

CSP Questions and Answers- Part-II

Question #: 145- Instantaneous or grab air samples are used to determine:

- 1) **Composition of the air at a specific point in time and location**
- 2) Average composition of the air during a given time period
- 3) Number of samples to be taken over an 8-hr shift
- 4) Compliance with a PEL

Answer:1- Grab or instantaneous samples are used to determine the composition of air at a specific point in time and at a specific location. They are used in many situations including determining concentrations during short exposures and in emergency response situations.

Question #: 146- A certain environment contains trichloroethylene, acetone, and xylene. Which of the following field instruments would most likely yield immediate information regarding concentrations of the individual vapors?

- 1) Combustible gas meter
- 2) Mass spectrometer
- 3) **Colorimetric detector tubes**
- 4) Passive dosimeters

Answer:3- Colorimetric detector tubes are a field instrument that will yield immediate information regarding the concentrations of the individual vapors of trichloroethylene, acetone, and xylene.

Question #: 147- Colorimetric detector tubes may be considered completely adequate for:

- 1) Evaluation of eight hour TWA's for any of the organic vapors
- 2) Collection of STEL organic vapor samples
- 3) Precise determinations by anyone capable of following the manufacturer's instructions
- 4) **Rough determinations when used by someone skilled in their use**

Answer:4- Detector tubes results yield rough estimates of instantaneous exposure levels when used by a trained professional. TWA's and STEL's cannot be determined using detector tubes, since they are instantaneous samples.

Question #: 148- When evaluating where to collect samples, which of the following should be considered first?

- 1) Those at risk due to own activity
- 2) Those nearby
- 3) **Those who exhibit symptoms of exposure**
- 4) Those who complain

Answer:3- The samples should be collected on a range of people. However, those exhibiting symptoms are most at risk and should be evaluated first; followed by those at risk but without symptoms, those who complain, and then others nearby.

Question #: 149- A chiller in the plant is suspected to have a leak due to a loss of pressure in the CFC closed loop system. What type of instrument would you use to detect the leak?

- 1) Detector tube
- 2) **Halide meter**
- 3) LEL meter
- 4) O2 meter

Answer:2- Chillers contain refrigerants such as CFC's which are also known as a class of chemicals called halides. Therefore, the best meter would be one that detects halides.

Question #: 150- Calculate the TWA of the following exposures:

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1 hour = 150 ppm

2 hours = 75 ppm

5 hours = 10 ppm

1) **44 ppm**

2) 53 ppm

3) 65 ppm

4) 74 ppm

Answer:1-

$$\text{TWA} = [(1 \text{ hr} * 150 \text{ ppm}) + (2 \text{ hr} * 75 \text{ ppm}) + (5 \text{ hr} * 10 \text{ ppm})] / 8 \text{ hr} \text{ TWA} = 43.75 \text{ ppm}$$

Question #: 151- Of the ways to evaluate the hazards of gases and vapors, all the following are true EXCEPT:

1) May be collected on an open-faced filter and weighed

2) May be collected on filter media

3) May be collected in containers or absorbed

4) May be collected on cloth material

Answer:4- Gases and vapors may not be collected on cloth material.

Question #: 152- In evaluating the hazards of fumes and mists, all of the following are true EXCEPT:

1) May be collected on filter media

2) May be absorbed on charcoal

3) May be collected with a cyclone separator

4) May be analyzed using fume arrestors

Answer:4- Fumes and mists may not be analyzed using fume arrestors.

Question #: 153- If a worker is exposed to lead for 4 hr at 24 mg/m³, 3 hr at 48 mg/m³, and 1 hr at 0 mg/m³, what is his exposure as an 8-hr TWA?

1) 28 mg/m³

2) 30 mg/m³

3) 33 mg/m³

4) 48 mg/m³

Answer:2- To get the TWA, you must calculate the exposure rate for each part of the 8-hr day for which there is an exposure.

$$(24 \text{ mg/m}^3)(4 \text{ hr}/8 \text{ hr}) = 12 \text{ mg/m}^3$$

$$(48 \text{ mg/m}^3)(3 \text{ hr}/8 \text{ hr}) = 18 \text{ mg/m}^3$$

$$(0 \text{ mg/m}^3)(1 \text{ hr}/8 \text{ hr}) = 0 \text{ mg/m}^3$$

Then, you need to add together each weighted exposure to get the 8-hr exposure.

$$\text{TWA} = 12 \text{ mg/m}^3 + 18 \text{ mg/m}^3 + 0 \text{ mg/m}^3 = 30 \text{ mg/m}^3$$

Question #: 154- What is the wet bulb-globe temperature to which an industrial assembly worker is exposed if the following temperatures are obtained:

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Dry bulb = 89°F
Natural wet bulb = 84°F
Globe = 81°F

- 1) 83.9°F **2) 83.1°F** 3) 84.0°F 4) 84.7°F

Answer:2- Use the WBGT formula for indoor applications.

WBGT = 0.7 WB + 0.3 GT, where WB is the temperature reading from the natural wet bulb and GT is the globe temperature.

$$\text{WBGT} = (0.7 * 84^\circ\text{F}) + (0.3 * 81^\circ\text{F}) \qquad \text{WBGT} = 83.1^\circ\text{F}$$

Question #: 155- What is the natural wet bulb globe temperature to which a construction worker, working outdoors, is exposed if the following temperatures are obtained:

Dry bulb = 92°F
Natural wet bulb = 88°F
Globe = 94°F

- 1) 89.8°F **2) 89.6°F** 3) 90°F 4) 91.3°F

Answer:2- Use the WBGT formula for outdoor applications.

WBGT = 0.7 WB + 0.2 GT + 0.1 DB, where WB is the temperature from the natural wet bulb, GT is the globe temperature, and DB is the dry bulb temperature.

$$\text{WBGT} = (0.7 * 88^\circ\text{F}) + (0.2 * 94^\circ\text{F}) + (0.1 * 92^\circ\text{F}) \qquad \text{WBGT} = 89.6^\circ\text{F}$$

Question #: 156- The correct procedure in performing a wipe sample is:

- 1) Start at center and make increasingly larger circles to edge
- 2) Start at outside edge and progress to the middle**
- 3) Make perpendicular swipes of area
- 4) Make parallel swipes of the area

Answer:2- The "OSHA Technical Manual" calls for starting at the edge and making increasingly smaller concentric circles to the middle. The surface area sampled is 100 cm².

Question #: 157- Assessments for potential TLV-C exposures should be sampled for:

- 1) 15 min**
- 2) 5 min
- 3) 1 min
- 4) Only where instantaneous monitoring is feasible

Answer:1- Where instantaneous monitoring is not feasible, the TLV-C can be assessed by sampling over a 15-min period except for those substances that may cause immediate irritation.

Question #: 158- A flammable gas detected in a confined space registers 10% by volume of the atmosphere. How many parts per million (ppm) does this equal?

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- 1) 100 ppm 2) 1,000 ppm 3) 10,000 ppm **4) 100,000 ppm**

Answer:4- To convert any gas concentration to parts per million, simply multiply the percentage expressed as a decimal by 1,000,000. In this problem, $0.10 \times 1,000,000 \text{ ppm} = 100,000 \text{ ppm}$.

Question #: 159- A hot wire combustible gas meter should not be used in an atmosphere containing:

- 1) Flammable liquids 2) Flammable gases **3) Silicone vapors** 4) Methane

Answer:3- Silicone vapors rapidly poison the platinum filament in hot wire combustible gas meters. Poisoning can occur when silicone vapors are at very low concentrations (e.g., as low as 1 ppm).

Question #: 160- An explosion meter reads 10%. What does this mean?

- 1) Concentration is 10% of the lower explosive limit**
2) Concentration is 10% of the upper explosive limit
3) Concentration is flammable
4) 100,000 ppm flammable gas is present

Answer:1- Explosion meters read in percentage of the lower explosive limit. For example if a compound's LEL were 10%, then a 10% reading on an explosion meter indicates an actual concentration of 1%.

Question #: 161- Problem(s) you may encounter with the use of a hot wire combustible gas meter with a platinum catalyst is that the catalyst may become:

- 1) Inactive 2) Poisoned 3) Enhanced **4) Both 1 and 2**

Answer:4- **The primary problem** with "hot wire" type combustible gas detectors is poisoning of the catalyst. Platinum catalysts are subject to poisoning by silicone vapors at concentrations as low as 1 ppm. This silicone vapor poisoning renders the platinum catalyst inactive.

A secondary problem that is less prevalent today because of advances in meter construction (primarily the coating of the reference bead of the detector with glass), is that un-coated reference beads can become "active" with aging, not inactive.

Question #: 162- In performing personal air sampling for welding fumes, where should the filter cassette be placed?

- 1) Attached to the lapel **2) Inside the welding helmet**
3) On the shoulder 4) At the waist

Answer:2- The OSHA Technical Manual specifies placement of the filter cassette inside the welding helmet.

Question #: 163- In the NIOSH lifting equation, what does RWL represent?

- 1) Range of weight limits **2) Recommended weight limit**
3) Reference work load 4) Recommended work limit

Answer:2- This equation calculates the recommended weight limit for workers. It is used to evaluate two-handed manual lifting tasks.

Question #: 164- When using the NIOSH lifting equation, you will be able to determine the recommended weight limit for lifting tasks using the formula developed through research in ergonomics. If the actual load is observed and divided by the recommended weight limit, you will calculate:

- | | |
|---|-----------------------------------|
| 1) The optimum task multiplier | 2) The severity rate for the task |
| 3) The percent of the population that can do the task | 4) The lifting index |

Answer:4- The lifting index, or LI , is calculated by dividing the actual load by the recommended weight limit. This is a good way to compare tasks or possible changes to a task.

Question #: 165- You are evaluating a lifting task in your facility that involves moving tote boxes containing parts from a lower conveyor to an upper conveyor at right angles to each other. The tote boxes have two handles and are easy to grasp. The tote box handles, when on the lower conveyor, are 10 in. from the floor. When the tote box is on the upper conveyor, the handles are 40 in. from the floor. The center of the belt of both conveyors is 10 in. from the feet of the worker. One lift is required every minute during the full 8-hr shift. The tote box weighs 4 lb. How much material can be placed in the tote box?

- 1) 4 lb 2) 12 lb **3) 16 lb** 4) 20 lb

Answer:3- The NIOSH lifting equation is: **$RWL = LC * HM * VM * DM * AM * FM * CM$**

- **RWL, the Recommended Weight Limit**
- **LC, Load constant**
- **HM, the Horizontal Multiplier factor**
- **VM, the Vertical Multiplier factor**
- **DM, the Distance Multiplier factor**
- **FM, the Frequency Multiplier factor**
- **AM, the Asymmetric Multiplier factor**
- **CM, the Coupling Multiplier factor**

where LC = 51 lb

HM = (10/H)

VM = [1-0.0075 * absolute value of (V-30)]

DM = [0.82 + (1.8/D)]

AM = (1-0.0032 * A)

(All of the above is part of the lifting equation BEFORE we start applying the numbers from the problem.)

These are the numbers we will use in the RWL equation.

H = 10 in. . . . this is the horizontal distance from the feet

V = 10 in. . . . this is the vertical distance from the floor

D = 30 in. . . . this is how far the item is lifted vertically

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A = 90° . . . this is the asymmetry (body twisting)

FM = 0.75 ... this is the frequency factor

CM = 1.00 ... this is the coupling factor

RWL = 51 lb(10/10)[1-(0.0075(absolute 10-30))](0.82 + (1.8/30))[1-(0.0032 * 90)] * 0.75 * 1.00

= 51 * 1.00 * 0.85 * 0.88 * 0.712 * 0.75 * 1.00

= 20.37 lb

Product weight = RWL - tote weight

= 20.37 lb - 4.0 lb

= 16.37 lb

Question #: 166- You are evaluating a lifting task in your facility that involves moving tote boxes containing parts from an upper conveyor to a lower conveyor. The totes are poorly constructed and are difficult to grasp. Most workers simply grasp the bottom of the slippery tote box from the upper conveyor (located 35 in. from the floor) and drop the tote box 1 in. from the lower conveyor (located 9 in. from the floor). The conveyors are at right angles to each other, and the center of the conveyor belts are 24 in. from the feet of the workers. Two lifts are required every minute during a 2-hr shift. The tote box weighs 4 lb. If the weight of parts placed in the tote box is 8 lb, what is the lifting index? Should changes be made?

1) 1.22/Changes should be made

2) 0.81/Changes are not necessary

3) 0.78/Changes are not necessary

4) 1.15/Changes should be made

Answer:1- The NIOSH lifting equation is: $RWL = LC * HM * VM * DM * AM * FM * CM$ where LC = 51 lb

HM = (10/H)

VM = [1-0.0075 * absolute value of (V-30)]

DM = [0.82 + (1.8/D)]

AM = (1-0.0032 * A)

(All of the above is part of the lifting equation BEFORE we start applying numbers from the problem.)

These are the numbers we will use in the RWL equation.

H = 24 in. . . . this is the horizontal distance from the feet

V = 35 in. . . . this is the vertical distance from the floor

D = 25 in. . . . this is the lifted distance (the workers drop the tote the last inch - that is why D is not 26 in.)

A = 90° . . . this is the asymmetry (body twisting)

FM = 0.84 ... this is the frequency factor

CM = 0.90 ... this is the coupling factor

RWL = 51 lb(10/24)[1-(0.0075(absolute 35-30))] [0.82 + (1.8/25)] [1-(0.0032 * 90)] * 0.84 * 0.90

= 51 lb * 0.417(0.9625) 0.892 * 0.712 * 0.84 * 0.90 = 9.8 lb

Total load = 4.0 lb + 8.0 lb = 12 lb

Lifting Index = Load / Recommended Weight Limit = 12 lb / 9.8 lb = 1.2

A lifting index of over 1.00 is too high and indicates that changes to the process and/or to the magnitude of the load should be made to reduce the lifting index to 1.00 or less.

Question #: 167- You are evaluating a lifting task in your facility that involves moving tote boxes containing parts from a lower conveyor to an upper conveyor at right angles to each other. The tote boxes have two handles and are easy to grasp. The tote box handles, when on the lower conveyor, are 10 in. from the floor. When the tote box is on the upper conveyor, the handles are 40 in. from the floor. The center of the belt of both conveyors is 10 in. from the feet of the

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worker. One lift is required every minute during the 8 hour shift. The tote box weighs 4 lb. If the lower conveyor is raised 10 in., how much more product can be placed in the tote box without exceeding the RWL?

- 1) 1.3 lb 2) **2.6 lb** 3) 3.0 lb 4) 15 lb

Answer:2- The NIOSH lifting equation is: $RWL = LC * HM * VM * DM * AM * FM * CM$

where

$LC = 51 \text{ lb}$

$HM = (10/H)$

$VM = [1 - 0.0075 * \text{absolute value of } (V - 30)]$

$DM = [0.82 + (1.8/D)]$

$AM = (1 - 0.0032 * A)$

(All of the above is part of the lifting equation BEFORE we start applying the numbers from the problem.)

These are the numbers we will use in the RWL equation.

$H = 10 \text{ in.}$. . . this is the horizontal distance from the feet

$V = 10 \text{ in.}$. . . this is the vertical distance from the floor

$D = 30 \text{ in.}$. . . this is how far the item is lifted vertically

$A = 90^\circ$. . . this is the asymmetry (body twisting)

$FM = 0.75$... this is the frequency factor

$CM = 1.00$... this is the coupling factor

$RWL1 = 51 \text{ lb} (10/10) [1 - (0.0075 \text{ absolute } 10 - 30)] [0.82 + (1.8/30)] [1 - (0.0032 * 90)] * 0.75 * 1.00 = 20.37 \text{ lb}$ RWL1 is the initial state.

When we change things, we must recalculate the new RWL. In this problem, the only things that change are the vertical distances.

V changes to 20 in. from 10 in.

D changes to 20 in. from 30 in.

$RWL2 = 51 \text{ lb} (10/10) [1 - (0.0075 * \text{absolute } 20 - 30)] [0.82 + (1.8/20)] [1 - (0.0032 * 90)] * 0.75 * 1.00 = 22.92 \text{ lb}$ Difference = $22.92 \text{ lb} - 20.37 \text{ lb} = 2.55 \text{ lb}$

Question #: 168- Under foundry conditions, the numerical value of the WBGT Index is calculated using the formula:

- 1) **0.7 WB + 0.3 GT** 2) 0.7 WB + 0.2 GT + 0.1 DB
3) 0.7 WB + 0.1 GT + 0.1 DB 4) 0.7 WB + 0.2 GT + wind velocity

Answer:1- The wet bulb globe temperature (WBGT) is calculated indoors or outdoors with no solar loads: $WBGT = 0.7 WB + 0.3 GT$

Foundry conditions would exclude the solar load. Had the question asked for the formula

outdoors with solar load, the answer would have been: $WBGT = 0.7 WB + 0.2 GT + 0.1 DB$

where WB = Natural wet bulb temperature GT = Globe temperature DB = Dry bulb temperature

Question #: 169- How much an employee can safely lift depends least on:

- 1) **Body size** 2) Frequency 3) Body position 4) Distance

Answer:1- Although body size can contribute to overall strength, it is not a good predictor of potential injury. When designing a lifting task and safe weight limits, the most important factors

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are how often the load is lifted (frequency), how far the load is carried (distance), and how the load is lifted (body position).

Question #: 170- You discover chemicals stored several years past their expiration date. Which chemical presents the highest hazard?

- 1) Nitric acid 2) Trichloroethylene **3) Perchloric acid** 4) Perchloroethylene

Answer:3- Perchloric acid forms chlorate salts with age, which are highly explosive upon contact.

Question #: 171- In the course of an eight-hour work shift, a maintenance mechanic works TWICE in the vicinity of an operation where the measured carbon monoxide concentration in the air at his breathing zone level is fairly constant at 50 ppm. The first time he works for 3 hr in the morning, and the second time he works 2.5 hours in the afternoon. All the other times, he works in areas of the plant where his exposure to carbon monoxide is essentially zero. What is his time-weighted average (TWA) exposure to carbon monoxide?

- 1) 17.2 ppm **2) 34.4 ppm** 3) 51.6 ppm 4) 103.2 ppm

Answer:2- $TWA = (3 \text{ hr} * 50 \text{ ppm} + 2.5 \text{ hr} * 50 \text{ ppm} + 2.5 \text{ hr} * 0 \text{ ppm}) / 8 \text{ hr}$
 $= [(150 + 125) \text{ hr-ppm}] / 8 \text{ hr} = 34.4 \text{ ppm}$

Question #: 172- Electromagnetic energy:

- 1) Is not a factor in heat stress calculations
2) Is not a factor in heat transfer calculations
3) Is best controlled by forced air ventilation
4) Insignificantly heats the air in the room as it passes through

Answer:4- Radiant heat is a form of electromagnetic energy. It is a major input in heat stress and heat transfer equations. It is best controlled by shielding and heats the air it passes through only insignificantly.

Question #: 173- A fiber is defined as a particle with an aspect ratio (L:W) of:

- 1) 2:1 **2) 3:1** 3) 4:1 4) 5:1

Answer:2- Fibers are particles with an aspect ratio of 3:1, that is, the length of the fiber is three times the width.

Question #: 174- The particle size of fumes range from:

- 1) 0.01 - 0.2 microns** 2) 0.001 - 0.02 microns
3) 0.001 - 0.002 microns 4) Fumes are not particles

Answer:1- Fumes are solid particles that are condensed from metal oxides. They range in size from 0.01 - 0.2 microns in diameter. Particles greater than 0.5 microns are considered dusts.

Question #: 175- The particle size of mists range from:

- 1) Mist are liquids-particle size does not apply
- 2) 0.4 - 4 microns
- 3) 4 - 40 microns
- 4) **40 - 400 microns**

Answer:4- Mists are a suspension of liquid particles from condensation of vapor. They range in particle size from 40 - 400 microns.

Question #: 176- The terminal settling velocity of a particle is:

- 1) Inversely proportional to its diameter
- 2) Directly proportional to its diameter
- 3) **Directly proportional to the square of its diameter**
- 4) Inversely proportional to the square of its diameter

Answer:3- The settling velocity of particles is described by **Stoke's Law: Terminal Settling Velocity = $0.006(\text{specific gravity})(\text{diameter})^2$** . This relationship shows that the settling velocity is proportional to the square of the diameter of the particle.

Question #: 177- Which of the following is NOT true about pitot tubes?

- 1) Not a direct reading instrument
- 2) May be susceptible to plugging
- 3) **Needs periodic calibration**
- 4) Measures velocity and static pressures

Answer:3- A pitot tube is a metallic, precision made instrument that is made to specific dimensions. The tube itself cannot be calibrated. The calibration occurs with the manometer that it is used with, to determine velocity and static pressures and air volume flowing through a duct. Tiny holes in the side for measuring static pressure could become plugged in a particulate airstream.

Question #: 178- Smoke tubes can be utilized in which of the following situations:

- 1) In hot, dry air
- 2) **At velocities below 150 ft/min**
- 3) When exact measurements are required
- 4) At velocities below 175 ft/min

Answer:2- The smoke tube is not applicable for velocities greater than 150 ft/min because the rapid air flow dissipates the smoke.

Question #: 179- The aspect ratio of fiber is defined as L/W. The aspect ratio of an exhaust hood is defined as:

- 1) Ratio of length to width
- 2) Ratio of length squared to width
- 3) **Ratio of width to length**
- 4) Ratio of width squared to length

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Answer:3- The formula for the aspect ratio of an exhaust hood is $AR = W/L$ where AR is Aspect ratio, W is width, and L is length. This is the reciprocal of the aspect ratio that would be used when discussing the aspect ratio of an asbestos fiber.

Question #: 180- When assessing ventilation systems, the pitot tube is limited to:

- | | |
|---------------------|--------------------------------|
| 1) Use at diffusers | 2) In-duct measurements |
| 3) Use at inlets | 4) Use at outlets |

Answer:2- Velometers and thermoanemometers can be used at diffusers and inlets. Pitot tubes are used to make in-duct measurements.

Question #: 181- Velocity pressure can be measured in a ventilation system using a:

- 1) Pitot tube- measure velocity pressure**
- 2) Thermoanemometer- measure velocity
- 3) Smoke tube-direction of flow
- ~~4) Piezo electric anemometer~~

Answer:1- Of all devices listed, only the pitot tube can be used to measure velocity pressure in ventilation systems. Smoke tubes can measure direction of flow, thermoanemometers measure velocity, and Answer 4 is fictitious.

Question #: 182- What device is commonly used to measure the capture velocity of the fume hood?

- | | | | |
|----------------------|---------------|---------------------|-------------|
| 1) Velometers | 2) Pitot tube | 3) Cascade impactor | 4) Air pump |
|----------------------|---------------|---------------------|-------------|

Answer:1- Velometers are commonly used to conduct those types of measurements.

Question #: 183- A good indicator gas for determination of adequacy of outdoor air exchange in buildings is:

- | | | | |
|--------------------|-----------|--------------------------|-------------|
| 1) Carbon monoxide | 2) Oxygen | 3) Carbon dioxide | 4) Nitrogen |
|--------------------|-----------|--------------------------|-------------|

Answer:3- Carbon dioxide is an indoor air pollutant that is given off by occupants of the building and generally is a good indicator of the degree of indoor air exchanged with outdoor air. Levels of carbon dioxide below 1,000 ppm indicate, in most cases, an adequate supply of outdoor air.

Question #: 184- When investigating an indoor air quality issue, the first step is to:

- 1) Take quantitative air samples
- 2) Inspect the building HVAC system
- 3) Meet with affected employees and management**
- 4) Survey the area for sources of air contaminants

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Answer:3- The first step in investigating an indoor air quality problem is to understand the nature of complaints from the affected employees. This will provide clues as to the potential contaminants or other sources of the problem. Air sampling is premature since potential contaminants are unknown. Inspecting the HVAC system or surveying for sources of contaminants may not be necessary if complaints point in a different direction.

Question #: 185- The concentration of carbon dioxide where symptoms of exposure begin to appear is:

- 1) 350 ppm 2) 600 ppm **3) 1,000 ppm** 4) 5,000 ppm

Answer:3- Many studies have shown that hypersensitive employees begin to report headaches, fatigue, dizziness, and other symptoms at about 1,000 ppm. 360 ppm is the concentration of carbon dioxide in a rural environment. Inside a well ventilated building, carbon dioxide is usually about 600 ppm. The ACGIH TLV for carbon dioxide is 5,000 ppm.

Question #: 186- Using the equation for adding decibels, what is the sound pressure level if the following 3 noise sources are added together: 80 dB, 85 dB, and 92 dB?

- 1) 89 dB **2) 93 dB** 3) 95 dB 4) 102 dB

Answer:2- Use the formula to add decibels:

$$\begin{aligned} L_{pt} &= 10 \log [10(P_1/10) + 10(P_2/10) + \dots 10(P_n/10)] \\ L_{pt} &= 10 \log [10(80/10) + 10(85/10) + 10(92/10)] \\ &= 10 \log (2.0011 \times 10^9) \\ &= 93 \text{ dB} \end{aligned}$$

Question #: 187- If an additional noise source of 120 dB is added to 3 others (80 dB, 85 dB, and 92 dB), what is the resultant sound pressure level?

- 1) 94 dB **2) 120 dB** 3) 125 dB 4) 213 dB

Answer:2 - The formula for adding decibels is:

$$\begin{aligned} L_{pt} &= 10 \log [10^{(P_1/10)} + 10^{(P_2/10)} + \dots 10^{(P_n/10)}] \\ &= 10 \log (1.0020 \times 10^{12}) \\ &= 120 \text{ dB} \end{aligned}$$

Question #: 188- When calculating estimated sound pressure levels in a room, R refers to:

- 1) Room constant** 2) Directivity of the noise 3) Size of the room 4) None of the above

Answer:1- The room constant is an indication of the amount of sound absorption in a room. The smaller the room constant, the more reverberant the room.

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Question #: 189- If a sound pressure level of 92 dB is obtained at 3 ft from a machine, what level should be expected at 8 ft from the machine, assuming free-field, non-directional noise source?

- 1) 82.1 dB 2) **83.5 dB** 3) 85.4 dB 4) 89.0 dB

Answer:2- Use the equation for calculating the effect of distance on sound pressure:
 $dB_0 = dB_1 + 20 \log (d_1/d_0)$ where db_0 is the pressure at the source, db_1 is the pressure at distance 1, d_0 is the distance where db_0 is measured, and d_1 is the distance where db_1 is measured

$$92 = dB_1 + 20 [\log (8/3)]$$

$$92 = dB_1 + 20 * 0.4260$$

$$dB_1 = 83.5$$

Question #: 190- What is an employees total exposure to noise, expressed as a Dose (or % PEL), if he/she has the following exposure? 90 dB for 4 hr, 92 dB for 2 hr, 80 dB for 2 hr

- 1) 110% 2) 96% 3) 92% 4) **89%**

Answer:4- $D = 100 * S(ci/Ti)$,
where D is dose, ci is length of exposure, and Ti is the permissible exposure time at that level.

$$Ti = 8 / 2[(Li-90)/5]$$

$$T(90 \text{ dB}) = 8 \text{ hr} \quad T(92 \text{ dB}) = 6.1 \text{ hr} \quad T(80 \text{ dB}) = 32 \text{ hr}$$

$$D = 100 (4 \text{ hr}/8 \text{ hr} + 2 \text{ hr}/6.1 \text{ hr} + 2 \text{ hr}/32 \text{ hr}) = 100(0.8904) = 89\%$$

Question #: 191- If an employee has a noise dosimetry reading of 62%, what does this correlate to as an 8 hr sound pressure level?

- 1) **86.7 dB** 2) 87.4 dB 3) 88.3 dB 4) 91.2 dB

Answer:1- Use the formula $TWA = 16.61 \log (D/100) + 90$ where D is the dosimetry reading.

$$TWA = 16.61 * \log (62/100) + 90$$

$$TWA = 16.61(- 0.2076) + 90$$

$$TWA = 86.7 \text{ dB}$$

Question #: 192- The maximum exposure to impulsive or impact noise should not exceed:

- 1) 90 dBA peak 2) 115 dB peak 3) 120 dB peak 4) **140 dB peak**

Answer:4- Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level. 29 CFR 1910.95 (b)(1)

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Question #: 193- Of the following, which sound measuring instrument is the LEAST commonly used for most noise problems encountered in a manufacturing plant?

- 1) Sound level meter
- 2) Octave-band analyzer
- 3) Noise dosimeter
- 4) Oscilloscope**

Answer:4- In a manufacturing plant, with a variety of noise problems, noise measuring equipment most commonly used include sound level meters, octave-band analyzers, and noise dosimeters.

SOUND LEVEL METER - This is the basic direct reading instrument used to measure sound pressure variations in air. The frequency range is usually 20 to 20,000 Hz.

OCTAVE-BAND ANALYZER - This instrument is used to determine where the noise energy lies in the frequency spectrum. It is an essential piece of equipment for engineering control of noise producing machines or equipment.

NOISE DOSIMETER - This instrument is worn by a worker to accumulate a record of the noise energy to which he/she was exposed during the work shift.

Question #: 194- A 73 dB sound pressure level (SPL) was measured at 600 ft. What is the SPL at 150 ft?

- 1) 75 dB
- 2) 78 dB
- 3) 85 dB**
- 4) 90 dB

Answer:3- For each halving of the distance you must add 6 dB. There were two halvings of the distance; therefore, add 12 dB. Answer = 85 dB

Question #: 195- An enclosure is placed around a worker and a noise source. Why is the sound pressure level experienced by the worker greater than without the enclosure?

- 1) Reverberation**
- 2) Impact
- 3) Masking
- 4) Increase in line component

Answer:1- Enclosing a noise source always increases the sound pressure level because direct sound is added to the reflected sound.

Question #: 196- An octave band analyzer is an instrument used to determine:

- 1) The noise frequency distribution**
- 2) SPL in A, B, and C weighted scales
- 3) Peak to peak SPL's
- 4) A sound level within a fraction of a decibel

Answer:1-The octave band analyzer input microphone divides the sound into frequency bands that are called octaves. It measures the sound pressure levels in each band. These data are often essential for designing effective controls.

Question #: 197- During noise level surveys the microphone should be:

- 1) Pointed at the source
- 2) Perpendicular to the source
- 3) Does not matter what orientation
- 4) Is determined by the manufacturer**

Answer:4- Instruments are different and the operating manual must be reviewed before using to ensure correct operation.

Question #: 198- How often is calibration of sound level meters required?

- 1) Monthly 2) Quarterly 3) Before each survey **4) Before and after each survey**

Answer:4- Good practice dictates that the meter be calibrated before and after each survey.

Question #: 199- Which instrument is required for assessing an individual's hearing ability?

- 1) Sound level meter 2) Octave band analyzer **3) Audiometric booth** 4) Noise dosimeter

Answer:3- The sound level meter and octave band analyzer are used for area sound measurements. The noise dosimeter is used for making noise dose measurements in the individual's hearing zone. The only way to assess hearing is with an audiometric booth.

Question #: 200- When might you use the C-weighting on a sound level meter?

- 1) For estimating adequacy of hearing protective devices**
2) For measuring very high frequency noise
3) For measuring community noise from aircraft
4) When trying to most closely imitate the human ear response

Answer:1- The C-weighting on a sound level meter can be used to estimate the actual reduction in noise level provided by hearing protection. Three steps of estimation:

Step 1 - Monitor the noise level in the workplace using the C-weighted scale

Step 2 - Convert the measured noise level to a C-weighted time-weighted average (TWA)

Step 3 - Subtract the noise reduction rating (NRR) specified by the hearing protection manufacturer from the C-weighted TWA found in Step 2.

The value found in Step 3 is based on the C-weighted scale and can be reliably used as a conservative estimate of the benefit of wearing hearing protection in high noise environments.

Question #: 201- Which of the following is used for detecting alpha radiation?

- 1) Film badge 2) Thermoluminescence detectors (TLD) 3) Pocket dosimeter
4) Geiger-Mueller with very thin windows

Answer:4- A Geiger-Mueller detector is used for radiation survey measurements because it is capable of detecting very small amounts of radiation. With very thin windows in the probes, the instrument can be used to detect alpha radiation. Without them, the instrument is used to detect beta, gamma, and x-rays. Note that this instrument does not give a uniform response for different radiation energy levels and is accurate only for the type of radiation energy for which it is calibrated.

Question #: 202- Which of these meter(s) would be used most often for monitoring weekly exposure to x-rays?

- 1) Film badge** 2) Thermoluminescence detectors (TLD) 3) Pocket dosimeter **4) Both 1 & 2**

Answer:4- The film badge and thermoluminescence detectors would be used most often for monitoring weekly exposure to x-rays. The film badge, worn on the outer clothing, will allow an estimate of an accumulated dose of radiation. Thermoluminescence detectors are dosimeters worn as a body badge or finger ring. Most commonly, they are small chips of lithium fluoride with an affinity for storing energy (accumulated dose of x-rays) that can be released on a

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readout using a TLD readout instrument. The pocket dosimeter is a direct reading instrument shaped like a pen. It is the instrument of choice when an individual finds it necessary to determine the radiation dose at any time he or she is working.

Question #: 203- The amount of material undergoing radioactive decay is often measured in:

- 1) Rem 2) Rad **3) Curie** 4) Roentgen

Answer:3- A curie is the amount of a material that will undergo 3.7×10^{10} disintegrations per second.

Question #: 204- How are the readings from a shake-out sample best reported?

- 1) Mppcf 2) mg/m³ total **3) mg/m³ respirable dust** 4) % silica

Answer:3- Shake-out refers to the shake-out operation in a foundry. The principal hazard is that of silica dust, hence the best answer is mg/m³ respirable dust.

