PRACTICE EXAM 6: T7 SIMULATION (40 QUESTIONS)

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1. The basic principle of refrigeration is:

A. Heat is created by compressing refrigerant vapor

B. Heat is transferred from the refrigerant to the cabin air

C. Heat moves from the warmer object to the cooler refrigerant

D. Heat is destroyed when the refrigerant changes state

2. The latent heat of vaporization of a refrigerant refers to:

A. Heat absorbed during phase change without temperature change

B. Heat absorbed during temperature rise of the liquid

C. Heat released during temperature fall of the vapor

D. Heat created during compression of the vapor

3. A heavy-duty truck A/C system uses a thermostatic expansion valve (TXV). The TXV controls refrigerant flow based on:

A. High-side pressure only

B. Low-side pressure only

C. Engine RPM input

D. Evaporator outlet temperature and pressure

4. The function of the accumulator in an orifice tube A/C system is to:

A. Increase refrigerant pressure entering the compressor

B. Prevent liquid refrigerant from reaching the compressor

C. Cool the refrigerant before the expansion device

D. Filter contamination from the high-pressure side

5. Tech A says superheat refers to vapor heated above its saturation temperature. Tech B says superheat measurement verifies proper TXV operation. Who is correct?

A. Both Tech A and Tech B

B. Tech A only

C. Tech B only

D. Neither Tech A nor Tech B

6. Subcooling in an A/C system refers to:

A. Vapor cooled below saturation temperature

B. Pressure reduced below atmospheric pressure

C. Liquid cooled below its saturation temperature

D. Refrigerant temperature equal to ambient temperature

7. The heat absorbed by the evaporator is rejected by the:

A. Compressor during the compression cycle

B. Expansion valve during pressure drop

C. Receiver-drier during moisture absorption

D. Condenser through airflow across the fins

8. A heavy-duty truck A/C system uses a fixed-displacement compressor. The compressor output is controlled by:

A. Variable internal swash plate angle

B. Cycling the compressor clutch on and off

C. Variable speed drive from the engine

D. Modulating the crankshaft speed

9. The pressure-temperature relationship of a saturated refrigerant follows the principle that:

A. Pressure and temperature have a fixed relationship at saturation

B. Pressure and temperature are independent at saturation

C. Pressure increases as temperature decreases at saturation

D. Pressure remains constant regardless of temperature changes

10. Tech A says the compressor performs work on the refrigerant by raising its pressure. Tech B says the work performed by the compressor adds heat to the refrigerant. Who is correct?

A. Tech A only

B. Tech B only

C. Both Tech A and Tech B

D. Neither Tech A nor Tech B

11. The refrigerant property that determines its boiling point at various pressures is:

A. The pressure-temperature curve specific to that refrigerant

B. The viscosity at operating conditions

C. The molecular weight of the compound

D. The ozone depletion potential

12. A variable-displacement A/C compressor controls capacity by:

A. Cycling the clutch on and off based on demand

B. Varying engine speed to match demand

C. Restricting refrigerant flow at the inlet

D. Varying the swash plate angle to change piston stroke

13. The temperature of refrigerant exiting the condenser on a properly functioning heavy-duty A/C system is typically:

A. Equal to ambient temperature

B. Above ambient temperature by approximately 10 to 30°F

C. Below ambient temperature by approximately 10 to 20°F

D. Equal to evaporator outlet temperature

14. Tech A says liquid refrigerant cannot be compressed efficiently. Tech B says liquid slugging into the compressor can cause mechanical damage. Who is correct?

