



Summer – 16 EXAMINATION Model Answer

Subject Code: 17620

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Important instructions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more importance.
4) While assessing figures, examiner may give credit for principal components indicated in the figure.
5) Credits may be given step wise for numerical problems.
6) In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Table with 2 columns: Question/Marks and Answer. Row 1: 1. a) Attempt any THREE of the following : (12 marks). Row 2: i) Define radiation and evaporation with one example each. (04 marks). Row 3: Answer: Definition - 1 mark each, example - 1 mark each. Includes sub-questions 1. Radiation heat transfer: (1 mark), 2. Evaporation: (1 mark) with definitions and examples. Row 4: ii) Explain with neat sketch core section. (04 marks). Row 5: Answer: Core Section: Includes a schematic diagram of a core section with labels: HEATER CORE, EVAPATOR CORE, AIR IN, AIR OUT, BLEND DOOR. Fig:- Core Section

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b) Attempt any **ONE** of the following :

06

i) Explain the following terms in human comfort control.

06

- 1) Effects of humidity
- 2) Wind chill factor
- 3) Comfort zone

Answer:

1. Effects of humidity:-

Moisture in the air is measured in terms of humidity. Relative Humidity (RH) is the ratio of amount of water vapor in the air to the amount of water vapor in the air at specific temperature and pressure.

2

The control of humidity is not only necessary for human comfort but it is also important from point of view of efficiency of driver. For human comfort, relative humidity is kept within a range of 35% to 60%. A RH more than 60% will lead to sweating, while a RH below 35% will cause dry sensation and affect the mucous membranes, leading to extreme discomfort.

2. Wind Chill factor:

Wind chill is not a measure of temperature, it is a measure of comfort due to the rate of cooling. It has no impact on the actual temperature for the purpose of physical things like water freezing. Though wind in conjunction with cold air will increase the speed at which warm objects cool down, the number associated with wind chill is not related to this.

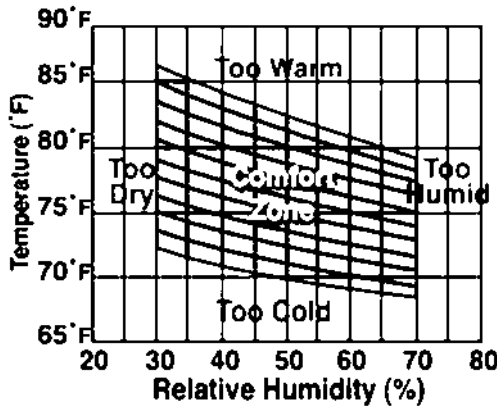
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The wind chill factor (WCF) is measure of the effect of air temperature and wind speed on human comfort and safety.

3. Comfort Zone:-

There is a range of combined temperatures and humidities that provides comfort to most people. This Comfort Zone Chart shows "Indoor Air Temperature" on the vertical axis, "Relative Humidity" on the horizontal axis, and a shaded area known as the "Comfort Zone."

2



ii) Explain construction and working of vacuum restrictor with neat sketch.

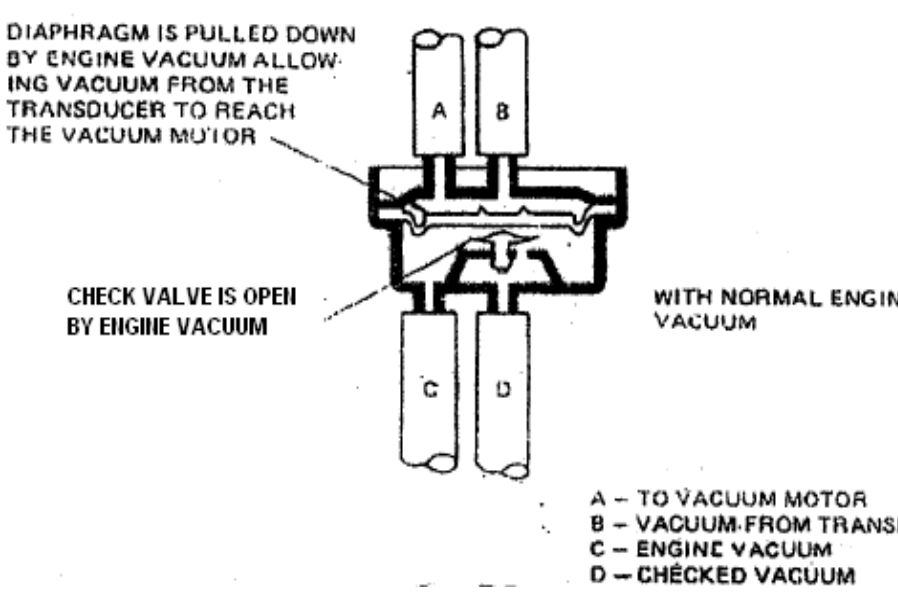
06

Answer: Vacuum restrictor:

Construction: Restrictor has a small orifice which sometimes becomes clogged with lint or other airborne debris. Vacuum restrictor is located in the vacuum line between the reserve tank and the vacuum source. Vacuum restrictor is opened whenever manifold vacuum is greater than reserve vacuum. In this position the vacuum restrictor connects the source the tank. The normal engine vacuum also opens the diaphragm & allows vacuum from control to reach the vacuum motor.

