

***Todays Technician Automotive Heating and Air  
Conditioning Classroom Manual and Shop Manual  
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## Chapter 02: Temperature and Pressure Fundamentals

### Classroom Manual

1. Heat flows from a hot object to an object containing less heat.

- a. True
- b. False

*ANSWER:* True

*POINTS:* 1

2. Humidity refers to the amount of heat in the air.

- a. True
- b. False

*ANSWER:* False

*POINTS:* 1

3. Heat is removed from the body by the process of evaporation.

- a. True
- b. False

*ANSWER:* True

*POINTS:* 1

4. Heat required to turn water into steam is latent heat.

- a. True
- b. False

*ANSWER:* True

*POINTS:* 1

5. Gravity causes warm air to sink.

- a. True
- b. False

*ANSWER:* False

*POINTS:* 1

6. Specific heat is the same as sensible heat.

- a. True
- b. False

*ANSWER:* False

*POINTS:* 1

7. The radiation process is not affected by the surrounding air temperature.

- a. True
- b. False

*ANSWER:* True

*POINTS:* 1

8. Air movement increases the body's rate of cooling.

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- a. True
- b. False

ANSWER: True

POINTS: 1

9. Heat is the absence of cold.

- a. True
- b. False

ANSWER: False

POINTS: 1

10. As heat energy is added to a liquid, the speed of its molecules increases.

- a. True
- b. False

ANSWER: True

POINTS: 1

11. How is heat transfer by convection accomplished?

- a. Heat travels by infrared rays.
- b. Heat travels by radio waves.
- c. Heat travels through the surrounding air.
- d. The cooler and warmer objects are touching.

ANSWER: c

POINTS: 1

12. *Technician A* says latent heat is hidden heat. *Technician B* says latent heat is required for a change of state. Who is correct?

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

ANSWER: c

POINTS: 1

13. Sensible heat can be measured with

- a. a pressure gauge.
- b. a thermometer.
- c. a scale.
- d. all of the above.

ANSWER: b

POINTS: 1

14. All of the following are true of voltage drops EXCEPT:

- a. Voltage drop is the conversion of electrical energy into another form of energy.
- b. Corrosion in a circuit does not cause a voltage drop.
- c. All of the source voltage in a circuit must be dropped.
- d. Voltage drop can be measured with a voltmeter.

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ANSWER: b

POINTS: 1

15. All of the following statements about oxygen are true, EXCEPT:

- a. Oxygen makes up 78 percent of the air we breathe.
- b. Oxygen is essential to all animal life.
- c. Oxygen combines readily with other elements to form complex chemicals.
- d. Oxygen is normally a gas.

ANSWER: a

POINTS: 1

16. The word latent means

- a. hot.
- b. cold.
- c. transfer.
- d. hidden.

ANSWER: d

POINTS: 1

17. All of the following statements about heat transfer are true, EXCEPT:

- a. Molecular motion is transmitted to molecules that have less motion.
- b. Some of the molecules give up their energy to other molecules that have more energy.
- c. Heat flows from matter at a higher temperature to matter at a lower temperature.
- d. Heat never flows from low-temperature matter to high-temperature matter.

ANSWER: b

POINTS: 1

18. The acceptable comfort range for the human body is:

- a. 45-50 percent relative humidity
- b. 72°F-80°F
- c. Both A and B
- d. Neither A nor B

ANSWER: c

POINTS: 1

19. The sun heats the earth through the process of

- a. convection.
- b. conduction.
- c. radiation.
- d. all of the above.

ANSWER: c

POINTS: 1

20. Technician A says sensible heat can be measured. Technician B says specific heat is the amount of heat required to change one pound of a substance by 1°F. Who is correct?

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

ANSWER: c

POINTS: 1

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21. *Technician A* says convection may occur in liquids and gases. *Technician B* says conduction can occur between two substances that are at different temperatures. Who is correct?

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

ANSWER: c

POINTS: 1

22. The ideal relative humidity is between \_\_\_\_ and \_\_\_\_ percent.

- a. 10, 100      b. 20, 80
- c. 30, 70      d. 40, 60

ANSWER: d

POINTS: 1

23. One British thermal unit (Btu) contains \_\_\_\_ calories.

- a. 144      b. 212
- c. 252      d. 970

ANSWER: c

POINTS: 1

24. *Technician A* says latent heat cannot be felt. *Technician B* says latent heat cannot be measured with a thermometer. Who is correct?