Question #: 205- IDLH means:

- 1) Industrial department, labor and health **2) Immediately dangerous to life or health**
3) Identification, detection, and limitations 4) Nothing pertaining to safety

Answer:2- This is a term which NIOSH defines as an atmosphere in which staying longer than 30 minutes will cause irreversible effects or hinder the workers ability to exit.

Question #: 206- Infrared analysis of breathing air is generally acceptable unless _____ contamination is a concern.

- 1) CO 2) CO₂ 3) HC **4) Mercury**

Answer:4- CO, CO₂, and hydrocarbons all absorb strongly in the infrared region of the electromagnetic spectrum. Mercury does not.

Question #: 207- Of the following airborne contaminants, which is likely to have the smallest average particle size?

- 1) Zinc fumes** 2) Graphite dusts 3) Silica dusts 4) Hydrocarbon mists

Answer:1- Condensation aerosols such as metal fumes tend to have the smallest particle sizes.

Question #: 208- One of the shortcomings of the taste test for qualitatively fitting a respirator is that there is:

- 1) A risk of harm to the person being fitted **2) Wide variation in the ability to taste saccharin**
3) The smoke is very irritating 4) Wide variation in the ability to taste banana oil

Answer:2- One of the shortcomings of the taste test is that there is a wide variation in the ability to taste saccharin. This implies different levels of protection for different people.

Question #: 209- An instrument that detects a mixture of flammable vapors when air is passed over a heated electric filament is called a:

1) Wheatstone bridge 2) Resistance bridge **3) Combustible gas indicator** 4) Gas detector

Answer:3- A combustible gas indicator is the instrument which operates on this principle. A Wheatstone bridge is the actual internal mechanism which provides the instrument with data.

Question #: 210- Passive monitors have been increasing in popularity in recent years. The monitors depend on two methods of collection. The method used most commonly for organic vapors is _____.

1) Active diffusion

2) Passive diffusion

3) Diffusion according to Fick's Law

4) Both 2 and 3

Answer:4- Organic vapors are allowed to passively diffuse across a membrane into some collection device. One common collection device is activated charcoal. Fick's Law describes the mathematics of passive diffusion.

Question #: 211- Personal portable samplers are better than fixed samplers in determining:

1) Average concentrations

2) Peak concentrations

3) Sources of emission

4) Reduction of emission

Answer:1- There may be some overlap in meanings of the terms; however, in common usage "average" is taken to mean TWA. Therefore the personal samplers are best for determining the average exposure of a worker.

Question #: 212- ACGIH Biological Exposure Indices (BEI's) help to measure employees' exposure to all of the following, EXCEPT:

1) Biohazards

2) Occupational benzene exposure

3) Non-occupational benzene exposure

4) Hazardous gas exposure

Answer:1- Biohazards are potentially infectious agents of biological origin, which are not addressed by the biological exposure indices. BEI's are the medical sampling determinants for a person's exposure to occupational and non-occupational hazardous chemicals. BEI's are published by ACGIH.

Question #: 213- Which of the following cannot be monitored using a cholinesterase test?

1) DDT 2) DVP

3) Parathion 4) Malathion

Answer:1- DDT is the only chemical in the above group that is not a cholinesterase inhibitor.

Question #: 214- The odor of diethylamine resembles:

1) Garlic

2) Dead fish

3) Ammonia 4) Xylene

Answer:3- Diethylamine has a decidedly ammonia- like odor.

Question #: 215- What instrument would be best to check for leaks of a CFC refrigerant?

- 1) Mass spectrometer
- 2) **Halide meter**
- 3) Combustible gas indicator
- 4) Gas chromatograph

Answer:2- Although a mass spectrometer or a gas chromatograph can detect chlorofluorocarbons (CFC's), a more specific instrument such as a halide meter can more easily and quickly detect the presence of halogens (chlorine and fluorine) from the CFC vapor. A combustible gas indicator cannot be used since CFC's are not combustible.

Question #: 216- Which of the following is an example of a typical VOC?

- 1) **Vinyl chloride**
- 2) Arsenic
- 3) Aldrin
- 4) Carbonic Acid

Answer:1- Vinyl Chloride is a typical Volatile Organic Compound (V.O.C.) found in contaminated water. Arsenic is a metal, Aldrin is a pesticide and carbonic acid is an inorganic compound. Volatile organic compounds (VOC) generally means any compound of carbon which participates in atmospheric photochemical reactions, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate.

Question #: 217- Speech interference levels can be determined with which of the following instruments?

- 1) Sound level meters
- 2) Impact noise analyzers
- 3) **Octave band analyzers**
- 4) Noise dosimeters

Answer:3- Speech occurs in the 500 - 2,000 Hz range. Identifying the noise levels in this frequency range requires an octave band analyzer.

Question #: 218- The best method for monitoring a long haul truck driver's exposure to noise is through the use of:

- 1) Sound level meter
- 2) Octave band analyzer
- 3) **Noise dosimeter**
- 4) Annual audiogram

Answer:3- Sound level meters and octave band analyzers require constant readings. Annual audiograms are a measure of the effects of noise on hearing. Noise dosimeters measure dose and are perfect for this application.

Question #: 219- The wet bulb, dry bulb, and psychrometric charts are used together to determine :

- 1) Water temperature
- 2) Ambient temperature
- 3) Radiant heat
- 4) **Relative humidity**

Answer:4- Using the wet bulb thermometer and the dry bulb thermometer, one can estimate the relative humidity using a psychrometric chart.

Question #: 220- The formula for calculating WBGT with solar load is:

- 1) $WBGT = 0.7 WB + 0.3 GT$
- 2) $WBGT = 0.3 WB + 0.7 GT$
- 3) $WBGT = 0.1 WB + 0.2 GT + 0.7 DB$
- 4) **$WBGT = 0.7 WB + 0.2 GT + 0.1 DB$**

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Answer:4- The formula for calculating WBGT with solar load is $WBGT = 0.7 WB + 0.2 GT + 0.1 DB$

Question #: 221- Dry bulb temperature is read from:

- 1) Psychrometric table 2) Psychrometer **3) Thermometer** 4) Dry bulb device

Answer:3- Dry bulb temperature is read from a thermometer.

Question #: 222- The temperature at which saturation occurs and condensation begins is:

- 1) Dew point** 2) Non saturation temperature 3) Wet 4) Vaporization

Answer:1- Dew point is the temperature at which saturation occurs and condensation begins.

Question #: 223- When the distance away from the source doubles, the noise level:

- 1) Decreases by 10 dB **2) Decreases by 6 dB**
3) Decreases by a factor of 2 4) Decreases by a factor of 4

Answer:2- As the distance from the noise source increases, the pressure of the noise decreases by approximately 6 dB.

Question #: 224- If an employee is exposed to greater than 85 dBA on average for the eight hour workday, that worker must be included in a hearing conservation program and be:

- 1) Provided with hearing protection** 2) Trained and retrained semi-annually
3) Given an audiogram within 6 months **4) Both 1 and 3**

Answer:4- Under OSHA's Hearing Conservation standard, when an employee is exposed to 85 dBA or more over an 8-hour TWA, he/she must be included in a Hearing Conservation Program, provided hearing protection, and given a baseline audiogram (in most cases, the audiogram is required within 6 months). Each employee must be retrained on an annual basis. 29 CFR 1910.95 (c)(1) 29 CFR 1910.95 (g)(1)

Question #: 225- When using a sound level meter for measuring an intermittent source, the meter should be set to:

- 1) Fast response, A-weighting 2) Slow response, no weighting
3) Slow response, A-weighting 4) Intermittent response, flat scale

Answer:3- Measurements of continuous or intermittent noise shall be measured at slow meter response, A-weighting. 29 CFR 1910.95 (a)

Question #: 226- Employers must monitor noise levels for employees exposed to more than _____.

- 1) 90 dBA **2) 85 dBA** 3) 80 dBA 4) 75 dBA

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Answer:2-The threshold for employee monitoring is 85 dBA. 29 CFR 1910.95 (d)(1)

Question #: 227- How many 150 dB impacts per day is permissible?

- 1) 50 2) 100 3) 1,000 **4) 0**

Answer:4- Impact or impulse noise should never exceed 140 dBA. 29 CFR 1910.95 (b)(1)

Question #: 228- Military contractors for weapons research played a major role in developing:

- 1) Event tree and fault tree analysis** 2) Environmental protection programs
3) Air sampling techniques 4) Noise measurement techniques

Answer:1- Event tree and fault tree analyses were developed for weapons systems in the 1950's and 1960's.

Question #: 229- The industry where system safety techniques first were widely used was the:

- 1) Aerospace industry** 2) Computer industry
3) Hazardous waste disposal industry 4) Steel industry

Answer:1- The aerospace industry developed the basic format of system safety. The government contracts issued to these companies required that systems safety be addressed in a quantitative manner. Military specifications have been written concerning system safety.

Question #: 230- A charcoal tube sample was taken by drawing 40 liters of air through the tube which was then analyzed for benzene. If 0.5 mg of benzene was found on the tube, what was the concentration of benzene in the air sample assuming STP? (MW of benzene is 78)

- 1) 3.92 ppm** 2) 4.10 ppm 3) 3.50 ppm 4) 4.05 ppm

Answer:1- Since $1 \text{ m}^3 = 1,000 \text{ liters}$, $40 \text{ liters} = 0.040 \text{ m}^3$
 $0.5 \text{ mg} / 0.040 \text{ m}^3 = 12.5 \text{ mg/m}^3$, Next convert mg/m^3 to ppm.
 $\text{ppm} = [(\text{mg/m}^3) 24.45] / \text{MW}$, $\text{ppm} = (12.5 \text{ mg/m}^3 * 24.45) / 78$, $= 3.92 \text{ ppm}$

Question #: 231- Hopcalite may be used in the detection of which of the following?

- 1) NO₂ **2) CO** 3) CO or CO₂ 4) NO₂ or CO₂

Answer:2- Hopcalite is commonly used in the detection of carbon monoxide monitors.

Question #: 232- What would be the TLV of a mixture containing 35% by weight methylchloroform (TLV = 1,900 mg/m³), 35% chloroform (TLV = 50 mg/m³), and 30% perchloroethylene (TLV = 170 mg/m³)?

- 1) 50 mg/m³ 2) 112 mg/m³ 3) 96 mg/m³ 4) 50 ppm

Answer:2- $\text{TLV}(\text{mixture}) = 1/S(f/\text{TLV})$
Where f = fraction of specific contaminant
 $\text{TLV} = \text{TLV for the specific contaminant}$

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$TLV(\text{mixture}) = 1/[(0.35/1,900 + 0.35/50 + 0.3/170)\text{mg}/\text{m}^3]$
 $TLV(\text{mixture}) = 1/0.0089 \text{ mg}/\text{m}^3$
 $TLV(\text{mixture}) = 112 \text{ mg}/\text{m}^3$

Question #: 233- A length of stain sulfur dioxide indicator tube indicates a breathing zone concentration of 15 ppm +/- 25% at barometric pressure of 650 mm Hg. What is the corrected concentration?

1) 17.5 ppm +/- 25% 2) 15.0 ppm +/- 25% 3) 14.5 ppm +/- 25% 4) 13 ppm +/- 25%

Answer:1- To correct for barometric pressure: $15 \text{ ppm} (760 \text{ mm Hg}/650 \text{ mm Hg}) = 17.5 \text{ ppm}$

Question #: 234- When used outdoors with solar radiation present, the WBGT requires measurement of all of the following EXCEPT:

- 1) Dry bulb temperature 2) Globe temperature
- 3) Natural wet bulb temperature **4) Wet globe/dry bulb temperature**

Answer:4- When solar radiation is present, the wet bulb globe temperature requires measurement of the dry bulb temperature, globe temperature, and natural wet bulb temperature. Answer choice 4 is meaningless.

Question #: 235- For indoor use, when solar radiation is not present, the WBGT requires:

- 1) Globe temperature and natural wet bulb temperature**
- 2) Dry bulb temperature and globe temperature
- 3) Dry bulb temperature and natural Wet bulb temperature
- 4) Globe temperature, natural Wet bulb temperature, and dry bulb temperature

Answer:1- When solar radiation is not present, the wet bulb globe temperature requires measurement of the globe temperature and natural wet bulb temperature.

Question #: 236- In the evaluation of heat stress, the natural wet bulb globe temperature combines the effect of all of the following EXCEPT:

- 1) Natural wet bulb temperature includes the effect of air temperature, humidity, and air velocity
- 2) Dry bulb temperature includes the effect of air temperature
- 3) Globe temperature includes the effect of radiant heat
- 4) Bott's Ball

Answer:4- Air temperature, humidity, air velocity and radiant heat all need to be considered when measuring heat stress. The natural wet bulb temperature, dry bulb temperature, and globe temperature consider all of these factors.

Question #: 237- For ventilation measurements, a pitot transverse refers to:

- 1) Systematic equal area velocity measurements**
- 2) A one point method of establishing flow rate

- 3) Measurements of velocity along the length of duct
- 4) Random velocity measurements to determine flow rate

Answer:1- Since the airflow in the cross section of a duct is not uniform, it is necessary to obtain the average by measuring velocity pressure at points in a number of equal areas of a cross section. The pitot tube traverse is a classic measurement method for obtaining duct velocities.

Question #: 238- The A-weighted sound level measurement is the preferred scale of measure because:

- 1) It distinguishes intermittent and impact noise
- 2) Weighting is related to effects of noise on the ear**
- 3) It filters high frequency background noise
- 4) It can assess temperature and pressure

Answer:2- The A-weighting most closely weights the sound to the injurious effects of the noise on the ear.

Question #: 239- The origin of the "A" weighting network on a sound level meter is to simulate the response of the human ear to all of the following EXCEPT:

- 1) Relatively low levels of sound
- 2) At 40 phons
- 3) At sound pressure levels less than 55 dB
- 4) 1,000 Hz**

Answer:4- The "A" scale was developed for the reasons listed in Answers 1, 2, and 3. "C" weighting is at 1,000 Hz.

Question #: 240- The sum of two sound intensities of 70 dB each is approximately:

- 1) 71 dB
- 2) 73 dB**
- 3) 76 dB
- 4) 140 dB

Answer:2- Doubling the sound intensity results in a three decibel increase.

Question #: 241- A cholinesterase test is used on workers exposed to:

- 1) Trichloroethylene
- 2) Parathion**
- 3) Mercury
- 4) Lead

Answer:2- Parathion is a cholinesterase inhibitor. A test for cholinesterase will help to determine exposure to parathion. The other answers are not cholinesterase inhibitors.

Question #: 242- Why is vapor density important in assessing the hazard of a spilled chemical?

- 1) The concentration of the vapor will determine the hazard
- 2) The vapor can cause visual problems for responders

- 3) Vapor density is not an issue in assessing hazard
4) **It will determine the behavior of the vapor at the spill scene**

Answer:4- Vapor density will determine if the vapor will sink into low areas or dissipate.

Question #: 243-- In some combustible gas meters, an electrical circuit consisting of a series of resistors is used to measure the mixture of combustible gas to air. The resistors are balanced and one leg of the circuit, called a hot wire, is exposed to the suspect atmosphere. If a combustible mixture is present, catalytic combustion increases the resistance of the wire and causes an imbalance. The circuit is called a:

- 1) Combustible resistor circuit
- 2) **Wheatstone bridge**
- 3) Combustible balancing circuit
- 4) Hot-wire detector

Answer:2- The circuit is called a wheatstone bridge.

Question #: 244- A wet bulb thermometer is part of the equipment used to determine:

- 1) Air temperature
- 2) Effective temperature
- 3) **Relative humidity**
- 4) Radiant heat load

Answer:3- The wet and dry bulb thermometer together may be used with a psychrometric chart or table to determine absolute and relative humidity.

Question #: 245- A combustible gas meter works on the principle of:

- 1) **A wheatstone bridge**
- 2) Ionization
- 3) Thermalization
- 4) Ion disintegration

Answer:1- The combustible gas meter works on the wheatstone bridge principle. A wheatstone bridge is an electronic circuit that is capable of detecting very small changes in current flow via changes in resistance from the heat released from the actual combustion of flammable/combustible materials.

Question #: 246- The resistance of a wheatstone bridge _____ when a flammable mixture is oxidized as it passes over a catalyst, releasing heat. The heat causes the resistance in the circuit to increase.

- 1) **Increases**
- 2) Decreases
- 3) Stays the same
- 4) Decreases then increases

Answer:1- The resistance increases. Most combustible/flammable gas detectors use this phenomenon to quantify the presence of combustible/flammable materials in an atmosphere.

Question #: 247- Which of the following statements about temperature units is CORRECT?

- 1) A Celsius degree is the same size as a Rankine degree
- 2) A Celsius degree is 1/180th the difference between the freezing point and boiling point of water
- 3) A Celsius degree and a Kelvin degree are the same size**
- 4) Celsius degrees and Fahrenheit degrees are approved SI units

Answer:3- Celsius and Kelvin degrees are the same size.

Question #: 248- As ambient temperature rises, what happens to the capacity of a single-wire, insulated conductor?

- 1) It goes up
- 2) It goes down**
- 3) It stays the same
- 4) It rises then falls

Answer:2- The capacity for a conductor to carry current declines as the heat of the conductor rises.

Question #: 249- A spirometer is used to measure:

- 1) Stack velocities
- 2) Air flow from sampling equipment
- 3) Exhaust volumes
- 4) Lung respiratory volumes**

Answer:4- A spirometer is used to measure lung respiratory volumes to determine lung function. A pitot tube with a manometer or a velometer is used to measure stack velocities and exhaust volumes. Air flow from sampling equipment is measured by a rotameter.

Question #: 250- Some of the following six statements VIOLATE hoisting equipment and crane regulations. Indicate which statements violate these regulations.

- I. Use of equipment is restricted to qualified employees.
- II. Load ratings must be marked on each side of the hoist.
- III. Loads may be only traversed over the heads of the actual materials handling crew performing the lift.**
- IV. Holding and self-setting brakes are optional for loads under 10,000 lbs.**
- V. Hoist rope or chain must be free from kinks or twists.
- VI. Hoisting or traveling is permissible only when a qualified person is on the load or hook.**

- 1) I, III, IV, and VI
- 2) II, III, IV, and VI
- 3) III, IV, V, and VI
- 4) III, IV, and VI**

Answer:4- OSHA regulations for cranes, hoists, chains, cables, ropes, and hooks are detailed in 29 CFR 1910.179. Spelled out are that loads must not be carried over the heads of people; hoists must be equipped with a self-setting brake that is applied to the motor shaft or gear train; holding brakes must be applied automatically when the power is off for powered hoists; and hoisting, lowering, or traveling is not permitted while anyone is on the load or hook.

Question #: 251- Which of the following types of radiation is not detected by film badges?

- 1) **Alpha** 2) Beta 3) Gamma 4) X-rays

Answer:1- Only alpha radiation is not detected by current film badges.

Question #: 252- As an OSHA Compliance Officer you are using a dosimeter with a 90 dBA threshold and a second dosimeter with an 80 dBA threshold to measure the same noise source. How should your 90 dBA threshold dosimeter's readings compare to your 80 dBA threshold dosimeter?

- 1) Greater than 2) Greater than or equal to
3) Less than **4) Less than or equal to**

Answer:4- A 90 dBA threshold dosimeter's reading would be less than or equal to the 80 dBA threshold dosimeter for the same noise source.

Question #: 253- The AAOO-AMA "Guide for the Evaluation of Hearing Impairment" has a dB "window" at selected frequencies below which no impairment in hearing is accepted. What is this "window"?

- 1) 10 dB 2) 15 dB 3) 20 dB **4) 25 dB**

Answer:4- A worker must exhibit at least a 25 dB threshold of hearing at selected frequencies to be considered impaired.

Question #: 254- The rule of thumb for predicting combined decibel readings from two separately measured noise sources, where the two sources differ by 3 decibels, is:

- 1) Multiply by 2 2) Multiply by 3 3) Add 1 **4) Add 2**

Answer:4 - The rule of thumb for combining decibels where the two sources differ from 2 to 5 decibels, is adding 2 to the higher decibel level.

Question #: 255- Risk-based inspection of pressure vessels involves:

- 1) Performing specific non-destructive examinations (NDEs) on specific intervals to understand the pressure vessel's current condition and to predict how the pressure vessel will degrade over the next inspection interval**
- 2) Performing the specific ASME-required pressure vessel tests
- 3) Performing the specific OSHA-required pressure vessel tests
- 4) Determining whether a high-risk inspection is required based on the age of the pressure vessel and the vessel's service

Answer:1- Risk-based inspection (RBI) is a strategy gaining ground that considers the holistic effect of pressure vessel service against prescriptive requirements for pressure vessel safety.

Sometimes the results of an RBI program recommend more frequent inspection intervals than are required by ASME, and sometimes the results of the RBI program recommend less frequent intervals. In many cases, an RBI program recommends tests in addition to those required by codes and regulations.

Question #: 256- In the context of reliability-centered maintenance (RCM), what is a task selection guide?

- 1) A guide developed to help choose appropriate maintenance tasks based on the service of the equipment
- 2) A guide that describes the intervals between maintenance tasks
- 3) A guide that describes the actual maintenance tasks to perform on equipment
- 4) All of the above

Answer:4- RCM is a method to define an appropriate maintenance strategy based on the criticality of the equipment and the effectiveness of maintenance tasks to produce acceptable reliability performance. A task selection guide is developed to define the actual maintenance tasks and their intervals based on the type of service of the equipment. This information helps the maintenance and operations professionals to choose maintenance tasks at appropriate intervals.

Question #: 257- Why would the following types of analyses be routinely conducted?

A) Vibration analysis B) Lubricant analysis C) Thermo graphic analysis

- 1) To determine how rotating equipment failed
- 2) **To determine whether additional maintenance is needed on rotating equipment**
- 3) To predict the day when rotating equipment will fail
- 4) To evaluate the overhaul of rotating equipment

Answer:2- Though any of these could be true, these types of condition monitoring tasks are typically associated with reliability-centered maintenance and help maintenance professionals determine when more extensive maintenance is needed on rotating equipment.

Question #: 258- What is meant when a system is said to be "two fault tolerant?"

- 1) The system will fail when it sustains two independent failures.
- 2) The system will fail when it sustains three independent failures.
- 3) **The system is designed to tolerate two independent failures and still operate.**
- 4) The system is designed to tolerate three independent failures and still operate.

Answer:3- Fault-tolerance is a method of designing equipment to sustain one or more independent failures and still operate (or be able to transition into a fail-safe mode). In this case, the system is designed to sustain two independent failures and still function. Fault tolerance has nothing to do with when the system will fail (i.e., the system may sustain more than three independent failures and still function).

Question #: 259- As a safety professional, you are concerned with professional liability. Your company has insurance for the errors and omissions of its employees. Does this insurance actually cover you for your errors and omissions made as an employee of this company?

1) Yes, completely 2) Yes, partially **3) No** 4) Safety professionals are not subject to such liability

Answer:3- The insurance policy owned by your company protects the company specifically, and does not cover you at all. If your company is sued as a result of errors and omissions of your work, your company and your company's insurance company are strictly looking out after their own best interests. It is likely that the company's insurance will be sufficient to resolve any claims; however, if the company settles a case for more than the insurance is required to pay, a plaintiff could sue you personally to recover additional damages.

Question #: 260- The loss of life from buildings equipped with sprinklers has been:

- 1) Almost negligible**
- 2) Used as an excuse by architects to avoid installing sprinklers in new construction
- 3) Statistically the same as buildings not equipped with sprinklers
- 4) Statistically higher than buildings not equipped with sprinklers

Answer:1- Automatic sprinkler protection is a particularly important factor in safeguarding life from fire. NFPA records show that the loss of life by fire in buildings equipped with automatic sprinklers has been almost negligible. The few deaths that have occurred have been unusual circumstances where the sprinkler system was inappropriately shut off or where the fire was confined to clothing and did not generate enough heat to fuse sprinklers.

Question #: 261- The 1947 Texas City, Texas disaster killed 200 people and injured over 600 people. The explosion was caused by:

- 1) Nitrate mixing with water
- 2) Ammonium nitrate mixing with oil**
- 3) Ionizing radiation
- 4) Molasses

Answer:2- One of the worst industrial accidents of all time occurred in the port of Texas City, Texas when ammonium nitrate cargo mixed with oil and caused a series of huge explosions and fires.

Question #: 262- The catastrophic hotel fire which occurred in Las Vegas, Nevada in 1980 was in the:

- 1) MGM Grand Hotel**
- 2) Caesar's Palace
- 3) Bally's Hotel
- 4) Flamingo Hilton

Answer:1- The MGM Grand Hotel fire occurred in Las Vegas, Nevada in 1980. This fire has been extensively studied. **Building codes were subsequently modified** in many municipalities as a result of the MGM fire.

Question #: 263- The Triangle Shirtwaist fire in New York led to the development of what standard?

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- 1) Sprinkler standards for public occupancies
- 2) Standards on interior finish
- 3) Life safety standards**
- 4) Occupant loading standards

Answer:3- This fire resulted in a major loss of life and was one of the reasons life safety codes were developed. The "Committee on Safety to Life" was formed after this fire.

Question #: 264- Two of the top three deadliest fires in US history have been associated with:

- 1) Forest fires
- 2) Industrial plant fires
- 3) Aircraft fires
- 4) Passenger ship fires**

Answer:4- Steamship fires were two of the top three deadliest fires in US history. The SS Sultana fire on the Mississippi River claimed 1,547 lives and the General Slocum fire in New York claimed 1,030 lives.

Question #: 265- Occupational fatalities due to workplace violence (homicide) is the _____ leading cause of occupational fatalities in the United States.

- 1) Highest
- 2) Second highest**
- 3) Fifth highest
- 4) Eighth highest

Answer:2- Workplace violence has emerged as an important safety and health issue in today's workplace. Its most extreme form, homicide, is the second leading cause of fatal occupational injuries in the United States. Nearly 1,000 workers are murdered, and 1.5 million are assaulted in the workplace each year. According to the BLS Census of Fatal Occupational Injuries (CFOI), there were 709 workplace homicides in 1998, accounting for 12% of the total 6,026 fatal work injuries in the United States. Environmental conditions associated with workplace assaults have been identified and control strategies implemented in a number of work settings. OSHA has developed guidelines and recommendations to reduce worker exposures to this hazard but is not initiating rulemaking at this time.

Question #: 266- System availability is defined as:

- 1) A measure of the degree to which an item is in an operable and committable state.**
- 2) The hardware which maintains the higher state of productivity
- 3) The average degree of reliability needed maintain to status quo
- 4) Simply stated by the formula: $As = (An)(Aq)(Ai)$

Answer:1- System availability is defined as a measure of the degree to which an item is in an operable and committable state.

Question #: 267- When using a FTA for accident investigation, the accident is the top event. What is a significant reason for using this technique to analyze the accident?

- 1) All the events are identified
- 2) The probability that the accident can occur again can be calculated
- 3) It speeds up the investigation
- 4) Events that have a zero probability of occurrence are eliminated and the remainder are investigated**

Answer:4- Often it is important to eliminate those items that did not contribute to an accident so they do not become the focus of investigation and change.

Question #: 268- The primary value of accident and injury/illness records is to:

1) Locate and prevent recurrences of the same accident

- 2) Meet reporting requirements
- 3) Provide information to OSHA
- 4) Union management progress reports

Answer:1- Records of all accidents, property damage, and personal injury/illnesses are essential to efficient and successful safety programs. Records supply the information necessary for implementing controls to prevent the accident(s) from happening again.

Question #: 269- The primary reason for an accident investigation is to:

- 1) Find and reprimand those responsible
- 2) Provide OSHA with the accident facts
- 3) Prepare insurance forms to recover losses
- 4) Correct the conditions that caused the accident**

Answer:4- The main purpose of an accident investigation is to identify the reason for the accident and correct it.

Question #: 270- A Gantt chart is used in manufacturing to:

- 1) Show product development
- 2) **Schedule work**
- 3) Indicate the competitor's product quality
- 4) Display management structure

Answer:2- Gantt charts show how long each production process should take and when it should take place. It is widely used in project scheduling.

Question #: 271- The most appropriate way to display critical quantitative data necessary for an operator to make a decision would be to use a:

- 1) Moving pointer
- 2) Fixed pointer
- 3) Printer**
- 4) Flashing light

Answer:3- Of these four choices, the most appropriate way to display critical quantitative data would be to use a printer. There are better ways than a printer; however, of the choices offered, printing critical quantitative data is the best.

Question #: 272- Laboratory quality control samples control which type of error?

- 1) Random
- 2) Systematic**
- 3) Sampler
- 4) Preservation

Answer:2- These quality control samples include spiked samples and blanks. This keeps the instrument in calibration during the analytical series. Equipment errors are systematic errors.

Question #: 273- The coefficient of variation of an asbestos sampling technique has been estimated to be 0.22. The coefficient of variation for charcoal tube sampling has been estimated to be 0.10. This means asbestos air sampling is:

- 1) More variable**
- 2) Less variable
- 3) Does not relate to variability of the data
- 4) No decision can be made based on the data given

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Answer:1- The coefficient of variation is the standard deviation divided by the true value multiplied by 100. This means that the higher the coefficient of variation, the more variability there is in the data.

Question #: 274- What is the error of measurement if the true value is 27 ppm and the experimental value is 33 ppm?

- 1) -18% 2) 18% 3) -22% **4) 22%**

Answer:4- Using the equation: % error = (EV - TV)/TV, Where EV= Experimental value and TV= True value , = (33 ppm - 27 ppm) / 27 ppm = 22%

Question #: 275- What was the cumulative error given the following?

- (a) sampling error was $\pm 50\%$
(b) analytical accuracy was $\pm 15\%$
(c) air sample timing error was $\pm 1\%$
(d) air flow rate error was $\pm 4\%$

- 1) $\pm 0\%$ 2) $\pm 37.3\%$ 3) $\pm 48.7\%$ **4) $\pm 52.4\%$**

Answer:4- Utilizing the equation of cumulative error:

$$Ec = \pm [(E1)^2 + (E2)^2 + \dots + (En)^2]^{1/2} \quad \text{So} \quad Ec = \pm [50^2 + 15^2 + 1^2 + 4^2]^{1/2} = \pm 52.4\%$$

Question #: 276- One use for a Student t-test is to determine whether or not differences exist in:

- 1) Variability 2) Quality costs 3) Correlation coefficients **4) Averages**

Answer:4- The t-test can be used when we want to determine if there is a difference between two population parameters. This test is used in situations where one of the conditions, the population standard deviation, is not known and the sample size is 30 or less. The t distribution was developed in Ireland in the early 1900's by Gossett under the pen name "Student", hence its name.

Question #: 277- A manufacturing process is adjusted so the mean of a certain dimension is 20 cm. A sample of 5 parts is checked with the following results: 19.66 cm, 20.04 cm, 19.96 cm, 19.92 cm, 19.95 cm . Calculate the t-statistic.

- 1) -1.301** 2) -1.672 3) 3.872 4) 2.592

Answer:1- First, calculate the mean for the five samples. This is determined by adding the dimensions and dividing by the number of measures. $M = S(A+B+C+D+E+F)/N$

$$= (19.66+20.04+19.96+19.92+19.95)/5 = 19.906$$

Then calculate the standard deviation, s. $s = 0.1445$

Using the formula for the t-test, $t = (N-1)^{1/2} \times [(\text{mean} - \text{true mean}) / s]$

$$= (5-1)^{1/2} \times [(19.906 - 20)/0.1445] = -1.301$$

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Question #: 278- A manufacturing process is adjusted so the mean of a certain dimension is 20 cm. A sample of 5 parts is checked with the following results: 19.66 cm, 20.04 cm, 19.96 cm, 19.92 cm, 19.95 cm . The t-statistic is calculated to be -1.301. What is the conclusion regarding the t-statistic?

- 1) The mean should no longer be considered to be 20 cm
- 2) The mean should continue to be considered to be 20 cm**
- 3) The mean has changed
- 4) The mean has not changed

Answer:2- Referring to the Table of Percentage Points of the t Distribution, at 4 degrees of freedom (N-1), the probability, p, that the result ($t = -1.301$) is a matter of chance is greater than 0.1. We therefore continue to accept the hypothesis that the mean is equal to 20 cm. (Note: the mean may or may not have actually changed; statistics only allow us to make inferences based on samples).

Question #: 279- A study was completed to determine if non-smokers were less susceptible to a chemical than were smokers. The following data were obtained:

	Smokers	Non smokers	Total
Sick	21 21 (16.52)	7 7 (11.48)	28 28
Healthy	29 29 (33.04)	27 27 (22.96)	56 56
Total	50 50	34 34	84 84

To prove that the non-smokers are less susceptible to the ill effects of the chemical, the χ^2 values for the data at a 95% confidence level must be greater than 7.815. What is the χ^2 value for the above data?

- 1) 4**
- 2) 5
- 3) 6
- 4) 7

Answer:1- In asking whether non-smokers are less susceptible, we are essentially looking at the hypothesis that "there is no difference between smokers and non-smokers." To test the hypothesis one must perform a Chi-Square (χ^2) test as follows:

1. Determine the expected frequencies of sick and healthy people. Of the population, 50/84 are smokers = 59%. 34/84 are non-smokers = 41%.
2. Now of the total sick (28), 59% (or 16.52) sick people are expected to smokers and 41% (or 11.48) sick people are expected to be non-smokers.
3. Of the healthy (56), 59% (or 33.04) healthy people are expected to be smokers and 41% (or 22.96) people are expected to be non-smokers.
4. Now put all of these expected values into the problem contingency table:

Calculate Chi-Square: $(c^2) = \sum (O-E)^2 / E$

Where: O = observed value and E = expected value

$$\begin{aligned} c^2 &= (21-16.52)^2 / 16.52 + (7-11.48)^2 / 11.48 + (29-33.04)^2 / 33.04 + (27-22.96)^2 / 22.96 \\ &= 1.22 + 1.75 + .49 + .71 \\ &= 4.17 \end{aligned}$$

Since 4.17 is less than 7.815, non-smokers are no less susceptible to the chemical than smokers, at a 95% confidence level.

