3) Oil-filled transformer fires 4) Corrugated box fire

Answer:2- The extinguishing properties of water include cooling, smothering, emulsifying, and diluting. The application of water in spray form or combination nozzles and sprinklers is considered to be an efficient method for extinguishing fire. However, using water to extinguish a burning metal fire may cause an explosion.

Question #: 1751- Halon 1301 is a clean extinguishing agent that leaves no residue. It has a "B" and "C" extinguishing classification, intended primarily for use on sensitive electronic equipment such as computer operations. In a 10,000 ft² computer room, what concentration of Halon 1301 would be needed to prevent combustion?

- 1) 2% 2) 6% 3) 8% 4) 15%

Answer:2 - For Halon 1301 to be effective, the ventilation systems must be stopped so that the designed concentration of 6% will effectively extinguish the fire. In a total flooding system, human exposure should be limited to one minute if the concentration is as high as 7% to 10%.

Question #: 1752- It is considered good practice to avoid all unnecessary exposure to Halon 1301 and to prohibit exposure above:

- 1) 15% 2) 18% 3) 20% 4) 25%

Answer:1- It is considered good practice to avoid all unnecessary exposure to Halon 1301 and to prohibit exposure above 15%.

Question #: 1753- On a loading dock in Minnesota, you would most likely find the following type of sprinkler system:

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- 1) A wet pipe system 2) A halon system 3) A dry-pipe system 4) No sprinklers

Answer:3- Dry-pipe systems are used where there is a possibility of freezing.

Question #: 1754- In a fire sprinkler system, what is the purpose of a check valve?

- 1) To limit water pressure to the sprinkler system
2) To check the flow and send an alarm to the central station
3) To prevent water from entering a dry pipe system
4) To prevent the sprinkler system from flowing back into a public water system

Answer:4- In some cases due to health requirements, two check valves may be needed in a system, but normally one is sufficient to prevent sprinkler system water from returning to the public water supply system.

Question #: 1755- Water storage tanks can be protected from internal corrosion on wetted surfaces by painting or by:

- 1) Anodic protection 2) Cathodic protection 3) Static protection 4) Galvanization

Answer:2- Cathodic protection using anodes of aluminum are common. Anodes must be renewed annually.

Question #: 1756- Which technique is employed by many hydraulically designed sprinkler systems to reduce friction loss and improve system performance?

- 1) Double check valves 2) Booster pumps 3) Grid or looped piping 4) Dual risers

Answer:3- Grid or looped piping systems reduce friction loss by putting the water supply from the riser closer to an operating sprinkler head and by bringing multiple sources of water to each head.

Question #: 1757- A paint spray operation will be located on the assembly floor. What precautions, with regard to ignition sources, must be exercised?

- 1) None are needed 2) All ignition sources must be eliminated 3) All flammable and combustible material must be removed from the area 4) All ignition sources should be prohibited within 20 ft of the spraying area

Answer:4- There shall be no open flame or spark producing equipment in any spraying area within 20 ft, unless separated by a partition. 29 CFR 1910.107 (c)(2)

Question #: 1758- A gas furnace installed in a ceiling that is used for heating a building is vented through the attic of the building. It is vented with the following type of vent:

- 1) Single wall metal pipe 2) Type L vent 3) Type BW gas vent 4) Type B gas vent

Answer:4- A Type B vent is appropriate for a gas fired furnace with a draft hood. A BW vent is used for a gas fired wall furnace. Type L vents are for oil fired furnaces. Single wall pipe cannot be used when the flue passes through an attic or concealed space.

Question #: 1759- Whenever flammable or combustible liquids are transferred from one container to another:

1) Both containers shall be effectively bonded and grounded

- 2) Only the dispensing container shall be bonded and the other container shall be grounded
- 3) Both containers need only be grounded
- 4) Both containers need only be bonded

Answer:1- To prevent discharge sparks of static electricity, it is necessary to both ground and bond each container.

Question #: 1760- A room 50 ft x 20 ft x 10 ft contains 100 ppm of CCl₄. How much time is required to lower the concentration to 25 ppm if a blower generating 300 cfm is used to clear the room?

- 1) 7.5 min
- 2) 11.1 min
- 3) 46 min
- 4) 54 min

Answer:3- $t = \log_{10}(C/C_0) (-2.303) (P/Q)$

Where C = end concentration, C₀ = beginning concentration, P = room volume, Q = flow of air

Substituting we get: $t = \log_{10} (25/100) (-2.303) (10,000 \text{ ft}^3/300 \text{ cfm}) = 46 \text{ min}$

Question #: 1761- A total flow of 800 cfm was measured in a large duct 5 ft * 5 ft. What is the average velocity of the air at the entrance of the duct?

- 1) 2000 ft/min
- 2) 160 cfm
- 3) 32 ft/min
- 4) 32 cfm

Answer:3- $Q = AV$ $A = 5 \text{ ft} * 5 \text{ ft} = 25 \text{ ft}^2$ $Q = 800 \text{ cfm}$ $800 \text{ cfm} = (25 \text{ sq ft})V$
 $V = (800 \text{ ft}^3/\text{min}) / 25 \text{ ft}^2$ $V = 32 \text{ ft/min}$

Question #: 1762- Given a velocity pressure reading of 0.60 in. of water in a circular duct, what is the average velocity in ft/min?

- 1) 15 ft/min
- 2) 29 ft/min
- 3) 1,023 ft/min
- 4) 3,102 ft/min

Answer:4-

$V = 4,005$ Where VP = velocity pressure

$V = 4,005$

$= 3,102 \text{ ft/min}$

Question #: 1763- If 3,500 cfm of air is drawn through an 8 in. diameter duct, what is the velocity in ft/min?

- 1) 800 ft/min
- 2) 1,000 ft/min
- 3) 1,023 ft/min
- 4) 10,000 ft/min

Answer:4- $Q = VA$ $A = \pi (0.33 \text{ ft})^2 = 0.349 \text{ ft}^2$
 $V = Q/A = (3,500 \text{ ft}^3/\text{min}) / 0.349 \text{ ft}^2 = 10,027 \text{ ft/min}$

Question #: 1764- In a mine opening you found a total flow of 2,000 cfm. The opening was 10 ft * 10 ft. What is the velocity of the air in the entrance?

- 1) 2 ft/min
- 2) 3 ft/min
- 3) 20 ft/min
- 4) 3,000 ft/min

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Answer:3- $Q = VA$ $V = Q/A$ $V = 2,000 \text{ cfm} / 100 \text{ ft}^2 = 20 \text{ ft/min}$

Question #: 1765- In industrial ventilation system design, which of the following assumptions is FALSE?

- 1) Air is considered a compressible fluid
- 2) Air flow requirements should be minimized
- 3) Energy should be conserved
- 4) The worker's breathing zone must be protected

Answer:1- Air is considered an incompressible fluid. This assumption allows various laws to be applied which otherwise could not be used to estimate air flows, velocities, etc.

Question #: 1766- The function of a slot in a slot hood is to:

- 1) Decrease capture velocity
- 2) Reduce material required to build system
- 3) Obtain proper air distribution
- 4) Increase capture velocity

Answer:3- Capture velocity is essentially independent of its slot air velocity. The function of the slot is to provide proper air distribution by making the pressure drop of the slot large relative to the plenum.

Question #: 1767- The rule of thumb for determining the average duct velocity from the center point velocity is to multiply the center point velocity by:

- 1) 0.75
- 2) 0.90
- 3) 1.10
- 4) No generalization can be made

Answer:2- When accuracy is not the prime concern, a velocity measurement can be made at least 10 diameters downstream and the center line velocity multiplied by 0.90. If VP is measured, then multiply $VP * 0.81$.

Question #: 1768- Total pressure is:

- 1) The difference between SP and VP
- 2) Measured parallel to the axis of flow
- 3) Normally positive on the suction side
- 4) Measured perpendicular to the axis of flow

Answer:2- It is measured parallel to the direction of flow since it contains a velocity pressure component. Total pressure is equal to the sum of the static pressure (SP) and the velocity pressure (VP), not the difference, as indicated in Answer 1.

Question #: 1769- Velocity pressure of a system is always:

- 1) Negative
- 2) Positive
- 3) Equal to total pressure
- 4) Equal to static pressure

Answer:2- The total pressure = static pressure + velocity pressure. Since VP is always exerted in the direction of flow, VP is always positive.

Question #: 1770- What is the duct velocity in a 6 in. duct with an airflow of 1,000 cfm?

- 1) 5,000 ft/min
- 2) 5,092 ft/min
- 3) 6,750 ft/min
- 4) 7,225 ft/min

Answer:2- The area of a 6 in duct is 0.1964 ft²
(remember to change inches to feet when calculating the area of the duct).

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Start with $Q = AV$ and solve for V . $V = Q/A = (1,000 \text{ ft}^3/\text{min}) / 0.1964 \text{ ft}^2 = 5,092 \text{ ft/min}$

Question #: 1771- What is the recommended duct velocity for an average industrial dust such as wool, wood, sand abrasive blasting dust, or shoe dust?

- 1) 2,000 ft/min 2) 3,000 ft/min 3) 4,000 ft/min 4) 5,000 ft/min

Answer: 3- 4,000 ft/min is value is recommended by the ACGIH in the Industrial Ventilation Handbook.

Question #: 1772- Which of the following is FALSE?

- 1) Q varies indirectly as fan speed 2) SP varies as the square of fan speed
3) HP varies as the cube of the fan speed 4) TP varies as the square of fan speed

Answer: 1- Q varies directly as fan speed and not indirectly as stated in Answer 1. The other listed relations between some operating parameter and the fan are true.

Question #: 1773- Which of the following is NOT a characteristic of a centrifugal fan?

- 1) High volume - low pressure drop 2) Low space requirements
3) Often used with particle-laden air 4) Low to medium noise

Answer: 1- High volume - low pressure drop are the most notable characteristics of axial flow fans, NOT radial or centrifugal flow fans.

Question #: 1774- Which of the following statements concerning various types of air pressure is NOT true?

- 1) Velocity pressure may be a positive or negative number
2) Static pressure may be a positive or negative number
3) SP is exerted on the sides of the duct
4) $TP = SP + VP$

Answer: 1- Velocity pressure is a measure of kinetic energy and therefore cannot be negative. Static pressure can be negative if the duct is an exhaust duct.

Question #: 1775- Which of the following statements is NOT true about the static pressure in a given ventilation system?

- 1) Is measured parallel to the direction of flow 2) Tends to collapse the duct in an exhaust system
3) Acts in all directions 4) Is available to do work

Answer: 1- The static pressure is always measured perpendicular to the direction of flow.

Question #: 1776- Why would 4,000 ft/min be maintained in an exhaust duct?

- 1) Prevents settling 2) Reduces abrasion
3) Minimizes noise 4) Minimizes energy consumption

Answer: 1- A velocity this high would normally be used only if dust transport were involved.

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Question #: 1777- A 50 ft x 190 ft x 20 ft building is supplied with 8,000 cfm. What is the number of air changes per hour in the building?

- 1) 1.4 air changes/hr 2) 2.5 air changes/hr 3) 3.6 air changes/hr 4) 4.7 air changes/hr

Answer:2- Determine total building volume: $50 \text{ ft} \times 190 \text{ ft} \times 20 \text{ ft} = 190,000 \text{ ft}^3$
Convert cfm to ft³/hr: $8,000 \text{ cfm} \times 60 \text{ min/hr} = 480,000 \text{ ft}^3/\text{hr}$
 $480,000 \text{ ft}^3/\text{hr} / 190,000 \text{ ft}^3 = 2.5 \text{ air changes/hr}$

Question #: 1778- A large office building is designed for 5.3 air changes per hour. With this design, how many minutes will it take for one air change?

- 1) 9.1 min 2) 10.2 min 3) 11.3 min 4) 12.8 min

Answer:3- Simply divide 60 min/hr by 5.3 air changes/hr
Minutes per Air Change = $(60 \text{ min/hr}) / (5.3 \text{ air changes/hr}) = 11.3 \text{ min/air change}$

Question #: 1779- A large office building currently houses 50 people. If the building HVAC system supplies 8,000 cfm and 90% of the air is recirculated, what is the outdoor air ventilation rate per person?

- 1) 0 cfm/person 2) 16 cfm/person 3) 25 cfm/person 4) 800 cfm/person

Answer:2- First determine the amount of outdoor air: $8,000 \text{ cfm} \times 0.1 = 800 \text{ cfm}$
Then determine cfm/person: $800 \text{ cfm} / 50 \text{ people} = 16 \text{ cfm/person}$

Question #: 1780- Canopy hoods are rarely used due to the often poor performance of this hood type. One equation used, however, to size a canopy hood is:

- 1) $Q = VA$ 2) $Q = C_e \times SPh \times V$ 3) $Q = 1.4 PDV$ 4) $Q = (LWH/2)V$

Answer:3- The equation used to size canopy hoods is
 $Q = (1.4 \times P \times D \times V)$ where P = tank perimeter (ft), D = vertical distance between tank and edge of hood, and V = design capture velocity.

Question #: 1781- If 500 cfm are needed to capture air contaminants 6 in. from a hood, what volume of air is needed to capture contaminants 12 in. from the hood face?

- 1) 550 cfm 2) 750 cfm 3) 2,000 cfm 4) 4,000 cfm

Answer:3- Required flow rate varies as the square of the distance from the contaminant source. A source twice as far away will require 4 times the original flow rate.

Question #: 1782- An exhaust system operates at 25,000 cfm. A hood is added to the system which requires a total system capacity of 30,000 cfm. How much should the fan speed be increased to handle the extra exhaust volume?

- 1) 20% 2) 25% 3) 30% 4) 40%

Answer:1- Utilizing the fan laws where cfm varies directly with fan rpm:

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$Q1/Q2 = rpm1/rpm2 = 30,000\text{ cfm}/25,000\text{ cfm} = 1.2$ or 120%

Increase the fan rpm by 20% and you can accommodate hood. (Assuming maximum fan rpm and tip speed are not exceeded).

Question #: 1783- An exhaust system operating at 25,000 cfm is increased to 30,000 cfm. What is the required increase in the fan horsepower to handle the increased volume?

- 1) 50% 2) 66% 3) 73% 4) 79%

Answer:3- Fan horsepower varies as the cube of the fan speed and cube of the fan volume. Therefore, the required ratio of increase in the fan speed is:

$$(30,000\text{ CFM}/25,000\text{ CFM})^3 = 1.73$$

The required increase in the fan horsepower is 73%. You must ensure that the fan motor horsepower rating is ample.

Question #: 1784- What is the approximate capture velocity 12 in. away from a 1 ft diameter duct exhausting air at a duct velocity of 4,000 ft/min?

- 1) 30 ft/min 2) 40 ft/min 3) 300 ft/min 4) 400 ft/min

Answer:4- The rule of thumb is that the velocity one duct diameter away from an exhaust opening is about 10% of the duct velocity, or 400 ft/min.

Question #: 1785- In order to ensure uniform capture and air distribution which would be applicable to most hoods, a maximum plenum velocity should be no more than _____ % of the slot velocity.

- 1) 10 2) 40 3) 50 4) 100

Answer:3- The rule of thumb is that the maximum plenum velocity should be 50% of the slot velocity. For a 2,000 fpm slot your maximum plenum velocity should not exceed 1,000 fpm.

Question #: 1786- A duct velocity of 4,005 ft/min is equivalent to what VP?

- 1) 1.0 in 2) 2.0 in 3) 3.0 in 4) 0.5 in

Answer:1- Using the equation $V = 4,005\sqrt{VP}$ $V/4,005 = 4,005/4,005 = 1.0 = 1.0\text{ in} = VP$

Question #: 1787- An exhaust duct static pressure is -1.50 in. Total pressure is -0.75 in. What is the standard air velocity pressure?

- 1) -0.25 in. 2) -0.50 in. 3) -0.75 in. 4) 0.75 in.

Answer:4- Using the equation $SP + VP = TP$ $TP = -0.75\text{ inch}$ $SP = -1.50\text{ inch}$
Substituting and rearranging we get: $VP = -0.75 - (-1.50) = 0.75\text{ in}$

Question #: 1788- An exhaust duct has a velocity pressure of 0.75 in.. What is the velocity inside of this duct?

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- 1) 3,000 ft/min 2) 3,400 ft/min 3) 3,500 ft/min 4) 3,600 ft/min

Answer:3- To solve this problem use the equation $V = 4,005\sqrt{VP} = 4,005 * 0.866 = 3,468\text{ft/min}$

Question #: 1789- A 12 in. diameter duct has an average duct velocity of 3,200 ft/min. What is Q?

- 1) 1,600 cfm 2) 2,500 cfm 3) 2,600 cfm 4) 2,700 cfm

Answer:2- $Q = VA$ $Q = [\pi(6 \text{ in})^2]/[12 \text{ in}/1 \text{ ft}^2] 3,200 \text{ ft/min} = 2,512 \text{ cfm}$

Question #: 1790- Two impingers are attached in series. What is the collection efficiency of the first impinger if it contains 95.6 mg, and the second impinger contains 7.5 mg of the same air contaminant?

- 1) 91.7% 2) 91.9% 3) 92.2% 4) 92.5%

Answer:3- To calculate collection efficiency utilize the equation:
 $\% \text{ efficiency} = 100\% [1 - (c_2/c_1)] = 100\% [1 - (7.5 \text{ mg}/95.6 \text{ mg})] = 100\% [0.922] = 92.2\%$

Question #: 1791- A rotameter calibrated at 25°C and 760 mm Hg gives a rate indicated as 1.45 l/min at 40°C and 680 mm Hg. What is the corrected standard air flow rate?

- 1) 1.24 l/min 2) 1.36 l/min 3) 1.41 l/min 4) 1.45 l/min

Answer:1- Utilize the correction equation:

$$Q = 1.45 \text{ l/min} (680 \text{ mm Hg}/760 \text{ mm Hg}) (25^\circ\text{C} + 273^\circ\text{C}) / (40^\circ\text{C} + 273^\circ\text{C}) = 1.24 \text{ l/min}$$

The colder and denser air at standard conditions has greater buoyancy for the rotameter float ball.

Question #: 1792- Calculate the density of air in units of mg/cm³ under Standard Industrial Hygiene Condition:

- 1) 1.18 mg/cm³ 2) 1.25 mg/cm³ 3) 1.27 mg/cm³ 4) 1.31 mg/cm³

Answer:1- Density of air = Pressure air * Mass air / (R * Temperature air)
 $= 1 \text{ atm} * 28.96 \text{ g/mole} / (0.08205 \text{ l-atm/mole K} * 298^\circ\text{K}) = 1.1838 \text{ mg/cm}^3$

Question #: 1793- What is the density of dry air in units of lb/ft³ at 70°F, the industrial ventilation design standard?

- 1) 0.075 lb/ft³ 2) 0.15 lb/ft³ 3) 1.0 lb/ft³ 4) 1.5 lb/ft³

Answer:1- Density air = Pressure air * Mass air / (R * Temperature air)
Use Rankine for absolute temperature (70°F = 529.6 R)
 $r = [14.7 \text{ lb/in}^2 * 28.96 \text{ lb/lb-mol} / [(10.73 \text{ lb/in}^2\text{-ft}^3/\text{lb-mol-R}) 529.6 \text{ R}]] = 0.07496 \text{ lb/ft}^3$

Question #: 1794- Calculate the density of standard air at 200°C and at 0.7 atm:

- 1) 0.10 g/l 2) 0.52 g/l 3) 0.80 g/l 4) 0.95 g/l

Answer:2- Remember to convert degrees C to Kelvin

Density is defined as mass per unit volume (m/V)

$$PV = nRT \quad PV = mRT/M$$

Remember that $n = m/M$ where "m" is the mass and "M" is the molecular weight

We want to find the density; therefore, we need to rearrange the equation to solve for density (m/V)

$$PV = mRT/M \quad PVM = mRT \quad PVM/RT = m \quad PM/RT = m/V = r$$

$$r = (0.7 \text{ atm} * 28.96 \text{ g/mol}) / (0.08205 \text{ l-atm/mol-K} * 473^\circ \text{ K}) = 0.522 \text{ g/l}$$

$$(\text{Density of air} = \text{Pressure air} * \text{Mass air} / (R * \text{Temperature air}))$$

Question #: 1795- Static pressure on the exhaust side of a fan is normally:

- 1) Negative 2) Positive 3) Neither negative or positive 4) Greater than 100 MPa

Answer:2- The static pressure on the exhaust side of a fan is normally positive in relation to atmospheric pressure. The static pressure on the suction side of an exhaust fan is negative compared with atmospheric pressure.

Question #: 1796- A building 100 ft x 20 ft x 10 ft experiences 12 air changes per hour. What is the flow rate in the building?

- 1) 400 cfm 2) 1,667 cfm 3) 4,000 cfm 4) 240,000 cfm

Answer:3- Volume of the room is $100 * 20 * 10 = 20,000 \text{ ft}^3$

$$\# \text{ Air changes in room} = \text{Air flow rate ft}^3 \text{ per Hr} / \text{Total Volume}$$

$$\text{So Flow rate cfm} = 20,000 \text{ ft}^3 * 12 \text{ changes/hour} / 60 \text{ min/hr} = 4,000 \text{ cfm}$$

Question #: 1797- Which of the following is true regarding a critical orifice?

- 1) Used only in the laboratory
2) Used ahead of the sampling device
3) Constant flow occurs when downstream pressure is more than 53% of upstream pressure
4) Each can only be used for a specific flow rate

Answer:4- A critical orifice achieves a specific constant flow rate when downstream pressure is less than 53% of upstream pressure. It is used in the field when constant flow at a specific flow rate is important and a strong enough pump to achieve high static pressure is available. The orifice must be used downstream of the sampling device.

Question #: 1798- Which of the following is NOT one of the three fan laws?

- 1) Velocity varies directly as the square of the RPM
2) Power varies directly as the cube of the RPM
3) Flow rate varies directly with the RPM
4) Static pressure varies directly as the square of the RPM

Answer:1- Velocity is directly related to flow rate and the diameter of the ductwork. Therefore, the correlation between velocity and RPM would be a direct relationship if the diameter of the duct is constant. The other answers are the three fan laws.

Question #: 1799- Velocity pressure is:

- 1) The velocity of air divided by 4005 times the square root of the SP
- 2) The difference between total pressure and static pressure
- 3) Independent of velocity
- 4) Proportional to the square root of velocity

Answer:2- The total pressure in a ventilation system is equal to the static pressure plus the velocity pressure. The velocity pressure, therefore, is the difference between the total pressure and the static pressure. The CFM is equal to the area of the duct multiplied by 4005 times the square root of the velocity pressure. The velocity pressure is directly related to the square of velocity of air in the duct.

Question #: 1800- The flow through a 10 ft * 10 ft opening to a spray booth was calculated to be 20,000 cfm. What is the velocity of air at the spray booth face?

- 1) 2 ft/min 2) 20 ft/min 3) 200 ft/min 4) 2,000 ft/min

Answer:3- The area of the spray booth face is 10 ft * 10 ft = 100 ft². To determine the velocity of air at the face of the booth, divide 20,000 cfm by 100 ft² = 200 ft/min.

Question #: 1801- If a spray booth has a frontal opening of 4 ft * 6 ft and requires a flow of 120 ft³/min, how many cubic feet of air would go through the opening every minute?

- 1) 1,620 cfm 2) 1,880 cfm 3) 2,280 cfm 4) 2,880 cfm

Answer:4- $Q = AV$ $Q = 120 \text{ ft}^3/\text{min}$ (4 ft * 6 ft) = $120 \text{ ft}^3/\text{min} \div 24 \text{ ft}^2 = 2,880 \text{ ft}^3/\text{min}$

Question #: 1802- What is capture velocity?

- 1) Linear flow rate through a hood 2) The velocity required to move particles through a duct
- 3) The velocity required in front of a hood to capture contaminants
- 4) The velocity of air in a slot

Answer:3- Capture velocity is the air velocity in front of a hood required to capture the contaminant and draw it into the hood.

Question #: 1803- What is the coefficient of entry?

- 1) The ratio of actual to theoretical flow of a hood
- 2) Linear flow rate at the hood opening 3) Linear flow rate in the hood
- 4) The velocity required in front of a hood to capture contaminants

Answer:1- The ratio of actual to theoretical flow caused by a given hood static pressure. The coefficient of entry reflects losses due to turbulence.

Question #: 1804- What is static pressure?

- 1) The kinetic pressure exerted in the direction of flow
- 2) The potential pressure exerted in all directions
- 3) The pressure exerted by a vapor
- 4) The pressure due to weight of the atmosphere

Answer:2- Static pressure is the potential pressure exerted in all directions. Static pressure is measured perpendicular to the direction of air flow.

Question #: 1805- What is velocity pressure?

- 1) The kinetic pressure exerted in the direction of flow
- 2) The potential pressure exerted in all directions
- 3) The pressure exerted by a vapor
- 4) The pressure due to weight of the atmosphere

Answer:1- Velocity pressure is always exerted in the direction of air flow.

Question #: 1806- If the velocity pressure in a duct is 2 in. of water, what is the air velocity (at STP)?

