Chapter 1: Heating and Air Conditioning - History and the Environment
Classroom Manual

TRUE/FALSE

1. Ozone has the same chemical properties as carbon monoxide.

   ANS: F PTS: 1

2. The most common gas in the earth's atmosphere is oxygen.

   ANS: F PTS: 1

3. Most ozone is formed over the earth's equator.

   ANS: T PTS: 1

4. The odor of a gas is not an indication of its toxicity.

   ANS: T PTS: 1

5. No special equipment is required to service R-134a (HFC-134a) refrigerant systems.

   ANS: F PTS: 1

6. George H. W. Bush signed the Clean Air Act ammendment of 1990 into law that placed strict regulations on CFC emissions.

   ANS: T PTS: 1

7. The EPA is a federal regulatory agency.

   ANS: T PTS: 1

8. Automotive technicians who service mobile air conditioning systems must be certified by an EPA-approved testing agency.

   ANS: T PTS: 1

9. Carbon Dioxide is considered a greenhouse gas that may contribute to global warming.

   ANS: T PTS: 1

10. Only some employees are covered by "right-to-know" laws

    ANS: F PTS: 1

MULTIPLE CHOICE

1. In the greenhouse effect what type of radiation is re-emitted by the earth's surface and is absorbed and reflected by greenhouse gas molecules in the atmosphere warming the earth's surface and lower atmosphere?
   a. Ultraviolet
   b. Infrared
   c. Gama
   d. Nuclear

   ANS: B PTS: 1

2. *Technician A* says ozone at ground level protects life from damaging ultraviolet radiation. *Technician B* says ozone is a poisonous gas. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both A and B
   d. Neither A nor B

   ANS: B PTS: 1

3. Ozone is formed by the action of
   a. lightning.
   b. electrical equipment.
   c. ultraviolet radiation.
   d. all of the above.

   ANS: D PTS: 1

4. *Technician A* says ozone is both created and destroyed by the action of UV radiation on oxygen molecules. *Technician B* says chlorine is the major gas causing the destruction of ozone. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both A and B
   d. Neither A nor B

