Technical Exam for New Applicants

Answers in **Blue**

Pre-employment Technical Exam

Directions: Please answer the questions to the best of your ability. There are questions of various types, some essay, some multiple choice, and some true-false. The exam starts with basic knowledge and moves into technical proficiency. You have four hours to complete the exam. If you have any questions, please feel free to ask.

1. What is a BTU?

**A British Thermal unit – A measure of heat energy.**

1. How many BTU’s are there in a nominal ton of cooling?

**A nominal 1 ton = 12,000 BTU’s**

1. Air Conditioning Systems involve five major components: A Thermostat, A Condenser, A Compressor, An Evaporator, and an Expansion Device. Using the correct terminology, describe how a residential air conditioning system operates?

**A call for heat is made by the thermostat, the thermostat is activated, either heating or cooling is brought on – in cooling – the compressor warms and starts, compressing refrigerant into the evaporator where it changes state, from liquid to a gas, transferring energy as air passes over evaporator removing heat from the air, sending cool air into the supply air duct system. After the refrigerant changes into gas in evaporator, it returns to compressor as a hot gas via the suction line.**

1. Refrigeration is based on the principles of evaporation and condensation. Please explain these principles and how they relate to heat transfer?

**Evaporation:Temperature heated over saturation point or dew point.**

**Condensation: Temperature cooled under saturation point or dew point.**

1. How is the furnace utilized when there is a call for air conditioning?

**The furnace is used an air handler by moving air across the evaporator coil and into the supply air system while drawing return air from the home back into the furnace for filtering and to be cycled again.**

1. Please explain how a heat pump system operates?

**A Heat pump will act just like an air conditioner in cooling mode, but in heating mode the check valves keep the refrigerant from bypassing the metering device, and the reversing valve will reverse its flow, allowing the refrigeration cycle in effect to operate the opposite direction of an air conditioner. The accumulator collects excess oil while in the heat mode.**

1. What makes a heat pump different than an air conditioner?

**Heat pump contains a suction line accumulator, reversing valve, check valves, and a defrost control, and an indoor unit with electric strip backup heat - all allowing the heat pump to utilize the reverse of the refrigeration cycle to provide heat to the home.**

1. What does the term CFM mean?

**Cubic feet per minute.**

1. Why do we need water drains on Air Conditioners?

**To remove the condensation from the coil.**

1. Why is airflow capacity critical to an air conditioners operation?

**Airflow allows the refrigerant to change state and create energy transfer to allow cooling to occur. Proper airflow keeps the evaporator coil from freezing up or icing.**

1. What methods can heat be transferred?

**Conduction**

**Convection**

**Radiation**

1. Use the following component terms to describe the operating cycle of a natural gas furnace. Thermostat, Gas Valve, Heat Exchanger, Ignition Device, Blower, and Fan & Limit Control?

**Thermostat calls for heat, air proving switch will be energized and checks pressure range for safe operation to occur, the ignition control is energized to open the pilot valve on the gas valve, the pilot flame lights testing the electrical circuit for main valve operation, once the ignition control receives back the electrical circuit from the pilot valve, the main valve opens and the furnace then ignites the main burners from the pilot. The heat exchanger will collect the heat, and as the heat builds in the heat exchanger, the safety limit will begin to sense the heat, at the preset factory temperature on low limit it will turn on the furnace blower. The blower will operate as long as the temperature at the thermostat is not satisfied. When the thermostat is satisfied, the system will shut off. The limit will also not allow the furnace to overheat to a factory preset high limit. If this high limit is reached, the limit control will shut down the main valve, and the blower will operate until the heat exchanger cools below the preset high limit.**

1. What is the difference between combustion air and cold air return?

**Combustion air is air used to feed the furnace combustion process, and we ultimately will jettison out of the home mixed with flue products from combustion. Cold air return is the air we return back to the home by the furnace blower. Cold air returns to the blower through our return air duct system to supply to blower with air to cycle back to the home.**