Question #: 280- Evaluation of safety and health program effectiveness is based on:

- | | |
|--|--|
| 1) Frequency and severity rate comparisons | 2) Quantitative criteria measures |
| 3) Workers' compensation rates | 4) ANSI Z16.4 - 1977 |

Answer:2- Sometimes, attempts to control accidents and their consequences can best be described as trial and error, chiefly because adequate measures of the effectiveness of controls do not exist in practice. Controls begin with quantifiable criteria measures. The degree to which accident control (the underlying purpose of a safety and health program) is possible is a function of the adequacy of the measures used to identify the type and magnitude of potential injury-producing situations. To do this effectively, a variety of quantitative measures are needed.

Question #: 281- In liquid systems, one ppm is equivalent to:

- | | |
|---|------------------------------------|
| 1) Milligram per liter of solution | 2) Microgram per liter of solution |
| 3) Milligram per cubic meter | 4) Both 1 and 3 |

Answer:1- In liquid systems, the expression "parts per million" represents one part by weight of solute per one million parts by weight of solvent.

Question #: 282- What is the probability of getting two heads (and only two heads) in three successive tosses of a Lincoln penny?

- | | | | |
|--------|--------|--------|---------|
| 1) 3/8 | 2) 1/4 | 3) 1/8 | 4) 3/16 |
|--------|--------|--------|---------|

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Answer:1- The probability of getting three coins in a particular order is:

$$P = (\frac{1}{2}) (\frac{1}{2}) (\frac{1}{2}) = 1/8$$

There are three ways of arranging two heads (and only two heads) in three positions.

$$P = (3)(1/8) = 3/8$$

Question #: 283- What is the probability that an even number will come up when a single six-sided die is thrown?

- 1) 1.000 **2) 0.500** 3) 0.333 4) 0.167

Answer:2- Of the six possible numbers on each face of the die, three are even (2, 4, 6). The probability of throwing any single number is $1/6$. Therefore, the probability of throwing an even number is $P = (3)(1/6) = 3/6 = \frac{1}{2} = 0.500$

Question #: 284- If four coins are tossed simultaneously, what is the probability that all four coins will be heads?

- 1) $\frac{1}{2}$ 2) $1/4$ 3) $1/8$ **4) $1/16$**

Answer:4- If one coin is tossed, the probability of heads is $\frac{1}{2}$. For four coins it is:

$$P = (\frac{1}{2}) (\frac{1}{2}) (\frac{1}{2}) (\frac{1}{2}) = 1/16$$

Question #: 285- From a deck of 52 cards, one card is drawn at random. What is the probability that the random card is either a ten or a jack?

- 1) $1/13$ **2) $2/13$** 3) $1/26$ 4) $1/52$

Answer:2- The probability of drawing a ten:

$$P = 4/52 = 1/13$$

The probability of drawing a jack: $P = 4/52 = 1/13$

The probability of drawing either a ten or a jack: $P_{\text{both}} = P_{\text{ten}} + P_{\text{jack}} = 1/13 + 1/13 = 2/13$

Question #: 286- If the probability of a success on a single trial is 0.2, and three trials are performed, what is the probability of at least one success?

- 1) 0.008 2) 0.384 **3) 0.488** 4) 0.600

Answer:3- The probability of one failure is 0.8. Since this example is an example of joint probability under statistical independence, the probability of three failures is:

$$P_{\text{failure}} = 0.8 * 0.8 * 0.8 = 0.512 \quad P_{\text{success}} = 1 - P_{\text{failure}} = 1 - 0.512 = 0.488$$

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Question #: 287- Statistically, when several events are independent they:

- 1) Are also mutually exclusive **2) Do not affect one another**
3) Are not capable of happening at the same time 4) Are also conditional on one another

Answer:2- Independent events do not have an effect on the probability of occurrence of any other event. Mutually exclusive events cannot happen together. It is possible that independent events could happen at the same time.

Question #: 288- Side effects with a certain drug occur in 3% of the patients who take it. If a doctor has two patients taking the drug, what is the probability that both will develop side effects?

- 1) 0.600 2) 0.060 3) 0.009 **4) 9×10^{-4}**

Answer:4- Since both events are independent, the probability of each event occurring is considered separately. In order to determine the probability of both events occurring $[P(A) \text{ and } P(B)]$, the individual probabilities are multiplied:

$$P = 0.03 \times 0.03 = 0.0009 = 9 \times 10^{-4}$$

Question #: 289- Side effects occur in 3% of the people who take a certain drug. If a doctor has two patients taking the drug, what is the probability that at least one (one or both) will develop the side effect?

- 1) 6.0 **2) 0.06** 3) 0.06% 4) 9%

Answer:2- Since one or the other has to occur, the probability of each is added together.
 $P = 3\% + 3\% = 6\% = 0.06$

If you were calculating the probability that both would develop side effects, you would multiply the two probabilities. Note: Probabilities are generally referenced as dimensionless. Sometimes, probabilities are referenced using "percent." Remember to account for this.

Question #: 290- Industry data reveals that out of 883 serious accidents, 24 are the result of vehicular use. What is the probability that a serious accident is due to vehicular use?

- 1) 0.027** 2) 0.041 3) 0.369 4) 0.406

Answer:1- The probability of a serious vehicular accident is: $P = 24 / 883 = 0.027$

Question #: 291- Out of 921 serious accidents at a plant, 127 were eye injuries. Of these, 100 were associated with failing to wear approved eye protection. What is the probability of a serious accident associated with failing to wear approved eye protection?

- 1) 0.11** 2) 0.22 3) 0.33 4) 0.44

Answer:1- The probability of a serious accident associated with failing to wear approved eye protection is : $P = 100 / 921 = 0.1086$

Question #: 292- For mutually exclusive events, the probability of A or B happening is equal to:

- 1) $P(A) + P(B)$ 2) $P(A) + P(B) - P(A \cap B)$ 3) $P(A) + P(B / A)$ 4) $P(A) * P(B)$

Answer:1- The formula for mutually exclusive events which determines the probability of either one event or another happening is: $P(A \text{ or } B) = P(A) + P(B)$.
Mutually exclusive events cannot occur at the same time.

Question #: 293- Mutually exclusive events are:

- 1) Events where the occurrence of one event has no effect on the probability of the occurrence of another event
- 2) **Events that cannot happen together**
- 3) All the possible outcomes of doing something
- 4) The set of all possible outcomes of an experiment

Answer:2- The words mutually exclusive themselves are a tip-off to this answer. Such events cannot happen together.

Question #: 294- Two events that cannot occur together are called:

- 1) Independent events
- 2) Non-random events
- 3) **Mutually exclusive events**
- 4) Bayesian events

Answer:3- Mutually exclusive means that the events cannot occur at the same time. Sometimes this is confused with independent events where one event does not influence another event.

Question #: 295- A process control system contains three independent subsystems A, B, and C. The probability of each subsystem failing is:

$$P(A) = 2 \times 10^{-5} \qquad P(B) = 3 \times 10^{-6} \qquad P(C) = 2 \times 10^{-6}$$

If the control system will fail if any of the subsystems fail, what is the probability of failure?

- 1) 25×10^{-17} 2) 7×10^{-6} 3) 7×10^{-17} 4) 2.5×10^{-5}

Answer:4- Since the subsystems are independent, the probability of each event occurring is considered separately. In order to determine the probability of any one event occurring [$P(A)$ or $P(B)$ or $P(C)$], the individual probabilities are added:

$$P = P(A) + P(B) + P(C) = 2 \times 10^{-5} + 3 \times 10^{-6} + 2 \times 10^{-6} = \mathbf{2.5 \times 10^{-5}}$$

Question #: 296- A process control system contains three dependent subsystems A, B, and C. The probability of each subsystem failing is:

$$P(A) = 2 \times 10^{-5} \qquad P(B) = 3 \times 10^{-6} \qquad P(C) = 2 \times 10^{-6}$$

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If catastrophic failure will occur only if all three subsystems fail simultaneously, what is the probability for failure?

- 1) 1.2×10^{-16} 2) 12×10^{-180} 3) 2.5×10^{-5} 4) 7×10^{-180}

Answer:1- Probability of failure for three dependent variables is determined by multiplying the individual probabilities, or:
 $P = P(A) \times P(B) \times P(C) = (2 \times 10^{-5}) \times (3 \times 10^{-6}) \times (2 \times 10^{-6})$
 $= 12 \times 10^{-17} = 1.2 \times 10^{-16}$

Question #: 297- In an assembly of 4,321 adults, 1,792 are college graduates. What is the probability (to the nearest tenth) that a person chosen at random from this group is NOT a college graduate?

- 1) 0.4 2) 0.5 3) 0.6 4) 0.7

Answer:3- There are $(4,321 - 1,792)$ people who are NOT college graduates. The probability of choosing one of these people is:
 $P = (4,321 - 1,792) / 4,321 = 2,529 / 4,321 = 0.585$

Question #: 298- Given the fact that the probability of "heat", "fuel", and "oxygen" are each 1×10^{-2} , what is the overall probability of "fire?"

- 1) 1×10^6 2) 1×10^{-6} 3) 1×10^{-2} 4) 1×10^2

Answer:2- All of these "states" are required for a fire. Therefore, multiply the probabilities to determine the probability of "fire."

$$P = P_{\text{heat}} \times P_{\text{fuel}} \times P_{\text{oxygen}} = (1 \times 10^{-2})(1 \times 10^{-2})(1 \times 10^{-2}) = 1 \times 10^{-6}$$

Question #: 299- If $A = \{5,6\}$ and $B = \{1,2,3,5\}$, then $A + B$ equals:

- 1) $\{5\}$ 2) $\{6\}$ 3) $\{1,2,3,5,6\}$ 4) $\{1,2,3,4,5,6\}$

Answer:3- The union of A and B ($A + B$) is the set whose numbers are members of either A or B. The result is $\{1,2,3,5,6\}$. Note that 4 does not appear in either set and is therefore not a member.

Note: "Union" is denoted by a plus sign, and "intersection" is denoted by multiplication. "OR" is also used to denote "union" and "AND" is also used to denote "intersection."

Question #: 300- In a semiconductor operation, a random sampling of 100 wafers showed that 3 were faulty. In a sampling of 2,500 wafers, how many wafers may be expected to be faulty?

- 1) 30 2) 75 3) 100 4) 150

Answer:2- There is a probability of $3/100$ (3%) that a wafer may be faulty.
Faulty Wafers = $0.03 \times 2,500$ wafers = 75 wafers

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Question #: 301- In a certain modern high-hazard laboratory, employee identification badges are color-coded. Five different colors are applied in groups of three. Each group of three colors represents one of the possible occupational hazards for which a worker has been properly trained. How many types of occupational safety training can be represented?

- 1) 10 2) **60** 3) 120 4) 240

Answer:2- When the order of selection is significant then it is a permutation.

Permutations = $N! / (N - X)!$

(where N is the total number of colors and X is the number in a single grouping)

Permutations = $5! / (5-3)! =$

So according to factorial division, this permutation

$$= 1 \times 2 \times 3 \times 4 \times 5 / 1 \times 2 \quad 120 / 2 = 60$$

There are 60 possible types of occupational safety training that can be displayed on an employee badge.

Question #: 302- Of the following, what is the greatest benefit to using a computer to process historical, safety-related data (accidents, injuries, illnesses, etc.)?

1) The computer can quickly perform complicated math and generate useful trend data and analyses

2)The computer can easily generate reports of high quality and consistency for management use

3)The computer can maintain the names and locations of supervisors for efficient incident report notification

4) The computer can distribute reports electronically for faster dissemination to employees

Answer:1- Though computers clearly assist in all of these areas, its ability to do complicated math for trend analyses allows the safety practitioner to rapidly identify trends and address these trends with the relevant supervisors and managers.

Question #: 303- Given two independent events, the probability of their joint occurrence is the product of the independent probabilities. What is the probability of getting two sixes when rolling a pair of dice?

- 1) 0.1 2) 0.01 3) **0.028** 4) 0.28

Answer:3- The probability of getting any one number on a die is 1 chance in 6; therefore, the probability of getting two sixes is: $P = 1/6 \times 1/6 = 1/36 = 0.028$

Question #: 304- In any study involving a statistical analysis, the main focus is on sets of numerical data. The entire set of data from which your data came is called the:

- 1) Sample 2) **Population** 3) Bell shaped curve 4) Normal distribution

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Answer:2- The sample is what you take. You hope (and assume) that your sample is representative of the population from which it was drawn.

Question #: 305- A Gaussian distribution implies that approximately 68% of the observations fall above or below the mean plus ____ standard deviation(s).

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

Answer:1- In a normal (Gaussian) distribution, approximately 68% of the observations will fall above or below the mean by 1 standard deviation.

Question #: 306- Air sampling data are log normally distributed. To analyze air sampling data using a t-test one must:

- 1) Use the log of the concentration 2) Convert to an exponential distribution
3) Use a Mantel-Haenzel test instead 4) Make no changes to use the t-test

Answer:1- A t-test is used with a normal distribution. To analyze log normally distributed data, one must convert the air sampling data to logarithms to use the t-test. Converting to logarithms should result in a normal distribution.

Question #: 307- Given the following sample distribution: 10, 10, 15, 25, 35. Compute the sample standard deviation.

- 1) 10.8 2) 9.7 3) 6.7 4) 11.9

Answer:1- The sample standard deviation is a measure of the variability of the sample data taken from the population. It is calculated using the equation graphic associated with this question. Usually, the sample standard deviation is simply referred to as "s."

$$(10+10+15+25+35) / 5 = 95 / 5 = 19$$

This number	Minus	Mean	Equals	Square of each	
10	Minus	19	-9	-9	81
10	Minus	19	-9	-9	81
15	Minus	19	-4	-4	16
25	Minus	19	6	6	36
35	Minus	19	16	16	256
					470

$$S = \sqrt{470 / 5 - 1} = \sqrt{470 / 4} = \sqrt{117.5} = 10.8$$

To calculate the sample standard deviation, s, by hand, one must first calculate the mean of the set of numbers. In this case, the mean is 19. The next step is to calculate how far away from the mean each data point lies. In this problem, these would be 9, 9, 4, 6, and 16 respectively. Next, square each of these numbers (yielding 81, 81, 16, 36, and 256). Now sum

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these squared numbers (yielding 470). Divide this summed number by the actual number of data points minus 1 (i.e., $5 - 1 = 4$). In our problem, this is $470/4 = 117.5$. Finally, take the square root of this number (yielding a sample standard deviation of 10.8).

Question #: 308- Given the following sample distribution: 10, 10, 15, 25, 35. Compute the mode.

- 1) 10 2) 15 3) 25 4) 35

Answer:1- The mode is the sample measurement that occurs most frequently. Here "10" occurs in all given numbers.

Question #: 309- Given the following sample distribution: 10, 10, 15, 25, 35. Compute the range:

- 1) 0 2) 5 3) 15 4) 25

Answer:4- The range is the difference between the smallest and the largest measurements of the sample. Here $35-10 = 25$.

Question #: 310- Given the following sample distribution: 10, 10, 15, 25, 35. Compute the mean:

- 1) 19 2) 17 3) 21 4) 23

Answer:1- The mean is the sum of the measurements divided by the total number of measurements (the average value).

Question #: 311- In a normal distribution, 99.0% of the observations will fall within approximately ____ standard deviations of the mean.

- 1) 1.96 2) 2.58 3) 3.00 4) 4.40

Answer:2- In a normal distribution, approximately 99.0% of the observations will fall within 2.58 standard deviations of the mean; 95% within 1.96 standard deviations, and 90% within 1.64 standard deviation. Approximately 99.9% of the observations will fall within 3.49 standard deviations.

Question #: 312- In a normal distribution, the mean plus 2.00 standard deviations estimates the _____ percentile of the distribution.

- 1) 97.7 2) 95.0 3) Lower 90.0 4) Middle 84.0

Answer:1- The mean plus two standard deviations will estimate the point at which 97.7% of the observations fall below. If the question asked for the mean minus two standard deviations, then that would be the point at which 2.3% of the observations fall below.

To determine this, use the Table of the Normal Distribution and select a "z" equivalent to the number of standard deviations above or below the mean. For this problem, we use a "z" of 2.00. On the far right column, find "2.0." Since we said 2.00, we will use the number in the "0" column immediately to the right of the "z" of 2.0. This number is 0.4772. [Had we asked for 2.09

standard deviations, you would have selected the number in the "9" column at the other end of the "z = 2.0" row (that number is 0.4817)].

With 0.4772, we now know the area under the curve of plus 2.00 standard deviations. But since we wanted the whole percentile, we need to add everything below the mean to the part we just found ABOVE the mean. Therefore, since the mean represents half of the area under the curve, then we must add 0.500 to our number. $\text{Area} = 0.4772 + 0.5000 = 0.9772 = 97.7 \text{ percentile}$

Question #: 313- Which of the following tests is statistical?

- 1) S-test **2) t-test** 3) q-test 4) s-test

Answer:2- A t-test is commonly used in statistics to test for differences between groups.

Question #: 314- The correlation formula is used to evaluate the relationship between two variables of the same interval. Of the following selections, choose the number that represents the closest correlation.

- 1) 0.00 2) 0.10 3) 0.50 **4) 0.95**

Answer:4-1.0 indicates a perfect correlation and 0 indicates no correlation; therefore, 0.95 indicates the best correlation of the four answers.

Question #: 315- The "t" distribution should be used for interval estimates when: A. The sample size is 30 or less, B. The population distribution is not normal, C. The population standard deviation is not known.

- 1) A and B **2) A and C** 3) B and C 4) None of these

Answer:2- Both conditions A and C are necessary. The normal distribution is used if the population standard deviation is actually known.

Question #: 316- Which of the following statements regarding the normal distribution is NOT true:

- 1) The mean, mode, and median are the same value
2) The normal distribution is a discrete distribution
3) The tails never touch zero
4) The normal distribution is symmetrical

Answer:2- The normal distribution is a continuous distribution.

Question #: 317- When computing a descriptive number from a set of sample data, the result is called a:

- 1) Continuous variable 2) Parameter 3) Discrete number **4) Statistic**

Answer:4- The results of statistical calculations from a set of sample data are called statistics. The results from a population are called parameters.

Question #: 318- The Poisson distribution can probably be used as a good approximation of the binomial distribution if:

- 1) p is greater than 0.15
- 2) The number of trials is less than 10
- 3) Both A and B are satisfied
- 4) **None of the above**

Answer:4- In general p should be less than 0.1 and the number of trials 15 or more. Some statisticians may argue that p should be less than 0.05 with at least 20 trials. While there is no agreement on the exact p and n values, p should be "small" and n should be "large."

Question #: 319- The mode of a data set: A. Is the middle value, B. Is the most often occurring value, C. May not be unique and there may be more than one

- 1) A and C
- 2) A and B
- 3) **B and C**
- 4) None of the above

Answer:3- The middle value in a set of data is the median. A disadvantage of using the mode to describe a set of data is that there may be more than one mode.

Question #: 320- The standard deviation of a set of data is:

- 1) The square of the variance
- 2) **The square root of the variance**
- 3) The sum of the square roots of the deviation of each data point from the mean
- 4) A measure of central tendency

Answer:2- The standard deviation is a measure of variation. With a known variance, the standard deviation is easily calculated by taking the square root of the variance.

Question #: 321- If there is an even number of data points in a set of data:

- 1) The mode is equal to the average of the middle two values
- 2) The mean and the median are equal
- 3) The median and the mode are equal
- 4) **None of the above**

Answer:4- None of these are correct. The median is equal to the average of the middle two values for the case where there is an even number of data points.

Question #: 322- The binomial distribution:

- 1) Is used to describe continuous data
- 2) Is a symmetrical distribution
- 3) **Can be approximated by the normal distribution under certain conditions**
- 4) Cannot be used if the probability of an outcome is less than 0.1

Answer:3- All the other statements are not true. Even though the normal distribution describes continuous data, it can be used to approximate the binomial distribution if certain conditions are met.

Question #: 323- The coefficient of variation of a population is equal to:

- 1) The population variance divided by the population mean
- 2) The average squared distance between the mean and each data point in the population
- 3) 100 times the population standard deviation divided by the mean**
- 4) The average distance of the data point from the mean

Answer:3- The coefficient of variation is the standard deviation expressed as a percentage of the mean. This is a relative measure of dispersion which allows us to more readily compare two distributions.

Question #: 324- The standard score of a normal distribution is equal to:

- 1) The mean of the distribution divided by the standard deviation
- 2) The difference between the highest and lowest values in the data set
- 3) The absolute deviation divided by the standard deviation
- 4) The number of standard deviations a data point lies from the mean**

Answer:4- The standard score is also known as the z-score or the z-value and is the number of standard deviations a point lies from the mean. For example, a standard score of 2 means the data point is 2 standard deviations in the positive direction from the mean.

Question #: 325- A sample mean:

- 1) Equals the population mean
- 2) Will never equal the population mean
- 3) Is likely to overestimate the population mean
- 4) None of the above**

Answer:4- A sample mean could equal the population mean although in general it will not. It may be larger or smaller than the population mean.

Question #: 326- If we use the sample standard deviation to estimate the population standard deviation this is an example of a(n):

- | | |
|--------------------------------------|-------------------------------------|
| 1) Interval estimate | 2) Point estimate |
| 3) Use of the standard error concept | 4) Use of the central limit theorem |

Answer:2- An interval estimate would contain an interval between which the population standard deviation would fall along with an associated probability of that happening. Neither Answer 3 nor 4 has anything to do with this question.

Question #: 327- The Chi-Square test:

- 1) Is useful for determining if a distribution is discrete or continuous

2) Can be used to determine if a particular probability distribution is an appropriate distribution for data we are considering

- 3) Is used to test for significance of the difference between two sample means
- 4) Is used only for discrete distributions

Answer:2- The Chi-Square test can be used to determine the appropriateness of a discrete or continuous distribution. Other tests are used to test significance of the difference between sample means.

Question #: 328- When deciding on a confidence interval for estimating the mean, a high confidence level will:

- 1) Reduce the confidence interval
- 2) Require a large sample size
- 3) Require the use of a finite population multiplier
- 4) Increase the size of the confidence interval**

Answer:4- The confidence interval will become larger as the confidence level is increased. The confidence level is independent of the sample size but the interval is reduced with a relatively larger sample size. The finite population multiplier affects the interval but not the level.

Question #: 329- A major advantage of using nonparametric statistics is:

- 1) Samples sizes can be reduced significantly
- 2) No assumption needs to be made regarding normality of the distribution**
- 3) It is easier to determine the correct hypothesis
- 4) It is not necessary to worry about the significance level

Answer:2- It does not matter if a distribution is normal. However, estimates using nonparametric methods may be much less precise. Also, information is lost because of ranking rather than using actual values.

Question #: 330- If alpha is 0.05 in a t-test:

- 1) 5% of the time we will say that there is no real difference but in reality there is a difference
- 2) 5% of the time we will say that there is a real difference when there really is not a difference**
- 3) 95% of the time we will make an incorrect inference
- 4) 95% of the time the null hypothesis will be correct

Answer:2- Rejecting a null hypothesis when there is not a real difference is called a Type I error and is symbolized by the Greek letter alpha. An alpha of 5% means there is a 5% probability of rejecting the null hypothesis when it is true.

Question #: 331- In dealing with normally distributed variables data, if obtaining the best possible accuracy of estimations of the population from samples were important, you would use:

- | | |
|-------------------------------------|---------------------------------|
| 1) Nonparametric statistics | 2) Parametric statistics |
| 3) Excerpts from a list of Adamisms | 4) A slide rule or calculator |

Answer:2- Parametric statistics are the statistics in most frequent use for QA purposes. The assumption of a normal distribution is required for some of the manipulations. Nonparametric statistics can be used when we do not know if the distribution is normal.

Question #: 332- In performing ANOVA for a single factor experiment, a fundamental assumption which is made is that the factor:

- | | |
|-------------------------------|--------------------------|
| 1) Means are equal | 2) Means are unequal |
| 3) Variances are equal | 4) Variances are unequal |

Answer:3- The ANOVA is performed to determine if the means are equal or not. The basic assumption is that the variances are equal.

Question #: 333- The basic reason for randomness in sampling is to:

- 1) Make certain that the sample represents the population
- 2) Eliminate personal bias**
- 3) Guarantee to reduce the cost of inspection
- 4) Guarantee correct lot inferences

Answer:2- Randomness does not guarantee that the sample represents the population, that inspection costs will be reduced, or that correct lot inferences will be obtained. Additional statistical methods, such as hypothesis testing, must be performed to obtain this additional information. Randomness does eliminate the personal bias of the person taking the sample, such as choosing known or assumed acceptable or unacceptable samples.

Question #: 334- A random variable:

- 1) May be either discrete or continuous**
- 2) Is called "random" because it depends on the normal distribution
- 3) Is called "variable" because it refers to the variance
- 4) All of the above

Answer:1- A random variable is a variable that can take on different values as a result of a random experiment. It is a discrete random variable if the values it can take on are limited, such as integers only. It is a continuous random variable, however, if it can take on any value in a given range.

Question #: 335- A statistic is:

- 1) The solution to a problem
- 2) A population value
- 3) A positive number between 0 and 1 inclusive
- 4) A sample value**

Answer:4- A statistic is a numerical value that describes some characteristic of a sample as opposed to a parameter which is a numerical value that describes some characteristic of a population.

Question #: 336- In the analysis of variance:

- 1) The total sum of squares of deviations from the grand mean is equal to the sum of squares of deviations between treatment means and the grand mean minus the sum of squares of deviations within treatments
- 2) The total standard deviation is equal to the sum of the standard deviation for the treatment effect plus the standard deviation of the random error
- 3) The degrees of freedom are additive**
- 4) A basic population model can be constructed to represent the behavior of the experimentation

Answer:3- The degrees of freedom for the treatments plus the degrees of freedom for the error will sum to the total degrees of freedom.

Question #: 337- In the regression equation $y = mx + b$, y increases with x in all cases:

- 1) If b is positive 2) If b is negative **3) If m is positive** 4) If m is negative

Answer:3- This is basic algebra. In this equation, m is the slope of the regression line. If m is negative, the relationship between x and y is inverse.

Question #: 338- The binomial distribution is a discrete distribution and may be used to describe:

- 1) Sampling without replacement from a finite population
- 2) The case of n independent trials with probabilities constant from trial to trial**
- 3) The case of n independent trials with several outcomes for each trial
- 4) Sampling without replacement from a finite population where there are several outcomes for each trial

Answer:2- The binomial distribution requires that there be only two possible outcomes from each trial. "Good" or "bad", for example. In addition, the probability of an outcome must be constant. When flipping a coin the probability of getting a head is always 0.5. There are other assumptions that must be met, in which case sampling without replacement will still yield an acceptable result.

Question #: 339- The standard deviation as a percent of the mean is called:

- 1) Relative precision
- 2) **Coefficient of variability**
- 3) Standard deviation of the mean
- 4) Standard error

Answer:2- This is also referred to as the coefficient of variation and is equal to: (the standard deviation of the population / the mean of the population)100.

Question #: 340- Which of the following cannot be a null hypothesis?

- 1) The population means are equal
- 2) $p' = 0.50$
- 3) $p' = 0.25$
- 4) **The sample means are equal**

Answer:4- A hypothesis is an assumption made about population parameters, not sample statistics.

Question #: 341- A number resulting from the manipulation of some raw data according to certain specified procedures is called a:

- 1) Sample
- 2) Population
- 3) Constant
- 4) **Statistic**

Answer:4- A statistic is a computed value from a portion of a population called a sample. It is therefore the best answer.

Question #: 342- If a distribution is skewed to the left, the median will always be:

- 1) Less than the mean
- 2) **Between the mean and the mode**
- 3) Greater than the mode
- 4) Equal to the mean

Answer:2-When a distribution is skewed, either left or right, the median will almost always be between the mean and the mode. This is because the median is less affected by outlying values than the mean and less affected by the frequency of a given value than the mode.

Question #: 343- Which of the following statistical measures of variability is not dependent on the exact value of every measurement?

- 1) Interquartile range
- 2) Variance
- 3) **Range**
- 4) Coefficient of variation

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 #: 344- A null hypothesis requires several assumptions, of which, a basic one is:

- 1) That the variables are dependent
- 2) **That the variables are independent**
- 3) That the samples size is adequate
- 4) That the confidence interval is 2 standard deviations

Answer:2- This is a part of the basic definition/assumptions of the hypothesis test. Another is that we must make assumptions about the normality of the population.

Question #: 345- The "Least Squares Method" is used in:

- 1) The Central Limit Theorem
- 2) Calculating the sample standard deviation
- 3) Calculating the sample deviation from the population standard deviation
- 4) Calculating a best fit regression line**

Answer:4- The "Least Squares Method" refers to the line that best describes or minimizes the sum of the squares of the distances between the line and the points not on the line (the error).

Question #: 346- In nonparametric statistics:

- 1) No assumptions are made concerning the distribution from which the samples are taken**
- 2) The parameters of the distribution do not relate to the parameters of the sample
- 3) The sample and the distribution must have no parameters in common
- 4) None of the above

Answer:1- Nonparametric statistics are useful when the distribution is not normal or we do not know if the distribution from which the samples were taken is normal. A disadvantage is that the obtained values are not as precise.

Question #: 347- Basic assumptions underlying the Analysis of Variance include: A. Observations are from normally distributed populations, B. Observations are from populations with equal variances, C. Observations are from populations with equal means.

- 1) **A and B** 2) A and C 3) B and C 4) A, B, and C

Answer:1- The ANOVA is conducted to determine the significance of the difference among more than two sample means. A and B are the basic underlying assumptions of the ANOVA.

Question #: 348- A blank sample in environmental measurement refers to:

- 1) Samples which exceed holding times
- 2) Samples with constituent concentrations beneath regulatory thresholds
- 3) Samples which are divided prior to containerization for analysis by different laboratories
- 4) An artificial sample designed to monitor contaminants introduced during sampling and/or analysis**

Answer:4- Blank samples are used as a quality control measure in environmental investigations for various reasons, related to the ability of current analytical technologies to detect constituents at part per billion levels and the potential regulatory implications and associated costs of finding regulated constituents even at parts per billion levels. The need to control the possibility of "false positives" is critical.

Question #: 349- Which of the following is not an element of a risk assessment?

- | | |
|------------------------------|-----------------------------|
| 1) Hazard identification | 2) Exposure assessment |
| 3) Risk communication | 4) Dose-response assessment |

Answer:3- Risk communication is the process of informing the public in a understandable and effective manner of the potential harm from a given exposure situation and/or particular agent. Hazard identification, dose-response assessment, and exposure assessment are all elements of risk assessment as outlined by the National Academy of Sciences.

Question #: 350- The most appropriate method of analysis to completely evaluate a product in a safety program is:

- | | |
|--------------------------------------|--|
| 1) Failure mode and effects analysis | 2) Fault-tree analysis |
| 3) Preliminary hazard analysis | 4) No single method of analysis |

Answer:4- While all are appropriate techniques for use in evaluation of a product, no single method can be used to completely evaluate a product.

Question #: 351- When using system safety techniques to evaluate a product, the most appropriate time to conduct the first analysis is:

- 1) When the patent is applied for
- 2) When the product is first conceived**
- 3) When the product prototype is developed
- 4) When the first products are manufactured but before it is distributed

Answer:2- While system safety techniques may be employed throughout the manufacturing process, the first analysis should be done at the time the product is conceived. This helps assure that safety is built in from the start and may help avoid costly decisions to re-engineer the product or perhaps even drop plans for the manufacture and distribution of the product.

Question #: 352- Which of the following components are not specifically required in a process hazard analysis?

- A. Facility inspection procedures**
- B. Facility siting
- C. Human factors
- D. The hazards of the process
- E. An assessment of the worst-case release into the environment of the covered process materials**
- F. The identity of engineering and administrative controls for specific process hazards
- G. Consequences of failures of engineering controls
- H. Consequences of failures of administrative controls

- | | | | |
|---------------|---------------|----------------|---------|
| 1) E, F, G, H | 2) A, F, G, H | 3) A, E | 4) B, C |
|---------------|---------------|----------------|---------|

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Answer:3- These items are not specifically required to be assessed in a process hazard analysis; however, depending upon the actual analysis, these items may come up.

Question #: 353- Two trains running on the same track travel at the rates of 30 and 40 mph respectively. If the slower train starts out an hour earlier, how long will it take the faster train to catch up with it?

- 1) 2.0 hr 2) 2.5 hr **3) 3.0 hr** 4) 4.0 hr

Answer:3- The slow train travels 30 miles in 1 hr. The slow train traveled thirty miles in the hour that the fast train sat in the station. Therefore, the distance that needs to be made up is 30 miles. Since the fast train is traveling at 40 mph, it is traveling 10 mph faster than the slow train. Since 30 miles needs to be made up, 30 miles/10 mph = 3 hr to catch the slow train.

Question #: 354- Water is poured into a cylindrical tank at the rate of 9 in³/min. How much time is required to fill the tank if its radius is 3 in. and its height is 14 in.?

- 1) 41 min **2) 44 min** 3) 47 min 4) 50 min

Answer:2- The volume of a cylinder = $\pi r^2 \text{ height}$ = $3.14 \times 3^2 \times 14$ = 396 in³

Since the rate of flow is 9 in³/minute, the time required to fill the tank is (396 in³)/(9 in³/min) = 44 min

Question #: 355- An object dropped from the top of a building falls to the ground in 4 sec. What is the building height?

