Total No. of Questions : 12]

SEAT No. :

P1374

[Total No. of Pages : 7

[4858] - 120

T.E. (Mechanical)

REFRIGERATION AND AIR-CONDITIONING

(2008 Pattern) (Semester - II)

Time : 3 Hour] *[Max. Marks : 100*

Instructions to the candidates:

1) ***Answers to the two sections should be written in separate answer books.***
2) ***Answer any three questions from each section.***
3) ***Neat diagrams must be drawn wherever necessary.***
4) ***Figures to the right side indicate full marks.***
5) ***Use of calculator is allowed.***
6) ***Use of psychrometic chart is allowed.***
7) ***Assume suitable data if necessary, state clearly he assumption made.***

SECTION - I

Q1) a) Explain : **[8]**

i) Vortex tube refrigeration

ii) Thermoelectric refrigeration

b) A refrigeration system operated on Bell Coleman cycle produces 20 kW with cooler pressure of 11 bar and refrigerated space at 1.05 bar. The temperature of air leaving the cooler is 38°C and the air suction to compressor is 16°C. Calculate **[8]**

i) mass of air circulated per min.

ii) compressor and expander displacement

iii) COP

iv) kW/TR

OR

Q2) a) Explain various processes in Bell-Coleman cycle. Derive the expression for COP of Bell Coleman cycle. **[8]**

P.T.O.

b) A cold storage is to be maintained at –5°C while surrounding are at 35ºC. The heat transfer from the surrounding into the cold storage is estimated to be 29 kW. The actual COP of the refrigeration plant is 1/3rd of an ideal COP of the plant working between the same temperature. Find actual COP and power required to drive the plant. Determine percent change in COP and power required when surrounding temperature is 55°C keeping all other conditions same. **[8]**

Q3) a) Draw actual vapour compression cycle on T-s and p-h diagram. Explain the various losses in VCC. **[8]**

b) A refrigeration plant of 100 TR capacity uses R-22 as refrigerant. The evaporator temperature is -30°C and condensing temperature is 30°C. The refrigerant enters the condenser as dry saturated and leaves the condenser, subcooled by 10°C. If Actual COP is 70% of the theoretical, find : **[8]**

i) theoretical and actual COP

ii) mass circulation of R-22 in kg/s

iii) power input to compressor

Use following properties of R-22.

T_s, °C	p, bar	h_f, kJ/kg	h_g, kJ/kg	S_f, kJ/kgK	S_g, kJ/kgK
-30	1.64	116.1	393.1	0.8698	1.803
+30	11.82	236.7	414.5	1.125	1.712

C_{pv} = 0.55 kJ/kgK, C_{pl} = 1.19 kJ/kgK.

OR

Q4) a) Explain the use of the following in VCRS. **[6]**

i) accumulator

ii) receiver

iii) suction line heat exchanger

b) With neat schematic explain the water-ammonia vapour absorption refrigeration system. Why deflagmeter is used in this system? Compare water-ammonia system with Li-Br system. **[10]**

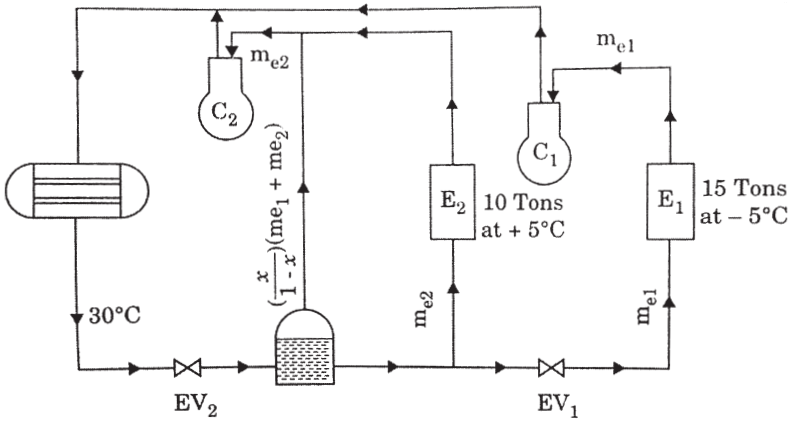
Q5) a) Classify the refrigerants. Explain the desirable properties of refrigerant when considered for VCRS. **[8]**

b) A refrigeration system as shown on Fig. with R-12 as refrigerant. Find the following : **[10]**

i) power required to run the system

ii) COP

iii) Mass circulation in each evaporator, kg/min



OR

Q6) a) A 25 TR two stage VCRS with flash chamber -as flash gas removal operates with ammonia as refrigerant. The evaporating and condensing temperature are -30°C and 40°C respectively. Estimate COP and power input. **[10]**

What is percent change in compressor work if compression is carried out in single stage?

