PRACTICE EXAM 15: RACM RED SEAL SIMULATION (125 QUESTIONS)

1. A service technician is reviewing a WHMIS 2015 supplier label before handling a cylinder of R-410A. Which piece of information is a mandatory element of that label?

A. Hazard pictogram, signal word, and supplier identifier

B. The technician's certification number and expiry date

C. The retail purchase price and date of last refill

D. A complete list of every job site where it may be used

2. When lifting a compressor weighing 40 kg from floor level, which technique most reduces the risk of lumbar strain?

A. Bend at the waist and keep the legs straight throughout

B. Twist the torso while lifting to position the load faster

C. Keep the load close, bend the knees, and lift with the legs

D. Lift quickly in one motion to minimize time under load

3. A tradesperson must communicate a confined-space entry plan to two helpers. Which document primarily defines the atmospheric testing required before entry?

A. The manufacturer's compressor warranty card

B. The refrigerant cylinder shipping manifest

C. A blank purchase order from the supply house

D. The site-specific confined-space entry permit

4. Oxy-acetylene equipment is being set up for brazing copper line sets. What is the correct order for opening valves and lighting the torch?

A. Light the torch first, then slowly open both gas valves

B. Open acetylene fully, open oxygen fully, then strike the igniter

C. Open the oxygen first and ignite before adding any acetylene

D. Open acetylene slightly, ignite, then add oxygen to set the flame

5. A digital multimeter set to measure microfarads is used to test a run capacitor removed from the circuit. A good capacitor should read:

A. Exactly zero on every functional capacitor tested

B. Infinite resistance with no measurable capacitance value

C. A value at or near its nameplate rating in microfarads

D. Line voltage equal to the supply feeding the unit

6. Which fastener is most appropriate for mounting an electrical disconnect box to a hollow concrete block wall?

A. A sleeve or wedge masonry anchor rated for the load

B. A standard wood screw driven directly into the block

C. A drywall toggle designed only for gypsum board

D. A friction-fit nail tapped lightly into the mortar joint

7. A scenario calls for documenting a refrigerant recovery for regulatory compliance. Which record must be retained?

A. The type and quantity of refrigerant recovered and its disposition

B. The technician's personal banking information for billing

C. A photograph of the customer's government-issued ID card

D. The brand of recovery machine the supplier prefers

8. Brazing a copper-to-copper joint with a 15% silver-phosphorus (BCuP) alloy generally requires:

A. A separate flux applied heavily to both copper surfaces

B. Galvanized steel fittings to improve capillary flow

C. No flux, because the phosphorus is self-fluxing on copper

D. Aluminum filler rod for a stronger finished joint

9. While purging a system with dry nitrogen before brazing, the primary purpose is to:

A. Increase internal pressure to test for joint leaks only

B. Cool the copper so the braze alloy solidifies faster

C. Add moisture that helps the flux flow into the joint

D. Prevent the formation of oxides (scale) inside the tubing

10. A pressure-temperature (P-T) chart for R-134a shows a saturation pressure of about 47 psig. The corresponding saturation temperature is approximately:

A. 50°F (10°C)

B. −20°F (−29°C)

C. 120°F (49°C)

D. 200°F (93°C)

11. In the basic vapor-compression cycle, which component's primary function is to reject heat to the surroundings?

A. The metering device controlling refrigerant flow

B. The condenser downstream of the compressor discharge

C. The accumulator on the compressor suction line

D. The evaporator located inside the conditioned space

12. Superheat is best defined as the number of degrees that refrigerant vapor has been heated:

A. Below its saturation temperature at a given pressure

B. Below the freezing point of water at the evaporator

C. Above its saturation temperature at a given pressure

D. Above the critical temperature of the refrigerant

13. A TXV-controlled evaporator shows abnormally high superheat and low capacity. The most likely cause is:

A. An underfeeding metering device or low refrigerant charge

B. A flooded evaporator caused by severe overcharge

C. A condenser fan running at excessive speed

D. The suction line being far too large in diameter

14. Subcooling is measured at the:

A. Compressor discharge before the oil separator

B. Evaporator inlet just after the metering device

C. Liquid line, comparing liquid temperature to saturation

D. Suction line entering the compressor housing

15. When charging an R-410A system, refrigerant must be removed from the cylinder:

A. As a vapor only, to protect the manifold gauges

B. As a liquid (cylinder inverted or via a metering device)

C. Only after heating the cylinder above 60°C

D. Through the high side while the compressor is off

16. A halide or electronic leak detector indicates a leak at a flare connection. The correct first corrective step is to:

A. Verify the flare nut torque and reseat or remake the flare

B. Add dye and return the unit to service immediately

C. Increase the system charge to mask the leak rate

D. Wrap the joint in electrical tape and monitor it

17. The metering device most commonly used in a residential heat pump that must control flow in both heating and cooling modes is:

A. A single fixed-orifice piston with no bypass capability

B. A hand-operated needle valve adjusted each season

C. A capillary tube sized only for cooling operation

D. A bi-flow TXV or a piston with a check-valve arrangement

18. A water-cooled condenser uses a cooling tower. Approach temperature is the difference between:

A. Entering and leaving water temperature across the tower

B. Condensing temperature and the compressor discharge

C. Wet-bulb air temperature and the dry-bulb temperature

D. Leaving water temperature and entering air wet-bulb

19. In a flooded chiller evaporator, the refrigerant level is typically controlled by:

A. A fixed capillary tube sized to the design load

B. A low-side float valve maintaining liquid level

C. The compressor's internal crankcase heater

D. Manual throttling of the discharge service valve

20. A reciprocating compressor has reed valves. A leaking discharge reed valve will typically cause:

A. Lower-than-normal discharge temperature and high capacity

B. The crankcase heater to draw excessive amperage

C. High discharge temperature with reduced pumping capacity

D. The evaporator to flood with excess liquid refrigerant

21. A scroll compressor that runs backward after a phase reversal on a three-phase supply will typically:

A. Produce no pumping and an unusual noise until corrected

B. Pump at higher-than-rated capacity in reverse rotation

C. Improve oil return throughout the entire system

D. Have no effect because scrolls are rotation-independent

22. Refrigerant oil must be miscible with the refrigerant primarily to ensure:

A. The compressor motor windings stay electrically isolated

B. The condenser can reject additional latent heat load

C. Oil returns to the compressor rather than logging in the system

D. The metering device meters liquid at a fixed superheat

23. A POE (polyolester) oil is specified for an R-410A system mainly because it:

A. Costs less than mineral oil at the supply house

B. Is non-hygroscopic and never absorbs any moisture

C. Is compatible/miscible with HFC refrigerants like R-410A

D. Can be mixed freely with mineral oil in any ratio

24. A liquid-line filter-drier shows a significant temperature drop across it during operation. This indicates:

A. The drier is new and functioning within normal limits

B. A restriction in the drier causing a pressure drop

C. The condenser is undersized for the application

D. The compressor discharge valve is leaking internally

25. When evacuating a system, a micron gauge is used to verify the vacuum reaches and holds:

A. About 0 psig measured on the compound gauge alone

B. Approximately 28 inHg with no further measurement needed

C. Atmospheric pressure after the pump is switched off

D. A deep vacuum (e.g., ~500 microns) that holds after isolation

26. A standing-pressure decay test after evacuation shows the micron reading rising and stabilizing at a mid-range value. This most likely indicates:

A. A large refrigerant leak to the atmosphere

B. Remaining moisture (off-gassing) in the system

C. The vacuum pump oil is brand new and clean

D. The system is perfectly dry and ready to charge

27. A three-phase motor nameplate lists 460 V, 12 FLA. Measured running current on all three legs is 11.8 A balanced. This reading is:

A. Within normal operating range for the motor

B. A sign of a shorted winding requiring replacement

C. Evidence of single-phasing on one supply leg

D. Proof the motor is severely overloaded mechanically

28. A PSC fan motor will not start but hums and trips on overload. The most likely faulty component is:

A. The main contactor coil in the disconnect

B. The thermostat anticipator resistor circuit

C. A failed (open) run capacitor for that motor

D. The condensate float switch in the drain pan

29. On a 240 V single-phase resistive heater drawing 20 A, the power consumed is:

A. 12 W

B. 260 W

C. 1,200 W

D. 4,800 W

30. A contactor's normally open auxiliary contacts are used in a control circuit to:

A. Provide an interlock or holding/seal-in function

B. Carry the full motor load current directly

C. Replace the need for any overload protection

D. Step down the line voltage to control voltage

31. A low-voltage (24 V) control transformer's secondary reads 0 V while the primary reads 120 V. The most likely cause is:

A. The thermostat is calling for cooling normally

B. An open (failed) transformer winding or blown fuse

C. The secondary is correctly isolated and working

D. The compressor contactor has welded shut

32. A defrost termination/fan-delay switch on a heat pump outdoor coil is designed to:

A. End defrost and delay the fan based on coil temperature

B. Energize the compressor crankcase heater only

C. Open the high-pressure safety during cooling

D. Control the indoor blower speed in cooling mode

33. A reversing valve solenoid is de-energized and the heat pump is in heating. This indicates the valve is wired:

A. So the solenoid is energized only during heating mode

B. Without any solenoid coil in the circuit at all

C. So heating is the de-energized (default) position

D. To bypass the indoor metering device in heating

34. A pressure switch set as a low-pressure cutout protects the system primarily against:

A. Excessive condenser fan motor amperage draw

B. Overcharging during the charging procedure

C. High head pressure from a dirty condenser

D. Loss of charge or evaporator freeze-up conditions

35. A capacity-controlled system uses hot-gas bypass primarily to:

A. Maintain evaporator pressure at light load conditions

B. Increase condenser subcooling at full load

C. Eliminate the need for any metering device

D. Reverse refrigerant flow during the defrost cycle

36. In a commercial walk-in freezer, an evaporator pressure regulator (EPR) is installed in the:

A. Liquid line just ahead of the metering device

B. Discharge line between compressor and condenser

C. Branch supplying the condenser fan motor

D. Suction line to maintain a minimum evaporator pressure

37. A multiple-evaporator rack system uses EPR valves so that:

A. All evaporators must operate at identical temperatures

B. The compressor can be eliminated from the circuit

C. Liquid refrigerant is metered by the discharge valve

D. Different cases can run at different temperatures on one suction group

38. Defrosting an air-cooled low-temperature evaporator with electric heaters requires that the defrost cycle:

A. Run continuously to keep the coil permanently warm

B. Operate only when the space thermostat calls for cooling

C. Be terminated by time and/or temperature to limit heat

D. Bypass the fan-delay so fans run during active defrost

39. Hot-gas defrost differs from electric defrost in that it:

A. Requires a separate electric element on the suction line

B. Cannot be used in any commercial refrigeration system

C. Always increases total system energy consumption

D. Uses the system's own discharge gas to warm the coil

40. A head-pressure control on an air-cooled condenser in winter is used to:

A. Lower the condensing pressure below ambient always

B. Maintain adequate high-side pressure for proper TXV feed

C. Prevent the evaporator from ever reaching set point

D. Disable the compressor whenever it is cold outside

41. Floodback of liquid refrigerant to a reciprocating compressor most directly risks:

A. Improved lubrication and extended bearing life

B. Higher superheat readings at the evaporator outlet

C. Reduced amperage draw and cooler windings

D. Oil dilution and possible valve or rod damage

42. A suction-line accumulator protects the compressor by:

A. Increasing the refrigerant charge automatically

B. Acting as the primary system metering device

C. Subcooling the liquid before the metering device

D. Holding liquid and metering it back as vapor/oil mix

43. A crankcase heater is energized during the off-cycle to:

A. Preheat the discharge gas before the condenser

B. Increase the evaporator capacity at start-up

C. Drive refrigerant out of the oil to prevent migration

D. Keep the contactor coil warm in cold weather

44. A psychrometric chart plots dry-bulb temperature against:

A. Humidity ratio / relative humidity (moisture content)

B. Refrigerant saturation pressure only

C. Compressor discharge superheat values

D. Condenser water flow rate in gpm

45. Sensible heat added to air causes a change in:

A. The moisture content without any temperature change

B. The latent load only, never the dry-bulb reading

C. The refrigerant's state inside the compressor

D. Dry-bulb temperature with no change in moisture content

46. Total cooling load on an evaporator equals:

A. The sum of sensible heat plus latent heat removed

B. Sensible heat only, ignoring any moisture removal

C. Latent heat only, ignoring temperature change

D. The compressor power input expressed in BTU/h

47. A duct system with high static pressure and low airflow most likely has:

A. An oversized return grille reducing resistance

B. A restriction such as a dirty filter or closed dampers

C. A blower wheel spinning too fast for the design

D. Ductwork that is far larger than required

48. Required airflow across a residential cooling coil is commonly about:

A. 50 CFM per ton of cooling capacity

B. 1,200 CFM per ton regardless of system size

C. 400 CFM per ton of cooling capacity

D. Zero CFM because coils need no airflow

49. A water-source heat pump rejects or absorbs heat using:

A. An air-cooled condenser coil exposed to outdoor air only

B. A water loop through a coaxial or plate heat exchanger

C. A cooling tower that must run in heating mode only

D. The evaporator's electric defrost heaters year-round

50. A glycol secondary loop is used in some refrigeration systems primarily to:

A. Transport cooling to remote loads while limiting refrigerant charge

B. Eliminate the need for a compressor entirely

C. Increase the refrigerant's ozone depletion potential

D. Replace the lubricating oil in the compressor

51. A scenario requires recovering refrigerant from a system with a burned-out hermetic compressor. The recovered refrigerant should be:

A. Returned directly to the system after a quick filter

B. Sent for reclamation/disposal as contaminated refrigerant

C. Vented slowly outdoors once the acid clears

D. Reused immediately in the next customer's unit

52. After a hermetic compressor burnout, the recommended cleanup includes:

A. Reusing the original oil to save material cost

B. Installing suction-line acid-removing filter-driers and changing oil

C. Skipping the drier because the new compressor is clean

D. Charging extra refrigerant to dilute the acid present

53. An acid test kit on the system oil after a burnout shows a strong acid reaction. This indicates:

A. Severe motor burn with acid contamination requiring cleanup

B. The oil is fresh and within normal acceptable limits

C. The refrigerant charge is simply slightly low

D. The condenser merely needs a routine cleaning

54. A TXV's external equalizer line connects to the:

A. Liquid line just downstream of the receiver outlet

B. Suction line near the evaporator outlet to sense pressure

C. Discharge line at the compressor service valve

D. Condenser inlet header to balance head pressure

55. A TXV that has lost its bulb charge (bulb empty) will most likely:

A. Overfeed the evaporator and flood the compressor

B. Modulate normally with no detectable symptom

C. Close and starve the evaporator of refrigerant

D. Increase subcooling well above design values

56. A capillary-tube system is critically charged, meaning:

A. It tolerates wide variation in refrigerant charge

B. Extra charge improves efficiency at all conditions

C. The charge must be precise; over/undercharge degrades performance

D. The system needs no metering control at all

57. A low-side float and a high-side float are both:

A. Used only on capillary-tube domestic refrigerators

B. Liquid-level metering devices for flooded systems

C. Types of suction-line accumulators by another name

D. Discharge-line oil separators in disguise

58. A receiver in a refrigeration system serves to:

A. Meter refrigerant directly into the evaporator

B. Reject heat in place of the condenser coil

C. Store liquid refrigerant and accommodate charge changes

D. Superheat the suction vapor before compression

59. A sight glass in the liquid line showing steady bubbles during stable operation typically indicates:

A. Excess subcooling and a slight overcharge

B. Normal operation with no possible concern

C. Flash gas from low charge or a liquid-line restriction

D. The presence of clean, dry oil only

60. A moisture-indicating sight glass turning from green to yellow signals:

A. The refrigerant has changed to a different chemical type

B. Excess moisture in the system requiring a drier change

C. The system is fully evacuated and ready to charge

D. The oil level in the crankcase is too high

61. Two pressure gauges on a manifold set read high-side and:

A. Both read the same line at all times by design

B. Low-side (suction) pressure for diagnosis

C. Only the ambient atmospheric pressure

D. The control transformer secondary voltage

62. When measuring evaporator superheat on a fixed-orifice system, you compare suction-line temperature at the evaporator outlet to:

A. The condensing saturation temperature from the high side

B. The ambient outdoor dry-bulb temperature reading

C. The saturation temperature for the measured suction pressure

D. The compressor discharge line temperature

63. A heat pump in heating mode with low capacity and a frosted, then iced, outdoor coil that never clears suggests:

A. The cooling mode TXV is feeding too much liquid

B. A defrost control or reversing-valve fault preventing defrost

C. The indoor blower is running at excessive speed

D. The condensate drain on the indoor coil is plugged

64. Auxiliary (supplemental) electric heat on a heat pump is typically energized:

A. During every cooling call to balance humidity

B. On a second-stage call or during defrost to offset cold air

C. Only when the compressor is completely disabled

D. Continuously throughout the entire heating season

65. A balance point on a heat pump is the outdoor temperature at which:

A. Heat pump capacity equals the building heat loss

B. The compressor amperage doubles its rating

C. The refrigerant changes from HFC to CFC type

D. The reversing valve must be manually switched

66. A defrost cycle initiated too frequently (short cycling defrost) wastes energy and may be caused by:

A. An oversized condenser fan motor on the unit

B. A correctly set demand-defrost board operating normally

C. A faulty defrost sensor or initiation control set wrong

D. The indoor thermostat set slightly too high

67. A commercial ice machine's harvest cycle uses hot gas to:

A. Subcool the liquid line entering the evaporator plate

B. Increase the freezing rate of the next batch

C. Lower the condensing temperature during the freeze cycle

D. Warm the evaporator plate so the ice slab releases

68. A water-regulating valve on a water-cooled condenser modulates water flow based on:

A. The evaporator suction pressure only

B. Condensing (head) pressure to control head pressure

C. The indoor thermostat cooling call signal

D. The compressor crankcase oil temperature

69. A cooling tower's purpose in a water-cooled system is to:

A. Add refrigerant charge to the condenser automatically

B. Meter water directly into the evaporator coil

C. Reject heat from the condenser water to the atmosphere

D. Heat the condenser water before it returns to the unit

70. Scale buildup inside a water-cooled condenser will cause:

A. Lower head pressure and improved heat transfer

B. No measurable effect on system performance

C. Reduced water flow but better condensing efficiency

D. Higher head pressure due to poor heat transfer

71. A brazed-plate heat exchanger fouled on the water side will most likely show:

A. Increased capacity and lower compressor amperage

B. Reduced heat transfer and abnormal operating pressures

C. A leak of refrigerant directly into the room air

D. Improved subcooling at all load conditions

72. When silver-brazing a service valve onto a copper line, the valve should be:

A. Charged with refrigerant before applying any heat

B. Protected from overheating (e.g., wet rag/heat sink) to save seals

C. Heated red-hot to ensure full alloy penetration

D. Left fully open so flame can pass through it

73. A nitrogen pressure (strength) test on a newly brazed system should be performed:

A. Only after charging the system fully with refrigerant

B. Using oxygen because it is cheaper and inert

C. At pressures far above the relief valve setting

D. To the lower of system design or component test limits

74. The primary reason to never pressure-test with oxygen is that oxygen:

A. Is too expensive compared to nitrogen for testing

B. Cannot reach the pressures required for a strength test

C. Can react explosively with oil and hydrocarbons

D. Will dissolve into the refrigerant and contaminate it

75. A leak-search using soap bubbles is best suited for:

A. Pinpointing micro-leaks below detector sensitivity

B. Locating a leak indicated under nitrogen pressure

C. Testing a system under deep vacuum conditions

D. Checking the electrical insulation of the windings

76. A standing vacuum test that holds at 500 microns for 15 minutes after isolating the pump indicates:

A. The system is leak-free and dry, ready to charge

B. A significant leak is present in the high side

C. The micron gauge sensor has failed completely

D. Moisture is boiling off and must continue pumping

77. When recovering refrigerant, recovery is faster when the recovery cylinder is:

A. Heated well above 60°C to raise its pressure

B. Overfilled past the 80% fill limit for speed

C. Cooler than the system and not overfilled

D. Pressurized with shop air before recovery begins

78. A recovery cylinder must never be filled beyond approximately:

A. 95% to allow only a small vapor space

B. 100% so no refrigerant is left behind

C. 50% to keep the cylinder lightweight

D. 80% of capacity to allow for liquid expansion

79. Refrigerant cylinders are color-coded primarily to:

A. Help identify the refrigerant type for safe handling

B. Indicate the cylinder's internal pressure rating only

C. Show the year the cylinder was manufactured

D. Match the color of the system being serviced

80. A technician finds R-22 in an older unit being retrofitted. R-22 is classified as a(n):

A. Pure hydrocarbon with no ozone concern at all

B. Inert gas that requires no recovery procedures

C. HCFC being phased out under environmental rules

D. Natural refrigerant identical to carbon dioxide

81. When mixing two different refrigerants is suspected in a recovered cylinder, the refrigerant should be:

A. Sent for reclamation or proper disposal, never reused

B. Topped off and returned to the original system

C. Vented because mixtures are environmentally harmless

D. Separated by simply boiling off the lighter component

82. A blended (zeotropic) refrigerant such as R-407C should be charged:

A. As vapor only to preserve the blend ratio

B. In any state because blends do not fractionate

C. After venting half the charge to set the balance

D. As a liquid to avoid fractionation of the blend

83. Temperature glide in a zeotropic blend refers to:

A. The compressor speed varying with load demand

B. The range of temperatures during phase change at constant pressure

C. The drift of the thermostat set point over time

D. The slow rise of oil temperature during operation

84. A subcooling measurement of 0°F on a TXV system with a receiver most likely indicates:

A. Excessive overcharge flooding the condenser

B. The condenser fan running far too slowly

C. Low refrigerant charge or flash gas in the liquid line

D. Perfect charge requiring no further adjustment

85. On a fixed-orifice system, charging by superheat means adjusting charge until:

A. The subcooling reaches exactly 20°F at the receiver

B. The discharge pressure equals the suction pressure

C. Measured evaporator superheat matches the target for conditions

D. The liquid line frost-line reaches the compressor

86. A compressor that trips on its internal overload after a few minutes, with normal voltage and a clean condenser, may indicate:

A. The thermostat is set a few degrees too low

B. The supply voltage is slightly above nameplate

C. High discharge pressure or a mechanical/winding fault

D. The filter-drier was recently replaced correctly

87. A start capacitor differs from a run capacitor in that the start capacitor:

A. Stays in the circuit continuously during running

B. Has a much lower microfarad value than a run cap

C. Is rated for momentary, high-microfarad starting boost

D. Is wired across the line voltage at all times

88. A potential (voltage) relay used with a start capacitor removes the capacitor from the circuit when:

A. The compressor first receives line voltage at rest

B. The motor reaches speed and back-EMF rises

C. The high-pressure switch opens on a fault

D. The crankcase heater de-energizes at start-up

89. A hard-start kit is typically added to a single-phase compressor to:

A. Increase starting torque for hard-starting conditions

B. Reduce the running amperage during normal operation

C. Eliminate the need for any run capacitor

D. Convert the motor to three-phase operation

90. Measuring locked-rotor amperage (LRA) far above nameplate with the compressor not turning suggests:

A. The compressor is operating at normal full load

B. A correctly functioning unloader has engaged

C. The capacitor is oversized for the application

D. A mechanically seized or electrically faulted compressor

91. A three-phase compressor protected by a phase-loss monitor will be shut down if:

A. All three phases are balanced and within tolerance

B. The suction pressure rises slightly above set point

C. The condenser fan draws rated amperage normally

D. One phase is lost or voltages become unbalanced

92. An electronic expansion valve (EEV) controls superheat by:

A. Relying solely on a fixed mechanical spring force

B. Venting refrigerant to atmosphere as needed

C. Modulating an orifice via a stepper motor and sensors

D. Reversing flow each time the load changes

93. A pressure-enthalpy (P-H) diagram plots pressure against:

A. Enthalpy (heat content) of the refrigerant

B. The outdoor ambient temperature only

C. Compressor rotational speed in rpm

D. Water flow through the condenser

94. On a P-H diagram, the horizontal distance across the evaporator process represents the:

A. Refrigerating effect (heat absorbed per unit mass)

B. Heat of compression added by the compressor

C. Total heat rejected at the condenser

D. Pressure drop across the metering device

95. Volumetric efficiency of a reciprocating compressor decreases as the:

A. Suction pressure rises well above design

B. Discharge line is shortened significantly

C. Compression ratio (head/suction) increases

D. Oil level in the crankcase is raised

96. Compression ratio is calculated using:

A. Absolute discharge pressure divided by absolute suction pressure

B. Gauge discharge pressure minus gauge suction pressure

C. Suction temperature divided by discharge temperature

D. The motor amperage divided by the supply voltage

97. Converting 100 psig to absolute pressure (at sea level) gives approximately:

A. 86 psia after subtracting atmospheric pressure

B. 100 psia, because gauge and absolute are equal

C. 200 psia by doubling the gauge reading

D. 115 psia by adding ~14.7 psi atmospheric

98. A ton of refrigeration is equivalent to:

A. 1,000 BTU per hour of cooling capacity

B. 3.5 kW measured at the compressor input

C. 24,000 BTU per hour by international standard

D. 12,000 BTU per hour (3.517 kW) of heat removal

99. To remove 12,000 BTU/h at an evaporator, increasing the refrigerant mass flow while holding refrigerating effect constant will:

A. Decrease the total cooling capacity delivered

B. Increase the cooling capacity proportionally

C. Have no effect on capacity whatsoever

D. Reverse the direction of refrigerant flow

100. A latent heat process at the evaporator involves:

A. A temperature change with no change of state

B. A change of state (boiling) at constant temperature

C. Only a pressure rise across the compressor

D. Heat rejection to the outdoor condenser air

101. Sensible heat ratio (SHR) of a cooling coil is the ratio of:

A. Latent capacity to the compressor power input

B. Total capacity to the condenser heat rejection

C. Airflow in CFM to the refrigerant mass flow

D. Sensible capacity to total cooling capacity

102. A coil running a very low SHR (high latent removal) is best suited for:

A. A dry climate needing mostly temperature drop

B. Heating mode operation in a heat pump

C. Condenser duty rejecting sensible heat only

D. A humid space requiring significant moisture removal

103. Airflow that is too low across a cooling coil tends to cause:

A. A colder coil with possible icing and low SHR

B. Higher SHR with a warmer, drier coil surface

C. Increased capacity and lower compressor amps

D. The condenser to overheat from excess air

104. A duct traverse using a pitot tube and manometer is performed to determine:

A. The refrigerant subcooling at the condenser

B. Airflow velocity and volume in the duct

C. The compressor's volumetric efficiency

D. The electrical resistance of the heater bank

105. Total external static pressure (TESP) on an air handler is measured:

A. Inside the refrigerant suction line only

B. Across the supply and return connections of the unit

C. At the compressor discharge service valve

D. Only on the condenser side of the system

106. A variable-frequency drive (VFD) on a fan motor controls speed by varying the:

A. Mechanical belt tension on the drive sheaves

B. Resistance in series with the motor windings

C. Frequency (and voltage) supplied to the motor

D. Number of stator poles physically in the motor

107. A VFD set to ramp a pump motor reduces inrush current primarily by:

A. Adding a large start capacitor across the line

B. Switching the motor to direct-on-line start

C. Soft-starting via controlled frequency ramp-up

D. Increasing the supply voltage above nameplate

108. A building automation system (BAS) communicates with field controllers most commonly over:

A. A network protocol such as BACnet or Modbus

B. The refrigerant suction line as a signal path

C. The condensate drain piping network

D. The 120 V lighting circuit exclusively

109. A thermistor used as a temperature sensor changes its:

A. Electrical resistance in response to temperature

B. Physical length proportional to airflow

C. Capacitance in farads with humidity only

D. Color visibly as the temperature rises

110. A 4–20 mA control signal is used in HVAC controls because it:

A. Carries refrigerant pressure directly to the valve

B. Eliminates the need for any control transformer

C. Powers the compressor motor windings directly

D. Provides a noise-resistant analog signal with a live-zero

111. A demand-defrost control on a heat pump improves efficiency over time-initiated defrost by:

A. Initiating defrost only when frost actually accumulates

B. Defrosting on a fixed 30-minute timer regardless of frost

C. Disabling the auxiliary heat during every defrost

D. Reversing the compressor rotation each cycle

112. Proper refrigerant pipe sizing on the suction line must balance pressure drop against:

A. Adequate velocity to return oil to the compressor

B. The color coding of the cylinder used to charge

C. The control transformer's secondary voltage

D. The thermostat's anticipator resistance value

113. An oil trap (P-trap) at the bottom of a suction riser is installed to:

A. Drain condensate from the conditioned space

B. Regulate the condenser water flow rate

C. Increase the system's refrigerant charge limit

D. Collect and lift oil up the vertical riser

114. A double suction riser is used in systems with capacity control to:

A. Maintain oil-return velocity at both full and reduced load

B. Double the total refrigerant charge in the system

C. Eliminate the need for any oil separator

D. Reduce the condensing temperature in winter

115. An oil separator installed in the discharge line returns oil to the:

A. Liquid line ahead of the metering device

B. Evaporator outlet to raise superheat

C. Compressor crankcase to reduce oil circulation

D. Condenser inlet to improve heat rejection

116. Insulating the suction line on a refrigeration system prevents:

A. The refrigerant from condensing inside the line

B. Heat gain and surface condensation/sweating

C. Oil from returning to the compressor crankcase

D. The metering device from controlling superheat

117. A vapor barrier on suction-line insulation is critical because without it:

A. The refrigerant will overheat in the compressor

B. The condenser will reject too little heat

C. The metering device will lose its bulb charge

D. Moisture migrates in, wetting insulation and causing condensation

118. The refrigerant property that contributes to global warming is measured as its:

A. Specific heat capacity at constant pressure

B. Critical temperature in degrees Celsius

C. Molecular weight relative to dry air

D. Global Warming Potential (GWP) value

119. Under environmental regulations, intentionally venting most refrigerants to the atmosphere during service is:

A. Permitted if the quantity is below one kilogram

B. Prohibited; refrigerant must be recovered

C. Allowed only for HFC refrigerants outdoors

D. Encouraged to relieve system pressure quickly

120. A leak-detection program on large commercial systems is required mainly to:

A. Increase the system's design refrigerant charge

B. Minimize refrigerant emissions and ensure timely repair

C. Eliminate the need for any annual maintenance

D. Allow venting once the leak rate is documented

121. When decommissioning a system at end of life, the technician must first:

A. Cut the lines open to let pressure equalize quickly

B. Disconnect power and discard the unit to the landfill

C. Sell the unit charged for someone else to recover

D. Recover all refrigerant before any disassembly

122. A scenario requires choosing PPE for handling liquid refrigerant during charging. The most appropriate added protection is:

A. Safety glasses/goggles and gloves to prevent frostbite

B. A hard hat alone, since refrigerant is harmless to skin

C. Hearing protection only, because of compressor noise

D. A respirator rated solely for fine particulate dust

123. Refrigerant displacing oxygen in an enclosed mechanical room is a hazard primarily because it can cause:

A. A sudden increase in room humidity that fogs glasses

B. The refrigerant to freeze solid on the floor surface

C. A fire by reacting with the room lighting

D. Asphyxiation due to reduced available oxygen

124. A refrigerant monitor/alarm in a machinery room is required to:

A. Meter refrigerant into the chiller automatically

B. Replace the need for mechanical ventilation entirely

C. Detect refrigerant concentration and warn occupants

D. Control the chilled-water set point precisely

125. Before energizing a newly installed system, a final pre-start checklist should confirm:

A. The warranty card has been mailed to the factory

B. Proper charge, tight electrical connections, and correct rotation

C. The customer's payment has cleared the bank

D. The recovery cylinder is filled to 100% capacity

Practice Exam 15: Answer Key and Explanations

1. A — A WHMIS 2015 supplier label must carry the hazard pictogram(s), signal word, hazard/precautionary statements, product identifier, and supplier identifier. These standardized elements let any worker recognize the hazard before handling. For refrigerant cylinders like R-410A, this ensures consistent hazard communication across all Canadian workplaces.

2. C — Keeping the load close, bending the knees, and lifting with the leg muscles transfers force to the strong lower body and keeps the spine neutral. Bending at the waist or twisting concentrates load on the lumbar discs. Proper technique is the single most effective prevention against musculoskeletal injury.

3. D — The confined-space entry permit is the site-specific document that defines required atmospheric testing, ventilation, and rescue provisions before entry. It is mandatory under occupational health and safety regulations. It protects the worker by confirming the atmosphere is safe before anyone enters.

4. D — Correct procedure is to open the acetylene slightly and ignite it first, then add oxygen to adjust the flame, because lighting acetylene alone prevents a sooty, oxygen-rich ignition. Reversing the order risks flashback or an unstable flame. This sequence produces a controllable neutral brazing flame safely.

5. C — A serviceable run capacitor measured in microfarads should read at or very near its nameplate (rated) value. A reading far below rating indicates a weak capacitor and one near zero or open indicates failure. Verifying capacitance confirms the motor will get proper phase shift to start and run.

6. A — A sleeve or wedge masonry anchor rated for the load grips the concrete block reliably and resists pull-out. Wood screws, gypsum toggles, and friction nails are unsuited to masonry and will fail. Choosing a properly rated anchor ensures the disconnect stays securely mounted and safe.

7. A — Regulations require recording the type and quantity of refrigerant recovered and its disposition (reused, reclaimed, or disposed). This documentation supports environmental compliance and tracks ozone-depleting and high-GWP substances. Accurate records protect both the technician and the employer during inspections.

8. C — Silver-phosphorus (BCuP) alloys are self-fluxing on copper-to-copper joints because the phosphorus chemically reduces copper oxides during brazing. No separate flux is needed for copper-to-copper. Flux is only required when joining copper to dissimilar metals like brass or steel.

9. D — Flowing dry nitrogen through tubing during brazing displaces oxygen and prevents oxide (scale) formation inside the pipe. Loose scale would otherwise circulate and plug metering devices or filter-driers. Purging protects system cleanliness and long-term reliability.

10. A — On an R-134a P-T chart, roughly 47 psig corresponds to a saturation temperature of about 50°F (10°C). Matching pressure to saturation temperature lets a technician determine superheat and subcooling. Reading the chart correctly is fundamental to diagnosing charge and system performance.

11. B — The condenser rejects heat to the surroundings as high-pressure refrigerant vapor condenses to liquid. It sits downstream of the compressor discharge where refrigerant is hottest. Heat rejection here completes the transfer of heat absorbed in the evaporator out of the conditioned space.

12. C — Superheat is the number of degrees a vapor has been heated above its saturation temperature at a given pressure. It confirms the refrigerant leaving the evaporator is fully vapor, protecting the compressor from liquid. Measuring superheat is central to verifying proper evaporator feed.

13. A — High superheat with low capacity points to an underfeeding metering device or low charge, leaving part of the evaporator starved of refrigerant. A flooded coil would instead show low superheat. Correctly reading this symptom directs the technician toward charge or valve diagnosis.

14. C — Subcooling is measured on the liquid line by comparing actual liquid temperature to the saturation temperature for the high-side pressure. It confirms the refrigerant leaving the condenser is fully liquid. Proper subcooling ensures a solid liquid column feeds the metering device without flash gas.

15. B — R-410A is a near-azeotropic blend that must be removed from the cylinder as a liquid (inverted cylinder or through a metering device) to preserve its composition. Vapor charging can fractionate the blend. Liquid charging keeps the refrigerant mixture at its designed ratio.

16. A — The correct first step at a leaking flare is to verify the flare nut torque and reseat or remake the flare connection. Masking the leak with dye or extra charge ignores the root cause. A properly made and torqued flare restores a leak-free mechanical seal.

17. D — A heat pump that meters flow in both directions uses a bi-flow TXV or a piston with a check-valve arrangement so refrigerant feeds correctly in heating and cooling. A single fixed piston cannot serve both modes optimally. Bi-flow metering maintains proper feed as the cycle reverses.