- 1) 64 ft 2) 96 ft 3) 128 ft **4) 256 ft**

Answer:4- The applicable formula, derived from Newton's laws is:

height = $\frac{1}{2}gt^2$ where g is the acceleration of the object due to gravity and t is the time

height = $\frac{1}{2} \times 32 \text{ ft/sec}^2 (4 \text{ sec})^2$ height = 256 ft

Question #: 356- A locomotive is traveling at 60 mph. The engineer's reaction time is 0.6 sec. How many feet will the locomotive travel before the engineer recognizes an emergency situation and actually applies the brakes?

- 1) 45 ft **2) 53 ft** 3) 60 ft 4) 75 ft

Answer:2- Determine the factor to convert mph to ft/sec:

(5,280 ft/mile * 1 hr/60 min * 1 min/60 sec) = 1.47 ft/sec per 1 mile/hr

Using this conversion factor, determine the velocity of the train in ft/sec:

60 mph * 1.47 ft/sec per mph = 88 ft/sec

Determine the distance traveled by the locomotive during the engineer's 0.6 sec reaction time:

88 ft/sec * 0.6 sec = 53 ft

Question #: 357- What is the velocity of a bus traveling 60 mph?

- 1) 17 ft/sec 2) 41 ft/sec **3) 88 ft/sec** 4) 94 ft/sec

Answer:3- Perform the following conversion:

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60 mile/hr * 5,280 ft/mile * 1 hr/60 min * 1 min/60 sec = 88 ft/sec note that all units cancel except ft/sec.

Question #: 358- If a lathe uses $P/4$ kilowatts of power to operate every t hours, how much power will be used by four such machines in 8 hours?

- 1) $4P/t$ 2) $4t/P$ 3) $8t/P$ **4) $8P/t$**

Answer:4- Understanding the answer requires an algebraic formula. One lathe uses $P/4$ kilowatts every t hours, which is a rate of $(P/4) / t$ or $P/4t$. Four lathes will use four times the rate of one machine, $4 P/4t = P/t$. Finally, a direct proportion will show how much is used in 8 hours. $P/t = x/8$ or $x = 8P/t$

Question #: 359- The smallest of the following measures is:

- 1) 0.432 km 2) 0.432×10^6 mm 3) 4.32×10^3 m **4) 0.432×10^4 cm**

Answer:4 - Convert all of the choices to meters.

- 1) 432 m (1,000 m / km) 2) 432 m (1 m / 1,000 mm)
3) 4,320 m (1 m / 1 m) **4) 43.2 m (1 m / 100 cm)**

Of these, 43.2 m is the smallest.

Question #: 360- How far will an object fall in 4 seconds?

- 1) 64 ft 2) 128 ft **3) 256 ft** 4) 320 ft

Answer:3- Knowing that the acceleration of gravity = 32 ft/s², known quantities are substituted into the formula: $d(\text{distance}) = \frac{1}{2}at^2$ Where: a = acceleration (gravity) , t = time
 $d = \frac{1}{2} * 32 \text{ ft/sec}^2 (4 \text{ sec})^2 = 256 \text{ ft}$

Question #: 361- When you are interviewing a person associated with a recent high-consequence incident, what fundamental law of human behavior must you consider at all times?

1) The person being interviewed will tell you what he or she views is in his or her best interests.

2) The person being interviewed can be subpoenaed to provide you any information you think he or she is hiding.

3) The person being interviewed will lie to you if you hit upon critical information.

4)

The person being interviewed will only cooperate in the presence of an attorney or other representative.

Answer:1- Though the other items may be true from time to time, when conducting an incident investigation, remember that the person being interviewed will likely describe things that he or she perceives is in her best interest to discuss. This means that if the person being interviewed believes that the incident investigation is in his or her best interests, the interviewer will likely obtain the information sought. If the person being interviewed believes that job reprisals, legal action, or other adverse things will occur, the quality of the information obtained during an interview will likely be degraded.

Question #: 362- Which of the following is the BEST method for conducting interviews associated with an incident investigation?

- 1) One interviewer and one witness in a room with audio recording
- 2) Three interviewers and one witness in a room
- 3) One interviewer and three witnesses in a room

4) One interviewer and one witness in a room

Answer:4- Audio and video recording should always be avoided as this will typically make the witness nervous and less likely to be fully open. Having three interviewers is intimidating to the witness. Interviewing multiple witnesses at the same time should be avoided since frequently, a dominant person will speak for the group. The other witnesses with information will reason with themselves that other witnesses in the room have better information - particularly if the information is contradictory.

Question #: 363- A chemical process uses cryogenic liquid ethylene and other additives to produce the product. A process hazard analysis (PHA) of this process determined that a potentially dangerous situation could occur if the liquid ethylene were aligned directly with the flare (the flare is not designed for liquid ethylene). This situation would occur if Automatic Valve AV-1 and Manual Valve MV-C were opened while liquid ethylene was flowing. The PHA team determined four options to correct this issue. Which is the most desirable corrective action?

1) Create and test a software interlock in the programmable logic controller to prevent AV-1 from opening when MV-C is open and liquid ethylene is flowing (according to Flow Controller FC-1).

2) Install a flare that can handle liquid ethylene at the flow rate expected when this situation occurs.

3) Invoke a strictly enforced administrative procedure to physically verify that MV-C is closed before the control room operator is allowed to open AV-1 when flowing liquid ethylene.

4) Replace AV-1 with a manual valve and require operators to strictly enforce an administrative procedure to physically verify that MV-C is closed before the operator is allowed to open the new manual valve when flowing liquid ethylene.

Answer:1- Though all of these corrective actions could work, the most desirable is to install a software interlock. A new flare would likely be an expensive solution, and administrative controls are always less desirable than engineering controls.

Question #: 364- A chemical process uses a flammable material under pressure. The flammable material is pumped into a reactor vessel (a pressure vessel). The pressure vessel is designed in accordance with ASME requirements. As a part of the process control, the safety relief valve is used to regulate pressure. When the vessel pressure is too high, the safety relief valve lifts, and a flammable mixture flows to the flare (the flare is designed to handle substantially more load than this). Which of the following statements best describes this process?

1) The process is designed adequately.

2) The process is not designed adequately because flammable materials should not be used under pressure.

3) The process is not designed adequately because safety relief valves should not be used to control the pressure in any process.

4) The process is not designed adequately because the products of the reactor should not be relieved to the flare through a safety relief valve.

Answer:3- It is considered poor engineering practice to control a process with its safety systems. Other process controls and design features should be put in place so that the safety system can be used to relieve the system when safety parameters have been exceeded.

Question #: 365- A quantitative risk analysis (QRA) was performed on a single process. The results of the analysis indicate that the process will fail causing catastrophic consequences once every 10,000 years. Your plant has seven of these processes operating at all times, and your company has 12 other plants similar to this one around the country. Also, your company has three other competitors with similar numbers of facilities with very similar processes. Assuming that the results of the QRA can be extrapolated to the other similar processes throughout the industry, how often should you expect a catastrophic accident in your company's industry related to this process?

- | | |
|-------------------------------|-------------------------------|
| 1) about once every 30 years | 2) about once every 80 years |
| 3) about once every 150 years | 4) about once every 180 years |

Answer:1- The results of the QRA are associated with a single process. Your company has 84 such processes (12 facilities * 7 processes/facility). Your company's competitors bring another 252 such processes (84 processes * 3). This is a total of 336 such processes in the industry. That means we can expect 336 catastrophic accidents in 10,000 years, or about one accident every 30 years.

Question #: 366- Of the following, which is a reason for avoiding quantitative analyses?

- 1) Probabilities calculated are often so small that many believe corrective action need not be taken
- 2) Quantitative analyses are often expensive and frequently require a team of trained professionals to perform the analyses
- 3) Quantitative analysis techniques often require the use of personnel capable in mathematical techniques and/or use of a computer
- 4) **All of the above**

Answer:4- All these and more are reasons that quantitative analyses are not always accepted or done on product evaluations.

Question #: 367- The deductive technique that selects the undesired outcome (top-level event) and all possible modes of happenings is the:

- | | |
|-----------------------------------|-------------------------------|
| 1) Failure modes effects analysis | 2) Fault tree analysis |
| 3) Fault hazard analysis | 4) THERP |

Answer:2- In the fault tree method, an undesired event is selected and all possible happenings that can contribute to the event are diagrammed in the form of a tree. The branches of the tree

are continued until independent events are reached. Probabilities are determined for the independent events and after simplifying the tree, both the probability of the undesired event and the most likely chain of events leading up to it can be computed.

Question #: 368- Systems safety techniques employ the use of four categories of analysis. Fault tree analysis is ALWAYS a member of which category:

- | | |
|---------------------------------|--------------------------------|
| 1) Deductive analyses | 2) Inductive analyses |
| 3) Quantitative hazard analyses | 4) Qualitative hazard analyses |

Answer:1- A fault tree analysis is an example of a deductive analysis. Deductive analyses start with a top-level event, and logically determine its specific causes. Some FTA's can be qualitative - some can be quantitative. No FTA is inductive.

Question #: 369- In developing a safe maintenance guide for robotic workstations, which method, useful for predicting potential injury situations, would apply to determining the combinations of human actions and equipment conditions that could lead to a robot related injury?

- | | | | |
|---------|--------|---------------|----------|
| 1) SADT | 2) JSA | 3) FTA | 4) FMECA |
|---------|--------|---------------|----------|

Answer:3- Fault tree analysis (FTA) begins with defining the unwanted injury event and proceeds by graphically constructing the sequences of events and conditions that would lead to that event. When failure rates and human reliability values are available, the probabilities of the various sequences can be computed. NIOSH Publication No 88-108 Safe Maintenance Guide for Robotic Workstations SADT - Structural Analysis and Design Techniques JSA - Job Safety Analysis FMECA - Failure Modes, Effects and Critical Analysis

Question #: 370- The technique that provides a means for quantitatively evaluating the contribution of human error to the degradation of product quality is called a:

- | | |
|--------------------------|-----------------------------------|
| 1) Fault hazard analysis | 2) Failure modes effects analysis |
| 3) Fault tree analysis | 4) THERP |

Answer:4- THERP, a **T**echnique for **h**uman **e**rror **p**redictions was developed by the Scandia Corporation. It provides a means for quantitatively evaluating the contributions of human error to the degradation of product quality. It can be used for human components in systems and can be combined with either failure modes effects or fault tree analysis.

Question #: 371- In system safety you would use which Boolean gate to connect the causative agents "exothermic reaction" and "outside heat source" to the end product "heat".

- | | | | |
|----------|----------------|-----------|------------|
| 1) "AND" | 2) "OR" | 3) Either | 4) Neither |
|----------|----------------|-----------|------------|

Answer:2- You would utilize an "OR" gate because either an "exothermic reaction" OR an "outside source" will cause heat.

Question #: 372- In performing a quantitative fault tree analysis, the first step is to define the top event to be investigated by the tree. Then you must gain an understanding of the system. Which of the following is NOT one of the remaining steps?

- 1) Construct the tree
- 2) Collect qualitative data**
- 3) Evaluate the probability of the event chosen as the event to be investigated
- 4) Analyze computer output

Answer:2- Quantitative data collection is the fourth step, not qualitative data collection.

Question #: 373- The first step of a system-level fault tree analysis is to define the top event. The failure selected to define the event must be:

- 1) Major system failures**
- 2) Procedure failures
- 3) Component failures
- 4) All failures

Answer:1- Major system failures are chosen because they will determine key improvements that must be made in system safety. Selection of other, lower-level failures would result in overlooking much of the system for potential failures.

Question #: 374- The value of λ in a fault tree analysis indicates:

- 1) An event expected to happen during normal use.
- 2) The hazard rate**
- 3) The failure rate**
- 4) The error rate

Answer:3- The Greek letter " λ " represents the probability of a failure of a component of a part of a system. It can also indicate the mean time between failures.

Question #: 375- The method that uses mathematical simulation, chance processes, and random numbers to determine whether and how frequently the outcome of an event or complex relationship will occur is known as:

- 1) Mathematical Simulation
- 2) Monte Carlo Method**
- 3) Modeling Method
- 4) Computer Simulation

Answer:2- The Monte Carlo Method of simulation is the name of the method used to analyze complex trees. It requires the use of a computer since a reasonably complex tree will require significant calculations to get a reliable answer for the reliability of the main event.

Question #: 376- The "bathtub" curve is a stress related depiction that describes the relationship between component failure and exposure. Failures occurring during early stages of use occur in the debugging period, which is also called:

- 1) Experimental period **2) Burn-in period** 3) Burn-out period 4) Assessment period

Answer:2- Failures occurring during early stages of use occur during the burn-in period.

Question #: 377- If the mean time between failures of a system is 5,000 trials, what is the reliability of the system over 15,000 trials?

- 1) **0.05** 2) 0.23 3) 0.33 4) 3.00

Answer:1- Using the reliability formula: $R_t = 1/\text{mean time between failures}$
 $R_t = e^{-15,000/5,000}$ $R_t = 0.0498$

Question #: 378- If the reliability of a system over 15,000 trials is 0.05, what is the probability of failure of the system?

- 1) 67% 2) 76% **3) 95%** 4) 100%

Answer:3- Using the formula: $P(f) = 1 - R(t)$, where:
 $P(f)$ is the probability of failure and $R(t)$ is the reliability over time.
 $P(f) = 1 - 0.05 = 0.95$ or 95%

Question #: 379- The reliability of a component that has two parallel redundant circuits (each redundant system has a reliability of 0.85) is:

- 1) 1.00 2) 0.98 3) 0.89 4) 0.85

Answer:2- The probability of failure of each leg is calculated as $R = (1 - 0.85) = 0.15$
The probability of a system failure is: $P_f = 0.15 * 0.15 = 0.0225$
The system reliability is: $R_s = 1 - 0.0225 = 0.9775$

Question #: 380- A system that has multiple units that must operate in order for a given output to occur is said to have:

- 1) Parallel redundancy 2) Fail safe characteristics
3) High failure rates **4) Series redundancy**

Answer:4- Such a system has series redundancy, and as such, has a low probability for a failure to occur.

Question #: 381- A system with two components in parallel, each with a reliability of 0.70, would have a reliability of:

- 1) 0.30 2) 0.50 3) 0.70 **4) 0.91**

Answer:4- $R_{\text{series}} = R_1 R_2$ $R_{\text{parallel}} = 1 - (U_1 U_2)$
 $U_1 = 1 - 0.70 = 0.30$ $U_2 = 1 - 0.70 = 0.30$

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$$R_{\text{Parallel}} = 1 - (0.30)(0.30) = 1 - 0.09 = 0.91$$

If one component fails, another can act as a backup.

Question #: 382- If a system consists of 100 components in series, each with a reliability of 0.9900, the reliability of the entire system is:

- 1) **0.366** 2) 0.634 3) 0.990 4) 0.999

Answer:1- In series, multiply the reliabilities of all components.

$R = 0.99^{100} = 0.366$ 366 times out of 1,000 the system would be able to properly perform its function.

Question #: 383- For reliability purposes, adding components in parallel:

- 1) Decreases reliability in the system 2) Has no effect on reliability in the system
3) **Increases the reliability of the system** 4) Depends on other subsystems

Answer:3- $R_{\text{series}} = R_1 R_2$ $R_{\text{parallel}} = 1 - (U_1 U_2)$
 $U_1 = 1 - R_1$ $U_2 = 1 - R_2$ Assume $R_1 = 0.9$ and $R_2 = 0.8$

In a series system the system reliability is: $R_s = 0.9 * 0.8 = 0.72$

In a parallel system the system reliability is: $R_p = 1 - (0.1 * 0.2) = 0.98$

Question #: 384- For system (A) to fail, components (B) and (C) which are in parallel, must fail. If the reliability of (B) and (C) are both 0.70, then what is the reliability of system (A)?

- 1) 0.49 2) 0.51 3) **1** 4) 0.97

Answer:3- In a parallel arrangement the reliability of system

$$R_A = 1 - (1 - 0.70)(1 - 0.70) = 0.91$$

Question #: 385- The reliability of a system is enhanced by adding a component in:

- 1) **Parallel** 2) Series 3) Sequence 4) Progression

Answer:1- The reliability is enhanced by adding a component in parallel. The additional component, which performs the same function within a given system, makes it redundant (or parallel).

Question #: 386- A switch has 5 components. Each part has a failure rate of 0.3. Failure of any part causes the switch to fail. What is the reliability of the switch system?

- 1) 1.50 2) **0.168** 3) 0.150 4) 0.00243

Answer:2- Reliability is defined as $(1 - \text{failure rate})$. The reliability of this system is the product of the reliabilities of the components.

$$R = (1 - 0.3)^5 = 0.168$$

Question #: 387- A switch has 5 components, all redundant to one another. The component failure rates are 1×10^{-3} , 1×10^{-2} , 1×10^{-1} , 1×10^{-3} , and 1×10^{-2} , respectively. What is the system failure rate?

- 1) 1×10^{-11} 2) 5×10^{-11} 3) 1.21×10^{-1} 4) 1.21×10^{-2}

Answer:1- Given the parallel construction, the total failure rate is multiplicative.

$$\text{Failure Rate} = (1 \times 10^{-3}) (1 \times 10^{-2}) (1 \times 10^{-1}) (1 \times 10^{-3}) (1 \times 10^{-2}) = 1 \times 10^{-11}$$

Question #: 388- You are asked to recommend a parallel or series design for a critical switch. The switch has two components with a failure rate of 1×10^{-5} and 1×10^{-8} . Which should you choose?

- 1) **Parallel construction** 2) Series construction
3) Double parallel construction 4) Double series construction

Answer:1- To reduce the failure rate you would choose the parallel construction.

$$\text{The parallel failure rate is: Failure Rate} = (1 \times 10^{-5}) (1 \times 10^{-8}) = 1 \times 10^{-13}$$

$$\text{The series construction failure rate is: Failure Rate (s)} = (1 \times 10^{-5}) + (1 \times 10^{-8}) = 1 \times 10^{-5}$$

Question #: 389- When assessing the reliability of a system, all of the following are considered appropriate EXCEPT:

- 1) Part usage 2) Functional requirements
3) Environmental requirements 4) **Reliability bonding**

Answer:4- Reliability bonding is not considered appropriate when assessing the reliability of a system.

Question #: 390- In a large sample of components, 5% were found to be defective. If 7 components are sampled, what is the probability that exactly 3 will be defective?

- 1) 0.999 2) 0.036 3) 0.001 4) **0.0001**

Answer:4- $P(d) = Qy [P(s)(n-y)]$

y = # of successes

n = # of trials

Q = Probability of Failure

P(s) = Probability of Success

P(d) = Probability of Defective

$$P(d) = (0.05)^3 [0.95(7-3)]$$

$$= 0.000125 * 0.95^4$$

$$= 0.000125 * 0.857$$
$$= 0.000107$$

Question #: 391- Pick the appropriate formula to calculate safety margin:

- 1) Minimum strength / 2
- 2) Minimum strength / (minimum strength - maximum strength)
- 3) (Minimum strength - maximum stress) / minimum strength**
- 4) Minimum strength / 4

Answer:3- The appropriate formula to calculate safety margin is: $K = (\text{minimum strength} - \text{maximum stress}) / \text{minimum strength}$

Question #: 392- A wind rose is:

- 1) A kind of flower
- 2) A graphical representation of yearly wind direction**
- 3) A computer-aided design
- 4) A graphical representation of stack discharges

Answer:2- Wind roses are graphical representations of wind direction. They are important in determining prevailing wind direction.

Question #: 393- Given that incident investigations require resources (time and money), what would be an efficient method to maximize your company's ability to harvest as much information from each incident investigation that is conducted?

- 1) Perform a formal incident investigation on every incident regardless of complexity and consequence.
- 2) Perform a formal incident investigation on every complex incident and on every incident with a high consequence.
- 3) Trend all incidents, perform a formal incident investigation on every complex incident, on every incident with a high consequence, and on other incidents that show a trend.**
- 4) Perform a formal investigation on a randomly selected set of incidents.

Answer:3- The key is trending. An incident can be as minor as a process upset leading to 5 seconds of downtime to a safety-related fatality due to a highly complex sequence of events. No company can afford to investigate every incident unless there is a method for choosing the incidents that will yield the most information and the most opportunity for improving. In some cases, regardless of the complexity, a formal investigation will be commissioned. More frequently, however, a company will want to trend incidents and only perform a formal incident investigation when the trend indicates that there is a higher-than-acceptable potential for a repeat. Trending applies to near misses, as well.

Question #: 394- What is a chain of custody?

- 1) **A documentation trail describing a detailed history of specific items particularly with respect to who has held custody of the item and the reason that person had custody of the item**
- 2) A documentation trail describing the manufacturing history or personal history of an item or person
- 3) A documentation trail describing the quality review and checklists that were performed on an item
- 4) None of the above

Answer:1- A chain of custody is typically associated with incident investigations and describes in detail the identity of the person who has held custody of an item and why the person had custody of the item.

Question #: 395- Change analysis is:

- 1) A method for understanding how an incident occurred
- 2) A method for understanding how a change in a system could cause problems later on
- 3) A method of understanding how a management system change will affect the system
- 4) **All of the above**

Answer:4- Change analysis is an excellent investigative tool for incident investigation as well as a proactive tool for performing risk assessments when a system change is anticipated.

Question #: 396- The F-statistic is associated with problems involving:

- 1) **ANOVA and inferences about standard deviations**
- 2) Chi-Square distributions
- 3) Inferences about means
- 4) None of the above

Answer:1- When performing an analysis of variance test (ANOVA) the F-statistic is computed. Chi-Square tests involve the Chi-Square distribution. Inferences about means usually involve the assumption of normal distributions for large samples and the "t" distribution for small samples.

Question #: 397- When performing a hypothesis test, a Type I error is:

- 1) Accepting a null hypothesis when it is true
- 2) **Rejecting a null hypothesis when it is true**
- 3) Accepting a null hypothesis when it is false
- 4) Rejecting a null hypothesis when it is false

Answer:2- Statistically it is possible to get a sample where the sample statistic falls outside the acceptance region but the null hypothesis is indeed true. This is called a Type I error.

Question #: 398-Accepting the null hypothesis when it is false is called a:

- 1) Type I Error **2) Type II Error** 3) Type III Error 4) Type IV Error

Answer:2-Accepting the null hypothesis when it is false is called a Type II error and is symbolized by the Greek letter beta.

Question #: 399- When testing an assumption about a population mean and we accept the alternative hypothesis:

- 1) The sample mean must have fallen within the acceptance b region
2) The sample mean must have fallen within the rejection region
3) The population mean must have fallen within the acceptance region
4) The population mean must have fallen within the rejection region

Answer:2- If the sample mean falls within the rejection region, we reject the null hypothesis and accept the alternative hypothesis.

Question #: 400- "Between column variance", "within column variance", "F Ratio", and "grand mean" are all terms associated with:

- 1) ANOVA** 2) Regression analysis 3) Chi-square test 4) Non-parametric statistics

Answer:1- ANOVA, which stands for analysis of variance, is associated with all the terms mentioned in the question. An analysis of variance procedure involves many steps and is quite time consuming to do by hand. Among the calculated values are the between column variance, the within column variance, the F Ratio, and the grand mean. Statistics for Management by Richard I. Levin and David S. Rubin

Question #: 401- The use of the range in describing a set of data is disadvantageous because:
A. It does not take into account all values in the data set, B. It is heavily influenced by extreme values, C. It ignores the nature of the variation of the data points.

- 1) A and B 2) A and C 3) B and C **4) A, B, and C**

Answer:4- The range is the difference between the largest value and the smallest value in a data set. The values in between do not influence the range and thus are not represented by the range. Data outliers (single extreme values - high or low) can significantly skew the range. Ranges do not provide any information on the variation of the data within the data set. The standard deviation and the mean are far more useful in evaluating data sets.

Question #: 402- All of the following are measures of central tendency EXCEPT:

- 1) Standard deviation** 2) Median 3) Mode 4) Mean

Answer:1- Measures of central tendency indicate the location about which the data points tend to congregate. The standard deviation is a measure of dispersion.

Question #: 403- The correlation coefficient for two variables is determined to be 0.98. This strongly indicates:

- 1) The independent variable is the direct cause of the dependent variable
- 2) The dependent variable and the independent variable are not well-related to one another
- 3) A high degree of relationship exists between the two variables**
- 4) None of the above

Answer:3- A high correlation coefficient does not mean one variable causes the other, only that there is a strong relationship between the two variables.

Question #: 404- For a positively skewed distribution:

- 1) The median is to the left of the mean**
- 2) The mean and median are equal and to the right of the mode
- 3) The mode is always equal to the median and always to the right of the mean
- 4) None of the above

Answer:1- A positively skewed distribution is also said to be skewed to the right. Most of the values are on the lower end of the scale or to the left of the mean. Thus the middle value or median is to the left of the mean.

Question #: 405- A data point that is extremely far from most of the data is:

- 1) Said to be skewed to the right or left
- 2) Said to be an outlier**
- 3) Automatically excluded from consideration
- 4) Used to average the other points

Answer:2- A data point that is much different from the main body of data is said to be an outlier. An outlier could be caused by an extraneous event, perhaps a measurement error, or by a situation that is not yet understood. Great care should be taken before rejecting such a data point from the analysis.

Question #: 406- Which of the following is NOT generally considered part of a behavioral observation process?

- 1) Identification of behaviors to observe
- 2) Engineering controls**
- 3) Conduct of observations
- 4) Provide feedback on results

Answer:2- A behavioral observation process generally consists of identifying the behaviors to be observed, conducting the observations, and providing feedback on the results.--E. Scott Geller, The Psychology of Safety

Question #: 407- In a behavioral observation process, the principle method of feedback is usually considered to be:

- 1) Posting group data on percent of safe behaviors observed**
2) Discipline when an employee is seen doing something incorrectly
3) Posting individual employee results
4) Supervisors are informed of their group's performance

Answer:1- In a behavioral observation process, feedback is generally given by posting group results such as the percent of safe behaviors observed. E. Scott Geller, The Psychology of Safety

Question #: 408- The psychologist considered to be the "father" of behavior modification is:

- 1) Sigmund Freud **2) B. F. Skinner** 3) Douglas McGregor 4) Frederick Herzberg

Answer:2- B. F. Skinner is generally considered to be the father of behavioralism. Dan Petersen, Safety Management: A Human Approach

Question #: 409- What does TWA mean?

- 1) Total weighted average 2) Total weighted attitude
3) Time weighted average 4) Time without answers

Answer:3- TWA is the acronym for Time Weighted Average. This is expressed in exposure for an eight hour day. Therefore, if an exposure was the same and continuous for eight hours, it would be the same as the exposure. If the exposure lasted for only four hours, the TWA would be divided by 2 to get the 8-hour exposure.

Question #: 410- How much heat is lost by a copper coil weighing 100 g when it cools from 140°C to 40°C? The specific heat of copper is 0.093 cal/(g-°C).

- 1) 310 cal 2) 620 cal **3) 930 cal** 4) 1,240 cal

Answer:3- The specific heat of a substance provides information on how much heat each gram of that substance must receive for each degree that its temperature rises:
Heat gained (or lost) = Mass * Specific heat * Temperature increase (or decrease).
= 100 g * 0.093 cal/(g-°C). * 100° = 930 cal

Question #: 411- To what volume will 100 ft³ of gas of 20°C expand, if it is heated at constant pressure to 60°C?

- 1) 113.65 ft³** 2) 300 ft³ 3) 333.3 ft³ 4) 166.66 ft³

Answer:1- Solution: $T_1 = 20^{\circ}\text{C}$ $T_1 = 20^{\circ} + 273^{\circ}$ $T_1 = 293^{\circ}\text{K}$
 $T_2 = 60^{\circ}\text{C}$ $T_2 = 60^{\circ} + 273^{\circ}$ $T_2 = 333^{\circ}\text{K}$

Substituting known quantities in the formula:

$$V_1 / V_2 = T_1 / T_2 \quad 100 / V_2 = 293 / 333 \quad 293(V_2) = 333(100) \quad V_2 = 113.65 \text{ ft}^3$$

Question #: 412- Which of the following statements is NOT true concerning human behavior?

- 1) There is no such person as an average person
- 2) Best approach is to design systems to fit percentiles of the population
- 3) In fitting personnel to a job consider both the physical and personality characteristics
- 4) **Attitude is an important characteristic of fitting the worker to the task**

Answer:4- Attitude is not an important characteristic of fitting the worker to the task.

Question #: 413- Which of the following is **NOT** true concerning critical incident technique when evaluating human behavior?

~~1) Take a structured sample of employees~~

- 2) Interview to collect accident information on near misses, difficulties in operations, and conditions that could have resulted in death or property loss
- 3) Incidents are classed into hazard categories and problem areas or behaviors are identified
- 4) Periodically repeat the procedure as conditions or populations change

Answer:1- Taking a RANDOM sample of employees is a critical incident technique when evaluating human behavior.

Question #: 414- Which one of the following is **NOT** true concerning behavior sampling when evaluating human behavior?

- 1) Use a behavior or activity sampling sheet
- 2) Do walk-around inspections and record the number and types of behavior observed
- 3) **~~Make the observations at the same time each day~~**
- 4) Calculate the percentage of times certain behaviors are observed

Answer:3- Making observations at DIFFERENT times of the day, days of week, and shifts is true when using behavior sampling.

Question #: 415- Extinction can be accomplished by:

- 1) Punishment
- 2) Withholding positive reinforcement
- 3) **Both 1 and 2**
- 4) None of the above

Answer:3- Extinction can be accomplished by punishment and withholding positive reinforcement. - Dan Petersen, Safety Management: A Human Approach

Question #: 416- A Theory Y leader would exhibit which type of management style?

- 1) Autocratic
- 2) **Democratic**
- 3) Supportive
- 4) Consultative

Answer:2- Theory Y leaders assume that their employees are intelligent, hard working, and willing to learn. They would encourage subordinates to self-manage, take responsibility, and share in decision making. This is democratic leadership.

Question #: 417- Which of the following is an example of biological monitoring?

A. Pulmonary Function Test B. Audiometry **C. CBC** **D. Urinalysis**

1) A and B 2) A, C, and D **3) C and D** 4) All of the above

Answer:3- Biological monitoring is the analysis of blood, urine, skin, etc., to determine the presence of agents or metabolites. Pulmonary function testing and audiometry are biological function measurements; they are examples of medical monitoring.

Question #: 418- To assess your company's loss control performance, several statistics are captured and analyzed. One of these is "Percent of operational personnel that have completed all phases of chemical safety training." This statistic is an example of a(n):

1) Leading indicator 2) Lagging indicator 3) Optional indicator 4) Occupational indicator

Answer:1- Leading indicators (such as risk assessments) provide data on how well the loss control system is expected to perform in the future. In this particular case, there is evidence that when a lower fraction of operational personnel have been trained, the company's loss control performance decreases.

Question #: 419- Calculate the standard deviation of the following sample set of data: 52, 20, 24, 31, 35, 42.

1) 10.8 **2) 11.8** 3) 12.8 4) 13.8

Answer:2- Most scientific calculators will calculate the population standard deviation (it may be labeled as σ). The formula used to calculate the sample standard deviation is:

where x is the difference between the sample data and the sample mean and n is the number of sample data points. The sample standard deviation is 11.8.

Question #: 420- Estimate the variance of the population from which the following sample data came: 22, 18, 17, 20, 21.

1) 4.3 2) 2.1 3) 1.9 4) 5.0

Answer:1- Use the following formula to calculate the sample standard deviation: The variance is then calculated by squaring the sample standard deviation. As we have no other information to draw on, we use the sample variance as a point estimate of the population variance.

The sample standard deviation is 2.074

$2.074^2 = 4.3$

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Question #: 421- What is the best estimate of the variance of the population from which the following samples came? 17 ppm, 20 ppm, 18 ppm, 22 ppm, 21 ppm, 22 ppm, 19 ppm, 21 ppm, 22 ppm

- 1) **3.44** 2) 4.30 3) 5.01 4) 5.13

Answer:1- The best estimate of the population variance is the sample variance (the sample standard deviation squared). To calculate the sample standard deviation, use the formula:

The sample standard deviation = 1.856 = 3.44

Question #: 422- A normally distributed population has total of 150 members and a standard deviation of 24. What is the standard error of the mean for a sample from this population?

- 1) 0.16 2) 1.60 3) 4.90 4) Cannot be determined

Answer:4- A sample size is not given and hence a question about the standard error of the mean is not relevant. The standard error of the mean is determined by dividing the population standard deviation by the square root of the sample size.

Question #: 423- Values on the Celsius temperature scale represent what kind of data?

- 1) Nominal 2) Ordinal **3) Interval** 4) Ratio

Answer:3- Interval data is associated with a measurement scale which does not have a true zero point. In other words, zero on this type of scale does not mean the absence of anything. Even though the Celsius temperature may read zero this does not mean there is no heat. Additionally the distance between values is a fixed constant and has some meaning. There is a fixed difference between 1 degree higher temperature readings no matter where you are on the scale.

Question #: 424- What is the standard deviation of the following air sampling results for benzene, given in ppm? 2.2, 4.6, 7.8, 5.3, 1.5, 8.0

- 1) 2.21 2) 2.72 3) 2.70 4) 3.10

Answer:2- In order to calculate the standard deviation for a set, you must first calculate the mean for the set of numbers. The mean is the arithmetic average of the numbers in the set. In this problem the mean is determined by: $\text{Mean} = (29.4)/6 = 4.9$
Once the mean is determined, calculate the deviation (or difference) between the each number in the set and the mean and square each individual deviation.