b) Explain ODP and GWP of refrigerants. What are the alternatives to R- 12 refrigerant? **[8]**

SECTION - II

Q7) a) Explain comfort chart. **[6]**

b) Define : **[6]**

i) RSHF,

ii) ESHF and

iii) ADP

c) Write a note on Evaporative Cooling. What is saturating efficiency? **[6]**

OR

Q8) a) Define : **[4]**

i) wet bulb temperature and

ii) specific humidity with their notations and units.

b) Write a note on ventilation requirement and infiltration air. **[6]**

c) In an industrial air conditioning system, 20 cmm of air at 30°C DBT, 75% RH is first cooled and dehumidified and then heated to obtain 20°C DBT and 60% RH. **[8]**

Show the process on the psychrometric chart and find :

i) Cooling coil capacity in TR,

ii) Capacity of the heating coil in kW,

iii) Amount of water removed from air.

Q9) a) Compare unitary and central air conditioning systems. **[6]**

b) Write a note on 'All Air System'. **[5]**

c) Explain any one expansion device used in refrigeration and air conditioning. **[5]**

OR

Q10) a) What are the different types of condensers used in refrigeration and air conditioning? Explain any one with neat sketch. **[8]**

b) Name the different types of compressors and evaporators used in refrigeration and air conditioning. **[3]**

c) Explain summer air conditioning. **[5]**

Q11) a) What are the different methods for designing ducts? Explain any one. **[7]**

b) Write a note on cold storage. **[4]**

c) Calculate the frictional drop through 40 m of 30 cm x 50 cm rectangular duct for flow rate of 100 m^3 per minute at a density of 1.2 kg/m^3. Assume friction factor of 0.005. **[5]**