2



<p>DIAPHRAGM IS PULLED DOWN BY ENGINE VACUUM ALLOWING VACUUM FROM THE TRANSDUCER TO REACH THE VACUUM MOTOR</p>  <p>CHECK VALVE IS OPEN BY ENGINE VACUUM</p> <p>WITH NORMAL ENGIN VACUUM</p> <p>A – TO VACUUM MOTOR B – VACUUM FROM TRANSI C – ENGINE VACUUM D – CHECKED VACUUM</p> <p>Working: Whenever the manifold vacuum drops below the valve of reserve vacuum the vacuum restrictor closes valve the diaphragm also close and blocks the passage of from control motor. As a result reserve vacuum is not lost because it is not allowed to bleed back through the manifold. The manifold vacuum drops during the period of acceleration and when the engine is stopped. The vacuum reserve is used to operate the air conditioning system vacuum components and other accessory equipment in the automobile such as headlamp, doors, door locks likewise.</p>	2
2. Attempt any FOUR of the following	16
a) List requirements of HVAC for heavy goods vehicle.	04
Answer: Requirements of HVAC in heavy goods vehicles.	
<ol style="list-style-type: none">1. In Heavy goods vehicle, Ac system consume significant amount of engine power by the compressor so power consumption should be as less as possible so that it should not affect fuel efficiency of vehicle that much2. Less power consumption & less load on engine does not affect acceleration of vehicle during this period HVAC system should maintain proper temperature inside goods compartment3. In goods compartment there should be equal circulation of air among all compartment4. Noise & vibration of system should be as less as possible	4
b) Explain with neat sketch rotary vane air cycle system.	04
Answer: Rotary vane air cycle system:	
The compressor of ROVAC system is called circulator. The condenser is called primary heat exchanger. The collector in the system serves in similar manner as an accumulator in conventional system. It separates liquid (hydrocarbon) from vapour (air). Unlike accumulator however the liquid is retained in the collector & is not metered back into the system. A small amount of oil circulates in the system at all times to provide lubrication for the circulator. Other liquid comprised of & hydrocarbons are vaporized in secondary heat exchanger as it pick up heat. Conversely this vapour changed back to the liquid in primary heat exchanger as its heat is given up to the outside air.	2

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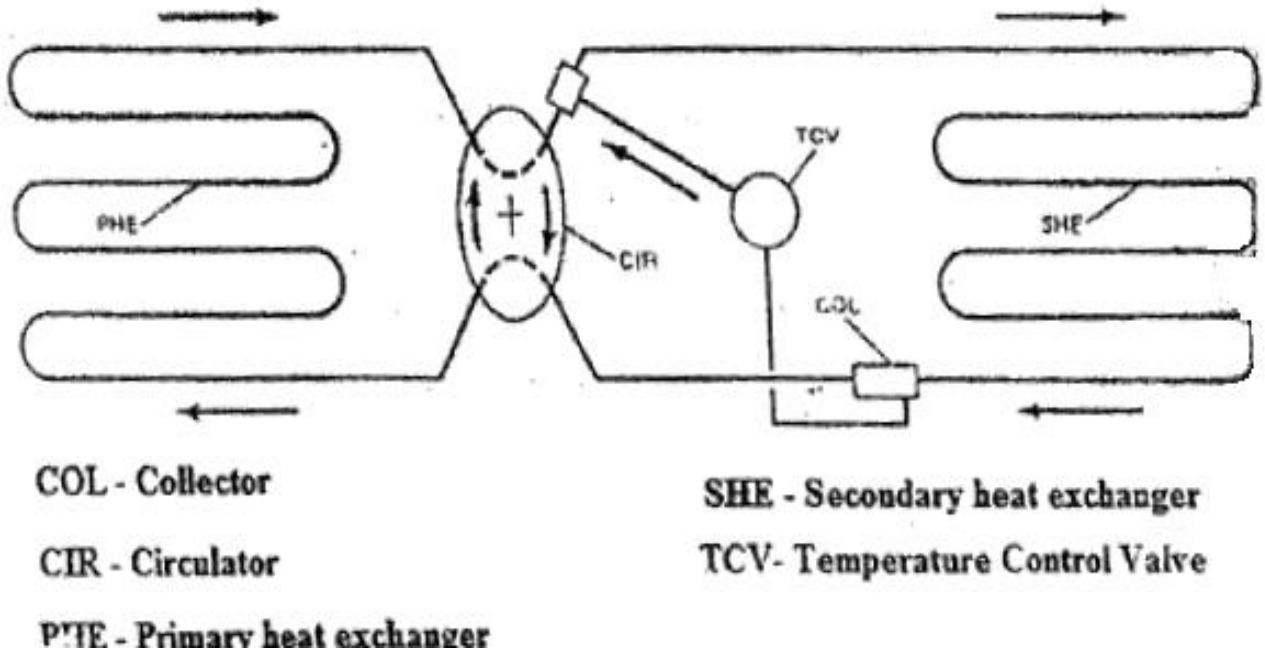


Figure: Rotary vane air cycle system

2

c) Explain concept of blower clutch control with neat sketch.