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

ANSWER: c

POINTS: 1

25. The metric term for pressure (psi) is

- a. Kilogram (kg).                      b. KiloPascal (kPa).
- c. Liter per millimeter (Lm).      d. Liter per centimeter (Lc).

ANSWER: b

POINTS: 1

26. *Technician A* says convection is the process of heat moving to cold. *Technician B* says convection also involves the movement of heat upwards. Who is correct?

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

ANSWER: c

POINTS: 1

27. Evaporation is being discussed. *Technician A* says heat is lost when evaporation occurs. *Technician B* says the rate of evaporation is not affected by air movement. Who is correct?

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

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ANSWER: a

POINTS: 1

28. A change in pressure can affect the \_\_\_\_\_ of a substance.

- a. vaporization
- b. toxicity
- c. condensation
- d. Both A & C

ANSWER: d

POINTS: 1

29. All of the following are gas laws, except:

- a. Charles' Law
- b. Darwin's Law
- c. Dalton's Law
- d. Boyle's Law

ANSWER: b

POINTS: 1

30. The heat added to a vapor causing it to become warmer is called:

- a. Latent heat
- b. Sensible heat
- c. Superheat
- d. Specific heat

ANSWER: c

POINTS: 1

31. Constant removal of body heat takes place by three processes. Name them.

ANSWER: Convection, radiation, and evaporation (any order)

POINTS: 1

32. Explain what happens to molecules at absolute zero ( $-459.67^{\circ}\text{F}$ ).

ANSWER: The molecules would have no motion (movement).

POINTS: 1

33. What are the three basic terms used to describe the three types of heat?

ANSWER: Sensible, latent, and specific heat (any order)

POINTS: 1

34. What are the three states of matter?

ANSWER: Solid, liquid, and gas (any order)

POINTS: 1

35. What is the heat that causes a change of state but cannot be measured on a thermometer called?

ANSWER: latent

POINTS: 1

36. What is the unit of measurement used to measure latent heat?

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**ANSWER:** The unit of measurement used to measure latent heat is the British thermal unit (Btu).

**POINTS:** 1

37. What unit of measurement is resistance in an electrical circuit measured in?

**ANSWER:** Ohm's

**POINTS:** 1

38. What is the major difference between evaporation and boiling?

**ANSWER:** The molecules of a boiling liquid are converted to a vapor at a much faster rate than during evaporation.

**POINTS:** 1

39. Define specific heat.

**ANSWER:** Specific heat is the amount of heat required to raise the temperature of a particular material. The specific heat of every material is different.

**POINTS:** 1

40. Identify the components of a molecule of water. Explain why the water molecule differs from its component elements.

**ANSWER:** A water molecule consists of two atoms of hydrogen and one atom of oxygen. The combination of two elements, both gas ions in their natural state, produces a liquid that is unlike either.

**POINTS:** 1

41. List some air conditioning service equipment that is usually supplied by the shop.

**ANSWER:** Refrigerant recovery/recycle system, electronic leak detector, electronic thermometer, charging station, ATC testers, compressor repair tools

**POINTS:** 1

42. Briefly define Charles' Law.

**ANSWER:** The volume of a fixed mass of gas held at a constant pressure varies directly with a change in the absolute temperature. And conversely, when a gas is held at a constant volume, its pressure varies directly with the absolute temperature.

**POINTS:** 1

43. Briefly define Dalton's Law.

**ANSWER:** The total pressure of a confined mixture in a sealed container is equal to the sum of the pressures of each gas in the mixture.

