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April-24
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Scoring Indicators

COURSE NAME: Refrigeration and air conditioning

COURSE CODE: 5022 QID: 2109230033

Q. No	Scoring Indicators	Split score	Sub Total
	PART A		**9**
I.1	The critical temperature of a substance is the temperature at and above which vapor of the substance cannot be liquefied, no matter how much pressure is applied.	1	1
I.2	3.5 KJ/s.	1	1
I.3	Carbon dioxide CO_2	1	1
I.4	Primary refrigerant is that which cools the substances by absorbing heat equal to its latent heat from them.	1	1
I.5	Airtight	1	1
I.6	types-dry and flooded type, natural, forced convection type	1	1
I.7	Heat Ventilation and Air Conditing	1	1
I.8	Dew point temperature. It is the temperature of air recorded by a thermometer, when the moisture (water vapour) present in it begins to condense. It is, usually, denoted by tdp. (In other words, the dew point temperature is the saturation temperature (tsat). corresponding to the partial pressure of water vapour (Pv))	1	1
I.9	Wet bulb temperature (WBT). It is the temperature of air recorded by a thermometer, when its bulb is surrounded by a wet cloth exposed to the air. Such a thermometer is called *wet bulb thermometer. The wet bulb temperature is generally denoted by tw or twb.	1	1
	PART B		**24**
II.1	Ice refrigeration 2.Dry ice refrigeration 3.Air expansion refrigeration 4.Evaporative refrigeration 5.Liquid gas refrigeration 6.Steam jet refrigeration	Any 3 3 x1	3

II. 2	R 717 Ammonia (NH_3) •Toxic, slightly explosive and inflammable. •Low specific volume in vapour state. •High refrigerating effect. •BP→ -33°C; FP→ -78°C.	Any thre e 3x1	3
II. 3	A flash chamber is a device that separates liquid and vapor refrigerant. It fits into the line after the expansion chamber, sending only liquid refrigerant to the evaporator and vapor to the compressor. The flash chamber provides a potentially important design element as part of the refrigeration cycle.	3	3
II. 4	Global warming is a gradual increase in the earth's temperature generally due to the greenhouse effect caused by increased levels of carbon dioxide, CFCs, and other pollutants. "	3	3
II. 5	Roller type rotary compressors,Vane type rotary compressors,Screw type rotary compressors, Centrifugal compressor	3x1	3
II. 6	Capillary tube; Automatic Expansion valve; Thermostatic expansion valve.	3	3
II.7	A psychrometer is a hygrometer made up of two thermometers that are identical. One thermometer's bulb is kept wet, causing it to record a lower temperature than the dry-bulb thermometer due to evaporation cooling. A psychrometer is a device for measuring air humidity.	3	3
II.8	Dalton's law of partial pressures is a gas law which states that the total pressure exerted by a mixture of gases is equal to the sum of the partial pressures exerted by each individual gas in the mixture.	3	3
II.9	The ratio of the *sensible heat to the total heat is known us sensible heat factor (SHF) or sensible heat ratio (SHR). SHF= SH/(Total Heat) = SH/(SH+LH), SH- sensible heat, LH- latent H	3	3
II. 10	Humidity. It is the mass of water vapour present in the moist air unit mass of dry air in a given volume, and is generally expressed in terms of gram of water vapour per kg of dry air (g / kg of dry air). It is also called specific humidity or humidity ratio. Absolute humidity. It is the mass of water vapour present in unit volume of dry air, and is generally expressed in terms of gram of water vapor per cubic metre of dry air (g /m3 of dry air). It is also expressed in terms of grains per cubic metre of dry air. Mathematically, one kg of water vapour is equal to 15 430 grains. Relative humidity. It is defined as the ratio of actual moisture present in the air to the maximum moisture the air can hold at the same temperature and pressure. It is briefly written as RH or ϕ (It is the ratio of actual mass of water vapour in a given volume of moist air to the mass of water vapour in the same volume of saturated air at the same temperature and pressure.)	3x1 ~~Any thre e~~	3

(3)