04

Answer: Blower Clutch Control:

The means used to convert low current signals from control panel to high current feed to the blower motor. Blower speeds with this control are infinitely variable. The speed is controlled through a resistor strip on temperature door actuator. The resistor strip then functions same as rheostat to input data to the control panel. The control panel in turn inputs the blower speed signal to the blower control.

A power transistor circuit is included in blower control which functions to engage compressor clutch circuit. The metal strip on which transistor is mounted serves as heat sink. This assembly is located in the blower air stream to aid in heat dissipation.

4

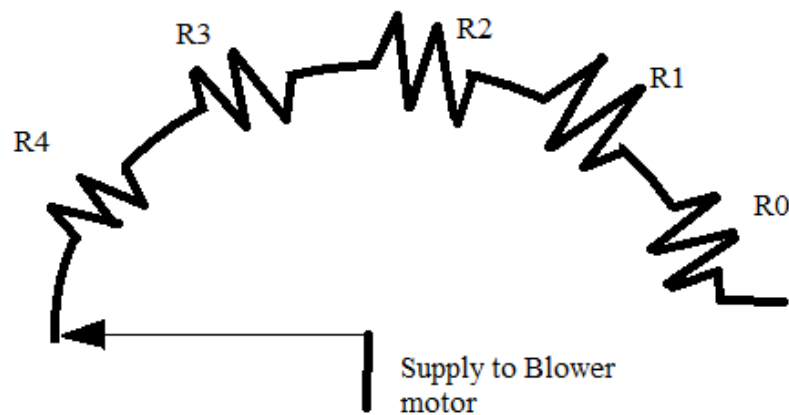


Fig :- Blower Clutch Controls

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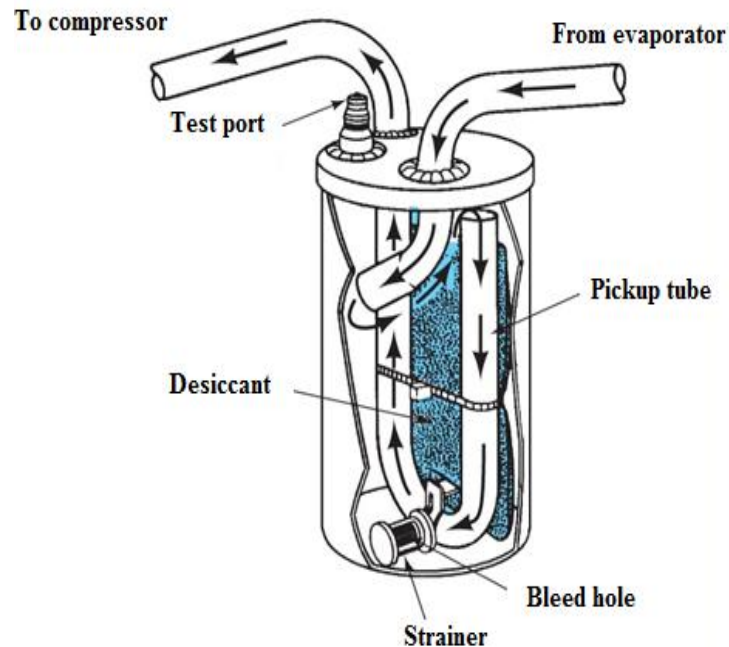


Figure: Accumulator

2

b) Describe construction and working of sun load sensor.

04

Answer: Sun load sensor:

Construction: The sun load sensor is a photochemical diode (PCD) located on top of the dashboard. This sensor send signal to the electrical climate control module (ECCM) indicating the strength of the sunlight (sun load) which influences the vehicle interior temperature.

2

Working: If the sun load is high as signaled by the sun load sensor the ECCM will activate the highest lower fan speed and max cooling to compensate for this additional radiated heat load. Likewise if the sun load is low (cloud cover) as sensed by the sun load sensor the ECCM will reduced the blower fan speed and the system will not operate at max cooling.

2

c) List four properties of refrigerant.

04

Answer: Properties: (Any four)

1. It should have low boiling point.
2. It should be above atmospheric pressure.
3. It should have high latent heat of vaporization
4. Toxicity should be low.
5. It should be corrosive.
6. It should not be inflammable.
7. It should be stable in nature.
8. It should have low viscosity.
9. It should have high thermal conductivity.
10. It should be easy and safe to handle.
11. It should be easily available at low cost.