**POINTS:** 1

44. Briefly define Boyle's Law.

**ANSWER:** The volume of a gas varies inversely with the absolute pressure at a constant temperature.

**POINTS:** 1

## Chapter 02: Typical Shop Procedures and Tools

### Shop Manual

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

- a. True
- b. False

ANSWER: False

POINTS: 1

2. Vacation time is considered a fringe benefit.

- a. True
- b. False

ANSWER: True

POINTS: 1

3. Because of the shortage of technicians habitual lateness is often tolerated.

- a. True
- b. False

ANSWER: False

POINTS: 1

4. OSHA was established to improve workers wages.

- a. True
- b. False

ANSWER: False

POINTS: 1

5. A vacuum pump is used to remove refrigerant from the system.

- a. True
- b. False

ANSWER: False

POINTS: 1

6. A halide leak detector is the best type to use to locate hard to find refrigerant leaks.

- a. True
- b. False

ANSWER: False

POINTS: 1

7. A shop that services refrigerant systems does not have to have a refrigerant recovery and recycling system.

- a. True
- b. False

ANSWER: False

POINTS: 1

8. A dual channel recovery system can recover either refrigerant or antifreeze.

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- a. True
- b. False

ANSWER: False

POINTS: 1

9. MACS stands for Modern Automotive Control Systems.

- a. True
- b. False

ANSWER: False

POINTS: 1

10. Service procedures generally provide information in a step-by-step sequence based on manufacturer recommendations.

- a. True
- b. False

ANSWER: True

POINTS: 1

11. *Technician A* says as an employee your obligation is to be a loyal, caring individual, and have the ability to follow directions. *Technician B* says that you are not entitled to a clean, safe place to work. Who is correct?

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

ANSWER: a

POINTS: 1

12. *Technician A* says to use the VIN to collect the correct repair information. *Technician B* says repair procedures will cover diagnostic routines and methods to perform the repair. Who is correct?

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

ANSWER: c

POINTS: 1

13. Refrigerant identifiers are being discussed. *Technician A* says a refrigerant identifier will display R-12 if the refrigerant is 90% CFC-12 by weight. *Technician B* says a refrigerant identifier will display R-134a if the refrigerant is 98% HFC-134a by weight. Who is correct?

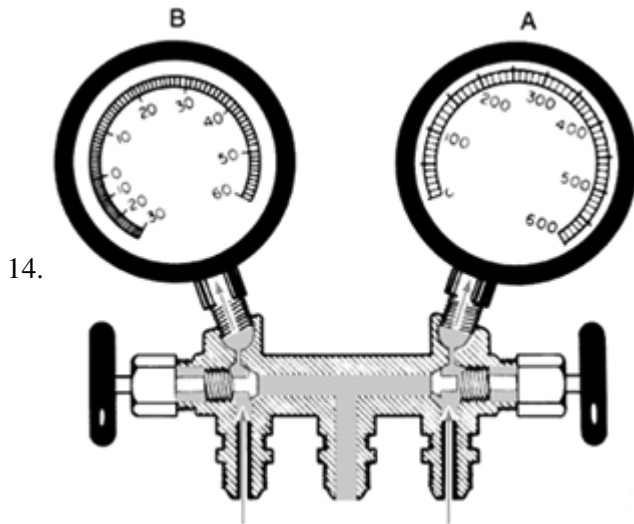
- a. Technician A only
- b. Technician B only
- c. Both A and B
- d. Neither A nor B

ANSWER: b

POINTS: 1

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The tool in the figure above is being discussed. *Technician A* says the "B" gauge will register vacuum in Hg as well as psig. *Technician B* says the "A" gauge will register pressure in psig. Who is correct?

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

ANSWER: c

POINTS: 1

15. *Technician A* says that when working on a refrigerant system you should work in a well-ventilated area. *Technician B* says to determine the type of refrigerant used in a system, a refrigerant identifier should be used prior to servicing the vehicles refrigerant system. Who is correct?

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

ANSWER: c

POINTS: 1

16. *Technician A* says a manifold and gauge sets is a manifold block complete with gauges and charging hoses. *Technician B* says a can tap is a device used to pierce, dispense, and seal small cans of refrigerant. Who is correct?

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

ANSWER: c

POINTS: 1

17. *Technician A* says a service information system may include estimating and shop management software. *Technician B* says service information you find on the internet is the most accurate information. Who is correct?

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

ANSWER: a

POINTS: 1

18. *Technician A* says a vacuum pump is an essential piece of equipment for servicing a refrigerant system. *Technician B* says that you only need one manifold gauge set for all types of refrigerant you need to service. Who is correct?

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

ANSWER: a

POINTS: 1

19. *Technician A* says shops must have dedicated manifold and gauge sets for each manufacturer-approved refrigerant. *Technician B* says a shop should also have an additional set for contaminated refrigerant. Who is correct?

