WINTER– 18 EXAMINATION

Subject Name: REFRIGERATION AND AIRCONDITIONING **Model Answer** Subject Code: 17612

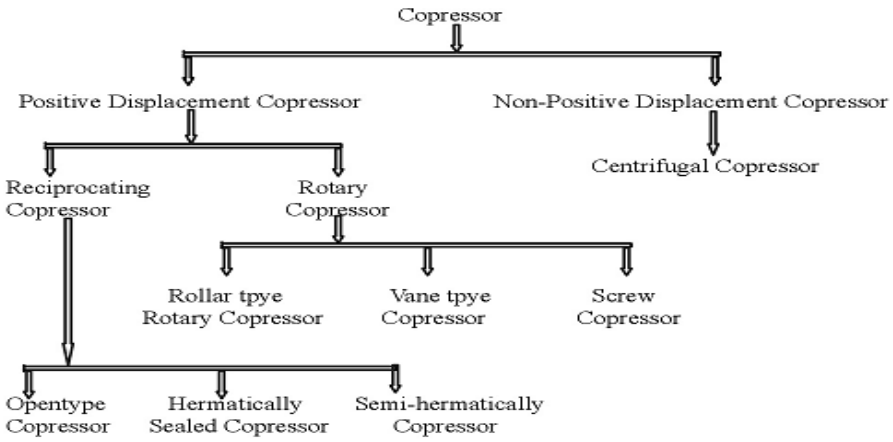
Important Instructions to examiners:

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 (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement 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.

Q. No.	Sub Q. N.	Answer		Marking Scheme
1.A)	a)	**Attempt any THREE of the following-**		01 Mark for each point
		Refrigerator	**Heat Pump**	
		a) When heat transfer from low temperature (Refrigerator temp.) To high temperature (atmospheric temp)	a) When heat transfer is from low temperature (atmospheric temp.) to high temperature (room temp.)	
		b) Particularly used for cooling purpose in a confined space.	b) Particularly used in winter to heat the rooms	
		c) $COP_{ref} = Q_A / W_{net}$	c) Efficiency is denoted by cop and C.O.P of heat pump is $COP_{HP} = COP_{Ref} + 1$	
		d) COP of refrigerator is less than COP of Heat Pump.	d) It is always greater than refrigerator by unity.	

WINTER – 18 EXAMINATION

Subject Name: RAC **Model Answer** Subject Code 17612

Q. No.	Sub Q. N.	Answer	Marking Scheme
1.A)	b)	**Classification of Compressor**  **Hermetic compressor:** A hermetic or sealed compressor is one in which both compressor and motor are confined in a single outer welded steel shell. The motor and compressor are directly coupled on the same shaft, with the motor inside the refrigeration circuit. Thus the need for a shaft seal with the consequent refrigerant leakage problem was eliminated. All the refrigerant pipeline connections to the outer steel shell are by welding or brazing. The electrical conductors to the motor are taken out of the steel shell by sealed terminals made of fused glass. Hermetic compressors are ideal for small refrigeration systems, where continuous maintenance (replenishing refrigerant and oil charge etc) cannot be ensured. Hence they are widely used in domestic refrigerators, room air conditioners etc. Since, the motor is in the refrigerant circuit, the efficiency of hermetic compressor based systems is lower as the heat dissipated by the motor and compressor becomes a part of the system load. Also material compatibility between the electrical winding, refrigerant and oil must be ensured. Since the complete system is kept in a welded steel shell, the hermetic compressors are not meant for servicing. A variation of hermetic compressor is a semi-hermetic compressor, in which the bolted	**02 Marks** **02 marks**

		construction offers limited serviceability.	

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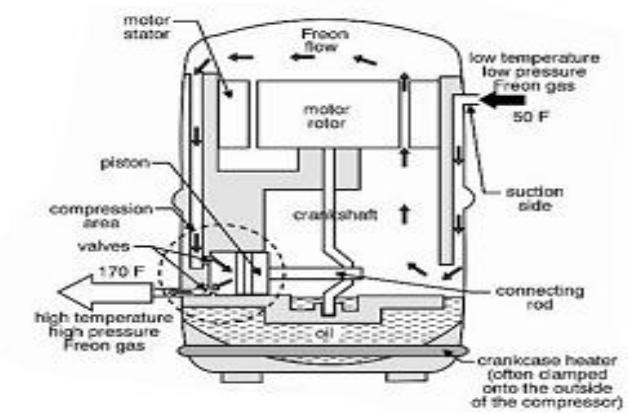
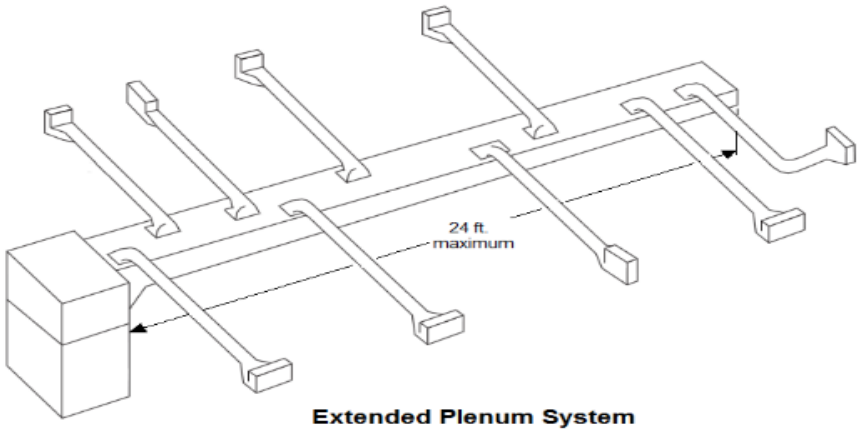
Subject Name: RAC **Model Answer** Subject Code 17612

Q. No.	Sub Q. N.	Answer	Marking Scheme
	c)		
		i) **Dry Bulb Temperature:** The temperature of the air measured by the ordinary thermometer is called as the dry bulb temperature of air, commonly referred as DBT. When ordinary thermometer is exposed to the atmosphere, it indicates the dry bulb temperature, which is nothing but the atmospheric temperature. ii) **Wet Bulb Temperature**: The wet bulb temperature of air is also measured by the ordinary thermometer, but the only difference is that the bulb of the thermometer is covered by the wet cloth. Temperature of the ordinary air measured by the thermometer when it is covered by wet cloth or wick is called as the wet bulb temperature, commonly referred to as WBT iii) **Dew Point Temperature:** The temperature at which the water vapor within the air at some temperature starts condensing is called as the dew point temperature of the air or DPT. When the dew is	**01 Mark Each** **4x1=4**

		formed the air is said to be in saturated condition. iv) **Specific Humidity:** Specific humidity is defined as the proportion of the mass of water vapor and mass of the moist air sample (including both dry air and the water vapor); it is closely related to humidity ratio and always lower in value.	
	d)	**Extended Plenum System:** In the **extended plenum systems**, a large main supply trunk of equal size is connected directly to the air handler. Smaller branch ducts and run-outs are connected to the trunk. The arrangement provides airflows that are easily balanced and can be easily designed to be located inside the conditioned space of the building. The principal design limitation of the extended plenum is the maximum length of the main supply trunk (of single size), which is usually limited to about 24 feet. When this length is exceeded, pressure tends to build up toward the end of the duct, resulting in too much air flow near the ends and insufficient air flow in branches closer to the air handler.  **Extended Plenum System**	**02 Mark** **02 Mark**
1.B		**Attempt any ONE of the following-**	
	a)	The simple absorption system is not very economical. In order to make the system more practical, it is fitted with an analyser, a rectifier and two heat exchangers as shown in fig. These accessories help to performance and working of the plant, as discussed below:	