- 1) 2,215 ft/min
- 2) 4,229 ft/min
- 3) 5,281 ft/min
- 4) 5,664 ft/min

Answer:4- $V = 4,005 \sqrt{VP} = 4,005 \sqrt{2} = 4005 * 1.414 = 5,664 \text{ ft/min}$

Question #: 1807- If the velocity of air in a duct is known to be 1,250 ft/min, what is the velocity pressure (assume STP)?

- 1) 0.097 in. of water
- 2) 0.31 in. of water
- 3) 0.097 mm Hg
- 4) 0.31 mm Hg

Answer:1- $V = 4,005 \sqrt{VP} \quad 1,250 = 4,005 \sqrt{VP} \quad 1,250/4,005 = \sqrt{VP} = 0.097 \text{ inches of water}$

Question #: 1808- When a fan is used to draw air through a duct, which of the following is true?

- 1) The total pressure is always equal to zero
- 2) The static pressure is always negative
- 3) The static pressure is always positive
- 4) The velocity pressure is always negative

Answer:2- When a fan is used to draw air through a duct, the static pressure is always negative.

Question #: 1809- If a hood's static pressure is measured at -1.25 in. of water and the coefficient of entry is known to be 0.82, what is the air velocity immediately downstream from the hood?

- 1) 1,187 ft/min
- 2) 2,889 ft/min
- 3) 3,261 ft/min
- 4) 3,672 ft/min

Answer:4- $V = 4,005 * Ce = 4,005 * 0.82 = 3,672 \text{ ft/min}$

Question #: 1810- Pressure drop occurs in a ventilation system due to all of the following EXCEPT:

- 1) Friction losses within the system
- 2) The number and type of bends in the system

3) Turbulence

4) Chemical composition of contaminant

Answer:4- Pressure drop in a system can occur for a number of reason including friction losses, the number and types of bends, and turbulence. The answer least associated with pressure drop is Answer 4.

Question #: 1811- What is the total pressure in a duct if the static pressure is -0.34 in. of water and the velocity pressure is 1.23 in. of water?

- 1) 0.42 in. of water 2) 0.89 in. of water 3) 1.57 in. of water 4) 3.62 in. of water

Answer:2- Since total pressure equals the sum of static and velocity pressure
 $TP = SP + VP = -0.34 \text{ in. of water} + 1.23 \text{ in. of water} = 0.89 \text{ in. of water}$

Question #: 1812- For a free hanging, unflanged, 6 in. diameter round hood, what is the centerline velocity at 3 in. from the front of the hood, where the total air flow into the hood is 400 cfm?

- 1) 487 ft/min 2) 523 ft/min 3) 582 ft/min 4) 993 ft/min

Answer:1- Formula for calculating the velocity at a distance d from a hood: $V = Q / (10 \cdot d^2 + A)$, where Q is the air flow in cfm, d is the distance from the hood face, and A is the area of the face of the hood. $V = 400 / [(10 (0.252)^2 + \pi (0.252)^2)] = 400 / (0.625 + 0.1963) = 487 \text{ ft/min}$

Question #: 1813- For a free hanging, 6 in. diameter hood with total air flow of 400 cfm, what is the centerline velocity if the distance is doubled to 6 in. from the face of the hood?

- 1) 37 fpm 2) 148 fpm 3) 187 fpm 4) 247 fpm

Answer:2- Formula for calculating the velocity at a distance d from a hood face:
 $V = Q / (10 \cdot d^2 + A)$, where V is velocity in ft/min, Q is the air flow in cfm, A is the area of the hood face and d is the distance from the hood face in ft.
 $V = 400 / [10 \cdot 0.52 + \pi (0.252)^2] = 400 / 10 \cdot 0.52 + 0.1963 = 400 / 2.6963 = 148 \text{ ft/min}$

Question #: 1814- A flange increases the capture velocity by about how much?

- 1) 200% 2) 100% 3) 50% 4) 33%

Answer:4-Measurements show that a flange increases the capture velocity by about 33%.

Question #: 1815- What is the coefficient of entry of a hood where the hood static pressure is measured as -1.37 in. of water and the velocity pressure is measured as 1.1 in. of water?

- 1) 0.90 2) 0.80 3) 0.76 4) 0.58

Answer:1- Use the formula for coefficient of entry:

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$C_e = \sqrt{VP / SPh}$, where VP = velocity pressure and SPh = the static pressure of the hood.
 $C_e = \sqrt{1.1 / -1.37} = 0.896$

Question #: 1816- If the hood static pressure = -1.37 in. of water and the velocity pressure = 1.1 in. of water, what is the hood entry loss?

- 1) 0.10 in. of water 2) 0.27 in. of water 3) 0.34 in. of water 4) 0.52 in. of water

Answer:2- Use the formula for calculating the static pressure of a hood: $SPh = VP + He$, where SPh is the static pressure of the hood, VP is the velocity pressure at the face of the hood and He is the hood entry loss. $-1.37 \text{ in. of water} = 1.1 \text{ in. of water} + He$ $He = 0.27 \text{ in. of water}$

Question #: 1817- If a hood has a coefficient of entry of 0.84 and the velocity pressure is measured as 1.3 in. of water, what is the hood entry loss in inches of water?

- 1) 0.23 2) 0.36 3) 0.45 4) 0.54

Answer:4- Using the formula for calculating the hood entry loss: $He = [(1 - C^2) VP] / C^2$, where He is the hood entry loss, C is the coefficient of entry, and VP is the velocity pressure.
 $He = [(1 - 0.84^2) 1.3] / 0.84^2 = 0.54 \text{ in. of water}$

Question #: 1818- When designing dilution ventilation, what does "K" denote?

- 1) Solvent evaporation rate 2) The % of the LEL expected
3) Safety factor 4) Rate of fume generation

Answer:3-When designing dilution ventilation, K is the safety factor.

Question #: 1819- How much dilution ventilation is required to reduce a solvent to a tenth of its TLV if the rate of evaporation is 2 pints per hour, and the solvent has a molecular weight of 36, its TLV is 50 ppm, and its specific gravity is 0.90?

- 1) $1.24 \times 10^6 \text{ ft}^3/\text{hr}$ 2) $1.56 \times 10^6 \text{ ft}^3/\text{hr}$ 3) $3.01 \times 10^6 \text{ ft}^3/\text{hr}$ 4) $4.03 \times 10^6 \text{ ft}^3/\text{hr}$

Answer:4- Use the formula for dilution ventilation:

$$Q = (403 * \text{Sp.Gr. of solvent} * 10^6 * \text{pints per hour} * K) / (\text{Mol.Wt. of solvent} * \text{TLV})$$
$$Q = (403 * 0.9 * 10^6 * 2 * 10) / (36 * 50) = 4.03 \times 10^6 \text{ ft}^3/\text{hr}$$

Question #: 1820- If a contaminant with a TLV = 500 ppm is generated at a rate of $1 \times 10^{-3} \text{ ft}^3/\text{min}$, what is the theoretical rate of dilution ventilation required to maintain the concentration of the contaminant at the TLV?

- 1) 2 cfm 2) 20 cfm 3) 200 cfm 4) 2,000 cfm

Answer:1- Using the dilution formula: $Q = G/C$ where Q is the dilution rate, G is the generation rate and C is the concentration limit $Q = (1 \times 10^{-3}) / (500 \times 10^{-6}) = 2 \text{ ft}^3/\text{min}$

Question #: 1821- What is the velocity at the face of a 10 ft * 10 ft dry-type paint booth if the total flow through the opening is 2,000 cfm?

- 1) 10 ft/min 2) 20 ft/min 3) 40 ft/min 4) 200 ft/min

Answer:2- The basic formula for ventilation calculation is:

$Q = VA$ Q , the airflow rate is measured in cfm V , the velocity is measured in fpm
 A , the cross sectional area is measured in ft^2
 $A = 10 \text{ ft} * 10 \text{ ft} = 100\text{ft}^2$ $Q = AV$ $V = Q/A$ $= 2,000 \text{ ft}^3/\text{min} / 100 \text{ ft}^2 = 20 \text{ ft/min}$

Question #: 1822- The amount of **make-up** air volume in most cases is determined by:

- 1) The number of air changes required 2) **The total volume of air removed**
- 3) The required comfort conditions 4) Carbon dioxide concentration

Answer:2- In most cases, make-up air volume should equal the total volume of air removed from the building by exhaust ventilation systems, process systems, and combustion processes. Determination of actual volumes of air removed usually requires an inventory of exhaust locations.

Question #: 1823- Which **type of hood** would you recommend be designed for operations which release **sudden surges of hot gases and vapors**?

- 1) Down draft 2) Enclosed 3) **Canopy** 4) Slotted

Answer:3- Canopy hoods are effective for the control of hot processes and for those operations which release sudden surges of hot gases and vapors such as those where the thermal currents caused by rising hot air funnel the contaminant into the exhaust system.

Question #: 1824- How is pressure normally stated when taken in exhaust ducts?

- 1) mm Hg 2) **in. of water** 3) psi 4) in. of Hg

Answer:2- Normally pressure measurements are reported as inches of water.

Question #: 1825- In general, **which** of the following **operations** would require the **greatest capture velocity** to achieve effective exposure control?

- 1) Evaporation from open surface tanks 2) Spray booths
- 3) Welding 4) **Grinding**

Answer:4- Grinding operations release contaminants at **high initial velocities**. The other operations release contaminants with low velocities. Higher capture velocities would be required to entrain the releases from the grinding operations.

Question #: 1826- The basic ionizing radiation control measures include any of the following EXCEPT:

- 1) Minimizing time of exposure 2) **Source substitution**
- 3) Using shielding 4) Increasing distance

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Answer:2 -The basic philosophy in reducing ionizing radiation exposures is time, distance, and shielding. Keep the time of exposure as low as possible, increase the distance as much as possible, and shield the source with an effective shielding material.

Question #: 1827-Which radioactive emission is the easiest to shield against?

- 1) Alpha 2) Beta 3) Neutron 4) Gamma

Answer:1- Alpha particles are relatively easy to shield. Paper is an effective alpha shield. The other answers (beta, neutron, and gamma) are more difficult to shield.

Question #: 1828- Why are the low-atomic-number materials such as aluminum and organo-plastics used to shield beta particles?

- 1) Cheaper to use 2) Reduces Bremsstrahlung radiation
3) Higher atomic number materials are not effective 4) Lighter than lead

Answer:2 - Beta particles can generate Bremsstrahlung (braking radiation) X-rays when they are slowed too quickly by hitting materials of high atomic numbers. Therefore, aluminum and plastics with atomic numbers

Question #: 1829- What type of shielding is used for X-ray or gamma radiation?

- 1) Paper 2) Aluminum 3) Plastic 4) Lead

Answer:4-This type of higher energy radiation can most effectively be shielded by **lead or concrete**. The other materials, while effective for other types of radiation, would not be effective for X-ray or gamma radiation shielding.

Question #: 1830- In which of the following **wavelength groupings** is the lowest amount of radiant exposure allowed?

- 1) 200 - 220 nm 2) 220 - 240 nm 3) 240 - 260 nm 4) 260 - 280 nm

Answer:4- The lowest allowable radiant energy exposures occur in the region 260 - 280 nm (nanometers). This is the UV region where exposures can cause the most damage. Note that allowable exposure INCREASES at around 270 nm. The 260 - 280 region is a minimum on the curve. Review this graph in the ACGIG TLVs and BEIs publication.

Question #: 1831- A group of foundry workers are exposed to an air temperature of 105°F. Which control would be **least** appropriate?

- 1) Wear more clothing 2) Decrease the air movement
3) Increase air velocity 4) Decrease the humidity

Answer:4- The principal heat load in a foundry is radiant. It is highly unlikely that foundry air will have much moisture. All other methods may have some net benefit.

Question #: 1832- TLV's for gases and vapors are estimated on what unit basis?

- 1) Weight to weight 2) Weight to volume 3) Volume to volume 4) Both 2 and 3

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Answer:4- TLV's for gases and vapors are expressed in parts per million, which is a volume/volume ratio, and milligrams per cubic meter, which is a weight/volume ratio.

Question #: 1833- It is necessary for a maintenance worker to enter a confined space where a potential atmosphere immediately dangerous to life or health (IDLH) may be present. Which of the following respirators should the worker use?

- 1) NIOSH-approved full face chemical cartridge respirator with cartridges rated for the chemical hazard
- 2) NIOSH-approved full face demand SAR (Supplied Air Respirator)
- 3) NIOSH-approved full face pressure demand SCBA (Self Contained Breathing Apparatus)
- 4) NIOSH-approved half face cartridge respirator with HEPA cartridges

Answer:3- A pressure demand SCBA or pressure demand SAR is required in a known or suspected IDLH atmosphere. A demand SAR may sometimes allow contaminants to be sucked into the mask which may have a negative pressure with respect to the outside atmosphere. A pressure demand SCBA constantly supplies air to the face piece (to ensure that a negative pressure is never experienced inside the face piece). Cartridge respirators are not permitted in known (or suspected) IDLH atmospheres. 29 CFR 1910.134 (d)(2)

Question #: 1834- The basic safety precaution for people who work in confined spaces or in dangerous atmospheres is:

- | | |
|---|------------------------|
| 1) The buddy system | 2) Use of SCBA's |
| 3) Use of safety harnesses and life lines | 4) Proper air sampling |

Answer:1- The basic safety precaution for people who work in confined spaces or in dangerous atmospheres is the "buddy system". With the buddy system, no worker enters a dangerous atmosphere until someone else has been designated to take responsibility for his/her safety. While one worker goes into a confined space or other dangerous area, the buddy stays in a safe place nearby, alert at all times for danger and ready to act in an emergency. (Usually the buddy is suited up in protective equipment, as is the worker, ready to help the worker out in case of trouble).

Question #: 1835- A mechanical filter respirator is designed to prevent entrance of _____ into the respiratory system.

- | | | | |
|----------|--------------------|--------------------|--------------------|
| 1) Gases | 2) Gases and dusts | 3) Dusts and mists | 4) Gases and fumes |
|----------|--------------------|--------------------|--------------------|

Answer:3- Mechanical filters can only remove particles, they cannot remove gases or vapors.

Question #: 1836- Air-purifying and atmosphere-supplying are:

- | | |
|----------------------------|------------------------------------|
| 1) Types of respirators | 2) Ventilation system designations |
| 3) ASTM respirator classes | 4) OSHA-approved respirators |

Answer:1- Respirators can be placed in two categories: a) air-purifying, and b) atmosphere-supplying. Most air-purifying respirators use chemical cartridges to remove contaminants from the outside atmosphere to a concentration acceptable for breathing. Atmosphere-supplying respirators include SCBA and SAR. These respirators have an independent supply of breathable air for the respirator-wearer. There is no such thing as an OSHA-approved respirator.

Question #: 1837- Barrier creams:

- 1) Neutralize potential irritants
- 2) Reduce contact of potential irritants with the skin
- 3) Are preferred to gloves in most cases
- 4) Are not effective

Answer:2- Barrier creams, as their name implies, form a protective barrier between the skin and the chemical. They are not neutralizing agents for chemicals.

Question #: 1838- In which of the following situations may an air-purifying respirator be worn safely?

- 1) Odor threshold is greater than the allowable level
- 2) Odor threshold is equal to the allowable level
- 3) Odor threshold is less than the allowable level
- 4) Odor threshold is at least 4 times the allowable level

Answer:3- To wear an air purifying respirator safely, the worker must be able to detect the material at a safe level. If the odor threshold is greater than the allowable level (e.g., the odor threshold is 20 ppm, while the allowable level is 10 ppm), the worker will not know the material is getting through until PEL/TLV levels are reached or exceeded.

Question #: 1839- The risk of developing active pulmonary tuberculosis is substantially increased by which of the following?

- 1) Exposure to free crystalline silica dust
- 2) Exposure to alpha radiation
- 3) The presence of arsenic
- 4) Exposure to beta radiation

Answer:1- Exposure to free silica dust is a risk factor for pulmonary tuberculosis. The fibrosis caused by the silica may make the lung more susceptible to tuberculosis.

Question #: 1840- Which of the following would be most effective in reducing dermatitis in electroplaters?

- 1) Barrier creams
- 2) Gloves
- 3) Local exhaust ventilation
- 4) Frequent hand washing

Answer:2- The best method of protecting oneself from dermatitis is to prevent all contact with the offending agent. Therefore, gloves is the best answer.

Question #: 1841- Which respirator is an air-purifying type?

- 1) Abrasive blasting helmet
- 2) Particulate filter
- 3) Gas mask
- 4) Both 2 and 3

Answer:4- Both the gas mask and the particulate filter respirators are air-purifying.

Question #: 1842- Which glove would offer the best protection against halogenated hydrocarbons?

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- 1) PVC 2) Neoprene 3) Viton 4) Natural rubber

Answer:3- Out of all of the gloves tested, Viton is the one that offers protection against halogenated hydrocarbons.

Question #: 1843- A worker is using trichloroethylene as a degreaser in a tank. On occasion her hands may come in contact with the solvent. Which type of glove would you recommend?

- 1) Nitrile 2) Butyl 3) Poly-vinyl acetate 4) Viton

Answer:4- Viton is the type of glove material that offers protection against chlorinated solvents.

Question #: 1844- What type of respiratory protection is minimally required for Level C protection?

- 1) NIOSH-approved full or half-face air-purifying respirator 2) NIOSH-approved full-face piece respirator only
3) NIOSH-approved SCBA 4) NIOSH-approved Positive pressure SCBA only

Answer:1- Level C protection includes full-face or half-face air purifying respirator. 29 CFR 1910.120 Appendix B

Question #: 1845- The following are types of glove materials EXCEPT:

- 1) Nitrile 2) Neoprene 3) PVC 4) Polynitrile

Answer:4- Polynitrile is not a glove material. Nitrile, PVC, and neoprene are common glove materials.

Question #: 1846- Before donning full-body chemical protective clothing, one should inspect all the following EXCEPT:

- 1) Seams 2) Snaps/buttons 3) Pressure relief valves 4) Other openings

Answer:2- Full-body chemical protective clothing does not contain buttons or snaps, otherwise there would be openings for chemicals to enter.

Question #: 1847- You would use a cartridge respirator during chemical spill cleanup operations when the following conditions apply EXCEPT:

- 1) The oxygen content is above 19.5%
2) The concentration of airborne material is less than the protection factor for the respirator
3) Hazards and concentrations of materials are known
4) The odor threshold of the material is greater than the TLV

Answer:4- A cartridge respirator cannot be used when the material has poor warning properties. If the odor threshold is greater than the TLV, the warning properties are poor.

Question #: 1848- If chemical warnings are not accessible when responding to a spill _____.

- 1) Odor can be used to determine the level of protection
- 2) No one should be sent into the spill area
- 3) Level A protection should be donned
- 4) The maximum level of respiratory protection and gloves should be donned

Answer:3- Level A protection will offer complete isolation from the hazard to allow safe emergency response.

Question #: 1849- In a machine shop, protective eye wear should be worn by:

- 1) Equipment operators
- 2) Shop supervisors
- 3) Casuals walking through the shop
- 4) All of the above

Answer:4- If there is a flying object hazard, all who may be exposed should wear eye protection.

Question #: 1850- Safety spectacles would be least effective in protecting an employee's eyes in which of the following situations?

- 1) Chipping rock
- 2) Pouring molten metals
- 3) Working in a high concentration of gaseous ammonia
- 4) Sharpening tools at a stand grinder

Answer:3- Ammonia (NH₃) is a gas; spectacles would not provide protection.

Question #: 1851- Which respirator has an assigned protection factor of 10,000?

- 1) SCBA operating in pressure demand mode
- 2) SAR in pressure demand mode with auxiliary SCBA in positive mode
- 3) SCBA operating in demand mode
- 4) Both 1 and 2

Answer:4- The protection factors were determined by conducting quantitative fit testing on human volunteers. The higher the factor, the more protection. Therefore, a SAR with an escape SCBA offers the same protection as an SCBA. Both must be in the supply mode. The demand mode may introduce contaminants into the face during strenuous circumstances.

Question #: 1852- If an SCBA is worn in an atmosphere that is immediately dangerous to life and health; he/she must:

- 1) Wear safety harnesses and lifelines
- 2) Have a standby worker with a canister respirator
- 3) Have an escape pack
- 4) Not go into the area

Answer:1- In the event of an emergency, a safety harness and lifeline is the means of quickly removing the person from the hazardous atmosphere.

Question #: 1853- What type of breathing air is used for supplied air respirators?

- 1) Class A
- 2) Class B
- 3) Class C
- 4) Class D

Answer:4- Class D breathing air is considered safe for supplied air respirators. Class D breathing air has specific levels of oxygen, hydrocarbons, carbon monoxide, and carbon dioxide.

Question #: 1854- Which of the following SCBA systems is required for IDLH atmospheres?

- 1) Demand 2) Negative pressure demand **3) Pressure demand** 4) Gas masks

Answer:3- Pressure demand SCBA's provide a continuous flow of positive pressure air to the face piece of the respirator. The demand/negative pressure demand respirators supply air to the face piece only upon inhalation. Gas masks are not SCBA's.

Question #: 1855- The static magnetic field TLV for an 8-hour TWA whole body dose should not exceed:

- 1) 600 Gauss** 2) 800 Gauss 3) 1,000 Gauss 4) 1,200 Gauss

Answer:1- The TLV for static magnetic fields is 600 Gauss or 60 milliTeslas (mT) for a whole body dose. Extremity doses can be 6,000 Gauss (600 mT). Static magnetic field can pose a severe danger to workers with pacemakers, and their exposure should not exceed 5 Gauss (0.5 mT). ACGIH TLVs and BEIs

Question #: 1856- What minimum level of airflow is required for supplied air respirators?

- 1) 1 cfm 2) 2 cfm 3) 3 cfm **4) 4 cfm**

Answer:4- Supplied air respirators must have a minimum airflow of 4 cfm to the face piece.

Question #: 1857- The vapor pressure of a solvent in air is 7×10^{-3} mm Hg. What is the concentration in ppm?

- 1) 920 ppm 2) 92 ppm 3) 9.2 ppm 4) 0.092 ppm

Answer:3- $C_{ppm} = (P_{vapor} / P_{total}) \times 10^6 \text{ ppm}$
 $= (7 \times 10^{-3} \text{ mm Hg} / 760 \text{ mm Hg}) \times 10^6 \text{ ppm} = 9.2 \text{ ppm}$

Question #: 1858- When an internal explosion occurs, it causes the shape of the enclosure to change from:

- 1) Rectangular to elliptical** 2) Rectangular to star-shaped
3) Rectangular to quadrilateral 4) Rectangular to pyramid

Answer:1- When an internal explosion occurs, it causes the shape of the enclosure to change from rectangular to elliptical. Adequate strength is one requirement for the design of an explosion proof enclosure; a safety factor of 4 is generally used. To prevent failure of the enclosure, openings are designed to relieve the pressure of the expanding gases.

Question #: 1859- There are two common enclosure designs: threaded-joint enclosures and ground-joint enclosures. When hot gases travel through the very small openings in either of these joints, they are ____ before reaching the surrounding hazardous atmosphere.

- 1) Heated 2) Cooled 3) Warmed 4) Frozen

Answer:2- When hot gases travel through the very small openings in either of these joints, they are cooled before reaching the surrounding hazardous atmosphere.

Question #: 1860- A force applied on a surface in the direction parallel to the surface is called a:

- 1) Normal force 2) Tangential force 3) Concurrent force 4) Perpendicular force

Answer:2- A force applied on a surface in the direction parallel to the surface is called tangential force.

Question #: 1861- Non-cellular, parasitic pathogens that are incapable of growth or reproduction apart from living cells describe infectious agents called:

- 1) Bacteria 2) Rickettsiae 3) Viruses 4) Parasites

Answer:3- Viruses are non-cellular, parasitic pathogens much smaller in size than bacteria or rickettsiae. They are incapable of growth or reproduction apart from living cells. Viral transmission occurs through contact with animals, objects, and aerosols carrying a virus.

Question #: 1862- Which of the following is located in the inner ear?

- 1) Tympanic membrane 2) Ossicles 3) Eustachian tube 4) Cochlea

Answer:4- The cochlea is the auditory part of the inner ear and is shaped like a snail shell. It contains the basilar membrane on which the end organs of the auditory nerve are distributed.

Question #: 1863- One of the reasons that the lungs are a major route of exposure is because they are very efficient at collecting and absorbing toxicants. One reason for this ability is the:

- 1) Tremendous surface area 2) Location of the lungs in the chest
3) Temperature differential 4) Adsorption coefficient of tissue

Answer:1- The lung has a very large surface area. In fact, the lung surface area for an average human is 55-75 m². In contrast, the skin has a surface area of only 2 m².

Question #: 1864- One potential by-product of water chlorination that is NOT beneficial is:

- 1) Destruction of E. coli 2) Lowered turbidity
3) Presence of trihalomethanes 4) Destruction of pathogens

Answer:3- The formation of trihalomethanes by water chlorination is an adverse byproduct. Chloroform, one of the trihalomethanes, is a suspected human carcinogen.