1. What does AFUE stand for?

**Annual Fuel Utilization Efficiency – it is the Department of Energy rating for furnaces.**

1. What are the average flue temperatures of the following furnace types:

60% AFUE **250 and above**

80 %AFUE **210-250**

93% AFUE **150-180**

1. Which furnace AFUE Range uses PVC pipe and why?

**88% AFUE and above commonly referred to as 90% AFUE plus, the combustion process produces contaminants during the burning process, which when cooled by the use of the blower circulating around the heart exchanger, the flue temperatures drop below the condensation range of 210 degrees, condensation occurs and these contaminants attack the vent system as part of the condensation occurring in the venting process. PVC is capable of withstanding these by-products including the acid that is produced when gas is burned.**

1. Which furnace AFUE range uses metal flue pipe and an inducer fan system?

**78% AFUE through 87% AFUE range - these products have much higher flue venting temperatures.**

1. What is the difference between a furnace and a boiler?

**A furnace uses air to heat the home, and a boiler uses water (Hydronic Heat) to heat the home by making steam and circulating the steam in a closed pipe system.**

1. Can air conditioning be added to a boiler system? Please explain?

**Not directly to a boiler, but Air Conditioning can be added to the system by adding an air handler and ductwork.**

1. What does a thermostat do?

**Controls the indoor comfort of the home- depending on the type of thermostat, it monitors the temperature, humidity, and the status of the home comfort system.**

1. What are the differences between a mechanical thermostat and an electronic setback thermostat?

**Mechanical stat uses a mercury switch to sense heat/cold and control the temperature.**

**A setback thermostat uses a digital thermister to sense and control temperature/humidity. The setback stat also can be programmed to keep a desired comfort level based on a computer program set by the occupant.**

1. What does a humidifier do and how and when it operates?

**Adds moisture to the supply air stream of a heating system. Operates during heating cycle. Depending on the type of humidifier, it simply allows water to be added into supply air stream changing from liquid to gas during the process.**

1. How does a media filter work?

**By trapping particulate matter in the media portion of the filter.**

1. How does an electronic filter work?

**Traps particulate through positively charged ion plates that attract the negatively charged particulate matter onto the plates.**

1. What does an air purification ultra violet germicidal light do and how does it operate?

**Uses UVC – Ultra Violet Light – in an always on mode, Either UV – “A”, “B”, or “C” which are different bandwidths of light to radiate organic compounds thereby sterilizing them and rendering them harmless. It can be mounted either in the supply or return, or even on the indoor evaporator coil.**

1. What is a HEPA filter system and how does it operate?

**Operates in the return air duct system, uses a very dense media to trap particulates down to .1 Microns.**

1. How do high efficiency furnaces (above 90 % AFUE) solve combustion air problems?

**Bring in the combustion air from the outside of the home in a precise amount through vent system.**

1. What is the condition called in a home when you see a black pattern around the perimeter of a home’s interior walls (shows up on carpeting), what causes this condition, and how do you remedy the condition?

**Ghosting – high indoor air pressure – which makes return air pull outdoor air - remedied by adding proper return air back to furnaces, and possibly adding outdoor air to the home for balance.**

1. Describe the steps you would use to wire the electrical power to a replacement outdoor condensing unit that will meet the national and local wiring codes?

**Use the data plate to determine the voltage, minimum and maximum amps, proper fuse size and gauge, wire UL approved water tight disconnect switch, conduit and fittings.**

1. Explain the differences between a single wall vent pipe and a double wall vent pipe?

**Single wall vent pipe is 1 layer of vent material. Double wall vent material contains an inner and an outer layer creating an inside air space between the two layers, effectively lowering the exterior layers temperature.**

1. What do you recommend for a furnace that is vented into a masonry chimney?

**A chimney liner to prevent any moisture from vent products condensation attacking the masonry chimney.**

1. Name the circumstances you may need to add additional refrigerant to an air conditioning system?
2. **Line set is longer than factory pre-charge will accommodate.**
3. **The system is leaking and you need to diagnose.**
4. **Adjusting the superheat at compressor.**
5. Describe the proper procedures for reclaiming refrigerant from an existing system?