1 mark

1.**Analyser.**

When ammonia is vaporized in the generator, some water is also vaporized and will flow into the condenser, along with the ammonia vapours in the simple system. If these unwanted water particles are not removed before entering into the condenser, they will enter into the expansion value where they freeze and choke the pipeline. In order to remove these unwanted particles flowing to the condenser, an analyser is used. The analyser may be built as an intergral part of the generator or made as a separate piece of equipment. It consists of a series of trays mounted above the generator. The strong solution from the absorber and the aqua from the rectifier are introduced at the top of the analyser and flow downward over the trays and into the generator. In this way, considerable liquid surface area is exposed to the vapour rising from the generator. The vapour is cooled and most of the water vapour condenses, so that mainly ammonia vapour (approximately 99%) leaves the top of the analyser. Since the aqua is heated by the vapour, less external heat is required in the generator.

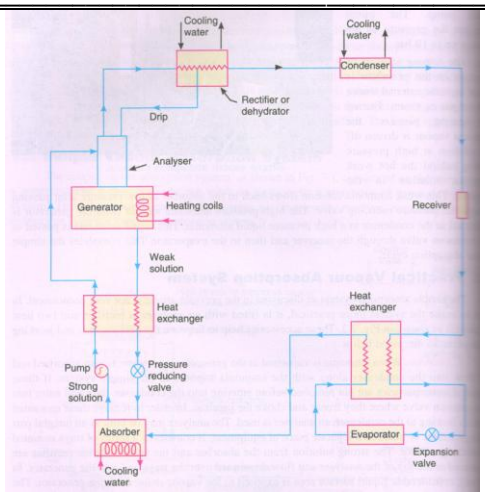
1 mark

2. **Rectifier**. In case the water vapours are not completely removed in the analyser, a closed type vapour cooler called rectifier (also known as dehydrator) is used. It is generally water cooled and may be of the double pipe, shell and coil or shell and tube type. Its function is to cool further the ammonia vapours leaving the analyser so that remaining water vapours are condensed. Thus, only dry or anhydrous ammonia vapours flow to the condenser. The condensate from the rectifier is returned to the top of the analyser by a drip return pipe.

1 mark

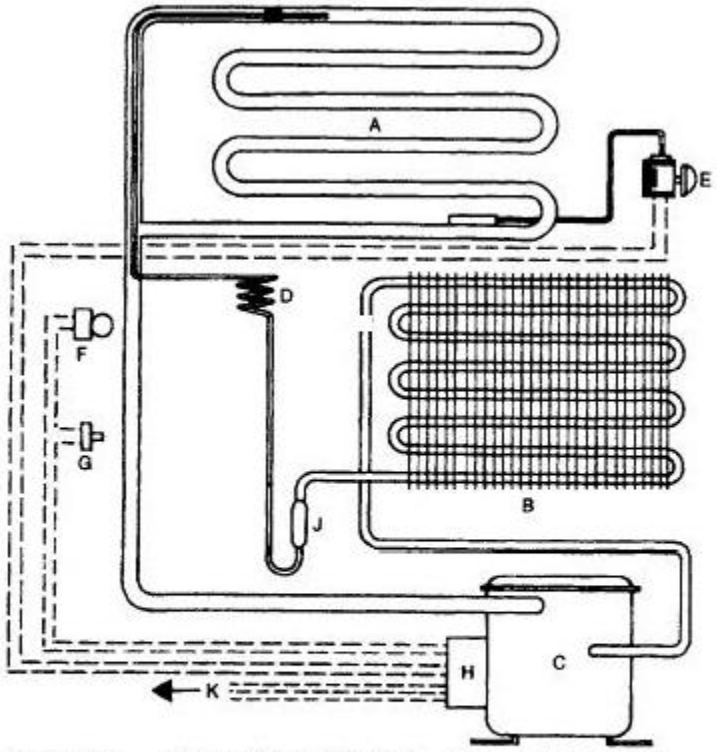
3. **Heat exchangers**.

The heat exchanger provided between the pump and the generator is used to cool the weak hot solution returning from the generator to the absorber. The heat removed from the weak solution raises the temperature of the strong solution leaving the pump and going to analyser and generator. This operation reduces the heat supplied to the generator and the amount of cooling required for the absorber. Thus the economy of the plant increases. The heat exchanger provided between the condenser and the evaporator may also be called liquid sub-cooler. In this heat exchanger, the liquid refrigerant leaving the condenser is sub-cooled by the low temperature ammonia vapour from the evaporator as shown in fig. this sub-cooled liquid is now passed to the expansion value and then to the evaporator. n this system, the net refrigerating effect is the heat absorbed by the refrigerant in the evaporator. The total energy supplied to the system is the sum of work done by the pump and the heat supplied in the generator.

		 Practical Vapour Absorption System	03 marks
	b)	**Domestic Refrigerator :** The internal parts of the refrigerator are ones that carry out actual working of the refrigerator. Some of the internal parts are located at the back of the refrigerator, and some inside the main compartment of the refrigerator. **1) Refrigerant:** The working substance used to make refrigeration is called the refrigerant. The refrigerant run through all the inner parts of the refrigerator. It is the refrigerant that carries out the cooling effect in the evaporator. It absorbs the heat from the body to be cooled in the evaporator (chillier or freezer) and throws it to the atmosphere via condenser. The refrigerant keeps on recalculating through all the inner parts of the refrigerator in cycle. **2) Compressor:** The compressor is to be found at the rear of the refrigerator and in the bottom area. The compressor sucks the refrigerant from the evaporator and discharges it at high pressure and temperature. The compressor is driven by the electric motor and it is the major power intense devise of the refrigerator. In most of the refrigerator reciprocating and hermitically sealed compressor are used. **3) Condenser:** In refrigerator air-cooled condenser is used since, the constriction of air-cooled condenser is very simple. The condenser is the thin coil of copper tubing situated at the back of the refrigerator. The refrigerant from the compressor come in the condenser where it is cooled by the atmospheric air thus losing heat absorbed by it in the evaporator and the compressor. To increase the heat transfer rate of the condenser, it is finned externally. **4) Expansion valve or the capillary:** The refrigerant leave-taking the condenser enters the expansion devise, which is the capillary tube in case of the household refrigerators. The capillary is the thin copper tubing made up of number of turns of the copper coil. When the refrigerant is passed through the capillary its pressure and temperature drops down suddenly. And it is a constant enthalpy process. **5) Evaporator or freezer:** The refrigerant at very low pressure and temperature enters the evaporator or the freezer. The evaporator is the heat exchanger made up of several turns of copper or aluminium tubing. In domestic refrigerators the plate types of evaporator is used as shown in the figure above. The refrigerant absorbs the heat from the substance to be cooled in the evaporator, gets evaporated and it then sucked by the compressor. This cycle keeps on repeating. **6) Temperature control devise or thermostat:** To control the temperature inside the refrigerator there is thermostat, whose sensor is connected to the evaporator. The thermostat setting can be done by the round knob inside the refrigerator compartment. When the set	**`04 Mark**

temperature is reached inside the refrigerator the thermostat stops the electric supply to the compressor and compressor stops and when the temperature falls below certain level it restarts the supply to the compressor.