18. D — Approach on a cooling tower is the difference between leaving water temperature and the entering air wet-bulb temperature. A small approach indicates an efficient tower. Monitoring approach helps diagnose tower performance and condenser water conditions.

19. B — A flooded chiller evaporator maintains its refrigerant level with a low-side float valve that admits liquid as it boils off. This keeps the tubes submerged for maximum heat transfer. The float continuously matches refrigerant feed to evaporator load.

20. C — A leaking discharge reed valve lets hot gas re-expand back into the cylinder, raising discharge temperature while reducing pumping capacity. The compressor works harder for less output. Recognizing this combination points to internal valve damage rather than a charge issue.

21. A — A scroll compressor running backward after phase reversal produces no pumping and an unusual noise until two supply legs are swapped. Scrolls are direction-sensitive. Correcting rotation immediately restores normal operation and prevents nuisance complaints.

22. C — Oil must be miscible with refrigerant so it travels through the system and returns to the compressor rather than logging in the evaporator or lines. Oil left stranded starves compressor bearings. Miscibility keeps lubrication circulating reliably.

23. C — POE oil is specified for R-410A because it is compatible and miscible with HFC refrigerants, unlike mineral oil. This miscibility ensures oil return. POE's chemistry matches HFC systems, supporting proper lubrication and oil circulation.

24. B — A significant temperature drop across a filter-drier signals a restriction creating a pressure drop, often from a plugged drier. The pressure drop produces the temperature difference. Replacing the restricted drier restores full liquid feed to the metering device.

25. D — Evacuation success is verified with a micron gauge confirming a deep vacuum (around 500 microns) that holds after the pump is isolated. Compound gauges lack the resolution. A holding deep vacuum proves the system is dry and leak-free before charging.

26. B — If the micron reading rises and then stabilizes at a mid-range value, remaining moisture is off-gassing (boiling) inside the system. A true leak would climb continuously toward atmosphere. Continued evacuation, sometimes with a nitrogen sweep, removes the moisture.

27. A — A measured 11.8 A balanced on all three legs against a 12 FLA nameplate is within normal operating range. Balanced current near but below FLA indicates a healthy motor under load. This reading requires no corrective action.

28. C — A PSC fan motor that hums and trips on overload but will not start almost always has a failed (open) run capacitor, which provides the phase shift needed to start. Without it, the motor stalls and overheats. Replacing the capacitor restores starting torque.

29. D — Power equals voltage times current: 240 V × 20 A = 4,800 W. For a resistive load the calculation is direct with no power-factor adjustment. Knowing the wattage lets the technician size circuits and verify heater performance.

30. A — Normally open auxiliary contacts on a contactor are used to provide an interlock or holding (seal-in) circuit that keeps the device energized after the initiating signal. They carry control current, not motor load. This logic maintains operation and coordinates equipment safely.

31. B — A 120 V primary with 0 V secondary indicates an open transformer winding or a blown secondary fuse. A healthy transformer would step the voltage down to 24 V. Loss of control voltage stops the system from responding to thermostat calls.

32. A — The defrost termination/fan-delay switch ends defrost and delays the outdoor fan based on coil temperature, preventing fans from blowing during defrost and stopping defrost once the coil clears. This optimizes the cycle. It saves energy and protects comfort.

33. C — If the reversing-valve solenoid is de-energized during heating, the system is wired so heating is the default (de-energized) position. Many heat pumps energize the solenoid for cooling. Knowing the wiring convention guides correct diagnosis of mode faults.

34. D — A low-pressure cutout protects against loss of charge or evaporator freeze-up by stopping the compressor when suction pressure falls too low. Low pressure signals insufficient refrigerant or airflow. This safety prevents compressor damage and coil icing.

35. A — Hot-gas bypass maintains evaporator pressure at light load by routing discharge gas into the low side, preventing the suction pressure from dropping too far. This avoids coil freeze-up and short-cycling. It provides smooth capacity control at part load.

36. D — An evaporator pressure regulator is installed in the suction line to maintain a minimum evaporator pressure, holding the coil temperature above a set point. It throttles suction flow. This keeps a case from running colder than its product requires.

37. D — EPR valves let different cases run at different temperatures on one shared suction group by holding each evaporator at its own minimum pressure. This allows a single compressor rack to serve mixed-temperature loads. It is common in supermarket refrigeration.

38. C — An electric defrost cycle must be terminated by time and/or temperature to limit how long the heaters run, preventing wasted energy and overheating. Continuous heating would ruin efficiency. Proper termination clears frost then promptly returns the coil to refrigeration.

39. D — Hot-gas defrost uses the system's own discharge gas to warm the coil from the inside, melting frost quickly without external heaters. It redirects hot refrigerant to the evaporator. This method is efficient because it reuses heat already in the system.

40. B — Winter head-pressure control maintains adequate high-side pressure so the metering device receives properly fed liquid. Without it, low ambient drops head pressure and starves the TXV. Maintaining pressure preserves capacity in cold weather.

41. D — Liquid floodback to a reciprocating compressor dilutes the oil and can wash bearings or hydraulically damage valves and rods. Liquid does not compress. Preventing floodback protects the compressor's mechanical integrity and lubrication.

42. D — A suction-line accumulator holds returning liquid and meters it back slowly as a vapor-and-oil mixture, protecting the compressor from slugging. It buffers floodback during transients and defrost. This safeguards the compressor on systems prone to liquid return.

43. C — A crankcase heater energizes during the off-cycle to drive refrigerant out of the oil, preventing migration and the resulting dilution and foaming at start-up. Warm oil holds less refrigerant. This protects bearings on the next compressor start.

44. A — A psychrometric chart plots dry-bulb temperature against humidity ratio/relative humidity, mapping the moisture content of air. It lets technicians evaluate sensible and latent conditions. The chart is the core tool for analyzing air-side performance.

45. D — Sensible heat changes the dry-bulb temperature of air with no change in moisture content. It is felt as a temperature change. Distinguishing sensible from latent heat is essential for load calculation and coil selection.

46. A — Total cooling load equals the sum of sensible heat plus latent heat removed from the air. Sensible lowers temperature; latent removes moisture. Combining both gives the true capacity an evaporator must deliver.

47. B — High static pressure with low airflow indicates a restriction such as a dirty filter, closed dampers, or undersized ductwork. The blower fights resistance and moves less air. Locating the restriction restores design airflow.

48. C — Residential cooling coils are commonly designed for about 400 CFM per ton. Too little airflow risks coil icing; too much reduces dehumidification. Verifying airflow per ton is key to proper system performance.

49. B — A water-source heat pump exchanges heat with a water loop through a coaxial or plate heat exchanger rather than an air coil. The loop absorbs or rejects heat as the season requires. This gives stable operation independent of outdoor air.

50. A — A glycol secondary loop transports cooling to remote loads while keeping the primary refrigerant charge small and contained. This limits leak risk and refrigerant inventory. Secondary loops are common in large or distributed refrigeration systems.

51. B — Refrigerant recovered from a burned-out hermetic compressor is contaminated with acid and byproducts and must be sent for reclamation or proper disposal, never reused. Reusing it would damage the replacement compressor. Proper handling protects the new equipment.

52. B — After a burnout, the cleanup installs suction-line acid-removing filter-driers and changes the oil to capture acids and contaminants. Reusing old oil reintroduces acid. This procedure protects the new compressor from premature failure.