   ANS: C PTS: 1

5. The Clean Air Act became law in
   a. 1985.
   b. 1970.
   c. 1980.
   d. 1990.

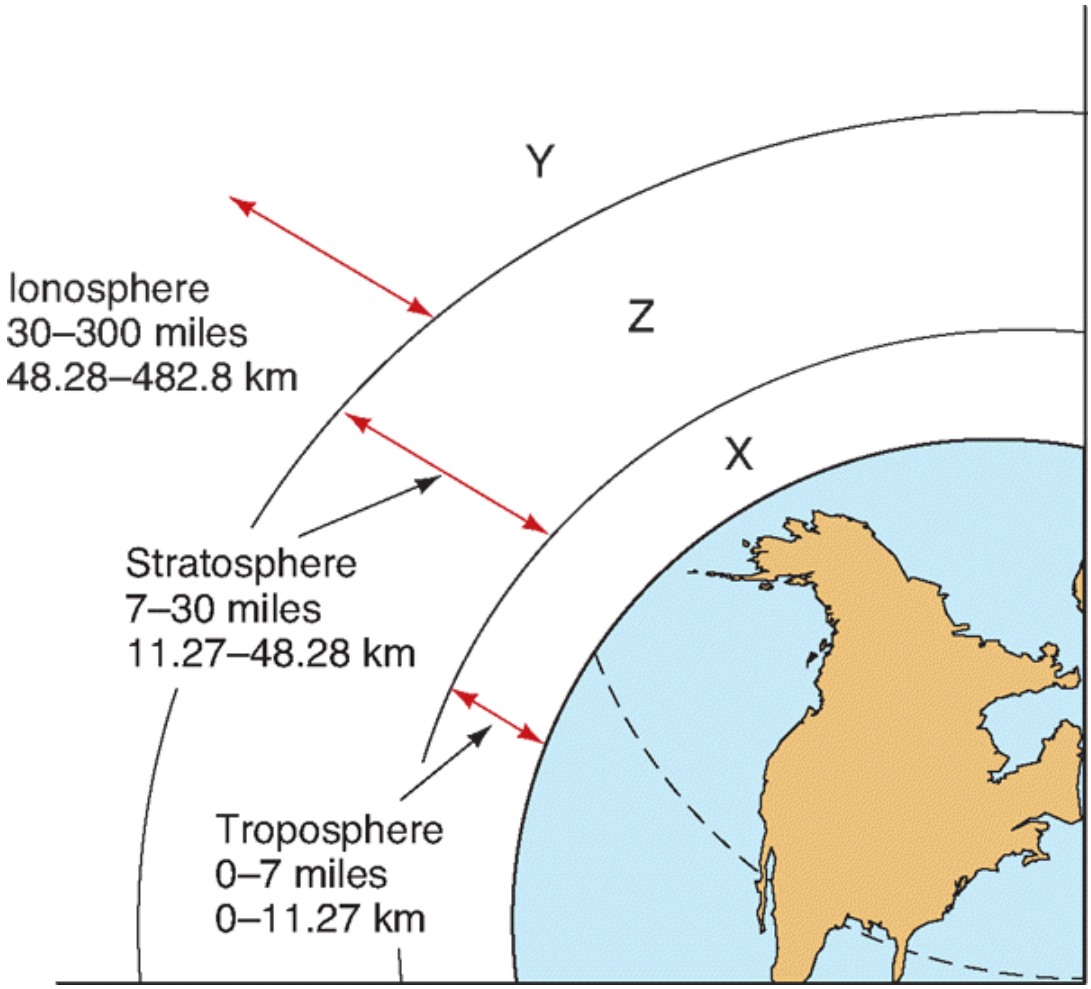
   ANS: D PTS: 1

6. Stratospheric ozone absorbs about ____ percent of incoming solar radiation.
   a. 3
   b. 10
   c. 21
   d. 78

   ANS: A PTS: 1

7. *Technician A* says air conditioning is the process of controlling the passenger compartment comfort level. *Technician B* says the fluid that circulates through an air conditioning system is referred to generically as refrigerant. Who is correct?
   a. Technician A only
   b. Technician B only
   c. Both A and B
   d. Neither A nor B

   ANS: C PTS: 1

8. 

In this figure, the ozone layer could be pictured in the area marked

a. X
b. Y
c. Z
d. None of the above

ANS: C PTS: 1

9. *Technician A* says chlorine in CFC-12 (R-12) refrigerant may destroy ozone molecules for over a century. *Technician B* says O_3 is destroyed and created by UV radiation. Who is correct?

a. Technician A only
b. Technician B only
c. Both A and B
d. Neither A nor B

ANS: C PTS: 1

10. Chlorofluorocarbons are being discussed. *Technician A* says CFC's production and use is strictly regulated by the Clean Air Act. *Technician B* says chlorofluorocarbons are an artificially made chemical. Who is correct?

a. Technician A only
b. Technician B only
c. Both A and B
d. Neither A nor B

ANS: C PTS: 1

11. *Technician A* says UV radiation inhibits the human body's immune system and causes skin tissue damage. *Technician B* says the release of CFCs into the atmosphere could help decrease the greenhouse effect. Who is correct?

a. Technician A only
c. Both A and B

b. Technician B only
d. Neither A nor B

ANS: A PTS: 1

12. The Clean Air Act is being discussed. *Technician A* says the Montreal Protocol is one of the results of the Clean Air Act. *Technician B* says it gave the EPA authority to control refrigerants in order to protect the environment. Who is correct?
a. Technician A only
c. Both A and B
b. Technician B only
d. Neither A nor B

ANS: B PTS: 1

13. *Technician A* says CFC-12 (R-12) is no longer being manufactured in the United States. *Technician B* says CFC-12 (R-12) refrigerant can still be sold. Who is correct?
a. Technician A only
c. Both A and B
b. Technician B only
d. Neither A nor B

ANS: C PTS: 1

14. Hydrostatic pressure is being discussed. *Technician A* says the pressure in a tank will increase as the liquid cools. *Technician B* says the containment system (tanks and lines) must withstand the changing pressures created as the liquid changes states. Who is correct?
a. Technician A only
c. Both A and B
b. Technician B only
d. Neither A nor B

ANS: B PTS: 1

15. *Technician A* says HFC-134a (R-134a) tanks are designed to hold a specific amount of refrigerant at a specific temperature. *Technician B* says overfilling the tank could cause it to burst at room temperature. Who is correct?
a. Technician A only
c. Both A and B
b. Technician B only
d. Neither A nor B

ANS: C PTS: 1

16. *Technician A* says a refrigerant service cylinder should have a pressure relief valve. *Technician B* says a fusible plug gives excellent protection between 160°F and 180°F. Who is correct?
a. Technician A only
c. Both A and B
b. Technician B only
d. Neither A nor B