7) Defrost system: The defrost system of the refrigerator helps removing the excess ice from the surface of the evaporator. The defrost system can be operated manually by the thermostat button or there is automatic system comprising of the electric heater and the timer.

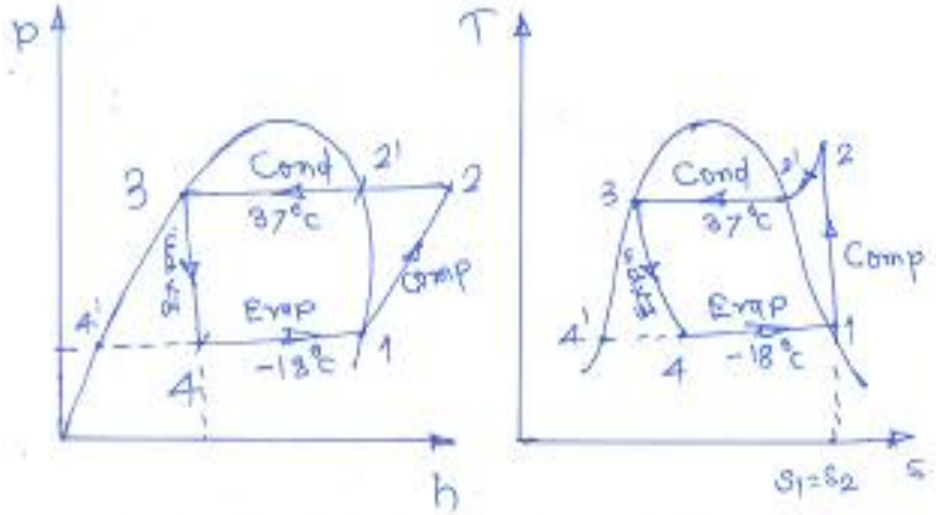


Domestic refrigerator details

02 Mark

2.	a)	**Attempt any TWO of the following-**	**02 Mark for Each Answer**

Q.2. (a) Solution:



VCC on P-h & T-S diagram

Temperature in Condenser = 37°C

Temperature in Evaporator = -18°C

Mass flow rate of refrigerant = 100 kg/hr.

Enthalpy of refrigerant after isentropic compression = $h_2 = 595.4$ kJ/kg from the properties of refrigerant

Enthalpy at compressor inlet $h_1 = 565$ kJ/kg

Enthalpy at condenser-exit = $h_3 = 455$ kJ/kg.

Consider the process 3-4, throttling process.

Enthalpy before throttling = Enthalpy after throttling

$h_3 = h_4 = 455$ kJ/kg.

Refrigerating effect is given as

$R.E. = m(h_1 - h_4)$

$= \frac{100}{60 \times 60}(565 - 455)$

$= 3.0555$ kW

Refrigerating capacity $= \frac{R.E}{3.517}$

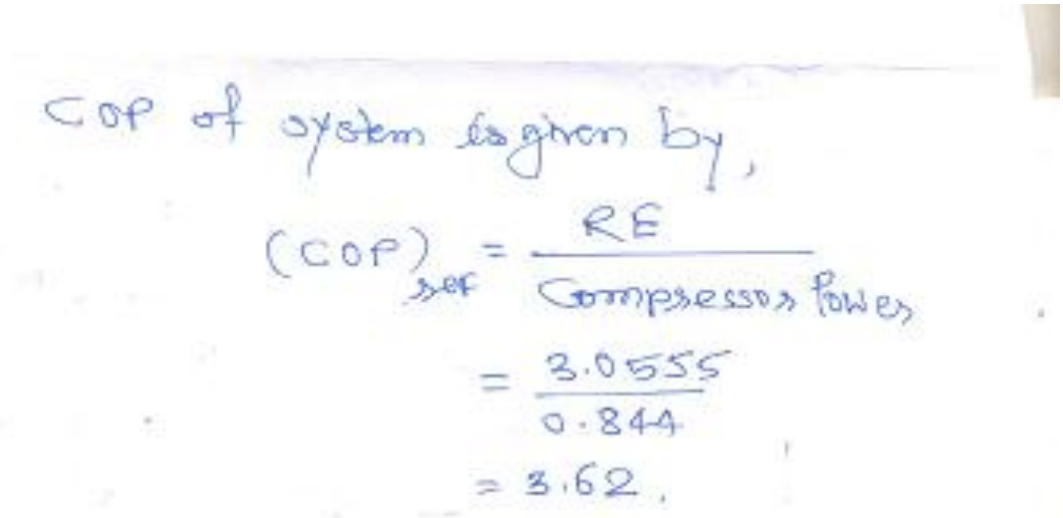
$= \frac{3.0555}{3.517}$

$= 0.868$ Tons of Refrigerati

Power required to drive the compressor $= m(h_2 - h_1)$

$= \frac{100}{60 \times 60}(595.4 - 565)$

$= 0.844$ kW.