A. Tech A only

B. Tech B only

C. Both Tech A and Tech B

D. Neither Tech A nor Tech B

15. The function of a heat exchanger between the suction line and liquid line is to:

A. Reduce compressor work by superheating the suction vapor

B. Increase condenser efficiency through liquid cooling

C. Prevent moisture from entering the system

D. Improve efficiency through subcooling and superheating

16. The pressure drop across a properly functioning expansion valve creates:

A. A liquid-to-mixture phase change at the device outlet

B. A vapor-to-liquid phase change at the device outlet

C. A temperature increase across the device

D. A pressure increase across the device

17. The function of the heater core in a heavy-duty truck cab is based on the principle that:

A. Engine combustion creates direct heat for cabin warming

B. Electrical resistance heating produces cabin warmth

C. Heat transfers from circulating coolant to cabin air across fins

D. Compressed air provides heating through pressurization

18. The coolant flow rate through a heavy-duty truck heater core is controlled by:

A. Engine RPM only

B. The heater control valve position

C. Coolant temperature only

D. Cabin air temperature only

19. Tech A says heavy-duty diesel cooling systems use higher pressure caps than gasoline engines. Tech B says higher pressure raises the boiling point of the coolant. Who is correct?

A. Tech A only

B. Tech B only

C. Neither Tech A nor Tech B

D. Both Tech A and Tech B

20. The function of supplemental coolant additives (SCA) in heavy-duty diesel cooling systems is to:

A. Prevent cylinder liner cavitation through inhibitor maintenance

B. Increase the boiling point of the coolant

C. Reduce the freezing point of the coolant

D. Provide lubrication for the water pump

21. The water pump on a heavy-duty diesel engine is typically:

A. Electrically driven by a motor

B. Hydraulically driven by oil pressure

C. Pneumatically driven by air pressure

D. Belt-driven by the engine crankshaft

22. The function of the cooling system thermostat is to:

A. Regulate coolant flow to maintain optimal engine temperature

B. Pump coolant through the engine cooling system

C. Filter contamination from the engine coolant

D. Pressurize the cooling system to prevent boiling

23. Tech A says heavy-duty diesel coolant should typically be a 50/50 mixture of antifreeze and water. Tech B says higher antifreeze concentrations reduce heat transfer capability. Who is correct?

A. Tech A only

B. Tech B only

C. Both Tech A and Tech B

D. Neither Tech A nor Tech B

24. The function of an intercooler on a turbocharged heavy-duty diesel engine is to:

A. Increase intake air temperature for better combustion

B. Cool intake air to increase air density and improve combustion

C. Provide cab heating through air-to-air exchange

D. Reduce exhaust temperature before catalytic conversion

25. The function of a blend door in a heavy-duty truck HVAC system is to:

A. Control air flow rate through the HVAC ducts

B. Control the air distribution between vent positions

C. Control the recirculation of cabin air

D. Control temperature by mixing hot and cold air streams

26. A modern heavy-duty truck HVAC actuator typically uses:

A. A small DC motor with position feedback potentiometer

B. A vacuum diaphragm with mechanical linkage

C. A solenoid with on/off positioning only

D. A hydraulic cylinder with pressure control

27. Tech A says heavy-duty truck blower motors use brush-and-commutator design. Tech B says some modern blower motors use brushless DC design with electronic commutation. Who is correct?

A. Tech A only

B. Both Tech A and Tech B

C. Tech B only

D. Neither Tech A nor Tech B

28. The PWM (pulse-width modulation) signal driving a blower motor controls:

A. The voltage applied regardless of duty cycle

B. The frequency of motor rotation in steps

C. The motor direction reversal during operation

D. The average voltage applied through duty cycle variation

29. The function of a recirculation door in a heavy-duty truck HVAC system is to:

A. Select between fresh outside air and recirculated cabin air

B. Control the temperature blend ratio

C. Direct air flow to specific outlets

D. Control the compressor clutch engagement

30. Tech A says heavy-duty truck HVAC systems may use thermistor cabin temperature sensors. Tech B says NTC thermistor resistance varies inversely with temperature. Who is correct?

A. Tech A only

B. Tech B only

C. Both Tech A and Tech B

D. Neither Tech A nor Tech B

31. The function of a sun load sensor in a heavy-duty truck ATC system is to:

A. Detect cabin moisture levels

B. Adjust ATC operation based on solar radiation entering the cabin

C. Detect outside ambient temperature

D. Detect cabin occupancy

32. The compressor clutch coil in a heavy-duty truck A/C system is essentially:

A. A capacitor for energy storage

B. A resistor for current limiting

C. An electromagnet for clutch engagement

D. A diode for current direction control

33. Tech A says some heavy-duty truck HVAC systems include electronic expansion valves (EEVs). Tech B says EEVs provide more precise refrigerant flow control than TXVs. Who is correct?