$2.2 - 4.9 = -2.7$	$-2.7 * -2.7 = 7.29$
$4.6 - 4.9 = -0.3$	$-0.3 * -0.3 = 0.09$
$7.8 - 4.9 = 2.9$	$2.9 * 2.9 = 8.41$
$5.3 - 4.9 = 0.4$	$0.4 * 0.4 = 0.16$
$1.5 - 4.9 = -3.4$	$-3.4 * -3.4 = 11.56$
$8.0 - 4.9 = 3.1$	$3.1 * 3.1 = 9.61$

Calculate the sum of the individual deviations. In this problem:

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$$S(x^2) = 7.29 + 0.09 + 8.41 + 0.16 + 11.56 + 9.61 = 37.12$$

The standard deviation (s) is the sum of the individual deviations divided by the number in the set minus one raised to the 1/2 power or: $s = [S(x^2)/N-1]^{1/2}$

In this problem: $s = [(37.12)/(6-1)]^{1/2} = 2.72$

Question #: 425- What is the sample standard deviation of the following data set? 2, 3, 4, 5, 6, 7
1) 1.00 2) 1.71 **3) 1.87** 4) 5.00

Answer:3- Most calculators can calculate this statistic (sometimes the function is marked as sn-1). To calculate the standard deviation by hand, first calculate the mean of the set of numbers. The mean is the arithmetic average of the numbers in the set. In this problem, the mean is determined by:

$$\text{Mean} = (2+3+4+5+6+7)/6 = 4.5$$

Once the mean is calculated, calculate the deviation (or difference) between each number in the set and the mean, and then square it. Put the numbers in a table to keep them orderly.

2 - 4.5 = -2.5	-2.5 * -2.5 = 6.25
3 - 4.5 = -1.5	-1.5 * -1.5 = 2.25
4 - 4.5 = -0.5	-0.5 * -0.5 = 0.25
5 - 4.5 = 0.5	0.5 * 0.5 = 0.25
6 - 4.5 = 1.5	1.5 * 1.5 = 2.25
7 - 4.5 = 2.5	2.5 * 2.5 = 6.25

Calculate the sum of the squares of the individual deviations.

$$\text{Sum} = 6.25 + 2.25 + 0.25 + 0.25 + 2.25 + 6.25 = 17.5$$

Divide this sum by the number of items in the set minus one. There are six numbers in the set; therefore, divide the sum calculated above by 6 - 1, or 5. After calculating this, take the square root of the result. This is the sample standard deviation . $s = 1.87$

Question #: 426- Given a normal distribution with a mean of 2.7 and a standard deviation of 0.8, what percentage of the distribution have values less than 3.2?

- 1) 68% **2) 73%** 3) 76% 4) 81%

Answer:2- Using the formula $z = [(X - \text{mean})/s]$ determine z. $z = (3.2 - 2.7)/0.8 = 0.625$
Using the Table of the Normal Distribution, $z = 0.625$ corresponds to 0.2341. This means that 23.41% of the distribution have values between the mean and the standard deviation of 0.8. Adding this to the remaining 50% of the values less than the mean, results in 73% of the values less than 3.2.

Question #: 427- Given the following data, calculate the correlation coefficient. (1.1, 4.6), (3.2, 5.3), (5.7, 6.4)

- 1) 0.943 2) -0.951 3) -0.312 **4) 0.997**

Answer:4- Coefficient of correlation equation (r).

$$r = [3 (5.06 + 16.96 + 36.48) - (10 * 16.3)] / \{[3 (1.21 + 10.24 + 32.49) - 102] * [3 (21.16 + 28.09 + 40.96) - 16.32]\}^{1/2} = 0.997$$

Question #: 428- Given the following data, develop a regression equation. (1,4), (2,5), (3,7)

- 1) $y = x + 2.0$ **2) $y = 1.5x + 2.33$** 3) $y = 1.3x + 2.67$ 4) $y = 2x + 2.51$

Answer:2- The general regression equation takes the form $Y = ax + b$. a and b can be determined by solving the following formulas simultaneously:

$$S(y) = bN + aS(x) \quad S(xy) = bS(x) + aS(x^2) \quad 16 = 3b + 6a \quad 35 = 6b + 14a$$

Solving simultaneously, $3 = 2a$, so $a = 1.5$ and $b = 2.333$

Question #: 429- Calculate the coefficient of correlation for the following data: (1,4), (2,5), (3,7)

- 1) -0.5341 2) -0.8793 3) 0.9672 **4) 0.9820**

Answer:4- Coefficient of correlation equation (r).

$$r = [3 (4 + 10 + 21) - (6 * 16)] / \{[3 (1 + 4 + 9) - (62)] * [3 (16 + 25 + 49) - (162)]\}^{1/2} = 0.9820$$

Question #: 430- In the regression equation, $y = ax + b$

- 1) a is the slope of the line 2) b is the y-intercept **3) Both 1 and 2** 4) None of the above

Answer:3- In the regression equation, $y = ax + b$, a is the slope of the line and b is where the line intercepts the y-axis.

Question #: 431- The hidden costs of accidents are:

- 1) 1 to 4 times the direct costs **2) 4 to 10 times the direct costs**
3) 10 to 20 times the direct costs 4) 50% of the direct costs

Answer:2- There are direct and indirect costs associated with an accident. These costs can be thought of as an iceberg, with the direct costs the visible portion of the iceberg and the indirect costs the large ice mass below the surface of the water. The indirect costs have been estimated to be 4 to 10 times the direct costs.

Question #: 432- Cost factor equals the total compensation and medical costs incurred per exposure, and is calculated by the following:

- 1) $CF = \text{Exposure}/\text{cost incurred}$
2) $CF = \text{Cost} * \text{exposure}$

3) $CF = \text{Cost incurred} * 1,000 / \text{total work-hours}$

4) $CF = \text{Total work-hours} / \text{cost incurred} * 100,000$

Answer:3- $\text{Cost incurred} * 1,000 / \text{total work-hours}$ is the formula for cost factor.

Question #: 433- The manual premium for a company under workers' compensation law is:

1) A premium from a manual for that type of company

2) Premium modified for the company's experience

3) The premium before experience modification is applied

4) The premium before automatic debits and credits are applied for safety program actions the company has taken

Answer:3- The manual premium is the premium before experience modification is applied. Modified premium is manual premium modified by a company's specific experience modifier. It is also known as the standard premium. If any credits or debits are applied for specific program actions, they are usually applied after experience modification is applied.

Question #: 434- If a company is an assigned risk under a workers' compensation program, it means that the company:

1) Has been assigned a classification for the degree of risk it presents to its employees

2) Is unable to secure coverage and has been assigned to an insurance company for workers' compensation coverage

3) Has been assigned to a group that represents the type of products or services it produces

4) Is a good risk, has low losses, and therefore is assigned a preferred rate

Answer:2- Assigned risks are also known as pool risks, or residual market risks. Most assigned risks either have higher than anticipated losses, are new companies without any history of losses to predict their actual losses, or are in financial difficulty, making them less desirable to insure.

Question #: 435- In workers' compensation systems, the premium a company pays for coverage is a function of:

1) Payroll 2) Manual class rates 3) Experience modification **4) All of the above**

Answer:4- $\text{Premium} = \text{Payroll} / \$100 * \text{Class Rate} * \text{Experience Modification}$.

Question #: 436- Which of the following traditional insurance coverages for business is a "no-fault" coverage?

1) Automobile insurance

2) Product liability insurance

3) Premises liability insurance

4) Workers' compensation insurance

CSP Questions and Answers- Part-II

Answer:4- Workers' compensation insurance is one of the first types of "no-fault" coverages for US businesses. No-fault coverage means that the injured party is compensated no matter who is at fault. While some states have sought to bring the concept of no-fault to other coverages such as automobile coverage, workers' compensation remains one of the only types of insurance that began as a no-fault coverage.

Question #: 437- In workers' compensation, most insurance is provided by private sector insurance companies. When insurance can only be obtained from the state government, that state is known as:

- 1) A residual market state 2) A state plan state **3) A state fund state** 4) A pool state

Answer:3- States that operate their own insurance mechanism for workers' compensation are known as state fund states.

Question #: 438- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on the data provided in the Table below, what did this company pay for worker's compensation insurance in 1998?

1996
1997
1998
1999

Class Rates
\$10.90
\$11.15
\$10.80
\$11.00

Experience
Modifiers
1.00
1.10
1.15
1.22

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

- 1) \$181,440 **2) \$208,656** 3) \$242,987 4) \$332,435

Answer:2- $\text{Premium} = (\text{Payroll}/\$100) * \text{Rate} * \text{Experience Modification} = (\$1,680,000/\$100) * \$10.80 * 1.15 = \$208,656$

CSP Questions and Answers- Part-II

Question #: 439- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on the data provided in the Table below, if this company had losses of \$245,000 in 1997, what was its loss ratio?

1996
1997
1998
1999

Class Rates
\$10.90
\$11.15
\$10.80
\$11.00

Experience
Modifiers
1.00
1.10
1.15
1.22

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

- 1) 78%
- 2) 85%
- 3) 117%
- 4) 129%**

Answer: 4- Loss Ratio = Losses / (payroll/\$100) * Rate * Experience Modification

$$\begin{aligned}\text{LR} &= \$245,000 / [(\$1,550,000 / \$100) * \$11.15 * 1.10] \\ &= \$245,000 / \$190,107.50 \\ &= 1.29 \text{ or } 129\%\end{aligned}$$

Question #: 440- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on the data provided in the Table below, in which year or years of experience would this company's experience modifier for the year 2000 be based?

1996
1997
1998
1999

Class Rates

\$10.90
\$11.15
\$10.80
\$11.00

Experience
Modifiers
1.00
1.10
1.15
1.22

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

- 1) 1998
- 2) 1997, 1998, 1999
- 3) 1996, 1997, 1998**
- 4) 1999

Answer:3- The experience modifier for a company is based on the last three years of actual experience, not counting the most recent year.

Question #: 441- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on the data provided in the Table below, what does the experience modifier of 1.00 in 1996 indicate?

1996
1997
1998
1999

Class Rates
\$10.90
\$11.15
\$10.80
\$11.00

Experience
Modifiers
1.00
1.10
1.15
1.22

CSP Questions and Answers- Part-II

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

- 1) The company had average losses in that year
- 2) The company was too new and did not have enough past actual experience to have a derived experience modifier**
- 3) The company had average losses in 1995
- 4) The company had changed their worker's compensation Class in that year because they changed the product they made

Answer:2- The experience modifier of 1.00 most likely indicated that the company was too new to have its own derived experience modifier. It could also indicate an ownership change or that the firm had average losses (experience modifier = 1.00) for several years in a row.

Question #: 442- A company manufactures machined parts and is in a worker's compensation Class for machine shops. For the year 2000, the test modifier is 1.16. Based on this information and the data provided in the Table below, if this company changes the product it makes to furniture in the year 2000, with a worker's compensation Class rate of \$6.00, what will its premium be per \$100 of payroll?

1996
1997
1998
1999

Class Rates
\$10.90
\$11.15
\$10.80
\$11.00

Experience
Modifiers
1.00
1.10
1.15
1.22

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

- 1) \$6.00 **2) \$6.96** 3) \$11.00 4) \$12.76

CSP Questions and Answers- Part-II

Answer:2- The rate per \$100 of payroll is the test experience modifier times the new worker's compensation class rate. The calculation retains the company's experience modifier.

$$\begin{aligned}\text{Rate} &= \text{Test Modifier} * \text{New worker's compensation Class Rate} \\ &= 1.16 * \$6.00 \qquad = \$6.96\end{aligned}$$

Question #: 443- A company manufactures machined parts and is in a worker's compensation Class for machine shops. For the year 2000, the test modifier is 1.16. Based on this information and the data provided in the Table below, if this company is sold to another group of owners who change the product they make in 1997 to furniture, with a worker's compensation Class rate of \$6.00, what will its premium be per \$100 of payroll?

1996
1997
1998
1999

Class Rates
\$10.90
\$11.15
\$10.80
\$11.00

Experience
Modifiers
1.00
1.10
1.15
1.22

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

1) **\$6.00** 2) \$6.96 3) \$11.00 4) \$12.76

Answer:1- When ownership changes the experience modification reverts back to 1.00. Therefore, the class rate per \$100 of payroll would be the manual rate for that class of business. In this case the class has changed because the product made has changed.

Question #: 444- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on the data provided in the Table below, which of the following statements is TRUE?

1996
1997
1998
1999

Class Rates

\$10.90
\$11.15
\$10.80
\$11.00

Experience

Modifiers

1.00
1.10
1.15
1.22

Payroll \$

\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

- 1) This company's losses are trending down
- 2) We do not have sufficient information to determine what is happening with loss trends
- 3) This company has losses better than other companies in this industry
- 4) This company's losses are trending up**

Answer:4- Experience modifiers, when compared from year to year is an indicator of the trend of losses. It is a lagging indicator since it is an average of three years of losses and expected losses.

Question #: 445- A company manufactures machined parts and is in a worker's compensation Class for machine shops. For the year 2000, the test modifier is 1.16. Based on this information and the data provided in the Table below, when this company's management decided to build a new plant in another state in 1997 to manufacture furniture, what experience modifier was used for the new plant?

1996
1997
1998
1999

Class Rates

\$10.90
\$11.15
\$10.80
\$11.00

Experience

Modifiers

1.00
1.10
1.15
1.22

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

- 1) Not enough information is provided
- 2) 1.00
- 3) 1.10**
- 4) 1.15

Answer:3- The experience modifier is an expression of the experience of the firm's managers/owners. Even though a new plant is built in another state, the new plant takes on the experience modifier of the management/owners of the existing company. The class rate/manual rate changes in this case, but the experience modifier remains the same.

Question #: 446- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on data provided in the Table below, and assuming that the ratable losses and expected losses in 1999 did not change significantly from the previous years, what is the firm's estimated modifier for the year 2000?

1996
1997
1998
1999

Class Rates
\$10.90
\$11.15
\$10.80
\$11.00

Experience
Modifiers
1.00
1.10
1.15
1.22

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

Total Ratable Losses
\$375,580
\$375,580
\$375,580

Total Expected Losses

\$284,530

\$284,530

\$284,530

1) Not enough information is provided

2) 0.76

3) 1.16

4) **1.32**

Answer:4- Each state sets its own formula to calculate the experience modifier based on the ratio of ratable (actual) losses with expected losses for the workers compensation Class. Some states average only the last year's ratio while other states permit the averaging of the last several years ratios.

Experience modifiers = ratable losses / expected losses EM = \$375,580 / \$284,430
= 1.32

Question #: 447- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on data provided in the Table below, what is the OSHA incident rate for cases in 1996?

1996

1997

1998

1999

Class Rates

\$10.90

\$11.15

\$10.80

\$11.00

Experience

Modifiers

1.00

1.10

1.15

1.22

Payroll \$

\$1,330,000

\$1,550,000

\$1,680,000

\$2,225,000

Work Hours

275,000

286,000

290,000

310,000

Number of Accidents

90

88

96

101

Lost Work Day Cases

12

12

9

7

1) 0.087 cases/year 2) 0.65 cases/year **3) 65 cases/year** 4) 87 cases/year

Answer: 3- Rate = No. of Cases (200,000 hr/yr) / (Total Work Hours)
= 90 cases(200,000 hr/yr) / 275,000 hr = 65.45

Remember that the OSHA incidence rate requires basing the calculation on 100 employees each working 2,000 hours per year (that is the purpose of the 200,000 hr/yr in the above equation).

Question #: 448- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on data provided in the Table below, what is the OSHA lost work day incidence rate for cases in 1999?

1996

1997

1998

1999

Class Rates

\$10.90

\$11.15

\$10.80

\$11.00

Experience

Modifiers

1.00

1.10

1.15

1.22

Payroll \$

\$1,330,000

\$1,550,000

\$1,680,000

\$2,225,000

CSP Questions and Answers- Part-II

Work Hours

275,000

286,000

290,000

310,000

Number of Accidents

90

88

96

101

Lost Work Day Cases

12

12

9

7

1) 1.5

2) 4.5

3) 15

4) 45

Answer: 2- Rate = No. of Cases (200,000 hr/yr) / (Total Work Hours)
= 7 cases (200,000 hr/yr) / 310,000 hr = 4.5

Remember that the OSHA incidence rate requires basing the calculation on 100 employees each working 2,000 hours per year (that is the purpose of the 200,000 hr/yr in the above equation).

Question #: 449- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on incidence rates (see Table below), what is the trend of total accidents for this company?

1996

1997

1998

1999

Class Rates

\$10.90

\$11.15

\$10.80

\$11.00

Experience

Modifiers

1.00

1.10

1.15

1.22

Payroll \$

\$1,330,000

CSP Questions and Answers- Part-II

\$1,550,000
\$1,680,000
\$2,225,000

Work Hours
275,000
286,000
290,000
310,000

Number of Accidents
90
88
96
101

Lost Work Day Cases
12
12
9
7

- 1) Accident rates are increasing
- 2) Accident rates are decreasing
- 3) Not enough information is provided
- 4) The trend is not apparent since the change from year to year is small**

Answer:4- The incidence rates for 1996 through 1999 were 65, 61.5, 66.2, and 65, respectively. There is not a great change from year to year to indicate any definite trend.

NOTE: Incidence rate is calculated by:
$$\text{Rate} = \frac{\text{No. of Cases}(200,000 \text{ hr/yr})}{(\text{Total Work Hours})}$$

Question #: 450- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on incidence rates (see Table below), what is the trend of lost work day accidents for this company?

1996
1997
1998
1999

Class Rates
\$10.90
\$11.15
\$10.80
\$11.00

CSP Questions and Answers- Part-II

Experience

Modifiers

1.00

1.10

1.15

1.22

Payroll \$

\$1,330,000

\$1,550,000

\$1,680,000

\$2,225,000

Work Hours

275,000

286,000

290,000

310,000

Number of Accidents

90

88

96

101

Lost Work Day Cases

12

12

9

7

1) Accident rates are increasing

2) Accident rates are decreasing

3) Not enough information is provided

4) The trend is not apparent since the change from year to year is too small

Answer:2- The incidence rates for 1996 through 1999 were 8.7, 8.4, 6.2, and 4.5. This is clearly a downward trend.

NOTE: Incidence rate is calculated by:

Rate = No. of Cases (200,000 hr/year) / (Total Work Hours)

Question #: 451- A company manufactures machined parts and is in a worker's compensation Class for machine shops. Based on the data provided in the Table below, which of the following is the best indicator of how this company's safety program is working.

1996

1997
1998
1999

Class Rates
\$10.90
\$11.15
\$10.80
\$11.00

Experience
Modifiers
1.00
1.10
1.15
1.22

Payroll \$
\$1,330,000
\$1,550,000
\$1,680,000
\$2,225,000

Work Hours
275,000
286,000
290,000
310,000

Accidents
90
88
96
101

Lost Work Day Cases
12
12
9
7

- 1) Experience modifier
- 2) Test modifier
- 3) OSHA incidence rate for all fatality cases
- 4) OSHA incidence rate for all lost work day cases**

Answer:4- The OSHA incidence rate for lost work day cases is the best indicator. Experience modifiers and test modifiers are also indicators but they are based on past losses over three years; the OSHA incidence rate is more current.

The fatality incidence rate will rarely have sufficient data from which trends can be drawn.

Question #: 452- The preferred course for a company's management to meet the consequent risks of product liability is:

- 1) Regulation of risks through careful statement of conditions of sale and delivery
- 2) Transfer of risks through the underwriting of product liability insurance
- 3) Reduction of risks through the introduction of effective quality assurance**
- 4) Acceptance of risks through passivity

Answer:3- The management of a company must consider what ways or combinations of ways are available to meet the consequent risks of product liability. Of the four fundamentally different risk alternatives that the company's management may take, the reduction of the existing risk through introduction or improvement of quality assurance will give better conditions for regulation and transfer of risk.

Question #: 453- The manufacturer of any product faces an environment in which:

- 1) Fault without negligence exists**
- 2) Present court rulings favor the company
- 3) Product liability is a not a significant financial burden
- 4) Product liability claims are generally decreasing

Answer:1- The manufacturer of any product faces an environment in which fault without negligence exists. Legal history shows a movement from buyer beware to seller beware.

Question #: 454- In reviewing designs for product safety, all of the following environmental consideration(s) must be dealt with EXCEPT:

- 1) Environmental conditions on product operations
- 2) Product operations on the environment
- 3) Product disposal on the environment
- 4) Aesthetic design**

Answer:4- The environment must be considered in designs for product safety because:

The ambient environment (temperature, humidity, corrosivity) will affect the condition and operation of the product

The operation of the product (noise, particles, toxic vapors, liquid effluent) would, without proper controls, pollute the environment

Product disposal, should it contain hazardous materials (mercury, lead, beryllium) has the potential to contaminate soil and groundwater.

Aesthetics are not part of a product safety environmental assessment.

Question #: 455- Alpha Company sold a product in 1990 that caused an accident in 1999. The company was not insured in 1990, but did acquire Mutual B product liability insurance for the same product in 1992. Which firm is responsible for losses?

- 1) Alpha Company since it was not insured in 1990
- 2) Mutual B**
- 3) Both Alpha and Mutual B share responsibility
- 4) Neither is responsible

Answer:2- Mutual B is likely still responsible for the losses unless specific disclaimers in the policy allow Mutual B to remain clear of product liability for products sold prior to the underwriting.

Question #: 456- A tool made by Echo Corporation is sold to Tango Corporation by Wholesale Company. A Tango employee modifies the Echo tool and is subsequently injured using the employee-modified tool. Which firm is potentially liable for damages?

- 1) Echo 2) Tango 3) Wholesale **4) All parties are potentially liable**

Answer:4- All parties involved are potentially liable in this situation. Tango's liability will likely not be associated with product liability, but biased toward worker-related injuries (if the employee elects to reject a workers' compensation settlement).

Question #: 457- For potential legal protection, how long should a manufacturer keep product records?

- 1) Life of the product 2) Life of the product guarantee
3) Well beyond life of the product 4) Should not keep any records

Answer:3- Due to product liability claims, a manufacturer should keep product records well beyond the intended life of the product.

Question #: 458- Implied warranty involves:

- 1) A written statement **2) Expectation of suitability** 3) Negligence 4) Tort

Answer:2- An implied warranty revolves around the implications, made by a manufacturer or dealer, that a product is suitable for a particular use.

Question #: 459- Which of the following is least likely to support a product liability claim?

- 1) Defective design 2) Defective manufacturing processes
3) Poor product instructions **4) Misuse by the consumer**

Answer:4- Even customer misuse may be used as valid support for a product liability claim if the misuse could have been reasonably anticipated by the manufacturer; however, the other three answers are much easier foundations on which to justify a product liability claim.

Question #: 460- The risk value for a given hazardous event is a measurement that combines all of the following variables EXCEPT:

- 1) Frequency of process **2) Unanticipated loss**
3) Exposed systems 4) Likelihood

Answer:2- Unanticipated loss is not a variable for the risk value of a given hazardous event.

Question #: 461- An insurable pure risk is NOT which of the following?

- 1) A car accident 2) A burglary **3) A business failure** 4) A death

Answer:3- A business failure does not meet the definition of a pure risk since it is not accidental. It is also a single exposure and an event unique to that business.

Question #: 462- Dealing with the uncertainty and unpredictability of personal injury, property loss, business interruption, and liability is identified with:

- 1) Casualty insurance 2) Loss prevention **3) Risk management**
4) Loss control management

Answer:3- Risk management is a decision-making process whose objective is to identify the proper mix of loss control, risk retention, and risk transfer that the organization should use in dealing with its risks of personal injury, property loss, and liability, including the expense and revenue losses associated with these exposures.

Question #: 463- "Risk analysis" is normally conducted before

- 1) Dose response modeling 2) Environmental analysis
3) Fault tree analysis **4) Risk management**

Answer:4- The methodology of risk analysis is quite different from risk management. Risk analysis is a scientific activity, the result of which is an estimate of risk. Risk management must determine whether the risk is acceptable and if not, what methods will be used to reduce the risk to an acceptable level.

Question #: 464- Under workers' compensation laws:

- 1) The employee has to prove negligence by the employer
2) The amount of compensation is decided by the employee and employer under arbitration
3) The employer assumes responsibility and compensation for accidents, regardless of fault
4) The employee may sue the employer if the compensation provided is not adequate

Answer:3- Under workers' compensation laws, the employer assumes responsibility for all accidents and compensation to the employee, regardless of fault. The employee does not have to prove negligence and is not allowed to sue for damages beyond what is set by the state's workers' compensation law.

Question #: 465- If the chi-square statistic of a sample corresponds to a p of 0.01, what may one infer?

- 1) The result will occur 1% of the time
2) The mean of the sample will occur 1% of the time
3) The result is statistically significant at the p = 0.01 level
4) The result is most likely a matter of chance

Answer:3- A chi-square statistic equal to 0.01 means that the result is statistically significant with a probability of error of 1% (0.01).

Question #: 466- An inductive technique that explores different responses to "challenges" is called:

- 1) **Event tree analysis** 2) Fault tree analysis 3) Logic analysis 4) Bottom-up assessment

Answer:1- An event tree analysis is an inductive technique that explores different responses to "challenges".

Question #: 467- This technique envisions a "primitive" or unprotected system and systematically evaluates the effects of adding various controls through a brainstorming approach.

- 1) Brainstorming 2) Primitive analysis **3) Naked man** 4) Hazard control review

Answer:3- Naked man is the technique that envisions a "primitive" or unprotected system and systematically evaluates the effect of adding various controls through a brainstorming approach.

Question #: 468- A technique that utilizes a method of developing job procedures that includes a systematic task analysis that examines each step, and identifies preventive or corrective actions required to ensure a safe operation is called a(n):

- 1) **Job safety analysis** 2) Task analysis 3) Operability study
4) Systematic task analysis

Answer:1- A job safety analysis is a technique that utilizes a method of developing job procedures that includes a systematic task analysis that examines each step, and identifies preventive or corrective actions required to ensure a safe operation.

Question #: 469- This technique utilizes a six-step process to analyze and control human errors. The process involves selecting an event, identifying the tasks associated with the event, separating specific behaviors of each task and assigning basic error rates. This is called a(n):

- 1) Behavioral assessment
2) Job safety analysis (JSA)
3) Technique for human error rate prediction (THERP)
4) Operability study

Answer:3- "Technique for human error rate prediction", (THERP) utilizes a six-step process to analyze and control human errors.

Question #: 470- A technique that provides formal documentation and feedback to a safety analysis performed on changes to the end product throughout the life cycle is called a:

- 1) Life cycle analysis **2) Change analysis** 3) Project evaluation tree 4) PERT

Answer:2- A change analysis is a technique that provides formal documentation and feedback of safety analyses performed on changes (to the end product) throughout the life cycle.

Question #: 471- The combined couplet of frequency and severity is defined as:

- 1) Accident severity **2) Risk** 3) Incident rate 4) Frequency rate

Answer:2- Risk is universally defined as the combination of frequency and severity, or consequence.

Question #: 472- The uncertainty of risk has which of the following components?

- 1) Likelihood and consequence 2) Consequence and exposure
3) Exposure **4) Exposure, consequence, and likelihood**

Answer:4- Exposure, consequence, and likelihood contribute to the uncertainty of risk.

Question #: 473- Three categories of hazards in hazard analysis studies are:

- 1) Errors of omission, errors of commission, and inherent properties
2) People, machines, and the environment
3) Environmental issues, human and material failure, and inherent properties
4) Material or human failure, environmental failure, and properties

Answer:3- The three broad categories are: environmental issues that create stress, inherent properties that create hazards, and failures of people and materials.

Question #: 474- A FMEA (failure modes and effects analysis) is extremely effective when applied to:

- 1) Multiple failures of a system 2) Multiple failures of a product
3) Single failures of a unit 4) Analyze non-critical events

Answer:3- A FMEA is the right systems safety tool to use to analyze a single failure or a single unit failure. Often FMEA is used in conjunction with a fault tree analysis to evaluate a product's safety. Fault tree logic can identify possible failures and a FMEA can be used to analyze each failure event.

Question #: 475- Which of the following is NOT a formal method for assessing risk?

1) Maintenance Mode Analysis

- 2) Preliminary Hazard Analysis
- 3) Failure Mode and Effects Analysis
- 4) Fault Tree Analysis

Answer:1- Many hazards are still possible in spite of product design efforts. They may result from component failures, malfunctions, operational methods, environments encountered, maintenance, and operation errors. These hazards can be identified by one or more of the analyses listed, all of which serve to accomplish a common function identified as risk assessment. The differences between the listed analyses is in that they occur at different times during a system safety program. A maintenance mode analysis is not a risk assessment method.

Question #: 476- The technique in which the failure or malfunction of each component is considered and the effects of the failure traced upward through the system is identified with:

- 1) **Failure modes and effects analysis**
- 2) Preliminary hazard analysis
- 3) Fault tree analysis
- 4) THERP

Answer:1- A failure modes and effects analysis is an analytical technique in which the failure or malfunction of each component is considered, including the mode of failures. The effects of the failure are traced upward through the entire system and its effect on the system performance is evaluated.

Question #: 477- A system safety analysis can clarify a complex process by:

- 1) Making a step-by-step evaluation of each component that makes up the system
- 2) **Developing a conceptual model of the system**
- 3) Employing the use of applicable statistics
- 4) Both 1 and 3

Answer:2- An analysis of the system can clarify a complex process by devising a chart or model that provides a comprehensive, overall view of the process by showing its principal elements and the ways in which they are interrelated.

Question #: 478- An event tree analysis is best defined as:

- 1) **A method for identifying various possible outcomes**
- 2) A system of numerical analysis
- 3) A method utilizing true and false options
- 4) A system of statistical analysis

Answer:1- An event tree analysis is a logic method that breaks down the possible outcomes of a single event.

Question #: 479- The first step in an event tree analysis is termed the:

- 1) Failure event 2) Primal event 3) Logic inhibit **4) Initiating event**

Answer:4- The initial event in any event tree is termed the "initiating event".

Question #: 480- The effects of the failure are traced through the system and the ultimate effect on task performance is evaluated. This process is called a:

- 1) Preliminary hazard analysis 2) Fault hazard analysis
3) Failure modes and effects analysis 4) Critical item

Answer:3- When the effects of the failure are traced through the system and the ultimate effect on task performance is evaluated, this process is called a failure modes and effects analysis.

Question #: 481- The mobility of a system, subsystem, component or part from performing its function within specified limits, under specified conditions for a specified duration is called (a):

- 1) Malfunction 2) Hazard 3) Risk **4) Failure**

Answer:4- When a system, subsystem, component, or part departs from its intended design parameters, the departure from design is called a failure. For example, if an electric motor is designed to produce 100 horsepower (+/- 1 horsepower) with a 40 amp current draw (+/- 1 amp), then the electric motor has experienced a failure if it produces only 50 horsepower when drawing 50 amps.

Question #: 482- A process to identify hazards and recommend risk reduction alternatives in procedurally controlled activities during all phases of intended use is called a(n):

- 1) Preliminary hazard analysis 2) Risk assessment
3) Operating and support hazard analysis 4) Fault tree analysis

Answer:3- An operating and support hazard analysis is a process to identify hazards and recommend risk reduction alternatives in procedurally controlled activities during all phases of intended use.

Question #: 483- A single item of hardware, the failure of which would lead directly to loss of life, vehicle, or mission is called a:

- 1) Critical hardware item 2) Risk item **3) Single failure point** 4) Failure event

Answer:3- A single failure point is a single item of hardware, the failure of which would lead directly to loss of life, vehicle, or mission.

Question #: 484- Those computer software components whose errors can result in a hazard or loss of predictability or control of a system are called:

- 1) Software code critical 2) Single failure point
3) Unsafe error **4) Safety-critical computer software components**

Answer:4- Safety-critical computer software components are those computer software components whose errors can result in a hazard or loss of predictability or control of a system.

Question #: 485- The formal analysis of a system and the interrelationships among its various parts to determine the real and potential hazards within the system, and to suggest ways to reduce and control those hazards is called a:

- | | |
|----------------------------------|---------------------------------------|
| 1) Fault hazard analysis | 2) Subsystem hazard analysis |
| 3) System hazard analysis | 4) Failure modes and effects analysis |

Answer:3- A system hazard analysis is a formal analysis of a system and the interrelationships among its various parts to determine the real and potential hazards within the system, and to suggest ways to reduce and control those hazards.

Question #: 486- An analysis technique that is used primarily to evaluate multiple failures that may be caused by a single event or causal factor common to or shared by multiple components is a:

- | | |
|--------------------------------------|---|
| 1) Failure modes and effect analysis | 2) Common cause failure analysis |
| 3) Fault hazard analysis | 4) Fault tree analysis |

Answer:2- A common cause failure analysis is an analysis technique that is used primarily to identify a single event or causal factor common to or shared by multiple components. This analysis is looking for failures that can cause multiple "independent" safeguards to fail. For example, a common cause failure of redundant cooling water pumps may be the loss of electricity to both pumps.

Question #: 487- A technique to determine an unintended energy route, which can allow an undesired function to occur, prevent functions from occurring, or adversely affect the timing of functions is called a:

- | | | | |
|----------------------------------|--------------------------|------------------------|------------------------|
| 1) Sneak circuit analysis | 2) Fault hazard analysis | 3) Fault tree analysis | 4) Energy route review |
|----------------------------------|--------------------------|------------------------|------------------------|

Answer:1- A sneak circuit analysis is a technique to determine an unintended energy route that can allow an undesired function to occur, prevent functions from occurring, or adversely affect the timing of functions.