**Use a properly approved EPA recovery machine, pump the refrigerant liquid and vapor from the system, into an approved tank – federal clean air act # 608.**

1. What heating and air conditioning equipment may require a drain to be installed?

**Any high efficiency furnace with flue temperatures dropping below 212 anywhere in the vent system.**

1. If there is no convenient floor drain, what can you do?

**Use a drain pump to nearest, or extend through a wall to exterior – refer to local codes.**

1. Why would it be necessary to relocate a thermostat?

**Improper location of thermostat will affect home comfort.**

1. Describe a good location for a thermostat and why?

**Inside hallway, no direct light. Never in kitchen or bathrooms, or laundry rooms.**

1. What could happen if you added another major natural gas appliance such as a fireplace insert, to the existing gas line?

**Gas pressure declines and becomes undersized to support the appliances.**

1. What is the solution to an undersized gas supply line?

**Increase the pipe size, or increase the gas pressure to proper water column rate based on fuel used.**

1. What is a potential relay and where is it used?

**Operates to drop out start capacitor and used in the circuit – operates on electromotive force.**

1. What type of tool would you use to test a capacitor?

**Ohm Meter.**

1. What is meant by the phrase, Locked Rotor Amps?

**Amp reading where motor is energized and rotor is locked. Refer to data plate on equipment.**

1. When referring to the low voltage wiring on a thermostat what do the following letters designate:

R\_\_\_\_\_\_\_\_\_\_\_\_\_W\_\_\_\_\_\_\_\_\_\_Y\_\_\_\_\_\_\_\_\_\_\_G\_\_\_\_\_\_\_\_\_\_\_\_\_T\_\_\_\_\_\_\_\_\_\_\_\_\_

**R=Voltage w=Heat y=Cooling g=Blower t=Thermister**

1. Why do you use a time delay relay in the control circuit of a residential condensing unit?

**Allows time for pressures to equalize.**

1. How many wires are used in a 120 volt power supply and name them?

**Line Voltage, Neutral, Ground**

1. What does the term temperature rise mean?

**The difference between the temperature at the plenum and the temperature at the return air**

1. What is the most common manifold gas pressure setting required on a standing pilot residential gas furnace?

**3” natural Gas, 13” propane – water column.**

1. What purpose does the limit control serve in a furnace?

**Regulates the furnace blower on and off as a safety control to maintain safe temperature ranges in furnace.**

1. When clocking a gas meter, what are you determining?

**Gas Leak**

1. What purpose does an isolation relay serve in a gas furnace that uses electronic ignition?

**Eliminates any feedback to the thermostat**

1. Why is an air-proving switch used on gas furnaces that utilize power vent systems?

**To maintain the safety for negative pressure range in case of a blocked flue or vent condition.**

1. What does super-heat refer too?

**Portion of heat that raises its temperature above saturation point corresponding to its pressure.**

1. What are the two primary causes of high head pressure in a refrigeration system?
2. **Blocked condenser coil .**
3. **Matter that will not condense in refrigerant system.**
4. What is a TEV and where is it found in a home comfort system?

**Thermostatic Expansion Valve and it is found on the liquid line before the evaporator coil, or a part of the manufactured evaporator coil and it meters the refrigerant flow.**

1. Where is the filter drier and what does it do?

**Found on the liquid line before the evaporator coil and it removes any moisture in the closed refrigerant system.**

1. How would you test the valves of a hermetic compressor in an air conditioner?

**Pump down the compressor to 500 microns and determine if it holds the vacuum.**

1. How would you determine if there was an internal electrical problem on a hermetic compressor?

**Short to ground or phase, or high Ohm readings.**

1. Name three areas of good customer service?

**Positive attitude, Friendly Demeanor, Smile, Educate the customer on repairs, Review Work, Arrive Timely.**

1. What do you consider to be your most important tool out of the following list?

Manifold Gauges Volt-Ohm Meter **Your Mouth** Micro-amp Meter Leak Detector?

