

CHAPTER 1—SAFETY THROUGH DESIGN

1. List the safety through design provisions in ANSI/AIHA Z10.

- Addressing safety and health needs in the design and redesign processes
- Identifying and analyzing hazards and assessing and prioritizing the risks that derive from them
- Applying a prescribed hierarchy of controls, to reduce risks to an acceptable level
- Implementing a management of change procedure so that hazards and risks are properly considered and minimized when changes are made
- Including safety and health specifications in purchasing documents to avoid bringing hazards and risks into the workplace

2. Define safety through design.

Safety through design is defined as the integration of hazard analysis and risk assessment methods early in the design and redesign processes and taking the actions necessary so that the risks of injury or damage are at an acceptable level. This concept encompasses facilities, hardware, equipment, tooling, materials, layout and configuration, energy controls, environmental concerns, and products.

3. What benefits are obtained by applying safety through design concepts?

- Significant reductions will be achieved in injuries, illnesses, damage to the environment, and the attendant costs
- Productivity will be improved
- Operating costs will be reduced
- Expensive retrofitting to correct design shortcomings will be avoided.

4. How do safety through design concepts relate to quality management?

There is a remarkable correlation between quality management and safety through design principles. We borrow from W. Edwards Deming, who was world renowned in quality management. Deming stressed again and again that, “Processes must be designed to achieve superior quality if that is the quality level desired, and that superior quality cannot be attained otherwise.” If the goal is to achieve superior quality, or superior safety, systems must be designed to achieve those performance levels, and a continuous improvement program must be maintained for the redesign of existing work places and work methods.

5. Define the following terms: acceptable risk; safety; hazards; risk; probability; severity; residual risk.

- a. **Acceptable risk:** Risk for which the probability of a hazard-related incident or exposure occurring and the severity of harm or damage that may result are as low as reasonably practicable, and tolerable in the setting being considered.
- b. **Safety:** Safety is defined as that state for which the risks are judged to be acceptable.
- c. **Hazards:** Are the potential for harm. Hazards include all aspect of technology and activity that produce risk. Hazards include the characteristics of things (equipment, dusts) and the actions or inactions of people.
- d. **Risk:** An estimate of the probability of a hazards related incident or exposure occurring and the severity of harm or damage that could result.
- e. **Probability:** The likelihood of a hazard being realized and initiating an incident or exposure that could result in harm or damage—for a selected unit of time, events, population, items or activity being considered.
- f. **Severity:** The extent of harm or damage that could result from a hazard-related incident or exposure. **Residual risk:** The risk remaining after preventive measures have been taken. No matter how effective the preventive actions, there will always be residual risk if a facility or operation continues to exist.

6. Outline the hazard analysis/risk assessment process.

The Hazard Analysis/Risk Assessment Process

Establish the Analysis Parameters

Identify the Hazards

Consider the Failure Modes

Determine the Frequency and Duration of Exposure

Assess the Severity of Consequences

Determine Occurrence Probability

Define the Risk

Rank Risks in Priority Order

Develop Remediation Proposals

Follow Up on Actions Taken

Document the Results

7. What would a risk assessment matrix include and what benefit derives from its use?

A risk assessment matrix includes combinations of occurrence probabilities and severities of harm, and the risk levels that derive from those combinations.

A matrix helps in communicating with decision makers and influencing their decisions on risks and the actions to be taken to ameliorate them. Also, risk assessment matrices can be used to compare and prioritize risks, and to effectively allocate mitigation resources.

8. Outline the hierarchy of controls.

- a. Eliminate or reduce risks in the design and redesign processes
- b. Reduce risks by substituting less hazardous methods or materials
- c. Incorporate safety devices
- d. Provide warning systems
- e. Apply administrative controls (work methods, training, work scheduling, etc.)
- f. Provide personal protective equipment

9. Why do the ameliorating elements in the first, second, and third levels of the hierarchy achieve more effective control of risk?

- a. They are preventive actions that eliminate or reduce risk by design, substitution, and engineering measures
- b. They rely the least on personnel performance.
- c. They are less defeatable by supervisors or workers.
- d. Actions described in the fourth, fifth and sixth levels are contingent actions and rely greatly on the performance of personnel

10. What is the desired outcome in applying the hierarchy of controls?

A major premise to be considered in applying a hierarchy of controls is that the outcome of the actions taken is to be an acceptable risk level.

11. What concepts must be taken into consideration in achieving an acceptable risk level?

Achieving acceptable risk requires taking into consideration the:

- practicable minimization of each of the two distinct aspects of risk as risk reduction actions are decided upon:
 - Avoiding, eliminating, or reducing the probability of a hazard-related incident or exposure occurring
 - Reducing the severity of harm or damage that may result, if an incident or exposure occurs
- feasibility and effectiveness of the risk reduction measures to be taken, and their costs, in relation to the amount of risk reduction to be achieved.

12. List the three critical points during which a safety practitioner can influence the design of the workplace and work methods.

- a. pre-operational in the design process where the opportunities are greatest and the costs are lower for hazard and risk avoidance, elimination, or control
- b. operational mode, where hazards are eliminated or controlled and risks reduced before their potentials are realized and hazards-related incidents or exposures occur
- c. post incident--as investigations are made of hazards-related incidents and exposures for causal factor determination and risk reduction.

13. Why may behavioral modification techniques be inadequate to resolve occupational risk design issues?

Although behavior modification and training are important elements of a safety and health initiative, such measures are misdirected when applied to solve workplace or work methods design problems.

14. Alan D. Swain suggested that management forego the temptation to place the burden of accident prevention on the individual worker.

15. What is the central point of Dr. Chapanis's work?

The improvement in system performance that can be realized from the redesign of equipment is usually greater than the gains that can be realized from the selection and training of personnel.

16. What is the central point of Dr. Haddon's unwanted energy release theory?

Haddon espoused the concept that unwanted transfers of energy can be harmful (and wasteful) and that a systematic approach to limiting their possibility should be taken.

17. Why are the “General Design Requirements: A Thought Process for Hazard Avoidance, Elimination, or Control” included in this text?

To provide guidance for those who consider adopting safety through design methods, and, subsequently, in applying the hierarchy of controls.

18. List the nine major requirements in the “General Design Requirements.”

- a. Avoid introduction of the hazard: Prevent buildup of the form of energy or hazardous materials.
- b. Limit the amount of energy or hazardous material.

- c. Substitute, using the less hazardous.
- d. Prevent unwanted energy or hazardous material buildup.
- e. Prevent unwanted energy or hazardous material release.
- f. Slow down the release of energy or hazardous material.
- g. Separate in space or time, or both, the release of energy of hazardous materials from that which is exposed to harm
- h. Interpose barriers to protect the people, property, or the environment exposed to an unwanted energy or hazardous material release.
- i. Modify the shock concentrating surfaces.

19. What is the objective of a management of change process?

The objective of a management of change process is to prevent the introduction of new hazards and risks into the work environment when changes are made in technology, equipment, facilities, work practices and procedures, design specifications, raw materials, organizational or staffing changes impacting on skill capabilities, and standards or regulations.

20. What benefits are obtained by including safety specifications in purchasing documents?

Having safety specifications included in purchasing documents (purchase orders and contracts) provides suppliers and vendors with knowledge of the safety specifications that are to be met. That substantially reduces the possibility of bringing hazards and the risks that derive from them into the workplace.

CHAPTER 2—BUILDINGS AND FACILITY LAYOUT

1. List five of the eight factors to consider in the general design of a workplace.
 - a. Illumination
 - b. Noise and vibration control
 - c. Product flow
 - d. Ventilation (particularly of dust, vapors, and fumes)
 - e. Control of temperature and humidity
 - f. Work positions and movements of employees
 - g. Supervision and communication
 - h. Support requirements for such things as vehicles, portable ladders, material handling devices, monitoring and controlling systems, and cleaning and maintenance equipment.
2. Companies should ensure that which of the following groups review and approve their plans and specifications for new facilities or facilities that need remodeling?
 - d. all of the above

3. Name the specific safety code for electric wiring and electrical installations and the organization that established it.

The specific safety code for electric wiring and electrical installations is NFPA 70, National Electrical Code, issued by the National Fire Protection Association (NFPA).

4. List four of the six factors to consider when designing machine tools and equipment.
 - a. Construction and procedures
 - b. Visual displays, signs, and labels
 - c. Protective features and guards
 - d. Controls and handles
 - e. Maintenance and service needs
 - f. Safety signs
5. What should be done to protect pedestrians if pedestrian entrances must be located near railroad tracks or busy thoroughfares?

To protect pedestrians when their entrances are located near railroad tracks or busy thoroughfares, fence part of the right-of-way, install traffic signals, and build subways or pedestrian bridges.

6. Knowing the nature of wastes is essential for knowing the appropriate disposal methods. Which of the following wastes can be disposed of by burning in an incinerator?
 - b. wood and paper
7. Describe the steps that should be taken to address the problem of confined spaces.
 - a. Identify all confined spaces.
 - b. Identify all potential hazards for each confined space and the methods to eliminate them.
 - c. Develop a confined space work permit form.
 - d. Train personnel on the dangers and proper observance of confined spaces.
 - e. Ensure that a trained and equipped rescue team is available to respond to an emergency.
8. Which type of lighting can provide better illumination levels in small or restricted areas?
 - a. supplementary lighting
9. What are the six security factors to consider when designing a facility's environment?
 - a. Keep the number of openings to a minimum.
 - b. Secure all windows.
 - c. Use protective lighting.
 - d. Have entrances and service doors lead to a reception area.
 - e. Install alarm systems that detect fire, fumes, vapors, and intruders.
 - f. Limit access to docks and other receiving areas.
10. Why do safety engineers use warm colors to call attention to dangerous machine parts, fire hazards, and physical hazards?

Safety engineers use warm colors to call attention to dangerous machine parts or hazards because warm colors (reds, yellows, and oranges) have longer wavelengths than cooler colors. Due to the human eye's reflective response to color, warm colors with longer wavelengths seem to move toward the observer.
11. Neutral colors of low light-reflectance values should be used in what type of working environment?

Neutral colors of low-light reflectance values should be used in laboratories where reflected color might prevent accurate observation of materials being tested and analyzed.

12. Red is the standard color for:

- d. identifying fire protection equipment, danger, and emergency stops on machines.