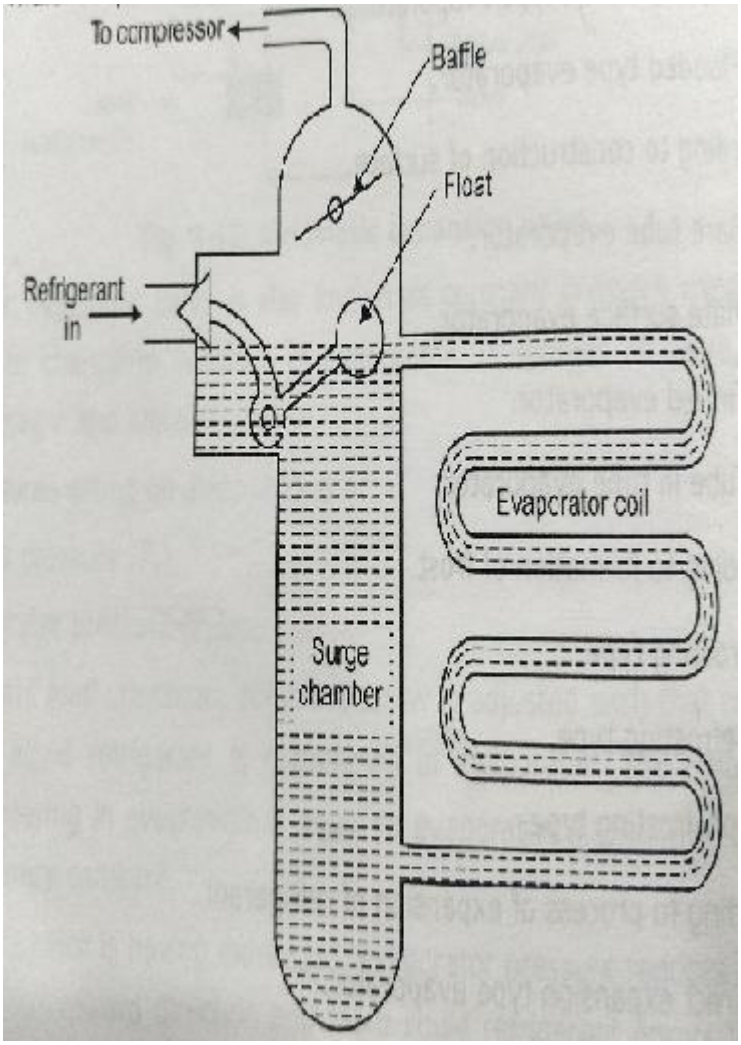


	b) i)	Dry Expansion Evaporator i)Limited amount of refrigerant is feed to evaporator ii) Rate of heat transfer is less iii) It is used for small capacity installations iv) It is used with constant load applications	Flooded Type Evaporator i)Evaporator coil is filled with excess amount of refrigerant. ii) Rate of heat transfer is very high iii) It is used for large capacity installations iv) It can be used with fluctuating load applications	**01 mark for each point 4x1=4**
	b) ii)	**Flooded Evaporator** A flooded evaporator type with float control valve shown in fig. the liquid flow on low passages passes the tubes upwords, and boils due to heat adsorption from the warmer substance, which is cooled. The resulted vapor so formed on boiling bubbles up in flash chamber, where separates liquid from vapor. Separated vapor passes to compressor, and liquid flows back to the evaporator. The flash chamber collects the vapor formed by liquid refrigerant boiling in the evaporator, and vapor obtained in the expansion device. In a flooded type evaporator refrigerant liquid level is maintained. Float valve is used as throttling device. The heat transfer efficiency increases because the entire surface is in contact with the liquid refrigerant. But the refrigerant charge is relatively large as compared to dry expansion type. The accumulator or flash chamber is used to prevent liquid Cray over to compressor. The evaporator coil is contacted to accumulator and the liquid flow from the accumulator to the		**02 Mark**

evaporator coil is generally by gravity. The vapor formed by the vaporizing of the liquid in the coil being lighter rises up and passes on to the top of the accumulator from where it enters the suction line.

In some cases liquid eliminators are provided in the accumulator top to prevent the possible carry over of liquid to suction line. Also a liquid suction heat exchanger is used on the suction line to superheat the suction vapor.

02 Mark



Flooded type evaporator

	c)	The different types of heat loads considered for the estimation of the total heat load of a large restaurant for air conditioning are Sensible Heat and Latent Heat are as follows **1. Sensible heat gain.** When there is a direct addition of heat to the enclosed space, a gain in the sensible heat is said to occur. This sensible heat is to be removed during the process of summer air conditioning. The sensible heat gain may occur due to any one or all of the following sources of heat transfer: (a) The heat flowing into the building by conduction through exterior walls, floors, ceilings, doors and windows due to the temperature difference on their two sides. (b) The heat received from solar radiation. It consists of (i) The heat transmitted directly through glass of windows, ventilators or doors, and (ii) The heat absorbed by walls and roofs exposed to solar radiation and later on transferred to the room by conduction. (c) The heat conducted through interior partition from rooms in the same building which are not conditioned. (d) The heat given off by lights, motors, machinery, cooking operations, industrial processes etc. (e) The heat liberated by the occupants. (f) The heat carried by the outside air which leaks in (infiltrating air) through the cracks in doors, windows, and through their frequent openings. (g) The heat gain through the walls of ducts carrying conditioned air through unconditioned space in the building (h) The heat gain from the fan work. **2. Latent heat gain.** When there is an addition of water vapour to the air of enclosed space, a gain in latent heat is said to occur. This latent heat is to be removed during the process of summer air-conditioning. The latent heat gain may occur due to any one or all of the following sources: (a) The heat gain due to moisture in the outside air entering by infiltration. (b) The heat gain due to condensation of moisture from occupants. (c) The heat gain due to condensation of moisture from any process such as cooking foods	**04 Marks** **04 Marks**

which takes place within the conditioned space.

(d) The heat gain due to moisture passing directly into the conditioned space through permeable walls or partitions from the outside or from adjoining regions where the water vapour pressure is higher.

The total heat load to be removed by the air-conditioning and refrigeration

equipment is the sum of sensible and latent heat loads of a large restaurant for air conditioning

3

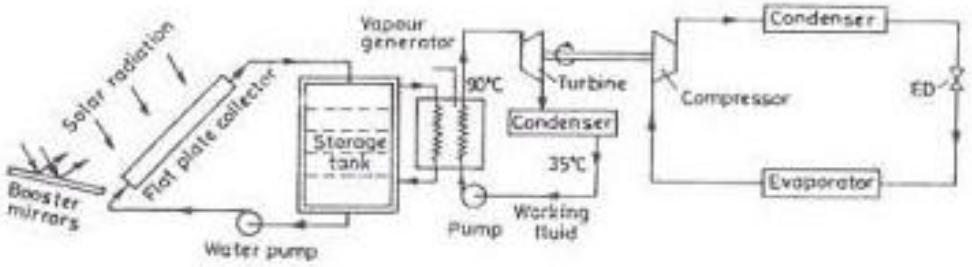
a

Attempt any FOUR:

Describe with neat sketch how solar energy can be used for refrigeration

A Solar vapor compression refrigeration system is shown in figure. It consists of mainly solar collector and storage tank for heat exchange in the exchanger. The turbine power is used to run the compressor of usual VCR system. **02**

It is to be noted that there is no requirement of external electrical power supply to the compressor as it is given by the turbine running on solar energy.



02

b

Differentiate between vapour compression and vapor absorption refrigeration system

particulars	Vapour compression system	Vapour absorption system
Type of energy supplied	Mechanical – a high grade energy	**Mainly heart – a low grade energy**
Energy supply	Low	**High**
Wear and tear	more	Less

01 for each any four

Performance as part loads	Poor	Not affected
Suitability	Where high grade mechanical energy is available	Can be used at remote places
Charging of refrigerant	simple	difficult
Leakage of refrigerant	More chances	No chances
Damage	Liquid traces in suction line damage the compressor	No danger

c

02

What is the function of condenser in refrigerating system ? Enlist different types .

Condenser : The function of condenser is to provide a heat transfer surface through which heat passes from the hot refrigerant vapour to the condensing medium .