1. What is the purpose of the crankcase heater in an air conditioning system?

**Heat the compressor to migrate liquid refrigerant out of compressor before start-up.**

1. You wish to identify start, run, and common terminals on a new single-phase compressor by measuring resistances. From terminal X to terminals Y, you read 1 ohm, from terminal Y to terminal Z you read 5 ohms; and from terminal X to terminal Z you read 4 ohms. On the basis of this data, which one of the following identification schemes is correct?
   1. X= Start Y = Run Z = Common
   2. X= Run Y = Common Z= Start
   3. **X = Common Y = Run Z = Start**
   4. X= Common Y = Start Z = Run
2. If a 220-volt source is applied to a load with a resistance of 100 ohms, how much current will flow in the circuit?
   1. 220 amperes
   2. .45 amps
   3. **2.2 amps**
   4. 45 amperes
3. When you are testing a capacitor with an ohmmeter, the meters needle goes to the low resistance end of the scale and then slowly returns to the high resistance end. Which of the following indicates the most probable condition of the capacitor?
   1. Bad
   2. Shorted
   3. **Good**
   4. Open
4. During a preventative maintenance check-up, you remove the indoor blower access panel to check the blower motor current and read 3.6 amps. The manufacturers data plate on the motor indicates 2.9 full load amps. Which one of the following would probably account for this finding?
   1. The blower wheel is too small
   2. **The access panel needs to be reinstalled.**
   3. The fan capacitor is open
   4. The voltage is too high
5. A temporary capacitance boost to start a single compressor should be applied:
   1. Directly across the R and C terminals on the compressor.
   2. Directly across the R and S terminal on the compressor
   3. Directly across the S and C terminals on the compressor
   4. **Directly across the existing run capacitor compressor connections.**
6. Resistance is measured in:
   1. Amperes
   2. Watts
   3. **Ohms**
   4. Volts
7. In an electrical circuit, the potential difference measured between to points in a circuit is called:
   1. **Amperage**
   2. Resistance
   3. Load
   4. Voltage
8. When additional loads are added to a parallel circuit, the current drawn from the power supply \_\_\_\_\_\_\_\_\_\_\_\_\_
   1. **Increases**
   2. Decreases
9. When capacitors are wired in parallel, the equivalent microfarad capacitance value is:
   1. **increased**
   2. decreased
   3. divided by two
   4. different for run and start capacitors
10. Power is measured in:
    1. **Watts**
    2. Volts
    3. Ohms
    4. Amperes
11. All three phase motors generally have \_\_\_\_\_\_\_\_\_\_\_\_\_starting torque?
    1. **High**
    2. Low
    3. Medium
    4. None
12. The run capacitor will be electrically connected to the compressor motor:
    1. **Terminal R & C**
    2. Terminal R & S
    3. Terminals S & C
    4. Terminals 2 & 5 on the potential relay
13. Which response best represents the direction of refrigerant flow in an operating cooling system?
    1. Evaporator coil, thermal expansion valve, and condenser coil
    2. Condenser coil, evaporator coil, and thermal expansion valve
    3. **Condenser coil, thermal expansion valve and evaporator coil.**
    4. Thermal expansion valve, condenser coil, and evaporator coil
14. Hot air will hold \_\_\_\_\_\_ moisture than cold air.
    1. **More**
    2. Less
15. A metering device \_\_\_\_\_\_ the pressure of a refrigerant.
    1. **Reduces**
    2. Increases
16. The generally accepted superheat range for a residential air conditioning expansion valves is:
    1. 3 to 5 degrees
    2. **8 to 15 degrees**
    3. 18 to 20 degrees
    4. 30 to 40 degrees
17. True or False? An increased load on the evaporator coil of an operating air conditioning unit will cause an increase in the suction pressure.
    1. **True**
    2. False
18. True or False? The cooling anticipator has current flowing through it when the thermostat is:
    1. **Calling**
    2. Satisfied
19. True or False? Compressor start windings have more resistance than the run windings.
    1. **True**
    2. False
20. If an evaporator is located above the compressor, the possibility is high for compressor damage due to:
    1. Oil migrating to the compressor during the running cycle
    2. **Liquid refrigerant draining to the compressor during the off cycle.**
    3. Excessive modulation of the expansion valve occurring during shutdown.
    4. Excessive increase in suction-gas pressure during the off cycle.
21. Heat transfer in a cooling system
    1. only takes place in the condenser coil
    2. only occurs when the thermostat is satisfied
    3. only takes place in the evaporator coil
    4. **only occurs from a high temperature region to a low temperature region.**
22. The most accurate method of charging an air conditioner is by:
    1. the approach method
    2. **weighing in the charge.**
    3. use of refrigeration gauges
    4. temperature split across the indoor coil
23. True or False? Slugging the compressor with liquid refrigerant is the primary cause of broken compressor valves.
    1. **True**
    2. False
24. A clogged distributor tube in an evaporator coil can be detected by:
    1. Measuring the superheat at the compressor
    2. **Determining which circuit of the coil I warmer than the rest.**
    3. Checking the suction accumulator for an accumulation of oil
    4. Checking the liquid sight glass for bubbles
25. At 240 volts the amperage of each 5 KW heat element in an electric warm air furnace is approximately?
    1. 5 amps
    2. 10 amps
    3. **20 amps**
    4. 40 amps
26. True or False? You should not make a high limit check on an electric warm air furnace.
    1. True
    2. **False**