Question #: 1865- The most sensitive and accurate method of physiologically measuring work is:

- 1) Heart rate 2) Oxygen consumption 3) Respiratory volume 4) Electromyography

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Answer:2- The body's oxygen consumption is the most sensitive and accurate method of measuring work.

Question #: 1866- Three layers of the skin include:

- 1) Hair follicles, capillaries, muscles
- 2) Epidermis, dermis, subcutaneous tissue
- 3) Id, ego, superego
- 4) Cuticles, capillaries, muscles

Answer:2- The 3 layers of the skin are the epidermis (outer layer), the dermis (true skin), and the subcutaneous tissue.

Question #: 1867- The sound pressure unit "dB" has become popular because:

- 1) It is specific to noise and its action
- 2) It covers a wide range of values
- 3) It is the only term available
- 4) It is easy to combine various sources

Answer:2- The dB is a logarithmic measure and therefore can cover a wide range of values. It would be cumbersome to use numbers which vary by a factor of more than one million.

Question #: 1868- The most important function of these micro-organisms in the environment is to break down the cellulose in wood and other plant materials.

- 1) Fungi
- 2) Bacteria
- 3) Algae
- 4) Amoeba

Answer:1- Fungi generate an enzyme called cellulase which breaks down insoluble cellulose to soluble carbohydrates.

Question #: 1869- In heat stress science, metabolism is assessed as:

- 1) Negative
- 2) Positive
- 3) Can be both positive and negative
- 4) Negligible

Answer:2- In heat stress science, the heat gained by the body through metabolism is positive.

Question #: 1870- In which part of the body is the main thermoregulation activity handled?

- 1) Lungs
- 2) Heart
- 3) Skin
- 4) Hair

Answer:3- Skin is the site of most thermoregulation activities including sweating, and conductive and radiant heat transfer.

Question #: 1871- Biological exposure indices data is important because they include type(s) of exposure in addition to inhalation. Which of the following exposures are least likely to be assessed by a BEI?

- 1) Skin absorption
- 2) Injection
- 3) Ingestion
- 4) Transplacental

Answer:4- BEI's measure certain biological functions to determine the "total" exposure from all routes. BEI's do not measure transplacental exposures. They may provide some useful information however on exposure of the fetus to workplace chemicals.

Question #: 1872- A device that protects equipment from an overload by opening the circuit automatically is commonly called a:

- 1) Circuit breaker 2) Fuse 3) Ground fault circuit interrupter (GFCI) 4) Both 1 and 2

Answer:4- Circuit breakers and fuses are **overcurrent devices** that open a circuit automatically when there is excessive current flow from an accidental ground, short circuit, or overload. The circuit breaker trips open when its mechanical mechanism is activated; it can be reset. The fuse contains a strip of wire or fusible metal link which melts when overloaded. GFCI devices do not protect equipment, per se. They are designed to protect people by opening a circuit rapidly upon detecting a fault.

Question #: 1873- The primary constituent of Hopcalite is?

- 1) Lime 2) Manganese dioxide 3) Zinc 4) Borate

Answer:2- Hopcalite is a specially prepared mixture of manganese dioxide with other oxides used for oxidizing CO.

Question #: 1874- You suspect that a worker's exposure has exceeded the TLV-C for a certain chemical. Unfortunately you do not have a device to measure instantaneous exposures. You do have a longer term measurement device. What do you do? Note: Substance does not cause an immediate reaction.

- 1) Take an 8-hr sample and back calculate 2) Take as short as sample as possible
3) Take a 15-min sample 4) Do not measure and assume the TLV-C was exceeded

Answer:3- If instantaneous monitoring is not feasible, then the TLV-C can be assessed by sampling over a 15-min period - except for those substances that may cause immediate irritation when exposures are short. ACGIH TLVs and BEIs

Question #: 1875- Pressure testing is a potentially _____ test.

- 1) Destructive 2) Hypergolic 3) Hyperbaric 4) Reverberant

Answer:1- Pressure testing may actually destroy the object being tested.

Question #: 1876- How many foot candles of illumination are necessary for work that requires fine assembly?

- 1) 5 footcandle 2) 50 footcandle 3) 500 footcandle 4) 5,000 footcandle

Answer:3- 500 foot candle is necessary for the performance of visual tasks of low contrast and very small size over a prolonged period of time (e.g., fine assembly, very difficult inspection, etc.). 5 foot candles is very low light, and is not appropriate for most working environments. 50 foot candle is a typical office environment lighting level, and 5,000 foot candle is well beyond the lighting necessary for the task described.

Question #: 1877- Class B portable fire extinguishers are rated by the size of the fire that a novice can extinguish and are identified by a red square containing the letter "B". The numeral preceding the "B" in the rating indicates:

- 1) Number of seconds it will take to dispense the contents of the extinguisher
- 2) Number of times the extinguisher may be used
- 3) Number of square feet of burning liquid that can be extinguished
- 4) Number of times the unit is effective compared with one gallon of water

Answer:3- The numeral preceding the letter "B" indicates the number of square feet of burning liquid that the novice can extinguish with that extinguisher. For example a 20B rating indicates the novice can extinguish 20 ft² of burning liquid fire.

Question #: 1878- Class A portable fire extinguishers are identified by a green triangle containing the letter "A." What does the rating number appearing before the "A" signify?

- 1) The time in seconds it takes to dispense the contents of the extinguisher
- 2) The time in minutes it takes to dispense the contents of the extinguisher
- 3) The ability to extinguish a fire as compared to one gallon of water
- 4) The number of square feet of paper waste that can be extinguished.

Answer:3- The number preceding the letter "A" rates its ability to extinguish a fire as compared to one gallon of water. For example, a "4A" rating means the unit is four times as effective as one gallon of water, or conversely, it has the same effectiveness as four gallons of water.

Question #: 1879- As a safety professional, you must recommend how to safely store the following quantities of flammable and combustible liquids: Class I - 35 gallons Class II - 35 gallons Class III - 50 gallons

- 1) Provide two (2) approved metal storage cabinets
- 2) Disburse the materials throughout the assembly area
- 3) Provide one (1) approved metal storage cabinet
- 4) Insist the quantities be reduced

Answer:1- NFPA 30 states that not more than 120 gallons of Class I, Class II and Class IIIA liquids may be stored in a storage cabinet. Of this total, not more than 60 gallons may be of Class I and Class II liquids.

Question #: 1880- In a 25 ft high assembly area designed for fire safety, a 6 ft metal curtain has been affixed to the bar joists. What is the LEAST likely fire safety purpose?

- 1) Delays and limits the horizontal spread of heat, gases, and smoke
- 2) Assists in making the venting more effective

3) Provides a horizontal confinement to obtain a stack effect

4) *Delays and limits the vertical spread of heat, gases, and smoke*

Answer:4- The metal curtain is a draft curtain that functions to delay and limit the horizontal spread of heat, gases, and smoke by providing a horizontal confinement to obtain a stack effect. The placement of draft curtains makes the venting more effective in that the volume of hot gases and smoke discharged by thermal updrafts through a vent varies directly with the height of the gas or smoke column.

Question #: 1881- As a safety professional, you are asked to provide guidance in the layout of a 5,000 square-foot, high-hazard facility to be occupied by up to 15 laboratory scientists. The expected configuration of the process equipment presents the need for a dead end corridor in the means of egress arrangement. Based on NFPA 101 (Life Safety Code), what will be your suggestion regarding the maximum permitted length of the anticipated dead end corridor?

- 1) 0 ft 2) 25 ft 3) 30 ft 4) 50 ft

Answer:1- Dead ends are not permitted in high hazard occupancies with an area of more than 200 square feet or an occupant load of more than 3 people. NFPA 101 7.11.4 (Life Safety Code)

Question #: 1882- The amount of water a public water system must provide includes all the following EXCEPT:

- 1) Domestic consumption 2) *Leakage in the system*
3) Industrial consumption 4) Fire fighting service

Answer:2- The amount includes all items except the system leakage which would be included in the domestic and industrial figures.

Question #: 1883- The term central station alarm or central station system is used to describe a type of alarm system that communicates trouble at a premises to those who will respond. These systems:

- 1) Directly notify the local fire department
2) *Notify a constantly attended location operated by a company that notifies appropriate authorities*
3) Notifies emergency personnel that work at the facility
4) Notifies a central point in the facility so that a designated person can call the fire department

Answer:2- This type of alarm system notifies a continuously attended facility operated by a company whose purpose is to alert appropriate authorities.

Question #: 1884- Automatic sprinkler systems seldom fail to control fires, however, when a failure does occur the dominant cause is:

- 1) Foreign material obstructing the piping system 2) Freezing of water in the piping system
3) *Improperly closed supply valve* 4) Inadequate supply of water

Answer:3 Factory Mutual records cite improperly closed PIV's to be the dominant cause for automatic sprinkler system failure. This occurs most often because of maintenance related actions that necessitate system shutdown followed by failure to open the valve after work has

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been completed. Shutting off the supply valves prematurely during a fire is another leading cause for failure.

Question #: 1885- Which of the following portable fire extinguishers should not be used to extinguish a small fire in a confined space?

- 1) ABC dry chemical 2) Carbon dioxide 3) Water 4) BC dry chemical

Answer:2- The carbon dioxide will replace oxygen in a confined space and could lead to asphyxiation.

Question #: 1886- The best fire protection system advisable in a plant where water damage would result in a serious product loss would be:

- 1) Pre-action 2) Deluge 3) Dry pipe 4) Wet pipe

Answer:1- Pre-action fire protection systems are designed to eliminate the danger of water damage and to counteract the operational delay of conventional dry pipe systems. In pre-action systems, the water supply valve is actuated independently of the opening of sprinklers.

Question #: 1887- Confronted with having to extinguish a small Class A fire in an office where only the following extinguishing agents were present, which would you select?

- 1) Bucket of sand 2) Multipurpose dry chemical 3) Carbon dioxide 4) Nothing (let it burn out)

Answer:2- A multipurpose dry chemical is effective because it provides a rapid knock-down of flames and forms a fire-retardant coating that prevents reflash. CO₂ may blow the contents around, leaving embers which can reflash.

Question #: 1888- Which class of fire extinguisher is best for extinguishing a paper fire?

- 1) Class "A" (green triangle with "A" in triangle) 2) Class "B" (red square with "B" in square)
3) Class "C" (blue circle with "C" in the circle) 4) Class "D" (yellow star with "D" in the star)

Answer:1- Class "A" fire extinguishers are used on paper or wood fires. Class "B" fire extinguishers are used on burning flammable and combustible liquids. Class "C" fire extinguishers are used on fires involving energized electrical equipment. Class "D" fire extinguishers are used on fires involving combustible metals.

Question #: 1889- Spark arresters are required on chimneys in certain applications. In which of the following applications is a spark arrester not required but is desirable?

- 1) On refuse burners 2) On incinerators 3) On solid fuel furnaces
4) On all heating equipment burning liquid fossil fuels

Answer:3- Spark arresters are required on refuse burners and incinerators. Arrestors are desirable (but not required) when burning solid fuels. They are not needed on liquid or gas fuels.

Question #: 1890- The best way to extinguish a chimney fire serving a wood burning stove or heater is to:

- 1) Close the damper and doors reducing the air supply 2) Let them burn out

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3) Use water in the fire box

4) Use water in the chimney

Answer:1- Close the damper to cut off oxygen to the fire. If it does not totally cut off the air, it will reduce the intensity of the fire.

Question #: 1891- One of the most effective forms of **area protection** from fires in combustible oil quenching operations is:

1) Draining the oil to a tank

2) Foam systems

3) **Automatic water spray systems over the tanks**

4) Automatic closing lids

Answer:3- The best protection is water sprays since they reduce heat, reduce oxygen, and protect the building from oil fires. The other controls can also be used but are not generally as effective as water spray.

Question #: 1892- The mixing room for a spray painting operation should be located:

1) In the flammable liquids storage room

2) In the spray painting room or booth

3) **Adjacent to an outside vented wall**

4) Outdoors

Answer:3- The best location is in a separate room located on an outside wall of the building so that explosion venting can be provided. It should be isolated from the rest of the building by fire-resistive construction.

Question #: 1893- High piled combustible storage presents a challenge to sprinkler systems. Above what height are special in-rack sprinkler system design considerations necessary?

1) 6 ft

2) 8 ft

3) **12 ft**

4) 16 ft

Answer:3- 12 ft is considered the upper range for piled combustibles without utilizing special system design techniques that can get water to a potential fire.

Question #: 1894- Your company is a grocery wholesaler and is planning a new warehouse with storage racks 60 ft high. What is one of the primary reasons you will recommend a sprinkler system that includes in-rack sprinklers?

1) In-rack sprinklers are required by code and will reduce the fire insurance costs

2) In-rack sprinklers are cheaper to install than other types of systems and are easy to protect from damage

3) Water requirements can be reduced when in-rack sprinklers are installed in addition to general building sprinklers

4) **High rack storage of commodities on pallets and in boxes will create significant flues through which fire will propagate**

Answer:4- In-rack storage creates flues in the storage area, particularly between pallets of goods stacked side-by-side. In-rack sprinklers will knock down the fire sooner and will probably reduce water damage from fire suppression. They will cost more to install but will protect the building and the contents.

Question #: 1895- In choosing a noise control barrier, which represents the best choice of design?

- 1) Baffles 2) Partial enclosure 3) Air-tight enclosure 4) Non-reflective surfaces

Answer:3- Air tight enclosures yield the best noise protection. Small leaks can cause significant noise leakage. It is best to design enclosures to keep leaks to an absolute minimum.

Question #: 1896- In the design of a noise reducing enclosure, all of the following characteristics are desired EXCEPT:

- 1) Acoustical-absorbing material inside enclosure 2) Acoustical-absorbing material outside enclosure 3) Enclosure made of solid non-porous material 4) Air-tight enclosure

Answer:2- Acoustical-absorbing material on the outside of an enclosure is much less effective than having the sound-absorbing material on the inside.

Question #: 1897- What control measures can be taken for adequate protection against external radiation hazards?

- 1) Use lead shielding and protective equipment
2) Follow the principals of the inverse square law
3) Limit exposure time, work at a safe distance, and use barriers
4) Use written procedures, employee training, personal protective equipment, and signage

Answer:3- Gamma rays, X-rays and neutrons are the most penetrating radiations and usually constitute the major external hazards. There are three principal factors that provide the basis for radiation protection: time, distance, and shielding.

TIME - To control personnel exposure, the dose rate from a radiation source may be measured and appropriate limits placed on the working time for control of the dose to the individual.

DISTANCE - The intensity of a radiation field decreases as you move further away from the radiation source. The relation between radiation exposure rate and distance follows the inverse square law.

SHIELDING - Since ionizing radiation will interact with most materials, in principle any can be used for shielding. Some materials, however, like lead, make more efficient shields than do others.

Question #: 1898- When a respirator has a HEPA filter, the filter is 99.97 % effective at capturing monodisperse particle _____ microns or larger in diameter.

- 1) 1.0 2) 0.5 3) 0.3 4) 0.1

Answer:3- HEPA filters are 99.97% efficient at collecting monodisperse particles 0.3 microns or larger.

Question #: 1899- When a respirator is worn by more than one person it must go through an additional step of cleaning. This step is called:

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- 1) Valve replacement 2) Disinfection 3) Quantitative fit testing 4) Qualitative fit testing

Answer:2- Any time a respirator is worn by more than one person it must be disinfected. If possible, it is preferable to have each person have their own respirator. This is difficult, however, in the case of emergency response respirators such as SCBA's. The employer's Respiratory Protection Program must stipulate in writing how the disinfection process will occur.

Question #: 1900- Which of the following items does not affect the fit of a respirator?

- 1) Strap tension 2) Sideburns 3) Dentures 4) Exhalation valve cover

Answer:4- Dentures, sideburns, and the adjustment straps all effect how well a respirator fits. The exhalation valve, although very important to respirator function, does not effect the fit.

Question #: 1901- Which of the following respirators has the highest protection factor?

- 1) Air purifying 2) Pressure demand full face piece
3) Demand full face piece 4) Continuous flow full face piece

Answer:2- The pressure demand unit with full face piece has a protection factor of 10,000. The other listed devices all have lower protection factors.

Question #: 1902- There are no established safety specifications for:

- 1) Bump caps 2) Safety glasses 3) Respirators 4) Boilers

Answer:1- Bump caps were originally developed by the airline industry for work inside fuselages. They have no established specifications.

Question #: 1903- An example of a mechanical collector for pollutants is:

- 1) A cyclone 2) An ESP 3) An afterburner 4) An incinerator

Answer:1- A cyclone collects pollutants by placing the incoming pollutant laden air into a vortex where the particulate matter drops out.

Question #: 1904- A tank farm is being designed and will be located in a geographical location that receives extensive rainfall. The tank farm will house four hazardous materials: fuel oil, ethanol, acetone, and sulfuric acid. To ensure that corporate safety and environmental protection policies are followed, you have been asked to provide input on the layout of the containment dikes.

Because of the soil, no dike can be higher than 4.5 ft. Due to the potential for heavy rains, company policy requires a 25% overage be designed into the capacity of any given diked volume.

A new tank (Tank I) is scheduled to be constructed after this tank farm is built and will be placed adjacent to Tank H. The piping drawings indicate that the horizontal centerlines of Tank H and Tank I line up. Tank I will be a duplicate of Tank H and will contain the same material.

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With respect to the graphic, the dimensions of the diked area containing Tank H are 190 ft horizontally x 140 ft vertically. If the design requires considering the anticipated addition of Tank I adjacent to Tank H, what is the minimum dike height surrounding Tank H?

- 1) 3.6 ft 2) 3.8 ft 3) 4.1 ft 4) 4.5 ft

Answer:1- Answer this question one step at a time.

Step 1: Find the capacity of either Tank H or Tank I (they are identical). Dikes must be able to contain a release of the largest tank in the diked area. Both Tank H and Tank I are 60 ft diameter tanks that are 24 ft high. Assume that the capacity of the tank is the same as the volume of a cylinder. Its volume is therefore $V = \pi [(60 \text{ ft})^2 / 4] 24 \text{ ft} = 67,858 \text{ ft}^3$

Step 2: The next step is to determine the required capacity of the diked area. The dike must contain a complete loss of either tank plus a rainfall overage of 25%. Therefore, the actual capacity of the dike is 25% higher than the volume of either tank. Total Volume = $1.25 * 67,858 \text{ ft}^3 = 84,823 \text{ ft}^3$

Step 3: Unfortunately, we cannot use the volume occupied by one of the tanks in the diked area. We DO assume that the volume occupied by the ruptured/leaking tank is available, though. We do not know the height of the dike, but we DO know the surface area of either tank. We will use this number shortly. Calculate the unavailable surface area of either tank.
Tank Surface Area = $\pi [(60 \text{ ft})^2 / 4] = 2,827 \text{ ft}^2$

Step 4: Based on the dimensions given for the dike surrounding Tank H, we can determine the existing surface area of the dike and subtract the additional surface area made unavailable by the other tank. Existing Surface Area = $190 \text{ ft} * 140 \text{ ft} = 26,600 \text{ ft}^2$
Net Surface Area = Existing Surface Area - Tank Surface Area = $26,600 \text{ ft}^2 - 2,827 \text{ ft}^2 = 23,773 \text{ ft}^2$

Step 5: Calculate the height of the dike by dividing the Total Volume by the Net Surface Area.
Dike Height = $84,823 \text{ ft}^3 / 23,773 \text{ ft}^2 = 3.57 \text{ ft}$

Question #: 1905-The typical "scrubber" used in a factory for acid vapor emissions control is:

- 1) Filter 2) Electrostatic precipitator 3) Cyclone 4) Wet collector

Answer:4- A wet collector controls emissions through absorption of the air stream with a caustic liquid.

Question #: 1906- Secondary standards as regards to drinking water are related to:

- 1) Health data 2) Aesthetics 3) Cancer risk 4) Reproductive hazard risk

Answer:2- Secondary standards for drinking water are related to aesthetic values that are more socially related.

Question #: 1907- The removal of insoluble matter from water is referred to as:

- 1) Primary waste treatment 2) Secondary waste treatment
3) Tertiary waste treatment 4) Activated sludge process

Answer:1- Primary waste treatment removes insoluble matter through screening, removal of grit, and primary sedimentation.

Question #: 1908- All of the following are steps in a chemical risk analysis EXCEPT:

- 1) Identification of risk
- 2) Dose-response
- 3) Exposure assessment
- 4) **Personal protective equipment required**

Answer:4- Chemical risk analyses classically involve risk identification, quantification, dose-response development, and exposure assessment.

Question #: 1909- **Who is LEAST responsible** for ensuring that each container of a hazardous chemical shipped to a facility is labeled?

- 1) Chemical manufacturer
- 2) Importer
- 3) Distributor
- 4) **End user**

Answer:4- The chemical manufacturer, importer, or distributor must ensure that hazardous chemical containers are labeled.

Question #: 1910- The ACGIH TLV-TWA Committee in 1996 and 1997 proposed which of the following as a **change** in the **designation** of carcinogenic chemicals?

- 1) No changes
- 2) No longer designate carcinogens
- 3) **Established 5 categories of occupational carcinogens**
- 4) No longer publish exposure limits for carcinogens

Answer:3- The Committee proposed that carcinogens be divided into 5 separate categories to better reflect degrees of uncertainty and scientific knowledge.

- A1 - Confirmed Human Carcinogens
- A2 - Suspected Human Carcinogens
- A3 - Animal Carcinogens
- A4 - Not classifiable as a Human Carcinogen
- A5 - Not suspected as a Human Carcinogen

Question #: 1911- A life-threatening disease epidemic has increased the normal annual death rate from 18 deaths per 1,000 people to 28 deaths per 1,000. This is:

- 1) **A death by disease rate of 1.0%**
- 2) A death by disease rate of 1.8%
- 3) An increased threat to the population of 2,800 per year
- 4) Both 2 and 3

Answer:1- The 10 deaths per 1,000 people increase in the death rate is attributed to the life-threatening disease epidemic. Therefore, the death by disease rate is 10 per 1,000 people, or 1%. The usual death rate includes deaths by everything EXCEPT the disease.

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Question #: 1912- "The equipment operator failed to shut down the boiler when the high pressure alarm activated in the control room". During an accident investigation, this will end up being a(n):

- 1) Causal factor 2) System effect 3) Accepted risk 4) Recognized fault

Answer:1- Causal factors are key events in the chain leading to an accident. If a causal factor is eliminated, the accident would likely not have happened. Causal factors are always in the form of "subject - verb".

Question #: 1913- Descriptions of the potential accidents that could result from the hazard in terms of number of persons affected, environmental impacts, and effects on other subsystems or the total system are called:

- 1) Causal factors 2) Hazards 3) System effects 4) Events

Answer:3- A description of potential accidents that could result from the hazard in terms of number of persons affected, environmental impacts, and effects on other subsystems of the total system are system effects.

Question #: 1914- A widely recognized protocol utilized to prevent the transmission of the HIV virus is called:

- 1) Aids quarantine 2) Universal precautions 3) Aids awareness 4) HBV vaccination

Answer:2- The terminology "universal precautions" is a set of work practices adopted by health care and related workers to prevent the spread of the HIV and other pathogenic organisms. 29 CFR 1910.1030 (d)(1)

Question #: 1915- In the late 1980s and early 1990s, which vaccine was identified as important for personnel at risk of exposure to blood borne pathogens?

- 1) Tetanus 2) HIV 3) HBV 4) HAV

Answer:3- The Hepatitis B vaccine was determined to be critical to offer to healthcare workers. In 1991 it was made mandatory for workers at risk of exposure to bloodborne pathogens in the United States. 29 CFR 1910.1030 (f)(1)

Question #: 1916- Human factors engineering or ergonomics is fitting the worker to a task or the task to the worker. In a man/machine system, the machine is better at all of the following EXCEPT:

- 1) Memory 2) Language ability 3) Exerting large forces smoothly 4) Rapid computations

Answer:2- Man is better at language ability.

Question #: 1917- The two most common techniques employed for the control of bio agents are:

- 1) Ventilation and housekeeping 2) Housekeeping and disinfection
3) Disinfection and sterilization 4) Sterilization and housekeeping

Answer:3- Disinfection and sterilization are the two most common techniques used to control bio agents. It is important to note disinfection and sterilization are not synonymous operations.

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To **disinfect** means to get rid of **some pathogenic microorganisms** that cause infection, but does not imply complete destruction of all that are harmful, whereas, **sterilization** means the **absolute destruction** of all living organisms.

Question #: 1918- SCBA is:

- | | |
|--|--|
| 1) Service connected binding arbitration | 2) Society for certified breathing apparatus |
| 3) Service certified breath analysis | 4) Self-contained breathing apparatus |

Answer:4- This is the common acronym for self-contained breathing apparatus.

Question #: 1919- Acronyms are used extensively in the various regulatory programs as a form of shorthand. Which of the following acronyms is not defined by the RCRA program?

