Total No. of Questions : 10]

SEAT No. :

P1853

[Total No. of Pages : 5

[4859]-1014

B.E. (Mechanical Engineering)

REFRIGERATION AND AIR-CONDITIONING

(2012 Course) (Semester - I) (402041)

Time : $2\frac{1}{2}$ Hours] *[Max. Marks :70*

Instructions to the candidates:

1) ***Neat diagrams must be drawn wherever necessary.***
2) ***Figures to the right indicate full marks.***
3) ***Use of logarithmic tables slide rule, mollier charts, electronic pocket calculator and steam tables is allowed.***
4) ***Assume suitable data, if necessary.***

Q1) a) A Carnot refrigerator requires 1.2 kW per ton of refrigeration to maintain a temperature of -35°C. Determine. **[6]**

i) COP of the refrigerator

ii) The temperature at which the heat is rejected

iii) COP, if the cycle is used as a heat pump

b) Discuss the necessity of phasing out of CFC refrigerants. List the alternative refrigerants. **[4]**

OR

Q2) a) A dense closed cycle refrigeration system operating between 4 bar & 16 bar extracts 126 MJ/hr. of heat from the cold chamber. Air enters the compressor at 5°C & into the expander at 20°C. Assuming compression & expansion to be isentropic, C_p=1.005 kJ/kg K, and γ= 1.4 determine: **[6]**

i) Power required.

ii) Capacity of the plant in TR.

b) What is sub-cooling? Explain the effect of sub-cooling of condensate with the help of T-s and P-h diagrams in VCC **[4]**

Q3) a) An ammonia refrigerator operates between-16°C and 50°C. The vapour is dry-saturated at the entry of the compressor and compression is isentropic. Assuming there is no undercooling, Determine **[6]**

i) The mass flow rate and powar input per kW of refrigeration

ii) COP of the system.

(Refer p-h chart attached)

b) Mention the functions of each fluid in a three fluid vapour absorption system (Electrolux refrigerator) **[4]**

OR

P.T.O.

Q4) a) A vapour compression refrigeration system operates between -10°C and 45°C . The refrigerant is dry-saturated at the entry of the compressor and attains 102°C after compression. The temperature of liquid refrigerant at the entry of throttle valve is 35°C. C_{pl}=1.62 kJ/kg K **[6]**

Determine COP of the system.

Use following properties of the refrigerant

Sat. Temp. (T_{sat}) (°C)	Specific enthalpy (kJ/kg)		Specific entropy (kJ/kg K)	
	h_f	h_g	s_f	s_g
-10	45.4	460.7	0.183	1.762
45	133	483.6	0.485	1.587

b) Why is flash intercooler used in multistage compression? **[4]**

Q5) a) 1.5 m^3/s of moist air at a state of 28°C dry-bulb, 21°C wet-bulb and 101.325 kPa flows across a cooler coil and leaves the coil at 13°C dry-bulb and specific humidity of 8.5 gm per kg of dry air. Determine the apparatus dew point, the contact factor and the cooling load. **[5]**

b) Define: RSHF, GSHF and ESHF. Explain the procedure to draw the lines of RSHF, GSHF and ESHF on psychrometric chart. **[7]**

c) Explain the ASHRAE comfort chart showing the comfort zones for winter and summer. **[6]**

OR

Q6) a) Define and explain the following: **[8]**

i) Humidity ratio

ii) Dew point temperature

iii) Relative humidity

iv) Wet bulb temperature

b) Moist air at a state of 21°C dry-bulb, 15°C wet-bulb and 101.325 kPa barometric pressure enters a spray chamber. If, for each kilogram of dry air passing through the chamber, 0.002 kg of water at 100°C is injected and totally evaporated, calculate the moisture content, enthalpy and dry-bulb temperature of the moist air leaving the chamber. **[5]**

c) Define Indoor Air quality. Discuss sources of pollutants in occupied room. **[5]**

Q7) a) Classify the air conditioning systems. Compare all air-air conditioning system with all water-air conditioning system. **[8]**

b) With neat diagram explain the working of single screw compressor. What are the advantages of it over reciprocating compressor? **[8]**