ANS: A PTS: 1

17. *Technician A* says the MSDS lists when the hazardous material was purchased by the shop. *Technician B* says the MSDS lists the protective clothing or equipment for that material. Who is correct?
a. Technician A only
c. Both A and B
b. Technician B only
d. Neither A nor B

ANS: B PTS: 1

18. *Technician A* says that it is safe to release R-12 refrigerant into the atmosphere. *Technician B* says as sunlight strikes CFC molecules in the statosphere chlorine will be released. Who is correct?
a. Technician A only
c. Both A and B
b. Technician B only
d. Neither A nor B

ANS: B PTS: 1

19. What is the air we breathe made up of?
    a. 51 percent oxygen and 49 percernt nitrogen
    b. 21 percent oxygen and 78 percernt nitrogen
    c. 21 percent nitrogen and 78 percernt oxygen
    d. 12 percent oxygen and 88 percernt nitrogen

    ANS: B PTS: 1

SHORT ANSWER

1. List four major components of chlorofluorocarbons (CFCs, freon, and halons).

   ANS:
   chlorine, fluorine, carbon, hydrogen
   chlorine, fluorine, hydrogen, carbon
   chlorine, hydrogen, carbon, fluorine
   chlorine, hydrogen, fluorine, carbon
   chlorine, carbon, hydrogen, fluorine
   chlorine, carbon, fluorine, hydrogen
   carbon, chlorine, hydrogen, fluorine
   carbon, chlorine, fluorine, hydrogen
   carbon, fluorine, hydrogen, chlorine
   carbon, fluorine, chlorine, hydrogen
   carbon, hydrogen, chlorine, fluorine
   carbon, hydrogen, fluorine, chlorine
   fluorine, hydrogen, carbon, chlorine
   fluorine, hydrogen, chlorine, carbon
   fluorine, chlorine, hydrogen, carbon
   fluorine, chlorine, carbon, hydrogen
   fluorine, carbon, chlorine, hydrogen
   fluorine, carbon, hydrogen, chlorine
   hydrogen, fluorine, hydrogen, carbon
   hydrogen, fluorine, carbon, hydrogen
   hydrogen, chlorine, fluorine, carbon
   hydrogen, chlorine, carbon, fluorine
   hydrogen, carbon, chlorine, fluorine
   hydrogen, carbon, fluorine, chlorine

   PTS: 1

2. What does EPA stand for?

   ANS:
   Environmental Protection Agency

   PTS: 1

3. What does SNAP stand for?

   ANS:
   Significant New Alternatives Policy

   PTS: 1

4. What is the common name or number used for the hydro-fluorocarbon (HFC) refrigerant used in automotive refrigerant systems today?

   ANS:
   R134a

   PTS: 1

5. What is the maximum temperature that a refrigerant cylinder is designed to be subjected to?

   ANS:
   130°F
   One hundred thirty degrees Fahrenheit

   PTS: 1

6. What does the term ozone hole refer to?

   ANS:
   The term ozone hole refers to the loss of the blocking effect of ozone against UV radiation.

   PTS: 1

7. What is the main ingredient of most automotive coolants?

   ANS:
   Ethylene Glycol

   PTS: 1

8. How many ozone molecules can be destroyed by a single molecule of chlorine?

   ANS:
   100,000
   One hundred thousand

   PTS: 1

9. What does the word *toxicity* mean?

   ANS:
   poisonous quality

   PTS: 1

10. What should the technician do before loosening bolts or screws on a refrigeration system?

    ANS:
    Make sure the pressure inside the part has been relieved.

    PTS: 1

11. What has NASA determined to be a potential major threat to ozone layer depletion besides CFCs?

ANS:
Recent studies by NASA indicate that by 2030 climate change may surpass chlorofluorocarbons as the main cause of ozone depletion.

PTS: 1

ESSAY

1. Explain why carbon dioxide in the atmosphere is necessary for life on earth.

   ANS:
   Carbon dioxide absorbs infrared radiation from the sun, preventing it from reradiating out of the earth's atmosphere and, thus, warming the atmosphere. This process is called the greenhouse effect.

   PTS: 1

2. Explain why ozone in the atmosphere is necessary for life on earth.

   ANS:
   Ozone absorbs ultraviolet radiation. Excessive UV radiation would be damaging to life on earth.

