

Refrigeration and Air conditioning tables and charts belong the students are allowed.

Answer all the following Questions

Question (1) (5+10 = 15 Marks)

- a- Explain the effect of condenser temperature on the following:
- i- Refrigeration effect
 - ii- Refrigerant mass flow rate.
 - iii- Volumetric efficiency
 - iv- Power
 - v- C.O.P.
- b- A window air conditioning unit uses R-22 as a refrigerant to reserve the inside temperature of a room at 25 °C in summer. The evaporation and condensation temperatures are 17 °C & 42 °C respectively. The compressor is single acting and has two cylinders of 90% volumetric efficiency. The compressor motor consumes 3 kW of electric power and runs at 900 r.p.m. Find:
- i) Unit R.C.
 - ii) Cylinder dimensions for (L/D = 1.25).

Question (2) (5+10 = 15 Marks)

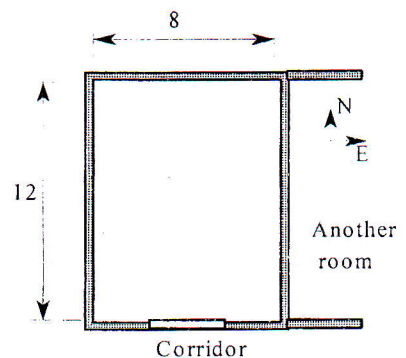
- a) Explain, how is the two stages compressor with flash intercooler increases the C.O.P.
- b) A vapor compression system uses R-134a as a refrigerant for cooling load of 20 T.R. The evaporator pressure is 1.2 bar while that of condenser is 10 bar. Isentropic compression is considered. One flash inter-cooler is installed between the evaporator and condenser at 4 bar. Find the power required and the C.O.P. of the system.

Question (3) (7+8 = 15 Marks)

- a) Prove that, the C.O.P. of an absorption refrigeration system is lower than that of mechanical vapor compression system and explain the method of increasing the C.O.P. of the absorption refrigeration system.
- b) An absorption refrigeration plant uses ammonia as a refrigerant to produce 20 T.R capacity at C.O.P = 0.5. The evaporation and condensation temperatures are -25 °C and 45 °C. Amount of heat rejected by condenser is 110 kW. Electric power consumed by the pump is 5 kW. Find the following:
- a - Type of the absorbent could be used.
 - b - Amount of heat removed in the absorber.
 - c - The suitable temperature of generator.

Question (4) (5+10 = 15 Marks)

- a- State the trade name of the following refrigerants:
 $C Cl_2 F_2$, $C H Cl F_2$, $C_2 Cl F_5$, $C_2 H_2 F_4$, NH_3 .
- b- In a factory of food manufacturing and storing at Cairo, frozen chickens at -18 °C are received to be stored at the same temperature in a room of inside dimensions of 8×12×6 m. The plan of the room is shown in the figure. The room lies in the second floor. All walls of the room are made of 10 cm polyurethane panel while the ceiling and the floor are



made of concrete and insulated with the same insulation used for walls. Maximum storing weight in the room is 200 tons. State the operating temperature of the required refrigeration system and calculate the refrigeration capacity of it.

Question (5) 10 Marks

A summer air conditioning system with outside condition of 38 °C dbt, 40 % RH and inside condition of 25 °C dbt, 50 % RH. The conditioned space has sensible heat load of 153 kW and total load of 180 kW. The re-circulated air contains 40 % of fresh air by mass basis and supplied to the conditioned space at 18 °C dbt. Represent the air processes on psychrometric chart and determine the following:

- a) Room sensible heat factor, RSHF.
- b) Supply air mass flow rate in kg/s.
- c) Cooling capacity in TR.
- d) Apparatus dew point temperature.
- e) Bypass factor, BPF.

Question (6) 10 Marks

A conference room has dimensions of 20×15×5 m. The external and internal loads except ventilation, infiltration and human loads are 0.18 kW/m² of floor area. The room is maintained at 25 °C dbt, 50 % R.H, and ambient condition of 38 °C dbt, 40 % R.H. The number of nonsmoking persons is 100. The air density and specific heat are 1.18 kg/m³ & 1.005 kJ/kg.K. The water evaporation heat is 2545 kJ/kg. Calculate the total cooling load and room sensible heat factor.

Question (7) 10 Marks

For air duct system shown below, if the velocity in main duct is 6 m³/s, using equal friction method to calculate the following:

1. The pressure drop per unit length in main duct A → B
2. The diameter and velocity in each branch, and record the results in the following table.

$\Delta P/L =$ (Pa/m)				
L (m)	Q (m ³ /s)	V (m/s)	d (m)	Q _{cal} (m ³ /s)
A-B				
B-C				
B-D				
C-E				
B-F				
C-G				

With our best wishes.

This exam measures the following ILOs															
Question Number	Q1,Q6	Q2,Q3	Q4,Q5	Q7		Q1, Q2, Q5	Q3	Q4	Q6	Q7	Q1	Q2	Q3	Q4	Q5
Skills	a14-1, a14-2	a14-3	a14-4	a14-7		b2-1, b2-2	b2-3	b13-1	b13-3		c4-1	c5-1	C8-1		
	Knowledge & Understanding Skills					Intellectual Skills					Professional Skills				