4



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OR

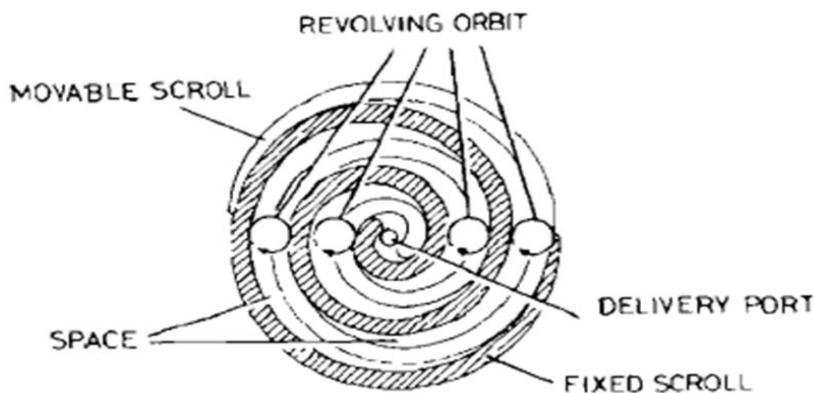


Figure: Scroll compressor

Working:

Scroll-type compressors have two metal scrolls, one fixed and one moveable, which provide an eccentric motion. As the compressor shaft rotates, an eccentric bushing on the shaft drives the moveable scroll, and refrigerant is forced against the fixed scroll, and towards its center. The motion creates an increase in pressure toward the center of the scroll. The refrigerant vapor moves in a circular pattern, and its pressure is increased as it moves toward the center of the scroll. The high pressure refrigerant is released through a delivery port located at the center of the scroll. Scroll-type compressors provide a longer effective compression stroke, and a smoother start-up than other compressor designs, and they produce less vibration.

1

4. a) Attempt any **THREE** of the following:

12

i) Compare controlled and uncontrolled ventilation with any four aspects.

04

Answer: Comparison of controlled and uncontrolled ventilation (*Any four*)

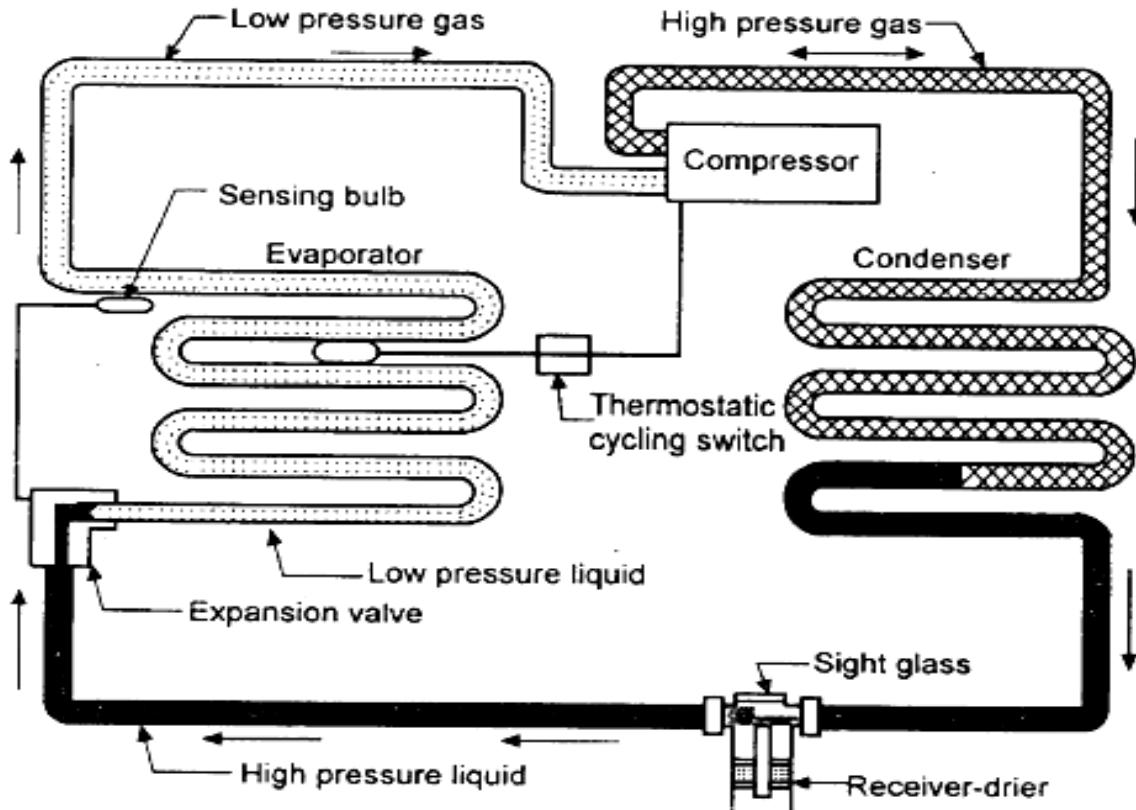
Sr.	Controlled Ventilation	Uncontrolled Ventilation
01	Forward movement of car and blower motor forces or rams air through the ducts and into the car.	Uncontrolled ventilation occurs when anyone opens window so that air can enter.
02	The air from outside enters the vehicle through openings in front grill.	The air from outside enters the vehicle through window.
03	This system does not provides any quantity of fresh air quickly	This system provides any quantity of fresh air quickly
04	This system does not allow wind, rain, dust and other airborne particles to enter inside the vehicle.	This system allows wind, rain, dust and other airborne particles to enter inside the vehicle.
05	Currently this method of ventilation is used in vehicles.	This method has been used for years
06	The entry of air is controlled by suitable valves or doors.	The entry of air is not controlled by suitable valves or doors.
07	This system includes heater and air conditioning system	This system does not include heater and air conditioner system.