   PTS: 1

3. Name some effects of ultraviolet radiation.

   ANS:
   Ultraviolet radiation can be damaging to living organisms, causing sunburn; skin cancer; damage to eyes, including cataracts; and premature aging and wrinkling of the skin. UV radiation can also break down the food chain by destroying plankton in the ocean and depriving certain species of their natural food. Plant life and crops can also be harmed or destroyed by excessive radiation.

   PTS: 1

4. What is the greenhouse effect?

   ANS:
   The greenhouse effect or global warming, is the result of the release of increasing amounts of so-called 'greenhouse gases' into the atmosphere, gases such as CO_2, CH4, and manmade gases such as CFC's and HFC's. These greenhouse gases act as a blanket around the earth retaining heat.

   PTS: 1

5. What are some of the factors that contribute to the greenhouse effect and climate change?

   ANS:
   The greenhouse effect or global warming, is the result of the release of increasing amounts of so-called 'greenhouse gases' into the atmosphere, gases such as CO_2, CH4, and manmade gases such as CFC's and HFC's. These greenhouse gases act as a blanket around the earth retaining heat.

   PTS: 1

6. Describe what is contained in a Material Safety Data Sheet (MSDS).

ANS:
Safety information about materials, including toxicity levels, physical characteristics, protective equipment requirements, emergency procedures, and compatibility with other substances.

PTS: 1

7. What does Title 6 of the Clean Air Act cover?

ANS:
Title 6 of the CAA concerns stratospheric ozone protection. It establishes regulations for the production, use, and phaseout of CFCs, halons, and HCFCs.

PTS: 1

8. On January 1, 2011 the European Union EU 2006/40/EC Act provisions went into effect. What impact does this act have on refrigerant systems?

ANS:
Beginning on January 1, 2011 the European Union EU 2006/40/EC Act provisions went into effect that would begin phasing out global warming refrigerants with complete phase out of R134a in European in 2017. The act requires all new automotive platform refrigerant systems to use a refrigerant with a global warming potential (GWP) that is not to exceed 150.

PTS: 1

9. What is the earth's natural processes by which concentrations of carbon dioxide in the atmosphere are regulated and give an example of how it works.

ANS:
The earth has a natural processes by which concentrations of carbon dioxide in the atmosphere are regulated known as the "carbon cycle". Through processes like plant photosynthesis carbon is moved from the atmosphere to the land and oceans of the earth.

PTS: 1

TRUE/FALSE

1. Carbon monoxide may cause vomiting, headaches, and/or dizziness.

   ANS: T PTS: 1

2. Do not use solvents or gasoline to clean electrical components.

   ANS: T PTS: 1

3. Ethylene glycol in even small quantities can be hazardous to small children if ingested.

   ANS: T PTS: 1

4. Ethylene glycol is essentially nontoxic.

   ANS: F PTS: 1

5. There are basically two types of antifreeze, those based on propylene glycol and those based on ethylene glycol.

   ANS: T PTS: 1

6. Proper precautions must be followed when working on refrigerant systems to avoid the potential risk of oxygen deficiency.

   ANS: T PTS: 1

7. Technicians working in the automotive repair industry are rarely exposed to hazards.

   ANS: F PTS: 1

8. Refrigerant R-134a is a flammable refrigerant.

   ANS: F PTS: 1

9. Ingestion of as little as 2 ounces of ethylene glycol can kill a dog.

   ANS: T PTS: 1

10. The use of makeshift tools is one of the major causes of hand-tool accidents.

    ANS: T PTS: 1

11. The EPA is a state regulatory agency.

    ANS: F PTS: 1

12. Automotive technicians who service mobile air conditioning systems must be certified by an EPA-approved testing agency.

ANS: T PTS: 1

MULTIPLE CHOICE

1. *Technician A* says 'Right-to-Know" laws are designed to insure employee awareness of the characteristics of chemicals and solvents existing in the workplace. *Technician B* says a list of all of the hazardous substances found in the workplace must be posted in the shop. Who is correct?
   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

   ANS: C PTS: 1

2. *Technician A* says that an OSHA poster must be displayed in the employees' common area, such as the break room. *Technician B* says that an OSHA is a state agency responsible for Occupational Standards for Heating and Air Conditioning. Who is correct?
   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

   ANS: A PTS: 1

3. *Technician A* says spills should be cleaned up before you leave the shop. *Technician B* says spills should be cleaned up as soon as they occur. Who is correct?
   a. A only
   b. B only
   c. Both A and B
   d. Neither nor B