			42

III. 1

Amount of ice produced = $\frac{12 \times 1000}{24 \times 60} = 8.33$ kg/min

Heat extracted from 1 kg water at 20°C to produce 1 kg ice at 0°C

$= 1 \times C_{pw} \times (20 - 0) + L_{ice}$

$= 1 \times 4.2 \times 20 + 336$

$= 420$ kJ/kg 1

Refrigerating effect, N = Total heat extracted

$= 8.33 \times 420$ 2

$= 3498.6$ kJ/min

From C.O.P $= \frac{N}{W}$, $W = \frac{N}{C.O.P}$ 7

Work supplied by compressor, $W = \frac{3498.6}{3}$

$= 1166.2$ kJ/min

i.e, $W = \frac{1166.2}{60} = 19.44$ kJ/s or kW 2

Considering the η given, power rating of the compress

$= \frac{19.44}{0.9} = 21.6$ kW **Ans.** 2

IV

C.O.P.:

(i) As a refrigerating machine:

$$\text{C.O.P.} = \frac{T_2}{T_1 - T_2} = \frac{263}{300 - 263} = \mathbf{7.11} \quad \textbf{(Ans.)}$$ 2

(ii) As a heat pump:

$$\text{C.O.P.} = \frac{T_1}{T_2 - T_2} = \frac{300}{300 - 263} = \mathbf{8.11} \quad \textbf{(Ans.)}$$ 2 7

(iii) As an heat engine:

$$\text{C.O.P.} = \frac{T_1 - T_2}{T_1} = \frac{300 - 263}{300} = \mathbf{0.123} \quad \textbf{(Ans.)}$$ 3

(4)

V

1.Compressor-It is the heart of the system, it is motor driven. It sucks vapour refrigerant from evaporator,compresses it and delivers to the condenser

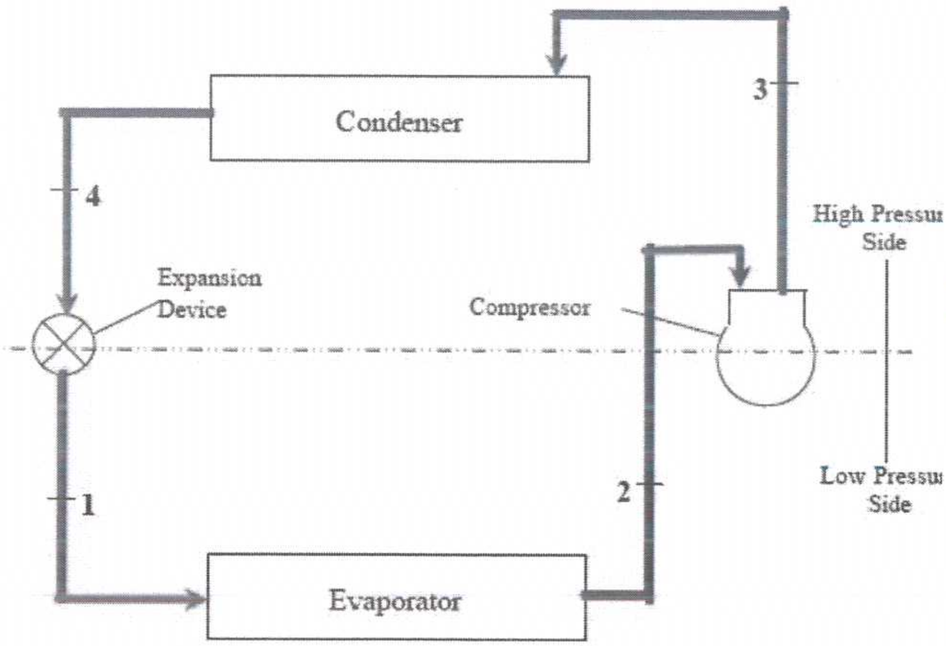
2.Condenser-High pressure vapour refrigerant from the compressor is condensed into liquid form at constant pressure. The condensation is done using a cooling medium such as water. Here the vapour refrigerant transform into liquid state by rejecting latent heat of evaporation.

3. Expansion Valve. Here, high pressure liquid refrigerant from condenser is throttled down(isenthalpically) to evaporator pressure. Rate of flow of refrigerant is metered here. In this stage, refrigerant has a tendency to change its state from liquid to vapour, but there will be no heat energy to change.

4.Evaporator. It is the cooling chamber in which products to be cooled is placed. Low pressure liquid refrigerant flows through the coils of evaporator and absorbs heat from the products at evaporator pressure. So refrigerant vapourises and passes to the compressor.

