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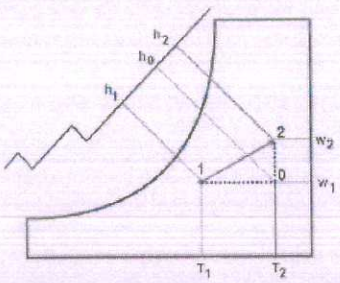
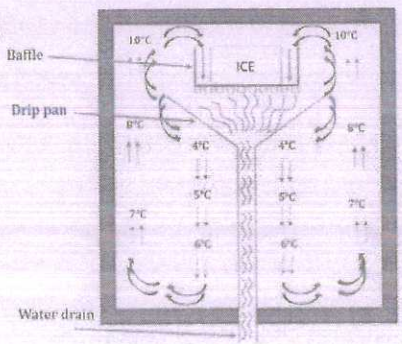
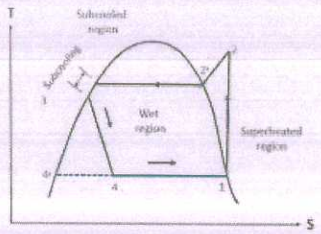
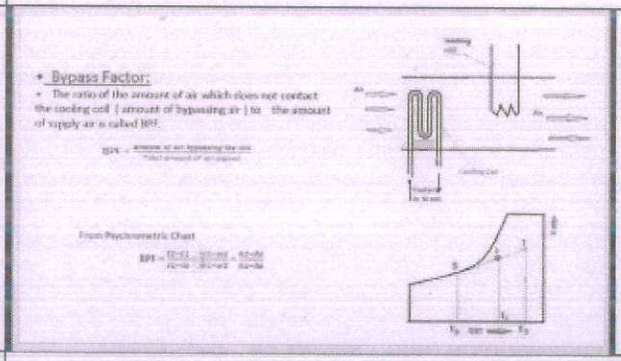
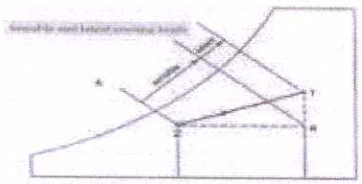
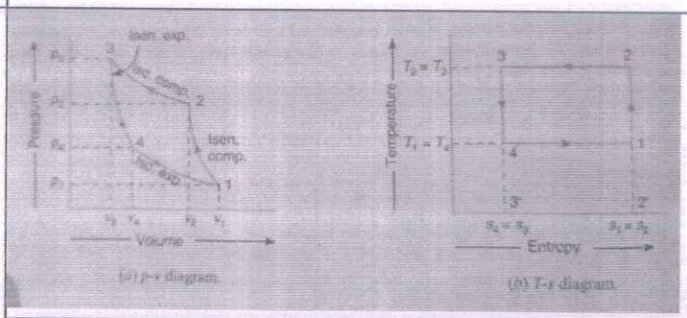
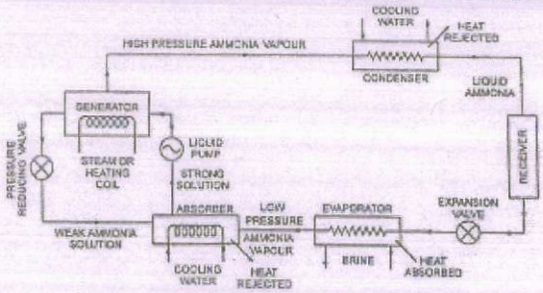
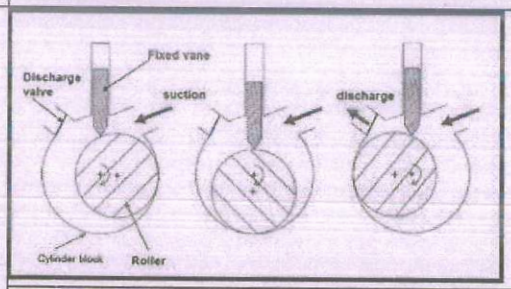
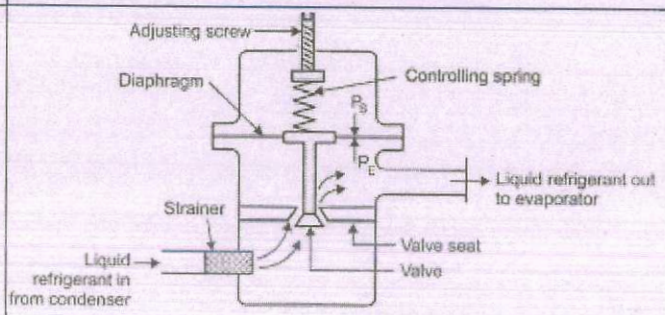
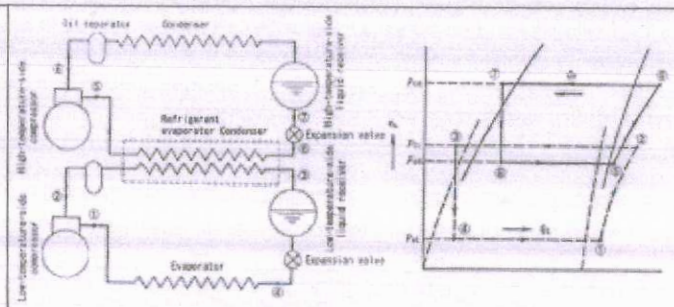
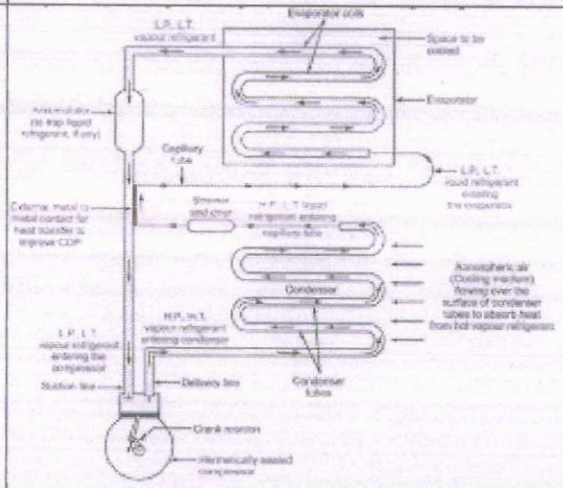
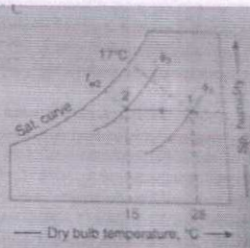
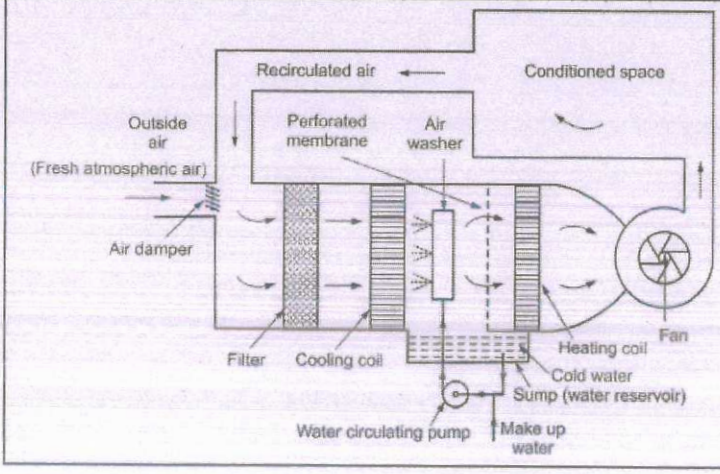
6