13. List seven factors to consider when determining the best type of floor for a particular location.

- a. Load
- b. Durability
- c. Maintenance
- d. Noise
- e. Dustiness
- f. Drainage
- g. Heat conductivity
- h. Resilience
- i. Electrical conductivity
- j. Appearance
- k. Chemical composition
- l. Slip-resistance

CHAPTER 3—CONSTRUCTION OF FACILITIES

1. The primary factor in the success of an effective safety program depends on _____ and its involvement in the safety program.
 - c. management
2. _____ ultimately pays the cost of the safety program on a job site.
 - a. Owners
3. Monitoring day-to-day activities of construction trades and contract compliance is an essential function of the
 - c. owner
4. It is the role of the _____ to clearly establish responsibility for safety down through the organizational hierarchy.
 - a. owner
5. A successful safety plan must address the following:
 - d. all of the above
6. To ensure a clear understanding of the owner's safety expectations, they should be documented in the
 - a. project safety plan.
7. A means of systematically identifying and evaluating safety issues associated with a work task is a
 - c. job safety analysis.
8. A JSA should be developed for all critical tasks, with priority given to addressing tasks
 - d. all of the above
9. For a safety program to be successful, who must recognize that they each have a role in the safety process?
 - d. all of the above
10. Workers are responsible for which of the following?
 - d. all of the above
11. It is the role of the designated safety representative to
 - d. all of the above
12. A competent person is defined as an individual who, as the result of training and/or experience,
 - d. all of the above

CHAPTER 4—MAINTENANCE OF FACILITIES

1. Facility maintenance can be described as:
 - d. all of the above
2. List four items to check periodically for signs of excessive foundation settlement.
 - a. Footings
 - b. Column bases
 - c. Foundation walls
 - d. Pits
3. Which of the following, when inadequately maintained, is a major source of injuries?
 - c. floors
4. It is recommended that roofs be inspected:
 - b. every 6 months
5. Describe four precautions to take to prevent roof damage from ice and snow.
 - a. Clear a path from the center of the roof to the drains to avoid ice and snow buildup near drain areas.
 - b. Clear a path leading to the roof's edge to allow drainage on a pitched roof with no drains.
 - c. Never use blowtorches or similar devices to melt ice from drains or roof surfaces.
 - d. Use care when removing ice and snow to avoid puncturing the roof.
6. What items should be considered when inspecting the condition of exits?
 - a. Exit signs should be appropriately placed.
 - b. Exits should not serve as storage areas.
 - c. Exits should be well-lit with smooth floors.
 - d. Exit doors should move freely with no obstructions.
 - e. Exit signs and emergency lighting, designed to operate in the dark in case the lighting system fails, should be tested.
7. List five precautions to take to reduce the possibility of heating equipment breakdowns during cold weather.
 - a. Inspect and thoroughly clean the heating systems.
 - b. Annually inspect chimneys and vent pipes for cracks, missing mortar, and rusted holes.
 - c. Keep the inside of buildings at a minimum temperature of 40°F.
8. Of the following, which have been associated with indoor environmental quality incidents?
 - d. all of the above
9. Preventive design is an important safeguard to prevent indoor environmental quality problems. List five of the seven basic elements that should be included in preventive design.
 - a. Choose a heating, ventilating, and air conditioning (HVAC) system that fits the building size and anticipated uses.
 - b. Allow for a generous number of intake and exhaust vents.
 - c. Locate intake vents where they will receive the largest supply of fresh air away from cars, buildings, and process exhausts, and as close as possible to trees and bushes.
 - d. Fit the HVAC system with regulating generators that are flexible enough to adjust to the varying air pressures of intake and exhaust vents.
 - e. Use only steam humidifiers.
 - f. Use prefilters to clean the air before it passes over higher-efficiency filters.
 - g. Institute a preventive-maintenance program. Provide for regular inspections of drain pans, filters, and any area of the HVAC that is accessible and that might fall prey to germs.
10. What are some of the hazards that can be prevented by properly training grounds maintenance workers?
 - a. Accidents and injuries from landscaping tools and machines
 - b. Poisonous vines, shrubs, fruits, insects, and reptiles
 - c. Pesticide poisoning
 - d. Snow-shoveling injuries
11. List five worker actions that result in injuries from electric hedge trimmers.
 - a. Changing hand position while the trimmer is running
 - b. Holding branches away from the cutting bar
 - c. Removing debris from the trimmer
 - d. Holding the trimmer with only one hand
 - e. Failing to wait for the blades to stop after turning the trimmer off

12. Briefly explain the purpose of a computerized predictive maintenance (CPM) program.

A CPM program is a preventive measure that monitors equipment before malfunctioning or failure begins. In addition to alerting the proper personnel to potentially hazardous conditions, a CPM program also provides the record keeping required by state and federal safety regulations.

13. The selection of maintenance employees should be based on what three criteria?

- a. Their experience
- b. Their alertness
- c. Their mechanical ability

14. The use throughout the facility of which of the following contributes to overall accident prevention and leads to higher operating standards?

- b. color-identification schemes

15. What safety precautions should be taken when employees work underneath pipelines that carry chemicals?

When employees work underneath pipelines that carry chemicals, isolate or cover the overhead pipelines so that the chemicals do not drip on workers or materials. Issue special protective equipment to workers, such as chemical-protective goggles, protective suits, rubber gloves, or respiratory-protective equipment. Provide emergency showers with plainly marked locations.

CHAPTER 5—FIRED PRESSURE VESSELS (BOILERS) AND UNFIRED PRESSURE VESSELS

1. What is the difference between the ASME Code and the NB Code for boilers and pressure vessels?

The ASME Code provides guidelines for inspection during the construction of boilers and pressure vessels. The NB Code provides guidelines for inspection after the installation, repair, or alteration of boilers and pressure vessels.

2. List four of the seven common causes of pressure vessel explosions.

- a. Errors in design, construction, and installation
- b. Improper operation, human failure, and improper operator training
- c. Corrosion or erosion
- d. Mechanical breakdown, failure, or blocking of safety devices
- e. Failure to inspect thoroughly and frequently
- f. Improper application of equipment
- g. Lack of planned preventive maintenance.

3. When inspecting safety and relief valves in a boiler, the inspection should be performed _____ to prevent damage to the valve seats.

- b. under pressure

4. What is a boiler?

A boiler is a closed vessel in which water is heated by combustion of fuel or other heat source.

5. What is the maximum recommended pH for water within a boiler?

- d. 11

6. When should a soot blower not be used?

When it is suspected that there is a fire in the gas passages

7. What is the purpose of safety valves in boilers and pressure vessels?

To relieve excess pressure or vacuum

8. During the cleaning process, when should soot and fly ash be removed?

As soon as the boiler has cooled

9. What is the proper way to wet down an ash pile?

Direct the water to the outside of the pile and move toward the center. Water aimed directly at the center of an ash pile can cause an explosion.

10. Every boiler's flame-safeguard supervisory system and other safety controls should be inspected during a scheduled shutdown period at least _____.

- d. yearly

11. What are the three general precautions for entering a boiler?

- a. Proper ventilation
- b. Proper equipment
- c. Proper protection

12. What is high-temperature water (HTW)?

Water in a closed system under high pressure that remains liquid instead of turning to steam when the temperature exceeds 212°F (100°C)

13. What is an unfired pressure vessel?

A vessel designed to withstand pressure or vacuum, but not external heat sources, such as burning fuel or electric heaters

14. List three of the six items that a vessel's history log should contain.

- a. Blueprints
- b. Manufacturer's data reports and instructions
- c. Design data
- d. Installation information
- e. Records of process changes
- f. Historical profile, including repair records and inspection reports

15. Why would you use a hydrostatic or pneumatic test to inspect a boiler or pressure vessel?

If the vessel cannot be inspected internally

16. Under what conditions should the safety valve of a pressure vessel not have a test lever?

When the vessel's contents are dangerous (e.g., toxic, flammable)

17. What is a water seal and when is it used?

It is a U-pipe filled with water, with one end connected to the pressure side of the pressure vessel and the other vented to the atmosphere. It is used on pressure vessels that operate on low pressure or slight vacuum.

18. The most hazardous part of an autoclave is the closure devices, and failure or blocking of automatic control.

CHAPTER 6—SAFEGUARDING

1. Define safeguarding.

Safeguarding is any means of preventing personnel from coming in contact with the moving parts of machinery or equipment that would potentially cause physical harm.

2. List the six characteristics of a proper guard.

- a. Integrated as part of the machine
- b. Well-constructed, durable, and strong
- c. Able to accommodate workpiece feeding and ejection
- d. Protective
- e. Easy to inspect and maintain
- f. Relatively tamper-proof or foolproof

3. Which of the following is a hazardous area involving two or more mechanical parts rotating in opposite directions within the same plane and in close interaction?

- b. nip point or bite

4. Name the four general types of safeguards.

- a. Built-in safeguards
- b. Barrier guards
- c. Interlocking barrier guards
- d. Automatic safeguarding devices

5. Briefly explain the three advantages that built-in machine safeguards, which are designed and installed by the manufacturer, have over safeguards made by the machine user.

- a. Built-in safeguards conform more closely to the contours of the machine, making them superior in appearance and placement.
- b. Built-in safeguards eliminate hazards completely and permanently while withstanding daily wear and handling.
- c. Built-in safeguards tend to cost less because the cost is usually spread over a large number of machines.

6. A point of operation is defined as:

- c. the area of a machine where material is positioned for processing and where processing of the material actually takes place.

7. An effective interlocking barrier guard must satisfy what three requirements?

- a. It must guard the hazardous area before the machine can be operated.
- b. It must stay closed until the rotating equipment is at rest.
- c. It must prevent operation of the machine if the interlocking device fails.

8. Which of the following is the preferred material to construct guards?

- b. metal

9. What are the benefits of nonmetal barriers?

Nonmetal barriers are less expensive and resist the effects of splashes, vapors, and fumes from corrosive substances that would react with metal.

10. What five factors should be considered when matching a machine or equipment to an operator?

- a. The workplace should require a minimum amount of strenuous lifting and traveling.
- b. The work height of workstations should be the optimal height for stand-up or sit-down operations.
- c. Controls should be standardized and readily accessible.
- d. Materials handling aids should be provided to minimize manual handling of materials.
- e. Factors contributing to operator fatigue should be minimized, including excessive speed-up, boredom from monotonous operations, and awkward work motion or operator position.