1. The electric heat elements in an electric furnace cycle on and off in this order.
   1. 1, 2, and 3 on, 1, 2, and 3 off
   2. **1, 2, and 3 on, 3, 2, and 1 off.**
   3. 3, 2, and 1 on, 3, 2, and 1 off
   4. 3, 2, and 1 on, 1, 2, and 3 off
2. An electric furnace is controlled by a single stage thermostat. On a call for heat, all connected circuit’s function properly; however, the heat rise across the furnace is much lower than the design requirement. Which one of the following actions should the technician take to correct this problem?
   1. Install a two-stage thermostat.
   2. Reduce airflow through the furnace.
   3. **Increase airflow through the furnace.**
   4. Replace the dirty filter in the return air.
3. The Btu output of an electric resistance heater at rated voltage may be determined by multiplying the wattage by:
   1. 4.31
   2. 1.08
   3. **3.413**
   4. 3.1416
4. True or False: Always use high speed for cooling and the low speed for heating on a direct drive blower motor in an electric furnace.
   1. **True**
   2. False
5. A multi-stage electric furnace operates only on the first bank of heaters, even though you have just turned the thermostat all the way up. Which of the following is a possible cause for this condition?
   1. The second-stage heat anticipator is improperly adjusted
   2. **The time delay sequencer may not have been energized long enough to bring on additional stages.**
   3. The outdoor thermostat is in the closed position
   4. The thermostat may be improperly located
6. While performing a preventive maintenance check on an electric furnace, you need to determine the total kilowatt input to the furnace (the data plate is missing). Which of the following instruments would you use to determine the kilowatt input of the furnace?
   1. A voltmeter and a thermostat
   2. An ohmmeter and a voltmeter
   3. An ohmmeter and a ammeter
   4. **An ammeter and a voltmeter.**
7. An electric furnace has four (4) 5 KW heating elements that are rated at 240 volts. The available voltage at the job site to operate the furnace is 208 volts. What effect will this have on the Btu output of the furnace?
   1. It will not reduce the Btu output
   2. There will be no reduction of Btu output if the elements are connected in series
   3. There will be no reduction of Btu output if the elements are connected in parallel
   4. **It will reduce the Btu output of the furnace.**
8. With 240 volt, 60 Hz single phase power, a 5 KW electric heating element will draw how many amps and produce how many Btu’s.
   1. 10.8 amperes, and 9,250 Btu
   2. 15.9 amperes, and 19,576 Btu
   3. **20.8 amperes, and 17,080 Btu**
   4. 20.8 amperes, and 14,450 Btu
9. Knowing the temperature rise across the electric furnace, the supplied voltage to the furnace and the current draw (amperage) of the furnace, what can be determined?
   1. Combustion Efficiency
   2. S.E.E.R.
   3. **Airflow Volume (CFM)**
   4. A.F.U.E.
10. True or False? An electric furnace is generally considered to be 100 % energy efficient.
    1. **True**
    2. False
11. In an atmospheric gas burner, the presence of a yellow or orange flame indicates:
    1. Too much primary air
    2. The burner orifice is too small
    3. The manifold gas pressure is too high
    4. **Not enough primary air.**
12. The secondary or auxiliary limit switch is located:
    1. in the blower compartment of an upflow furnace
    2. in the heat exchanger area
    3. in the stack control
    4. **in the blower compartment of a down flow furnace.**
13. Temperature rise on a furnace is defined as:
    1. Temperature of supply air plus temperature of return air
    2. Temperature of outdoor air plus temperature of condenser coil
    3. Temperature of indoor air minus temperature of outdoor air
    4. **Temperature of supply air minus temperature of return air.**
14. On a spark ignition gas furnace, the spark ignites the pilot flame but continues to spark and the main gas valve will not open. Why?
    1. **flame rectification current is low or missing.**
    2. thermostat anticipation current too low
    3. gas valve stuck open
    4. limit switch open