A. Both Tech A and Tech B

B. Tech A only

C. Tech B only

D. Neither Tech A nor Tech B

34. The function of a high-pressure cutoff switch in a heavy-duty A/C system is based on:

A. Pressure measurement at the low side of the system

B. Temperature measurement at the evaporator

C. Engine RPM signal from the ECU

D. Pressure measurement at the high side of the system

35. The defrost mode in a heavy-duty truck HVAC system typically:

A. Activates the A/C compressor and directs airflow to the windshield

B. Operates without compressor engagement

C. Recirculates cabin air to retain moisture

D. Operates only at high blower speed without temperature control

36. Tech A says some heavy-duty truck sleeper auxiliary HVAC systems use battery-powered compressors. Tech B says these systems allow cab climate control during engine-off periods to reduce idle fuel use. Who is correct?

A. Tech A only

B. Tech B only

C. Both Tech A and Tech B

D. Neither Tech A nor Tech B

37. The principle of refrigerant recovery is based on:

A. Venting refrigerant to atmosphere through a filter

B. Burning refrigerant in a controlled chamber

C. Chemical conversion to a non-refrigerant compound

D. Capturing refrigerant in a cylinder for reuse, recycling, or disposal

38. The function of a refrigerant identifier is to:

A. Measure refrigerant pressure in the system

B. Verify refrigerant type and purity before service

C. Detect refrigerant leaks in the system

D. Measure refrigerant temperature in the system

39. Tech A says recycling involves removing contamination to allow reuse. Tech B says reclaiming involves processing to virgin specification quality. Who is correct?

A. Both Tech A and Tech B

B. Tech A only

C. Tech B only

D. Neither Tech A nor Tech B

40. The function of EPA refrigerant disposal certification is to:

A. Allow venting of contaminated refrigerant

B. Provide alternative storage methods

C. Ensure proper handling of refrigerant unsuitable for reuse

D. Permit conversion of refrigerant to other compounds

PRACTICE EXAM 6: ANSWER KEY AND EXPLANATIONS

1. C — Heat moves from the warmer object to the cooler refrigerant. The basic principle of refrigeration is that heat naturally moves from warmer objects to cooler objects, and the refrigerant cycle creates a low-temperature evaporator that absorbs heat from cabin air. Heat is not destroyed or created — it is transferred from one location to another.
2. A — Heat absorbed during phase change without temperature change. Latent heat of vaporization is the heat absorbed by refrigerant as it changes from liquid to vapor without temperature change, which is the fundamental cooling mechanism in the evaporator. This phase-change heat absorption is much greater than sensible heating.
3. D — Evaporator outlet temperature and pressure. The thermostatic expansion valve (TXV) controls refrigerant flow based on evaporator outlet temperature and pressure, providing precise metering that maintains proper superheat. This control method optimizes evaporator performance under varying load.
4. B — Prevent liquid refrigerant from reaching the compressor. The accumulator in an orifice tube system prevents liquid refrigerant from reaching the compressor, ensuring only vapor enters the compression cycle. Liquid in the compressor causes mechanical damage from incompressibility.
5. A — Both Tech A and Tech B. Superheat refers to refrigerant vapor heated above its saturation temperature, indicating all liquid has vaporized in the evaporator. Superheat measurement verifies proper TXV operation, with proper superheat indicating correct refrigerant metering.
6. C — Liquid cooled below its saturation temperature. Subcooling refers to liquid refrigerant cooled below its saturation temperature, which occurs at the condenser outlet when condenser efficiency is adequate. Proper subcooling indicates effective heat rejection.
7. D — Condenser through airflow across the fins. Heat absorbed by the evaporator is rejected by the condenser through airflow across the fins, completing the cycle's heat rejection function. The condenser converts heat absorbed from cabin air to heat in outside air.
8. B — Cycling the compressor clutch on and off. Fixed-displacement compressors control output by cycling the clutch on and off based on demand, since the compressor produces a fixed displacement per revolution. Variable-displacement compressors use different control mechanisms.