02

Classification of condensers

i. Air-cooled
   a) Natural circulation air cooled condensers,
   b) Force circulation air cooled condensers

ii. water cooled
   a) Double tube type
   b) Shell and coil condensers
   c) Shell and tube condensers

i) Evaporative condensers

d

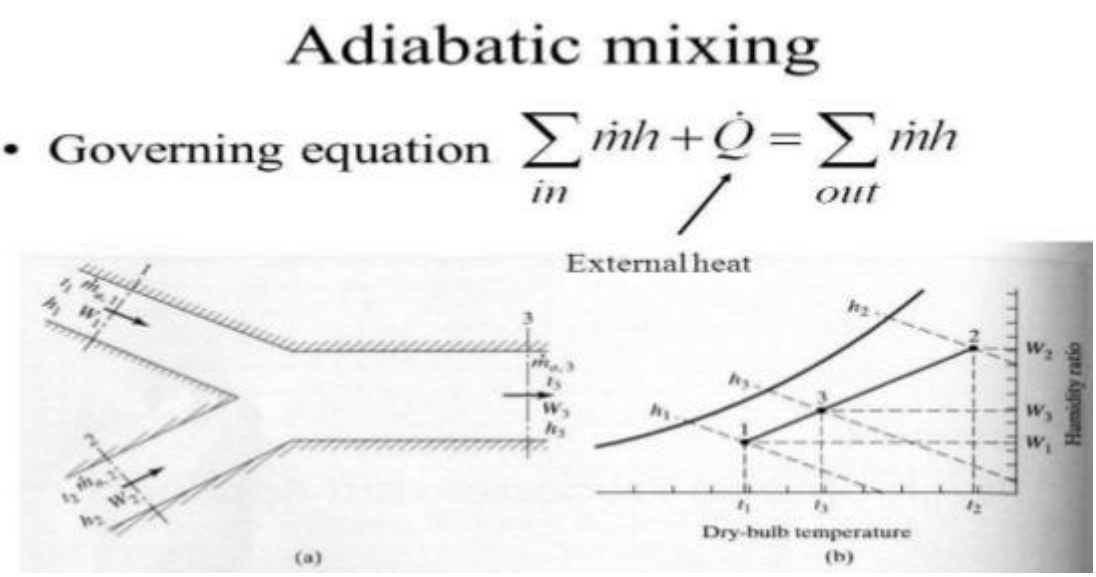
Explain adiabatic mixing of air streams

Adiabatic Mixing of air streams: Adiabatic Mixing of air streams in air conditioning. Depending upon the state of the individual streams, the mixing process can take place with or without condensation of moisture.

02

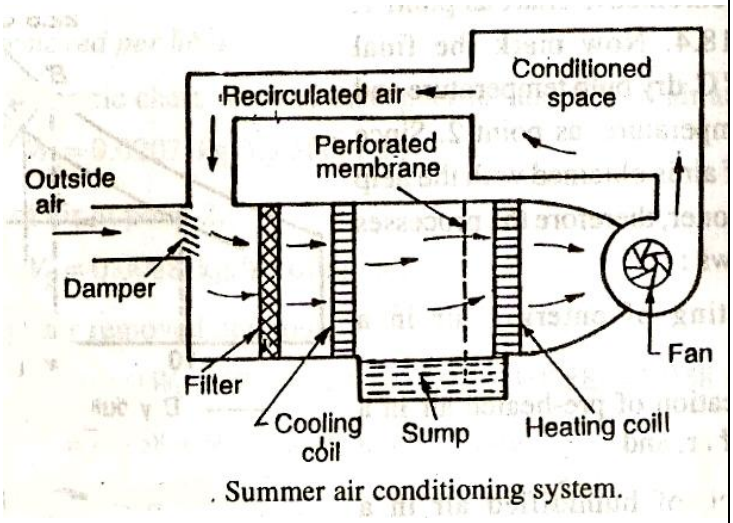
Figure shows an adiabatic mixing of two moist air streams during which no condensation of moisture takes place. As shown in the figure, when two air streams at state points 1 and 2 mix, the resulting mixture condition 3 can be obtained from mass and energy balance.

it can be observed that the final enthalpy and humidity ratio of mixture are weighted averages of inlet enthalpies and humidity ratios. A generally valid approximation is that the final temperature of the mixture is the weighted average of the inlet temperatures. With this approximation, the point on the psychrometric chart representing the mixture lies on a straight line connecting the two inlet states. **02**



Schematic adiabatic mixing of two moist air stream

e Explain with sketch summer air conditioning system **Fig. 2marks**



. Summer air conditioning system.

Explanation -2 marks

Summer Air conditioning System

This system is used in summer air conditioning applications. In this system air is cooled and generally dehumidified. Schematic diagram is shown in figure. The outside air flows through damper and mixes up with recirculated air .which is obtained from air conditioned space. The mixed air passes through a filter to remove dirt, dust and other impurities. The air now passes through cooling coil. The coil has a temperature much less than required dry bulb temperature of the air in the conditioned space. The cooled air passes through a perforated membrane and loses its moisture in the condensed form which is collected in a sump. Air now passes through a heating coil which heats up the air slightly, in order to bring air to requisite DBT and relative humidity. Now conditioned air passes to conditioned space by a fan. From the conditioned space the part of air is exhausted to atmosphere by exhaust fans or ventilators. The remaining part of the used air or recirculated air is again conditioned as shown in the figure. The outside air is sucked and made to mix with recirculated air in order to make up for the loss of conditioned or used air through exhaust fans or ventilators from conditioned

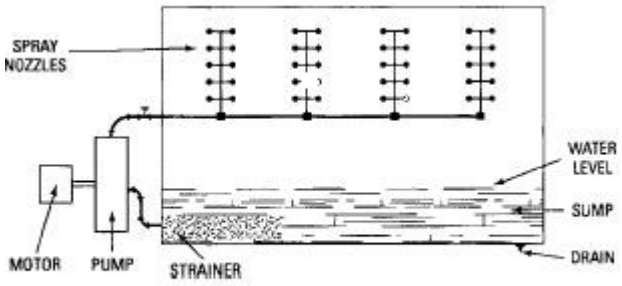
space.

4 A a **Explain the process of "Humidification by air washing with neat sketch** — **02**

Humidification by Air Washing (fig: 02 marks, explanation : 02 marks)

System consists of components like water tank, pump, heating/cooling coil, spray pipe & nozzles, air damper for air in-flow and eliminator plate.

Humidification can be achieved by spraying water in the stream of air. The air washer has a chamber in which water is sprayed through the nozzles from the top. Air enters into the chamber through air dampers and it flows through the sprays of water. While flowing, it absorbs the water particles & get humidified. The complete process is known as Humidification by air washing.



Elementary diagrams showing essential parts of air-washer unit with identification of parts. — **02**

b What are the factors affecting comfort air conditioning?

Following are the factors affecting comfort air conditioning — 01 for each any four

1. Temperature Control
2. Dehumidification Mode
3. Room Size
4. AC Capacity
5. Cooling Speed
6. Energy Efficiency
7. Noise

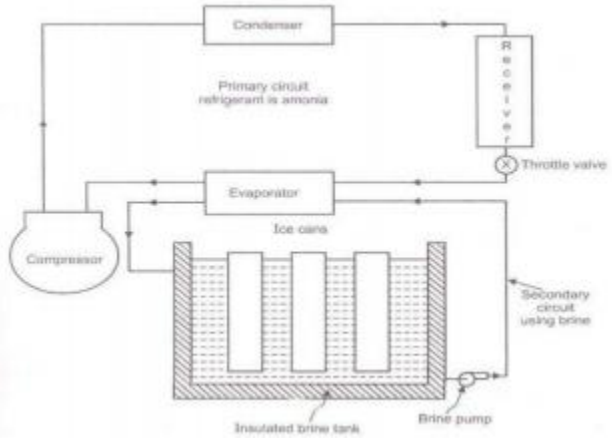
c Explain the factors to be considered for selecting insulating material in air conditioning field — 01 for each any four

Desirable properties of insulating material

1. Low thermal conductivity

2. adequate structural strength
3. Light weight.
4. Odourless
5. Nonflammable
6. Chemical stability
7. Moisture resistance

d Draw the neat labeled sketch of ice plant



04

B **Attempt any one of the following**

a **Explain the concept of green house effect and ozone depletion**

Continuous Destruction of protective Ozone gas layer around earth's atmosphere by chemical reaction of CFC refrigerants which are leaked from innumerable refrigeration systems on earth's surface is known as "Ozone Layer Depletion".