- | | | | |
|---------|--------------|--------|--------|
| 1) TCLP | 2) RQ | 3) SQG | 4) LQG |
|---------|--------------|--------|--------|

Answer:2- RQ, standing for Reportable Quantity, is defined under the CERCLA program. Please note, however, that hazardous wastes are by definition a subset of hazardous substances, and RQs have been assigned to each listed hazardous waste and each characteristic of hazardous waste. TCLP, SQG, and LQG are acronyms for RCRA defined terms of toxicity characteristic leaching procedure, small quantity generator, and large quantity generator, respectively.

Question #: 1920- Delegation of authority and chain of command are characteristic of a:

- | | |
|----------------------------|---------------------------------|
| 1) Democratic structure | 2) Formal structure |
| 3) Autocratic organization | 4) "Laissez faire" organization |

Answer:2- The formal structure has a system of objectives that defines roles and responsibilities of the participants. Delegation of authority means authorizing individuals within the structure with defined rights and responsibilities resulting in a "chain of command".

Question #: 1921- All have been identified as "megatrends" by John Naisbett EXCEPT:

- | | |
|--|--|
| 1) Transition from industrial to information society | 2) National to world economy |
| 3) Short term to long term | 4) Decentralization to centralization |

Answer:4- Naisbett predicted a number of changes including the movement from centralization to decentralization in government and business.

Question #: 1922- Heinrich's domino theory of accidents includes:

- | | |
|---|---|
| 1) Worker, perception, physical, social, injury | 2) The 5 B's |
| 3) Social, fault, unsafe act, accident, injury | 4) Men, machine, money, capital, accident |

Answer:3- Heinrich's domino theory involved social, fault, unsafe act, accident, injury.

Question #: 1923- An effective fire loss control program must include objectives that prevent loss of life and personal injury, prevent inception of fire, protect property and:

- 1) Provide means to extinguish fire
- 2) Provide uninterrupted operations
- 3) Incorporate the use of fire resistive building materials
- 4) Effect controls that limit the fire load (amount of combustibles)

Answer:2- In any fire loss control program there is a necessity for a plan that protects against a business interruption. Generally, there is a condition of insurance that you reduce the loss resulting from a business interruption by resuming complete or partial operations on the fire damaged premises and/or making use of other property and materials at other facilities.

Question #: 1924- Political and socioeconomic factors are NOT important considerations in which of the following processes?

- 1) Risk communication
- 2) Risk assessment
- 3) Risk management
- 4) Risk acceptability

Answer:2- Risk assessment is the scientific discipline involved in characterizing and quantifying the magnitude of potential harm to human health from the presence of a particular agent in the environment. Unlike risk management, risk assessment does not consider economic impact.

Question #: 1925- What does the management term "line function" mean?

- 1) An employment function for which the enterprise exists
- 2) An employment function to support the work for which the enterprise exists
- 3) An employment function associated with a manufacturing assembly line
- 4) An employment function providing direct supervision

Answer:1- A line function is a position or role directly involved with the main enterprise of the company. For example, "pigment mixer" would be a line function in a paint manufacturing plant. A staff function, on the other hand, is a position or role that supports the line functions. For example, "security guard" is a staff function for a paint manufacturing plant to ensure the protection of the facilities and people involved in manufacturing paint.

Question #: 1926- A manager who utilizes an external reward and punishment system to affect performance is a _____ manager.

- 1) Theory A
- 2) Theory X
- 3) Theory Y
- 4) Theory Z

Answer:2- Theory X holds that people must be motivated to work by external reward and punishment.

Question #: 1927- A manager who utilizes the inherent motivation that is present in all humans is a _____ manager.

- 1) Theory A
- 2) Theory X
- 3) Theory Y
- 4) Theory Z

Answer:3- Theory Y managers utilize the goal-orientation of the worker to achieve results.

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Question #: 1928- Safety behavior modification programs have the following purpose:

- 1) Eliminate unsafe acts 2) Increase safe acts 3) Both 1 and 2 4) None of the above

Answer:3- Behavior modification programs generally try to eliminate unsafe acts and increase safe acts. Dan Petersen, Safety Management: A Human Approach

Question #: 1929- Early hearing loss caused by noise:

- 1) Seriously affects speech reception 2) Makes a person's speech sound distorted
3) Affects telephone usage 4) Is not generally noticeable to the subject

Answer:4- Most people do not notice the hearing loss until there is significant detriment to their hearing.

Question #: 1930- The most important sensory input for human decision-making is:

- 1) Visual 2) Auditory 3) Tactile 4) Olfactory

Answer:1- Visual input is the most important. Eye-hand coordination is required for the successful completion of most workplace operations.

Question #: 1931- The tendency for an individual who finds himself in a frustrating circumstance and reverts to an earlier form of behavior - such as putting on a temper tantrum - is called:

- 1) Negativism 2) Aggression 3) Reactivity 4) Regression

Answer:4- Regression is the tendency for an individual who finds himself in a frustrating circumstance to revert to an earlier form of behavior.

Question #: 1932- The tendency for an individual to give up or withhold any sense of emotional or personal involvement in the situation is called:

- 1) Resignation 2) Aggression 3) Regression 4) Reactivity

Answer:1- Resignation is the tendency for an individual to give up, or withhold any sense of emotional or personal involvement in the situation.

Question #: 1933- Human performance is a function of:

- 1) Age and sex 2) Attitude and motivation
3) Training and motivation 4) (Aptitude + training) * motivation

Answer:4- Human performance is a function of (aptitude + training) * motivation.

Question #: 1934- In behavioral terms, "ABC" refers to:

- 1) Activator, behavior, consequence 2) Attitude, behavior, consequence
3) A nice way of saying, "keep it simple stupid"
4) The ease with which people's behavior can be understood

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Answer:1- ABC refers to the activator, behavior, consequence model of behavior.
E. Scott Geller, The Psychology of Safety

Question #: 1935- Behavior is most influenced by:

- 1) **Activators** 2) Consequences 3) Discipline 4) Feedback

Answer:2- While all four answers have an impact on behavior, consequences, in general, have the most impact. Discipline and feedback can be considered types of consequences, but there are others to be considered including positive reinforcement and reward. E. Scott Geller, The Psychology of Safety.

Question #: 1936- Which of the following **characteristics of consequences** have the most influence on increasing desired behaviors?

- 1) Negative, future, uncertain 2) Negative, immediate, certain
3) Positive, future, certain 4) **Positive, immediate, certain**

Answer:4- Consequences which are positive, immediate, and certain have the most impact on behavior. E. Scott Geller, The Psychology of Safety

Question #: 1937- The toxic chemical which caused the Bhopal disaster had the acronym MIC. This stands for:

- 1) **Methyl iso-cyanate** 2) Methyl iso-carbamate 3) Methyl iso-chromate 4) Methyl iso-oxylate

Answer:1- Methyl iso-cyanate was the toxic chemical released during the Bhopal disaster.

Question #: 1938- Which one of the following is NOT a recommended engineering control method?

- 1) Isolation or enclosure 2) Substitution of less toxic materials
3) **Use of NIOSH-approved respirators** 4) Local exhaust ventilation

Answer:3- Use of respirators is not an engineering control.

Question #: 1939- It is possible to reduce incidents involving **human error** by:

- 1) Carefully screening job applicants
2) Furnishing workers with personal protective equipment
3) **Providing training and education to workers and line supervisors**
4) Improving workplace conditions

Answer:3- It is generally agreed that the majority of incidents leading to an accident are attributed to unsafe acts rather than unsafe conditions. Although general estimates of the mental and emotional states that cause accidents (like indifference, resentment of authority, disregard of danger, undue haste, anger, impatience, boredom, etc.) are not reliable, there is consensus that effective training and education will prevent many of the human errors (unsafe acts) that arise from mental and emotional states.

Question #: 1940- Workers' compensation represents a significant business expense for employers. To a large extent, employers can influence the cost of this coverage by:

- 1) Obtaining a low rate prospective experience rating plan
- 2) Improving their experience modification rate
- 3) Obtaining a low rate retrospective experience rating plan
- 4) Negotiating with life underwriters

Answer:2- One of the objectives of the workers' compensation system is to encourage safety in the workplace. A credit rating is awarded for better than average injury/illness accident prevention OR a debit rating is charged against the premium for one that is worse than average. Injury rates and the experience modification rating are used to estimate charges. By lowering the experience modification rate one can lower their insurance premium.

Question #: 1941- Workers' compensation regulations are determined by:

- 1) Federal law
- 2) Casualty insurance companies
- 3) State law
- 4) Unions

Answer:3- Workers' compensation statutes are legislated through state law as are its benefits. Although the laws and benefits may vary among the 50 states that have workers' compensation laws, there is similarity on its basic principles.

Question #: 1942- In doing a risk assessment for your hazard analysis, what is the most appropriate definition of risk?

- 1) The product of hazard severity and hazard probability
- 2) Psychometric hazard perception
- 3) Anthropologic perception of hazard
- 4) Hazard fault

Answer:1- In hazard analysis the correct definition of risk is the hazard severity times the hazard probability. Answers 2 and 3 are social risk parameters that have little value in system safety.

Question #: 1943- A truck driver transporting hazardous materials must know the following:

- 1) Rest stops along the intended route
- 2) First aid
- 3) Nature of cargo
- 4) CPR

Answer:3- The truck driver is legally obligated to know the nature of the cargo being transported.

Question #: 1944- Reliability-centered maintenance (RCM) is an approach to equipment maintenance starting with a facility or system analysis to develop a cost-effective regime for:

- 1) Repairing/maintaining systems when they fail
- 2) Repairing/maintaining systems based on historical failure data
- 3) Repairing/maintaining systems based on the results of constant equipment monitoring data
- 4) Both 2 and 3

Answer:4- RCM is a high-level process for maintaining equipment that focuses on preventing problems through equipment monitoring (vibration tests, oil tests, thermography, etc.) as well as considering the criteria for equipment routine and preventive maintenance frequency (from equipment criticality data, etc.). RCM is designed for maintenance resources to be used in a highly structured way, focused on critical equipment and critical monitoring.

Question #: 1945- A system safety technique that starts with an undesired event and an analysis of how that event can occur is called?

- 1) Fault tree analysis 2) Boolean algebra 3) Preliminary hazard analysis 4) Both 1 and 3

Answer:1- Fault tree analysis starts with an undesired event (top-level event) and analyzes its antecedents.

Question #: 1946- In systems safety, logic gates are used in fault tree construction. An "AND" gate is used when:

- 1) Outputs occur if any inputs are present
2) Outputs occur if an input and a condition exist
3) Outputs occur if two or more necessary inputs are present
4) Outputs occur if all necessary inputs are simultaneously present

Answer:4- An "AND" gate is used if all inputs are present at the same time.

Question #: 1947- An "inhibit" gate is used in fault tree construction when:

- 1) An input produces an output all the time
2) An output inhibits another output
3) An output occurs if an input and a condition exist at the same time
4) An input does not always produce an output

Answer:3- An inhibit gate shows an input and an output along with the condition that must exist for the output to occur.

Question #: 1948- In systems safety fault tree analysis, a "random" gate is a variation of what type of gate?

- 1) AND 2) OR 3) NOT 4) Inhibit

Answer:4- A random gate is similar to an inhibit gate. In a random gate, it is drawn as a hexagon like an inhibit gate but an ellipse is attached to the side and shows the probability for the random event to occur.

Question #: 1949- Two valves are placed in parallel on a tank. Valve "A" has a failure rate of 1×10^{-3} . Valve "B" has a failure rate of 1×10^{-2} . The likelihood of both devices failing simultaneously is:

- 1) 1×10^{-2} 2) 1×10^{-3} 3) 1×10^{-5} 4) 1×10^{-10}

Answer:3- To determine the probability of this failure, two simultaneous events must occur, therefore, the probability of the two events is the product of the two probabilities.
Failure Rate = $(1 \times 10^{-3})(1 \times 10^{-2}) = 1 \times 10^{-5}$

Question #: 1950- Valve system V1 has the following valve component failure rates:

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$X1 = 0.4$, $X2 = 0.1$, $X3 = 0.2$, $X4 = 0.5$

The fault tree of the valve system indicates that valve subsystem SS1 contains series components X1, X2, and X3. Valve component X4 and SS1 are parallel and redundant. What is the anticipated failure rate of V1?

- 1) 0.35 2) 0.65 3) 0.75 4) 0.95

Answer:1- Add the series components for the failure rate of SS1 = $0.4 + 0.1 + 0.2 = 0.7$
Multiply the failure rate of SS1 with redundant valve component X4 to calculate the failure rate of V1. $V1 = 0.5 \times 0.7 = 0.35$

Question #: 1951- A switch is operated twice per day. If the switch fails after 10 years of operation, what is its failure rate?

- 1) 2.7×10^{-1} 2) 1.8×10^{-2} 3) 1.9×10^{-3} 4) 1.4×10^{-4}

Answer:4- Total Number of Ops = 10 years * 365 days/year * 2 ops/day = 7,300 operations
Failure Rate = 1 failure/7,300 operations = $0.00014 = 1.4 \times 10^{-4}$

Question #: 1952- Given a failure rate per year of 3×10^{-3} for a valve, if the valve operates once per year, how many failures will you expect in 1,000 years?

- 1) 0.03 2) 0.3 3) 3 4) 30

Answer:3- Multiply the failure rate per year by the number of years.
Failure Rate = 3×10^{-3} failures/year * 1,000 years = 3 failures

Question #: 1953- A automotive parts distributor purchases parts from overseas locations and markets these parts in the United States. The distributor receives 25% of its parts from country "A" who has a 10% reject rate, 25% from country "B" who has a 5% reject rate, 12.5% from country "C" with a 15% reject rate, and 37.5% from country "D" with a 1% reject rate. If you purchase a defective part what is the probability it came from country "D"?

- 1) 42% 2) 31% 3) 21% 4) 6%

Answer:4- Basis: 100,000 parts

Country "A"	$25,000 \times 10\% = 2,500$ rejects	$P(A) = 2,500 / 6,000 = 0.4167$
Country "B"	$25,000 \times 5\% = 1,250$ rejects	$P(B) = 1,250 / 6,000 = 0.2083$
Country "C"	$12,500 \times 15\% = 1,875$ rejects	$P(C) = 1,875 / 6,000 = 0.3125$
Country "D"	$37,500 \times 1\% = 375$ rejects	$P(D) = 375 / 6,000 = 0.0625$

Question #: 1954- The reliability department has determined that the MTBF (Mean Time Between Failures) for a computer disk drive is 95,000 hours. What is the probability that the disk drive will experience at least one failure in the first 10 years of operation (87,000 hours)?

- 1) 75% 2) 60% 3) 25% 4) 2%

Answer:2- $P_f = 1 - R(t)$ Probability over time

$P_f = 1 - e^{(-87,000 / 95,000)}$ $P_f = 1 - .40$ $P_f = 0.60$ or 60%

Question #: 1955- A major failure requires that two conditions, A and B, exist. Condition A occurs if Event 1 and Event 2 exist. Condition B exists if any one of Events 3, 4, or 5 occur. The probability for Events 1, 2, 3, 4, and 5 are as follows:

E1 = 0.98, E2 = 0.95, E3 = 0.20, E4 = 0.29, E5 = 0.50

What is the probability that the major failure will occur?

- 1) 0.931 2) 0.922 3) 0.056 4) 0.027

Answer:2- To get the answer, E1 and E2 are multiplied together to get the probability for Condition A.

$$P(A) = 0.98 * 0.95 = 0.931$$

The probability for Condition B to exist is the sum of E3, E4, and E5.

$$P(B) = 0.20 + 0.29 + 0.50 = 0.99$$

The probability of Condition A and Condition B are then multiplied to get the probability of a major failure. $= P(\text{major}) = 0.931 * 0.99 = 0.9216$

Question #: 1956- The probability of failure of a system is 0.922. The system fault tree requires both "A" and "B" to occur. "A" occurs when Events 1 and 2 occur. "B" occurs when either Events 3, 4 or 5 occur. The probability of each event occurring are as follows:

E1 = 0.98, E2 = 0.95, E3 = 0.20, E4 = 0.29, E5 = 0.50

What is the probability of failure if the events generating "B" had to happen in parallel?

- 1) 0.922 2) 0.27 3) 0.056 4) 0.027

Answer:4- Condition B events are multiplied together to get the probability of Condition B. Condition A events are also multiplied together to get the probability of Condition A. The respective probabilities of Condition A and Condition B are then multiplied together to get the system failure probability.

$$P(A) = 0.98 * 0.95 = 0.931$$

$$P(B) = 0.20 * 0.29 * 0.50 = 0.029$$

$$P(\text{major}) = P(A) * P(B)$$

$$= 0.931 * 0.029$$

$$= 0.027$$

Question #: 1957- When applying the concept of system safety to fire prevention and protection, the **system characteristics** include all the following EXCEPT:

- 1) Boundary 2) Input and output 3) The environment 4) Variables and structure

Answer:3- This does not mean that the system does not interact with the environment, but outside events do not necessarily govern the behavior of the system.

Question #: 1958- In the context of pure systems safety, the fire safety concept tree is similar to:

- 1) Preliminary hazard analysis 2) Fault tree analysis

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- 3) Failure mode and effect analysis 4) Decision trees

Answer:2- The fire safety concept tree uses "AND" and "OR" gates to determine the probability of events. However, the top event may be a positive action, not a failure or fault.

Question #: 1959- Air brakes on a railroad train is an example of a device that is:

- 1) Fail-safe 2) Fail-passive 3) Fail-redundant 4) Fail-operational

Answer:1- These brakes are fail-safe and fail-active. If air is lost the brakes are automatically set.

Question #: 1960- A good safety design feature that helps to overcome failures or malfunctions is a:

- 1) Safety margin 2) Safety factor
3) Maximum foreseeable failure margin 4) Maximum permissible failure factor

Answer:2- By definition, a safety factor is the ratio of the ultimate (breaking) strength of a member, or piece of material, to the actual working stress or to the maximum permissible (safe load) stress when in use. The magnitude of the safety factor depends on how great the cost of failure will be in terms of life or damage.

Question #: 1961- In product safety, the safety professional must give consideration to the design parameters involving malfunctions, operator errors, environmental differences, and:

- 1) Safety margins 2) Ergonomics 3) Loss minimization 4) Structural failure

Answer:3- The design factors that must be considered include: - minimizing loss - malfunctions - operator error - environmental conditions. MINIMIZING LOSS is a provision of protective methods which can be applied to product safety for the purpose of containment and damage minimization. Examples include bumpers, seat belts, explosion barriers, and other forms of energy absorbing mechanisms or personal protective safety devices.

Question #: 1962- Fail-safe designs try to ensure that a failure will leave the product unaffected or will convert it to a state in which no injury or damage will occur. Which design does NOT meet this criterion?

- 1) Fail-passive arrangements 2) Fail-active design
3) Fail-operational arrangements 4) Fail-mode design

Answer:4- All of the following designs may be considered fail-safe: **FAIL-PASSIVE ARRANGEMENTS** are similar to fuses and circuit breakers; they reduce the system to its first level. **FAIL-ACTIVE DESIGN** maintains any condition that will keep the system in a safe mode until corrective or overriding action occurs. **FAIL-OPERATIONAL ARRANGEMENTS** allow functions to continue safely until corrective action is possible.

Question #: 1963- A system that is designed to shut down when one or more critical components fail is called:

- 1) Fail-safe 2) Interlock 3) Circuit breaker 4) Fuse

Answer:1- There are times when a system, guard, elevator, and other high risk equipment is designed to shut down when one or more critical components fail. When this occurs, it will do so in a safe position or condition without the experience of a major loss.

Question #: 1964- The interaction of component parts to perform a function or task that accomplishes something defines:

- 1) An analysis 2) A system 3) A planning method 4) A subsystem

Answer:2- A system is an orderly arrangement of components that are interrelated and that act and interact to perform some task or function. As parts of a system, the components usually interact and complement each other. However, it is essential to recognize that a malfunction of one component can affect others, which impacts the total system.

Question #: 1965- A key advantage of Boolean algebra is considered to be:

- 1) It is superfluous 2) It is deceptively simple
3) It can utilize AND/OR/NOT connectors 4) A calculator is not needed

Answer:3- Boolean algebra is widely used to develop probabilities involving AND/OR/NOT situations.

Question #: 1966- An example of a fail-passive device is the:

- 1) Fuse 2) Emergency generator 3) High temperature limit switch 4) Both 1 and 3

Answer:1- A fuse would be the best example of a fail passive device as its failure brings the system to its lowest energy state (no current flow). The other devices do not necessarily bring the system to its lowest energy state given a failure.

Question #: 1967- This system safety design philosophy, given a failure, keeps the system energized in a safe mode until corrective or overriding action can take place:

- 1) Intrinsically safe 2) Fail-passive 3) Fail-active 4) Fail-operational

Answer:3- The fail-active design philosophy keeps the system energized and in a safe mode until corrective action or an override can take place. Intrinsic safety eliminates failure, fail passive knocks the system to its lowest energy level, and fail operational allows the system to operate without interruption.

Question #: 1968- The following system is an example of a fail-active design:

- 1) Cylinder with rupture disc 2) Class I, Division 1 wiring
3) Chirping smoke detector 4) Either 2 or 3

Answer:3- A fail-active design normally creates redundancy by the use of standby equipment. A chirping smoke detector is the classic example of a fail-active design. When the battery starts to run down, most ionizing smoke detectors for home use will chirp periodically to warn the occupants that the battery is failing. The smoke detector may not function (depending upon the

actual battery status), but the chirp design actively informs the occupant that a failure has occurred or will soon occur.

Question #: 1969- A system safety design concept that allows functions to continue safely given a failure is:

- 1) Intrinsically safe 2) Fail-active 3) Fail-passive 4) Fail-operational

Answer:4- A fail-operational design allows a system that is experiencing a failure to continue to operate safely until corrective action is possible. Limited disruption, if any, is experienced.

Question #: 1970- Water feed valves for boilers that remain open during a control failure to allow the boiler to operate and not build up excess pressure are:

- 1) Intrinsically safe devices 2) Fail-passive devices
3) Fail-active devices 4) Fail-operational devices

Answer:4- Water feed valves that remain open during boiler control failure, allowing the boiler to operate and not build up excess pressure are fail-operational devices.

Question #: 1971- An example of a non-fail-safe device would be:

- 1) Any single point failure 2) Deadman switches 3) Circuit breaker 4) GFCI

Answer:1- Any single point failure is an example of a non-fail-safe device.

Question #: 1972- A battery operated smoke detector is an example of what type of design?

- 1) Interlock 2) Fail-active 3) Fail-passive 4) Fail-operational

Answer:2- A battery operated smoke detector is an example of a fail-active design.

Question #: 1973- An "AND" gate implies:

- 1) Boolean division 2) Boolean addition 3) Boolean multiplication 4) Boolean introspection

Answer:3- If A and B are required for C to operate, and A and B are joined by an "AND" gate, then the probability of C is AB.

Question #: 1974- How would you perform the Boolean connection of "heat", "fuel", and "oxygen" to the output "fire?"

- 1) "AND" 2) "OR" 3) "NOR" 4) "NOT"

Answer:1- As you must have "heat" AND "fuel" AND "oxygen" to have a fire, the "AND" gate is necessary.

Question #: 1975- The technique of probabilistic risk assessment was developed by what industry?

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1) Electronics 2) Transportation 3) Aerospace 4) Nuclear power

Answer:4- Many of the techniques in PRA were applied and developed by the nuclear power industry in the 1970's. The techniques were developed to estimate failure rates, develop maintenance schedules, assess population safety, etc.

Question #: 1976- Which of the following is NOT correct Boolean logic?

1) $AA = A$ 2) $A + A = A$ 3) $A + 1 = 1$ 4) $A + (AB) = AB$

Answer:4- $A + (AB) = A(A + B)$

Question #: 1977- Which of the following is considered to be the least effective method for group teaching?

1) Demonstration 2) Role play 3) Lecture 4) Discussion

Answer:3- Demonstration is especially effective when a language problem exists. Role playing allows participants to try different behaviors without a great deal of risk, providing immediate feedback. Discussion allows students to actively participate and lends itself toward greater behavioral modification.

Question #: 1978- Training is recognized as a powerful influence and motivator in safety. When developing a safety training program, the first consideration should be to:

1) Acquire a training staff 2) Determine the scope and content of the training program
3) Define the training objectives 4) Obtain training materials

Answer:3- Objectives should always be spelled out before the content, methods, and staffing can be selected. These objectives should be reduced to terms of behavior; in other words, what is it that the training participants should be able to accomplish when their training has been completed.

Question #: 1979- The best fire extinguisher training course will have what components?

1) Dynamic classroom instruction using extensive graphics and pictures
2) Classroom instruction with instructor-performed demonstrations of actual fire extinguishers
3) Classroom instruction with instructor-performed demonstrations and instructor-supervised student use of actual fire extinguishers on controlled fires
4) Instructor-performed demonstrations along with instructor-supervised student use of actual fire extinguishers on controlled fires

Answer:3- The best fire extinguisher training course will couple classroom instruction with actual demonstrations leading to student use of fire extinguishers on real fires. Adults learn effectively with practical exercises.

Question #: 1980- When confronted with a problem with which you have little practical experience, which of the following problem-solving schemes is likely to produce the best resolution?