11. List the five steps that should be taken after a machine or piece of equipment has been locked out for repair and is ready to return to normal operating condition.

- a. Check the machine or equipment and the surrounding area to ensure that nonessential items have been removed and that the machine or equipment components are operationally intact.
- b. Check the work area to ensure that all employees have been safely positioned or removed from the area.
- c. Verify that the controls are in neutral.
- d. Remove the lockout devices and reenergize the machine or equipment.
- e. Notify affected employees that the maintenance is completed and the machine or equipment is ready to use.

12. Which of the following is a principal hazard when using robots?
 - d. all of the above
13. Name three devices that can sense a person's presence within a robot's movement zone.
 - a. Photoelectric cells
 - b. Pressure-sensitive mats
 - c. Light or sound curtains

CHAPTER 7—PERSONAL PROTECTIVE EQUIPMENT (PPE)

1. What are the three broad categories of methods used to control harmful exposures to hazardous substances?

- a. Engineering controls
- b. Administrative controls
- c. Personal protective equipment (PPE)

2. Define *personal protective equipment* (PPE).

Personal protective equipment is referred to as the use of respirators, special clothing, safety glasses, hard hats, or similar devices whose proper use reduces the risk of personal injury or illness resulting from occupational hazards.

3. Information on certified equipment is available through which of the following?

- e. only b and c

4. Which of the following adds considerably to the protection offered by a helmet?

- a. chin strap

5. Name the standard established by the American National Standards Institute (ANSI) for eye and face protection.

The standard established for eye and face protection is ANSI Z87.1 1989, Practice for Occupational and Educational Eye and Face Protection.

6. The aspect of protective eye lenses that provides the filtering effect against infrared and UV radiation is:

- b. chemical composition.

7. Briefly describe the four types of hearing protection devices.

- a. Enclosure—completely surrounds the head, such as an astronaut's helmet
- b. Aural insert—acts as a plug, commonly called earplug
- c. Superaural—cap seals the external edge of the ear canal, also called canal cap
- d. Circumaural—cup covers the external ear, also called earmuff

8. Name the two classifications of fall protection systems.

- a. Passive
- b. Active

9. List three devices used in passive fall arrest systems.

- b. General all-purpose nets
- a. Personnel nets
- b. Debris nets

10. How often should audiometric testing be done on employees?

- b. when new employees are hired and annually thereafter

11. Name five components of active fall arrest systems.

- a. Safety belts
- b. Fall arresters and shock absorbers
- c. Harnesses
- d. Lifelines
- e. Fall-arresting systems

12. What are the three steps in selecting respiratory protective equipment?

- a. Identify the hazard.
- b. Evaluate the hazard.
- c. Select the appropriate, approved respiratory equipment.

13. The two main categories of respirators are:

- a. Air-supplying respirators
- b. Air-purifying respirators

14. Gloves or mittens having metal parts or reinforcements should never be used around:

- c. electrical apparatus.

15. Protective footwear is classified according to its ability to meet what two requirements?

- a. Compression resistance
- b. Impact resistance

CHAPTER 8—ELECTRICAL SAFETY

1. What is a person's main resistance to current flow?

Skin surface

2. Why is low voltage often considered more dangerous than high voltage?

Low voltage is considered dangerous in regards to electrical shock because it often prevents the victim from breaking the contact with the circuit, often referred to as "locked" because the muscles in the hand will contract and lock the victim on the circuit. As the time of exposure is increased, the severity of the injury is increased.

3. What is measured in ohms?

Resistance

4. Name two factors that determine the outcome of an electrical shock.

- a. Current flow: the amount of current that flows through the victim
- b. Time: the length of time that the body receives the current
- c. Path: the path and body parts affected as the current travels through the victim

5. Why is an unguarded knife switch especially hazardous?

An open or exposed knife switch is extremely hazardous in systems over 50 volts. This is because current-carrying parts are exposed and an arc forms whenever the switch is opened or closed.

6. How is the safe current-carrying capacity of conductors determined?

The safe current-carrying capacity of conductors is determined by calculating the conductors' size, length, material type (e.g., aluminum versus copper), insulation, and manner of installation.

7. What is the function and primary purpose of an over-current device?

Over-current devices should interrupt the current flow whenever it exceeds the conductor's capacity.

8. What is the limited approach boundary?

The limited approach boundary (LAB) or restricted approach boundary represents the distance necessary to prevent electrical shock. Unqualified workers must remain outside of the LAB. For fixed systems 750 volts and below this distance is 42" (1 m).

9. What are the two main categories of circuit breakers?

- a. thermal
- b. magnetic

10. What are the three classes of hazardous locations?

- a. Class I—explosive or flammable gases or vapors are or may be present
- b. Class II—combustible dust are or may be present
- c. Class III—ignitable fibers are or may be present

11. What is the purpose of system grounds? What is the purpose of equipment grounds?

The electrical distribution system is grounded in order to prevent the occurrence of excessive voltages from such sources as lightning, line surges, or accidental contact with higher voltage lines. Equipment grounds protect the facility electrical system and equipment.

12. Where are GFCIs required, and what is their purpose?

GFCIs are required in wet locations and "where an employee is operating or using cord and plug connected tools related to maintenance and construction activities supplied by 125 volt, 15, 20, or 30 amp circuits". Their purpose is to protect people from electrical shock.

CHAPTER 9—FIRE PROTECTION

1. What are the four components of a comprehensive fire protection program?
 - a. preventing fires
 - b. detecting and responding to fires
 - c. controlling, suppressing, and extinguishing fires
 - d. recovering from fires in order to resume business operations
2. Name at least three nongovernmental organizations from which information can be obtained on all aspects of fire protection and building codes.
 - a. National Fire Protection Association (NFPA)
 - b. Society of Fire Protection Engineers (SFPE)
 - c. Fire Detection and Suppression System Manufacturers
 - d. International Code Council (ICC)
3. What are the seven steps necessary in performing a comprehensive facility fire risk assessment?
 - a. Step 1: Define risk assessment objectives
 - b. Step 2: Identify hazards
 - c. Step 3: Develop scenarios
 - d. Step 4: Analyze severity
 - e. Step 5: Analyze probability
 - f. Step 6: Presentation of risk
 - g. Step 7: Analyze risk reduction
4. When should a facility's fire prevention activities first occur?

The activities should occur during the early design and construction of a building.
5. List at least five things related to fire prevention that ought to be considered during the design of a facility
 - a. Site planning; building easily accessible to fire fighters, traffic patterns, etc.
 - b. Adequate doors and exits, plan for orderly emergency evacuations
 - c. Sophisticated fire suppression system, e.g., automatic sprinkler system with fire department connection
 - d. Adequate water mains available; hydrants properly located?
 - e. Confining fire with structurally sound fire doors and fire walls

6. What is the major cause of occupant injury and death in structural fires?

The major cause of occupant injury and death in structural fires is asphyxiation from exposure to smoke and toxic gases.

7. What are four essential fire prevention practices that must occur continuously in existing buildings?
 - a. Perform routine fire safety inspection and follow up inspections to ensure findings are resolved.
 - b. Maintain good housekeeping habits (reduce rubbish, reduce combustible loading).
 - c. Maintain fire walls and fire doors (ensure fire wall penetrations are maintained, ensure fire doors are maintained and not blocked open)
 - d. Maintain fire protection equipment (maintain fire detection and alarm systems, maintain fire extinguishers, maintain automatic sprinkler systems).
8. What are the four ways fires can be controlled?
 - a. removing fuel
 - b. cooling burning materials (water or chemical)
 - c. removing oxygen from fire
 - d. inhibiting chemical's chain reaction
9. When should an employee abandon his or her attempts at fighting a fire with a portable fire extinguisher?
 - a. The fire could block an exit.
 - b. The fire is spreading beyond its point of origin.
 - c. The employee is unsure how to use a fire extinguisher.
 - d. The use of one fire extinguisher fails to suppress or extinguish the fire.
10. Class A fires are associated with ordinary materials such as wood, paper, and rubbish.
11. Class B fires are associated with vapor-air mixture over the surface of flammable and combustible liquids, such as gasoline, oil, grease, paints, and thinners.
12. What makes a Class C fire unique when compared with a Class A or Class B fire? What makes it the same?

Class C fires involve energized electrical equipment. When the electrical equipment is de-energized, a Class C fire becomes a Class A or Class B fire (based on the materials that continue to burn after the electricity is turned off).

13. What are Class D fires, and what should not be done to extinguish them?

Class D fires are associated with fires involving combustible metals such as magnesium and titanium. Fire extinguishers not rated for Class D fires should not be used on them, as the wrong extinguishing agent on a Class D fire can make the fire more intense.

14. What are Class K fires, and how are they different from Class B fires?

Class K fires involve vegetable and animal fat fires in commercial kitchens. These fires are different from Class B fires because of the presence of the very hot cooking surfaces facilitating the vaporization of the fuel.

15. List four comprehensive national consensus standards and codes related to general facility fire protection.
NFAP 1 (Uniform Fire Code)

- a. NFAP 1 (Uniform Fire Code)
- b. NFPA 101® (Life Safety Code®)
- c. NFPA 5000 (Building Construction and Safety Code®)
- d. ICC (International Building Code®)

CHAPTER 10—FLAMMABLE AND COMBUSTIBLE LIQUIDS

1. What is a flammable liquid, as defined by NFPA 30, Flammable and Combustible Liquids Code?

A flammable liquid, as defined by NFPA 30, Flammable and Combustible Liquids Code is any liquid having a closed-cup flash point below 100°F(37.8°C) and having a vapor pressure not exceeding 40 psia (1,276 kPa) at 100°F.

2. When flammable and combustible liquids vaporize, forming flammable mixtures with air, the degree of danger depends on what four factors?

- a. The flash point of the liquid
- b. The concentration of vapors in the air
- c. The possibility of a source of ignition at or above a temperature or energy level high enough to cause the mixture to burst into flame
- d. The amount of vapors present

3. What is auto-ignition temperature?

Auto-ignition temperature is the minimum temperature at which a flammable gas-air or vapor-air mixture will ignite from its own heat source or a contacted heated surface without the presence of an open spark or flame.