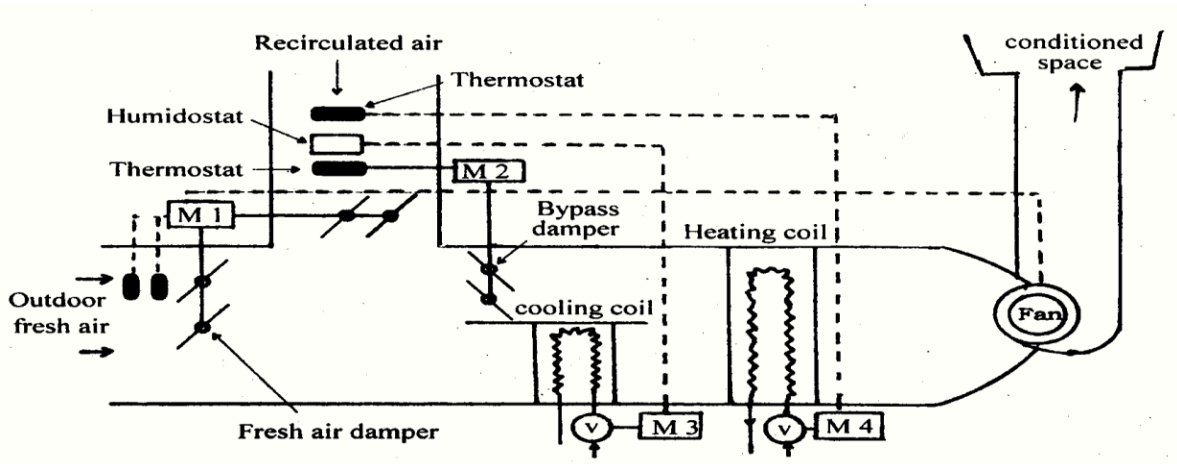
06

In the outer atmosphere of earth up to 50 Km, there is layer called Stratosphere. In this layer there is more concentration of Ozone gas. This ozone layer forms a protective layer around earth's surface which absorbs the Harmful Ultraviolet rays (UV) from Sun's rays and allows only beneficial light and heat rays to reach on earth's surface. Prevention of UV rays reaching to earth's surface protects human and

Depletion of Ozone layer leads to formation of "Ozone Holes" in the Ozone layer and through these ozone holes Harmful Ultra Violet rays enters into the atmosphere endangering the earth's biolife.

Due to "Ozone Layer Depletion" **t**he atmosphere allows a large percentage of the rays of visible light from the sun to reach the earth surface and heat it. Out of the incident radiation some infrared radiation is trapped by the earth atmosphere due to molecules of carbon dioxide and water vapour in the atmosphere and causes the earth's surface and lower atmospheric layer to warm to high temperature. This is called as **global warming.**

b Explain with neat sketch year round air conditioning system



03

The arrangement of year round air conditioning system is as shown in fig. The amount of outdoor fresh air and recirculated air is controlled by motor. The air conditioner designed such that when outdoor air temperature is either above or below a certain selected value, it assume the season as summer or winter respectively.

03

In summer season, by pass damper is almost closed and most of air passes through cooling coil. The cooling coil may be evaporator of refrigeration system or coil through which chilled water is passed. All air is passed through heating coil. In winter season, by pass damper is in almost open position. Most of the air is directly passed to heating coil by passing cooling coil.

5 **Attempt any TWO:**

a **Explain Bell Coleman Air Refrigeration cycle with P-V diagram and state the COP of the refrigerator-**

Bell Coleman cycle consist of compressor, expander, heat exchanger and evaporator. The air from evaporator is drawn into compressor and is compressed to heat exchanger pressure isentropically. During compression along with pressure rise, temperature of air also increases. This warm compressed air is forced in to heat exchanger, which cools the

Explanation- 04 marks

air at constant pressure. It has an effect of reducing volume from 2to 3. Simultaneously its temperature reduces due to rejection of heat.

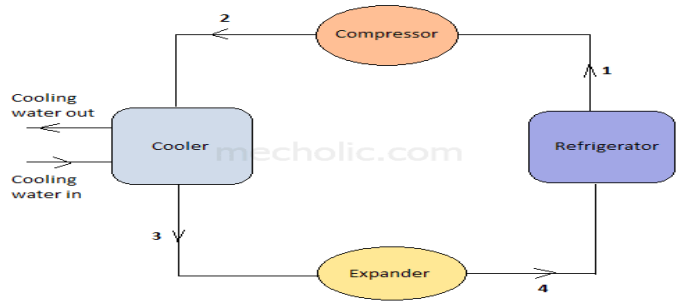
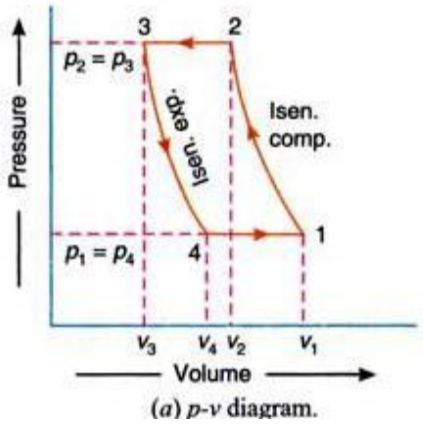
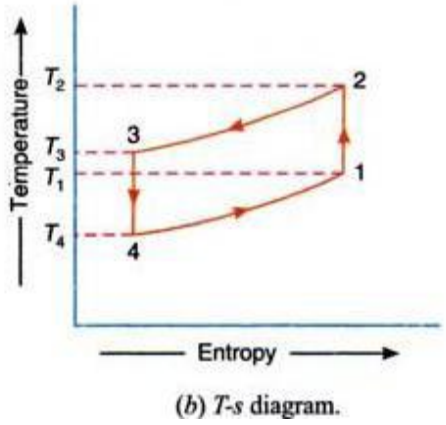


Figure: Bell Coleman Cycle.



(a) p-v diagram.



(b) T-s diagram.

P-V Diagram
02 marks

COP

2 Marks

$$\text{Coefficient of performance, C.O.P.} = \frac{\text{Heat absorbed}}{\text{Work done}}$$

$$= \frac{(T_1 - T_4)}{(T_2 - T_3) - (T_1 - T_4)}$$

b **Explain with the neat sketch vapour compression cycle. Draw P-H and T-S diagram for VCC with superheated compression.**

Ans- Simple vapour compression cycle consist of 4 different process –Compression ,Condensation, Expansion and Evaporation.

In compression low pressure vapour in dry state is drawn from the evaporator during the suction stroke of compressor.

In condenser- when high pressure refrigerant vapour enters the condenser, cooling media absorbs the heat and converts vapors into liquid.

In expansion –after condensation liquid refrigerants is stored in the liquid reservoir. The expansion valve reduces the pressure by keeping enthalpy constant.