- 1) Establishing a committee of subject matter experts (at least 15) to discuss ways to resolve the problem and come to a consensus
- 2) Establishing a small group of subject matter experts (at least 3) to discuss ways to resolve the problem and come to a consensus
- 3) Performing your own thorough research and resolving the problem yourself
- 4) Delegating the problem to another person with experience and training similar to your own for resolution

Answer:2- Though all of these could ultimately lead to the best resolution, the dynamics of a small group of subject matter experts typically offer the best foundation for solving problems.

Question #: 1981- After any initial ice-breaking/rapport-building sessions, all training courses should start with:

- 1) The course's objectives
- 2) The course's break schedules
- 3) The course's daily adjournment expectations
- 4) A description of the course's sponsor

Answer:1- Though all of these would be appropriate in some training courses, not all training courses will have them all. On the other hand, all training courses should have course objectives very clearly defined by the instructor at the beginning of the course.

Question #: 1982- Evaluate the following course objectives that are on the instructor's first slide:

- To provide the student with the tools necessary to understand and feel comfortable with working in an environment containing hazardous chemicals such as acetone, methanol, methyl ethyl ketone, muriatic acid, lye, and iso-propanol
- To provide the student with the confidence to effectively understand the contents of the company's material safety data sheets and the contents of the company's inventory of hazardous chemicals
- To provide the student with the knowledge necessary to understand the types of hazards posed by the various chemicals listed above and how the student can protect himself or herself from exposure to these hazards using personal protective equipment
- To provide the student with information on OSHA's hazard communication standard and the company's hazard communication program as required by 29 CFR 1910.1200.

- 1) The objectives are adequate.
- 2) The objectives are not adequate because they do not adequately define all of the necessary hazard communication training objectives.
- 3) The objectives are not adequate because they are too detailed and wordy.
- 4) The objectives are not adequate because they are insufficiently detailed for the student.

Answer:3- Objectives at the beginning of the course should be as short as possible to help the students mentally navigate through the course. Very few details should be given in objectives - that's what the rest of the training should provide.

Question #: 1983- Students should be given the opportunity to demonstrate competence in a new skill in the presence of an instructor. Is it a good idea for the instructor to "test" students performing these practical exercises against objective criteria?

1) Yes

2) No, students have sufficient pressure performing the skill without the added stress of being tested.

3) No, an instructor cannot fairly gauge a student's practical performance against objective criteria.

4) No, students will be unfairly competing with one another in a testing environment.

Answer:1- Without question, an instructor should evaluate a student's practical performance against objective criteria for successfully performing the skill.

Question #: 1984- A multiple-choice quiz that requires the student to demonstrate an understanding of the knowledge from a course is an example of what kind of test?

1) Subjective

2) Objective

3) Random

4) Sequential

Answer:2- Multiple-choice quizzes are typically objective. The difference between an objective and a subjective multiple-choice test is how it would be graded by different people with the same knowledge as presented by the instructor. A student's score on an objective test will be the same no matter who grades it because the facts are absolute and not subject to an instructor's interpretation.

Question #: 1985- An essay test that requires the students to demonstrate an understanding of the two objectives from a course is an example of what kind of test?

1) Subjective

2) Objective

3) Random

4) Sequential

Answer:2- Even though this is an essay test, it is still objective because the essay question is limited to an explanation of the objectives from the course. These objectives are based on the facts that the instructor presented and do not require much in the way of subjective interpretation. There could be some subjectiveness in the grading, however, this test would be mostly objective.

Question #: 1986- An essay test that requires the students to interpret the meaning of a philosophy discussed during the class is an example of what kind of test?

1) Subjective

2) Objective

3) Random

4) Sequential

Answer:1- This is an example of a subjective test. The interpretation of a philosophy is subjective to both the student and the instructor. There will likely be very broad differences in grading based on the specific experiences of the graders.

Question #: 1987- Modern technology exists for presenting visual images to students. A popular example of more modern visual imaging devices is the:

- 1) Opaque projector
- 2) Computer video projector
- 3) 35 mm slide projector
- 4) Overhead projector

Answer:2- Computer video projectors have gained popularity due to their light weight, affordable prices, and their ability to present colorful images without the need to physically print or produce an image from film or on transparencies.

Question #: 1988- With the proliferation and advancement of computer technology, instructors have access to sophisticated software tools for generating visual and audio aids (multimedia presentation software). Two commercial examples of this software include:

- 1) Microsoft® PowerPoint™ and Lotus® 1-2-3™
- 2) Microsoft® PowerPoint™ and Corel® Presentations™
- 3) Microsoft® Excel™ and Microsoft® Windows™
- 4) Corel® Presentations™ and Microsoft® Outlook™

Answer:2- Microsoft® PowerPoint™ and Corel® Presentations™ are two of the most popular multimedia presentation software packages. When connected to a computer video projector, these software packages assist instructors with their presentations by providing colorful graphics and pictures along with video and audio clips and animations.

Question #: 1989- When conducting presentations, there is usually confusion whether it should be done primarily using auditory or visual signals. Which one of the following is NOT true:

- 1) When the message is simple - use auditory signals
- 2) When the message is short - use auditory signals
- 3) When the message will be referred to later - use visual signals
- 4) *When the message deals with events in time - use visual signals*

Answer:4- When the message deals with events in time, one should primarily use auditory signals. When the message deals with events in space, visual signals should primarily be used.

Question #: 1990- Besides expertise with the instructional material, an effective instructor must consider:

- 1) The time of day in which the class will be held
- 2) The layout of the room in which the class will be held
- 3) The names of the students in the class
- 4) The background and informational needs of the students

Answer:4- Though all of the above can help, an effective instructor must consider the background and the informational needs of the students to effectively present the material. Background includes educational background, experience, language skills (for speakers of languages not native to the instructor), and positions within the company. Informational needs are also critical. A class full of high-level managers will need far less detail on specific operational issues but may need much more detail on legal and regulatory issues and other business management information.

Question #: 1991- In most cases, safety-related training courses for managers will be _____ than a similar course for line/operations employees.

- 1) Shorter 2) Longer 3) More detailed 4) None of the above

Answer:1- In most cases, the manager's awareness component of a safety-related class will be shorter. In these components, managers are interested in the course's objectives and what they need to do (as managers) to ensure that the course's objectives are implemented by their employees.

Question #: 1992- What is the best technique to explain a process flow or other sequential operation to employees with a low level of formal education?

- 1) Classroom lecture 2) One-on-one explanation
3) Visually, with few words 4) None of the above

Answer:3- Where possible, visual cues and explanations should be provided to employees who have a low level of formal education (i.e., employees who are functionally illiterate). These can be explained; however, the visual explanation should be sufficient.

Question #: 1993- CBT is:

- 1) A system for assessing employee aptitude by computer
2) A system for delivering computer-based training to employees
3) A method for characterizing employee behavior traits
4) A strategy for calculating the employee's basic technical skills

Answer:2- Computer-based training is now an accepted method for delivering training to employees. Site-specific information can easily be adapted into more generic training programs, and employees' understanding of the material can be evaluated easily.

Question #: 1994- In a training course, you give a quiz at the end of the course to assess the students' understanding of the course content. Several of your students score 68% while the rest scored between 95% and 100%. What should you do next?

- 1) Require them to retake the course and retake the quiz.
2) Require them to retake the sections of the course containing the material that they missed and require them to retake the relevant section of the quiz.
3) Research the questions they missed and discuss the quiz questions and course content with the students before determining any additional activities.
4) Pass the students.

Answer:3- In many cases, course quizzes have questions that can be misinterpreted by some students. Also note that a 70% is not necessarily an adequate raw score. Some quizzes may require a 100% raw score to pass while others may require a 60% raw score. Quizzes should be considered holistically with respect to the objectives of the course.

Question #: 1995- Safety professionals frequently require feedback to understand the effectiveness of various safety-related management systems. Which of the following is a typical method for obtaining feedback on management systems?

- 1) Responses to written surveys
- 2) Personal discussions
- 3) Discussion groups
- 4) All of the above

Answer:4- There are several methods for obtaining feedback. Sometimes, the feedback is obtained formally, sometimes it's obtained informally.

Question #: 1996- On a quiz you developed and delivered to assess the students' understanding of the course material, you noticed that 15 out of your 30 students missed the same question. Your first action should be to:

- 1) Rewrite this question as it is obviously poorly written.
- 2) Abandon this question from this quiz and rescore the students' quizzes.
- 3) Discuss this question with a sample of students from the class (including those who missed it and those who did not).
- 4) Ignore the statistical anomaly.

Answer:3- Though you could perform a formal statistical treatment on this quiz question to officially determine that it is anomalous, your gut tells you that when half the class misses the same question, there is likely a system error in either the test or the instruction. Before you rewrite the quiz question, you have to know more about the problem. Is it the wording in the question? Did you cover the material in class? The answers to these questions will likely come from a discussion with a sample of students from the class.

Question #: 1997- What type of formal statistical treatment would you apply to an item on a training quiz to determine whether the item was statistically missed more frequently than would be statistically expected?

- 1) -test
- 2) -test
- 3) -test
- 4) T -test

Answer:4- A T -test would be used to determine the statistical significance of a test problem that was observed as missed more than was expected.

Question #: 1998- Of the following, which would be considered the minimum number of exam items from which a viable statistical sampling could be obtained?

- 1) 2
- 2) 3
- 3) 5
- 4) 20

Answer:4- Most statisticians would agree that a sample of between 15 and 20 items is the minimum number of points from which viable statistical sampling can be performed.

Question #: 1999- Your test instructions are as follows:

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"This test has 25 multiple-choice questions. Each question has exactly one correct answer selection and four incorrect answer selections. Choose the correct answer to each question from the five answer selections. You will receive 2 points if you select the correct answer for the question. You will receive 0 points if you select no answer (i.e., leave the question blank), and you will have 1 point deducted for each wrong answer you select."

One of your students correctly answered 22 questions and incorrectly answered 2 while leaving one blank. What is this student's percentage score?

- 1) 84% 2) 86% 3) 88% 4) 97%

Answer:1- The total points that are available are 50 points (25 questions * 2 points per question). This student earned 44 points from correct answers (22 questions * 2 points per questions) but lost 2 points from incorrect answers (2 wrong questions * 1 point per wrong question). Therefore, his raw score was 42 points (44 points - 2 points = 42 points). The percentage score is therefore 84% (42 points/50 points = 0.84 = 84%)

Question #: 2000- The acronym CAD/CAM has become very important to manufacturing. What does CAD stand for?

- 1) Cost and development 2) Computer aided design
3) Computer assisted development 4) Count all devices

Answer:2- CAD/CAM stands for computer aided design and computer aided manufacturing. CAD/CAM is used to make manufacturing more cost effective, more time efficient, and to increase overall product quality.

Question #: 2001- A safety professional is asked to evaluate a procedure to address a high pressure steam fitting leak. He or she should ensure that which of the following safety-related caution steps is included prior to repairs being made?

- 1) Use an intrinsically safe wrench
2) Ensure system is shut down, bled, locked out, and tagged out
3) Wrap line with electrician's tape before making repairs
4) Patch leak with non-hazardous epoxy

Answer:2- The correct caution step is to verify that the system is properly bled and to ensure that the lock out/tag out procedures have been implemented.

Question #: 2002- A current problem with risk and its perception is that the public's estimation of risk _____ the government or experts.

- 1) Is often not the same as 2) Is much less valid
3) Is usually not financially acceptable 4) Cannot be calculated by

Answer:1- The public's perception of risk associated with a given technology may vary widely from the perception of the government or risk experts. The view may be based on partial information. The differences are real and must be addressed as thoroughly and carefully as the scientific analyses associated with the risk assessment.

Question #: 2003- Which one of the following statements is NOT true concerning conducting presentations?

- 1) A moving person should use auditory signals
- 2) A stationary person should use visual signals
- 3) If the message calls for immediate action, auditory signals should be used
- 4) **When the receiving location is noisy, auditory signals should be used.**

Answer:4- When the receiving location is noisy, anything BUT auditory signals should be used.

Question #: 2004- Which of the following technologies supports duplex voice communication?

- 1) Personal pagers
- 2) Trunked radio systems
- 3) Conventional radio systems
- 4) **Cellular phones**

Answer:4- Duplex communication is supported when all parties can hear all other parties and speak to all other parties at the same time. A telephone is an example of a device that supports duplex communication. Conventional and trunked radio systems are typically simplex (i.e., only one person can talk at a time).

Question #: 2005- Software "suites" have become popular both at home and at workplaces to help automate record keeping chores. What main types of software are typically found in a standard business software suite marketed to homes and businesses?

- 1) **Word processor, spreadsheet, database**
- 2) Scanner software, printer software
- 3) Financial accounting software, scanner software
- 4) Modem software, operating system, human resources software

Answer:1- Frequently, more than just word processing, spreadsheet, and database software are included in software suites. Multimedia presentation software, e-mail, Internet, and other software are frequently included as well.

Question #: 2006- By what mechanisms can existing data be input into a computerized data logging system?

- 1) Manually, via a keyboard
- 2) Electronically, via a scanner and optical character recognition software
- 3) Electronically, via an interface with another computer on which the data resides
- 4) **All of the above**

Answer:4- There are hundreds of ways to obtain data and make it reside on a specific computer. Using local and wide area network technology, as well as the Internet, computers on the other side of the world can provide data to a specific computer. Raw data can be processed by a computer through sensors and sent to a central computer for storage and distribution. Images and sound can even be captured, categorized, and stored.

Question #: 2007- A colleague e-mails you the following line of text: http://www.osha-slc.gov/OshStd_toc/OSHA_Std_toc_1910.html. This is an example of a(n):

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- 1) E-mail address 2) Internet address via file transfer protocol
3) Internet address via hypertext transfer protocol 4) Hexadecimal address

Answer:3- A hypertext transfer protocol string such as this one is commonly called a "web address" or "website." There are several protocols for transferring information through the Internet. Each has advantages and disadvantages. In this particular case, the Internet address points to the table of contents of OSHA's General Industry Safety and Health Standards (those standards associated with 29 CFR 1910.).

Question #: 2008- On your computer, you have a digital image of a hazardous condition you noticed last week. You want to immediately send this image to your peer at another facility. Both of you have e-mail. You attach the computer file containing the image to the body of your e-mail. In which of the following image formats would you likely send the image?

- 1) JPEG or GIF 2) FTP or VBS 3) EXE or COM 4) DLL or FOT

Answer:1- There are other ways to attach the image. For example, you could insert the image into a word processor document and send the word processor document instead of just the image. You could also send the image in several proprietary formats if you knew that your peer's computer had the capability to read these formats. JPEG and GIF formats are nearly universal, and these formats should be used for images if you are unsure of the capabilities of the receiver's computer.

Question #: 2009- When teaching a class, body language is important. Regarding attire, which of the following is most appropriate?

- 1) Dress the same way as the majority of the students so that you "fit-in" with the students. If your students are dressed very casually, then you should be dressed very casually.
2) Dress "one notch better" than your students. If your students are dressed very casually, then you should dress business casual - if your students are dressed business casual, then you should wear a tie (man) or a suit (woman), etc.
3) Dress formally for all training.
4) Dress is completely irrelevant when leading a training class.

Answer:2- Most experts will say that the instructor should be dressed better than the majority of his or her students, but not to the point where the instructor looks out of place. Dressing slightly better than your students may influence your students to consciously and unconsciously respect you as an expert and also allow you to stand out so that you are easily identified during breaks.

Question #: 2010- From a monetary view point in current US dollars, the most expensive single fire event in US history was the:

- 1) The Great Chicago Fire 2) The Phillips Petroleum Plant Fire
3) The San Francisco Earthquake and fire in 1906 4) The Great Boston Fire of 1872

Answer:3- These are the top four fires in terms of current valued dollar loss. The leader, however, by a factor of over two is the San Francisco fire and earthquake of 1906.

Question #: 2011- The Bhopal disaster was directly responsible for a loss of life totaling:

- 1) Tens 2) Hundreds 3) Thousands 4) Millions

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Answer:3- Bhopal directly caused the loss of several thousand lives and injuries to 100,000 - 200,000 individuals.

Question #: 2012- The Bhopal tragedy was directly responsible for this major Federal law:

- 1) TSCA 2) SARA Title III 3) EPA 4) CERCLA

Answer:2- The Bhopal and Institute, West Virginia incidents caused the federal government to enact the SARA Title III statute which requires industry to notify local municipalities of their toxic chemicals. The companies and communities are required to perform emergency planning. The companies are also required to report releases of specific chemicals to the EPA.

Question #: 2013- In the past 150 years, which industry in the US has had the highest number of fatalities?

- 1) Underground mining 2) Construction 3) Logging 4) Fire fighting

Answer:1- Mining, (specifically underground mining) has had the highest number of fatalities.

Question #: 2014- Which of the following are current specialty certifications offered by the Board of Certified Safety Professionals (BCSP)?

- 1) System Safety, Construction Safety, Product Safety
2) Construction Safety, Ergonomics Specialty, Product Safety
3) Construction Safety, Ergonomics Specialty, System Safety
4) Engineering Aspects, Management Aspects, Construction Safety

Answer:3- The BCSP currently offers Construction Safety, Ergonomics Specialty, and System Safety as specialty certification opportunities.

Question #: 2015- A standard that specifies an objective to be obtained but does not require a specific method is called a:

- 1) Design standard 2) Performance standard
3) Vertical standard 4) Horizontal standard

Answer:2- A performance standard sets the objective to be obtained but leaves the details of how to achieve the objective up to the company or organization.

Question #: 2016- What type of guarding should be installed at the approach zone to a fixed robotized workstation?

- 1) Chain link fence 2) Pressure sensitive mats
3) Fixed barrier with interlocked gate 4) Kill switch

Answer:3- A robotized work station is divided into a robot movement zone (work envelope) and the zone of approach to it. The boundaries of the zone can be defined so that the limits within which protection is provided are known. Fixed barriers with interlocked gates permit workzone entry into an area, free from robot movement, which are monitored by the interlock. More detail on safety requirements for industrial robots can be found in ANSI/RIA R 15.06 - 1986 and NIOSH publication No. 88-108.

Question #: 2017- Major types of machine guards include any of the following EXCEPT:

- 1) **Push-button** 2) Interlocked 3) Automatic 4) Fixed

Answer:1- Machine guards include fixed, interlocked, and automatic.

Question #: 2018- The least likely term which describes designing the job to fit the worker is:

- 1) Human factors 2) Human engineering 3) Ergonomics 4) **Human systems**

Answer:4- Ergonomics, human factors, human engineering, biomechanics, and engineering anthropometry are terms common to the objective leading to designing a work station, display, or job, to fit the worker and avoid unnecessary environmental stresses. The desired results of this design is a decrease of injury/illness and an increase in productivity.

Question #: 2019- What is the most appropriate definition of human factors engineering?

- 1) **Discipline dealing with man/machine interface**
2) Discipline related to industrial psychology
3) Discipline seeking to improve worker happiness
4) Discipline to increase worker efficiency

Answer:1- Human factors engineering is the discipline which is concerned with the man/machine interface. Factors it considers include sensory inputs, operator response, operator movements, work/rest cycles, and whether speed and accuracy are required. Answers 2 and 3 are marginally related to human factors engineering.

Question #: 2020- As part of a valid and complete hazard communication program, the employer must do all of the following EXCEPT:

- 1) **Prepare MSDS's for all substances in the process**
2) Have MSDS's for substances with employee exposure
3) Have a written Hazard Communication Program
4) Train employees in the hazards of the chemicals

Answer:1- Employers are not required to prepare MSDS's for the substances they use. The manufacturer has that responsibility. The employer is required to have MSDS's on hand and readily available to the employee for all the substances to which he or she is exposed.

Question #: 2021- In organizing and implementing a successful safety and loss control program, it is essential that you:

- 1) Obtain adequate funding
2) **Get top management support and participation**
3) Acquire an environmental health and safety staff
4) Promulgate a formal safety policy and program

Answer:2- An effective safety program must begin at the top. Only top management can assign the responsibility for safety and loss control and ensure its performance. Also, top management can implement the controls in the workplace environment along with worker operations that will control accidents.

Question #: 2022- All of the following are examples of staff functions EXCEPT:

- 1) Training 2) Assisting 3) Facilitating 4) *Commanding*

Answer:4- Commanding is a line function and, therefore, not an example of a staff function.

Question #: 2023- What type of respirator is best for initial response during an emergency?

- 1) Organic vapor/acid gas cartridge full-face air-purifying respirator
- 2) Powered air-purifying respirator
- 3) SAR with escape bottle
- 4) *SCBA*

Answer:4- A positive pressure SCBA is recommended until the type and level of hazardous chemicals have been identified.

Question #: 2024- In responding to a spill, one would use SCBA in the following situations EXCEPT:

- 1) When the oxygen level is below 19.5%
- 2) When the concentration of the material is greater than the protection factor for other levels of respiratory protection
- 3) When the hazards or concentrations are unknown
- 4) *When oxygen deficiency is not a factor, and the maximum concentrations of airborne hazardous chemicals are within the limits of appropriate NIOSH-approved air-purifying respirators*

Answer:4- If oxygen deficiency is not a problem, then a properly selected air-purifying respirator may be used.

Question #: 2025- A supervisor's job responsibilities include the "3-E's" principles. Which of the following would NOT be included under the "3-E's"?

- 1) Making sure employees comply with safety rules and procedures
- 2) Instructing employees how to work safely
- 3) *Establishing a safety program*
- 4) Determining ways for eliminating injury/illness potential from the job

Answer:3- The supervisor's job involves:

ENGINEERING - to determine the most effective way of doing the job and designing the injury/illness potential out of the job.

EDUCATION - to instruct the employee in the right method, and through training, improve job skill, knowledge, and behavior.

ENFORCEMENT - to ensure the employee follows the prescribed work practice and complies with safety rules and procedures.

Question #: 2026- Within a PERT network, slack time is defined as:

- 1) Low production time 2) Rest time
- 3) The difference between the length of time scheduled for an event and the length of time required for completion
- 4) The longest path between critical events

Answer:3- Slack time within the PERT network is defined as the difference between the length of time scheduled for an event and the length of time required to complete the event.

Question #: 2027- The critical path in a PERT network is defined as:

- 1) The time slippage between tasks 2) The start time between the longest tasks
- 3) The longest time path between beginning and end events
- 4) The shortest time path between beginning and end events

Answer:3- The critical path in a PERT network is the longest time path between beginning and ending events. Critical path defines the sequence of events that control the amount of time needed to complete the effort described by the PERT network.

Question #: 2028- The responsibility for IMPLEMENTING a company's safety and health policy is that of:

- 1) Top management 2) Line and operating management
- 3) Safety and health professionals 4) Both 1 and 2

Answer:2- Top management is responsible for setting the company's policy on safety. Top management sets clear-cut restrictions and regulations appropriate to the type of operation, processes, and company size to keep employees at all levels aware of what is required of them in regard to safety. Line and operating management are responsible for implementing this policy and are accountable to top management. Together they are accountable for the safety and health program. The safety professional is the technical expert and can provide advice and counsel on potential implementation plans, but does not generally implement them.

Question #: 2029- Responsibility for safety in day-to-day operations belongs to:

- 1) The assigned safety engineer 2) Top management
- 3) The line supervisor 4) Operations management

Answer:3- The line supervisor is the key person who plays an important role as the link between management and the worker. The worker follows the line supervisor's orders, and each worker is responsible for the quality and quantity of their own work.

Question #: 2030- It is generally accepted that the most effective safety program places safety responsibility on the:

- 1) Chief executive officer 2) Safety director **3) Supervisor** 4) Employee

Answer:3- If a supervisor is held responsible for safety performance, he or she will have a personal interest in the program.

Question #: 2031- The success of the system safety effort depends on:

- 1) Employing applicable systems safety techniques
2) Implementing current design practices
3) Defining safety objectives
4) Identifying and correcting potential hazards

Answer:3- The success of the system safety effort depends on definitive statements of safety objectives and requirements by the managing activity and their translations into functional hardware and software.

Question #: 2032- Relatively new developments in human resources management include:

- 1) Flex-time 2) Job-sharing 3) Work-sharing **4) All of the above**

Answer:4- New developments include flex-time (flexible working hours), job-sharing (two or more workers sharing the same job), and work sharing (during downtime, hours are taken away from everyone to prevent layoffs).

Question #: 2033- System engineers seek to drive down the probability of causing a death to users of a system. What is this probability?

- 1) 10^{-3} 2) 10^{-4} 3) 10^{-5} **4) 10^{-6}**

Answer:4- To the average person, accidents with the probability of death of 10^{-6} or less per person per year are not of great concern to the average person. Hence, many systems safety experts are attempting to design products or processes to a level that is "ten to the minus six" level of performance, or one in a million.

NOTE: the probability of being killed in a motor vehicle accident hovers consistently around 10^{-4} .

Question #: 2034- The design, development, and delivery of a new product can be called:

- 1) System engineering **2) Manufacturing system**
3) Production cycle 4) Designing for manufacturing

Answer:2- The design, development, and delivery of a new product can be called a manufacturing system. The system incorporates accidental loss consideration involving system integration of a Machine/Environment (occupational safety) with subsystems pre-production safety and quality reviews (product safety).