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

ANSWER: c

POINTS: 1

20. *Technician A* says that a repair order does not need to be filled out for a no charge (free) repair. *Technician B* says that the repair order is a legal document that must be filled out for every vehicle worked on. Who is correct?

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

ANSWER: b

POINTS: 1

21. All of the following are basic employee obligations that must be adhered to EXCEPT:

- a. Positive attitude      b. Responsibility and pride
- c. Dependability          d. Tardiness

ANSWER: d

POINTS: 1

22. Refrigerant identifiers are being discussed. *Technician A* says the identifier will identify CFC-12 (R-12) and HFC-134a (R-134a) by name. *Technician B* says the identifier will not indicate the presence of flammable gases. Who is correct?

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

ANSWER: a

POINTS: 1

23. *Technician A* says the high-side gauge on the manifold gauge set is on the left and has a red housing. *Technician B* says the low-side gauge on the manifold gauge set is on the left and has a green housing. Who is correct?

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

ANSWER: d

POINTS: 1

24. All of the following are method of detecting refrigerant leaks EXCEPT:

- a. Halogen detector      b. Soap solution
- c. hepide detector      d. Fluorescent dye

ANSWER: c

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*POINTS:* 1

25. All of the following are sources of repair information about automotive refrigerant systems EXCEPT:

- a. ALLDATA      b. EPAC
- c. iATN          d. MACS

*ANSWER:* b

*POINTS:* 1

26. Which of the following terms is used to refer to a vehicle that must return to a repair facility for a repeat repair.

- a. back-job      b. repeater
- c. bad one      d. come-back

*ANSWER:* d

*POINTS:* 1

27. What is your employer expected to supply first and foremost?

*ANSWER:* A safe and clean place to work

*POINTS:* 1

28. What must a shop have for tools in addition to technician's tools for refrigerant service?

*ANSWER:* In addition to the technician's tools needed to perform refrigerant service, the shop must have the required refrigerant recovery, recycle, and recharge systems for all refrigerant types serviced at their facility.

*POINTS:* 1

29. What is a manifold and gauge set?

*ANSWER:* A manifold and gauge set is a manifold block complete with gauges and charging hoses used to check and service refrigerant gas in an air conditioning system.

*POINTS:* 1

30. What are the four basic employee obligations?

*ANSWER:* Attitude, responsibility, dependability, pride (any order)

*POINTS:* 1

31. List three special service tools besides the manifold and gauge set that will expand your service and repair capabilities considerably.

*ANSWER:* Thermometer, leak detector, vacuum pump (any order)

*POINTS:* 1

32. What does the acronym VIN stands for?

*ANSWER:* Vehicle identification number.

*POINTS:* 1

33. What is the purpose of the refrigerant recovery, recycling, and recharging equipment SAE standard J2788H?

*ANSWER:* It is designed to avoid refrigerant oil cross contamination.

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*POINTS:* 1

34. List some other air conditioning service equipment that is usually supplied by the shop.

*ANSWER:* Refrigerant recovery/recycle system, electronic leak detector, electronic thermometer, charging station, ATC testers, compressor repair tools, vacuum pump, refrigerant identifier, and an electronic scale.

*POINTS:* 1

35. Explain why it is important to consult service information when working on any type of air conditioning system.

*ANSWER:* The vast number and variety of modern air conditioning systems make it impossible to give a standard repair procedure.

*POINTS:* 1

36. Why are shop rules and regulations put in place?

*ANSWER:* Shop rules and regulations are put in place by management to create and maintain a safe and pleasant environment for both employees and customers.

*POINTS:* 1

37. What is a manifold and gauge set?

*ANSWER:* A manifold and gauge set is a manifold block complete with gauges and charging hoses used to check and service refrigerant gas in an air conditioning system.

*POINTS:* 1

38. How are the R-1234yf recovery/recycling/recharge equipment requirements different from R-134a?

*ANSWER:* The refrigerant equipment for R-1234yf meets the same stringent charging and recover requirements as the R-134a J2788 systems but also includes the mandatory use of a refrigerant identifier prior to recovery of refrigerant.

*POINTS:* 1