4. Define *flash point*.

Flash point is the minimum temperature at which a liquid gives off vapor concentrated enough to form an ignitable mixture with air near the surface of the liquid within a vessel specified by the appropriate testing procedure and apparatus.

5. How is static electricity generated?

Static electricity is generated by the contact and separation of dissimilar materials.

6. What is the difference between bonding and grounding?

Bonding eliminates a difference in the static-electrical-charge potential between two or more objects. Grounding eliminates a potential difference between an object and the ground (earth). Bonding and grounding are effective only when the bonded objects are conductive materials.

- 7. Petroleum liquids can build up a static charge when they
 - a. flow through piping or filters.
- 8. Which of the following would put a combustible-gas indicator out of service if drawn into the instrument?
 - f. only a, c, and d
- 9. When a tank truck containing flammable liquids is being loaded or unloaded, what are the steps to take to ensure safety?
 - a. Set the brakes.
 - b. Stop the engine (unless power takeoff is required for unloading).
 - c. Turn off the lights.
 - d. Make the bonding connection before the dome cover is opened for inspection or gauging.
- 10. Which government agencies should operators of flammable and combustible liquid facilities contact to confirm requirements pertaining to their operations?
 - a. U.S. Department of Transportation
 - b. Occupational Safety and Health Administration
 - c. National Fire Protection Association
 - d. U.S. Environmental Protection Agency
- 11. What type of extinguishing agents should be used on a flammable-liquid fire?

Use dry chemicals or carbon dioxide on a flammable-liquid fire.
- 12. What are the three ways to protect an underground tank when it is buried under a heavily traveled roadway?
 - a. Cover with at least 3 ft (0.9 cm) of earth.
 - b. Cover with 18 inches (0.46 m) of tamped earth plus 6 inches (15 cm) of reinforced concrete
 - c. Cover with 18 inches (0.46 m) of tamped earth plus 8 inches (20 cm) of asphalt concrete.
- 13. Why is it common practice to paint flammable-liquid tanks with aluminum, pastel, or white paint?

Aluminum, pastel, and white paint reflect the heat and help reduce the internal vapor pressure of tanks that are exposed to the sun.

14. Even after a tank has been freed of vapor through proper cleaning, combustible mixtures may be formed again through admission of flammable vapors or liquids from what sources?

- a. Unblanketed lines or connections
- b. Breaks in the bottom of the tank
- c. Sludge, sediment, sidewall scale, and wood structures soaked with the liquid

CHAPTER 11—NANOMATERIALS IN THE WORKPLACE

1. What definitions are usually applied to nanoparticles?

Nanoparticles are materials at the nano (one billionth of a meter) scale, also called the “near-atomic” scale. Guidance documents from the National Nanotechnology Initiative describe nanotechnology as including materials in the length scale of 1 to 100 nanometers in any one direction.

2. Do nanoparticles have strength characteristics different from those of conventional-sized materials?

Yes, scientists have known for decades that nano-scale materials have properties of strength, electrical conductivity, and chemical reactivity that are different and distinct from the same materials at their normal scale of traditional use.

3. How does explosivity relate to nanoaerosol particle size?

Because nanoaerosol particles are very small and little is known about how they will react, there may be different and perhaps more intense likelihood of reactions that lead to fire or explosion hazards. Precautions are regularly taken with conventional-size chemicals and particles to avoid explosion and fire hazards. It is safe to assume that such hazards will also exist with these smaller particles.

CHAPTER 12—MATERIALS HANDLING AND STORAGE

1. Materials handling accounts for what percentage of all occupational injuries?

- b. 20% to 45%

2. What are the three main factors to consider when determining the safety of manual lifting for a particular load?

- a. Task repetition
- b. Load location
- c. Load weight

3. What advantage is gained by holding a load close to the body?

It lessens the stress on the lower back.

4. What is the key to safe carrying by teams?

- a. Make every movement in unison.

5. What are the three most common hand tools for materials handling and the principal hazard for each?

- a. Hook—the hook glancing off a hard object and injuring the worker
- b. Crowbar—slippage
- c. Rollers—fingers or toes may be pinched or crushed between the roller and the floor

6. What should be avoided to prevent slippage when using a jack, and how can this be achieved?

Metal-to-metal contact between the jack head and the load can be avoided by using a hardwood shim between the jack and the load.

7. What is the proper method for using wood or metal jack extenders?

Such extenders should not be used.

8. What special precaution should be taken when using a two-wheeled hand truck for moving pressurized items (e.g., gas cylinders)?

Strap or chain the items to the hand truck.

9. Why should four-wheeled hand trucks be pushed instead of pulled?

It causes less stress to the lower back and protects the worker's heel from being caught under the truck back.

10. What are the three main hazards to be aware of when using two- or four-wheeled hand trucks?

- a. Running wheels off bridge plates or platforms
- b. Colliding with other trucks or obstructions
- c. Hands may be jammed between the truck and other objects

11. What two purposes do tie pieces serve in the stacking of lumber?

- a. Stabilize the lumber pile
- b. Allow for air circulation through the lumber pile

12. To prevent injuries that are caused when the wrong valve is opened, piping should be clearly labeled with which three pieces of information?

- a. The material being piped
- b. The hazards involved
- c. Directions for safe use

13. What color flags and lights should be used to isolate railroad tank cars during unloading?

- c. blue

14. To prevent the accumulation of static electricity on most surfaces in areas with airborne dust, the relative humidity should be maintained at what level?

- c. 60% to 70%

15. What is the simplest solution to the potentially dangerous production of fine dust during filling operations?

Moisten the material.

16. A cryogenic liquid has a normal boiling point below:

- b. -238°F

17. What is the main precaution that should be taken in areas where flammable fluids are stored or handled?

No smoking or open flame.

18. Workers should use a self-contained breathing apparatus in areas where the oxygen content may be below.

19.5%

19. What is a Dewar container?

An open-mouthed, nonpressurized, vacuum-jacketed vessel used to hold liquid oxygen, nitrogen, or helium

20. How much weight should dock boards used in railcar loading be designed to carry?

Four times the heaviest expected load

CHAPTER 13—HOISTING AND CONVEYING EQUIPMENT

1. Why should a load be lifted only when it is directly under the hoist?

A load should be lifted only when it is directly under a hoist because stresses for which the hoist was not designed could be imposed upon it. If the load is not properly centered, it can swing, and injury could result.

2. What are the three general types of chain hoists, and which is most efficient?

The three general types of chain hoists include spur geared, differential, and screw geared. The spur geared is the most efficient because it can pick up a load with the least effort on the part of the operator.

3. What is the purpose of a spring return on an operating lever?

A spring return guarantees that if the operator releases a lever it will automatically move into the OFF position.

4. Which crane movement control hand signal should be obeyed even if it is being given by someone other than the signaler in charge?

The Stop movement control hand signal should be obeyed even if it is being given by someone other than the signaler in charge.

5. What is the maximum bend or twist from the plane of the unbent hook in a crane hook that is allowable before corrective action must be taken?

c. 10 degrees

6. What are the first three steps that should be taken before maintenance work can be performed on a crane?

a. The crane must be moved to a location where there will be minimum interference with other cranes and operations.
b. All controllers should be placed in the OFF position.
d. The main power source should be disconnected/deenergized and locked, tagged, or flagged in the deenergized position. All power sources should be neutralized so that they are in a state of energy isolation.

7. Name and describe the three groups of monorail hoists.

- Hand-operated monorail—material is raised with a hand-powered hoist and the trolley is propelled by hand.
- Semi-hand operated monorail—has a power hoist and is moved horizontally by hand.
- Power-operated monorail—electrically actuated for both vertical and horizontal movements.

8. Why should hoists or cranes not be used to lift, support, or otherwise transport people?

Hoists and cranes should not be used to lift, support, or transport people because they do not provide an alternate means of supporting the load if the suspension element fails.

9. Before the first use and after modification, cranes must be tested to of the rated load unless the manufacturer recommends otherwise.

- 125%

10. What is the difference between light service and heavy service?

Light service is operation with loads that are usually half or less of the rated load.

11. What is the difference between frequent inspections and periodic inspections?

Frequent inspections are usually completed by the operator with no record-keeping requirement. Periodic inspections require records and are done by an appointed person.

12. What are five factors that are implicated in unintended mobile crane incidents?

- Operator error
- Support failure
- Failure to use outrigger
- Crane failure
- Rigging

13. What rating should the fire extinguisher that is stored in the cab of a crane have?

- 5BC

14. What three pieces of information should be on a crane operator's capacity chart?

- a. Boom length
- b. Boom angle
- c. Capacity

15. For loads limited by structural competence, the weight should be determined to what level of precision before the load is lifted?

- d. 10% of the load weight

16. Name two purposes of a trial run before lifting personnel.

- a. To ensure that the boom configuration and load lines are adequate
- b. To ensure that no interference of any kind exists and protection devices are working

17. What three things should the authorized signaller for an on-track crane do while walking ahead of the crane?

- a. Warn others
- b. See that switches are properly set
- c. See that the track is free of obstructions

18. For a crane operating near power lines that are rated between 50 kV and 345 kV, what is the minimum necessary clearance between the lines and any part of the crane?

- c. 10 ft

19. What are the four benefits/purposes of using a safety factor of 10 when determining the safe working load of Manila rope?

- a. It allows for errors in load weight estimation
- b. It allows for vibration or shock during load handling
- c. It allows for loss of strength at knots or bends
- d. It allows for deterioration of the rope due to wear

20. What is the maximum distance between emergency stopping devices for a conveyor that operates near a walkway?

- d. 75 ft

21. What are two types of chain conveyors?

- a. Tow conveyors
- b. Trolley conveyors

22. What is the difference between chute conveyors and roller conveyors?

Roller conveyors are similar to chute conveyors, except that the angle of slope is 2% to 4% less than chute conveyors.

23. What code governs the use and design of elevators?

The American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) A17.1, Elevators, Escalators, and Moving Walks, also referred to as the Elevator Code, govern the use and design of elevators.

24. Why are car safeties not required on electrohydraulic elevators?

Car safeties are not required for electrohydraulic elevators because they can come down no faster than the fluid can be forced out of the cylinder by the descending plunger.