OR

Q8) a) With neat schematic explain the variable air volume air conditioning system. What are the advantages over constant volume system? **[8]**

b) Draw the constructional diagram for TXV and explain its working. What are the limitations TXV? **[8]**

Q9) a) Explain in brief the different types of filters used in air conditioning. **[6]**

b) Determine the duct sizes of the duct system as shown in Fig.1 using equal friction method. Determine the FTP and dampering required at each branch. Assume the velocity in main duct A as 300 mpm. Also dynamic loss coefficient in elbow k=0.22. Use static regain factor R=0.75. **[10]**

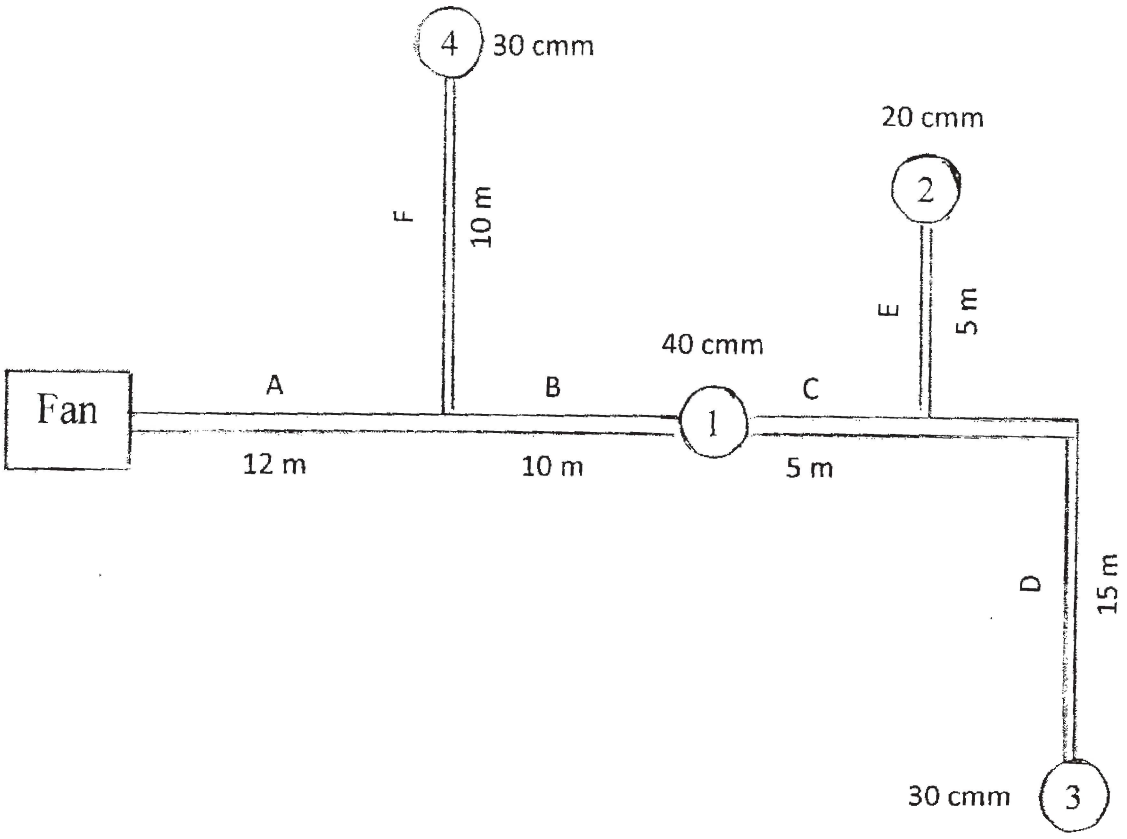


Fig. 1 - for Q. 9 b)

OR

Q10)a) Explain step by step the static regain method of duct design. List commonly used duct materials. **[10]**

b) A 600 mm x 400 mm size duct carries 90 cmm of air having density of 1.2 kg/m^3. Determine the equivalent diameter of the circular duct: **[6]**

i) If the quantity of air carried in both the cases is same.

ii) If the velocity of air in both the cases is the same.

If friction factor, f = 0.011, find the pressure loss per 100 m length of duct. Find air power required.