4

ii) Draw neat and labeled layout of automobile air conditioning system.

04

Answer: Layout of automobile air conditioning system: (*Layout with correct labels – 4 marks*)



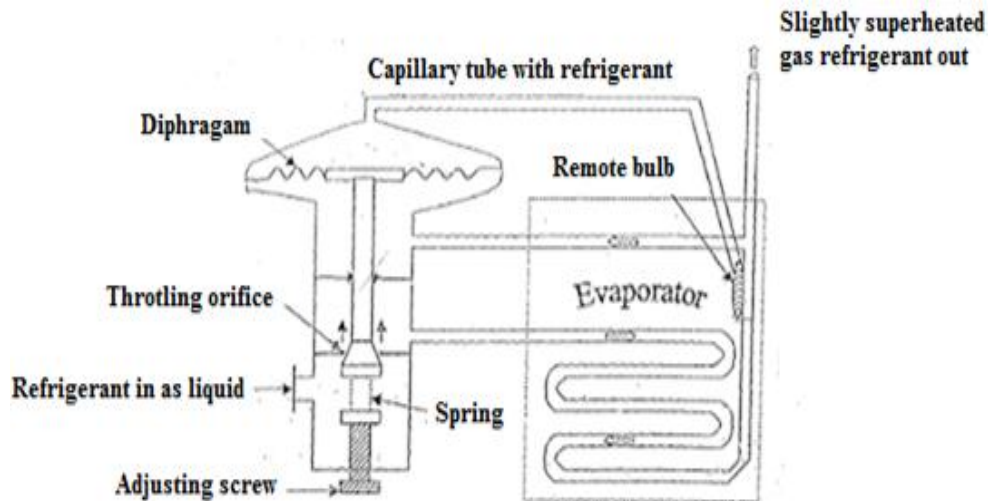
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Figure: General layout of automotive A/c System

iii) Explain the working of externally equalized thermostatic expansion valve with neat sketch.

04

Answer: Working of externally equalized thermostatic expansion valve:



2

Figure: Externally equalized thermostatic expansion valve



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<p>Any increase in refrigerant temperature at the evaporator outlet increases the pressure in the remote bulb and tube system. This in turn exerts a downward pressure on the diaphragm. This downward pressure on diaphragm is greater than combination of the evaporator pressure and the superheat spring pressure. As a result, the valve will open. Similarly, a decrease in refrigerant temperature decreases the pressure in the remote bulb and tube system. This decreases the pressure on the diaphragm and this pressure is less than combination of the evaporator pressure and the superheat spring pressure and allowing the valve to close. Externally equalized expansion valves have a line connected to the outlet side of the evaporator and refrigerant pressure passes through this line to push against the underside of the diaphragm</p>	2
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<p>iv) Distinguish between manual climate control and electronic climate control system (any four points)</p>	04
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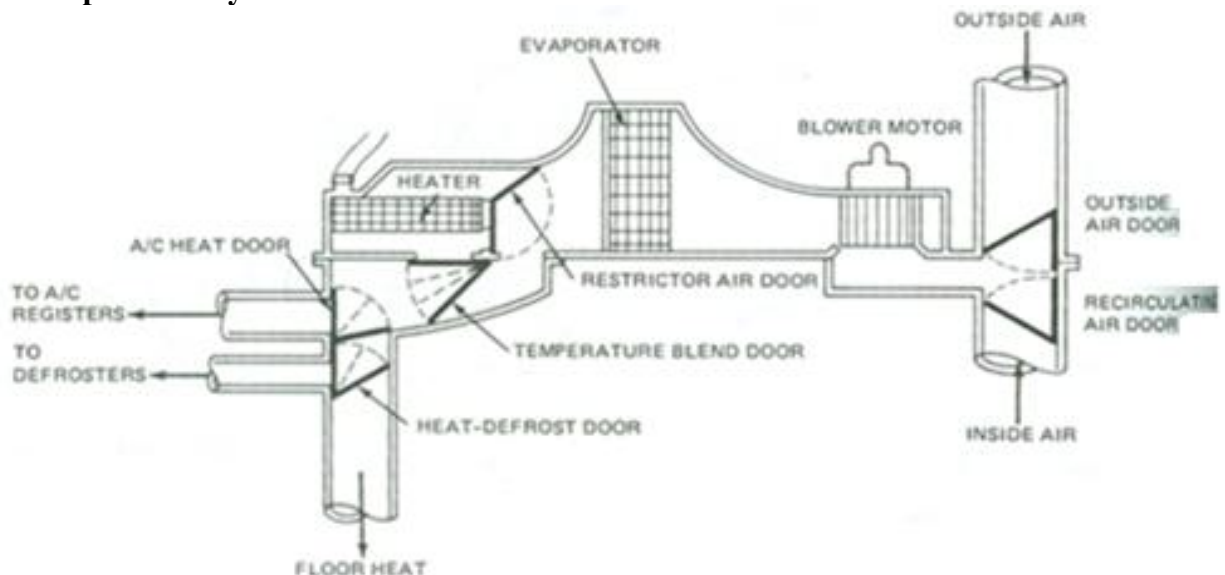
Answer: (Any four points each carry 1 mark)