CHAPTER 14—ROPES, CHAINS, AND SLINGS

1. Which of the following fiber ropes gives the best uniform strength and service?
 - a. Manila or nylon
2. The properties of fiber make it the best-suited natural fiber for cordage, and it is often recommended for capstan work.
3. List the three major types of synthetic fiber ropes.
4. How often should fiber rope, being used under ordinary conditions, be inspected for damage?
 - b. once a month
5. What is a quick way to make a good estimate of the strength of fibers in a rope and to test for chemical damage?
6. When lengths of fiber rope must be joined, a well-made splice will retain up to 100% of the strength of the rope, but a knot retains only
 - b. 50%.
7. Wire rope is more widely used than fiber rope because
 - d. all of the above
8. Generally speaking, when there are more wires per strand, the wire rope is more
 - a. flexible.
9. The minimum design factors for wire rope used in hoisting depend upon what two conditions?
 - a. The type of service required
 - b. The federal, state or provincial, or local codes covering the particular hoisting operation
10. List the causes of deterioration of wire ropes.
 - a. Corrosion
 - b. Wear
 - c. Kinks
 - d. Fatigue
 - e. Drying out of lubrication
 - f. Overloading
 - g. Overwinding
 - h. Mechanical abuse
11. In the United States, OSHA regulations and other industrial and construction codes prohibit the use of knots in wire rope.
12. In the United States, OSHA requires wire rope or cable to be inspected how often?

In the United States, OSHA requires wire rope or cable to be inspected when installed and weekly thereafter.
13. The safety of a rope sling assembly depends on what six factors?
 - a. Material used (fiber rope or wire rope)
 - b. Fittings of suitable strength for the load
 - c. Method of fastening the rope to the fittings
 - d. Type of sling
 - e. Type of hitch
 - f. Regular inspection and maintenance
14. Why has alloy steel become the standard material for chain slings?

Alloy steel has become the standard material for chain slings because it has high resistance to abrasion and is practically immune to failure since the metal is cold worked.
15. What is the best way to detect wear and stretching of chains and chain slings?
 - d. visual, link-by-link inspection
16. What is the difference between the usage of synthetic web slings and metal mesh slings?

Synthetic web slings are useful for lifting loads that need their surfaces protected. Metal mesh slings can safely handle sharp-edged materials, concrete, and high-temperature materials.

CHAPTER 15—POWERED INDUSTRIAL TRUCKS

1. Name five types of powered industrial trucks.
 - a. Lift trucks
 - b. Straddle trucks
 - c. Crane trucks
 - d. Tractors and trailers
 - e. Motorized hand trucks
 - f. Automated Guided Vehicles (AGVs)
2. What aids should leased or purchased industrial trucks have to reduce driver fatigue and strain?
 - a. Backup alarm lights
 - b. Headlights
 - c. Turn signals
 - d. Enhanced front and rear vision
 - e. Noise-reducing insulation
 - f. Fail-safe brakes
 - g. Comfortable, wrap-around seats that provide protection
3. Which of the following should conform to ANSI/ITSDF B56.1?
 - e. all of the above
4. Because operators in straddle trucks sit so high off the ground, their angle of sight is reduced immediately to the front and to the rear, posing a hazard to pedestrians.
5. What are the two principal hazards of operating a motorized hand truck?
 - a. The operator being pinned between the truck and a fixed object
 - b. The truck running up on the operator's heels
6. Operators of powered industrial trucks can prevent traffic accidents by using the same safe practices that they apply to highway traffic.
7. Describe the common dangerous misuses of powered industrial trucks that operators should never perform.
 - a. Bumping skids
 - b. Pushing piles of material out of the way
 - c. Using makeshift connections to move heavy objects
 - d. Using the forks as a hoist
 - e. Moving other trucks
8. Operators should be aware of what basic differences between lift trucks and automobiles or highway trucks?
 - a. Lift trucks are generally steered by the rear wheels.
 - b. Lift trucks steer more easily loaded than empty.
 - c. Lift trucks are driven in the reverse direction as often as in the forward.
 - d. Lift trucks are often steered with one hand.
 - e. The other hand is used to operate the controls.
9. To be effective, a training program should focus on what three aspects?
 - a. Company policies
 - b. Operating conditions
 - c. Types of trucks used

CHAPTER 16—HAULAGE AND OFF-ROAD EQUIPMENT

1. What signal should be made before a truck goes forward?
 - b. The driver should blow two blasts on the truck's horn.
2. What are the three purposes of having the signaler stand on the driver's side of the vehicle during dumping procedures?
 - a. So the driver can see the signals easily
 - b. So the driver will have the helper in sight
 - c. So the helper will be clear of the backing vehicle and falling material
3. How much weight should the canopy and the canopy support of heavy machinery be able to bear?

Twice the weight of the machinery
4. What are five guidelines that should be followed when coupling or uncoupling motorized equipment?
 - a. No one should go between the vehicles while either one is in motion.
 - b. Parked vehicles should have their brakes set, their wheels blocked, or both.
 - c. Before moving, the driver should receive an all clear signal, to indicate that no one is between the vehicle and a solid and immovable object.
 - d. Two bars are safer than tow ropes.
 - e. Equipment towed on trailers should be secured to the trailer.
5. Grounding rods or electrodes should be driven at least into the ground.
 - c. 8 ft
6. What is the purpose of boom stops?

Boom stops limit the travel of the boom beyond the angle of 80 degrees above the horizontal plane and prevent the boom being pulled backward over the top of the machine.
7. List three of the six essential safe practices for handling loads.
 - a. The hook should be centered over the load to keep the load from swinging.
 - b. Hands should be kept out of the pinch point when holding the hook or slings in place while the slack is taken up.
 - c. The hooker, rigger, and all other personnel must be in the clear before a load is lifted.
 - d. Tag lines should be used for guiding loads.

- e. Hookers, riggers, and others working around cranes must keep clear of the swing of the boom and cab.
- f. No load should be lifted without a signal.

8. What three conditions make driving at slow speeds extremely important?
 - a. When driving off the road and beyond the shoulder, on steep grades, or at rough places
 - b. In congested areas
 - c. Under icy or slippery conditions

9. What are the precautions that should be taken before stepping down from standing machinery?

Look down to make sure footing is secure and no vehicles are approaching.

10. When traveling up a slope, the operator should keep the bulldozer blade for balance.
 - d. close to the ground

CHAPTER 17—HAND AND PORTABLE POWER TOOLS

1. Most incidents involving hand tools and portable power tools can be eliminated by observing what six safety practices?

- a. Provide proper protective equipment and have employees wear it.
- b. Select the right tool for the job.
- c. Know if a tool is in good condition and keep it in good condition.
- d. Use tools correctly.
- e. Keep tools in a safe place.

2. What is the advantage of having centralized tool control in an industrial setting?

Central tool control ensures uniform inspection and maintenance by a trained employee.

3. When metal tools break during normal use, the causes are usually related to the tools' _____.

- b. quality

4. Which of the following is probably the most commonly used and abused tool?

- a. screwdriver

5. When striking another tool, the striking face of the hammer should have a diameter approximately 3/8 in. (0.9 cm) larger than the struck face of the tool.

6. Identify the tool that is more frequently the source of disabling injuries than any other hand tool.

The knife is more frequently the source of disabling injuries than any other hand tool.

7. Based on their power source, portable power tools are divided into what five primary groups?

- a. Electrical
- b. Pneumatic
- c. Gasoline
- d. Hydraulic
- e. Powder actuated

8. What are the inherent risks of portable power tools?

- a. They can easily come in contact with the operator's body.
- b. It is difficult to guard such equipment.
- c. There is the possibility of breakage because the tool may be dropped or roughly handled.
- d. The source of power is brought closer to the operator, creating additional potential hazards.

9. What are three precautions that should be observed when using portable power tools?

- a. Always disconnect the tool from the source of power before changing accessories.
- b. Never leave a tool in an overhead place where there is a chance that the cord or hose can be pulled, causing the tool to fall.
- c. Use proper hearing protection when using power-loaded equipment for driving anchors into concrete, or when using air-driven hammers or jacks.

10. Name seven ways to properly maintain power tools.

- a. Set up an inspection schedule and a system for keeping records for each tool.
- b. Tag defective tools and withdraw them from service until they are repaired.
- c. Provide a visual or external inspection at the toolroom each time a tool is returned. Inspect as specified by the OSHA electrical safety-related work standard.
- d. Use colored tags to tell when the tool was last inspected.
- e. Instruct and train employees to inspect tools and to recognize and report defects
- f. Clean power tools with a recommended nonflammable and nontoxic solvent
- g. Use air drying in place of blowing with compressed air

11. What is the most convenient way of safeguarding the operator of portable electrical tools?

Grounding portable electrical tools and using a ground-fault circuit interrupter (GFCI) provide the most convenient way of safeguarding the operator.

12. Name 7 of the 12 precautions that should be observed when using portable electric drills.

- a. Be sure the trigger switch works properly.
- b. Check carefully for loose power-cord connections and frays or damage to the cord.
- c. Be sure the chuck is tightly secured to the spindle.
- d. Tighten the drill bit securely.
- e. Check auxiliary handles to ensure they are securely installed.
- f. Always wear safety goggles, or safety glasses with side shields, that comply with current national standards and a full face shield when needed.
- g. Always hold or brace the tool securely.
- h. If the drill binds in the work, release the trigger immediately, unplug the drill from the power source, and then remove the bit from the workpiece.
- i. Never attempt to free a jammed bit by starting and stopping the drill.
- j. As the hole is about to be broken through, grip or brace the drill firmly, reduce pressure, and allow the bit to pass easily through the hole.
- k. Unplug the drill before changing bits, accessories, or attachments.
- l. Do not raise or lower a drill by its power cord.