15. On a service call, you notice the gas flame ignites in the venturi of the burner. What is probably the cause?
    1. gas pressure too high
    2. too much secondary air
    3. **gas pressure too low.**
    4. too much primary air
16. Flame impingement produces incomplete combustion in a natural gas furnace because:
    1. the flame is cooled below its ignition temperature
    2. **the secondary air is reduced.**
    3. the fuel supply is decreased
    4. the gas pressure is too high
17. The heat anticipator is in series with the main gas valve on a natural gas furnace, and therefore:
    1. is energized when the thermostat is satisfied
    2. anticipates when the thermostat will call for heat
    3. blows the fuse when the thermostat calls for heat
    4. **is energized when the thermostat calls for heat.**
18. Some spark ignition gas furnaces use flame rectification to prove the pilot flame. To check the micro-amp current value the pilot flame, connect the micro-amp meter in \_\_\_\_\_\_\_\_\_ with the pilot sensor.
    1. **Series**
    2. Parallel
19. In a condensing furnace, the burners cycle intermittently on the inducer-proving pressure switch. What is a possible cause of the problem?
    1. **Blockage or restriction in the combustion air or vent piping.**
    2. Flame rollout switch open.
    3. Inducer motor open.
    4. Open contacts in the pressure switch.
20. Which of these components provide the same function?
    1. fan switch and limit switch
    2. fan relay and limit switch
    3. **fusible link and flame rollout switch.**
    4. inducer motor and vent damper
21. What is a possible consequence of too low a temperature rise in a gas-fired condensing furnace?
    1. No adverse consequences.
    2. Furnace may overheat.
    3. Primary heat exchanger may corrode.
    4. **Condensation may form in the secondary heat exchanger.**
22. Flame rectification is a process by which:
    1. the burner flames are rectified for quieter operation.
    2. The pilot flame is rectified for quieter operation.
    3. **An electrical current passes through a flame.**
    4. A voltage is generated by a flame.
23. In a heat pump defrost cycle, the following components operate as indicated:
    1. Outdoor fan – off; reversing valve – heating position; indoor fan – on.
    2. Outdoor fan – on; reversing valve – cooling position; indoor fan – off
    3. Outdoor fan – off; reversing valve – cooling position; indoor fan – off
    4. **Outdoor fan – off; reversing valve – cooling position; indoor fan – on; auxiliary heat – on.**
24. The term “balance point” for a heat pump refers to the point where the:
    1. **heating capacity of the heat pump equals the heat loss of the structure.**
    2. heating capacity and cooling capacity of the heat pump are equal
    3. suction pressure and head pressure have equalized so the compressor can start
    4. amount of heat picked up by the outdoor coil equals the heat rejected by the indoor coil
25. Abnormally high heat pump suction pressure at the compressor in the heating and cooling cycles could indicate:
    1. **bad compressor valves or an internal leak in the reversing valve.**
    2. and external leak in the reversing valve or an undercharged system
    3. a restricted accumulator
    4. a stuck reversing valve
26. Refrigerant in a heat pump will condense in:
    1. the outdoor coil in the heating cycle and the indoor coil in the cooling cycle
    2. both the indoor and outdoor coils any time the compressor is running
    3. **the outdoor coil in the cooling cycle and the indoor coil in the heating cycle.**
    4. the outdoor coil in both the heating and the cooling cycle
27. Refrigerant migration to the compressor during the off cycle can be prevented by the use of:
    1. a reversing valve relay
    2. **a crankcase heater.**
    3. a de-ice control
    4. a check valve
28. In the heating season, if the heat pump’s indoor fan failed to operate while the thermostat was calling for heat, what would happen?
    1. the unit would operate in the cooling mode
    2. **the high pressure switch would open.**
    3. the low pressure switch would open
    4. the indoor coil would ice up
29. During the cooling cycle, in a heat pump with a piston-type metering device, the outdoor metering device will be in the:
    1. **bypass position**
    2. front-seated position
    3. neutral position
    4. metering position
30. In an air-to-air heat pump, the refrigerant will condense in:
    1. **the outdoor coil in the cooling cycle and the indoor coil in the heating cycle.**
    2. the outdoor coil in the heating and cooling cycles
    3. both the indoor and outdoor coils anytime the compressor is running
    4. the outdoor coil in the heating cycle and the indoor coil in the cooling cycle
31. On a routine heat pump service call, you note there are low superheat, high suction pressure and excessive sweating of the compressor. The unit is equipped with a TEV. The most likely problem is:
    1. the power element of the TEV has lost its charge
    2. **the sensing bulb on the suction line is loose.**
    3. the system has a slight overcharge of refrigerant
    4. the system has an undercharge of refrigerant
32. Which statement best describes heat pump operation?
    1. It is too cold to operate a heat pump in Alaska or Canada
    2. Heat pumps are only economically feasible in the southern parts of the United States
    3. **Heat pumps can extract heat from the outdoor air even if the temperature is below zero.**
    4. Heat pumps require no special installation considerations versus an air conditioner.
33. Which statement about heat pump compression ratio is correct?
    1. **Compression ratio is higher in cooling**
    2. Compression ratio is the same in heating and cooling
    3. Compression ratio is higher in heating
    4. The greater the difference between suction and discharge pressure, the lower the compression ratio.
34. You are called on to change a failed compressor in a heat pump. After you remove the failed compressor you notice it contains almost no oil. Further investigation reveals the accumulator is nearly full of oil. What does this indicate?
    1. The compressor discharged its oil into the accumulator.
    2. The accumulator is too small for the system
    3. The system was overcharged with oil.
    4. **The accumulator has an internal blockage.**
35. In an air cooled system with capacity control, compressor unloading will cause the :
    1. **suction pressure to rise and the discharge pressure to fall.**
    2. suction pressure to fall and energy consumption to decrease
    3. suction pressure and discharge pressure to fall
    4. discharge pressure to rise and energy consumption to decrease
36. Which of the following electrical components must a compressor non-recycling pump-down circuit contain?
    1. Liquid line solenoid valve, high pressure switch, compressor contacts, winding thermostats, and low pressure control
    2. **Control relay, low pressure switch, auxiliary compressor contacts, liquid line solenoid valve, compressor contactor, and temperature control.**
    3. High pressure control, condenser fan contacts, and compressor contacts control relay
    4. Compressor winding thermostat, control relay A, condenser fan contacts, and compressor contactor
37. The installation instructions of an air conditioning system call for trapping the suction line when the condenser is installed above the evaporator. Which of the following is the reason for doing this?
    1. To keep suction pressure from rising
    2. **To ensure oil return to the compress.**
    3. To maintain proper head pressure
    4. To provide for proper condensate drainage
38. On start-up, a newly installed 20-ton packaged roof top air conditioning unit is operating with a very high head pressure. Which one of the following situations is the most likely cause of the problem?
    1. **The condenser fan motor is running backwards.**
    2. The evaporator motor is not running
    3. The system is undercharged
    4. The expansion valve is stuck open
39. To operate properly, the duct system of a 7.5 ton packaged heat pump should be designed for a nominal airflow of:
    1. 1200 cfm
    2. **3000 cfm**
    3. 4000 cfm
    4. 7500 cfm
40. A common problem with restaurant units is their location near kitchen exhaust hoods. This could cause high discharge pressure in the cooling mode because the:
    1. air filters become plugged
    2. evaporator belts slip
    3. grease plugs the condensate line
    4. **grease plugs the condenser coil.**
41. A customer requests repair of a packaged rooftop air conditioner that uses R-22. The head pressure is 145 psig and the suction pressure is 120 psig. The compressor is hot; the discharge and suction lines at the compressor are extremely hot. Which of the following is the most likely cause for this malfunction:
    1. Restricted refrigerant flow
    2. Air in high side
    3. **A defective compressor valve.**
    4. A low refrigerant charge
42. You make a service call in answer to a complaint of little or no cooling from a roof top air conditioning unit. Upon checking pressures when the unit is running, you read 52 psig on the low side and 190 psig on the high side. The unit uses R-22. Superheat at the compressor is 0 degrees F. The problem most likely occurs because the:
    1. **evaporator coil is iced up.**
    2. unit is full of non-condensable agents
    3. unit is undercharged
    4. unit is overcharged
43. On a delta wound motor, the effective voltage on a 480 volt motor between terminals will be:
    1. 208 volts AC
    2. **240 volts AC**
    3. 277 volts AC
    4. 480 volts AC
44. In an economizer, an enthalpy control regulates the use of outdoor air on the basis of the air’s;
    1. **humidity and temperature**
    2. sensible heat
    3. latent heat
    4. return flow temperature
45. A packaged rooftop heat pump you are called to service will not defrost adequately. What is a common reason for this?
    1. **The time in defrost is too short.**
    2. Wind on the roof is retarding defrost.
    3. Compressor suction valves are broken
    4. Condensing coil is too big.
46. One advantage a semi-hermetic (serviceable hermetic) compressor has over a welded hermetic compressor is that:
    1. It is usually lighter and more compact.
    2. **The oil can be easily removed and replaced.**
    3. It does not require motor protection.
    4. It does not require a crankcase heater.
47. What percentage of CO2 should be in the flue gas of a properly adjusted oil furnace?
    1. 3to 5 %
    2. 5 to 8 %
    3. 8 to 10 %
    4. **10 to 13 %**
48. If you convert a two-line oil system to a one-line system and do not remove the internal bypass plug from the pump, what will result?
    1. **the furnace will be over fired.**
    2. the furnace will not get enough oil
    3. the seals in the oil pump will blow
    4. the primary control will not permit the furnace to operate.
49. A harsh white flame in an oil burner is an indication of?
    1. too little air
    2. **too much air**
    3. too little oil pressure
    4. too much oil pressure
50. The minimum draft over the fire should be?
    1. +0.02 water column
    2. +0.01 water column
    3. 0.00 water column
    4. **–0.01 water column**
51. True or False? If you install a larger nozzle in an oil furnace, you must raise the oil pressure to over 100 psig.
    1. True
    2. **False**
52. If an oil furnace is firing and the Cad cell is disconnected, what will happen?
    1. burner will shut down
    2. **burner will operate for 30 to 90 seconds, then shut down.**
    3. will have no effect
    4. blower will shut down
53. A high vacuum reading in the oil supply line indicates:
    1. the oil tank is full
    2. there is no oil in the tank
    3. **a restriction in the oil line.**
    4. the oil line has an air leak in it
54. The barometric damper, or draft control in an oil furnace is:
    1. a temperature device
    2. **a pressure sensitive device.**
    3. a light sensitive device
    4. a thermal overload
55. When installing an oil fired heating unit that is located significantly higher than the oil storage tank, the technician should use a:
    1. **two-stage oil pump and a two-pipe system.**
    2. two-stage oil pump and a single-pipe system
    3. single-stage oil pump and a single-pipe system
    4. single-stage oil pump and a two-pipe system
56. True or False? In northern climates where temperatures are consistently below freezing, No. 2 fuel oil is the best choice if the customer has an outdoor fuel storage tank.
    1. **True**
    2. False