Question #: 488- An example of an inductive analysis is a:

- | | |
|---------------------------|---|
| 1) Fault tree analysis | 2) Failure mode and effects analysis |
| 3) Accident investigation | 4) Qualitative hazard analysis |

Answer:2- Inductive analyses begin with a component or function, and then attempt to determine possible outcomes of failures of the function or component. It is a predictive tool for the user and does not rely on a history of failures to determine the future failures.

Question #: 489- Many of the potential failures of a system can be determined before manufacturing of the product by using a technique known as a:

- | | | | |
|---------------|---------|--------|--------|
| 1) PHA | 2) FMEA | 3) JSA | 4) FHA |
|---------------|---------|--------|--------|

Answer:1- A preliminary hazard analysis is a technique used to conduct an initial hazard evaluation that can then be used to make informed decisions about the product's design and manufacture.

Question #: 490- The system safety technique that starts with an undesired event and analyzes the way the undesired event occurs is:

- 1) SADT **2) Fault tree analysis** 3) PERT 4) Job Safety Analysis

Answer:2- A fault tree analysis starts with the undesired event - the top-level event.

Question #: 491- The most commonly used systems safety analysis technique is:

- 1) Fault tree analysis 2) Failure mode and effect analysis
3) Preliminary hazard analysis 4) Fault hazard analysis

Answer:3- Preliminary hazard analysis is the most common tool used by the systems safety practitioner. It is used at the beginning stages of the development of a product.

Question #: 492- An example of an inductive analysis technique is the:

- 1) Quantitative fault tree analysis 2) Qualitative fault tree analysis
3) Failure Modes, Effects, and Criticality analysis 4) Top-down analysis

Answer:3- FMECA is an example of an inductive analysis.

Question #: 493- Which of the following is not an inductive analysis technique?

- 1) FTA** 2) JSA 3) FMEA 4) FMECA

Answer:1- The fault tree analysis (FTA) is an example of a deductive analysis technique.

Question #: 494- In order to use Boolean logic to simplify the calculations needed to analyze a fault tree:

- 1) An entry can only be in one of two possible modes: on-off, will occur-will not occur, closed-not closed**
2) Intermediate conditions can be expressed and analyzed
3) Events are dependent on each other
4) Cause-effect relationships are never used

Answer:1- Entries are either on or off and can have no intermediate condition for a fault tree to be analyzed using Boolean logic.

Question #: 495- When determining the relative safety of a product using fault tree analysis, a quick way to evaluate this safety is to:

- 1) Count the number of "OR" gates
2) Subtract the number of "OR" gates from the number of "AND" gates
3) Count the number of "AND" gates
4) Add the total number of gates in the tree except for the "inhibit" gates

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Answer:3- "AND" gates require that all events must occur in order for the failure to occur therefore, the probability of failure is the product of all the individual input probabilities. This value is much smaller than from the same events going through an "OR" gate .

Question #: 496- A bleeder valve on a furnace fails after 20,000 days of operation. If the valve operates once per day what has been its success rate?

- 1) 0.99995 2) 0.99999 3) 0.99900 4) 0.99000

Answer:1- Success Rate = 19,999 successes / 20,000 attempts = 0.99995 success rate

Question #: 497- A bleeder valve on a furnace fails after 20,000 days of operation. If the valve operates once per day, what is its failure rate?

- 1) 1×10^{-4} 2) 5×10^{-4} 3) 1×10^{-5} 4) 5×10^{-5}

Answer:4- Failure Rate = 1 failure / 20,000 attempts = 0.00005 = 5×10^{-5}

Question #: 498- A door hinge fails 4 times out of 1,000,000 operations. What is the failure rate?

- 1) 4×10^{-7} 2) 4×10^{-9} 3) 4×10^{-6} 4) 4×10^{-5}

Answer:3- Failure Rate = 4 failures / 1,000,000 attempts = 4×10^{-6}

Question #: 499- A door hinge fails 4 times out of 1,000,000 operations. What is its success rate?

- 1) 99.9996×10^{-2} 2) 99.9999×10^{-2} 3) 99.9×10^{-3} 4) 99×10^{-2}

Answer:1- Success Rate = 999,996 successes / 1,000,000 attempts = 0.999996 = 99.9996×10^{-2}

Question #: 500- A switch has 4 components. Each has a failure rate of "a". The components are connected in series. What is the switch's failure rate?

- 1) $(4a) + 1$ 2) a^4 3) $4a$ 4) $a(a+4)$

Answer:3- For n components in series, the overall failure rate is the sum of the single components' failure rates.

Question #: 501- Two valves are in series. Valve "A" has failure rate of 1×10^{-3} . Valve "B" has a failure rate of 1×10^{-2} . What is failure rate of the system?

- 1) 1×10^{-2} 2) 1×10^{-3} 3) 1×10^{-5} 4) 1×10^{-10}

Answer:1- Since the valves are in series, you must add the failure rates.
Failure Rate = $1 \times 10^{-2} + 1 \times 10^{-3} = 1.1 \times 10^{-2}$

Question #: 502- A boiler has three valves in series that have failure rates of: 3×10^{-3} ; 8×10^{-4} ; 2×10^{-4} . What is the overall failure rate of the system?

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- 1) 48×10^{-11} 2) 13×10^{-11} 3) 48×10^{-3} **4) 4×10^{-3}**

Answer:4- Add the failure rates of components in series.

$$\text{Failure Rate} = 3 \times 10^{-3} + 8 \times 10^{-4} + 2 \times 10^{-4} = 4 \times 10^{-3}$$

Question #: 503- An airplane landing gear has 4 components in parallel with failure rates of 1×10^{-5} , 1×10^{-8} , 1×10^{-8} , and 1×10^{-9} , respectively. What is the approximate failure rate?

- 1) 1×10^{-37} **2) 1×10^{-30}** 3) 4×10^{-8} 4) 3×10^{-8}

Answer:2- Multiply the failure rates for parallel construction.

$$\text{Failure Rate} = (1 \times 10^{-5})(1 \times 10^{-8})(1 \times 10^{-8})(1 \times 10^{-9}) = 1 \times 10^{-30}$$

Question #: 504- The heart of the systems safety approach is the:

- 1) Failure analysis **2) Hazard analysis**
3) Charting and modeling 4) Structural analysis

Answer:2- Hazard analysis is the heart of the system safety approach. An effective hazard analysis effort over the life cycle of a system is the spine on which all body components of a safety program are attached. Anticipating and controlling hazards at the design stages of an activity is the cornerstone of a system safety effort. "System Safety Engineering and Management" by Harold E. Roland and Brian Moriarity

Question #: 505- A product safety factor is defined as:

- 1) The extra margin of safety over intended use** 2) The product "Safeness"
3) The product's cost factor override 4) Amount of product liability insurance needed

Answer:1- The product safety factor is that extra margin of safety designed into the product over and above its intended use.

Question #: 506- All of the following are examples of redundant design philosophy EXCEPT:

- 1) Series 2) Single parallel 3) Double parallel **~~4) Boolean design~~**

Answer:4- Series, single parallel, and double parallel are all examples of redundant design philosophy.

Question #: 507- What is critically needed prior to conducting a formal system safety analysis?

- 1) System models** 2) Management cooperation 3) Detailed engineering drawings
4) Liability transfer

Answer:1- A system safety analysis must have models of the involved system. Before analysis of safety can be made, a model of the system must be constructed.

Question #: 508- To increase the reliability of a process, which of the following methods would LEAST likely be used?

- 1) Design parallel components **~~2) Design complementary components~~**
3) Design redundancy into the system 4) Design series components

Answer:2- Parallel and series design, as well as redundancy, are all appropriate methods for increasing the reliability of a system.

Question #: 509- What is a bathtub curve?

- 1) New product innovation cycle 2) Failure rate analysis showing a spiraling rate of failure
3) Typical failure rate over the life of a product 4) A typical failure rate over the life of a product

Answer:3- The bathtub curve traces the typical failure rate of a product over time.

Question #: 510- If a 5 hp, 220 V electric motor runs for 8 hr per day, and electricity costs 12 cents per kWh, what is the daily electricity cost to run the motor?

- 1) \$0.45 2) \$3.58 3) \$1.79 4) \$45.00

Answer:2- Convert hp to W. (1 hp = 0.745699872 kilowatts)

$$5 \text{ hp} = 3,730 \text{ W} = 3.725 \text{ Kw}$$

$$8 \text{ hr/day} * 3,730 \text{ W} = 29,840 \text{ W-hr per day} = 29.84 \text{ kWh per day}$$

$$29.84 \text{ kWh} * \$0.12 \text{ per kWh} = \$3.58 \text{ per day.}$$

Question #: 511- What is the daily electric cost of a 60 W light bulb on a 110 V circuit if the light is on for 9 hours per day and electricity costs 17.5 cents per kWh?

- 1) 1.11 cents per day 2) 3.21 cents per day 3) 6.32 cents per day **4) 9.45 cents per day**

Answer:4- (60 W/ 1,000 W per kWh) * 9 hr (\$0.175 per kWh) = \$0.0945

Question #: 512- A load of 500 lb is supported by a two-leg sling. If the legs of the sling make an angle of 60° with the load, what force is exerted on each leg of the sling?

- 1) 144.3 lb **2) 288.7 lb** 3) 433.0 lb 4) 500.0 lb

Answer:2- Use the sine trigonometric identity.

Total load is divided by 2 because we have a two-leg sling.

sine of angle = opposite leg length / hypotenuse leg length

$$\sin 60^\circ = 250 \text{ lb} / \text{hypotenuse leg length} \quad 0.8660 = 250 \text{ lb} / \text{hypotenuse leg length}$$

$$\text{hypotenuse leg length} = 250 \text{ lb} / 0.8660 = 288.68 \text{ lb}$$

Question #: 513- A pulley system consisting of 3 fixed and 2 movable pulleys is being used to raise a 500 lb load to a height of 20 ft. Neglecting friction, how much effort must be exerted?

- 1) 100 lb** 2) 125 lb 3) 250 lb 4) 500 lb

Answer:1- As there are five ropes holding up the load, the mechanical advantage is 5.

NOTE: The distance is irrelevant to the effort needed.

$$F (\text{effort}) = W (\text{weight}) / MA (\text{mechanical advantage}) \quad F = W/MA \quad F = 500 \text{ lb} / 5 = 100 \text{ lb}$$

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Question #: 514- A 1,000 lb load is lifted with a two-leg sling whose legs are at a 30° angle with respect to the load. The stress on each leg of the sling is:

- 1) 500 lb 2) 577 lb **3) 1,000 lb** 4) 2,000 lb

Answer:3- Use the sine trigonometric identity.

The vertical component of each sling supports 500 lb (1,000 lb / 2).

sine of angle = opposite leg length / hypotenuse leg length

$\sin 30^\circ = 500 \text{ lb} / \text{hypotenuse leg length}$ $0.5000 = 500 \text{ lb} / \text{hypotenuse leg length}$

hypotenuse leg length = 1,000 lb

Question #: 515- Given a two-leg sling (each leg makes a 60° angle with respect to the load) supporting 20,000 lb, what is the tension on the left sling leg?

- 1) 8,754 lb 2) 9,967 lb **3) 11,547 lb** 4) 12,333 lb

Answer:3- Remember that you must divide the load by 2 because this is a two-leg sling. Your sketch should include a figure with a triangle with 10,000 lb as the side opposite the 60° angle. The hypotenuse leg (the tension in the sling leg itself) is calculated using the sine trigonometric identity.

sine of angle = opposite leg length / hypotenuse leg length

$10,000 \text{ lb} / \sin 60^\circ = 10,000 \text{ lb} / 0.8660 = 11,547 \text{ lb}$

Question #: 516- A crane is lowering a 1,500 lb load to the ground. The operator applies the brakes causing the cable to break. What is the maximum tension on the cable if the breaking acceleration is 50 ft/sec²?

- 1) 2,344 lbs. 2) 3,486 lbs. **3) 3,844 lbs.** 4) 6,224 lbs.

Answer:3- $F = \text{force}$, $W = \text{weight}$, $G = \text{gravity constant}$, $A = \text{acceleration}$

Use the formula: $F = (W/G)A$ $= (1500 \text{ lbs} / 32 \text{ ft/sec}^2)(50 \text{ ft/sec}^2)$
 $= 2344 \text{ lbs} + 1500 \text{ lbs (Load)} = 3844 \text{ lbs}$

Question #: 517 - A procedure analysis is a product evaluation technique that is similar to:

- 1) Accident investigation. **2) Job safety analysis**
3) Failure modes and effects analysis 4) Preliminary hazard analysis

Answer:2- The techniques of a procedure analysis are similar to those of a job safety analysis except that in a JSA one identifies the actions the employee might take that could injure himself/herself, injure a fellow employee, or do damage to the operations. In a procedure analysis, the evaluator looks for procedures that the employee might use in the manufacturing of a product that could induce a hazard in the product.

Question #: 518- What is a CMMS?

- 1) A strategy for managing occupational safety in a construction environment
2) A computerized data management system for tracking equipment maintenance tasks
3) A computerized chemical safety management system
4) A method for managing compliance with Minerals Management Service regulations

Answer:2- CMMS stands for computerized maintenance management system. It is designed to assist maintenance and operations professionals with tracking equipment maintenance tasks and equipment history.

Question #: 519- Elements of a hazardous waste manifest include all of the following EXCEPT:

- 1) ~~Liability insurance company~~
- 2) Manifest number
- 3) EPA identification number
- 4) Total quantity of waste generated

Answer:1- A manifest does not require an insurance company number. It does require manifest number, EPA ID number, and total quantity of waste.

Question #: 520- What is the fundamental objective that a developer of a form, report, or other written instrument must remember?

- 1) The needs of the end user of the written instrument
- 2) The needs of the one who will read the written instrument
- 3) The needs of the ones described by the written instrument
- 4) **All of the above**

Answer:4- A developer must balance these three needs when creating forms, reports, and other written instrument.

Question #: 521- There are several safety-related uses for personal computers. Considering the vast amount of information relating to safety, computers should allow safety practitioners, employees, and supervisors access to anything to mitigate risks. Of the following, what is one of the most critical pieces of safety-related information that company employees should have computer access to?

- 1) OSHA-reportable/recordable injury and illness statistics
- 2) **Near miss/lessons learned data**
- 3) Company occupational accident rates, by plant
- 4) Company occupational illness rates, by department

Answer:2- Of these, the information that is extremely helpful is the kind which helps in PREVENTING future accidents - near miss and lessons learned data. Unfortunately, most companies do a very poor job of tracking this type of information, let alone granting employees computer access to it. The other information in Answers 1, 3, and 4 is somewhat helpful for employees to have on a computer; however, real-time access to historical data is only marginally useful in preventing future accidents.

Question #: 522- Heinrich's ratio of no-injury accidents to minor injuries to major injuries is:

- 1) 100-20-1
- 2) 200-30-10
- 3) **300-29-1**
- 4) 600-58-1

Answer:3- Heinrich wrote that for every 300 no-injury accidents, there are 29 minor injuries accidents and 1 major injury accident.

Question #: 523- In 1931, Heinrich significantly changed the thinking of safety professionals. He:

1) **Shifted emphasis from conditions to actions** 2) Suggested the use of JSA to analyze accidents 3) Applied forensic science to accident analysis 4) Proposed monetary penalties for accidents

Answer:1 - In the early 1900's, employers concentrated more on the inspection of the workplace. Heinrich suggested that more emphasis be placed on the actions of employees.

Question #: 524- It is generally accepted that accidents:

- 1) Are all preventable
- 2) Are preventable about 50% of the time
- 3) Are unexpected events that cannot be controlled
- 4) **Can generally be prevented, but where absolute prevention is not possible, steps can be taken to reduce accident severity**

Answer:4- Each of the answers is a history of accident prevention. The prevalent concept in the early 1900's was that no more than 50% of all accidents were preventable. In the 1940's, it changed to a concept that all were preventable, and finally to today's more realistic theory that not all accidents can be prevented, but in those cases where absolute prevention is not possible, steps can be taken to reduce the severity of the damage or injury.

Question #: 525- Your company's chief executive officer feels that she has too many employees reporting directly to her (among whom is you, the safety director). She has asked your opinion about where in the organizational structure is the best place from which the safety function should report? Your opinion is:

- 1) Safety should report through Human Resources
- 2) Safety should report through Procurement Support
- 3) Safety should report Production Operations
- 4) **Safety should remain on the chief executive officer's staff**

Answer:4- Safety should report to a function with the authority and the control to correct company-wide safety problems. Therefore, the safety function should continue reporting to the chief executive officer.

Question #: 526 - Until the widespread availability of inexpensive personal computers, the information associated with safety-related facility and site inspections and surveys was difficult to maintain. Of the following, what is the best use of the personal computer to manage information from these endeavors?

- 1) Organizing and categorizing findings
- 2) Maintaining an up-to-date list of responsible supervisors
- 3) **Tracking and following up on the results of recommendations and corrective actions**
- 4) Allowing for consistent documentation and reports

Answer:3- Though all of these have benefits, the key advantage to using personal computers is the ability to track and verify that recommendations and corrective actions are being addressed in a timely fashion. The key purpose of inspections and surveys is to prevent accidents, and the implementation of these corrective actions and recommendations is management's window to verifying that these identified risks have been addressed.

Question #: 527 - The following clause from the OSH Act of 1970 is known as: "...of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm to his employees"

- 1) "Recognized hazard clause" **2) "General duty clause"**
- 3) "General hazard clause" 4) "Death or injury clause"

Answer:2 - This clause gives OSHA broad regulatory license. It is known as the "general duty clause". If there is a serious hazard for which OSHA does not have a specific standard, and OSHA compliance officer can cite the employer using the General Duty Clause, thus requiring the hazard to be abated.

Question #: 528- Which of the following common law causes of action is NOT used to pursue legal remedies in hazardous waste/hazardous materials, or "toxic tort", damage suits?

- 1) Negligence 2) Nuisance and trespass 3) Strict liability for ultra-hazardous activities
- 4) *Corpus delicti***

Answer:4- Answers 1, 2, and 3 are legal instruments that are available to plaintiffs in toxic tort suits for damages from hazardous materials/wastes releases or exposure.

Question #: 529- At one time, a plaintiff could not recover damages unless the injury was due to physical contact. This principle is called:

- 1) Forseeability 2) Negligence per se
- 3) Fright without physical contact** 4) Proximate cause

Answer:3- Fright without physical contact is the principle that a plaintiff could not recover damages unless the injury was due to physical contact.

Question #: 530- When an injured person's care for his own safety was less than reasonable for a prudent man under existing conditions, he is considered negligent and the defendant will not be held liable. This principle is called:

- 1) Gross negligence **2) Contributory negligence** 3) Comparative negligence 4) Strict liability

Answer:2- Contributory negligence is the principle that an injured person's care for his own safety was less than reasonable for a prudent man under existing conditions. He is considered negligent and the defendant will not be held liable.

Question #: 531- Every person has a legal duty to exercise due care for the safety of others and to avoid injury to others if possible. This principle is called:

- 1) Exercise of due care** 2) Slight care 3) Non gross negligence 4) Great care

Answer:1- Exercise of due care is the principle that every person has a legal duty to exercise due care for the safety of others and to avoid injury to others if possible.

Question #: 532- A standard applying to a particular industry with specifications that relate to individual operations is termed a:

- 1) Design std. 2) Performance std. **3) Vertical standard** 4) Horizontal standard

Answer:3 - A vertical standard pertains only to a particular industry (e.g., OSHA requirements for pulp, paper, and paperboard mills).

Question #: 533- Which of the following statements about regulatory standards is INCORRECT?

- 1) Regulatory standard are developed by a federal agency such as OSHA
2) Regulatory standards can be developed by state level agencies
3) Regulatory standards are enforceable
4) ~~Regulatory standards are voluntary~~

Answer:4 - Regulatory standards are mandatory. If voluntary, they are not standards.

Question #: 534- The "Whirlpool" decision of the U.S. Supreme Court dealt with:

- 1) Employee right to refuse life-threatening work** 2) Employee right to refuse a respirator
3) Employee right to refuse medical exam 4) Employee right to request an OSHA inspection

Answer:1- The "Whirlpool" decision established an employee's right to refuse life- threatening work.

Question #: 535- The first legally upheld workers' compensation law was in which state:

- 1) Minnesota **2) Wisconsin** 3) Massachusetts 4) Alabama

Answer:2- Wisconsin had the first workers' compensation law.

Question #: 536 - The first state to utilize factory inspectors was:

- 1) Massachusetts** 2) Illinois 3) Minnesota 4) Wisconsin

Answer:1- Massachusetts was the first state to have factory inspectors in 1867.

Question #: 537 - The most dangerous industry from the 19th to the 20th century was:

- 1) Automobile manufacturing **2) Mining** 3) Railroad 4) Construction

Answer:2 - Mining has been (and still is) one of the most dangerous industries in the United States. Fire fighting, construction, and logging also remain high on the list.

Question #: 538- What was one of the first incentives for management to ensure safe working conditions for employees?

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- 1) The Occupational Safety and Health Act
- 3) Reduction of insurance premiums

- 2) **Workers' compensation legislation**
- 4) Increased productivity

Answer:2- In 1911, the Wisconsin workers' compensation law was the first law of its kind that required compensation for injuries which occurred on the job, without regard to fault.

Question #: 539- A Phase I environmental site assessment typically includes the following activities EXCEPT:

- 1) Inspect the property, review environment records, and assess chemical handling and disposal practices
- 2) Aerial photo search and review of past ownership
- 3) Determine whether the subject or surrounding properties are identified on any government lists of contaminated sites, or lists of sites requiring investigation, clean-up, and/or enforcement.
- 4) ~~Aerial hydrogeologic analysis~~

Answer:4 -Phase I environmental site assessments, a common term for the initial investigation in industrial property transfers, includes the listed activities in Answers 1, 2, 3, and others as well. It does not involve aerial analysis of the hydrogeology.

Question #: 540 -Phase I environmental assessments should include, but are not limited to:

- 1) Historical review of the uses(s) and improvement(s) made to the subject site
- 2) An investigation of subject and neighboring properties with respect to environmental enforcement actions and/or listing on federal or state contaminated property lists
- 3) Evaluation of whether present or past owners or tenants have managed hazardous materials or wastes on-site
- 4) **All of the above**

Answer:4 - Phase I environmental site assessments, as state of the art is currently defined, should include each of the above listed activities.

Question #: 541- In the RCRA program, UTS refers to:

- 1) Underlying treatment standards
- 3) Universal technology standards
- 2) **Universal treatment standards**
- 4) Universal technical standards

Answer:2 - Universal treatment standards are one of the key regulatory reforms of the Land Disposal Restrictions program found at 40 CFR 268. The universal treatment standards are the regulatory mechanism whereby a single ("universal") maximum allowable concentration is established for each regulated constituent in wastes that are hazardous at the point of generation, regardless of the waste code(s) carried by the waste. In other words, the concentration limit for the constituent chromium for land disposal purposes would be the same regardless of whether the waste was F006 or K051. Distinctions are still made between wastewater and non-wastewater forms of particular waste codes. The universal treatment standards were introduced in the so-called Phase II LDR final rule, appearing in the September 19, 1994 Federal Register, at 59 FR 47982-48110. The UTS are found at 40 CFR 268.48, appropriately entitled "Table UTS - Universal Treatment Standards". The Phase II rule went into effect on December 19, 1994.

Question #: 542 - A TLV-TWA is defined as:

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1) A time-weighted average concentration for a normal 8-hour workday and 40 hour work week to which all workers can be exposed continuously, day after day, without effect.

2) A time-weighted average concentration for a normal 8-hour workday and 40-hour work week, to which nearly all workers can be repeatedly exposed, day after day, without adverse effect

3) A relative index of toxicity

4) Both 2 and 3

Answer:2 - TLV-TWA is a time weighted average concentration for a normal 8-hour workday and 40-hour work week, to which "nearly" all workers can be repeatedly exposed, day after day, without "adverse" effect.

Question #: 543- TLV-STEL is the concentration to which workers can be exposed for a short period of time without suffering from the following, EXCEPT:

1) Dermatitis 2) Irritation 3) Chronic or irreversible tissue damage 4) Narcosis

Answer:1- Dermatitis is not a factor in definition of the TLV-STEL, and therefore, employees may suffer from some dermatitis. A STEL exposure should NOT result in irritation, chronic or irreversible tissue damage, and narcosis of sufficient degree to increase the likelihood of accidental injury, impair self-rescue, or materially reduce work efficiency (provided that the 8-hour TWA-TLV was not exceeded).

Question #: 544 - A STEL is defined as a ____ minute TWA exposure which should not be exceeded at any time during the workday.

1) 1

2) 5

3) 10

4) 15

Answer:4- Exposures above the TLV-TWA up to the short term exposure limit (STEL) should be no longer than 15 minutes. The 15-minute STEL is a time weighted average exposure which should not be exceeded even if the 8-hour TWA is within the TLV- TWA.

Question #: 545- Exposures up to the TLV-STEL should not be longer than 15 minutes and should not occur more than:

1) Once per day

2) Twice per day

3) Four times per day

4) Eight times per day

Answer:3- Employees should not be exposed to the 15 minute STEL more than four times per day. There should be at least an hour between successive exposures.

Question #: 546- TLV-C stands for:

1) Threshold Limit Value-Concentration

2) Threshold Limit Value-Ceiling

3) Threshold Limit Value-Carcinogen

4) Threshold Limit Value-Corrected

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Answer:2- The Threshold Limit Value-Ceiling is the concentration that should not be exceeded during any part of the working exposure period.

Question #: 547- Excursions in worker exposure levels may exceed ___ times the TLV-TWA for no more than ___ minutes during a workday.

- 1) 1, 10 2) 2, 20 **3) 3, 30** 4) 5, 50

Answer:3- Excursions in worker exposure levels may exceed 3 times the TLV-TWA for no more than 30 minutes during a workday. This is based upon a geometric standard deviation of 2.0, in which 5% of all values will exceed 3.13 times the geometric mean.

Question #: 548- The main source of fire standards/codes used in the United States is promulgated by:

- 1) ANSI **2) NFPA** 3) OSHA 4) UL

Answer:2- The National Fire Protection Association (NFPA) is the main source of fire standards/codes in the United States.

Question #: 549 - Explosion proof apparatus is intended for what class of locations?

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

Answer:1- Explosion proof apparatus is intended for Class I locations, while dust- ignition-proof equipment is primarily intended for Class II and III locations. NFPA 70 Article 500-2 (National Electric Code)

Question #: 550- Common law requires employers to:

- 1) Provide a workplace free of hazards
- 2) Compensate employees for workplace injuries
- 3) Provide a workplace that is reasonably safe**
- 4) Applies to employees NOT employers

Answer:3- Common law only requires the employer to provide a workplace that is reasonably safe.

Question #: 551- What frequency range of hearing loss is generally considered compensable under workers' compensation?

- 1) 500 - 2,000 Hz** 2) 10,000 - 20,000 Hz 3) 3,000 - 4,000 Hz 4) 0 - 500 Hz

Answer:1- The range most important for speech is 500 to 2,000 Hz. Significant losses in this frequency range often result in compensation eligibility.

Question #: 552- What is the limit of hearing damage, currently suggested by the American Medical Association (AMA), before compensation should be awarded?

- 1) 15 dB loss at 2,000, 3,000, and 4,000 Hz octave bands
- 2) 25 dB loss at 2,000, 3,000, and 4,000 Hz octave bands
- 3) 25 dB loss at 500, 1,000, and 2,000 Hz octave bands**
- 4) 15 dB loss at 500, 1,000, and 2,000 Hz octave bands

Answer:3- If the average monaural hearing level at 500, 1,000, and 2,000 Hz is 25 dB or less, the AMA guide states that usually no impairment exists in the ability to hear everyday speech under everyday conditions. If there is more than 25 dB in loss, then compensation is suggested.

Question #: 553- The standard error of the mean:

- 1) Is always less than the population standard deviation
- 2) Cannot be determined if the population standard deviation is not known
- 3) Increases as the sample size increases
- 4) None of the above**

Answer:4 - In general, Answer 1 is true. However, if the sample size is 1, the standard error of the mean is the standard deviation.

Answer 2 is not true because the standard error of the mean can be determined by using a point estimate derived from a sample standard deviation. The standard error of the mean decreases as the sample size increases.

Question #: 554 - When dealing with outliers in statistical data sets one should:

- 1) Always eliminate them from consideration since it is obvious that a mistake has been made
- 2) Be suspect but always give careful consideration before discarding them**
- 3) Rerun the experiment or take a new sample
- 4) Include them in the analysis since there is no way to determine how they appear

Answer:2- There are many sources of outliers including instrument failure, errors in reading instruments, poor experimental design, etc. But it is always possible there is something going on that would legitimately produce that result. Since they can have a considerable influence on the data set they should always be carefully considered before being accepted or summarily discarded.

Question #: 555- Inferential statistics can best be described as:

- 1) Setting up an experimental design for collecting data to be analyzed
- 2) Organizing, presenting, and analyzing data
- 3) Making predictions from data
- 4) Predicting the probabilities of certain events occurring in a population**

Answer:4- Answer 4 is a basic definition of inferential statistics. We are concerned with predicting or inferring something about a population usually based on a sample. While it may be tempting to pick Answer 3, Answer 4 is the best answer.

Question #: 556- Which of the following measures is likely to be the best measure of central tendency in a skewed (or non-symmetric) distribution?

- 1) Mean **2) Median** 3) Mode 4) They are all affected equally

Answer:2- A measure of central tendency is a number which represents the "average" value for a set of scores. The MEAN is computed by summing all the scores and dividing by the number of scores. The MODE is the most frequently-occurring score in a distribution. The MEDIAN is computed by rank-ordering all the scores and taking the one which is sequentially in middle. When a distribution of scores is "normal" and not skewed, the mean, median and mode are all the same score. When the distribution is skewed, they all differ. Under these conditions, it is generally accepted that the median is less affected than the other measures of central tendency.

Question #: 557- What is the best definition regarding percentiles that defines the interquartile range?

- 1) The 95th percentile
2) The range from the 25th to the 75th percentiles
3) The 5th percentile
4) The "average range"

Answer:2 - Answer 1 is incorrect. This means that 95% of the subjects fall within this percentile. Answer 3 is incorrect. This means that 5% of the group falls within this number.

Question #: 558- If variable 1 and variable 2 are highly correlated with one another ($r = 1.0$), this means:

- 1) Variable 1 causes variable 2 2) Variable 2 causes variable 1
3) Both 1 and 2 **4) None of the above**

Answer:4- Even if two variables are perfectly correlated with one another ($r = 1.0$), we cannot say that one CAUSES the other. For all we know, a third variable may be responsible for the observed correlation. A correlation coefficient simply indicates the degree to which two variables covary. As such, you can generate correlations between any two measurable things (e.g., the amount of rainfall in Burma with the number of baseball tickets sold in New York). Such correlations might not be interesting, but it is still possible to compute them even though they have no conceivable causal relationship to one another.

Question #: 559- If two variables (1 and 2) have a correlation of $r = -0.09$, this would be considered a:

- 1) Strong, direct correlation 2) Weak, direct correlation
3) Strong, inverted correlation **4) Weak, inverted correlation**

Answer:4- Correlation coefficients can range from -1.0 to 1.0. The negative value indicates that the correlation is inverted. The correlation of -0.09 indicates that the relationship between the two variables is very weak.

Question #: 560- The mode is defined as:

- 1) The average of all the numbers in a sequence
- 2) The value which appears most frequently in a sequence**
- 3) The difference between the highest and lowest values in a sequence
- 4) The value in a sequence for which there are an equal number of values greater than the value and less than the value

Answer:2- The mode is defined as the value in a sequence which appears most frequently. The median is the number in the middle of a sequence and average or mean is an arithmetic average of the sum of the numbers divided by the number (n) in the set.

Question #: 561- The median is defined as:

- 1) The average of all the numbers in a sequence
- 2) The number which appears most frequently in a sequence of numbers
- 3) The difference between the highest and lowest values in a sequence
- 4) The value in a sequence for which there are an equal number of data points greater than the value and less than the value**

Answer:4- The median is defined as the value in a sequence for which there are an equal number of data points greater than the value and less than the value. The mean is the arithmetic average of the set and the mode is the number in the set which appears most frequently.

Question #: 562- The standard deviation is:

- 1) A measure of the average distance of all observations from the mean**
- 2) A measure of the average distance of all observations from the median
- 3) A constant which accounts for randomness
- 4) Not useful when working with normal distributions

Answer:1- The standard deviation is a measure of the average distance of all observations from the mean.

Question #: 563- In a normal distribution, approximately 95.4% of the observations will fall between:

- 1) The median plus or minus one standard deviation
- 2) The median plus or minus two standard deviations
- 3) The mean plus or minus one standard deviation
- 4) The mean plus or minus two standard deviations**

Answer:4- In a normal distribution, 95.4% of the observations will fall between the mean plus or minus two standard deviations.

Question #: 564- In a normal distribution, about 68.3% of the observations will fall between:

- 1) The median plus or minus one standard deviation
- 2) The median plus or minus two standard deviations
- 3) The mean plus or minus one standard deviation**
- 4) The mean plus or minus two standard deviations

Answer:3- In a normal distribution, about 68.3% of observations will fall between the mean plus or minus one standard deviation.

Question #: 565- The geometric mean:

- 1) Is synonymous with the arithmetic mean
- 2) Is used when evaluating log normally distributed data**
- 3) Is the median of log normally distributed data**
- 4) Both 2 and 3

Answer:4 - The geometric mean is used when evaluating log normally distributed data and is equal to the median of the log normally distributed data. The geometric mean is the square root of the product of all of the data points.

Question #: 566- Which of the following is TRUE about a normal distribution?