Sr.	Manual climate control system	Electronic climate control system
01	It is also called manual temperature control system	It is also called automatic temperature control system
02	It does not use an electronic control unit to monitor the vehicles interior temperature.	This system uses an electronic control unit to monitor the vehicles interior temperature.
03	It does not use an electronic control unit to adjust the vehicles interior temperature.	This system uses an electronic control unit to d adjust the vehicles interior temperature.
04	The system does not have the ability to maintain vehicle comfort settings throughout a variety of conditions	The system has the ability to maintain vehicle comfort settings throughout a variety of conditions
05	Sensors are not used in this system	Different sensors are used in this system
06	Maintenance cost is low.	Maintenance cost is high.

b) Attempt any **ONE** of the following:

i) Explain with neat sketch construction and working of split case system.

Answer: Split Case System:





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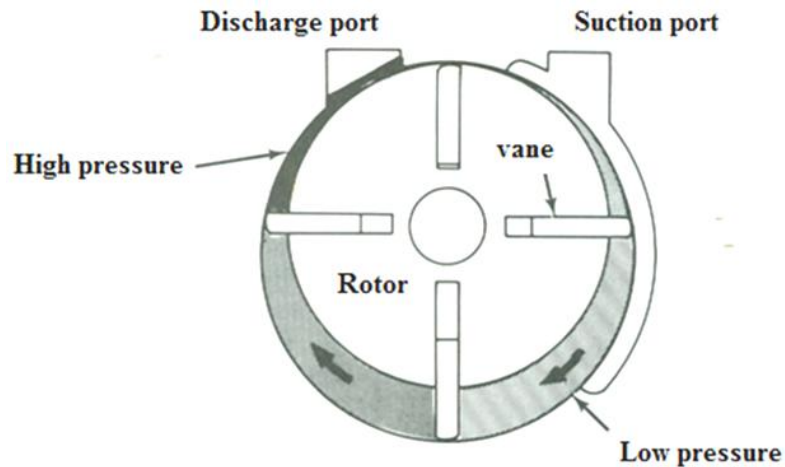
blower speed.

12. Open low side gauge valve which will admit refrigerant into the system.
13. Charge until proper weight of refrigerant has been added and sight glass clears. Close low pressure gauge valve.
14. Charge is complete and vehicle should be returned to idle speed and turned OFF.
15. Remove gauge set carefully
16. Install protective caps on valves.
17. As final check use the leak detector and check for leaks.

b) Draw a neat labelled sketch of rotary vane compressor.

04

Answer: Sketch with correct labeling- 4 marks



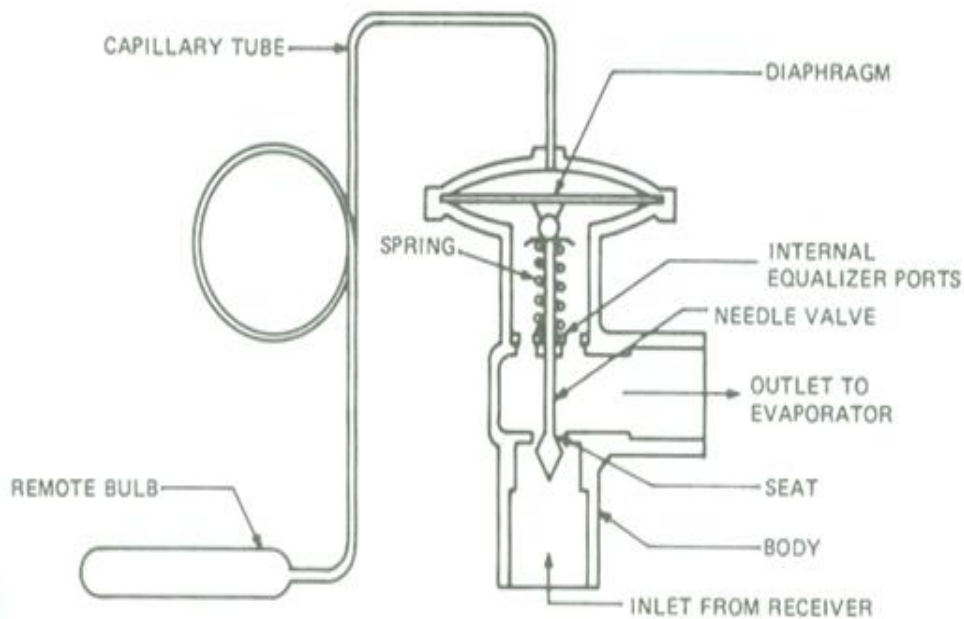
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Figure: Rotary vane type compressor