9. A — Pressure and temperature have a fixed relationship at saturation. The pressure-temperature relationship of a saturated refrigerant follows a fixed curve specific to each refrigerant, allowing pressure measurement to determine temperature at saturation conditions. This relationship is fundamental to A/C diagnosis.

10. C — Both Tech A and Tech B. The compressor performs work on the refrigerant by raising its pressure, which is the energy input to the cycle. The work performed adds heat to the refrigerant (compression heating), which is rejected at the condenser along with heat absorbed at the evaporator.

11. A — The pressure-temperature curve specific to that refrigerant. Each refrigerant has a unique pressure-temperature curve that determines its boiling point at various pressures. This curve is fundamental to refrigerant selection and system operation.

12. D — Varying the swash plate angle to change piston stroke. Variable-displacement compressors control capacity by varying the swash plate angle, which changes piston stroke and therefore displacement per revolution. This allows continuous capacity matching without clutch cycling.

13. B — Above ambient temperature by approximately 10 to 30°F. Refrigerant exiting the condenser on a properly functioning system is typically 10 to 30°F above ambient temperature, with the differential indicating proper heat rejection. Equal to ambient indicates inadequate condenser performance.

14. C — Both Tech A and Tech B. Liquid refrigerant cannot be compressed efficiently because liquids are essentially incompressible compared to vapors. Liquid slugging into the compressor causes mechanical damage from the high pressures generated when compressing incompressible liquid.

15. D — Improve efficiency through subcooling and superheating. The heat exchanger between suction and liquid lines improves system efficiency by simultaneously subcooling the liquid line refrigerant and superheating the suction line refrigerant. This dual benefit improves overall performance.

16. A — A liquid-to-mixture phase change at the device outlet. The pressure drop across the expansion valve creates a phase change from high-pressure liquid to low-pressure liquid-vapor mixture, which is the entry condition to the evaporator. This phase change is essential to the refrigeration cycle.

17. C — Heat transfers from circulating coolant to cabin air across fins. The heater core function is based on heat transfer from circulating engine coolant (containing engine waste heat) to cabin air passing across the fins. This uses engine waste heat for cabin heating without additional energy consumption.

18. B — The heater control valve position. Coolant flow rate through the heater core is controlled by the heater control valve position, which regulates flow based on heating demand. The valve position is controlled by the HVAC system based on temperature setpoint.

19. D — Both Tech A and Tech B. Heavy-duty diesel cooling systems use higher pressure caps than gasoline engines to allow higher operating temperatures. Higher pressure raises the boiling point of the coolant, allowing higher operating temperatures without boiling.

20. A — Prevent cylinder liner cavitation through inhibitor maintenance. Supplemental coolant additives (SCA) prevent cylinder liner cavitation through chemical inhibitor maintenance, with the inhibitors maintaining a protective film on liner surfaces. Other functions are not the primary purpose of SCA.

21. D — Belt-driven by the engine crankshaft. Heavy-duty diesel water pumps are typically belt-driven by the engine crankshaft, providing coolant circulation proportional to engine speed. Other drive methods are not standard in heavy-duty diesel applications.

22. A — Regulate coolant flow to maintain optimal engine temperature. The cooling system thermostat regulates coolant flow to maintain optimal engine operating temperature, blocking flow when cold and opening progressively as temperature rises. This regulation is critical for engine efficiency, emissions, and component life.

23. C — Both Tech A and Tech B. Heavy-duty diesel coolant should typically be a 50/50 mixture of antifreeze and water for optimal heat transfer and freeze protection. Higher antifreeze concentrations reduce heat transfer capability because antifreeze has lower thermal conductivity than water, requiring the 50/50 balance for optimal performance.

24. B — Cool intake air to increase air density and improve combustion. The intercooler on a turbocharged heavy-duty diesel cools intake air after turbo compression, increasing air density and improving combustion efficiency. Cooler, denser air supports more fuel injection and higher power output.