4x1

7



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VI

Vapour compression Refrigeration System	Vapour Absorption Refrigeration System
The Vapour compression refrigeration system has parts like Compressor, receiver, condenser, refrigerant control device, and evaporator. Whereas,	Vapour Absorption Refrigeration has Parts like condenser absorber, generator, rectifier, and evaporator.

Any 7

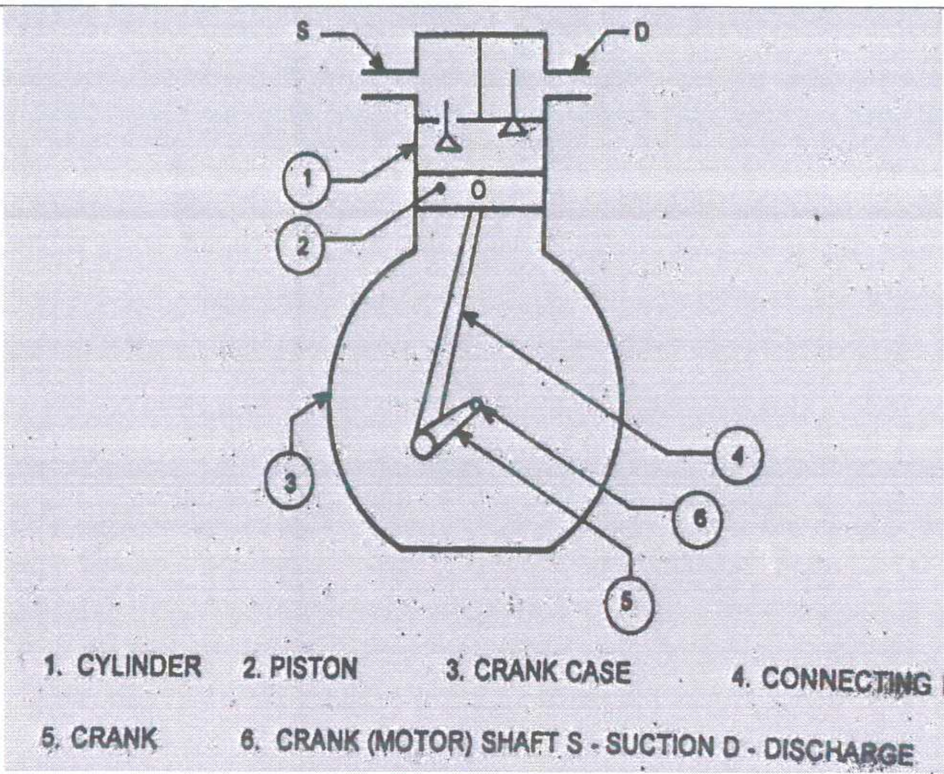
7x1

1

	Here when the operation is going it produces noise.	There is very less in noise or you can say it is quiet in operation.		
	The refrigerant we use here is Chlorofluorocarbons, Hydrocarbons, and Hydrochlorofluorocarbons. Or you can say R12 refrigerant is used.	In the Absorption system, we use refrigerant is Ammonia or water.		
	Here the charging of these refrigerants is very simple. Whereas	In this case, charging is very difficult.		
	The supply of energy is low.	Here the supply of energy is high.		
	The compression system occupies more space and It is less efficient.	The Absorption system occupies less space and It is more efficient comparatively the Compression refrigeration system.		
	Vapour compression refrigeration system required to operate by prime movers like electric Motor, Petrol engine or Diesel Engine.	But here It is required to operate by heat energy like kerosene oil, gas, or electric heater.		
	The compressor is used and The flow of gas depends upon the compressor only. Whereas	In the Absorption system, the flow of gas depends upon the generator's working and Gravity.		
	The mechanical energy is supplied as input here.	The heat energy is supplied here as input.		
	Here the chances of wear and tear because the compression system has many moving parts.	Here the chances of wear and tear are very less because the Absorption system has not any moving parts.		

	Here the refrigerant is being compressed for working operation.	In the Absorption system, refrigerant is being absorbed and heated.			
	The operationg cost is high becasue here we compressor and it consumes more work.	The operationg cost is Less because of less heat energy is required.			
	The coefficient of Power (COP) is high in the compression system.	The coefficient of Power (COP) is low in the Absorption system.			
	Maintenance is more.	Less Maintenance.			
	The compressor system is not used for large capacity work as it is limited. Whereas	This system is used for large-capacity works.			
	The leakage chance is more because of high pressure.	The leakage chance is very less or negligible because of low pressure.			