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Question #: 2035- An excellent way to reduce hazardous material inventory in manufacturing is:

- 1) JIT 2) CAD 3) CAM 4) QA

Answer:1- JIT or Just-In-Time inventory control only delivers hazardous materials when such items are actually needed by the process, thus allowing for reduced hazardous materials storage requirements.

Question #: 2036- What is the most critical period in crisis management?

- 1) First 24 hours 2) First week 3) First month 4) First year

Answer:1- It is generally considered that the first 24 hours of any crisis are the most critical during the life of the crisis. Management's function is to explain the problem, control rumors, and control panic.

Question #: 2037- One characteristic of system safety is that it includes all other types of safety. A second characteristic of system safety is that:

- 1) It is performed before mishaps occur 2) It is effective only on complex designs
3) It is most effective during testing 4) There is no second characteristic of system safety

Answer:1- System safety is always conducted before mishaps actually occur. This factor, plus the fact that the system safety practitioner may use information from all other safety areas, makes this discipline unique.

Question #: 2038- Systems safety analytical techniques to determine foreseeability include:

- 1) Use of biorhythms
2) Use of fault finding
3) Use of statistical techniques including determination of mean, mode, standard deviation
4) Use of preliminary, failure modes and effects, fault hazard, and fault-tree analysis

Answer:4- All the techniques in Answer 4 are legitimate techniques for the safety professional. Biorhythms were used in Japan with questionable results for predicting bus accidents. Fault finding is not a legitimate technique. Statistical techniques may be used as part of the analyses done when applying other appropriate systems safety techniques.

Question #: 2039- Which group of specially trained employees, who have been delegated by their employer, is qualified to respond to an emergency in which a drum of hazardous substance has been ruptured?

- 1) ER Team 2) PEO Team 3) HAZMAT Team 4) Any of the above

Answer:4- All of the above groups, given the proper training that covers the necessary information to control and handle chemical substances, spills, and leaks safely, including information on the proper personal protective equipment and procedures that safeguard employees against hazards and toxic substances exposure, can respond to a ruptured drum of a hazardous substance.

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ERT = emergency response team

PEO = plant emergency organization

HAZMAT = hazardous materials response team

Question #: 2040- What is the value of an investment that will be worth \$10,000 after 5 years, given that the interest rate during this period is 10%?

- 1) \$3,209 2) \$6,209 3) \$12,000 4) \$20,000

Answer:2- This question requires calculating the time value of money. Find the present worth of the future investment value as follows:

Use the formula: $P = F(1 + i)^{-n} = \$10,000 (1 + 0.10)^{-5} = \$6,209$

Question #: 2041- Organizations allocate costs into various categories to aid decision making. Often, these costs are determined as a percent or ratio of manufacturing costs. Examples include raw materials, direct labor, indirect materials, selling costs, distribution costs, and other costs. In calculating return on investment of ergonomic controls, a key expense used to determine the cost-benefit of controls is:

- 1) Direct costs of accidents inflated over time to determine present value of future workers' compensation injury dollars
- 2) The cost of capital associated with purchase and installation of controls
- 3) Depreciation costs and pretax operating expenses after controls are implemented
- 4) Profit and quality loss as a result of increased absenteeism and poor employee morale

Answer:2- While all are important, the cost of capital (interest lost from the initial investment) is often ignored. Knowledgeable financial managers will consider the cost of capital when calculating their desired return on investment of a capital expenditure. The challenge of the practitioner is to keep this in mind when determining cost-benefit of controls and, when possible, to quantify productivity efficiency and productivity enhancements to help support action plans.

Question #: 2042- At an annual interest rate of 6.0%, what must the total return on a \$50,000 investment be over 3 years to break even?

- 1) \$59,551 2) \$56,180 3) \$50,000 4) \$53,000

Answer:1- This is a compound interest problem. If invested and left alone, the \$50,000 would be worth \$53,000 after year 1; \$56,180 after year 2; and \$59,551 at the end of year 3.

This is found as follows: $\$50,000 * 1.06 = \$53,000$, $\$53,000 * 1.06 = \$56,180$, $\$56,180 * 1.06 = \$59,551$

Question #: 2043- It is estimated that the total cost to the country from an OSHA regulation is \$20 million the first year and \$5 million in each subsequent year. If the regulation is estimated to save 5 lives per year, what is the cost per life saved over a 10 year period, not considering the time value of money?

- 1) \$1,000,000 2) \$1,400,000 3) \$1,300,000 4) One cannot put a value on human life

Answer:3- To get the cost per life, first calculate the total cost of the regulation.

The total cost of the regulation is \$20 million for the first year plus (9 * \$5 million) for each of the subsequent years. This is \$65 million.

Then calculate the total lives saved. The total number of lives saved is (10 years * 5 lives per year) = 50 lives.

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Then divide the total cost by the total lives saved.

Thus, the cost per life saved is \$65 million / 50 lives = \$1.3 million/life.

Question #: 2044- If an investment of \$20,000 is made to buy ergonomic tools, and these tools should prevent \$10,000 per year in injury-related costs, when will the investment pay for itself, assuming an annual interest rate of 10%?

- 1) At the end of 2 years
- 2) During the third year
- 3) During the fourth year
- 4) At the end of the first year

Answer:2- This question requires calculating the time value of money. Find the present worth of the future savings as follows:

Present worth of at the end of each year:

$$PW = F (1 + i)^{-n}$$

$$PW(1) = \$10,000 (1 + 0.10)^{-1}$$
$$= \$9,090.90$$

$$PW(2) = \$10,000 (1 + 0.10)^{-2}$$
$$= \$8,264.46$$

$$PW(3) = 10,000 (1 + 0.10)^{-3}$$
$$= \$7,513.15$$

$$PW(1) + PW(2) = \$17,355.36$$

$$PW(1) + PW(2) + PW(3) = \$24,868.51$$

The tools will pay for themselves at some time during the third year. Remember that $PW(1) + PW(2)$ is the present worth at the END of Year 2.

Question #: 2045- A company's finance department requires that all investments pay for themselves within 24 months. You have recommended that \$50,000 in material handling equipment be installed to prevent \$35,000 in material handling injuries per year. Will the finance department approve your request, assuming an annual interest rate of 8%?

- 1) Yes
- 2) Not enough information
- 3) No
- 4) Only if the payback is extended to 36 months

Answer:1- This question requires calculating the present worth of the future savings. That is, what is the present value of \$35,000 in loss that will be prevented each year over the next two years required by this finance department.

$$PW(1) = \$35,000 (1 + 0.08)^{-1}$$
$$= \$32,407$$

$$PW(2) = \$35,000 (1 + 0.08)^{-2}$$
$$= \$30,006$$

$$\text{Total savings after 2 years} = PW(1) + PW(2) = \$62,413$$

Since the present value of the savings is greater than the cost, your request should be approved.

Question #: 2046- The finance department requires that all investments pay for themselves in 24 months. You have recommended that \$50,000 in material handling equipment be installed to prevent \$35,000 in injuries per year. Will the finance department approve your request if the annual interest rate is 12%?

1) Yes 2) Not enough information 3) No 4) Yes if the payback period is extended to 48 months

Answer:1- This question requires calculating the present worth of the future savings (in this case, the accident costs of \$35,000 per year).

$$\begin{aligned}PW(1) &= \$35,000 (1 + 0.12)^{-1} \\&= \$31,250 \\PW(2) &= \$35,000 (1 + 0.12)^{-2} \\&= \$27,902\end{aligned}$$

Total savings = $PW(1) + PW(2) = \$59,151$ which is STILL greater than \$50,000. Therefore, this request ought to be approved, too.

Question #: 2047- Risk is an expression of probable loss over a specific time period. It can be expressed in accidents, deaths, dollars, or other units. If a company operates a fleet of 25 trucks worth \$22,000 each, and each operates 1,600 hours per year, what is the risk due to total loss per year if the replacement cost for a new truck is 1.2 times the old truck, and accidents occur 4.5 times per 10,000 hours of operation?

1) \$118,800 per yr 2) \$475,200 per yr 3) \$396,000 per yr 4) \$2,970,000 per yr

Answer:2- Risk = $D * M * N$ where, D = loss per accident, M = Accident rate, N = time of measurement

$$\text{Risk} = (1.2 * \$22,000 / \text{truck})(4.5 \times 10^{-4} \text{ per hour})(25 \text{ trucks} * 1,600 \text{ hr/yr}) = \$475,200 / \text{yr}$$

Question #: 2048- An oral promise or representation concerning the product's life is an:

1) Express warranty 2) Implied warranty
3) Warranty of merchantability 4) Warranty of fitness

Answer:1- An expressed warranty is a written or oral promise or representation concerning the product's quality, use, or life. By choice, it is a sales tool carefully worded and often evidenced by an embossed certificate of warranty. An express warranty is often made at the time of the sale to induce a person to buy. This is an obligation to abide by the obligation expressly assumed by the manufacturer. In some cases, these express warranties result in unanticipated exposures by the product manufacturer.

Question #: 2049- A clause in a contract in which one party agrees to assume the liabilities, losses, or expenses of another is known as a:

1) Deductible clause 2) Hold harmless agreement
3) Exemption 4) Assumption of risk clause

Answer:2- This type of agreement is a hold harmless agreement.

Question #: 2050- Stare decisis is a Latin term:

1) Meaning "case law" 2) Meaning "to stand by decided cases"
3) That is not absolute 4) All of the above

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Answer:4- When a law does not cover given events, the courts can "make law" by using past judicial decisions as a basis for their decisions. Case law can be changed by legislative action.

Question #: 2051- The elements of a contract include all of the following EXCEPT:

- 1) Competent parties 2) Subject matter 3) Mutuality of agreement 4) **Monetary duty**

Answer:4- The elements of a contract include: competent parties, subject matter, legal consideration, mutuality of agreement, and mutuality of obligation. Legal consideration is required in a contract, but the legal consideration does not have to be a monetary duty.

Question #: 2052- In conducting a safety and health audit you ask for workers' compensation cost data. You find the location's experience modification rate to be 0.55. How would you rate the location's safety and health performance with respect to this measure?

- 1) Excellent 2) Average 3) Slightly below average 4) Poor

Answer:1- The experience modification is developed from the location's injury/illness frequency and severity rate and the industry rate. If the plant had the same experience as the industry as a whole, the experience modification rate would be 1.0. Since this plant had an experience modification rate of 0.55, it would be considered excellent.

Question #: 2053- Workers' compensation insurance premiums are determined by three rating systems namely, retrospective rating, experience rating, and:

- 1) Modification factor 2) **Manual (or state) rating**
3) Loss exposure rating 4) Prospective experience rating

Answer:2- The first step in the rate making process is to determine a basis for potential loss. With workers' compensation, it is obtained from the payroll (i.e., the number of employees), the number of hours worked, and pay rate. Different types of work entail various degrees of hazard. For example, an office worker will be insured with less risk than a machine operator based on their job classifications. Similar industries have similar or matching classifications. Manual rates are governed by the experience of the industry and are reported annually by insurance carriers.

Question #: 2054- As the manager of the safety and health function, you have access to cost data relating to insurance, medical, wages, and operations. How would you determine the total cost of an injury or illness?

- 1) **Sum the insured and non-insured costs**
2) Combine insurance cost for medical and compensation paid to claimant
3) Determine the direct cost and multiply it by four
4) Determine the direct cost and add 25%

Answer:1- Accident costs include both those that are insured and those that are not insured. The insured costs include medical and compensation costs paid to the claimant by the insurance company. The non insured costs include time lost by others who observed or rendered assistance at the time of the accident, time lost to investigate the accident, time to train a replacement, cost for damaged materials, etc.

Question #: 2055- In one year, a company with 65 employees recorded in their Form OSHA No. 300: 7 injury cases with lost workdays, 2 injury cases without lost workdays, and 2 illness cases without lost work days. The total hours worked by all employees is 130,000. What is the incidence rate of recordable injuries for that year?

- 1) 6.2 cases/yr 2) 11.0 cases/yr 3) 13.9 cases/yr 4) 16.9 cases/yr

Answer:4- Computation of incidence rate for OSHA-recordable cases:

$$= (\text{No. of recordable cases} * 200,000) / \text{Total employee hours}$$

$$= (11 \text{ cases} * 200,000 \text{ hr/yr}) / 130,000 = 16.92 \text{ cases/yr}$$

The OSHA incidence rate is based on 100 employees working 2,000 hours per year. This is the basis for the 200,000 hr/yr in the equation.

Question #: 2056- In one year, a company with 65 employees recorded in their Form OSHA No. 300: 7 lost workdays from injuries, 2 injury cases without lost workdays, and 2 illness cases without lost work days. The total hours worked by all employees was 130,000. What is the incidence rate of lost workday injuries for that year?

- 1) 6.2 cases/yr 2) 7.0 cases/yr 3) 10.0 cases/yr 4) 10.8 cases/yr

Answer:4- Computation of incidence rate for lost workday cases:

$$= (\text{No. of lost workday cases} * 200,000) / \text{Total employee hours}$$

$$= (7 \text{ cases} * 200,000 \text{ hr/yr}) / 130,000 \text{ hr} = 10.77 \text{ cases/yr}$$

The OSHA incidence rate is based on 100 employees working 2,000 hours per year. This is the basis for the 200,000 hr/yr in the equation.

Question #: 2057- Determine the OSHA-recordable injuries incidence rate for a company if the firm sustained 40 OSHA-recordable injuries in a year in which the 750-person firm worked 1,500,000 hours.

- 1) 5.3 cases/yr 2) 8.7 cases/yr 3) 10.2 cases/yr 4) 11.5 cases/yr

Answer:1- Computation of incidence rate for OSHA-recordable cases:

$$= (40 \text{ cases} * 200,000 \text{ hr/yr}) / 1,500,000 \text{ hr}$$

$$= 5.3 \text{ cases/yr}$$

Question #: 2058- A worker can perform a certain task in 16 hours. The part of the task the worker can do in H hours is:

- 1) 16 / H 2) H / 16 3) 16 - H 4) 16H

Answer:2- In one hour, the worker can do 1/16 of the total task. In H hours, the worker can do H times (1/16) = H / 16 of the task.

Question #: 2059- In situations involving the transfer of industrial property, the buyer should:

- 1) Determine whether there are any state laws regarding the environmental aspects of real property transfers
- 2) Perform business and environmental "due diligence" audits

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3) Determine whether the necessary environmental permits have been obtained, and whether the facility is in compliance with permit terms and conditions. Identify any limitations on permit transfers and the appropriate procedures

4) All of the above

Answer:4- All of the above activities are prudent in situations involving the transfer of industrial properties due to the risks, costs, and liabilities under common law, state environmental statutes, and federal environmental statutes, especially CERCLA (Comprehensive Environmental Response, Compensation, and Liability Act) or "Superfund".

Question #: 2060- "Due Diligence" is an environmental term most commonly used to describe the evaluation of:

1) Air pollution control equipment

2) Business property transactions

3) Commercial hazardous waste management facilities prior to waste shipments

4) The integrity of landfill and surface impoundment liners

Answer:2- Due diligence is associated with business property transfers as a natural extension of business with respect to asset values, accounts receivable, etc. Due diligence is often accomplished through the mechanism of an environmental site assessment, also known as a property transfer site assessment. Such investigations attempt to discover and estimate the risks, liabilities, and costs of various environmental impacts associated with current conditions and past activities at the site.

Question #: 2061- Environmental risks in a property transaction include:

1) Liability for cleaning up contaminated property and compensating injured third parties

2) Liability associated with violating environmental laws and regulations

3) Inadequate profits to finance clean-ups and environmental control equipment

4) Both 1 and 2

Answer:4- Environmental risks include both remediation costs and costs associated with regulatory non-compliance. Business risks are also associated with property transactions.

Question #: 2062- A thorough evaluation of environmental threats present at a particular property includes all EXCEPT:

1) Evaluation of adjoining properties for high risk activities

2) Identification of activities of past landowners, tenants, and relevant third parties

3) Identification of adjoining and nearby sites that appear on any state or federal lists of hazardous waste sites (NPL, CERCLIS, HWDMS)

4) Severity rate

Answer:4- A thorough evaluation should include each of the above listed activities in Answers 1, 2, and 3. Answer 4 is related to injuries on the job and is not related to the site.

Question #: 2063- Which party has the ultimate liability/responsibility for the disposition and environmental impact of hazardous waste (mis-) management?

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- 1) Transporters 2) Generators 3) Brokers 4) TSD facilities

Answer:2- Generators bear the ultimate and perpetual responsibility/liability for the disposition and environmental impact of their hazardous wastes under the RCRA and CERCLA programs. Commercial TSD facilities handling a generator's wastes will be initially held responsible to the extent of their financial responsibility mechanisms and ability to pay if there is some release or other catastrophic event, such as loss of a permit. Transporters and brokers are potentially responsible parties under CERCLA, but are not typically the high priority "deep pocket" targets of EPA enforcement actions under CERCLA. Generators are well advised to take appropriate precautions in chemical and waste handling, use secondary containment, respond to on-site releases, and carefully select off-site treatment/disposal facilities.

Question #: 2064- Prior to the passage of workers' compensation laws, workers often obtained limited injury benefits due to the doctrine of _____.

- 1) Contributory negligence 2) Corpus delecti 3) The NLRB 4) Company rights

Answer:1- Prior to workers' compensation, an employee whose actions contributed to his own injury could be used to limit or eliminate the payments that a company may make. Modern workers' compensation laws do not consider who was at fault, but whether the injury/illness arose out of the course of employment.

Question #: 2065- An injured party who was partially at fault in the accident or incident that caused the injury may have any payment of damages reduced. The principle this is based on is known as:

- 1) Strict liability 2) Burden of proof 3) Due care 4) Comparative negligence

Answer:4- If a person is partially at fault, then they have been partially negligent and may have any award for their injury or loss reduced by their own degree of negligence.

Question #: 2066- What is the principle that an occurrence of an accident is sufficient proof that negligence existed?

- 1) Res ipsa loquitor 2) Strict liability 3) Proximate cause 4) Liability

Answer:1-Res ipsa loquitor means "the thing speaks for itself". In this case, the accident speaks for itself. For this principle to apply, the event causing the accident must have been under the full control (manufacture) of the defendant, and the accident would not have occurred if the defendant had exercised proper care, and the plaintiff was not negligent.

Question #: 2067-A "Hold Harmless Agreement" attempts to do one the following.

- 1) Prevent law suits 2) Meet federal law 3) Allay the blame 4) Protect employees

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Answer:1- A Hold Harmless Agreement is developed to prevent law suits by assigning liability in a contract. Hold harmless means that if there is a problem and a suit later, one party shields or "holds harmless" the other.

Question #: 2068- Your plant has a storm sewer runoff pond that is not fenced. A child drowns in it, and the child's family sues your company. Under what doctrine will the plaintiff likely sue?

- 1) Criminal negligence
- 2) Attractive nuisance
- 3) Strict liability
- 4) Criminal manslaughter

Answer:2- The attractive nuisance doctrine holds that a person is under the duty to prevent injury to children who may be attracted to something that can cause harm.

Question #: 2069- Just-in-time (JIT) inventory control seeks to:

- 1) Minimize the amount of raw material inventory in the facility at any time.
- 2) Provide line employees with exactly what they need when they need it.
- 3) Minimize procurement anomalies by establishing standard schedules (based on need) for delivering raw materials/spare parts.
- 4) All of the above

Answer:4- JIT inventory control also helps to reduce overhead costs by reducing storage/warehousing requirements. JIT requires a company to fully understand its production and maintenance system so that optimizations can be made while enhancing quality.

Question #: 2070- Your company (a local chemical plant) convened a large public meeting with extensive external stakeholder involvement. Members of the public were invited along with regulators, labor leaders, politicians, and the media. A total of 100 people were invited, including the media representatives. All invitees ultimately received the following invitation:

"You are invited to attend a public meeting at the Smoke City Civic Center at 1000 Civic Center Road, at 7:00 p.m., Tuesday, December 18, 2001, to listen to Mr. John Boss discuss the Helpful Chemical Company's 3-year plan for expansion. Refreshments will be served. The meeting is expected to last until 8:30 p.m."

What critical item is missing from this invitation?

- 1) Driving directions to the Smoke City Civic Center
- 2) A seating chart
- 3) Whether or not questions from the floor are permitted
- 4) How to contact someone to obtain more information

Answer:4- Though all of the above should probably be on the invitation, information on how to answer any question should be addressed by putting a Helpful Chemical Company contact person's phone number and e-mail address on the invitation.

Question #: 2071- Your company has convened an "all-hands" company meeting. Mr. John Boss, the CEO, will be delivering the "state-of-the-company" address. Nearly 400 employees are expected to attend. What would be the best presentation technique for this scenario?

- 1) Mostly lecture sprinkled liberally with business-related graphs
- 2) Mostly lecture with no visual aids
- 3) Some lecture, some high-level graphs, some multimedia presentations with video and audio
- 4) Mostly multimedia video and audio with minimal input from Mr. Boss

Answer:3- Because of the varying degree of education and experience associated with a company of 400 employees, lecture with business graphs will likely not appeal to everyone. Likewise, a presentation with nothing but flashy video and audio effects will likely be misunderstood without extensive clarification. The best mix that would appeal to the largest part of the audience is a little lecture with the necessary high-level, easy-to-understand business graphs and predictions coupled with some flashy video and audio effects to break any monotony and keep the employees' attention.

Question #: 2072- Zero-based budgeting means:

- 1) Eliminating the budget
- 2) Developing a budget without considering the value of last year's budget
- 3) Creating a budget with no basis
- 4) None of the above

Answer:2- The essence of zero-based budgeting is starting at "zero", determining which programs are critical, and assessing how much each program actually costs. Last year's budget is not relevant, except as a data point. True zero-based budgeting sometimes shows that some programs are under-funded, while others are not critical or are duplicative.

Question #: 2073- Which of the following is true regarding communication?

- 1) Both the sender's and the receiver's body language is very important in one-on-one communication.
- 2) Visual communication is inappropriate in groups of ten or more.
- 3) Visual communication is inappropriate in groups of twenty or more.
- 4) Body language is only important in one-on-one communication.

Answer:1- Some experts say that body language is as important as the actual content of the verbal communication during communication - regardless of whether the communication is one-on-one or to an audience. Visual communication is appropriate for any number of people as is verbal communication.

Question #: 2074- Manufacturing records of products produced are maintained for the following reason:

- 1) To comply with the Consumer Product Safety Act and other legislation

- 2) To be able to trace product manufacture and facilitate a recall if necessary
- 3) To demonstrate a company's commitment to quality and comply with ISO 9000 requirements
- 4) All the above

Answer:4- All of the above are appropriate reasons for maintaining manufacturing and service records on products. These records should be kept for at least the expected life of the product.

Question #: 2075- Fundamental in negotiation (in any situation) is understanding:

- 1) The education and experience background of the one representing the other side
- 2) The basic perspective of the other position
- 3) How you yourself are perceived by the one representing the other side
- 4) All of the above

Answer:2- When entering into a negotiation, you will be unable to come to a win-win arrangement until you understand the basic perspective of the other side. Sometimes, both sides realize that each shares each other's perspective, and the negotiation proceeds very smoothly. When this common understanding is missing, the negotiation can become adversarial.

Question #: 2076- Crew Resource Management (CRM) is a technique to properly use all of the operations professionals on a team to reliably meet mission objectives. It is derived from efforts to make aircraft cockpit crews more team-oriented versus the highly authoritarian environments in which cockpit crews formally found themselves. Of the following, which dynamic human environment is the best candidate for applying the principles of CRM?

- 1) Offsite incident command staff-on-site incident command staff during an emergency
- 2) Trainer-trainees during a class
- 3) Employee-supervisor during a performance appraisal
- 4) Passengers-flight attendants during a flight

Answer:1- Incident command could greatly benefit from applying the principles of CRM. In this environment, all of the incident command professionals have the same goal; however, culture, work habits, and other non-relevant issues can cloud the efficient exchange of information to meet the mission objectives.

Question #: 2077- Theory X management assumes the following:

- 1) The worker is basically uninterested in work
- 2) Worker must be motivated to work
- 3) Work is natural and desirable
- 4) Both 1 and 2

Answer:4- Theory X management holds that workers must be made to work by a set of external rewards and punishments. Work is not a natural condition.

Question #: 2078- Theory Y management assumes the worker is:

- 1) Basically uninterested in work
- 2) Basically interested in work
- 3) Basically blasé towards work
- 4) Basically accident prone

Answer:2- Theory Y management holds that the worker is interested and motivated to work, as opposed to Theory X.

Question #: 2079- System safety is defined as:

CSP Questions and Answers- Part-II

- 1) A method to detect and eliminate potential hazards 2) An engineering method
3) An analysis of major components 4) A statistical analysis of the safety system

Answer:1- Systems safety is the utilization of systematic scientific engineering and management principles to identify and minimize potential hazards.

Question #: 2080- Within a Management Oversight Risk Tree (MORT) analysis, what is NOT considered part of the management system factors?