25. D — Control temperature by mixing hot and cold air streams. The blend door controls cabin air temperature by varying the proportion of air passing through the heater core (hot) versus bypassing it (cold from evaporator), creating a controllable temperature blend. This is the temperature control mechanism.

26. A — A small DC motor with position feedback potentiometer. Modern heavy-duty truck HVAC actuators use small DC motors with position feedback potentiometers, providing precise position control through closed-loop operation. Vacuum, solenoid, and hydraulic actuators are not used in modern systems.

27. B — Both Tech A and Tech B. Heavy-duty truck blower motors traditionally use brush-and-commutator design, providing reliable operation. Some modern blower motors use brushless DC design with electronic commutation, eliminating brush wear and providing improved efficiency and longevity.

28. D — The average voltage applied through duty cycle variation. PWM signals control motor speed by varying the duty cycle of a fixed-frequency square wave, which determines the average voltage delivered to the motor. Higher duty cycle produces higher average voltage and higher motor speed.

29. A — Select between fresh outside air and recirculated cabin air. The recirculation door selects between fresh outside air (door open) and recirculated cabin air (door closed), allowing the system to draw from either source based on operating conditions. This is the air source selection mechanism.

30. C — Both Tech A and Tech B. Heavy-duty truck HVAC systems may use thermistor cabin temperature sensors, which provide variable resistance changing with temperature. NTC (Negative Temperature Coefficient) thermistor resistance varies inversely with temperature, with resistance decreasing as temperature increases.

31. B — Adjust ATC operation based on solar radiation entering the cabin. The sun load sensor in an ATC system detects solar radiation entering the cabin and adjusts operation accordingly, providing additional cooling capacity when solar load increases cabin heating demand. This sensor improves ATC accuracy.

32. C — An electromagnet for clutch engagement. The compressor clutch coil is essentially an electromagnet that creates a magnetic field when energized, attracting the clutch armature and engaging the compressor with the engine drive. De-energization releases the armature and disengages the compressor.

33. A — Both Tech A and Tech B. Modern heavy-duty truck HVAC systems may include electronic expansion valves (EEVs) controlled by a dedicated module, providing precise refrigerant flow control. EEVs provide more precise control than thermostatic expansion valves through electronic positioning rather than mechanical sensing.

34. D — Pressure measurement at the high side of the system. The high-pressure cutoff switch is based on pressure measurement at the high side of the system, opening the compressor circuit when pressure exceeds safe limits. This protection prevents component damage from over-pressure conditions.

35. A — Activates the A/C compressor and directs airflow to the windshield. Defrost mode activates the A/C compressor (for dehumidification) and directs airflow to the windshield outlets (for moisture removal), providing the most effective windshield defrost combination. Both functions work together for fast defrost.

36. C — Both Tech A and Tech B. Heavy-duty truck sleeper auxiliary HVAC systems may use battery-powered compressors that operate from the truck's batteries during engine-off periods. These systems allow cab climate control during engine-off periods to reduce idle fuel consumption, providing significant fuel economy benefits for sleeper operations.

37. D — Capturing refrigerant in a cylinder for reuse, recycling, or disposal. Refrigerant recovery captures refrigerant in a cylinder for subsequent reuse, recycling, or disposal, preventing release to atmosphere. Other approaches (venting, burning, conversion) are not acceptable refrigerant handling methods.

38. B — Verify refrigerant type and purity before service. The refrigerant identifier verifies refrigerant type and purity before service, preventing contamination of recovery equipment and ensuring proper service procedures. Other measurements use different equipment.

39. A — Both Tech A and Tech B. Refrigerant recycling involves removing contamination (moisture, oil, particles) to allow reuse in similar systems. Reclaiming involves processing to virgin specification quality for reuse in any application, providing a higher level of purification than recycling.

40. C — Ensure proper handling of refrigerant unsuitable for reuse. EPA refrigerant disposal certification ensures proper handling of refrigerant that is unsuitable for reuse (heavily contaminated, mixed types, end-of-life), providing controlled disposal that prevents environmental release. Other approaches are not acceptable.