VII

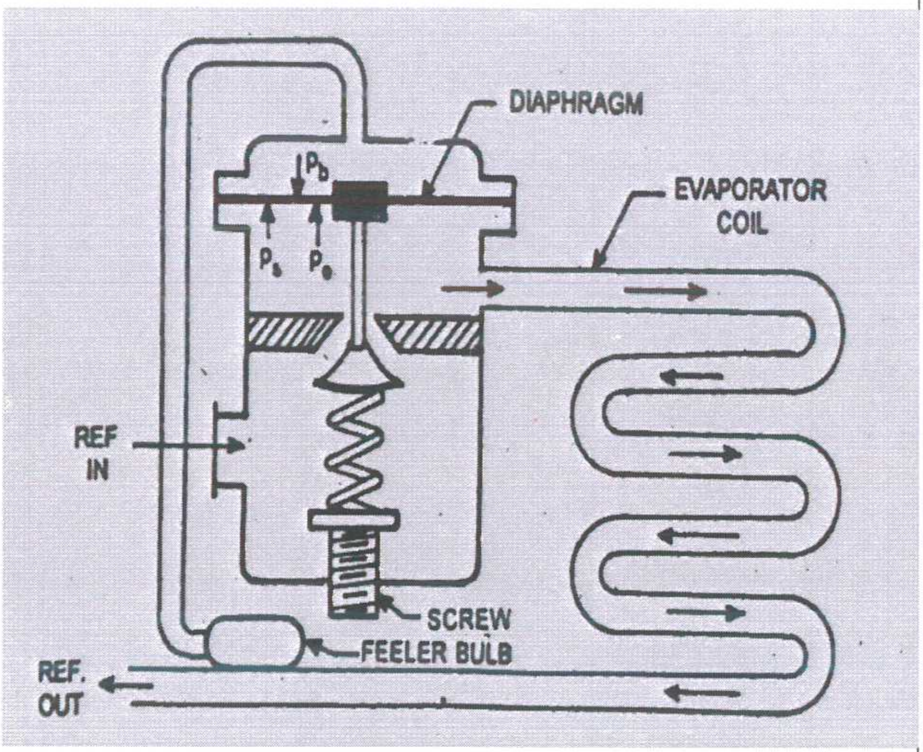


4 7

Explanation

It has a piston cylinder arrangement which creates suction eventuallaay pressure is created 3

VIII



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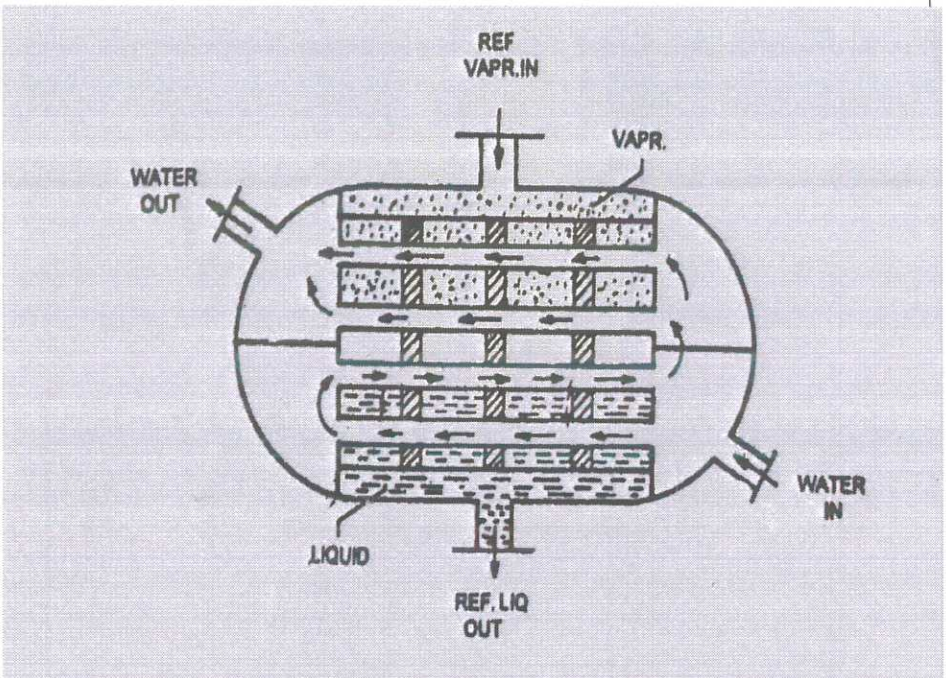
Explanation