c) Draw and labelled the components of thermostatic expansion valve.

04

Answer :



4

Figure Thermostatic Expansion Valve

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d) Explain the concepts of time delay relay with neat sketch.

04

Answer: Concepts of time delay relay:

The time delay control unit is designed to prevent the heat cycle from coming on in the automatic unit until the engine coolant has reached temperature of 43.34°C . The unit consists of two resistors, capacitors, and transistors. Following figure shows time delay circuit of the wiring diagram.

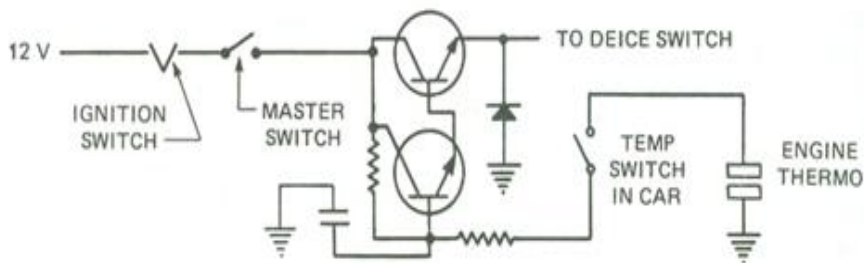


Figure: Time delay relay

2

2

e) State the causes and remedies for following faults in compressor:

04

- i) Noise in compressor
- ii) Compressor not working.

Answer :

Fault	Causes	Remedies
Noise in compressor	Loose Components	Tightening
	Lack of oil	Replenish the oil level and check the bearings
	Piston	Check debris on piston
	Loose floor mounting	Tightening of bolts
Compressor not working	Broken belt	Replace belt
	Broken clutch wire	Repair wire
	Bad thermostat	Repair thermostat
	Bad clutch coil	Repair

2

2

f) Write procedure of Freon leak detector test.

04

Answer: Leak Test Procedure:

1. Install the gauges and gauge manifold. Note the pressure and temperature in the beginning.
2. Close the manifold valves A and B.
3. Now attach the refrigerant cylinder at the centre of the gauge manifold. Do not open the refrigerant cylinder valves. Do not operate compressor.
4. Start halide/freon leak detector.
5. Now open the refrigerant cylinder valve.
6. Open gauge manifold valves A and B slowly raising the pressure to about 1.75kgf/cm^2 .
7. Check the leaks with torch. Any leak detected should be repaired properly.
8. Raise the system pressure to about 3.75kgf/cm^2 and check leaks at every joint and surface. If any leak is found place should be repaired immediately.
9. Now, raise the pressure to about 5.0kgf/cm^2 in the gauges and check the leaks in the system at various joints, surfaces and repair the leaks.
10. If the flame colour is blue, there is no leak, if the flame colour is yellow-green the leak is small, if the flame colour is bright blue purple the leak is large. If the leakage is severe, the flame is put out.

4

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c) Explain construction and working of typical vacuum system.

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Answer : Construction and working of typical vacuum system:

The various components used in vacuum system are reserve tank, check valve, vacuum pump and vacuum motor. Connection for evacuation of system is shown in figure. Whenever opened, a/c system must be evacuated by using a vacuum pump. Connect low and high charging hoses of manifold gauge set respectively as follows-

2

- High charging hose → Compressor delivery hose.
- Low charging hose → Compressor suction hose.

Attach central charging hose of manifold gauge set to vacuum pump. Operate vacuum pump and then open suction side valve of manifold gauge set. If there is no blockage in the system, there will be an indication on high pressure gauge. When this occurs, open the other side valve of the set.

Approximately 10 minute later, low pressure gauge should show a vacuum lower than 760 mm of Hg providing no leakage exists. Evacuation should be carried out for a total of at least 15 minutes. Continue evacuation until low pressure gauge indicates vacuum less than 760mm of Hg and then close both the valves. Stop vacuum pump, disconnect central charging hose from pump inlet. Now the system is ready for charging refrigerant.