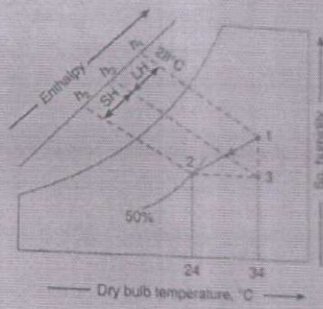
SCHEME OF VALUATION				
(Scoring Indicators)				
Revision: 2021				
Course Name: REFRIGERATION AND AIR-CONDITIONING				
Course Code: 5022		QID:2109230034		
Qst. No	Scoring Indicator	Split up Score	Sub Total	Total
I	PART A			9
1)	is defined as the ratio of heat removed from the cold reservoir (i.e., inside a refrigerator) to the work W done to remove the heat		1	
2)	name any one pair		1	
3)	analyser is used to remove the unwanted ar particle from the ammonia vapour before entering the condenser		1	
4)	global warming and ozone layer depletion		1	
5)	any two examples of primary and secondary refrigerants		1	
6)	The compressor works by increasing the pressure and temperature of the vaporized refrigerant.		1	
7)	dew point temperature of the air is the temperature at which the moisture present it is begin to condense.		1	
8)	it is the mass of water vapor present in 1 kg of air		1	
9)			1	
II				24
1)	ICE Refrigeration System **Refrigeration System** **Air-conditioning System** • Oldest cooling method • Use Natural and Artificial ICE • Latent heat of ice is 335kJ/kg Advantage • It prevent dehydration of fresh vegetables Disadvantage • Controlling the rate of refrigeration makes it difficult 		3	