   ANS: B PTS: 1

4. *Technician A* says when removing the battery from a vehicle, disconnect the negative cable first. *Technician B* says when removing the battery from a vehicle, disconnect the positive cable first. Who is correct?
   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

   ANS: A PTS: 1

5. *Technician A* says you should always disconnect the power source while working on electric cooling fan motors. *Technician B* says it is safe to work on electric cooling fan motors when the ignition switch is off. Who is correct?
   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

   ANS: A PTS: 1

6. *Technician A* says the third prong on an electrical cord is to provide extra current during a power surge. *Technician B* says it is a safety ground. Who is correct?
   a. A only
   b. B only
   c. Both A and B
   d. Neither A nor B

   ANS: B PTS: 1

7. What should you do if battery acid gets into your eyes?
   a. Blink fast to start tears.

b. Rub salve in your eyes.
c. Flush your eyes with water and go to a doctor.
d. All of the above

ANS: C PTS: 1

8. *Technician A* says shop ventilation is not needed when working on new vehicles because new-vehicle emissions are low. *Technician B* says the shop's ventilation system should be connected to the exhaust pipe if the engine is running. Who is correct?
a. A only
b. B only
c. Both A and B
d. Neither A or B

ANS: B PTS: 1

9. What should you do before turning on a battery charger?
a. Check the polarity of the battery
b. Clean the battery cables
c. Connect the leads
d. All of the above

ANS: D PTS: 1

10. Which of the following describe(s) carbon monoxide?
a. Carbon monoxide is a colorless gas.
b. Carbon monoxide is odorless.
c. Carbon monoxide is a by-product of combustion.
d. All of the above

ANS: D PTS: 1

11. *Technician A* says material safety data sheets (MSDS) contain specific information about hazardous materials. *Technician B* says material safety data sheets (MSDS) must contain information about health, fire, and reativity hazards posed by the material. Who is correct?
a. A only
b. B only
c. Both A and B
d. Neither A nor B

ANS: C PTS: 1

12. *Technician A* says to remove the service plug prior to disconnecting or reconnecting any HV connections or components. *Technician B* says the wire harness, terminals, and connectors of the high-voltage system are identified by red. Who is correct?
a. A only
b. B only
c. Both A and B
d. Neither A nor B

ANS: A PTS: 1

13. *Technician A* says when replacing the battery in the vehicle, you should connect the negative cable last. *Technician B* says when replacing the battery you should always use new leads. Who is correct?
a. A only
b. B only
c. Both A and B
d. Neither A nor B

ANS: A PTS: 1

14. Which of the following should NOT be used to clean electrical components?
a. Denatured alcohol
b. Solvents
c. Compressed air
d. All of the above

ANS: B PTS: 1

15. *Technician A* says all vehicles with on-board computers must have an auxiliary power source connected before disconnecting the battery. *Technician B* says to check the service manual before disconnecting the battery to make sure an auxiliary power source should be connected to the on-board computer. Who is correct?
    a. A only
    b. B only
    c. Both A and B
    d. Neither A nor B

    ANS: B PTS: 1

16. *Technician A* says carbon monoxide is an oderless, tasteless, colorless gas. *Technician B* says when working on air conditioning systems in confined spaces the atmosphere may be deficient in oxygen. Who is correct?
    a. A only
    b. B only
    c. Both A and B
    d. Neither A nor B

    ANS: C PTS: 1

17. Where would the most concise information about the composition of a shop solvent be found?
    a. Factory service manual
    b. First aid manual
    c. MSDA sheet
    d. EPA website

    ANS: C PTS: 1

18. *Technician A* says "Right-to-Know" laws do not cover proper labeling requirements of hazardous materials. *Technician B* says "Right-to-Know" laws require employers to train their employees regarding hazardous waste materials they may come in contact with. Who is correct?
    a. A only
    b. B only
    c. Both A and B
    d. Neither A nor B

    ANS: C PTS: 1

19. Any hazardous materials that strike the skin should be washed off
    a. immediately.
    b. within 24 hours.
    c. after work.
    d. none of the above.