CHAPTER 18—WOODWORKING MACHINERY

1. Companies should provide employees with equipment that meets the existing standards and regulations of what three organizations?
 - a. U.S. Occupational Safety and Health Administration (OSHA)
 - b. American National Standards Institute (ANSI)
 - c. National Fire Protection Association's (NFPA) National Electrical Code
2. On most machines, the point-of-operation guard must be:
 - d. all of the above
3. The working surfaces of the machine should be at a height that will minimize fatigue.
4. The machine inspection process should include inspecting what elements?
 - a. Operating controls
 - b. Safety controls
 - c. Power drives
 - d. Sharpness of cutting edges and other parts
5. Name the two most frequent hazardous incidents involving circular saws.
 - a. Blade cuts or abrasions
 - b. Kickbacks
6. When feeding a table saw, make push sticks long enough to keep hands well away from the blade by adding 6 in. (15.2 cm) to the blade's diameter.
7. What three actions can the operator of a saw take to seriously affect the saw's efficiency and safety?
 - a. Alter its original design.
 - b. Operate it at other than the rated speed.
 - c. Change the balance or tension.
8. Name three ways overhead swing saws and straight-line pull cutoff saws can cause hand injuries.
 - a. While the blade coasts or idles
 - b. When operators attempt to remove a sawed section of board or a piece of scrap
 - c. When operators measure boards or place them in position for the cut
9. What two possibilities of severe injury arise from feeding from the wrong side of a saw?
 - a. The blade's direction of rotation makes it easy for the operator's hands to be drawn into the revolving saw.
 - b. Flying stock can be thrown with enough force to drive the stock through a 1 in. (2.5 cm) board.
10. Because long stock is often ripped on power-feed ripsaws, the clearance at each working end of the saw table should be at least 3 ft (0.9 m) longer than the length of the longest material handled.

CHAPTER 19—WELDING AND CUTTING

1. What is the most significant health hazard in the welding process?

The most significant health hazard in the welding process is the generation of toxic fumes and gases.

2. List five health conditions a welder can experience as a result of exposure to various toxic gases generated during welding.

- a. Inflammation of the lungs (chemical pneumonitis)
- b. Pulmonary edema (swelling and accumulation of fluids)
- c. Emphysema (loss of elasticity of the lungs)
- d. Chronic bronchitis
- e. Asphyxiation

3. Ozone, one of the primary pulmonary gases that can injure the lungs, is formed by

- e. only a and c

4. Which of the following inhalants is highly toxic in high concentrations and can produce total disability after exposure as short as a few months?

- a. manganese

5. If closed containers that have held flammable liquids cannot be removed for standard cleaning procedures prior to welding or cutting them, what two other practices can be followed?

- a. The containers can be purged with an inert gas.
- b. The containers can be filled with water to within an inch or two of the place where the work is to be done with a vent left open.

6. Name the three general categories of personal protective equipment that should be used by welders.

- a. Respiratory protection equipment
- b. Eye protection equipment
- c. Protective clothing

7. Why is dark, woolen clothing preferred when welders work with inert-gas-shielded arc-welding machines?

Dark, woolen clothing is preferred when welders work with inert-gas-shielded, arc-welding machines because it reduces any reflection to the operator's face underneath the helmet. Woolen clothing is more resistant to deterioration and is not readily ignited.

8. The standards for training and qualification of welders were established by which organization?

The standards for training and qualifications of welders was established by the American Welding Society (AWS).

9. What are the five steps in handling a leaking fuel gas cylinder?

- a. Close the valve, and take the cylinder outdoors well away from any source of ignition. A regulator attached to the valve may be used temporarily to stop a leak through the valve seat.
- b. Properly tag the cylinder, and notify the supplier.
- c. If the leak occurs at a fuse plug or other safety device, take the cylinder outdoors well away from any source of ignition, open the cylinder valve slightly, and permit the fuel gas to escape slowly. Tag the cylinder plainly.
- d. Post warnings against approaching with lighted cigarettes or other sources of ignition.
- e. Promptly notify the supplier, and follow instructions for returning the cylinder.

10. Which of the following piping should be used for acetylene distribution systems?

- e. only b and c

11. The color that is generally recognized for a fuel gas hose is

- b. red.

12. What device must be used on both oxygen and fuel gas cylinders to maintain a uniform gas supply to the torches at the correct pressure?

Pressure regulators must be used on both oxygen and fuel gas cylinders to maintain a uniform gas supply to torches at the correct pressure.

13. Define resistance welding.

Resistance welding is a metal-joining process where welding heat is generated at the joint by the resistance to the flow of electric current.

14. Name three relatively new heat sources for welding and cutting.

- a. Friction
- b. Ultrasonics
- c. Lasers

15. Installation of resistance welding equipment should conform to what standard?

The installation of resistance-welding equipment should conform to NFPA National Electrical Code, Standard No. 70.

CHAPTER 20—METALWORKING MACHINERY

1. What two factors result in fewer accidents when operating machine tools?

- a. Good housekeeping
- b. Good work habits

2. Identify one of the major causes of accidents from machine tools, especially drilling equipment.

One of the major causes of accidents from machine tools, especially drilling equipment, is the careless use of high-pressure compressed air to blow chips, cuttings, or shavings from machines or workers' clothing.

3. List three preventive measures that will help operators run engine lathes safely.

- a. Use faceplates and chucks without projections whenever possible.
- b. Install plastic or fine-mesh screen chip shields, particularly on high-speed operations, because they allow operators to see through them while confining the flying chips.
- c. Provide an overhead hoist or a swinging, welded pipe fixture to lift heavy faceplates, chucks, and stock on both lathes and screw machines.

4. What are six common causes of injury in boring mill operations?

- a. Being struck by insecurely clamped work or by tools left on or near a revolving table
- b. Catching clothing or rags for wiping in revolving parts
- c. Falling against revolving work
- d. Caliper or checking work while the machine is in motion
- e. Allowing turnings to build up on the table
- f. Removing turnings by hand

5. Operators should do what four things after the electrical discharge machine (EDM) has been hooked up?

- a. Be sure the machine is properly grounded, and check that all exposed systems are properly covered.
- b. Place all selector switches in the OFF or neutral (disengaged) position.
- c. Be sure that the machine's push buttons, manual limit switches, or controls are set for a safe setup.
- e. Check that the doors of the main electrical cabinet are closed and that the main disconnect switch is in the OFF position.

6. Injuries from shapers and planers frequently result from contact with projections on the workpiece or with projecting bolts or brackets, especially when the table is being adjusted vertically.

7. What type of machine shapes material by bringing it into contact with a rotating abrasive wheel or disk?

- c. grinding

8. Specifications for operation of grinding machines and construction of guards and safety devices are in what code?

Specifications for operation of grinding machines and construction of guards and safety devices are in ANSI B7.1, The Use, Care, and Protection of Abrasive Wheels.

9. What effect do cold and wetness have on grinding wheels?

Cold and wetness can cause grinding wheels to break or crack.

10. Many grindstone failures result from faulty handling and incorrect mounting.

CHAPTER 21—WORKING WITH HOT AND COLD METALS

Part 1

1. Describe the primary means of safeguarding power presses.

Safety of power presses depends on (1) adequately safeguarding the point of operation, (2) properly training press operators, and (3) enforcing safe working practices. Setup and maintenance personnel must be trained to ensure their safety while working in or around a press.

2. Briefly describe the antirepeat function of the clutch/brake control system.

Antirepeat requires release of all actuating mechanisms before another stroke can be initiated.

3. Identify and describe the two types of clutches.

- a. Full-revolution clutch: A type of clutch that, when tripped, cannot be disengaged until the drive mechanism has completed a full revolution and the slide, a full stroke.
- b. Part-revolution clutch: A type of clutch that can be disengaged at any point before the crankshaft has completed a full revolution and the press slide, a full stroke.

4. What is a presence-sensing device?

A device designed, constructed and arranged to create a sensing field or area and to deactivate the clutch control when an operator's hand or any other body part is detected in the area

5. What is a pinch point?

Any point of the power press machine, except the point of operation, where a body part can be caught between the moving parts of a press component or between material and moving parts of the press

6. What is the point of operation?

The area of the die or tooling where material is positioned and work is performed during any process such as cutting, forming or assembly

7. List the two basic categories of safeguarding the point of operation.

- a. Guard
- b. Device

8. Name three of the four types of guards.

- a. Fixed die-enclosure guards
- b. Fixed barrier guards
- c. Interlocked press-barrier guards
- d. Adjustable-barrier guards

9. Where is the two-hand tripping device used?

On a full-revolution clutch machine

10. If more than one operator is used on a machine, how many pull-back devices are necessary?

Each operator must have his or her own set.

11. What is a kick press? Give two uses.

A kickpress is a press that is hand or foot powered, and is used for piercing, notching, forming, or shearing.

12. What is the recommended safeguard for a kick press?

Interlocking tripping mechanism

13. Setup, removal, and handling of power press dies can be very hazardous. Identify three of the six typical injuries that can be suffered by maintenance personnel.

Strains and hernias, foot injuries, crushing injuries, hand injuries or amputations, lacerations from wrench slip page and eye injuries

14. How should a power squaring shear be guarded?

- a. Prevent operators from placing their hands into the point-of-operation.
- b. Prevent or stop the operation if any part of the body approaches the point-of-operation.

15. What type of guard is commonly used on alligator shears?

Adjustable guard

16. What is the function of a power press brake?

Cold bend angles, channels, and curved shapes in plate, strip, or sheet stock

17. When is the safe-distance method used on power press brakes?

The safe-distance method is used when guards and devices cannot be used.

18. What is the combined stroking control system?

Two independent control systems on the same power press brake, only one of which is operable at a time

Part 2

19. Identify two ways of eliminating dust as a health hazard.

- a. Vacuum cleaning to remove dust deposits
- b. Using local exhaust systems that remove dust at the point of origin

20. List three ways of minimizing the toxic and flammable hazards involved in using solvents.

- a. Proper labeling
- b. Substituting less hazardous for more hazardous chemicals
- c. Limiting the quantities in use

21. Which of the following presents a fire and explosion hazard in dust-collecting systems?

- a. aluminum

22. What aspects should be included in the safety and health program for foundry workers?

- a. Baseline physical examinations, including chest x-rays, audiometric tests, and pulmonary-function tests
- b. Periodic physical examinations, keeping track of employees' health, detecting incipient disease, and helping to reclassify workers as needed
- c. Adequate first aid facilities, approved by the physician, and employee training in first aid
- d. Observing regulatory requirements if respirators must be worn
- e. Monitoring industrial hygiene where needed

23. Prolonged contact with oil, grease, acids, alkalis, and dirt can produce dermatitis.

24. The need for controlling ventilation in foundries is determined by what three factors?

- a. Applicable federal, state/provincial, and local regulations or standards, codes, and recommendations
- b. Comparison with similar operations in a like environment
- c. Collection and analysis of representative air samples taken by qualified personnel in the breathing zone of workers

25. What hazard is sometimes generated when charging and blasting takes place in cupolas?

Carbon monoxide (CO) is sometimes generated when charging and blasting take place in cupolas.