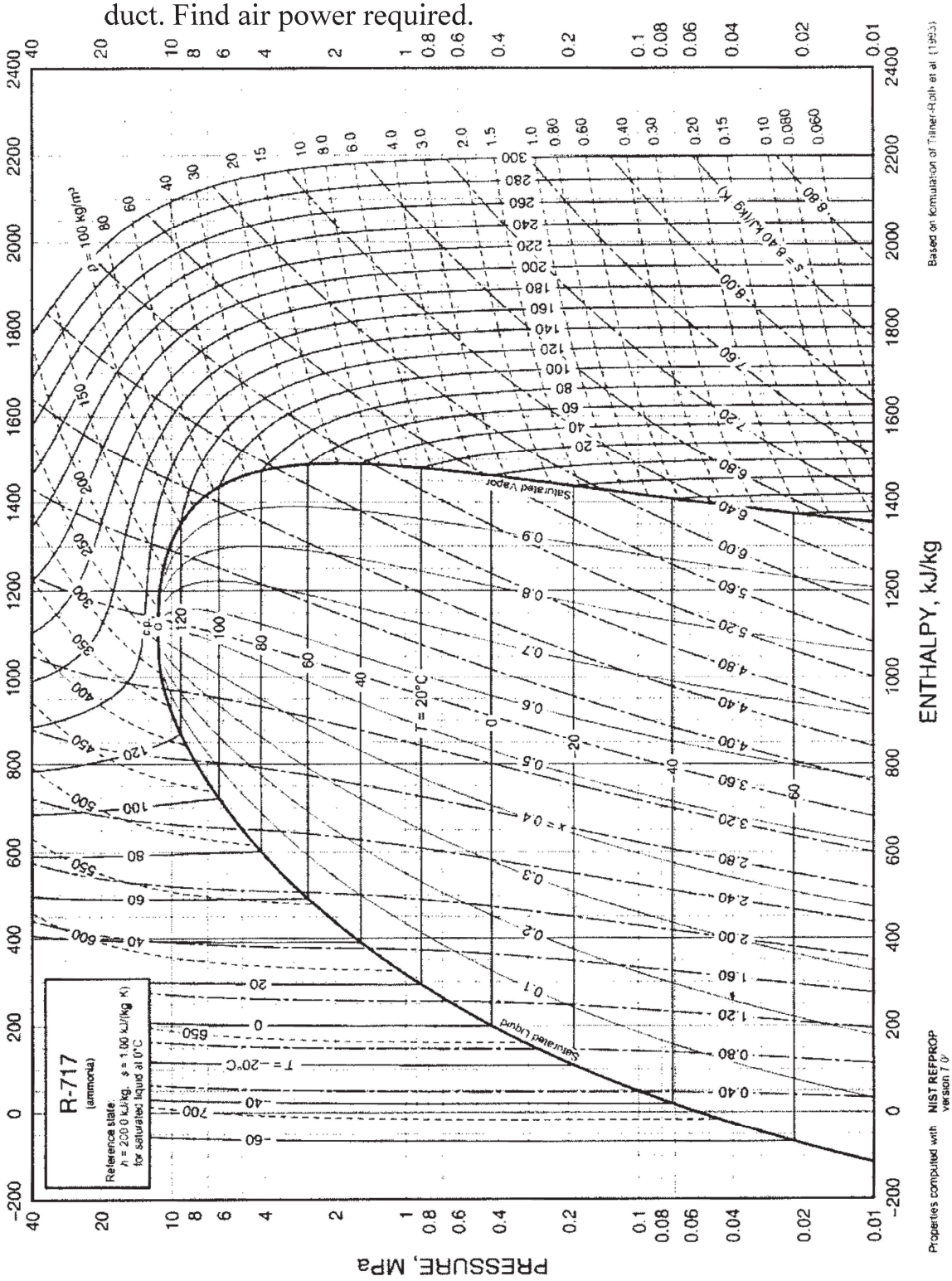
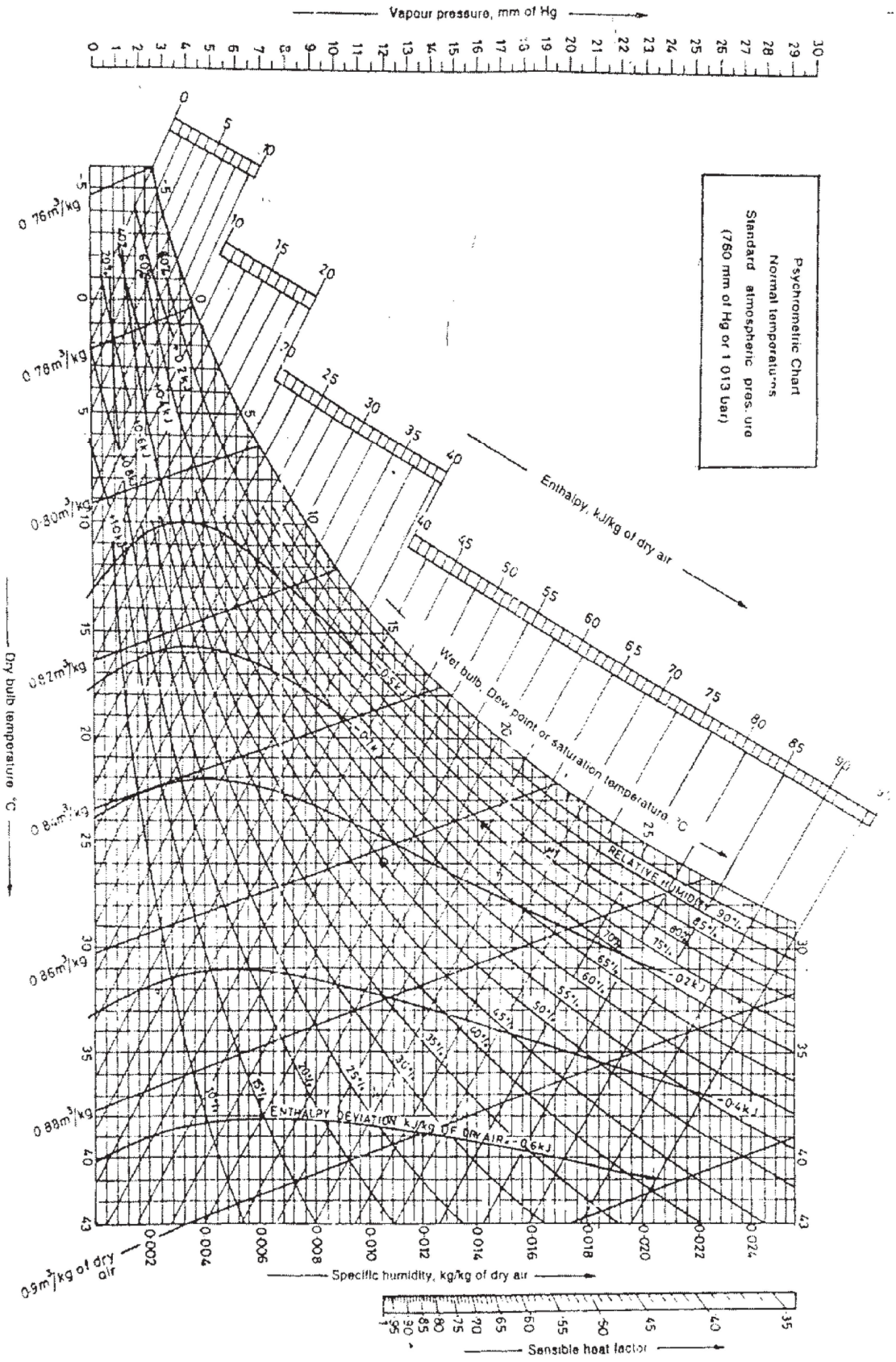


Fig. 16 Pressure-Enthalpy Diagram for Refrigerant 717 (Ammonia)


Vapour pressure, mm of Hg
Psychrometric Chart
Normal temperatures
Standard atmospheric pressure
(760 mm of Hg or 1 013 bar)
Enthalpy, kJ/kg of dry air
Wet bulb, Dew point or saturation temperature, °C
Dry bulb temperature, °C
RELATIVE HUMIDITY
ENTHALPY DEVIATION kJ/kg OF DRY AIR
Specific humidity, kg/kg of dry air
Sensible heat factor