53. A — A strong acid reaction on the system oil indicates a severe motor burn with acid contamination requiring full cleanup. Acid attacks windings, oil, and metal. Detecting it directs the technician to install acid-removing driers and replace oil.

54. B — A TXV's external equalizer connects to the suction line near the evaporator outlet so the valve senses true evaporator outlet pressure, compensating for coil pressure drop. This keeps superheat control accurate. External equalization is essential on coils with significant pressure drop.

55. C — A TXV that has lost its bulb charge cannot open and will close, starving the evaporator of refrigerant. The diaphragm loses the force that opens the valve. The result is low capacity and high superheat, signaling valve replacement.

56. C — A capillary-tube system is critically charged, meaning the refrigerant charge must be precise because over- or undercharging directly degrades performance. The fixed orifice cannot self-adjust. Exact charge is essential to capillary system operation.

57. B — Low-side and high-side floats are both liquid-level metering devices used in flooded systems to maintain proper refrigerant level. Each controls feed based on liquid level at its location. They keep flooded evaporators or receivers correctly charged.

58. C — A receiver stores liquid refrigerant and accommodates charge changes between operating conditions, ensuring a solid liquid supply to the metering device. It buffers the system during load swings. This stabilizes liquid feed across varying demand.

59. C — Steady bubbles in the liquid-line sight glass during stable operation indicate flash gas from low charge or a liquid-line restriction. Solid liquid should appear clear. Bubbles warn the technician of charge or restriction problems feeding the metering device.

60. B — A moisture-indicating sight glass changing from green to yellow signals excess moisture in the system, calling for a filter-drier change. Moisture causes acid formation and icing at the metering device. Acting on the indicator protects the system.

61. B — A manifold gauge set reads high-side pressure on one gauge and low-side (suction) pressure on the other for diagnosis. Comparing both pressures reveals system performance. These readings underpin nearly all refrigeration troubleshooting.

62. C — Evaporator superheat is found by comparing the suction-line temperature at the coil outlet to the saturation temperature corresponding to the measured suction pressure. The difference is the superheat. This confirms proper evaporator feed on a fixed-orifice system.

63. B — A frosted outdoor coil in heating that never clears points to a defrost control or reversing-valve fault preventing defrost. Ice blocks airflow and capacity collapses. Diagnosing the defrost circuit restores heating performance.

64. B — Auxiliary electric heat is energized on a second-stage call or during defrost to offset the cold air discharged while the outdoor coil defrosts. It supplements heat-pump capacity when needed. This maintains comfort during demanding conditions.

65. A — The balance point is the outdoor temperature at which heat-pump capacity equals the building's heat loss. Below it, supplemental heat is required. Knowing the balance point guides auxiliary heat sizing and system design.

66. C — Defrost that initiates too frequently usually stems from a faulty defrost sensor or an initiation control set incorrectly. Each unnecessary defrost wastes energy and disrupts heating. Correcting the sensor or settings restores efficient cycling.

67. D — During an ice machine's harvest cycle, hot gas warms the evaporator plate so the formed ice slab releases and drops. This is essentially a localized defrost. Hot-gas harvest frees the ice efficiently using the system's own heat.

68. B — A water-regulating valve modulates condenser water flow based on condensing (head) pressure, opening as head pressure rises. This holds head pressure stable and conserves water. It matches water flow to actual heat-rejection demand.

69. C — A cooling tower rejects heat from the condenser water to the atmosphere, primarily through evaporative cooling. It lowers the water temperature before return. The tower is the heat-rejection stage of a water-cooled system.

70. D — Scale inside a water-cooled condenser insulates the tubes, reducing heat transfer and raising head pressure. Higher head pressure lowers efficiency and stresses the compressor. Regular descaling restores proper condensing performance.

71. B — A water-side fouled brazed-plate heat exchanger transfers heat poorly, producing abnormal operating pressures and reduced capacity. Fouling acts as insulation. Cleaning restores heat transfer and normal pressures.

72. B — When brazing a service valve onto copper, protect it from overheating with a wet rag or heat sink to save the internal seals and seats. Excess heat warps or destroys soft components. This preserves valve function after installation.

73. D — A nitrogen strength test must be limited to the lower of the system design pressure or the weakest component's test limit. Exceeding it risks rupture. Respecting the limit verifies integrity safely without overstressing parts.

74. C — Oxygen must never be used for pressure testing because it can react explosively with oil and hydrocarbons under pressure. Nitrogen is inert and safe. Using oxygen creates a serious fire and explosion hazard.

75. B — Soap bubbles are well suited for locating a leak indicated under nitrogen pressure, showing the escape point visibly. They confirm and pinpoint a known pressurized leak. This simple method verifies leaks before repair.

76. A — A vacuum holding at 500 microns for 15 minutes after isolating the pump indicates the system is leak-free and dry, ready to charge. A rising reading would signal moisture or a leak. A stable deep vacuum confirms a clean evacuation.

77. C — Recovery proceeds faster when the recovery cylinder is cooler than the system and not overfilled, because the temperature/pressure difference drives refrigerant into the cylinder. Heating or overfilling slows recovery and is unsafe. Keeping the cylinder cool improves transfer.

78. D — A recovery cylinder must never be filled beyond about 80% of capacity to leave room for liquid expansion with temperature. Overfilling risks hydrostatic rupture. The 80% limit is a critical safety rule.

79. A — Refrigerant cylinders are color-coded mainly to help identify the refrigerant type for safe handling and to prevent cross-contamination. The color signals contents at a glance. Correct identification avoids mixing incompatible refrigerants.

80. C — R-22 is an HCFC being phased out under environmental regulations due to its ozone-depletion potential. It must be recovered, not vented. Recognizing R-22's status guides proper retrofit and handling decisions.

81. A — A cylinder of suspected mixed refrigerants must be sent for reclamation or proper disposal and never reused, because mixtures cannot be reliably recharged. Reusing them harms systems. Proper disposal prevents contamination and equipment damage.

82. D — A zeotropic blend like R-407C must be charged as a liquid to avoid fractionation, which would shift the blend's composition. Vapor charging removes components unevenly. Liquid charging preserves the designed mixture ratio.

83. B — Temperature glide is the range of temperatures over which a zeotropic blend changes state at constant pressure. The components boil and condense at different temperatures. Accounting for glide is necessary when calculating superheat and subcooling.

84. C — Zero subcooling on a TXV system with a receiver indicates low charge or flash gas in the liquid line, since a properly charged system shows measurable subcooling. The liquid is not fully condensed. This points the technician toward adding charge or finding a restriction.

85. C — Charging a fixed-orifice system by superheat means adding or removing charge until measured evaporator superheat matches the target for the operating conditions. Superheat is the charging benchmark. This method sets the correct charge without a sight glass.

86. C — A compressor tripping on its internal overload after minutes, with normal voltage and a clean condenser, suggests high discharge pressure or a mechanical/winding fault. The motor overheats from excess load. This directs diagnosis toward internal or high-side problems.

87. C — A start capacitor is rated for momentary, high-microfarad use to provide a strong starting boost, then drops out of the circuit. A run capacitor stays in continuously at lower capacitance. This distinction explains their different roles in motor starting.

88. B — A potential (voltage) relay removes the start capacitor once the motor reaches speed and back-EMF rises enough to open the relay contacts. The relay senses the increased voltage. Proper dropout protects the start capacitor from continuous duty.

89. A — A hard-start kit increases starting torque to help a compressor start under hard-starting conditions such as low voltage or high head pressure. It boosts the initial current to the start winding. This overcomes difficult starts without altering normal running.