- 1) It is symmetric around the mean
- 2) It can be characterized by the mean and the standard deviation
- 3) It is also known as a Gaussian distribution
- 4) All of the above

Answer:4- A normal, or Gaussian, distribution is symmetrical around the mean and is completely characterized by the mean and standard deviation.

Question #: 567- What is the advantage of the use of historical control groups in toxicology studies?

- | | |
|----------------------------------|-----------------------------|
| 1) No concurrent controls needed | 2) Statistical value |
| 3) Cost savings | 4) There is no advantage |

Answer:2- In the event of a non-statistically significant increase in a rare tumor type in treated animals, a low level or lack of occurrence in historical controls gives greater biological validity to the finding. Use of only a concurrent control group which is usually smaller might have resulted in dismissal of the effect as due to chance alone.

Question #: 568- Of the following, the LEAST likely principle value of accident statistics is:

- | | |
|--------------------------------|---|
| 1) Measurement of performance | 2) Determining trouble spots |
| 3) OSHA reporting requirements | 4) Lower worker's compensation costs |

Answer:4- Accident statistics are used to measure performance, detect trouble spots, and fulfill OSHA record-keeping requirements.

Question #: 569- You passed the CSP Examination with a score of 192. The cumulative statistics for this examination are as follows: The mean score is 180 and the standard deviation is 32. Assuming a standard distribution, how many safety practitioners taking the exam scored higher than you scored?

- 1) 35.4% 2) 37.5% 3) 40.2% 4) 64.6%

Answer:1

$$z = (X - \mu) / s = (192 - 180) / 32 = 0.375$$

With a z of 0.375, refer to the Table of the Normal Distribution and determine the area under the curve associated with a z of 0.375.

To do this, select 0.3 under the "z" column. Go over to the "7" column along the row of z = 0.3 (representing a z of 0.37). The area for z = 0.37 is 0.1443. The area for z = 0.38 is 0.1480. Interpolate these two numbers (take the average). This is the area under the curve for z = 0.375.

$$\text{Area} = (0.1443 + 0.1480) / 2 = 0.14615$$

Since we are interested in ALL folks who have scored higher than you, we have to add the area under the curve less than the mean to the area we just calculated that falls above the mean. This means that we have to add 0.50000 to the area we calculated above.

$$\text{Total Area} = 0.50000 + 0.14615 = 0.64615$$

$$\begin{aligned} \text{The percentage of folks who scored higher than you scored} &= 1 - \text{Total Area} \\ &= 1 - 0.64615 \\ &= 0.35385 \\ &= 35.4\% \text{ scored higher} \end{aligned}$$

Question #: 570- Descriptive statistics can best be defined as statistics that:

- 1) Deal with methods of planning the observation
- 2) Summarize population data
- 3) Make generalizations based on sample data
- 4) Provide information about individuals rather than groups

Answer:2- Descriptive statistics is the branch of statistics that deals with methods that help to classify, summarize, and present the results of observations in forms that are comprehensible and likely to be suggestive of fruitful hypotheses.

Question #: 571- What is the preferred method for measuring variability in statistical analysis?

- 1) Arithmetic mean **2) Standard deviation** 3) Absolute dispersion 4) Mean square

Answer:2- The standard deviation is the most widely used measure of dispersion (or variability, or spread). The computation of the standard deviation is based on, and is representative of, the deviations of the individual observations about the mean of those values.

Question #: 572- In Boolean logic and its application, the LEAST likely definition for a set is:

- 1) A group of objects having at least one characteristic in common
2) A collection of ideas having at least one characteristic in common
3) A collection of mathematical relationships having at least one characteristic in common
4) A group of objects having no characteristics in common

Answer:4- Boolean algebra was developed originally for the study of symbolic logic. Its rules and expressions in mathematical symbols permit complicated propositions to be clarified and simplified. In Boolean algebra, a set is a group of objects having at least one characteristic in common. The set may be a collection of objects, conditions, events, symbols, ideas, or mathematical relationships.

Question #: 573- A process of examining any system, design, or operation to discover inherent hazards, characterizing them as to the level of risk, and identifying risk-reduction alternatives is called a:

- 1) Failure modes and effects analysis 2) Job safety analysis
3) Fault tree analysis **4) Hazard analysis**

Answer:4- A hazard analysis is the process of examining a system, design, or operation to discover inherent hazards, characterizing them as to the level of risk, and identifying risk-reduction alternatives. Of course, there are several TYPES of hazard analysis techniques.

Question #: 574- A successful research study is characterized by which of the following?

- 1) The study must include random samples
2) The study and control groups must show the same results
3) Variables for the study and control group must be controlled by one person
4) Evidence of the study must be reproducible by others

Answer:4- If results of a study cannot be reproduced by other independent researchers, the study has questionable validity.

Question #: 575- Safety sampling is a technique using statistics to measure:

- 1) Accidental injury/illness performance

2) The effectiveness of line manager safety activities

- 3) The risk potential for accidental injury/illness
4) Both 1 and 3

Answer:2- Safety sampling measures the effectiveness of line manager safety activities - but not in terms of accidents. It measures effectiveness by conducting periodic samplings of how safely the employees are working. Safety sampling is based on the quality control principle of random sampling inspection. The degree of accuracy is dictated by the number of samples taken.

Question #: 576- In probability, if order is important, a permutation is used. What is the formula for a permutation?

- 1) $P = N! / (N - X)!$ 2) $P = N! / [X! (N - X)!]$ 3) $P = X! / (X - N)!$ 4) $P = X! / [N! (X - N)!]$

Answer:1- The formula for a permutation is: $P = N! / (N - X)!$

Question #: 577- In probability, if order is not important, a combination is used. What is the formula for a combination?

- 1) $C = N! / (N - X)!$ 2) $C = N! / [X! (N - X)!]$ 3) $C = X! / (X - N)!$ 4) $C = X! / [N! (X - N)!]$

Answer:2- The formula for a combination is: $C = N! / [X! (N - X)!]$

Question #: 578- Which one of the following is not ALWAYS true?

- 1) $A + B = B + A$ 2) $(A + B) + C = A + (B + C)$ 3) If $A = B$ and $B = C$, then $A = C$
4) ~~If $A = B$ and $C = D$, then $A - C = A - D$~~

Answer:4- Under SOME conditions, Answer 4 can be true. However, Answers 1, 2, and 3 are ALWAYS true.

Question #: 579- There are 9 subsystems utilized within a process. Three subsystems are utilized at random to produce a desired output. How many different ways can these 9 subsystems can be utilized within this process?

- 1) 84 2) 120 3) 210 4) 504

Answer:1- Order is not important. This is a combination.

$$C = N! / [X! (N - X)!] = 9! / (3! * 6!) = 9*8*7*6*5*4*3*2*1 / 3*2*1 (6*5*4*3*2*1) !$$
$$C = 362880 / 4320 = 84$$

Question #: 580- From a statistical standpoint grab sampling is _____ continuous sampling when trying to verify compliance with an OSHA 8-hour TWA standard.

- 1) Simpler than 2) **More difficult than** 3) About as difficult as 4) Treated in exactly the same way as

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Answer:2- Verifying compliance with an OSHA TWA using grab sampling is extremely difficult. The preferred method is to take a full shift sample.

Question #: 581- Evaluate the following to predict which set of circumstances will produce severe injuries if they are not identified and controlled:

- 1) Routine work tasks **2) Unusual and/or non-routine work tasks** 3) Supervised assembly operations 4) Mass-production machine shop

Answer:2- A number of recent studies have shown that severe injuries are fairly predictable in certain situations. One of these involves unusual, non-routine work. This includes the job that happens occasionally, or a one-of-a-kind situation. Non-routine work may arise in factory operations but normal controls that apply to routine work have little effect in the non-routine situation.

Question #: 582- ALARA is most often applied in:

- 1) Industrial hygiene 2) Safety engineering **3) Health physics** 4) Loss control

Answer:3- ALARA is the main tenet of health physics. ALARA stands for As Low As Reasonably Achievable.

Question #: 583- PEL's are:

- 1) Pollutant Emission Levels 2) Established by NIOSH
3) Permissible Exposure Limits 4) Not used in industrial hygiene

Answer:3- PEL's are permissible exposure limits and are established by OSHA.

Question #: 584- Boilers and unfired pressure vessels are designed, constructed, tested, and installed in accordance with which code:

- 1) NFPA 2) ANSI **3) ASME** 4) ASTM

Answer:3- Design, construction, testing, and installation of boilers and unfired pressure vessels is covered by applicable sections of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel code. Boilers and pressure vessels are not covered by present OSHA Standards.

Question #: 585- Hazardous locations are classified as Class I, Class II or Class III, depending on what type of hazardous substance is or may be present. Each of these classes is divided into two hazard categories, Division 1 and Division 2, depending on the likelihood of the presence of a flammable or ignitable concentration of a substance. Which one of the following statements is NOT true?

- 1) Division 1 locations are designated as such because a flammable gas, vapor, dust, or easily ignitable material is normally present in hazardous quantities
2) Division 2 locations are designated as such because a flammable gas, vapor, dust, or easily ignitable material is normally present in hazardous quantities
3) In Division 2 locations, the existence of hazardous quantities of these materials is not normal, but they may occasionally exist either accidentally or when material in storage is handled

4) In general, the installation requirements for Division 1 locations are more stringent than for Division 2 locations

Answer:2- Division 1 locations are designated as such because a flammable gas, vapor, dust, or easily ignitable material is normally present in hazardous quantities. NFPA 70 Article 500-3 (National Electric Code)

Question #: 586- If the mean and median diastolic blood pressure screened on a large population of men are both 83 mm Hg, and the standard deviation of the screening is 12 mm Hg, which is TRUE?

- 1) The mode is 83 mm Hg
- 2) About 95% of the men have a diastolic blood pressure between 59 and 107 mm Hg**
- 3) About 80% of the men have a diastolic blood pressure between 71 and 95 mm Hg
- 4) About 50% of the men have a diastolic blood pressure between 71 and 94 mm Hg

Answer:2- When the mean and median numbers of a set are the same, one may assume that the population is normally distributed. In a normal distribution, approximately 95% of the results are within the mean plus or minus 2 standard deviations. This means that the diastolic blood pressure of 95% of the population of men falls between the mean minus 24 mm Hg and the mean plus 24 mm Hg (1 standard deviation is 12 mm Hg, 2 is 24 mm Hg).

Question #: 587- A correlation between two variables measures the degree to which they are:

- 1) Statistically associated**
- 2) Causally related
- 3) Statistically significant
- 4) Cause one another

Answer:1- Correlation measures the statistical association between two variables. A determination of causation requires consideration of other factors in addition to statistics.

Question #: 588- A study collected 347 death certificates of former workers. The study found that 22 workers died from a form of cancer where 9.7 would be expected. The remaining workers died of other causes where 337.3 would be expected. Using the chi-square statistic, determine the p level at which this finding is significant.

- 1) The finding is not significant at any level
- 2) The finding is significant at p less than 0.01**
- 3) The finding is significant at p greater than 0.99
- 4) The finding is significant at p less than 0.05

Answer:2- $C^2 = S [(observed - expected)^2 / expected]$
 $= (22 - 9.7)^2 / 9.7 + (325 - 337.3)^2 / 337.3 = 16.05$

Referring to the Upper Percentage Points of the C^2 Distribution Table with one degree of freedom, 16.046 corresponds to a "p" much smaller than 0.01.

This means it is very unlikely that the finding was the result of chance and it is thus significant at a "p" less than 0.01.

Question #: 589- When using the chi-square statistic, why would one use that portion of the table with values for one degree of freedom?

- 1) It is the most conservative approach when evaluating cancer risks
- 2) Only one of the expected numbers can be determined independently of the total number of outcomes**
- 3) Both 1 and 2
- 4) None of the above

Answer:2- Degrees of freedom is determined by the number of expected outcomes which can be determined independently of the total number of outcomes.

Question #: 590- The statistical correlation coefficient is:

- 1) A constant used to correlate two dependent variables
- 2) The percentage of hood entry loss associated with different ventilation hoods
- 3) Used to develop a predictive model between two variables
- 4) An index of the extent to which two variables are associated**

Answer:4- The correlation coefficient is an index of the extent to which two variables are associated.

Question #: 591- Which of the following is NOT true about the correlation coefficient?

- 1) It can range from -1.0 to +1.0
- 2) Positive means a direct correlation
- 3) Negative means no correlation**
- 4) As the correlation approaches 1.0, the association is stronger

Answer:3- A correlation of 0 (zero) means there is no correlation, (i.e., the variables show complete independence from one another). A negative correlation means the variables are inversely related to one another (e.g., as one increases, the other decreases).

Question #: 592- A correlation coefficient of 0.95 means two variables are:

- 1) Weakly and directly correlated
- 2) Strongly and directly correlated**
- 3) Weakly correlated in an inverse manner
- 4) Strongly correlated in an inverse manner

Answer:2- The two variables are strongly correlated because the coefficient of correlation almost approaches 1.0.

Question #: 593- A regression equation is used to:

- 1) Determine the slope of a straight line
- 2) Determine the degree of correlation between two variables
- 3) Develop a predictive model between two variables**
- 4) Determine the extent of deviation

Answer:3- A regression equation is used to develop a predictive model between two variables.

Question #: 594- The z-test is used:

- 1) Only with normal distributions**
- 2) To measure the distance of a particular value from the mean**
- 3) Both 1 and 2**

4) None of the above

Answer:3- A z-test is used on normal distributions to measure the distance of a value from the mean.

Question #: 595- The t-test is used:

- 1) Only with normal distributions
- 2) To test the hypothesis that the mean score from a group does not differ from the expected mean
- 3) Both 1 and 2
- 4) None of the above

Answer:3- A t-test is used with normal distributions to test the hypothesis that the mean score does not differ from the mean. It is used to determine statistical significance.

Question #: 596- In a group of 1,000 adults, 630 are women. What is the probability that a person chosen at random from the group will be a man?

- 1) 0.185 2) **0.370** 3) 0.630 4) 0.740

Answer:2- If 630 people out of the 1,000 are women then 1,000 minus 630 (370) are men. The probability of choosing a man is $P = 370 / 1,000 = 0.370$

Question #: 597- What is the statistical distribution that considers the probability that an event will occur a specified number of times OR not at all? It is used for events that occur randomly.

- 1) Standard distribution
- 2) t-Distribution
- 3) s-Distribution
- 4) **Poisson distribution**

Answer:4- The Poisson distribution is the statistical technique to address this event.

Question #: 598- Given ignition and that a fire does not terminate (probability = 0.80) and automatic sprinklers do not extinguish the fire (probability = 0.05) and manual suppression does not extinguish the fire (probability = 0.60), what is the probability that the fire will reach full involvement?

- 1) 0.024 2) 0.45 3) 0.55 4) 1.45

Answer:1- Use the formula.

$$P = ABC = P_{\text{terminates}} * P_{\text{sprinklers}} * P_{\text{suppression}} = 0.80 * 0.05 * 0.60 = 0.024$$

Question #: 599- The National Institutes of Health (NIH) "Recombinant DNA Research Guidelines" requires the formation of what type of administrative body?

- 1) **Biohazard Safety Committee**
- 2) DNA Candidate Screening Committee
- 3) Recombinant Czar
- 4) OSHA Staff Officer Review

Answer:1- The NIH guidelines require the formation of a Biohazard Safety Committee. This Committee serves as a technical resource to investigators, develops biohazard safety manual, and reviews research proposals.

Question #: 600- Who among the following is REQUIRED to be on a process hazard analysis (PHA) team specified in OSHA's process safety management standard (29 CFR 1910.119)?

- A. At least one operations/maintenance line employee (hourly, non-supervisory)
- B. At least one operations/maintenance supervisor
- C. At least one operations/maintenance engineer
- D. At least one safety representative/safety manager
- E. At least one person knowledgeable in the PHA methodology used**
- F. At least one person knowledgeable of the process being analyzed**
- G. At least one person capable of representing the company from a legal perspective
- H. At least one external regulator (OSHA compliance officer, fire marshal, etc.)

- 1) A, E, F **2) E, F**
- 3) All listed are specifically required
- 4) None listed are specifically required

Answer:2- No corporate positions are specifically required by the standard; however, the standard requires a team, and the team must have, at a minimum, one person knowledgeable in the PHA methodology (i.e., what-if/checklist, HAZOP, FMEA, etc.) and one person knowledgeable of the process being analyzed. Good practice would suggest composing a PHA team with the people occupying some of the other positions in this list. 29 CFR 1910.119 (e)(4)

Question #: 601- Hazardous waste determinations are to be performed at what point in time?

- 1) Prior to seeking off-site disposal approvals
- 2) After any on-site treatment activities
- 3) At the point of generation**
- 4) None of the above

Answer:3- The EPA, in both recent rulemakings regarding listings and characteristics of hazardous wastes, as well as in the Land Disposal Restrictions rulemakings, has made their position regarding the importance of point of generation determinations quite clear. The determination may need to be redone after any on-site treatment, but such treatment does not alter the need for hazardous waste determinations to be performed at the point of generation for any wastes undergoing treatment on-site.

Question #: 602- The EPA considers all of the following pollutants "criteria pollutants" EXCEPT:

- 1) Carbon monoxide 2) Oxides of nitrogen 3) Oxides of sulfur **~~4) Hydrogen sulfide~~**

Answer:4- Hydrogen sulfide is not a criteria pollutant.

Question #: 603- Acronyms are used extensively in the various regulatory programs as a form of shorthand. Which of the following acronyms is NOT associated with the CWA program?

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1) POTW (Publicly Owned Treatment Works) 2) SPCC (Spill Prevention Control and Counter Measures) **3) NAAQS (National Ambient Air Quality Standards)** 4) BAT (Best Available Treatment)

Answer:3- National Ambient Air Quality Standards (NAAQS) is associated with the Clean Air Act program. POTW, SPCC, and BAT are all terms associated with the Clean Water Act program.

Question #: 604- Contract employers have specific responsibilities under the OSHA Process Safety Management Standard. These responsibilities include all of the following EXCEPT:

- 1) Assuring employees are trained in work practices
- 2) Assuring employees are instructed in the Emergency Action Plan
- 3) Conducting process hazard analyses of contract work**
- 4) Advising facility employees of unique hazards discovered

Answer:3- The contract employer is not required to perform the process hazard analyses. It is the responsibility of the employer that owns the applicable processes to conduct the process hazard analyses. The other answers are contract employer responsibilities.

Question #: 605- Means of egress, as defined by the National Fire Protection Association (NFPA) Life Safety Code (NFPA 101) consists of three separate and distinct parts. Which of the following should be excluded?

- 1) Exit access 2) The exit 3) The exit discharge **4) The critical exit**

Answer:4- Means of egress is a continuous and unobstructed way of exit travel from any point in a building or structure to a public way and consists of three separate and distinct parts, namely, exit access, the exit, and exit discharge.

Question #: 606- Section 5 (a)(1) of the Occupational Safety and Health (OSH) Act:

- 1) Gives the Occupational Safety and Health Administration (OSHA) the right of entry
- 2) Defines responsibility for research
- 3) Is commonly called the general duty clause**
- 4) Both 1 and 3

Answer:3- Section 5 (a)(1) of the OSH Act is commonly called the general duty clause and specifies the requirement that employers keep their workplaces free from recognized hazards that are causing or likely to cause death or serious physical harm.

Question #: 607- The "Superfund" law primarily addresses:

- 1) Worker safety **2) Toxic waste sites** 3) PCB's 4) Carcinogens

Answer:2- The Superfund law was written to force clean-up of sites contaminated with toxic materials. Sites are prioritized and those of highest priority are listed on the NPL (National Priorities List). Money is set aside to clean these sites up if the responsible parties cannot be found or refuse to clean it up.

Question #: 608- What major code(s) are utilized in the design and construction of pressure vessels in the United States?

- 1) ASME Code 2) API Standard 620 3) Code of Federal Regulations **4) Both 1 and 2**

Answer:4- The two major codes in use today are ASME (American Society of Mechanical Engineers) Code and the API (American Petroleum Institute) Standard 620. An earlier code, discontinued in 1956, was the API-ASME Code.

Question #: 609- Standards that have been developed over time by a consortium of experts and those affected by the standard are generally known as:

- 1) Regulatory standards 2) Mandatory standards
3) Voluntary standards **4) Consensus standards**

Answer:4- Standards so developed are consensus standards because they are developed as a result of a consensus of opinion of the group.

Question #: 610- Which of the following statements about OSHA variances is true?

- 1) A variance can be requested by employers if they cannot meet a compliance date for reasons other than financial**
2) Employees must be notified by the employer, via posting, of any variance request to OSHA
3) Temporary variances are valid for up to five years
4) Both 1 and 2

Answer:4 - OSHA reform is supposed to eliminate variances; however, employers may continue to apply, but must notify employees because it affects their safety. Variances are valid for up to one year (renewals are permitted). OSH Act Section 6 (b)(6)

Question #: 611- What recourse do employers have if they are cited by OSHA?

- 1) Appeal to OSHA and the OSHRC** 2) Require OSHA to repeat the inspection
3) Appeal to the Department of Justice 4) Require NIOSH to verify the OSHA finding

Answer:1- An employer can appeal to OSHA, the OSHRC, or the Courts (not the Department of Justice). They cannot appeal to NIOSH for a remediation of the citation.

Question #: 612- Drivers of any size vehicle transporting hazardous materials that require placarding must pass the pre-trip skills and written test to obtain a:

- 1) Class I license 2) Class II license **3) CDL** 4) Either 1 or 2

Answer:3 - Under the terms of the Commercial Motor Vehicle Act, anyone driving a vehicle weighing more than 26,000 pounds, transporting more than 15 people including the driver, or transporting hazardous materials that require placards, must pass the pre-trip skills and written test to obtain a commercial driver's license (CDL).

Question #: 613- ISO-9000 compliance has now become very popular in the United States and in other countries. What do the standards associated with ISO-9000 address?

- 1) A company's methods for environmental management
2) A company's methods for system quality management

- 3) A company's methods for system safety management
- 4) All of the above

Answer:2- ISO-9000 standards are designed to enhance a company's quality performance by documenting all aspects of the company's operations. Though safety and environmental performance enhancements are possible, the focus of ISO-9000 is to enhance quality by defining the processes and management systems necessary to produce a company's product. ISO-14000 standards deal with environmental management methods. Other ISO standards dealing with various aspects of safety management also exist and are expected to become more popular in the United States in the future.

Question #: 614- After establishing the required management systems, to become formally registered as compliant with ISO-9000 or ISO-14000 standards, a company must:

- 1) Certify in writing to the International Organization for Standardization (ISO) that the company complies with the relevant standards.
- 2) Hire an ISO-certified third-party registrar to perform an external audit of the company's facilities at which point the third-party registrar will certify to the ISO that the company complies with the relevant standards (if the company is compliant).**
- 3) Hire an ISO-trained auditor to perform an external audit of the company's facilities at which point the external auditor will certify that the company complies with the relevant standards (if the company is compliant).
- 4) Simply maintain compliance with the relevant ISO standards and submit an annual certification fee to ISO.

Answer:2- A registrar formally certified by ISO as a registrar must be retained for the audit and subsequent certification to ISO that the company meets ISO requirements.

Question #: 615- What is the purpose of organizations such as Underwriters' Laboratories (UL) and Factory Mutual (FM)?

- 1) To perform independent product safety evaluations on products sold to consumers
- 2) To certify that products sold to consumers meet a minimum level of product safety
- 3) To certify that safety-related products will perform as expected
- 4) All of the above**

Answer:4- These organizations also maintain listings of the products that they certify so that individuals with questions can request information about how the product performed in the tests that were conducted on it.

Question #: 616- Which of the following agencies has an interest in safety and health matters and regulates selected chemical substances and mixtures?

- 1) NIOSH **2) EPA** 3) DOT 4) NACOSH

Answer:2- The Environmental Protection Agency (EPA) was established by the Toxic Substances Control Act (TSCA) in 1976 to regulate selected chemical substances and mixtures being manufactured, processed, distributed, imported, and disposed of, if they are considered an unreasonable risk to health and the environment.

Question #: 617- A firm makes a plated device that it installs on the purchaser's property. The device discharges a water effluent. Which of the following agencies govern the device operation?

- 1) OSHA and NRC **2) EPA and OSHA** 3) NRC and DOT 4) EPA and DOT

Answer:2- Normal operation of the device would be governed by EPA and OSHA.

Question #: 618- Biosafety is currently regulated primarily by which federal agency.

- 1) NIOSH 2) NIEHS 3) FDA **4) CDC**

Answer:4- The Center for Disease Control's Office of Biosafety has developed most of the biosafety programs now in use. The EPA does have some authority concerning the release of bioengineered organisms to the environment.

Question #: 619 - By legislative fiat, who has the responsibility for conducting educational programs to ensure an adequate supply of qualified safety and health professionals?

Answer:1- **NIOSH**, in the Department of Health and Human Services, has in its charter the directive to train safety and health professionals and to ensure that an adequate supply of these trained professionals are available.

Question #: 620 - By legislative fiat, who trains employers and employees in matters of safety and health?

Answer:2- This duty is described in the OSH Act at Section 21 (c).

Question #: 621- In the area of automobile safety, which agency is responsible for reducing accidents on the nation's highways?

Answer:2- The NHTSA was established in 1970 to oversee the nation's highway safety program.

Question #: 622- NIOSH is located in this federal agency:

Answer:1- NIOSH is located within the Department of Health and Human Services, Center for Disease Control.

Question #: 623- OSHA approves:

Answer:4- OSHA does not approve any personal protective equipment. NIOSH approves respirators, and several ANSI standards address the design requirements for the listed personal protective equipment.

Question #: 624- OSHA standards are promulgated by:

Answer:4- The Secretary of Labor promulgates OSHA standards.

Question #: 625- The Occupational Safety and Health Administration (OSHA) is a part of the _____.

Answer:1- OSHA is located within the Department of Labor.

Question #: 626- The Public Health Service (PHS) plays the following important role in occupational safety and health:

Answer:2- Many NIOSH employees are also commissioned officers in the PHS.

Question #: 627- The Toxic Substances Control Act (TSCA) is enforced by the:

Answer:2- The EPA enforces TSCA.

Question #: 628- What agency governs man-made radionuclide use?

Answer:2- The NRC (National Regulatory Commission) governs radionuclide use if the materials are man-made. If the material is a naturally occurring radionuclide, then OSHA has jurisdiction.

Question #: 629- As established by the OSH Act of 1970, the Occupational Safety and Health Review Commission is part of:

Answer:1- As part of the separation of power, this commission is part of the Executive Branch of the federal government.

Question #: 630- A manufacturer of lawn, leaf, and brush shredders has just learned that an interlock on the shredder guard is defective and may not shut down the unit when the guard is removed or unintentionally works loose. The company is required by the CPSC to:

Answer:3- While the other answers may be "good business", the Consumer Product Safety Act requires that the CPSC be notified by the manufacturer of such defects.

Question #: 631- A listing of Nationally Recognized Testing Labs is published by:

Answer:4- This listing, compiled by OSHA, contains a listing of labs that can test samples sent to them for contaminants according to the protocols established by the OSH Act or adopted by OSHA.

Question #: 632- The key element of RCRA designed to track hazardous waste from "cradle to grave" is the:

Answer:3 - The manifest system was developed by RCRA to track hazardous waste from originator to final resting place.

Question #: 633- A manifest serves the following purposes:

Answer:4- The manifest serves both shipping paper requirements under DOT regulations, and acts as a tracking document under RCRA regulations. The manifest is not a fail-safe document, however, and does not absolve the generator of CERCLA liabilities. At best the manifest merely indicates that the waste actually was received by the designated facility.

Question #: 634- The mandatory shipping document for hazardous waste purposes is:

Answer:3- The uniform hazardous waste manifest (EPA Form 8700-22) is the mandatory format for hazardous waste shipping documents. The actual forms are to be obtained from states mandating the use of state issued uniform hazardous waste manifests, or when the state is not involved in manifest distribution, from commercial printers following the mandatory format with the appropriate number of pages (minimum of 4).

Question #: 635- Most employers now allow their employees to access the Internet for work-related activities. Which of the following are available on the Internet?

- 1) CBT safety courses delivered by commercial firms
- 2) Codified regulations and laws maintained by their respective government agencies
- 3) Discussion groups dedicated to the practice of safety and risk management
- 4) All of the above

Answer: - The Internet provides a huge repository of information that safety professionals can use to carry out their duties. This is just a small slice of the information available.

Question #: 636- Among the most useful modern data storage technologies is a media called "CD-ROM." Each unit of this media can store nearly 640 megabytes of information in an optical format. The format is superior to magnetic media (such as floppy discs, hard drives, and tape) because of the following:

Answer: - CD-ROMs are not susceptible to data degradation or data loss from magnetic fields (such as those near monitors and speakers). CD-ROMs do experience data degradation over time, depending upon the quality of the CD-ROMs used. CD-ROMs are quite delicate and can easily be scratched or marked if not properly protected. CD-ROMs are actually quite bulky when compared to the storage capacity of modern multi-gigabyte hard drives.

Question #: 637- For a state plan to be approved by OSHA, the state plan must have regulations to cover the safety and health of state and local employees.

Answer:- For OSHA to approve a state plan, OSHA requires the state to cover its own employees and those employees of all of its political subdivisions to a level at least as effective as the OSHA regulations that cover all other employees. Some states have state plans approved that ONLY cover state and local employees while allowing OSHA to maintain its jurisdiction over all other employees in the state (currently, these states are Connecticut, New Jersey, and New York).

Question #: 638- The organization which has been the most influential in researching temperature-humidity comfort is:

Answer:- The American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), has been the most influential organization in researching temperature- humidity comfort. ASHRAE publishes ventilation standards that specify minimum ventilation rates and

indoor air quality which are acceptable to human occupants and are intended to avoid adverse health effects. ASHRAE 62-1989, "Ventilation for Acceptable Indoor Air Quality" is its most recent standard.

Question #: 639- Which organization authors the "National Fire Codes" and is recognized as the worldwide clearinghouse for fire safety information?

Answer:- The National Fire Protection Association (NFPA) is the clearinghouse for information on the subject of fire protection and fire prevention. It is a non-profit technical and educational organization whose technical standards are widely accepted and used as the basis for good practice. Many are incorporated by reference in OSHA regulations.

Question #: 640- Which organization is responsible for establishing the codes governing electric hazards as a source of ignition?

Answer:- The National Fire Protection Association (NFPA) governs electrical hazards as a source of ignition through the National Electric Code (NEC), also called NFPA 70. This organization is responsible for reviewing, revising, and setting the standards that control electrical wiring and hardware in Class I, II, and III hazardous locations.

Question #: 641- The Fire Protection Handbook is published by which of the following organizations?

Answer:- The National Fire Protection Association (NFPA) publishes the Fire Protection Handbook.

Question #: 642- For a TLV change listed in the notice of intended changes to be considered for adoption, the ACGIH waits _____.

Answer:- At least one year must pass for comments before it can be considered for adoption.

Question #: 643- CHEMTREC is an arm of the Chemical Manufacturers Association (CMA) that provides:

Answer:- CHEMTREC is a highly successful program of the CMA to assist in response to HAZMAT incidents.

Question #: 644- AIHA laboratory accreditation is good for how many years?

Answer: The AIHA Industrial Hygiene Laboratory Accreditation process follows ISO 17025; Requirements for the Competence of Testing and Calibration Laboratories. Every **two years**, a multiple day site inspector audits both management and technical requirements for evidence and documentation of laboratory best practices. If testing and calibration laboratories comply with the requirements of this International Standard, they are deemed to operate a quality management system to their testing and calibration activities that also meets the principles of ISO 9001.

Question #: 645- The Accident Prevention Manual is published by the following organization:

Answer:- The Accident Prevention Manual is published by the National Safety Council.

Question #: 646- The designation "CIH" is awarded by the:

Answer: The American Board of Industrial Hygiene awards the title "CIH". Similar to the CSP, the CIH has experience and academic requirements that must be met. There is also a maintenance certification program that must be adhered to if certification is to be continued. Note: There is no such organization as ABCIH.

Question #: 647- The precursor of the National Safety Council was the:

Answer: The Association of Iron and Steel Electrical Engineers evolved into the National Safety Council.

Question #: 648- The primary organization dealing with compressed gas cylinder safety is:

Answer: The CGA (Compressed Gas Association) is the primary organization dealing with compressed gas safety. Some of the CGA documents are incorporated by reference into OSHA standards.

Question #: 649- Who accredits industrial hygiene laboratories?

Answer: Only the AIHA accredits industrial hygiene laboratories.

Question #: 650- What organization sponsors the "CSP" designation?

Answer: The Board of Certified Safety Professionals (BCSP) sponsors the "CSP" designation. The American Board of Industrial Hygiene sponsors the "CIH" designation.

Question #: 651- A TLV posted in the "Notice of Intended Changes" is considered for adoption after how many years if no evidence comes to light that questions the appropriateness of the value?

Answer: A TLV posted in the "Notice of Intended Changes" is considered for adoption after 1 year, if no evidence comes to light that questions the appropriateness of the value.

Question #: 652- Which of the following is NOT true?

- 1) Certified Safety Professional - An applicant issued the designation "Certified Safety Professional" may use the initials "CSP" after his or her name
- 2) Each "Certified Safety Professional" may obtain a seal and/or stamp bearing the certificate holder's name, serial number, and the legend, "Certified Safety Professional"
- 3) Associate Safety Professional - This designation must be renewed every three years until the candidate is eligible to sit for the Certified Safety Professional examination
- 4) ~~The certificate for the "Certified Safety Professional" is signed by the Board's President and Secretary whereas the "Associate Safety Professional" is signed only by the Secretary~~

Answer: The certificates of qualification for both the "Certified Safety Professional" and the Associate Safety Professional" are signed by the Board's President and Secretary.