2

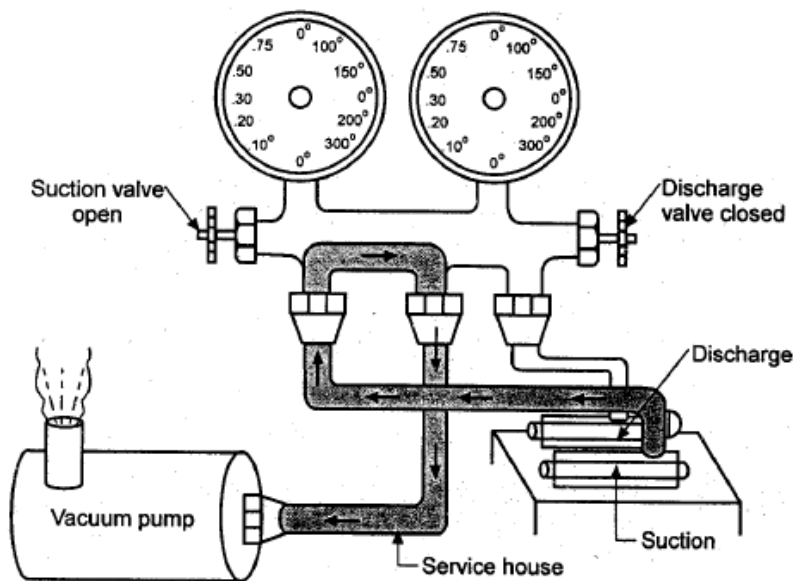


Figure: Typical Vacuum system.

d) Explain the construction of system hoses.

04

Answer: Construction of System hoses: Features of System hoses include:

- Standard 870 psi working pressure, 3600 psi burst pressure making the System hoses good for all refrigerants including R410A
- Eight sided crimp ensures maximum hose life.
- Knurled brass nut for easy finger tightening.
- Multiple lengths available.
- Color coded for convenience.
- Available in packs of 3 (one red, one yellow and one blue hose) or individually

2

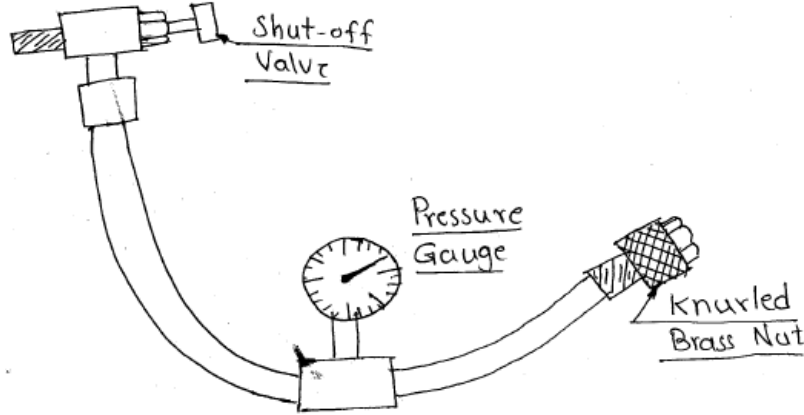


Figure: System hose

2

e) Explain with neat sketch superheat switch along with its location.

04

Answer :

Location: The superheat switch is located in the rear head of some six cylinder compressors.

1

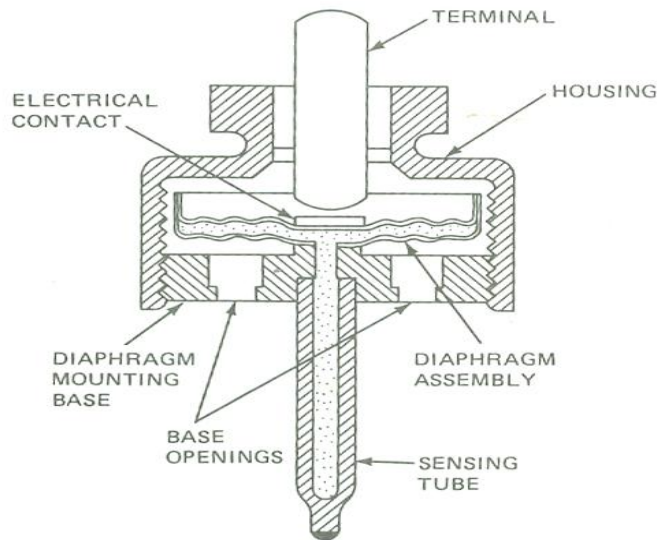


Figure: Superheat switch

2

This device is a temperature/pressure sensitive electrical switch which is normally in the open position. The switch remains open during the system high pressure and high temperature conditions or low pressure and low temperature conditions. The switch closes when the system experiences high temperature and low pressure conditions. The high temperature and low pressure condition of the system is usually caused by loss of refrigerant. This loss may result in compressor or system damage if air conditioning system remains in operation.

1

The superheat switch offers a failsafe method of stopping the compressor until the problem is corrected. When superheat switch closes, a circuit is completed through a heater or thermal fuse. The fuse blows, opens the clutch circuit and stops the compressor.