    ANS: A PTS: 1

20. *Technician A* says a new technician should be trained in the maintenance and operation of any special shop equipment. *Technician B* says the new technician should not attempt to use any special shop equipment without first being instructed in its use. Who is correct?
    a. Technician A only
    b. Technician B only
    c. Both A and B
    d. Neither A nor B

    ANS: C PTS: 1

21. *Technician A* says MSDS sheets are required for all chemicals used or stored on the premises. *Technician B* says the MSDS lists the protective clothing or equipment for that material. Who is correct?
    a. Technician A only
    b. Technician B only
    c. Both A and B
    d. Neither A nor B

    ANS: C PTS: 1

22. All of the following statements are true concerning high-voltage system safety, EXCEPT:
    a. Test lineman gloves for damage and leaks prior to use.

b. Disconnect the motor generators prior to turning the ignition off.
c. Do not attempt to test or service the system for 5 minutes after the high-voltage service plug is removed.
d. Turn the power switch to the off position prior to performing a resistance check.

ANS: B PTS: 1

SHORT ANSWER

1. List five examples of when proper eye protection should be worn.

   ANS:
   machining equipment, grinders, chemicals, compressed air, fuels, working under a vehicle

   PTS: 1

2. When working on electric fan motors, what should you do first?

   ANS:
   Disconnect the power source

   PTS: 1

3. What are the characteristics of carbon monoxide gas.

   ANS:
   Colorless, odorless, and toxic
   Colorless, toxic and odorless
   Toxic, odorless, and colorless
   Toxic, colorless and odorless
   Odorless, colorless and toxic
   Colorless, toxic and odorless

   PTS: 1

4. What should be added to a battery if its liquid level is low.

   ANS:
   distilled water

   PTS: 1

5. What type of injury is caused by improper lifting techniques.

   ANS:
   back injuries

   PTS: 1

6. Name three pieces of information that must be listed on an MSDS.

   ANS:

health hazards, medical treatment, reactivity, cleanup, environmental impact, safety-related issues associated with the use and storage of the product.

PTS: 1

7. Explain safety hazards that may result from wearing improper footgear in the shop.

ANS:
Injuries may occur from falling objects, slipping on spilled liquids, or electrical shock.

PTS: 1

8. When working around pulleys and revolving belts, what can happen if proper safety procedures are not followed?

ANS:
They may break; you could get caught in them; they might throw something at you.

PTS: 1

9. What action must be taken immediately when a chemical gets in the eyes.

ANS:
A chemical must be washed out of the eyes immediately to prevent burns.

PTS: 1

10. What do the right-to-know laws ensure?

ANS:
It ensures that employees have the right to know when the materials they handle at work are hazardous.

PTS: 1

11. What is the main ingredient of most automotive coolants?

ANS:
Ethylene Glycol

PTS: 1

12. What does the word *toxicity* mean?

ANS:
poisonous quality

PTS: 1

13. What should the technician do before loosening bolts or screws on a refrigeration system?

ANS:
Make sure the pressure inside the part has been relieved.

PTS: 1

14. What is OSHA?

ANS:
The Occupational Safety and Health Administration (OSHA) is a federal agency established to ensure safe and healthful conditions for every American worker.

PTS: 1

ESSAY

1. Describe what professional work ethics are and how they enable you to be a better technician.

ANS:
Neatness in dress and work habits promote safety, speed, and accuracy; produce high customer satisfaction; result in pride in self and one's work.

PTS: 1

2. Explain, in the proper sequence, the steps performed to remove a battery from a vehicle.

ANS:
Remove negative cable first; then remove the positive cable; finally, remove the hold-down clamp.

PTS: 1

3. Explain the safety precautions that should be taken when running an engine in a shop.

ANS:
Ensure there is good ventilation; block the wheels; check for pulleys and belts that could break; connect exhaust hose to the tailpipe; set the parking brake.

PTS: 1

4. Describe some of the procedures that should be followed when working with gasoline.

ANS:
You should never smoke around gasoline. Never perform any grinding or welding around liquid or vaporous gasoline. Make sure that any gasoline that is spilled is immediately wiped up. Be sure that gasoline is stored in an approved container.

PTS: 1

5. Explain what carbon monoxide is and where it comes from in the automotive industry.

ANS:
carbon monoxide is poisonous, colorless, and oderless.
carbon monoxide causes headaches.
vehicle exhaust contains carbon monoxide.

PTS: 1

6. Describe what is contained in a Material Safety Data Sheet (MSDS).

   ANS:
   Safety information about materials, including toxicity levels, physical characteristics, protective equipment requirements, emergency procedures, and compatibility with other substances.The information includes signs and symptoms of exposure, medical conditions, and first aid procedures.

   PTS: 1