26. To eliminate a carbon monoxide explosion hazard, supply adequate natural or mechanical ventilation in back of the cupola, and open two or more tuyeres after the blowers are shut down.

27. What is the principal danger in handling refractory clay crucibles?

The principal danger in handling refractory clay crucibles is that one may break when full of molten metal.

28. List four hazards in the construction and operation of core ovens and mold-drying ovens.

- a. Excess smoke, gases, and fumes
- b. Unprotected firing pits
- c. Unguarded, vertical sliding doors or their counterweights
- d. Flashbacks from fire boxes

29. Which of the following is usually considered adequate for ovens under 500 ft³ (14,000 L) in volume?

- c. natural-draft ventilation

30. Describe four safeguards that should be provided when grinding magnesium.

- a. A means for immediate quenching of sparks from grinding wheels, disks, or belts
- b. Dust-proof motors to prevent the accumulation of static charges
- c. Explosion doors on the collection system
- d. An automatic interlocking control on the collection system to assure its operation whenever grinding is started

31. To help prevent fires in areas where welding operations are conducted, spread sand on the floor to a depth of

- c. 2 in. (5 cm).

32. What are the differences between the conventional cold-stamping press and the forging press?

The differences between the conventional coldstamping press and the forging press are that the forging press has its own operating technique, die

setup, and maintenance problems, and is designed with a faster-acting slide.

33. Identify the most widely used nondestructive testing method for forgings.

The most widely used nondestructive testing method for forgings is the magnetic particle inspection.

34. The resonant-frequency method falls under what general type of nondestructive testing for forged and cast metals?

a. ultrasonic

CHAPTER 22—AUTOMATED LINES, SYSTEMS, OR PROCESSES

1. What is the disadvantage of automation being designed, implemented, or modified using the just-in-time (JIT) philosophy?

The disadvantage of automation being designed, implemented, or modified using the JIT philosophy is that machines may be interdependent, with little or no provision for inventory to back up operations between any two stations.

2. How can a computerized maintenance management system (CMMS) reduce company costs?

CMMS can shorten factory cell downtime by providing easy-to-retrieve information from databases on replacement parts, vendor contact information, and repair instructions.

3. Safety in automated manufacturing processes can be greatly improved in what two ways?

- By careful identification of hazards
- By the development of strategies to control the environment where the processes are taking place

4. List four factors that influence the kinds of automation-related safety precautions that companies must incorporate into their safety planning.

- The type of industry
- The type and complexity of machines on the line
- The way workers interact with the machinery
- The success of the automation used to integrate
- the various components of the production line

5. A minimum clearance of 18 in. (46 cm) is required between an automated guided vehicle (AGV) with its load and any fixed object in all areas that include pedestrian travel or interaction with workers.

6. Name the standard that specifies the areas, or spaces, necessary for machine motion.

The standard that specifically defines the areas, or envelopes, required for machine motion is Safety Standard for Industrial Robots and Industrial Robot Systems, ANSI/RIA R15.06-1992.

7. What two areas of automated materials-handling and transport systems have particular risks?

- Conveyors
- Automated guided vehicles

8. Refer to ANSI B56.5 for standards on bumper design, activation, and requirements for AGVs.

9. List the three basic parts that make up a robot.

- A manipulator
- A power supply
- A system for controlling the robot

10. List the three major areas of robot safety.

- Safety in the process of manufacturing, remanufacturing, and rebuilding robots
- Installation of robots
- Safeguarding of workers exposed to hazards associated with the use of robots

11. Why are hazards most likely to occur when a robot is in the TEACH mode?

Hazardous situations are most likely to develop when a robot is in the TEACH mode. A Japanese survey in 1977 indicated that the greatest risk of injuries involving robots occurs when robots are being programmed, taught, and maintained. These are the times when a person is within a robot's operating space.

12. List the three “whats” that the person in charge is required to ask to ensure the safe operation of any chemical process.

- What can go wrong?
- What is the probability that something will go wrong?
- What would be the consequences if something does go wrong?

13. Name the formal procedure used to identify hazards in a chemical-processing facility.

The formal procedure used to identify hazards in a chemical process facility is commonly known as a hazards and operability (HAZOP) study.

CHAPTER 23—THE COMPUTER AS A SAFETY INFORMATION TOOL

1. Discuss the pros and cons of using Internet-based tools for gathering safety information.

Pros of using Internet-based tools include:

- Computer networks provide convenient access to a wide variety of information resources of value to the safety professional
- Topics can be searched quickly with multiple results
- Searches can be refined on most search sites to narrow margin of error for results
- Large library of books on specific topics not required
- Reduction of time in libraries or searching books for information

Cons include:

- Information provided may fall short of professional quality.
- It is time-consuming to check out a long list of links unless in an exploratory mode.
- A search provides numerous results which are not always related to the topic being searched.
- It is possible that a search engine's weighting of the search results is at odds with identifying the subject of one's concerns. The order of results from some search engines is based on sponsorship deals with specific vendors, rather than the value of the information the site contains
- It can be difficult to determine whether information provided is valid (e.g., Wikipedia).

2. Describe the process for conducting an effective Internet-based search for safety-related information.

- a. Refine the question.
- b. Select keywords.
- c. Select a website.
- d. Ask a discussion group.
- e. Check the information.

3. Compare and contrast the different roles list-serv participants engage in as part of an Internet-based safety discussion group.
 - a. E-mail lists or list-servs are populated by groups of individuals involved in the same or similar professions or have information concerning these areas. The use of these group increases the chances of finding information concerning the question or topic that is being investigated.
 - b. The user should follow the policy or etiquette of the list-serv group being used and should join as a observer until they understand the groups process and procedure as well as the topic or expertise of the group
 - c. A review of the list-serv's discussion archives should be reviewed to assure that the list-serv is the right group of which to ask the question. Also be sure that the question has not been previously asked and answered. When framing the question, be as specific as possible in asking the question, so those who read it can determine what type of answers are appropriate (i.e., general pointers to the professional literature versus specific interpretations of your information).
 - d. It is most helpful, if possible, to monitor the traffic on the list for about a week before asking a question to see what sorts of questions are appropriate for the list.
 - e. Always remember that the information being provided is specific to the list-serv's being visited and may not be applicable to the visitor's needs.
4. Discuss issues related to online training.

Issues to be considered include:

 - a. the type of presentations to be made (text documents versus animated sequences versus interactive games)
 - b. the comfort level with computer use of the population in question
 - c. how specific the information to be provided must be
 - d. how often refresher training must be provided
 - e. pilot group to test and evaluate the system
 - f. follow-up plan for determining whether the training was successful

5. Discuss areas where the Internet can be used to support safety program management elements.
 - a. Data Collection—data gathered from specific environmental sampling instruments/audits/inspections can be collected and organized more effectively and at lower costs to enable safety professionals to provide a more accurate and meaningful assessment of workplace hazards than could be previously considered
 - a. Data management—there are several Internet-based software packages commercially available for maintaining safety management systems for quality or environmental management aspects of an organization.
 - b. Connecting to other management information systems—the development of a safety management system will greatly benefit from being connected to other management systems within an organization, such as those containing facility information, financial information, and human resources data. Implementing these connections can be more challenging than first anticipated because the software involved is designed for other purposes.

CHAPTER 24—PROCESS SAFETY MANAGEMENT

1. According to OSHA, what is process safety management?

The proactive identification, evaluation, and mitigation or prevention of chemical releases that could occur as a result of failures in processes, procedures, or equipment

2. What two things must manufacturers do, according to the Hazard Communication Standard?

- Identify hazardous materials in the workplace
- Inform employees and consumers of the hazards presented by their manufacture, use, storage, and handling

3. What is the main difference between the OSHA and EPA chemical safety management regulations?

The OSHA regulation deals with process safety within the workplace, while the EPA regulation focuses on releases primarily affecting areas outside the workplace.

4. The PSM standard applies to the handling, storage, processing, and transport of flammable gases and liquids in quantities of

- none of the above; the PSM standard deals with weight of flammable liquids and gases, no volume

5. What are the three purposes of a risk management program?

- Identify hazards
- Maintain safe facilities
- Minimize the hazards of accidental releases

6. Which two people (i.e., what proficiencies) must be present for a hazard analysis team to be successful?

- Someone thoroughly familiar with the process being analyzed
- Someone competent in the hazard analysis methodology being used

7. When deciding the priority order for hazard process analysis, the company should take what four criteria into account?

- Extent of the process hazards
- Number of potentially affected employees
- Operating history of the process
- Age of the process

8. What is the difference between fault tree analysis and event tree analysis?

Fault tree analysis works backwards from the incident to identify the operations errors and/or equipment failures; event tree analysis works forward from events to identify those that could result in hazards and to calculate the probability of an incident.

9. What does HAZOP stand for?

Hazards and Operability study

10. Briefly define failure mode and effect analysis.

- Potential failure mode of each system or piece of equipment
- Effect of each potential failure on system or unit
- Criticality of each failure to system integrity

11. When is the “What if ... ?” method of process hazard analysis appropriate?

When analyzing proposed changes to materials, processes, equipment, or facilities.

12. Operating procedures need to be certified for completeness and accuracy every

- 1 year.

13. List five of the eight areas that operating instructions must address.

- Initial startup and startup after turnaround
- Normal startup and shutdown, and normal and temporary operations
- Emergency operation and emergency shutdown
- Startup after emergency and/or temporary operation
- Conditions requiring emergency shutdown and assignment of shutdown responsibilities
- Nonroutine work
- Operator/process and operator/equipment interface
- Administrative controls versus automated controls

14. List four times that a pre-start-up process safety review should be conducted.

- Before startup of new process facilities
- Before introduction of hazardous chemicals into a new facility
- Following major turnaround

d. When facilities have had significant process modifications

15. List three of six items of information that inspection and test result documentation should contain.

- a. Date of inspection or test
- b. Name of person performing test
- c. Identification of equipment
- d. Description of work performed
- e. Acceptance limits/criteria and results
- f. Steps required/taken to correct/mitigate deficiencies

16. What is the purpose of a process safety management audit program?

To measure facility performance and ensure compliance with internal and external process safety management requirements.