- 1) Policy 2) Implementation 3) Risk assessment 4) Barriers LTA

Answer:4- Barriers are considered part of specific control factors.

Question #: 2081- Within a Management Oversight Risk Tree (MORT) analysis, what is NOT considered part of specific control factors?

- 1) Amelioration LTA 2) Persons or objects in an energy path
3) Assumed risks 4) Unwanted energy flow

Answer:3- Assumed risks are considered as a separate tree path.

Question #: 2082- Which is not part of the risk assessment system defined within a MORT analysis?

- 1) Safety program review 2) Hazard analysis process
3) Unwanted energy flow 4) Information systems

Answer:3- Unwanted energy flow is considered under specific control factors and is not a part of the risk assessment system defined within a MORT analysis.

Question #: 2083- Good operating practices as a waste minimization measure are intended to:

- 1) Maximize the useful lifetime of process solutions
2) Minimize inadvertent releases or wastage
3) Incorporate preventative maintenance and spill containment measures
4) All of the above

Answer:4- Good operating practices as waste minimization measures can be implemented to achieve any or all of the above listed objectives.

Question #: 2084- Intrapreneurs are:

- 1) Corporate executives who develop businesses 2) Inside traders
3) Sales executives 4) Same as entrepreneurs

Answer:1- Intrapreneurs are corporate executives given the mission to develop businesses within the corporation that move rapidly with changing times.

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Question #: 2085- One function of management is to set goals and objectives. One way to do this is:

- | | |
|-------------------------|-------------------------------------|
| 1) Performance review | 2) Management By Objectives (MBO) |
| 3) Zero-based budgeting | 4) Objective Oriented Outlook (OOO) |

Answer:2- Management by Objective (MBO) is a well-recognized method to set goals and measure the results.

Question #: 2086- Industrial safety and system safety start from a common base, a desire to:

- | | |
|---|---|
| 1) Identify, analyze, and control hazards | 2) Save lives and property |
| 3) Analyze and improve equipment | 4) Control and prevent accidents to employees |

Answer:2- Industrial safety and system safety start from a common base, the desire to save lives and property. Whereas industrial safety directs itself to people, system safety is oriented toward analysis and improvement of hardware (e.g., systems).

Question #: 2087- TRADITIONAL safety program components utilized to influence employee attitudes and behavior are identified with:

- | | |
|---------------------------|--|
| 1) Written procedures | 2) Posters, booklets, awards |
| 3) Education and training | 4) Provision of free personal protective equipment |

Answer:2- Traditional safety programs attempt to communicate with employees for the purpose of motivating them to change their attitudes, or better yet, their behavior. To do this, posters, booklets, slide shows, displays, signs, bulletin boards, awards, dinners, and prizes are utilized.

Question #: 2088- According to contemporary motivation theory, the strongest motivator is:

- | | | | |
|-------------------------|-----------|-------------------------------|--------|
| 1) Fear of a supervisor | 2) Status | 3) Recognition of achievement | 4) Pay |
|-------------------------|-----------|-------------------------------|--------|

Answer:3- Current theory holds that recognition of achievement is the single most important motivator.

Question #: 2089- The LEAST effective means for involving employees in process safety management at a facility is through:

- | | |
|---------------------------------|------------------------------------|
| 1) Reward and discipline | 2) Training |
| 3) Safety and health committees | 4) Review and input to the program |

Answer:1- An individual reward and discipline program does less to encourage involvement than employee training, committees, and review/input to the program. The latter three allow employees to become informed and involved up-front in decisions that affect their safety and health.

Question #: 2090- Responsibility for safety at the operational level rests with:

- 1) General managers 2) Safety directors 3) Facilities personnel 4) Line supervisors

Answer:4- Line supervisors are responsible for safety. Safety management is among the other key aspects of a supervisor's job duties.

Question #: 2091- What functions do corporate safety groups normally NOT perform?

- 1) Safety policy development 2) Safety procedure development
3) Corporate safety manual 4) Investigate plant accidents

Answer:4- Corporate safety groups do not normally investigate plant accidents. They frequently review the findings, root causes, and corrective actions generated from a formally conducted incident investigation, though.

Question #: 2092- It can be difficult to get non-users of seat belts to wear them because:

- 1) The positive consequence of wearing them is future and uncertain
2) The negative consequences of wearing them are immediate and certain
3) Both 1 and 2
4) None of the above

Answer:3- Since the positive consequences of wearing seat belts (i.e., prevent injury) is future and uncertain, and the negative consequences of wearing them are immediate and certain (uncomfortable and it takes time), some people may be motivated not to wear them.
E. Scott Geller, The Psychology of Safety

Question #: 2093- In behavioral terms, safety management can be considered a continuous fight against human nature because:

- 1) Positive consequences of unsafe behavior tend to be immediate and certain
2) Negative consequences of unsafe behavior tend to be uncertain
3) Both 1 and 2
4) None of the above

Answer:3- The positive consequences of unsafe behavior tend to be immediate and certain, for example, more comfort in not wearing personal protective equipment. In addition, the negative consequences of unsafe behavior, such as having an accident, are uncertain.
E. Scott Geller, The Psychology of Safety

Question #: 2094- Why is it a good idea to have a formal safety and health statement of policy?

- 1) Safety and health should be of primary concern to everybody
2) It is the starting point for all activities in the safety and health program
3) It expresses management's attitude toward safety and health
4) It publicizes the safety and health function

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Answer:3- The formal safety and health statement of policy is an endorsement of top management's commitment and support. It is management's expression of the direction to be followed.

Question #: 2095- A good company safety policy will include all of the following EXCEPT:

- 1) Responsibility 2) Accountability 3) Authority 4) **Accident history**

Answer:4- A company safety policy should include: responsibilities, accountabilities, authority, scope, intent, and standards. Though accident history is interesting, a company's safety policy should not dwell on specific past events, but should indicate management's expectations toward future safety-related performance.

Question #: 2096- What is the principle focus of an in-plant medical program?

- 1) Diagnosis 2) Treatment 3) **Prevention** 4) Rehabilitation

Answer:3- The focus of medical programs is on the prevention of occupational disease.

Question #: 2097- The concept of "hierarchy of needs" was developed by:

- 1) Freud 2) **Maslow** 3) Jung 4) MacGregor

Answer:2- Maslow's hierarchy of needs is a critical component of many management theories dealing with human needs.

Question #: 2098- A supervisor's attitude toward safety and health _____ influence on those that he or she supervises.

- 1) Has little 2) **Has significant** 3) Has no 4) May have

Answer:2- A supervisor's attitude is of critical importance to an employee's perception of job safety and health.

Question #: 2099- There are several management theories of motivation, such as Theory X and Theory Y. Which one of the following is NOT true?

- 1) Theory X - The worker is uninterested and unmotivated to work
2) Theory Y - The worker is interested and motivated to work
3) **Job Enrichment Theory of Herzberg - Work environment, benefits, and work conditions are all-important**
4) Job Enrichment Theory of Herzberg - Work must be meaningful, must provide recognition, give responsibility, and allow for professional growth in order to motivate the worker

Answer:3- Answer 3 incorrectly identifies Herzberg's Job Enrichment Theory. Herzberg believed that hygiene issues (such as work environment, benefits and work conditions) are necessary before motivation and resultant productivity increases can occur but do not result in

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motivation. Instead, workers are motivated by work that is meaningful, provides recognition, gives responsibility, and allows for professional growth.

Question #: 2100- The process of determining safety goals, allowing supervisors a chance to perform, providing assistance along the way, and rewarding them according to their progress is known as?

- 1) Management by Exception
- 2) Safety by Objectives
- 3) OSHA Star Program
- 4) Motivation-Hygiene Theory

Answer:2- Safety by Objectives is the process of determining safety goals, allowing supervisors a chance to perform, providing assistance along the way, and rewarding them according to their progress.

Question #: 2101- The key to effective line safety performances are management procedures that fix _____.

- 1) Accountability
- 2) Flexibility
- 3) Optimization
- 4) Variability

Answer:1- To be effective, line managers must be accountable for safety performance. Accountability is critical.

Question #: 2102- In the study of traditional management, the term "Span of Control" is used to indicate:

- 1) The control of many by one
- 2) The number of personnel under one supervisor
- 3) The number of supervisors that should be in control
- 4) The number of supervisors actually in control

Answer:2- Span of control is the number of personnel that directly report to a single supervisor.

Question #: 2103- The best way to create acceptable new responses to environmental stimuli is to:

- 1) Discipline when not performed properly
- 2) Provide training
- 3) Reward the desired response
- 4) Write a mandatory procedure

Answer:3- Rewarding a desired response is the best way to encourage the response in the future. Dan Petersen, Safety Management, A Human Approach

Question #: 2104- Which of the following is NOT generally considered positive reinforcement?

- 1) Money
- 2) Praise
- 3) Recognition
- 4) Training

Answer:4- Money, praise, and recognition are forms of positive reinforcement. Dan Petersen, Safety Management: A Human Approach

Question #: 2105- Total quality management (TQM) is an overall commitment to continuously improve quality performance at all levels. All of the following concepts apply EXCEPT:

- 1) Empowerment
- 2) Improvement
- 3) Central thinking
- 4) Auditing

Answer:3- Central thinking is not a concept of TQM, although acting as one voice is a concept of TQM.

Question #: 2106- Communication means conveying a message and having it understood. Retention of the safety message is best retained when it is:

- 1) Presented orally at a rate of 120 words/min
- 2) Presented orally at a rate of 450 words/min with body movement
- 3) Presented orally at a rate of 120 words/min with visual aids
- 4) Presented orally at a rate of 120 words/min with hand and face gestures

Answer:3- We learn 87% through our eyes and only 7% through our ears. (The remaining 6% balance occurs from other senses, e.g. touch and smell.) Also, there are differences in the rates of listening versus talking and understanding. The average speech rate is 120 words/min, while the rate of understanding is 450 words/min. Adding visual aids to an oral presentation increases the rate of learning and retention of the message presented.

Question #: 2107- A management technique frequently used to explore options and to determine the most remote contingencies is:

- 1) Brainstorming
- 2) "One on One"
- 3) Staff meeting
- 4) Retreat meeting

Answer:1- Brainstorming is normally used to fully develop a situation's potential impact. It normally involves several people in a setting designed to draw out all ideas. The ideas are then sorted out and prioritized, and action plans are developed. The unstructured nature of this activity tends to produce more creative ideas. A trained facilitator is often used.

Question #: 2108- The goal of ergonomic/human factors engineering (HFE) may be any of the following EXCEPT:

- 1) Increase worker's compensation costs
- 2) Reduce worker errors and accidents
- 3) Control stresses affecting worker's psychic comfort
- 4) Increase worker productivity

Answer:1- Ergonomics and human factors engineering in the United States is a multidisciplinary activity. It deals with interactions between individuals and their total working environment, plus stresses relating to such environmental elements as atmosphere, heat, light, and sound, in addition to workplace tools and equipment.

Question #: 2109- One of the current principles of safety management states that the key to effective line safety performance is having management procedures that:

- 1) Fix accountability for accidents
- 2) Identify and correct unsafe acts and or conditions
- 3) Improve worker attitude through education and training
- 4) Engineer the hazard out of operations

Answer:1- Fixing accountability is based on the belief that a line manager will achieve results only in those areas in which he or she is being measured. It has long been felt by professional safety practitioners that the lack of procedures for fixing accountability is safety's greatest failing.

Question #: 2110- One of the principles of safety management states that certain sets of circumstances can be predicted to produce severe injuries. Which of the following circumstances does NOT apply?

- | | |
|------------------------------------|---|
| 1) High energy sources | 2) Nonproductive activities |
| 3) Unusual, non-routine activities | 4) Accidents occur by chance and cannot be predicted |

Answer:4- The old approach to safety states that once an accident occurs, the severity of injury is dictated by chance. Modern thinking asserts that certain sets of circumstances can be predicted to produce severe injuries. Essentially, we can attack severity directly instead of hoping the severe accident frequency is low.

Question #: 2111- In what ways should safety be managed differently from other company functions?

- | | |
|------------------------------------|---|
| 1) Cannot set goals | 2) Personal contacts are more important |
| 3) Budget support is not available | 4) Managed the same |

Answer:4- The management of a safety program should not differ from any other program - set goals, plan, organize, and execute the plan to achieve the goals. The more the safety program's goals and management style are understood, the more support there will be for the program.

Question #: 2112- What is the key to effective safety management?

- | | |
|--|---------------------------------------|
| 1) Compliance with OSHA standards | 2) Establishing accountability |
| 3) Engineering controls of workplace hazards | 4) Safety committees |

Answer:2- Management must hold supervisors accountable for the unsafe acts committed by the employees they supervise. Accountability produces interest and attention. The result is a more effective program.

Question #: 2113- What is the most important factor in accident prevention?

- | | |
|--|--|
| 1) Comprehensive, written accident prevention programs | 2) Adequate training for all employees |
| 3) Competent staff safety professionals | 4) Dedicated management support |

Answer:4- The most critical element of any accident prevention program is management support. Without this support the program cannot succeed.

Question #: 2114- Which of the following is the first step in establishing an effective process safety management program?

- | | |
|---------------------------------------|---|
| 1) Training employees and contractors | 2) Performing comprehensive hazard analyses |
|---------------------------------------|---|

operations until a new facility can be commissioned. Depending upon the risk of a natural disaster, some companies purchase business interruption insurance to help finance operations.

Question #: 2119- A generic process of evaluating competing courses of action by examining the dollar costs of certain abatement actions versus the dollar value of the benefits received is called:

- 1) Prime cost assessment 2) Cost analysis **3) Cost-benefit analysis** 4) Risk management

Answer:3- Cost-benefit analyses are generic processes for evaluating competing courses of action by examining the dollar costs of certain actions versus the dollar value of the benefits received.

Question #: 2120- A measure of the projected dollar loss per unit (or prorated per unit) calculated by dividing the **total risk exposure** by the total number of units produced is called:

- 1) Unit loss 2) Unit loss exposure **3) Unit risk exposure** 4) Risk unit

Answer:3- Unit risk exposure is a measure of the projected dollar loss per unit (or prorated per unit) and is calculated by dividing the total risk exposure by the total number of units produced.

Question #: 2121- The ratio of the risk exposure to the project cost is called:

- 1) Cost ratio 2) Loss ratio **3) Risk exposure ratio** 4) Risk ratio

Answer:3- Risk exposure ratio is the ratio of the risk exposure to the project cost.

Question #: 2122- If a company is using self insurance to handle risk, the company:

- 1) Is using the insurance of the employees to cover their risk **2) Is not insured**
3) Is buying the insurance from a state plan 4) Is carrying no deductible

Answer:2- The company is not insured and must "fund" their own insurance plan. Self insurance can be used for various types of risks, including worker's compensation, but often the state will require the company to be in good financial health to use this approach, or be bonded for the exposure.

Question #: 2123- Strict liability places the responsibility upon the manufacturer because:

- 1) There is no one else you can sue
2) The manufacturer is best able to distribute the loss if sued
3) The manufacturer is in the best position to prevent accidents by improving the safety of the product
4) Both 2 and 3

Answer:4- Strict liability places the responsibility upon the manufacturer because: The cost of accidental injuries caused by defective products can be passed along to the general public by means of insurance or price structure. It is the manufacturer that is in the best position to prevent accidents by improving product safety through design or planning.

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Question #: 2124- Your company manufactures and fills small propane cylinders that are used for torches, camp stoves, and gas-powered lanterns. This product is packaged and distributed to wholesalers and retailers using a combination of transportation options including the company's own fleet of trucks. Your company is responsible for the:

- 1) Safe containerization of the product shipped via the company fleet. For other modes of shipment, safe containerization is the responsibility of the receiver of the cylinders.
- 2) Development of safe containers and transportation specifications for the product.
- 3) Safety of manufacturing, handling, and storage of the product within the facility, and the safe containerization for shipment.
- 4) Safety of manufacturing. The shipper is responsible for containerization.

Answer:3- The company is responsible for safety in manufacturing and for safe containerization for shipping no matter who does the shipping.

Question #: 2125- Products put on the market must be reasonably safe and fit for the ordinary purposes for which they are marketed. This is the fundamental principle underlying:

- 1) Strict liability
- 2) Breach of implied liability
- 3) Liability without fault
- 4) Negligence

Answer:2- Claims may be made by another if a product was not reasonably safe for the purpose for which it was marketed, and the product was the proximate cause of the injury or condition that led to the injury.

Question #: 2126- If a plaintiff can prove that a product was defective when it left the control of the defendant, and the defect made the product unreasonably dangerous, and the defect caused the injury, the plaintiff may bring suit under:

- 1) Negligence
- 2) Liability without fault
- 3) Breach of express warranty
- 4) Strict liability

Answer:4- Most product claims are brought under these circumstances. Negligence may or may not exist. In this case the product was defective when it was shipped, it made the product dangerous, and the danger caused the accident and injury. The manufacturer is strictly liable.

Question #: 2127- If Alpha Corporation manufactures a product and sells it to Bravo Corporation, and Bravo sells it to Consumer, under the principle of privity, which firm(s) may be sued by Consumer if he or she is injured using the product?

- 1) Alpha
- 2) Bravo
- 3) Alpha and Bravo
- 4) Neither firms may be sued under the principle of privity

Answer:2- No contract exists between Alpha and Consumer, so under the principle of privity, Consumer may only sue Bravo.

Question #: 2128- In 1916, a landmark product case (McPherson v. Buick Motor Company) brought an end to what principle that governed the treatment of product cases by the courts?

- 1) Strict Liability
- 2) Comparative negligence
- 3) Privity
- 4) Contributory negligence

Answer:3- Privity was the principle used by the courts from the mid 1800's until they began to abandon the concept in 1916.

Question #: 2129- What is the principle that holds a manufacturer liable for injuries caused by unintended use of the product?

- 1) Strict liability 2) Negligence 3) Negligence per se 4) Foreseeability

Answer:4- If the unintended use is foreseeable, the manufacturer can be held liable.

Question #: 2130- Records pertinent to all phases of a company's manufacturing, packaging, procurement, testing, marketing, distribution, and final disposition of finished products should be retained:

- 1) For 30 years
2) For the life of the product plus 10 years
3) Indefinitely
4) For 5 years

Answer:3- It is essential in product safety loss control that information be collected and maintained through all phases of the manufacturing cycle including final disposition of finished products. In addition, the records should include quality control activities, labeling, warnings, recall plans, and all other program elements that would, if needed, be used in court as evidence of the company's efforts to do the right thing. Prudence dictates these records be kept on file for an indefinite period of time.

Question #: 2131- An express warranty from a manufacturer states?

- 1) That a product is suitable for a specific use
2) That a product will perform in a specific manner
3) That you can return the product within 30 days
4) That a product will perform for at least 30 days

Answer:2- An express warranty is a written or oral statement that a product will perform in a specific manner.

Question #: 2132- The responsibility for a defective product as it moves from the manufacturer to the customer rests with?

- 1) Manufacturer 2) Distributor 3) Wholesaler 4) The entire chain from raw materials onward

Answer:4- The entire chain, from raw materials onward, may be held liable for a defective product.

Question #: 2133- Under what doctrine does one not need to prove negligence on the part of the manufacturer, but only that an injury was attributed to a defect or to an unreasonably dangerous condition.

- 1) Implied consent 2) Implied warranty 3) Negligence 4) Strict liability

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Answer:4- The strict liability doctrine holds that the seller is liable for any and all defective or hazardous products.

Question #: 2134- Using the concept of strict liability, the manufacturer of a product is liable for injury to the plaintiff:

- 1) When negligence or fault exists on the part of the manufacturer
- 2) When negligence or fault exists on the part of the plaintiff
- 3) Whether or not there was negligence or fault on the part of the manufacturer
- 4) Both 1 and 2

Answer:3- Strict liability assumes manufacturer liability for injury from their product without necessity for plaintiff to show manufacturer negligence. Under strict liability, plaintiff negligence is not applicable (but will be used in the manufacturer's defense).

Question #: 2135- A mutual insurance company is owned by:

- 1) Stockholders
- 2) An association
- 3) Its policyholders
- 4) A combination of the above

Answer:3- A mutual insurance company is owned by its policyholders while a stock insurance company is owned by its stockholders.

Question #: 2136- Which type of insurance coverage usually provides for the highest percent of the policy premium for loss prevention services?

- 1) Workers' compensation
- 2) Property coverage
- 3) Product liability
- 4) Boiler and machinery

Answer:4- Over a third of the premium for boiler and machinery coverage is usually spent on loss prevention services. In contrast, less than 3% of the Worker's Compensation premium is spent on loss prevention services.

Question #: 2137- You have been tasked to assist with a capital project to retrofit several large buildings with sprinklers and fire alarm systems. The total cost to design and install the sprinkler and fire alarm systems was estimated as \$6,565,575 by the fire protection engineering firm with which your company has contracted. Your company is going to have to issue a public debt instrument (similar to acquiring a private bank loan) to pay for this capital project. The fee for issuing this public debt instrument is 3.375% of the principal. Your company intends to put \$500,000 of cash toward the initial capital costs. What is the uniform annuity the company must pay at the end of each year to repay this debt instrument if it was locked in at an annual rate of 8.465% (compounded annually) and loses all of its value in 10 years?

- 1) \$532,208
- 2) \$954,150
- 3) \$2,097,782
- 4) \$2,789,707

Answer: 2- This is an annuity problem given the present value.
First, determine the total present value of the debt instrument.
Direct Capital Cost = \$6,565,575

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Company "Down Payment" = \$500,000

Total Funding Required = \$6,565,575 - \$500,000 = \$6,065,575.

Debt Origination Fee = (3.375%)(Total Funding Required) = (0.03375)(\$6,065,575) = \$204,713.

Total Present Value of Debt Instrument = \$6,065,575 + \$204,713 = \$6,270,288

Uniform Annuity = $PV \{ [i (1 + i)^n] / [(1 + i)^n - 1] \} = (\$6,270,288) (0.08465 * 1.08465^{10}) / (1 + 0.08465)^{10} - 1 = \$954,150$

Therefore, the company will have to pay this amount once per year for ten years to pay off this debt.

Question #: 2138- You are recommending that your organization purchase an expensive digital trunked radio system for emergency response to replace the single frequency system currently being used. Your manager is looking at several other systems with similar features and capabilities and wants to compare them from only a cost-basis. He has asked you to give him the total cost of the system in today's dollars. Your company uses an annual interest rate (compounded annually) of 8.5% to perform these types of small capital project comparisons. Based on the data provided in the Table below, what is the total system cost assuming a useful life of 15 years? Note that the maintenance agreement and utility costs are assessed at the end of the first year.

\$25,000 = Cost of 8 portable radios and one base station

\$55,000 = Cost of antenna and transmitter (and facilities)

\$17,500 = Cost of electrician labor and materials

\$10,000 = Cost of computer aided dispatch computers

\$12,500 = Annual maintenance agreement cost

\$2,500 = Annual utilities above those from current system

\$7,500 = Anticipated total system salvage value in 15 years

1) \$229,858 2) \$234,270 3) \$325,000 4) \$414,375

Answer:1- This is a present value problem with an annuity and a future value.

The capital cost of the system is \$25,000 + \$55,000 + \$17,500 + \$10,000 = \$107,500

The annual costs are (\$12,500 + \$2,500) for 15 years. The present value of this annual cost (annuity) is

$PV = A [(1 + i)^n - 1] / [i (1 + i)^n] = \$15,000 (1.085^{15} - 1) / (0.085 * 1.085^{15}) = \$124,564$

The present value of the salvage value of \$7,500 is $PV = FV (1 + i)^{-n} = \$7,500(1.085)^{-15} = \$2,206$

The TOTAL cost of this option is therefore the present value of all of the costs MINUS the present value of the salvage value.

Total Cost = \$107,500 + \$124,564 - \$2,206 = \$229,858

Question #: 2139- You have been appointed safety director of a company with 4 plants. These plants are subject to annual safety audits which are scored. You want to determine if success in

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the audit program correlates to success in injury prevention. Based on the data provided in the Table below, what is the Spearman rank coefficient of correlation between the safety audit score and injury rates?

PLANT	AUDIT SCORE	INJURY RATE
PLANT A	75	3.2
PLANT B	86	4.4
PLANT C	45	4.8
PLANT D	90	5.6

- 1) 1.4 2) 0.40 3) -0.40 4) -0.60

Answer:3- First, determine the difference in rank of each set, and square that difference. Use a chart like this one.

Plant	Rank	Rank	D	D ²
A	3	1	2	4
B	2	2	0	0
C	4	3	1	1
D	1	4	-3	9

Audit Score Injury Rate

The sum of the squares of the differences is

$$\sum D^2 = 4 + 0 + 1 + 9 = 14$$

The symbol "N" represents the number of data points. N is 4.

Use the following formula to calculate the Spearman rank:

$$r = 1 - 6 \sum \{ D^2 / [N (N^2 - 1)] \}$$

$$= 1 - 6 \{ 14 / [4 (4^2 - 1)] \}$$

$$= 1 - 1.40$$

$$= -0.40$$

Question #: 2140- If a Spearman rank coefficient = -0.4 for injury rates and plant audit scores, what is your conclusion regarding the correlation between the injury rates and audit scores?