It has a diaphargm over which 3 press 3 acts. Screw pressure, pressure of gas, pressure from feeler bulb. Accordingly value open and close

IX	 Fig. 6.11 SHELL AND TUBE WATER COOLED CONDENSER Water is circulated ~~in shell of~~ accross the the refrigent and heat exchange happens	4 3	7
X	Space Rocket propulsion, Cooling of Infra-Red (IR) sensor, Space simulation,Mechanical Applications, Magnetic Separation,Recycling, Medical applications, Food preservation,Cell preservation,Gas industry applications,Liquefaction of gases Explain any 4 Explain any 4 in detail	7	7
XI	The different types of lines are Dry bulb temperature lines Specific humidity or moisture content lines Dew point temperature lines Wet bulb temperature lines Constant Enthalpy (total heat) lines. Specific volume lines Vapour pressure lines Relative humidity lines Explain any 7	7x1	7
XII.	Industrial Air Conditioning System It is an important system of air conditioning these days in which the inside dry bulb temperature and relative humidity of the air is kept constant for proper working of the machines and for the proper research and manufacturing processes. Some of the sophisticated electronic and other		

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machines need a particular dry bulb temperature and relative humidity. Sometimes, these machines also require a particular method of psychrometric processes. This type of air conditioning system is used in textile mills, paper mills, machine-parts manufacturing plants, tool rooms, photo-processing plants etc.

7×1

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XII
I.

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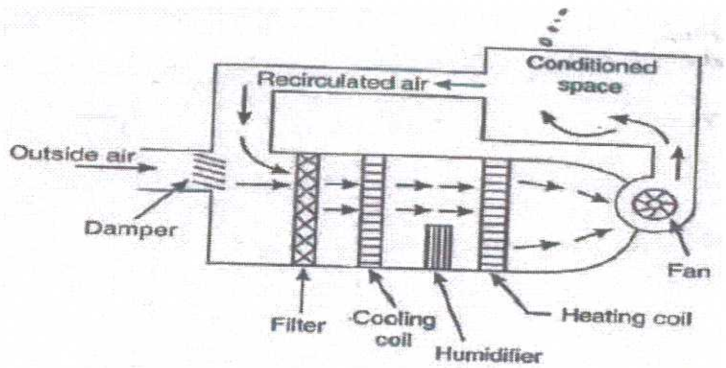

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Expln

3

III.
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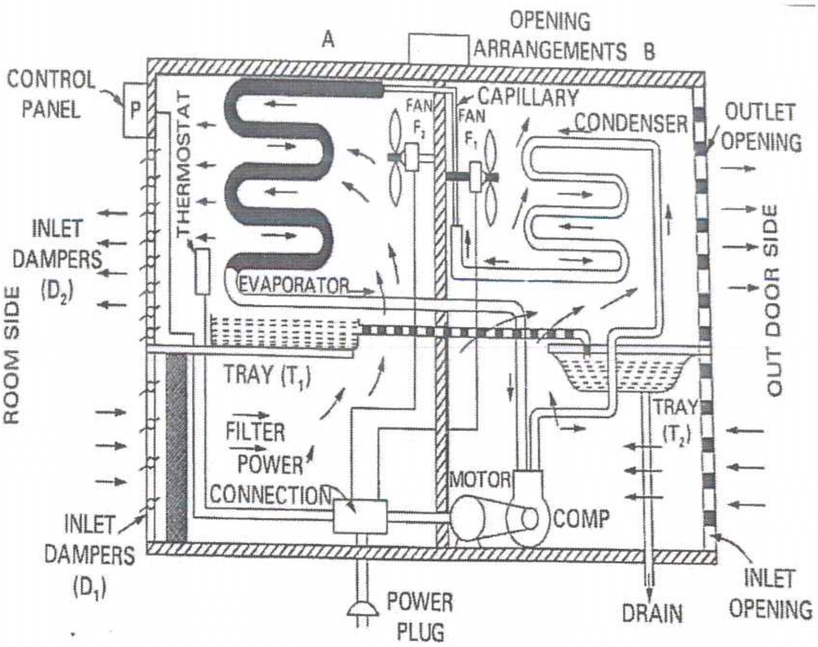

4 7

Expln

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