2)	 Fig.: Representation of subcooling T-S diagram		3	
3)	using flash chamber in between expansion valve and evaporator,using accumulator,subcooling of liquid refrigerant by vapour refrigerant.		3	
4)	**Desirable properties of a good refrigerant:** Thermodynamic properties 1. Low boiling point 2. Low freezing point 3. Positive gauge pressure in condenser and evaporator, but not very high 4. High latent heat of vaporization Chemical properties 1. Non–toxic 2. Non–inflammable & non–explosive 3. Non–corrosive 4. Chemically stable 5. No effect on quality of stored products		3	
5)	list any three compressor. 1 mark each		3	
6)			3	
7)	1. Effective temperature, 2. Heat production and regulation in human body. 3. Heat and moisture losses from the human body, 4. Moisture content of air, 5. Quality and quantity of air 6. Air motion, 7. Hot and cold surfaces, and 8. Air stratification.		3	
8)	The temperature at which motionless saturated air would induce, the same sensation of comfort as that induced by the actual		3	

9)	**COMPARISON OF UNITARY SYSTEM WITH CENTRAL SYSTEM** **UNITARY SYSTEM** • Saves installation and labour • Reqd temp of each room is met • Zoning, distribution, duct eliminatd • Unit run only where A/C is needed • Failure restricted to particular rm. • Easy to A/C the spaces in phases. • Large area this works out costly • Noise/vibration cannot be elimintd • Maintenance disturbs the room. **CENTRAL SYSTEM** • Installation cost is more • Uniform throughout. • Zoning, Ductwork is a must. • Runs throughout • Failures disturbs all A/C area. • A/C system - worked out - including future expansion • Economical for large areas • Remote plant rm - eliminate noise, vibration • Easy maintenance		3	
10)	Sensible heat factor • Heat added during a Psychometric process can be split in to sensible heat and latent heat $SHF = \frac{Sensible\ heat}{total\ heat}$, $SHF = \frac{sensible\ heat}{sensible\ heat + latent\ heat}$ 		3	
III	**PART C**			42
III	 (a) p-v diagram. (b) T-s diagram.	2	7	
	$q_A = q_{4-1} =$ Area 4–1–2′–3′ $= T_4(s_1 - s_4) = T_4(s_2 - s_3) = T_1(s_2 - s_3)$ We know that work done during the cycle per kg of air $w_R =$ Heat rejected – Heat absorbed $= q_R - q_A = q_{2-3} - q_{4-1}$ $= T_2(s_2 - s_3) - T_1(s_2 - s_3) = (T_2 - T_1)(s_2 - s_3)$ ∴ Coefficient of performance of the refrigeration system working on reversed Carnot cycle $(C.O.P.)_R = \frac{\text{Heat absorbed}}{\text{Work done}} = \frac{q_A}{q_R - q_A} = \frac{q_{4-1}}{q_{2-3} - q_{4-1}}$	5		
	$= \frac{T_1(s_2 - s_3)}{(T_2 - T_1)(s_2 - s_3)} = \frac{T_1}{T_2 - T_1}$			