- 1) There is a weak direct correlation
2) There is a strong direct correlation
3) There is no meaningful correlation
4) It is not possible to correlate injury rates and audit scores

Answer:3- The Spearman rank is a reflection of correlation between two sets of numbers. Since the Spearman rank is negative, the injury rates and audit scores are mathematically inversely related. When dealing with plant scores and injury rates, though, this inverse relationship is somewhat meaningless. If taken with mathematical literalness, the Spearman rank of -0.4 implies that there is a weakly related INCREASE in injury rates when the plant audit scores are good.

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Question #: 2141- A study collected 161 death certificates of former workers at a plant. Of these 161 deaths, 38 workers died of cancer where 27.9 would normally be expected to do so. The rest of the workers died of other causes where 133.1 would normally be expected to do so. Compute the χ^2 (chi-square) statistic.

- 1) 2.79 2) 4.42 3) 9.21 4) 13.3

Answer: $\chi^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$
 $= \frac{(38 - 27.9)^2}{27.9} + \frac{(123 - 133.1)^2}{133.1} = 4.42$

Explanation of the χ^2 Statistic: We have only one degree of freedom in this study since we can only set one of the two death rates (the second rate is dependent on the first). Use the Upper Percentage Points of the χ^2 Distribution table and determine the "p" associated with a degree of freedom of 1 and a χ^2 statistic of 4.42.

The "p" will be between 0.05 and 0.01 (closer to 0.05). If you want a better estimate of "p," you could interpolate to derive a better estimate based on this χ^2 statistic.

The "p" of approximately 0.05 means that the data are statistically significant at the $p = 0.05$ level. In other words, there is only a probability of 0.05 that the data are NOT significant.

Question #: 2142- The percentage of union membership in the United States has _____ since the 1960's.

- 1) Grown 2) Decreased 3) Stayed the same 4) Varied year to year with no trend

Answer: 2- The percentage of United States workers in unions has dropped steadily since a peak in the early 1960's.

Question #: 2143 - As an effective manager, how would you discipline an employee's first minor safety rule infraction?

- 1) Oral reprimand 2) Written reprimand 3) Ignore it 4) Suspension

Answer: 1- The most logical way to deal with a minor rule infraction is some sort of oral reprimand for the first offense. Ignoring it will not cause a change in employee behavior, and a formal reprimand/suspension will likely cause employee dissension.

Question #: 2144- How can a Safety Director LEAST influence line accountability for safety?

- 1) Charge accidents to departments 2) Put safety in the supervisor's appraisal
3) Have safety affect the supervisor's income 4) Put the supervisor on warning

Answer: 4- All of the above actions will make line supervisors accountable for the safety of their group. However, "putting a supervisor on warning" will cause an adversarial relationship which benefits no one. Once accountability is assigned, improvement in performance is attained more readily. This is true in any line function. Human nature is to pay attention to those things that will be measured.

Question #: 2145- Employees have certain rights under the Occupational Safety and Health Act of 1970. Which of the following is NOT an employee right under this act?

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- 1) The right to have input on the development of standards
- 2) The right to be informed about the purpose of an inspection
- 3) The right to be informed about imminent dangers by OSHA
- 4) Access to accident records

Answer:2- Employers have the right to be informed about the purpose of an inspection, not the employee.

Question #: 2146- What is the reason that line employees fail to report near misses to supervisors and/or safety staff?

- 1) Fear of job reprisals from reporting
- 2) Fear of peer pressure from reporting
- 3) Perception that nothing ever happens to near miss reports
- 4) All of the above

Answer:4- There are several other reasons why employees do not report near misses. A critical component to an effective loss control program is removing these barriers to reporting near misses. Without effective near miss reporting, a loss control program will have difficulty evolving beyond reactive assessment.

Question #: 2147- Waste minimization measures are driven by:

- 1) Statutory and regulatory requirements
- 2) Economic considerations
- 3) Legal liabilities
- 4) All of the above

Answer:4- All of the above listed considerations drive waste minimization/pollution prevention efforts. The Pollution Prevention Act of 1990, while not regulatory in nature, is evidence of Congressional interest in this area. The Hazardous and Solid Waste Amendments to RCRA resulted in waste minimization certifications being placed on manifests, and requirements for discussion of waste minimization efforts and achievements being added to biennial reports. Many states have their own waste minimization requirements.

Question #: 2148- In behavioral terms, a safety poster:

- 1) Is an activator
- 2) Is "visual noise"
- 3) Has no impact on behavior
- 4) All of the above

Answer:1- As an activator which serves to direct desired behavior, safety posters have only a small impact on behavior. E. Scott Geller, The Psychology of Safety

Question #: 2149- In biosafety nomenclature, which agent Class is the most hazardous?

- 1) Class 1
- 2) Class 2
- 3) Class 3
- 4) Class 4

Answer:4- Biosafety agents range from Class 1 (safest) to Class 4 (most hazardous). Class 5 agents are foreign animal pathogens regulated by the USDA.

Question #: 2150- The color to indicate fire or danger is:

- 1) Red 2) Magenta 3) Green 4) Orange

Answer:1- Red is the color used to denote fire or danger. 29 CFR 1910.144 (a)(1)

Question #: 2151- The basic color used for designating caution is:

- 1) Red 2) Orange 3) Yellow 4) Blue

Answer:3- Yellow is the basic color for designating caution. Applications include: aisle marking, "caution" signs, construction tractors and bulldozers, handrails, guardrails, marking for low beams, pipes, and projections. ANSI Z53.1 (1967) 29 CFR 1910.144 (a)(3)

Question #: 2152- The color used to identify physical tripping hazards is:

- 1) Red 2) Blue 3) Green 4) Black/yellow

Answer:4- Black/yellow is normally used to identify physical tripping hazards. 29 CFR 1910.144 (a)(3)

Question #: 2153- The color generally utilized to denote information is:

- 1) Blue 2) Red 3) Yellow 4) Orange

Answer:1- Blue is the color utilized to denote information.

Question #: 2154- What color is generally used to identify moving machine parts?

- 1) Red 2) Magenta 3) Green 4) Orange

Answer:4- Orange is used to identify moving machine parts.

Question #: 2155- What color is generally used to identify safety facts or first aid?

- 1) Red 2) Magenta 3) Green 4) Orange

Answer:3- Green is the universal symbol for safety and first aid.

Question #: 2156- NFPA 704 provides a diamond shaped diagram shown for inherent hazards of a chemical. What does the color blue indicate?

- 1) Reactivity hazard 2) Flammability hazard 3) Combustibility hazard 4) Health hazard

Answer:4- The color blue stands for health hazard.

Question #: 2157- NFPA 704 provides a diamond shaped diagram shown for inherent hazards of a chemical. What does the color yellow indicate?

1) Reactivity hazard 2) Flammability hazard 3) Combustibility hazard 4) Health hazard

Answer:1- The color yellow relates to a reactivity hazard.

Question #: 2158- NFPA 704 provides a diamond shaped diagram shown for inherent hazards of a chemical. What does the color red indicate?

1) Reactivity hazard 2) Flammability hazard 3) Combustibility hazard 4) Health hazard

Answer:2- The color red indicates a flammability hazard.

Question #: 2159- ANSI A-13.1 provides a scheme for the identification of piping systems. What is the standard color used to identify protective materials?

1) Blue-yellow 2) Bright blue 3) Green 4) Red

Answer:2- Bright blue is the standard color used to identify protective materials.

Question #: 2160- ANSI Z-35.1 provides the specifications for industrial accident prevention signs. What is appropriate to indicate caution against lesser hazards?

1) Yellow background color; black lettering 2) Black lettering on white background
3) Light blue background color, black lettering 4) Black lettering on orange background

Answer:1- Yellow background color with black lettering is appropriate to indicate caution against lesser hazards.

Question #: 2161- ANSI A-13.1 provides a scheme for the identification of piping systems. What standard color is used to identify dangerous materials?

1) Red 2) Blue-green 3) Yellow 4) Orange

Answer:3- Yellow is the standard color used to identify dangerous materials according to ANSI A-13.1.

Question #: 2162- Rank the order of traditional hazard warning terms from most serious to least serious.

1) Caution, warning, danger 2) Danger, caution, warning
3) Danger, warning, caution 4) Warning, danger, caution

Answer:3- Traditionally, there are three levels of hazards: Danger - used where there is an immediate hazard, which, if encountered, will result in severe personal injury or death. Warning - used for hazards or unsafe acts which could result in severe personal injury or death. Caution - used for hazards or unsafe acts which could usually result in minor personal injury, product damage, or property damage.

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Question #: 2163- Flammable storage cabinets are normally:

- 1) Blue 2) Magenta 3) Yellow 4) Green

Answer:3- Most flammable storage cabinets are painted yellow. In addition to being painted yellow they are labeled as Flammable Liquid Storage Cabinets. Some are also red.

Question #: 2164- A fire hydrant painted red on the bonnet and the caps usually indicates that the water flow rate from the hydrant is:

- 1) Less than 500 gpm 2) 500 to 999 gpm
3) 1,000 to 1,499 gpm 4) 1,500 gpm or greater

Answer:1-

Red corresponds to less than 500 gpm.

Orange corresponds to 500 to 999 gpm.

Green corresponds to 1,000 to 1,499 gpm.

Light blue corresponds to 1,500 or greater gpm.

NFPA 291 - Recommended Practice for Fire Flow Testing and Marking of Hydrants

Question #: 2165- When walking through an office occupancy where the acoustic ceiling was 10 ft, you noticed that the automatic sprinkler heads hung down and were color coded white. What should this tell you?

- 1) It was an ordinary pendent sprinkler head with an operating temperature of 135°F - 170°F
2) It was an ordinary upright sprinkler head with an operating temperature of 175°F - 225°F
3) It was an intermediate pendent sprinkler head with an operating temperature of 175°F - 225°F
4) It was an intermediate pendent sprinkler head with an operating temperature of 135°F - 170°F

Answer:3- Sprinkler heads that hang down are called "pendent" and when color coded white signify an intermediate rating with a 175°F - 225°F operating temperature. NFPA 13 2-2.3.2 (Standard for the Installation of Sprinkler Systems)

Question #: 2166- An uncolored sprinkler head is suitable for use in which temperature range?

- 1) 135°F - 170°F 2) 175°F - 225°F 3) 250°F - 300°F 4) 325°F - 375°F

Answer:1- The NFPA has a color code for sprinkler heads to indicate temperature rating.

Uncolored: 135°F - 170°F

White: 175°F - 225°F

Blue: 250°F - 300°F

Red: 325°F - 375°F

Green: 400°F - 475°F

Orange: 500°F - 650°F

NFPA 13 2-2.3.2 - Standard for the Installation of Sprinkler Systems

Question #: 2167- When walking through a chemical mixing area, you noticed that the automatic sprinkler heads faced the roof and were color-coded blue. What should this tell you?

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- 1) It was an intermediate temperature pendent sprinkler head with an operating temperature of 175°F- 225°F
- 2) It was a high temperature upright sprinkler head with an operating temperature of 250°F - 300°F
- 3) It was an extra high temperature upright sprinkler head with an operating temperature of 325°F - 375°F
- 4) It was a high temperature pendent sprinkler head with an operating temperature of 250°F - 300°F

Answer:2- Sprinkler heads facing up are called "upright". When color coded blue, it signifies a high temperature rating with a 250°F - 300°F operating temperature. NFPA 13 2-2.3.2 - Standard for the Installation of Sprinkler Systems

Question #: 2168- The basic color used for designating radiation hazards is:

- 1) Yellow
- 2) Orange
- 3) Blue
- 4) Purple

Answer:4- Purple is the basic color for designating radiation hazards. Examples include: Radiation warning signs, containers of radioactive material, and signal lights to indicate radiation machines are in operation. The safety color code for marking physical hazards and the identification of certain equipment is detailed in ANSI Z53.1 and 29 CFR 1910.144.

Question #: 2169- The warning symbol for radiofrequency (RF) radiation is a:

- 1) Circle with a red background and black letters
- 2) Diamond with a red and black background with aluminum letters
- 3) Diamond with a yellow background and white letters
- 4) Yellow circle with a microwave antenna

Answer:2- A sign with a diamond with a red and black background and aluminum letters denotes RF hazards. 29 CFR 1910.97 (a)(3)

Question #: 2170- What color is used to identify ionizing radiation?

- 1) Red
- 2) Magenta
- 3) Green
- 4) Orange

Answer:2- A magenta field identifies areas with ionizing radiation.

Question #: 2171- Both DOT and NFPA systems use _____ coloring to identify an oxidizing material.

- 1) Red
- 2) Yellow
- 3) Green
- 4) Blue

Answer:2- Although systems employed by DOT and NFPA for identifying hazardous materials are similar, their purposes differ as does their color coding, with the exception of yellow for oxidizing materials and red for flammable materials.

Question #: 2172- What does a "3" in the health section of a HMIS label mean?

- 1) Poison
- 2) Moderate health hazard - use reasonable precautions

3) Non-hazardous

4) Very hazardous to health - avoid all routes of exposure

Answer:4- The HMIS is the hazardous materials identification system commonly used to identify chemicals. The rating scale is 0-4, 0 being the least hazardous and 4 being the most hazardous. Materials are rated for reactivity, flammability, and health hazards

Question #: 2173- The NFPA 704 diamond has four classes of materials by position and color on the diamond. The classes are:

1) Health hazard, flammability, reactivity, and specific hazards

2) Toxicity, ignitability, corrosivity, and reactivity

3) Explosivity, health, flammability, and specific hazards

4) Health hazards, flammability, reactivity, and corrosivity

Answer:1- The four classes of materials and colors on the National Fire Protection Association 704 (NFPA 704) diamond are: health hazard-blue ; flammability-red ; reactivity-yellow ; and specific hazards-white.

Question #: 2174- HMIS labels contain the following information:

1) Health, fire, reactivity, toxicity

2) Health, fire, reactivity, personal protective equipment

3) Toxicity, fire, reactivity, personal protective equipment

4) Health, fire reactivity, special precautions

Answer:2- The Hazardous Materials Information System (HMIS) uses a standard label for communicating hazards on health, fire, reactivity, and recommended PPE.

Question #: 2175- You are conducting a formal safety inspection of a manufacturing plant with your newly hired safety engineer. During your inspection you observe an employee, without eye protection, working at a bench installing parts. This is not a hazardous operation but it is a posted "Eye Protection" area. Which one of the following is the best course of action?

1) Contact the supervisor and discuss the situation

2) Test the skills of your new safety professional by letting him or her handle the situation

3) Confront the employee and determine "Why" eye protection is not being used

4) Note the discrepancy and do not discuss it until the outbrief when the CEO and the supervisor are both present

Answer:1- Contact the supervisor who has control of the workplace and discuss the infraction. Communicate this process to the new safety professional.

Question #: 2176- On vehicles used for transporting hazardous cargo, placards are used as a warning. A placarded vehicle must have at least how many identical placards?

1) One

2) Two

3) Four

4) Six

Answer:3- Placards are used to warn others of hazardous cargo. Placards are signs put on the outside of a vehicle to show the hazard class of the cargo. A placarded vehicle must have at least four identical placards. They are put on the front, rear, and both sides. Placards must be

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readable from all four directions. There are 19 DOT-specification placards. They are 10¾ inches square, turned upright on a point (in the shape of a diamond).

Question #: 2177- A hazardous chemical shipment Bill of Lading must have the NFPA 704 label.

- 1) True 2) False 3) Depends on the type of hazard 4) Depends on the destination

Answer:2- The Bill of Lading must have the hazard class, chemical ID number, and the quantity of the transported chemical, but the NFPA 704 label is not required.

Question #: 2178- Aspects of the NFPA 704 labeling system include all of the following EXCEPT:

- 1) May be used without a supplementary manual 2) Must list all chemical hazards
3) Warns of worst hazards possible 4) Easily understood

Answer:2- The NFPA 704 system is easy to understand, may be used without a supplementary manual, and summarizes the worst hazards.

Question #: 2179- Disadvantages of the NFPA 704 labeling system include:

- 1) Gives minimal information 2) Not extensively used
3) Difficult to understand 4) Misleading

Answer:1- The summarized information on the NFPA 704 label is frequently inadequate for emergency response and other applications where detailed, accurate hazard information is essential.

Question #: 2180- In the NFPA 704 diamond symbol, the top number indicates the degree of _____ risk of a certain chemical.

- 1) Health 2) Flammability 3) Reactivity 4) Water reactivity

Answer:2- The NFPA 704 diamond symbol is used to denote the health, flammability, and reactivity risk of a substance. The top number in the red-background area indicates the degree of flammability hazard, the left number in the blue-background area indicates the degree of health hazard, the right number in the yellow-background area indicates the degree of reactivity hazard, and the symbol in the lower, white-background area of the diamond indicates special hazards such as water reactivity, radioactivity, etc.

Question #: 2181- While investigating a serious accident at your facility, you are approached by a journalist with a microphone. You should:

- 1) Politely ignore the journalist
2) Indicate to the journalist that he or she is interfering with an investigation
3) Stop and talk to the journalist
4) Direct the journalist to your supervisor

Answer:3- Journalists want the facts, and if you do not give them factual information, they may theorize and then collect evidence to verify these theories (regardless of the actual facts). In most cases, stopping and spending a minute or two with a journalist and providing him or her

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with appropriate facts is worthwhile for public goodwill. Passing off a journalist to your supervisor (who probably has fewer facts than you) will not be helpful.

For most major accidents, the organization sets up a dedicated public affairs area for journalists. If this is the case, you may want to direct the inquiring journalist there; however, stopping and talking with the lone journalist is still a pretty good tactic.

Question #: 2182- Planning for spills, explosions, etc. is considered:

- 1) Job safety analysis
- 2) Containment planning
- 3) Emergency planning
- 4) Backing up

Answer:3- Emergency planning includes planning for spills, explosions, etc.

Question #: 2183- Your company has an emergency brigade established under 29 CFR 1910.156. As your plant has expanded, the roles and capabilities of your company's fire brigade have also expanded. To promote community goodwill and to provide an opportunity to interact with the local volunteer fire department, your company is seeking an opportunity to provide its fire suppression, rescue, and emergency medical services to the community within the local fire district. What is a common method for outlining the roles, responsibilities, and communication channels between your company's fire brigade and the community fire district should this be agreeable to the community?

- 1) Fire fighting agreement
- 2) Mutual aid agreement
- 3) Agreement of contracted services
- 4) Emergency response agreement

Answer:2- These types of agreements are called mutual aid agreements. The terms of these agreements detail what (if any) compensation will occur as a result of a request for an emergency response by both parties as well as chains of command, communication channels, and other policy-related information.

Question #: 2184- You are the safety manager in a large manufacturing facility. According to company policy, the safety office must approve any activity that is not classified as a routine operation. This has led to the safety office directly approving activities such as truck loading and unloading activities, machine maintenance activities, and custodial activities. Your chief compliant with this policy is that it:

- 1) Fails to make line managers accountable for their own operations
- 2) Requires the safety office staff to be larger than is necessary for a facility of this size
- 3) Requires a huge volume of record keeping and auditing
- 4) Prevents the safety office staff from focusing on more important activities

Answer:1- If the "safety office" is the final authority for approving these activities, then line supervisors have little (if any) stake in the work. The principles of accountability cannot be maintained in this environment.

Question #: 2185- "Because the safety office said not to" is a chronic excuse used by employees to explain why certain unsafe work acts are not allowed. As the safety manager of this "safety office," your chief compliant with this tired phrase is that it:

- 1) Makes your office appear as an enforcement agency instead of a consultant
- 2) Demonstrates that the employees' perceive themselves as unaccountable toward managing their own personal safety
- 3) Causes your staff in the safety office to feel unappreciated
- 4) Requires extensive efforts by your staff to explain the real reasons behind the prohibited practices

Answer:2- Employees have to see themselves as the ultimate accountable agent of their own safety. The company's culture must be adjusted to reflect better attitudes toward employee and line supervisor accountability.

Question #: 2186- As a safety professional employed by a Fortune 500 company, you find that your immediate supervisor disregards recommendations that you have made concerning a serious life-threatening hazard you have identified. What is your ethical obligation?

- 1) Inform OSHA of your findings
- 2) Tender your resignation
- 3) Arrange for a meeting that will include your immediate supervisor and his manager
- 4) Try speaking to your immediate supervisor at a later date

Answer:3 -It is incumbent upon the safety professional to properly channel information concerning the prevention and control of a serious life threatening hazard. Meeting with the manager of your supervisor, although not an ideal situation, is necessary in this situation.

Question #: 2187- In spite of a contract deadline, your immediate supervisor directs you to shut down a project due to safety reasons. These safety reasons do not exist. You should:

- 1) Shut down the project
- 2) Resign
- 3) Bring the situation to the attention of next level of management
- 4) Write a letter of protest to the President's Office

Answer:3- The most prudent measure would be to go up the management chain until you find a manager who supports your refusal to shut down the project. Before doing this, you must first let your supervisor know of your concern and that you feel it is necessary to escalate the issue to the next level of management.

Question #: 2188- The term "underwriter" was generated from:

- 1) Early insurance contracts on ships and their cargo
- 2) Factory Mutual publications
- 3) The property insurance industry in the United States
- 4) Lloyd's of London publications

Answer:1- Early insurers of ships and their cargo used to write their names under the agreement they made with the ship's owner, thus the term "underwriter" came to be.

Question #: 2189- Line employee accountability means all of the following EXCEPT:

~~1) Line employees are expected to determine the job safety requirements and implement them.~~

- 2) Line employees are expected to abide by safe work practices without constant supervision.
- 3) Line employees are expected to report unsafe work conditions when such conditions are detected.
- 4) Line employees are expected to report near misses and accidents when they occur.

Answer:1- Line employees have never been required to determine the job safety requirements. This is one of the roles of supervisors.

Question #: 2190- Management accountability means all of the following EXCEPT:

- 1) Managers and supervisors have the most influence on management systems and must change them when they are found to be working inadequately.
- 2) Managers and supervisors are accountable for their line employees' safety and safety performance, and such accountability is manifested in the managers' and supervisors' performance appraisals.
- 3) Managers and supervisors are accountable for the costs associated with risk management as well as the cost of losses.
- ~~4) Managers and supervisors are accountable for their line employees' safety while off duty.~~

Answer:4- Though management accountability does not follow employees when they leave for home, a well-designed safety and health program will influence employees to live and work safely outside of the workplace.

Question #: 2191- The analytical technique called 5-Whys is used to identify:

- | | |
|--------------------------------|-----------------------------------|
| 1) Root causes of incidents | 2) Human behavior characteristics |
| 3) Behavior-based safety rules | 4) Human errors |

Answer:1- 5-Whys is a qualitative analytical technique to identify the root causes of an incident sequence. Once the causal factors (discreet human errors and equipment malfunctions that led to the loss event) are known, a 5-Whys analysis can be performed on each causal factor to determine "Why" the causal factor was allowed to exist. See example copied below.

- The vehicle will not start. (the problem)
 1. **Why?** - The battery is dead. (first why)
 2. **Why?** - The alternator is not functioning. (second why)
 3. **Why?** - The alternator belt has broken. (third why)
 4. **Why?** - The alternator belt was well beyond its useful service life and not replaced. (fourth why)
 5. **Why?** - The vehicle was not maintained according to the recommended service schedule. (fifth why, a root cause)

Question #: 2192- PRP is an acronym for:

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- 1) Perpetually Responsible Party
- 2) Potentially Responsible Party
- 3) Principal's Responsibility Provision
- 4) Person Receiving Prison (Sentence)

Answer:2- PRP has become a common term in the discussion of responsibility for environmental contamination. In the United States, the EPA allows the use of the word "potentially" in front of the term "responsible party" in the CERCLA context.

Question #: 2193- Joint and several liability defines a scope of liability in the United States. The practical meaning of joint and several liability is best described as:

- 1) All responsible parties must jointly contribute to clean-up costs, to the extent of their volumetric share of the wastes at the site
- 2) Each and every responsible party could be held individually liable for the entire cost of the clean-up
- 3) NPL sites where there are multiple responsible parties must act jointly, through generator committees, to severally apportion costs amongst themselves
- 4) EPA must allocate costs among responsible parties in a manner that reflects both the volume and toxicity of their wastes, as well as the difficulty of clean-up

Answer:2 - The liability provisions under Section 107 of CERCLA are strict, joint and several, and retroactive in application.

Question #: 2194- Strict liability can refer to the standard of liability in the United States. The practical implications of strict liability in cases of environmental contamination are best described as:

- 1) The liability applies regardless of fault, and the government does not have to prove intent or negligence on the part of the responsible party
- 2) Compliance with laws and regulations in effect at the time of disposal does not matter
- 3) The government does not need to prove that a responsible party's waste at the site actually was released or caused harm
- 4) All of the above

Answer:4- The liability provisions of CERCLA are found at Section 107, and are strict, joint and several, and retroactive.

Product Safety Markings

- Marks Prove Compliance - Design, Testing, Certification