90. D — Locked-rotor amperage with the compressor not turning indicates a mechanically seized or electrically faulted compressor. The motor draws stall current but cannot rotate. This reading typically condemns the compressor.

91. D — A phase-loss monitor shuts down a three-phase compressor when one phase is lost or voltages become unbalanced, preventing single-phasing damage. Single-phasing overheats windings rapidly. The monitor protects the motor from costly failure.

92. C — An electronic expansion valve controls superheat by modulating its orifice with a stepper motor driven by temperature and pressure sensors. It responds precisely and quickly to load changes. This electronic control improves efficiency over mechanical valves.

93. A — A pressure-enthalpy diagram plots pressure against enthalpy (heat content) of the refrigerant, mapping the entire refrigeration cycle. Each process appears as a line on the chart. It is the key tool for analyzing cycle performance.

94. A — On a P-H diagram, the horizontal distance across the evaporator represents the refrigerating effect — the heat absorbed per unit mass of refrigerant. A larger span means more cooling per pound. This value underlies capacity calculations.

95. C — Volumetric efficiency of a reciprocating compressor falls as the compression ratio (head over suction pressure) rises, because re-expansion of clearance gas reduces intake of fresh vapor. Higher ratios pump less. This links operating conditions to capacity loss.

96. A — Compression ratio equals absolute discharge pressure divided by absolute suction pressure. Both pressures must be converted to absolute before dividing. The ratio indicates how hard the compressor is working and predicts efficiency.

97. D — Adding atmospheric pressure (~14.7 psi) to 100 psig gives about 115 psia. Gauge pressure plus atmospheric equals absolute pressure. This conversion is needed for compression-ratio and saturation calculations.

98. D — One ton of refrigeration equals 12,000 BTU per hour (3.517 kW) of heat removal, derived from melting one ton of ice in 24 hours. It is the standard unit of cooling capacity. Knowing it lets a technician size and compare equipment.

99. B — Holding refrigerating effect constant while increasing refrigerant mass flow increases cooling capacity proportionally, since capacity equals mass flow times refrigerating effect. More mass moved means more heat absorbed. This relationship governs system capacity.

100. B — A latent heat process at the evaporator is a change of state (boiling) at constant temperature, absorbing heat as the refrigerant vaporizes. Temperature stays constant during the phase change. Latent heat absorption provides most of the cooling effect.

101. D — Sensible heat ratio is the ratio of sensible capacity to total cooling capacity. It describes how much of the coil's work lowers temperature versus removing moisture. SHR guides coil selection for a given climate and load.

102. D — A low SHR coil removes a large share of latent heat and suits a humid space requiring significant moisture removal. Low SHR means strong dehumidification. Matching SHR to the space ensures comfort and proper humidity control.

103. A — Low airflow across a cooling coil makes the coil colder, risking icing and producing a low SHR with heavy condensation. Less air dwells longer and cools further. Correcting airflow prevents freezing and restores balanced performance.

104. B — A pitot-tube traverse with a manometer measures airflow velocity and volume in a duct by sampling velocity pressure across the cross-section. Averaging the readings yields CFM. This is a standard method for verifying duct airflow.

105. B — Total external static pressure is measured across the supply and return connections of the air handler, capturing the resistance the blower must overcome. It reflects duct and filter restriction. TESP guides blower setup and diagnosis.

106. C — A VFD controls motor speed by varying the frequency (and proportionally the voltage) supplied to the motor. Changing frequency changes synchronous speed. This allows efficient, stepless speed control of fans and pumps.

107. C — A VFD reduces inrush current by soft-starting the motor through a controlled frequency ramp-up rather than applying full line voltage instantly. Gradual acceleration limits starting current. This reduces electrical and mechanical stress.

108. A — Building automation systems communicate with field controllers over network protocols such as BACnet or Modbus. These open protocols let devices from different makers exchange data. Standard communication enables integrated building control.

109. A — A thermistor changes its electrical resistance in response to temperature, allowing a controller to read temperature precisely. The resistance-temperature relationship is predictable. Thermistors are common, accurate sensors in HVAC controls.

110. D — A 4–20 mA signal provides a noise-resistant analog signal with a live-zero, so a broken wire (0 mA) is distinguishable from a true zero (4 mA). Current loops resist electrical interference. This makes 4–20 mA reliable for field control signals.

111. A — Demand-defrost initiates defrost only when frost actually accumulates, sensed by coil conditions, rather than on a fixed timer. This avoids unnecessary defrost cycles. It improves efficiency and heating comfort over time-initiated defrost.

112. A — Suction-line sizing must balance pressure drop against maintaining adequate velocity to return oil to the compressor. Too large a line slows oil return; too small a line wastes capacity. Correct sizing protects both efficiency and lubrication.

113. D — A P-trap at the bottom of a suction riser collects oil and uses refrigerant velocity to lift it up the vertical riser back toward the compressor. It ensures oil does not pool at the base. This protects compressor lubrication in tall risers.

114. A — A double suction riser maintains oil-return velocity at both full and reduced load by using a small riser at low load and both risers at full load. This keeps oil moving across the capacity range. It prevents oil logging in capacity-controlled systems.

115. C — A discharge-line oil separator returns captured oil to the compressor crankcase, reducing the amount of oil circulating through the system. Less circulating oil improves heat transfer in the coils. The separator protects compressor oil level.

116. B — Insulating the suction line prevents heat gain into the cold refrigerant and stops surface condensation (sweating) on the cold pipe. This preserves capacity and prevents water damage. Suction-line insulation is standard practice on cold lines.

117. D — Without a vapor barrier on suction-line insulation, moisture migrates into the insulation, wetting it and causing condensation that ruins its thermal value and drips. The barrier keeps moisture out. It is essential to long-term insulation performance.

118. D — A refrigerant's contribution to climate change is measured as its Global Warming Potential (GWP). GWP compares its warming effect to carbon dioxide. This value increasingly drives refrigerant selection and regulation.

119. B — Intentionally venting most refrigerants to the atmosphere during service is prohibited; refrigerant must be recovered. Venting harms the ozone layer and climate. Recovery is a legal and environmental requirement for technicians.

120. B — Leak-detection programs on large commercial systems exist to minimize refrigerant emissions and ensure leaks are repaired promptly. Early detection reduces environmental release and operating cost. These programs are often regulatory requirements.

121. D — When decommissioning a system, the technician must recover all refrigerant before any disassembly. Cutting lines first would vent refrigerant illegally. Recovery first protects the environment and complies with regulations.

122. A — Handling liquid refrigerant calls for safety glasses/goggles and gloves to prevent frostbite from contact, since liquid refrigerant flashes to very cold vapor. Eye and skin protection is essential. This PPE guards against cryogenic injury.

123. D — Refrigerant displacing oxygen in an enclosed room creates an asphyxiation hazard due to reduced available oxygen. Refrigerants are heavier than air and pool low. This is why mechanical rooms require ventilation and monitoring.

124. C — A refrigerant monitor/alarm detects refrigerant concentration in a machinery room and warns occupants before levels become dangerous. It triggers ventilation and alarms. This protects workers from asphyxiation and toxic exposure.

125. B — A final pre-start checklist confirms proper charge, tight electrical connections, and correct rotation before energizing the system. These checks prevent damage and ensure safe startup. Verifying them protects equipment and personnel on commissioning.