IV	1. *C.O.P.* We know that $$(C.O.P.)_R = \frac{T_1}{T_2 - T_1} = \frac{258}{308 - 258} = 5.16 \text{ Ans.}$$ *2. Heat rejected from the system per hour* Let W_R = Work or power required to drive the system. We know that $(C.O.P.)_R = \frac{Q_1}{W_R}$ $$\therefore \quad W_R = \frac{Q_1}{(C.O.P.)_R} = \frac{2520}{5.16} = 488.37 \text{ kJ/min}$$ and heat rejected from the system, $Q_2 = Q_1 + W_R = 2520 + 488.37 = 3008.37$ kJ/min $= 3008.37 \times 60 = 180\,502.2$ kJ/h Ans.		7	
V	 Fig. 9.3. *Simple Vapour Absorption Refrigeration System*	4	7	
	WORKING-EXPLANATION	3		
VI	*Advantages* 1. It has smaller size for the given capacity of refrigeration. 2. It has less running cost. 3. It can be employed over a large range of temperatures. 4. The coefficient of performance is quite high. *Disadvantages* 1. The initial cost is high. 2. The prevention of leakage of the refrigerant is the major problem in vapour compression system.	7	7	
VII	 	4	7	
	WORKING	3		
VIII	 	4	7	
	WORKING	3		

IX		4	7	
	WORKING	3		
X		4	7	
	WORKING	3		
XI	The initial condition of air, *i.e.* 28° C dry bulb temperature and 17° C wet bulb temperature is marked on the psychrometric chart at point 1, as shown in Fig. 16.23. Now mark the final condition of air by drawing a horizontal line through point 1 (because there is no change in moisture content of the air) to meet the 15° C dry bulb temperature line at point 2, as shown in Fig. 16.23.  Fig. 16.23 *1. Original relative humidity* From the psychrometric chart, we find that the original relative humidity at point 1, $\phi_1 = 34\%$ Ans. *2. Final relative humidity* From psychrometric chart, we find that the final relative humidity at point 2, $\phi_2 = 73\%$ Ans. *Final wet bulb temperature* From the psychrometric chart, we find that the final wet bulb temperature at point 2, $t_{w2} = 12.2°$ C Ans.	4	7	
XII		4	7	

	WORKING	3		
XIII	$v_{s1} = 0.9$ m³ / kg of dry air — we find that specific volume at point 1. Enthalpy of air at point 1, $h_1 = 90$ kJ / kg of dry air Enthalpy of air at point 2, $h_2 = 48$ kJ / kg of dry air and enthalpy of air at point 3, $h_3 = 58$ kJ / kg of dry air We know that mass of air supplied per min, $m_a = \frac{V_1}{v_{s1}} = \frac{10}{0.9} = 11.1$ kg / min and sensible heat removed from the air $= m_a (h_3 - h_2) = 11.1(58 - 48) = 111$ kJ / min $= 111 \times 60 = 6660$ kJ / h ∴ Total sensible heat of the room, $SH = 6660 + 125\,600 = 132\,260$ kJ / h  Fig. 18.12 We know that latent heat removed from the air $= m_a (h_1 - h_3) = 11.1(90 - 58) = 355$ kJ / min $= 355 \times 60 = 21\,300$ kJ / h ∴ Total latent heat of the room, $LH = 21\,300 + 42\,000 = 63\,300$ kJ / h We know that sensible heat factor, $SHF = \frac{SH}{SH + LH} = \frac{132\,260}{132\,260 + 63\,300} = 0.676$ Ans.		7	
XIV		7	7	

Sensible	Latent
Roofs/Walls – Conduction	Moisture from Ventilation/ Infiltration
Roofs/Walls – Radiation	Moisture from People
Skylights/Windows – Conduction	Moisture from Miscellaneous Equipment
Skylights/Windows – Radiation	
Ventilation/Infiltration	
Lights	
People	
Miscellaneous Equipment	