In evaporation-the low pressure liquid refrigerant after expansion enter in evaporator when a considerable amount of heat is absorb by it and converts into vapors.

Neat labeled sketch 02 Marks, Explanation 02 Marks,

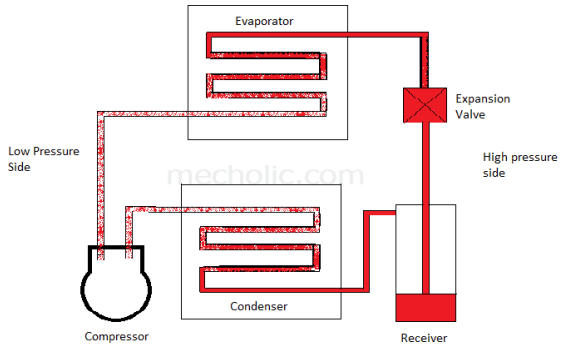
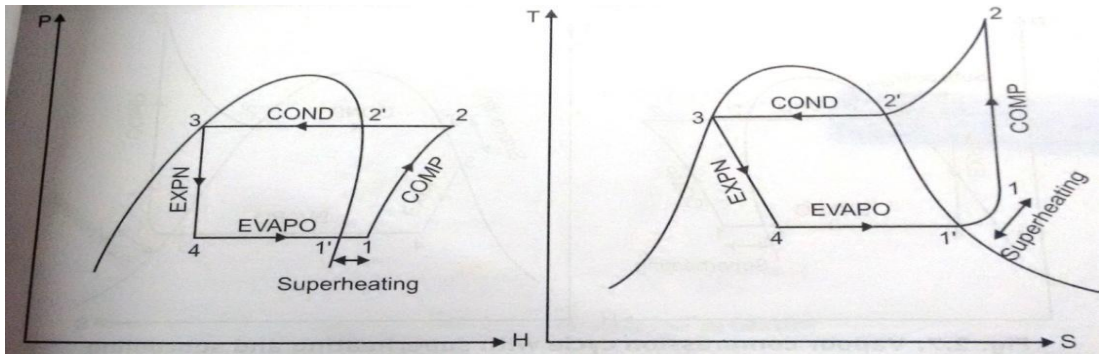


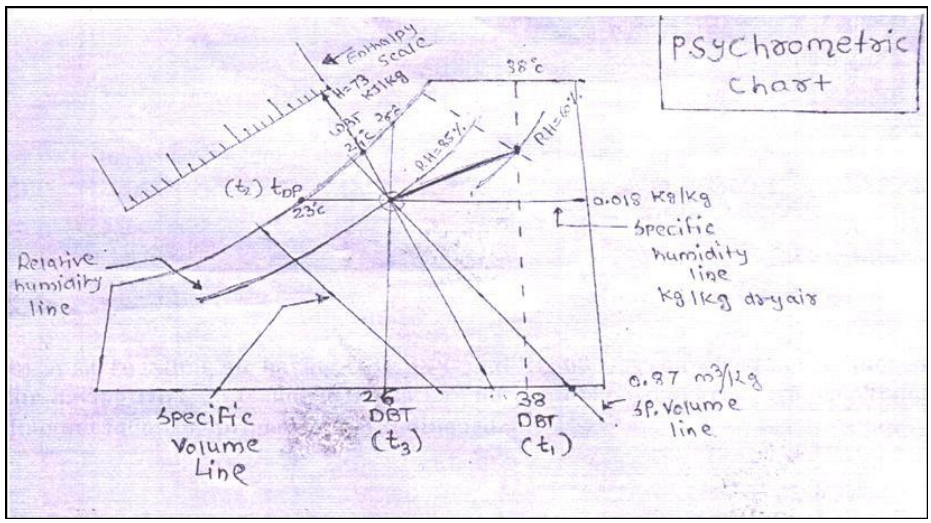
Figure: Vapour Compression Cycle.

P-H And T-S diagram 02 marks each.

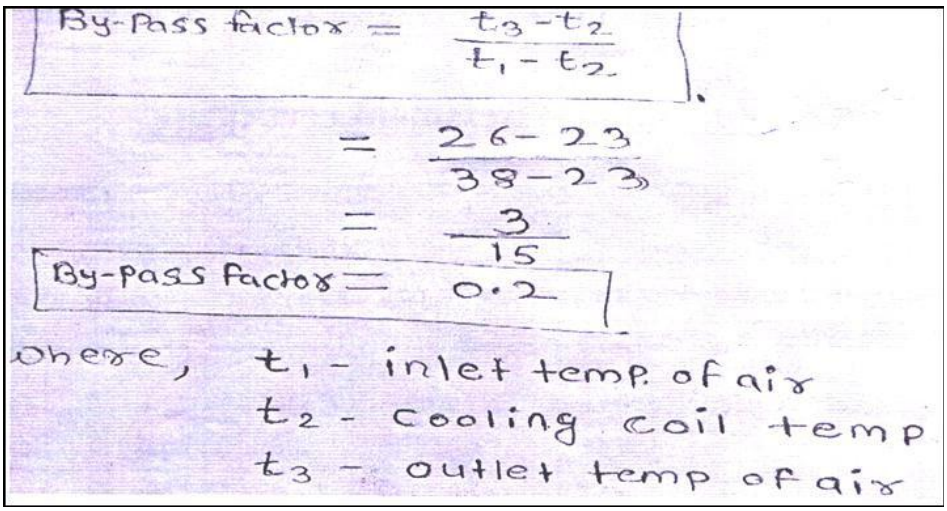


P-H And T-S Diagram of VCC with superheated compression.

C **A surrounding Air having 38 ^{o}C and RH 60% is converted to conditioned air having DBT 26^{0}C . Plot the process on psychrometry chart and find out the following properties of conditioned air. i) RH- ii)Enthalpy iii)Apparatus Dew point Temperature iv) By pass factor of cooling Coil**



1. RH = 85%
2. Enthalpy = 73 kJ/kg
3. Apparatus dew point temperature = 23^0 C



4. **By pass factor of cooling coil = 0.2**

Process Plot on psychrometric charts -04 marks

01 marks for Each properties of air.

6 **Attempt Any Four of the following**

2 Marks for each term.

a **Explain the following** :

i) 1 Ton Of Refrigeration-

One ton of refrigeration is defined as "the quantity of heat required to be removed from one ton of ice at 0^0 C within 24 hr when initial condition of water is 0^0 C"

1 Ton of refrigeration = 3.517 kW

ii) Energy efficiency ratio (EER):

Energy Efficiency Ratio, or EER, is a way to exhibit how well an air-conditioner is operating based on the power being used.

EER = Capacity / Power

b **Explain working of Electrolux Refrigeration system with neat sketch.**

Explanation 02 marks

Ans: It is old system known as three fluid absorption system in which refrigerant is ammonia and solution used is aqua ammonia. Third liquid is hydrogen gas.

1. Circulation of system is achieved by providing high pressure in condenser and generator

and low pressure in evaporator and absorber. Liquid ammonia flows under gravity into evaporator. As soon as ammonia liquid enters evaporator partial pressure of ammonia decreases due to presence of hydrogen.