Question #: 653- The administrative sponsor of the National Electric Code is:

Answer: In 1911, the National Fire Protection Association (NFPA) assumed sponsorship and control of the National Electric Code. The 1984 Edition of the Code (NFPA 70- 1984) was adopted by the Fire Protection Association (FPA) and approved by the American National Standards Institute (ANSI) as ANSI/NFA 70-1984.

Question #: 654 - What is the name of the journal published by the National Safety Council?

Answer: Safety + Health is the journal of the National Safety Council.

Question #: 655- What is the name of the journal published by the American Society of Safety Engineers?

Answer: The ASSE journal is entitled "Professional Safety."

Question #: 656- What is a trade association?

Answer: A group concerned with furthering the aims of a particular profession-- Trade associations (i.e., Compressed Gas Association, American Society of Safety Engineers, Alliance of American Insurers, etc.) play a major role in furthering the aims of a specific industry or profession.

Question #: 657- FOIA is:

Answer: The Freedom Of Information Act (FOIA) allows the public to obtain information created or maintained by agencies of the federal government. Though there are restrictions on the type of information that can be distributed, if a member of the public can define the information that he or she wants, then the relevant agency is obliged to address the request. FOIA requests from agencies are frequently an excellent way to obtain internal memos, directives, and other information that would not normally be published, but may provide valuable information.

Question #: 658 - Fires have various stages of burning. All the following are true EXCEPT:

- 1) Incipient Stage - No visible smoke, flame, or significant heat is developed, but a significant amount of combustion particles are generated over a period of time
- 2) Smoldering Stage - ~~The quantity of combustion particles decreases to the point where they become almost invisible.~~ The quantity of combustion particles increases to the point where they become visible (smoke).
- 3) Flame Stage - The point of ignition occurs and flames start
- 4) Heat Stage - Large amount of heat, flame, smoke, and toxic gases are produced

Answer: Smoldering Stage

Question #: 659- Of the following, which occupational illness occurs at the highest rate?

Answer: According to OSHA statistics, cumulative trauma disorders have the highest incidence rate.

Question #: 660- A pallet of material in a freight elevator which goes up with constant upward acceleration exerts a push on the floor of the elevator whose value is:

2) Greater than the weight of the pallet and its load

Answer: Applying Newton's third law of motion, "Every action (force) is accompanied by an equal and opposite reaction (force)", the push of the floor of the elevator must be enough to support the weight of the pallet and its load and in addition, must accelerate the combined weights upward. Hence, the push of the elevator is greater than the weight of the pallet and load by an amount needed to give it acceleration [$F = W + W (a/g)$].

Question #: 661- The worker/working surface coupling has been cited as a causative factor in a large percentage of slips and falls accidents. The major mediating variable in this type of accident is the:

Answer: The general recommendation for the control of slip and fall accidents is to adjust shoes and working surfaces to give a static coefficient of friction (SCOF) of at least 0.50. This is particularly important in manual materials handling where forward movement requires increased frictional forces to prevent foot slippage (NIOSH publication No. 81-122).

Question #: 662- Factors that effect the stability of a trench include all of the following EXCEPT:

Answer: The stability of a trench can be affected by the moisture content, freezing and thawing, and location of the spoil pile. Other factors include the depth of the trench and external vibration sources.

Question #: 663- A ground fault circuit interrupter functions by:

Answer: A ground fault circuit interrupter functions by monitoring current.

Question #: 664- In the theory of fire extinguishment, all of the following are believed appropriate EXCEPT:

- 1) Extinguishment by cooling
- 2) Extinguishment by oxygen dilution
- 3) Extinguishment by fuel removal
- 4) Extinguishment by fire break

Answer: Per the NFPA Fire Protection Handbook, all but Answer 4, extinguishment by fire break, are appropriate.

Question #: 665- The level of protection that chemical protective clothing offers is affected by all of the following EXCEPT:

1) Durability

- 2) Permeability
- 3) Degradation
- 4) Penetration

Answer: Durability is not one of the factors that affect protection levels for chemical protective clothing (CPC).

Question #: 666- Of the following, the most effective way to control heat stress is by:

Answer: Heat stress is usually controlled by engineering methods, administrative work practices, or by the use of personal protective equipment.

ENGINEERING METHODS are procedures which may be used to reduce the stress of a hot environment. Examples include general ventilation, spot cooling, local exhaust ventilation, air conditioning, cooling fans, and radiant heat shields.

ADMINISTRATIVE WORK PRACTICE controls include acclimatizing to heat, a work-rest program, and rotation of workers, education, and training.

PERSONAL PROTECTIVE EQUIPMENT for heat stress is ordinarily used only when a worker must remain in a hot environment long enough to cause unacceptable high heat strain without protection.

Question #: 667 - A one story steel framed factory building with a metal roof, concrete floor, and masonry exterior/interior walls represents what type of construction?

Answer: Non combustible-

A standard classification of buildings into five major types based on the fire-resistance ratings of their component parts was developed by NFPA to help prevent confusion of terms used in various building codes and by insurance companies. Non-combustible construction is made entirely of non-combustible materials that either fail to meet the full requirements for fire-resistive construction or are without fireproofing protection for the structural steel elements.

Question #: 668- What category, by property class, has the highest incidence of fatal fires (fires that take 50 or more lives per incident)?

- 1) American community (stores, theatres, clubs, etc.)
- 2) The industrial environment, excluding mines
- 3) The industrial environment, including mines**
- 4) The mobile environment (planes, trains, ships)

Answer: From 1900, 98 fires caused 50+ deaths. Of these 98, 68 were in the industrial environment, and 59 of these were in mine fires or explosions.

Question #: 669- The traditional method of describing fire growth has been through fire loads reflected in:

1) Occupancy classifications

- 2) Special hazards
- 3) Flame spread
- 4) Ordinary hazards

Answer: Occupancy classifications include consideration for special hazards and ordinary hazards. Fire load considers flame spread.

Question #: 670- Water damage from firefighting is a major cause of damage from fires. What is the most important consideration to reduce damage from water?

Answer: Floor drains reduce water damage more than any other approach, especially during salvage operations after the fire.

Question #: 671- A method of identifying errors and unsafe conditions that contribute to both potential and actual injurious accidents within a given population by means of a stratified, random sample of participants and observers selected from within this population is called:

Answer: **Critical incident technique** is a method of identifying errors and unsafe conditions that contribute to both potential and actual injurious accidents within a given population by means of a stratified random sample of participants and observers selected from within this population.

Question #: 672- Human errors in a system can be detected using the following system safety technique:

Answer: In using the **Critical incident technique**, those involved in accidents or near misses are interviewed. A survey is made of those having similar experiences, and everyone involved is asked to describe near misses or mishaps they can recall.

Question #: 673- The procedure in which a job is broken into its component parts, and each task is analyzed to determine if there is a better, safer way to accomplish the job, is called a: JSA.

Answer: A job safety analysis (JSA) is a procedure used by safety professionals and supervisors to review job methods and uncover hazards that had either been overlooked or resulted from changes in operations and/or personnel. The procedure evolved from military applications in World War II.

Question #: 674- The analysis technique where individuals are interviewed about accidents, near misses, and hazardous conditions is known as a(n):

Answer: Critical incident technique involves the examination of accidents and near misses to find hazards.

Question #: 675- The critical organ for the soluble form of radon is the:

Answer: The lung is the organ most impacted by both the soluble and the insoluble forms of radon. Lung cancers can arise from elevated radon exposures.

Question #: 676- What is the critical organ for the soluble form of radium?

Answer: The soluble form of radium is incorporated into the bone, leading to bone cancers. The critical organ for the insoluble form of radium is the GI tract. Other critical organs for the soluble form of radionuclides include:

Isotope	Critical organ
Tritium	Total body
Strontium	Bone
Iodine	Thyroid
Plutonium	Bone

Question #: 677- The ACGIH has established cold stress TLV's for workers in cold occupations. At what body core temperature (°F) is the worker in danger of developing severe hypothermia if his/her core temperature dropped further?

Answer: Once the core body temperature falls below 91.4°F, severe hypothermia sets in rapidly. Normally the oral temperature is 98.6°F and rectal temperature 99.6°F. (Hypothermia- the condition of having an abnormally (typically dangerously) low body temperature.)

Question #: 678- "In vivo" toxicology refers to studies conducted with the following methodology.

- 1) Toxic agent is added to tissue slices or tissue homogenate
- 2) Toxic agent is administered to live animals**
- 3) Toxic agent is modeled mathematically
- 4) Toxic agent is administered to human volunteers

Answer: The most correct answer is that "in vivo" toxicology refers to toxicity studies conducted with live animals who are eventually sacrificed and the effect measured. "In vitro" toxicology refers to toxicity studies conducted upon tissue slices or homogenate.

Question #: 679 - Toxicity recognizes several different mechanisms of multiple chemical interaction. What is potentiation?

- 1) A substance which does not have a toxic effect upon a system or organ, but when in combination with another chemical, makes that chemical much more toxic
- 2) Two substances, which when together, interfere with each other's actions
- 3) The combined effect of these two chemicals is much greater than the sum effect of each agent acting independently

Answer: Potentiation is defined in Answer 1. A classic example of this effect is isopropanol and carbon tetrachloride. Isopropanol is not toxic to the liver but when it is added to carbon tetrachloride, the toxicity of the CCl₄ to the liver is greater.

Question #: 680- A classic example of synergism, regarding a toxic effect, involves asbestos coupled with a synergistic agent to produce lung cancer. What is this synergistic agent?

Answer: The classic example of toxicological synergy is asbestos and cigarette smoke.

Question #: 681- Storage of lead in the human body takes place primarily in the:

Answer: The primary reservoir for lead in the human body is the bones.

Question #: 682- The result of acute exposure to beryllium inhalation is:

Answer: Beryllium is a suspect carcinogen that causes chemical pneumonitis upon acute inhalation exposure. Chronic exposure can, among other things, cause berylliosis, a cumulative lung disorder.

Question #: 683- Bladder cancer is sometimes associated with:

Answer: Benzo(a) pyrene is a suspect human carcinogen associated with bladder cancer. Benzo(e) pyrene is also a volatile benzene soluble derivative of coal tar pitch; however, it is not currently classified as a suspect human carcinogen. VCM is associated with human liver cancers.

Question #: 684- Shaver's Disease is associated with exposure to:

Answer: Shaver's Disease is a bauxite pneumoconiosis associated with silica. Rickettsia is a human pathogen often carried by arthropods.

Question #: 685- An occupational disease which is characterized by wrist drop, anemia, and abdominal cramps is:

Answer: Lead Poisoning- Other symptoms of lead overexposure include: Lassitude, insomnia, pallor, eye irritation, anorexia, low-weight, malnutrition, gingival lead line, and tremors.

Question #: 686- A cigarette contains 6 mg of tar. Calculate the cumulative daily dose of tar received by a 160 lb adult male who smokes 2 packs per day. Each pack contains 20 cigarettes.

Answer:

Dose = (6 mg tar/cig * 20 cig/pack * 2 packs/day) / [(160 lbs * (1 kg/2.2 lbs))]
=3.3 mg tar/kg body weight per day

Question #: 687- The effective temperature is a determined index of the degree of warmth perceived on exposure to different combinations of:

- 1) Radiant heat, humidity, and air movement
- 2) Temperature, humidity, and air movement**
- 3) Clothing, humidity, and air movement
- 4) Temperature, humidity, and radiant heat

Answer: The effective temperature is an empirically determined index of different combinations of temperature, measured as the dry bulb, humidity, measured as the wet bulb, and air movement.

Question #: 688- A worker in a warehouse on a hot summer day suffers from heat stroke. Her body temperature is:

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Answer: Elevated body temperature in heat stroke is a major factor in causing the most important other clinical symptom, that being lack of sweating. Lack of sweating causes an increase in body temperature.

Question #: 689- The most accurate measure of heat stress to the body is:

- 1) Blood pressure
- 2) Skin temperature
- 3) Rectal temperature**
- 4) Oral temperature

Answer: Rectal temperature measures the body's core temperature. Body core temperature rise is used as the limiting parameter in heat stress work.

Question #: 690- If the air temperature is above the skin temperature one should _____ the air velocity to reduce the convective load: - Decrease

Answer: If the air temperature is ABOVE the skin temperature, increasing the air velocity will increase the convective load.

Question #: 691- A person can lose his or her heat acclimatization in as little as:

Answer: Significant loss of acclimatization may be seen after 3 days off.

Question #: 692- The most serious form of heat injury is:

Answer: Heat stroke is truly life threatening and therefore the most serious. The body temperature rises to dangerous levels causing potential irreversible damage and possibly death.

Question #: 693- Thermal stress is associated with all of the following jobs EXCEPT:

- 1) Freezer workers
- 2) Life guards
- 3) Foundry workers
- ~~4) Teachers~~

Answer: Thermal stress refers to both heat stress and cold stress.

Question #: 694 - Of the following, which is NOT taken into account when figuring the effective temperature index?

- 1) Ambient temperature
- ~~2) Wall temperature~~
- 3) Moisture
- 4) Air movement

Answer: Effective temperature is figured by measuring ambient temperature, air movement, and humidity.

Question #: 695 - Of the factors listed, which LEAST influences the interchange of heat between a person and their environment?

- 1) Air velocity
- ~~2) Air density~~
- 3) Air temperature
- 4) Radiant temperature

Answer: Answers 1, 3, and 4 appear as variables in the heat stress equations.

Question #: 696- The condition that results when the body's heat regulating mechanism fails to function is: Heat stroke

Answer: With heat syncope, heat cramps, and heat exhaustion, the body is still capable of producing sweat and is therefore able to achieve some cooling.

Question #: 697- A primary sign of heat stroke on a worker is:

- 1) Cyanosis
- 2) Pale, clammy skin
- 3) Hot, dry skin**
- 4) Nausea

Answer: Answers 2 and 4 are associated with heat exhaustion.

Question #: 698- A risk-specific dose (RSD) applies to:

- 1) Non-carcinogens
- 2) Carcinogens**
- 3) Mutagens
- 4) Teratogens

Answer: The RSD is a dose that corresponds to a specific level of risk to an individual of contracting cancer over a 70-year lifetime due to the intake of contaminated drinking water.

Question #: 699- A reference dose (RfD) applies to:

- 1) Non-carcinogens**
- 2) Carcinogens
- 3) Mutagens
- 4) Teratogens

Answer: An RfD is an estimate of daily exposure of the human population, including sensitive subgroups, to a substance that would not represent an appreciable risk of deleterious effects during a lifetime. RfD applies to non-carcinogens, while RSD applies to carcinogens.

Question #: 700- If the ambient temperature rises above the dew point:

Answer: At the dew point, the air is saturated with water vapor. When the temperature of the air rises, it can hold more water vapor. Its relative humidity will be less than 100%, and evaporation will occur if water is present.

Question #: 701- What happens to a normal gas when it is compressed rapidly?

Answer: Work is done ON the gas when it is compressed, and the gas's temperature will rise.

Question #: 702- What happens to the heat energy of a 2 qt pan of water when it is heated from 30°C to 100°C?

Answer:- Less than doubled- The heat energy varies directly with the absolute temperature of the substance (i.e., Kelvin), not the relative temperature (i.e., degrees Celsius). Water heated from 30°C to 100°C is being heated from 303° K to 373° K (add 273 to the Celsius temperatures to get the absolute Kelvin temperatures). This is less than a doubling of temperature resulting in less than a doubling of heat energy.

Question #: 703- The temperature of a block of ice while melting remains constant. In the course of changing state, the block of ice is:

Answer:- Gaining energy but using energy to change state.
In the process of melting, the block of ice gains heat energy. To illustrate, if a block of ice is heated, its temperature will reach 32°F. The temperature then remains constant and the ice begins to melt. As more heat is added, more ice will melt until it all turns to 32°F water. The energy gained by the ice is used to melt it. The energy necessary to "melt", or to change from a solid state to liquid state, is called the latent heat of fusion.

Question #: 704- The amount of heat required to change 100 g of water at 15°C to 75°C is:

Answer:

Heat gained/lost = $(m * c) * (DT)$ where:

m = mass of the substance

c = specific heat of the substance

DT = change in temperature

1 cal is required to heat 1 g of water 1°C

Heat required = $100 \text{ g} * [1 \text{ cal}/(\text{g } ^\circ\text{C})] * (75^\circ\text{C} - 15^\circ\text{C})$

= $100 \text{ g} * 60 \text{ cal/g}$

= 6,000 cal

Question #: 705- The amount of heat needed to raise the temperature of 1 lb of water 1°F is called:

Answer:- BTU- The British thermal unit (Btu) is the amount of heat that is required to raise the temperature of 1 lb of water 1°F.

Question #: 706- The quantity of heat needed to raise the temperature of 1 g of a material by 1°C is a characteristic property of the material. It is commonly called:

1) A calorie 2) The specific heat 3) A Btu 4) Temperature rise

Answer: The specific heat is the heat energy that is required to raise the temperature of a substance 1°C.

Question #: 707- The ability of a material to be drawn out into the form of wire is called:

Answer:- ductility- Copper, gold, silver, brass, and other substances can be drawn out in the form of wires. A material which can be drawn out this way is said to be ductile.

Question #: 708- The specific gravity of cast iron is 7. A 1 ft³ bar of it will weigh:

Answer: The number of times a substance is as heavy as an equal volume of water is called specific gravity. The specific gravity (SG) of a substance may be found from the relation:
 $SG = \text{Weight of substance} / \text{Weight of an equal volume of water}$

1 ft³ of water weighs 62.4 lbs and SG of cast iron is 7

Then:

$SG = (\text{Weight of 1 ft}^3 \text{ of iron}) / (\text{Weight of 1 ft}^3 \text{ of water})$

$7 = (\text{Weight of 1 ft}^3 \text{ of iron}) / (62.4 \text{ lbs})$

$(7)(62.4 \text{ lbs}) = (\text{weight of 1 ft}^3 \text{ of iron})$

$436.8 \text{ lbs} = (\text{Weight of 1 ft}^3 \text{ of iron})$

Question #: 709- Find the density of a block of iron 12 cm long, 8 cm wide, and 2 cm high, if the block has a mass of 700 g:

Answer:

Apply the following formula.

$\text{Density} = \text{Mass} / \text{Volume}$

$\text{Density} = 700 \text{ g} / (12 \text{ cm} * 8 \text{ cm} * 2 \text{ cm}) = 700 \text{ g} / 192 \text{ cm}^3 = 3.65 \text{ g/cm}^3$

Question #: 710- A quantity of air exerts a pressure of 720 mm Hg when it occupies a volume of 50 cm³. This air is compressed until it exerts a pressure of 810 mm Hg. If the temperature is kept constant, what would be the volume of the gas after compression?

Answer: If the temperature of a confined gas is kept constant, its volume will vary inversely as its pressure. This may be expressed by the following formula:

$P_1 V_1 = P_2 V_2$

$720 \text{ mm Hg} * 50 \text{ cm}^3 = 810 \text{ mm Hg} * V_2$

$V_2 = 44.4 \text{ cm}^3$

Question #: 711- A rectangular barge, 10 ft wide and 40 ft long sinks 6 in. deeper in the water after a truck is loaded on it. What is the weight of the truck?

Answer:

A floating body will displace its own weight of the fluid in which it is immersed. The additional volume of water displaced by the barge after the truck is loaded on it is equal to:

$10 \text{ ft} * 40 \text{ ft} * 0.5 \text{ ft} = 200 \text{ ft}^3$

Since:

1 ft³ of water weights 62.4 lb

Then:

$200 \text{ ft}^3 * 62.4 \text{ lb/ft}^3 = 12,500 \text{ lb}$
 $12,500 \text{ lb} / 2,000 \text{ (lb/ton)}$
 $= 6.25 \text{ ton}$

Question #: 712- At a depth of 1,000 ft, what is the pressure on the deck of a submarine? (The density of salt water is 64.4 lb/ft³)

Answer:

Pressure is caused by the weight of the fluid acting on a surface. A dense liquid will exert more pressure on bodies immersed in it than will a lighter liquid. Pressure on the deck of the submarine is equal to the height of the column of salt water acting on it multiplied by the density of the salt water.

$\text{Pressure} = 1,000 \text{ ft} * 64.4 \text{ lb/ft}^3$
 $= 64,400 \text{ lb/ft}^2$
 $= 144 \text{ in}^2$
 $\text{Pressure} = (64,400 \text{ lb/ft}^2) / (144 \text{ in}^2/\text{ft}^2)$
 $= 447.2 \text{ lb/in}^2$
 $= 447.2 \text{ psi}$

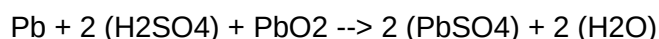
Question #: 713- When atmospheric water vapor condenses in the air, it always leaves the surrounding air temperature:

Answer:- When a liquid is vaporized, it must be heated. Whenever it reverts back to a liquid state through condensation, it must give up this heat. The heat that is given off must therefore warm the surrounding air.

Question #: 714- What is the ratio of elemental Pb atoms (non-oxidized) to molecules of H₂SO₄ after balancing the equation?



Answer: The balanced equation consisting of lead, sulfuric acid and lead oxide is:



Question #: 715- An industrial wastewater stream has high levels of dissolved copper that must be reduced before discharge. The wastewater is chemically treated to remove the copper. Which of the following will NOT drive the reaction to remove more copper?

- 1) Removing one of the products as a precipitate
- 2) Removing one of the products as a gas
- 3) ~~Reducing the concentration of one of the reactants~~
- 4) Removing one of the products as a slightly ionized substance

Answer: Reducing reactant concentration tends to retard the chemical reaction process. On the other hand, if a product is removed, the chemical equilibrium is perturbed, and the reactants will continue to react until a new equilibrium is achieved.

Question #: 716- 9 g of an ideal gas occupies 11.5 liters at a pressure of 35.0 cm Hg. What is the volume when the pressure is increased to 55.0 cm Hg?

Answer:

The pressure changes to 55/35 of the original pressure. The volume changes to 35/55 of the original volume. ($P_1V_1 = P_2V_2$)

Final volume = $35/55 \times (\text{initial volume})$

= $(35/55) \times 11.5$ liters

= 7.32 liters

Question #: 717- Relative humidity is calculated using:

Answer: To calculate relative humidity, first determine the wet bulb and dry bulb temperatures, then use a psychrometric chart to determine the actual relative humidity.

Question #: 718- Which of the following chemicals is not a solvent in the operation described?

- 1) Alcohols in paint cleanup
- 2) Ketones in spray painting
- 3) Hydrocarbons in metal cleaning
- 4) Epoxies in core making in foundries

Answer: To be a solvent, the chemical must dissolve something. Epoxies in core making form a resin matrix (i.e., a polymer) that binds sand together - no solvent

Question #: 719- Which of the following would react with a strong oxidizing agent?

- 1) Iron
- 2) Freon 22
- 3) Oxygen
- 4) Silicon dioxide

Answer:- Iron (Fe) reacts readily with oxidizing agents like oxygen to form rust. Oxygen (O₂) is an oxidizer itself, and silicon dioxide (SiO₂) is unreactive to oxidizing agents. Freons are noted for their relative unreactive nature.

Question #: 720- What is the weight of a hollow concrete cylinder with an outside diameter of 5 feet, an inside diameter of 3 feet, and a length of 6 feet? (Concrete weighs 150 lb/ft³).

Answer:

Find the volume of the cylinder as though it were solid, and then subtract the volume of the empty space. Finally, multiply the difference by the density of concrete.

Volume is $3.14 \times \text{radius}^2 \times \text{length}$

Volume (solid) = $3.14 \times (2.5 \text{ ft})^2 \times 6 \text{ ft} = 117.75 \text{ ft}^3$

Volume (empty space) = $3.14 \times (1.5 \text{ ft})^2 \times 6 \text{ ft} = 42.39 \text{ ft}^3$

Volume concrete = $117.75 \text{ ft}^3 - 42.39 \text{ ft}^3 = 75.36 \text{ ft}^3$

Weight = $75.36 \text{ ft}^3 \times 150 \text{ lb/ft}^3 = 11,304 \text{ lb}$

CSP Questions and Answers- Part-II

Question #: 721- If the two legs of a right triangle have lengths of 20 feet and 30 feet, what is the angle formed by the longer leg and the hypotenuse?

- 1) 49° 2) 30° **3) 34°** 4) 52°

Answer: - Draw the triangle. The angle between the longer leg and the hypotenuse is determined by finding the tangent.

$$\text{Tangent} = \text{opposite side} / \text{adjacent side} = 20 \text{ ft} / 30 \text{ ft} = 0.6667 \quad \tan^{-1}(0.6667) = 33.7^\circ$$

Question #: 722- If the two legs of a right triangle have lengths of 10 feet and 15 feet, how long is the hypotenuse?

- 1) 12 ft **2) 18 ft** 3) 20 ft 4) 25 ft

Answer:- In mathematics, the sum of the sides of a triangle squared equals the sum of the hypotenuse squared or: $c^2 = a^2 + b^2$ $c^2 = (100 \text{ ft}^2 + 225 \text{ ft}^2) = 325 \text{ ft}^2$ $c = 18 \text{ ft}$

Question #: 723- If the diagonal of a rectangle has a length of 20 ft and forms a 30° angle with the base, what are the dimensions of the rectangle?

- 1) 10 ft * 17.3 ft** 2) 10 ft * 15.5 ft 3) 8 ft * 12 ft 4) 8 ft * 10 ft

Answer:1- Draw a picture. The length of the sides can be found by using trigonometry.
opposite side = hypotenuse side * sine of the angle the hypotenuse makes with the other side of the triangle opposite side = $\sin 30^\circ / 20 \text{ ft} = 10 \text{ ft}$
The length of the base can be found by dividing the length of the opposite side by the tangent of the angle the unknown side makes with the hypotenuse.
base = $10 \text{ ft} / \tan 30^\circ = 10 \text{ ft} / 0.5774 = 17.3 \text{ ft}$

Question #: 724- What is the wavelength of an electromagnetic wave with a frequency of 10^8 Hz? (The speed of light is 3×10^8 m/sec.)

- 1) 1 m 2) 1/3 m **3) 3 m** 4) 1 cm

Answer:- Speed of light = wavelength * frequency:

$$3 \times 10^8 \text{ m/sec} = \text{wavelength} * (10^8 \text{ Hz}) \quad \text{wavelength} = 3 \text{ m}$$

Question #: 725- The term "Hertz" refers to:

- 1) A car rental company 2) The wavelength of an electromagnetic wave, in meters
3) 10% of the speed of light **4) Frequency, in cycles per second**

Answer: Hertz is defined as a cycle per second.

Question #: 726- Two forces of 50 lb each act on a bolt at angles from the horizontal of 30° and 60°. What is the magnitude of the resultant force on the bolt?

- 1) 100 lb **2) 97 lb** 3) 75 lb 4) 67 lb

Answer:- Draw a sketch showing two vectors (P and Q) acting on the bolt. Now transpose one vector to the tip of the other. The opposite side of the triangle formed by the two vectors is the

CSP Questions and Answers- Part-II

resultant force R. The included angle B between the vectors is 150°. Use the Law of Cosines to determine R.

$$R^2 = P^2 + Q^2 - 2 * P * Q * \cos B$$

$$R^2 = 2,500 \text{ lb}^2 + 2,500 \text{ lb}^2 - 2 * 50 \text{ lb} * 50 \text{ lb} * \cos 150$$

$$R = 96.6 \text{ lb}$$

Question #: 727- Two forces of 50 lb each act on a bolt at angles from the horizontal of 30° and 60°. What is the direction of the resultant force?

- 1) 30° 2) 60° **3) 45°** 4) 57°

Answer:- Draw this problem. This problem can be solved intuitively or by using the Law of Cosines followed by the Law of Sines.

$$\begin{aligned} c^2 &= a^2 + b^2 - 2ab \cos C & c^2 &= 50^2 + 50^2 - 2(50)(50) \cos 150^\circ & c^2 &= 9330 & c &= 96.6 \\ a/\sin A &= b/\sin B = c/\sin C & a/\sin A &= c/\sin C & 50/\sin A &= 96.6/\sin 150^\circ & \sin A &= .26 \\ A &= 15^\circ \end{aligned}$$

$$\text{Direction of resultant force} = 30^\circ + 15^\circ = 45^\circ$$

Question #: 728- A unit used to describe sound pressure is:

- 1) **Newtons per square meter** 2) Joules
3) Kilograms per meter 4) Newtons per square foot

Answer:- Sound pressure is measured in newtons per square meter.

Question #: 729- Another unit used to describe sound pressure is:

- 1) **Pascals** 2) Footpounds 3) Ergs 4) Slugs

Answer:- One pascal equals one newton per square meter.

Question #: 730- Effective temperature is defined as:

- 1) A non-comfort index which combines the effect of a body of temperature, humidity, and air movement
- 2) Any specific temperature, the vapor pressure, and absolute humidity
- 3) The rate in which temperature effects the body
- 4) **Comfort index which combines the effects of a body temperature, humidity, and air movement**

Answer:- Effective temperature is defined as the comfort index which combines the effects of a body temperature, humidity, and air movement.

Question #: 731- Hypothermia is defined as a condition when:

- 1) The body experiences extremely high blood pressure

- 2) The body experiences extremely low blood pressure
- 3) The body gains heat faster than it can lose it
- 4) The body loses heat faster than it can produce it**

Answer:- Hypothermia is defined as a condition when the body loses heat faster than it can produce it. NOTE: Hypotension is very low blood pressure, and hypertension is very high blood pressure.

Question #: 732- Ionizing radiation has the greatest effect on which tissues or organs?

- 1) Kidneys
- 2) Liver
- 3) Blood
- 4) Bone marrow**

Answer:- Damage to the blood can be overcome if there is replacement of the injured blood cells by new ones from the bone marrow. However, radiation damage can injure the bone marrow so that cell replacement cannot take place. Damage to the body will be permanent in such cases. Kidneys and the liver are generally highly resistant to ionizing radiation and will be injured only by very high dosages such as those which result from the presence of an internal source.

Question #: 733- The effects of ionizing radiation on this body tissue or organ is generally temporary after exposure stops.

- 1) Skin
- 2) Eyes
- 3) Nervous system
- 4) Hair**

Answer:- Radiation will lead to loss of hair. This effect is generally temporary after exposure stops.

Question #: 734- The combined effects of all or some of physical climate factors can be expressed in the form of:

- 1) Combined temperature index
- 2) Non-effective temperature
- 3) Climate index**
- 4) Temperature index

Answer:- The combined effects of all or some physical climate factors can be expressed in the form of climate index.

Question #: 735- Acclimatization to a hot environment includes controlled blood flow to the skin, facilitated sweating, and increased stroke volume of the heart without an increase in heart rate. It can be accomplished in:

- 1) One or two weeks**
- 2) One month
- 3) 7 days
- 4) 12 days

Answer:- Acclimatization to a hot environment includes controlled blood flow to the skin, facilitated sweating, and increased stroke volume of the heart without an increase in heart rate. It can be accomplished in one or two weeks.

Question #: 736- Identify the major avenue(s) by which the human body controls heat transfer between the core and the skin.

- 1) Sweat production
- 2) Efferent motor pathways, sweat production, and vasomotor**
- 3) Sudomotor pathways only
- 4) Motor, vasomotor pathways

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Answer: The efferent motor pathways, sweat production, and vasomotor mechanisms are the systems by which the body transfers heat from the core to the skin.

Question #: 737- Which is the most vulnerable to injury induced by laser energy?

- 1) Skin 2) **Eye** 3) Internal organs 4) Glands

Answer: The eyes are the most vulnerable to injury by laser energy.

Question #: 738- The most common cause of ultraviolet radiation exposure is from:

- 1) Television/computer monitors 2) Ultraviolet lights (tanning lights, black lights, etc.)
3) **The sun** 4) Special devices

Answer: Exposure to direct and indirect sunlight is the most common cause of ultraviolet radiation exposure.

Question #: 739- An important element of a production machine shop safety program is:

- 1) Safety training schedule 2) Organizational reporting protocols
3) **Lockout/tag out procedures** 4) Personnel policies for discipline

Answer: A specific lockout/tag out program facilitates protecting workers from life threatening hazards. This is more important than the other choices.

Question #: 740- What may be a negative consequence of wearing personal protective equipment?

- 1) Uncomfortable 2) Inconvenient 3) Requires more effort 4) **All of the above**

Answer:- Negative consequences of wearing personal protective equipment may include less comfort, more inconvenience, and more effort. E. Scott Geller, The Psychology of Safety

Question #: 741- Byssinosis is an occupational disease related to exposure to:

- 1) **Cotton fiber dust** 2) Droppings of infected cattle
3) Rickettsial organism 4) Fumes of metals

Answer:- Byssinosis is a disease occurring in those who experience prolonged exposure to heavy air concentrations of cotton or flax dust.

Question #: 742- The most frequent occupational disease is attributed to:

- 1) Pneumoconiosis 2) **Dermatitis** 3) Chemical poisoning
4) Radioactive exposure

Answer:- Industrial skin diseases account for more than half of all compensation claims for occupational disease. These claims are scattered throughout all types of industry and sometimes appear where occupational skin disease may be least expected. There are two general types of dermatitis, primary irritation and sensitization. Cause can be classified under

the headings of: chemical agents, mechanical agents, physical agents, plant poisons, and biological agents.

Question #: 743- Occupational arsenic exposure is highly unlikely in which of the following industries?

- 1) Agricultural pesticide workers
- 2) Electronics industry workers
- 3) ~~Tire manufacturing~~
- 4) Copper smelting

Answer:- Some arsenates are used as pesticides; various arsenic compounds are used as doping agents in the semiconductor industry, and arsenic trioxide is produced in large quantities in the smelting of copper.