17. How long does OSHA require accident investigation records to be kept?

- c. 5 years

18. What are the four types of OSHA process safety compliance inspections?

- a. Inspection resulting from response to accidents or catastrophes
- b. Unprogrammed inspection
- c. Programmed general industry inspection
- d. Program quality verification inspection

19. What are the three goals of PQV inspections?

- a. Evaluate employer's and contractor's PSM programs
- b. Compare the quality of the programs to acceptable industry practices
- c. Verify effective implementation of the programs

20. What are two basic principles of conducting self-evaluation audits?

- a. Gather all relevant documentation covering process safety management requirements at a specific facility
- b. Determine program's implementation and effectiveness by following up on their application to one or more selected processes

21. Mr. Smith is the head of the audit team in charge of reviewing documentation for your area. As a manager, you should provide him with access to which compliance audit reports for the area?

- c. the two most recent

CHAPTER 25—AVIATION SAFETY

1. The Air Commerce Act of 1926 was a milestone in the early development of aviation. The act was important in that it was responsible for providing two specific elements to early aviation. What are these two elements?
 - a. The causes of civil aviation accidents to be made public
 - b. Set aircraft airworthiness requirements, air traffic rules, periodic examinations of aircraft, and ratings of pilots
2. What are the three main parts of the FAA's Air Traffic Control operations?
 - a. Terminal Radar Approach Control Facilities (TRACON)
 - b. Air traffic control towers
 - c. En-route centers
3. The FAA's current responsibilities include a broad range of air transportation safety measures. List five.
 - a. Registering aircraft, issuing airworthiness certifications, approving aircraft designs and productions
 - b. Regulating airport safety, environmental programs, engineering design and construction, and compliance
 - c. Administering Air Traffic Control services through its operational arm, the Air Traffic Organization
 - d. Overseeing runway safety, firefighting, safety management systems, and wildlife strike prevention
 - e. Providing data and research to the public and the aviation industry
 - f. Aviation Safety Information Analysis and Sharing (ASIAS) system
 - g. Training and testing programs
4. What are the responsibilities of the National Transportation Safety Board (NTSB)?

The NTSB's responsibility is to investigate all U.S. aviation accidents; serious accidents in other transportation areas such as rail, highway, and marine; hazardous materials; and the nation's pipelines.

5. What are the NTSB's four strategic goals regarding aircraft investigations?
 - a. To conduct effective accident investigations
 - b. To increase advocacy for its safety recommendations and to maintain and advocate for items on its "Most Wanted List
 - c. To conduct fair and expeditious adjudication of airmen and mariner appeals of the FAA and the U.S. Coast Guard's enforcement actions and certificate denials
 - d. To provide outstanding mission support
6. What types of injuries are required to be reported to the NTSB under its serious injury category?
 - a. Injuries that require hospitalization for more than 48 hours
 - b. Injuries that cause the fracture of any bone (except fingers, toes, or nose)
 - c. Injuries that involve any internal organs
 - d. Injuries that cause second- or third-degree burns or any burns that affect more than 5% of body's surface
7. What is ICAO, and where does it obtain its authority to regulate international aviation programs and policies?

ICAO stands for the International Civil Aviation Organization. It was established to secure international cooperation and the highest possible degree of uniformity in regulations, standards, procedures, and organizations regarding civil aviation matters. Originally there were 52 signatory states, now there are 191 signatory states, which give the organization its authority.
8. What are ICAO's five main objectives?
 - a. Safety
 - b. Security
 - c. Environmental protection
 - d. Air navigation capacity and efficiency
 - e. Economic development of air transport
9. What are the responsibilities of commercial airlines flight departments in relation to safety?
 - a. To develop developed competent, professional departments devoted to aviation safety
 - b. Flight safety departments are responsible for creating policies, procedures, and programs that ensure a safe environment for aircrews
 - c. Provide the world with the safest form of transportation

10. In order to prevent and to react to potential/real incidents, the airlines develop Accident/ Incident Preparedness Programs. List five departments and/or programs within an airline that are involved in these programs.
 - a. Aircraft and Systems Engineering
 - b. Cabin Safety
 - c. Safety Audits
 - d. Aircraft Accident/Incident Investigation
 - e. Interaction with the NTSB
11. Name three aviation-related trade organizations.
 - a. International Air Transport Association (IATA)
 - b. Airlines for America (A4A)
 - c. Aircraft Owners and Pilots Association (AOPA)
12. List the four components of SMS and identify the purpose of each.
 - a. Safety policy establishes senior management's commitment to continually improve safety and defines the methods, processes, and organizational structure needed to meet safety goals.
 - b. Safety assurance evaluates the effectiveness of implemented risk control strategies and supports the identification of new hazards.
 - c. Safety risk management determines, based on the assessment of acceptable risk, the need for, and the adequacy of, new or revised risk controls.
 - d. Safety promotion includes training, communication, and other activities that create a positive safety culture within all levels of the workforce.

CHAPTER 26—OIL AND GAS SAFETY

1. Operationally, the petroleum industry is divided into three distinct yet interrelated sectors. List these sections and their components.
 - a. Upstream (also called exploration and production, or E&P) includes exploration, site preparation, drilling, completion, production, and service operations.
 - b. Midstream includes storage, transportation, and marketing.
 - c. Downstream operation includes refining, sales, and distribution.
2. OSHA regulations governing workplace safety and health are contained in the five parts of Title 29 of the Code of Federal Regulations. List these parts and the section regulated.
 - a. 1910—Occupational Safety and Health Standard
 - b. 1915—Occupational Safety and Health Standards for Shipyard Employment
 - c. 1917—Marine Terminals
 - d. 1918—Safety and Health Regulations for Longshoring
 - e. 1926—Safety and Health Regulations for Construction
3. When upstream operations are conducted in an offshore environment, not only does the employer fall under the authority of OSHA, but it also falls under the jurisdiction of what two other federal departments?
 - a. the Bureau of Safety and Environmental Enforcement (BSEE)
 - b. the U.S. Coast Guard (USCG)
4. List four nationally recognized standard-producing organizations that have developed and have adopted guidelines for oil field workers and workplace safety.
 - a. American National Standards Institute (ANSI)
 - b. National Fire Protection Association (NFPA)
 - c. the Compressed Gas Association (CGA)
 - d. the American Conference of Industrial Hygienists (ACGIH)
5. List the three business groupings that make up the oil and gas extraction sector.
 - a. Oil and gas extraction companies (operator) (NAICS 21111)
 - b. Oil and gas drilling companies (NAICS 213111)
 - c. Support activities for oil and gas operations (service companies) (NAICS 213112)
6. List at least four conditions or activities that could be hazardous for exploration and production workers.
 - a. working long hours, generally 12 hours or more a day
 - b. working outdoors and, with few exceptions, in all weather conditions
 - c. working in environments that utilize heavy equipment
 - d. working with high-pressure oil and gas systems
 - e. working at locations that may contain explosive concentrations of hydrocarbons
 - f. working at locations that contain hydrogen sulfide gas or respirable levels of silica
 - g. working at elevated heights
 - h. working around heavy power equipment working around high voltage electrical systems

CHAPTER 27—WASTE AND RECYCLING SAFETY

1. After garbage is collected, what are three possible destinations for the garbage to end up?
 - a. Landfill
 - b. Transfer station
 - c. Materials recovery/recycling facility
2. List at least four of the EPA general guidelines for landfill design and operation.
 - a. Location restrictions—ensure that landfills are built in suitable geological areas away from faults, wetlands, flood plains, or other restricted areas
 - b. Composite liners requirements—include a flexible membrane (geomembrane) overlaying two feet of compacted clay soil lining the bottom and sides of the landfill, protect groundwater and the underlying soil from leachate releases
 - c. Leachate collection and removal systems—sit on top of the composite liner and removes leachate from the landfill for treatment and disposal
 - d. Operating practices—include compacting and covering waste frequently with several inches of soil help reduce odor; control litter, insects, and rodents; and protect public health
 - e. Groundwater monitoring requirements—requires testing groundwater wells to determine whether waste materials have escaped from the landfill
 - f. Closure and post-closure care requirements—include covering landfills and providing long-term care of closed landfills
 - g. Corrective action provisions—control and clean up landfill releases and achieve groundwater protection standards
 - b. Financial assurance—provides funding for environmental protection during and after landfill closure (i.e., closure and postclosure care)
3. What is the main purpose of a transfer station, and what is the primary safety concern?

The main purpose is to consolidate waste from multiple collection vehicles into larger, high-volume transfer vehicles for more economical shipment to distant disposal sites. A significant safety issue in this scenario is the presence of moving equipment in close proximity to collection workers from the vehicles or those who work at the transfer stations.
4. Materials found in some “nonregulated hazardous” wastes and recyclables have the potential to cause injury to employees if the materials are not managed properly. List four examples of nonregulated hazardous wastes.
 - a. Discarded chemicals from home environments (e.g., cleaning and pool chemicals, bleach, paint);
 - b. Medical wastes (e.g., needles used in home care);
 - c. Commercial wastes that contain residual hazardous materials (e.g., Paint pigments, cement dust); and
 - d. Industrial wastes that contain silica dust (e.g., foundry sand).
5. Define clean MRF and dirty MRF.

A clean MRF accepts recyclable commingled materials that have already been separated at the source from municipal solid waste generated by either residential or commercial sources. A dirty MRF accepts a mixed solid-waste stream and then proceeds to separate out designated recyclable materials through a combination of manual and mechanical sorting.
6. List two simple ways to alert customers to potential dangers associated with a waste and recycling facility.
 - a. Post signs
 - b. Apply brightly colored paint or tape to hazards
7. How can a worker minimize hazards from extreme heat?

Acclimation, good ventilation inside buildings, access to water and shade, and periodic work breaks
8. List four entities that are currently working to enhance safety efforts in the waste and recycling industry.
 - a. National Waste and Recycling Association (NWRA)
 - b. Solid Waste Association of North America (SWANA)
 - c. Environmental Research and Education Foundation (EREF)
 - d. National Institute for Occupational Safety and Health National Occupational Research Agenda (NORA) Services Sector group