2. Mixture of ammonia vapour and hydrogen vapour passed to the absorber. Weak solution of aqua ammonia is sprayed into absorber where it absorbs ammonia vapour and converted into strong solution. Hydrogen left is recirculated in evaporator. Then strong solution passed through heat exchanger where heat is transfer from weak aqua ammonia to strong aqua ammonia solution.
3. Strong aqua ammonia solution heated in generator and due to addition of heat ammonia vapour are release and strong solution converted into weak solution, which is passed to the absorber.
4. Then moisture in ammonia removed by analyzer and rectifier.
5. Advantage of this system is it has no moving parts, no noise and can be used where no electricity is available.

Neat labeled sketch 02 marks

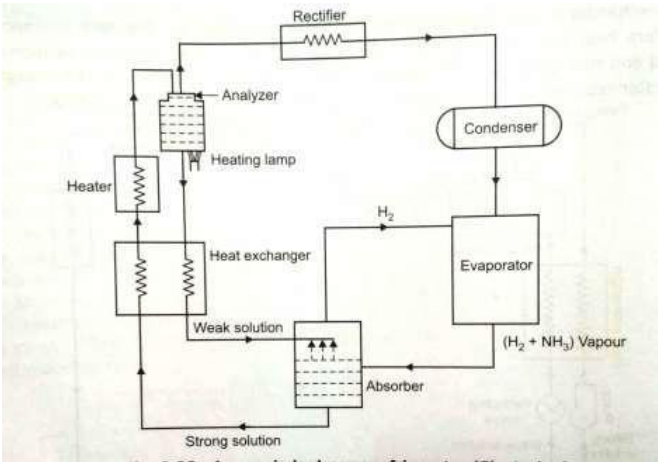
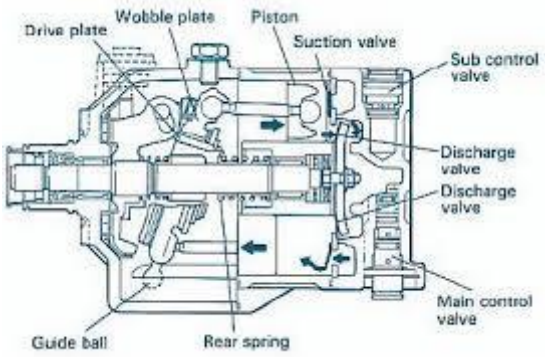


Figure: Electrolux Refrigeration system.

C **Explain Wobble plate type car A.C. system of compressor.** **02**



02

The pistons in an opposed axial compressor are connected together by a solid piece that

keeps them at a fixed distance from each other. A rotating device called the swash plate causes the pistons to move. The swash plate is an elliptical disc that is mounted at an angle to the compressor drive shaft.

d

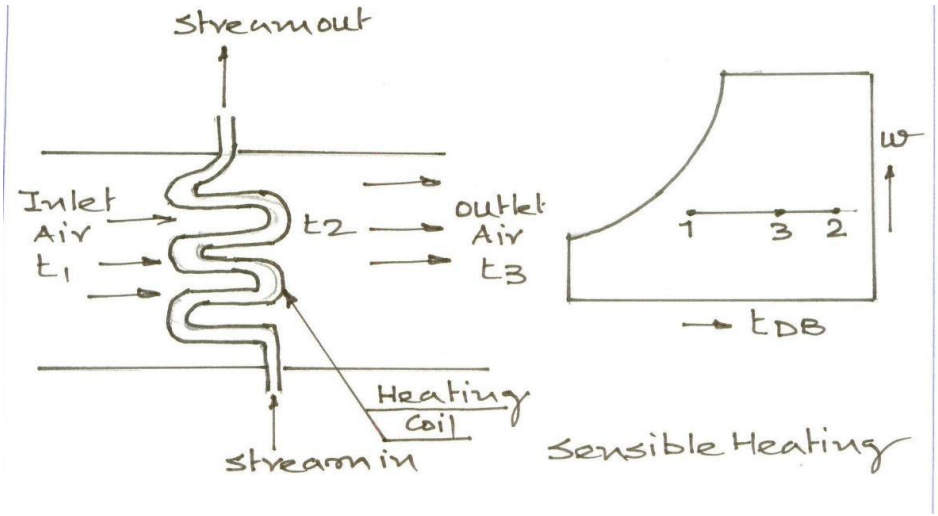
Explain By-pass factor of cooling and heating coil.

By pass factor

When a stream of air passes over a coil , which may be heating or cooling, part of it comes in direct contact with coil surface while remaining just by passes on affected. The amount of air, which by passed depends upon velocity of flow. This by pass process measured in terms of by- pass factor.

Figure 02 Marks and Explanation 02 marks

By pass factor of heating coil

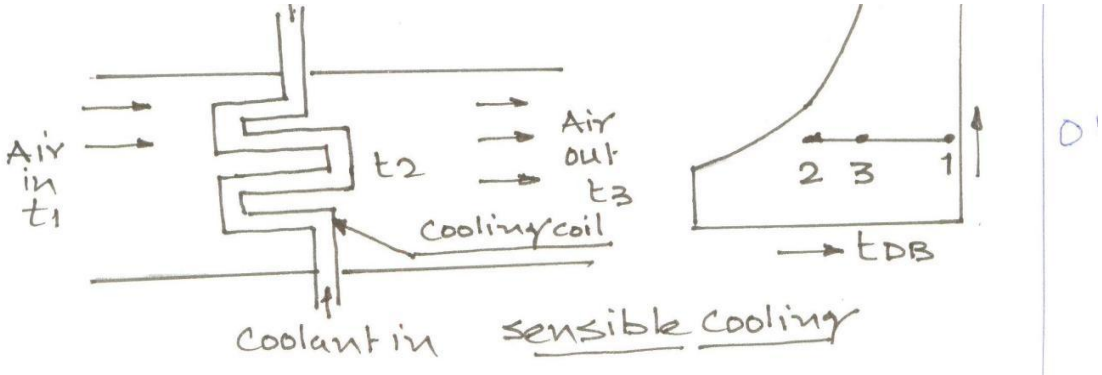


The arrangement for sensible heating is as shown in fig. and process is shown on psychrometric chart.

The process 1-2 is expected however the actual process terminates. The process 3-2 does not occur due to by passing of air.

By Pass factor = $\frac{t2-t3}{t2-t1}$

By Pass factor of cooling coil



		The arrangement for sensible cooling and its psychrometric process is as shown in the fig above By pass factor of cooling coil = $\frac{t3-t2}{t1-t2}$	
	e	**Give classification of Duct used in air conditioning system.** **Ducts** are classified according to their use as : (air distribution system mainly consists of supply ducts and return ducts) **1.According to cross section:** a. Circular Duct b. Rectangular Duct c. Square Duct **2.According to pressure:** a. Low pressure duct-when static pressure in duct is less than 50 mm of water gauge. b. High pressure duct- when static pressure in duct is 150 to 250mm of water gauge. c. Medium pressure duct-when static pressure in duct is 150mm of water gauge. **3.According to velocity:** a. Low velocity duct: when velocity in duct upto 600m/min. b. High velocity duct: when velocity in duct more than 600m/min. 4. **Supply duct** – conditioned air from the air conditioning equipment to the space to be conditioned **Return air duct**- carry the recirculating air from the conditioning space back to the air conditioning equipment.	**(01 Marks for each classification =04 marks).**