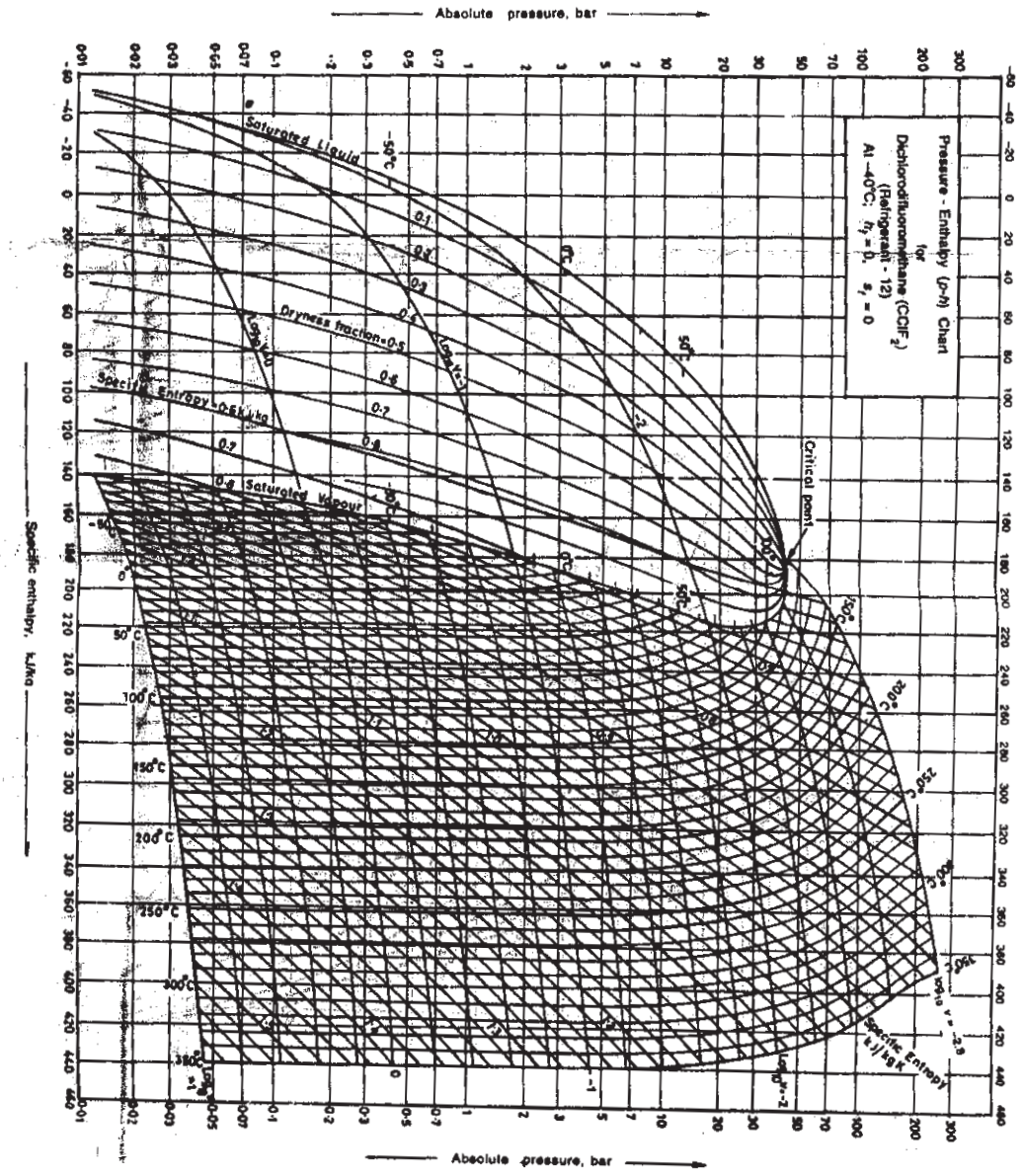
OR

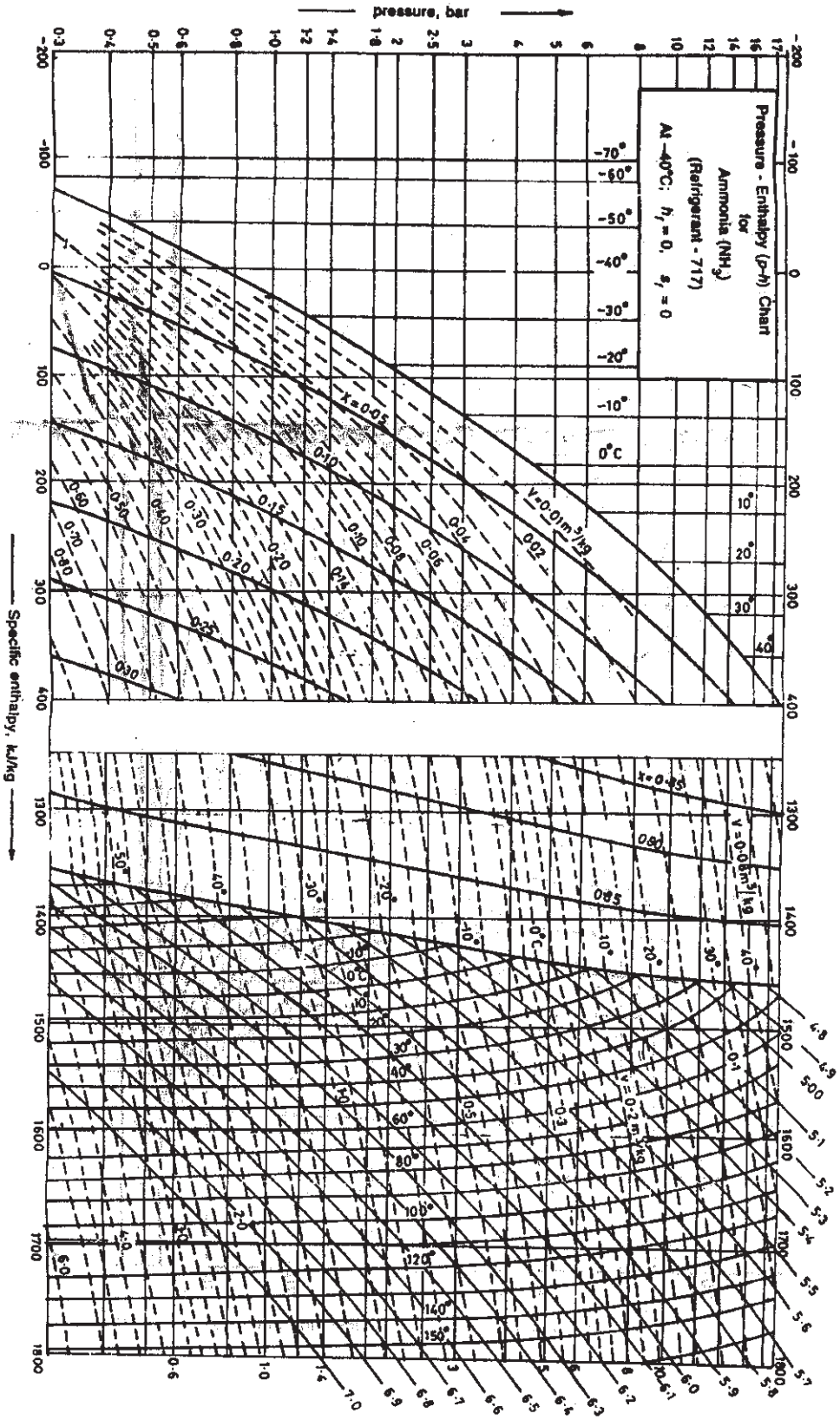
Q12) a) How ducts are classified? **[4]**

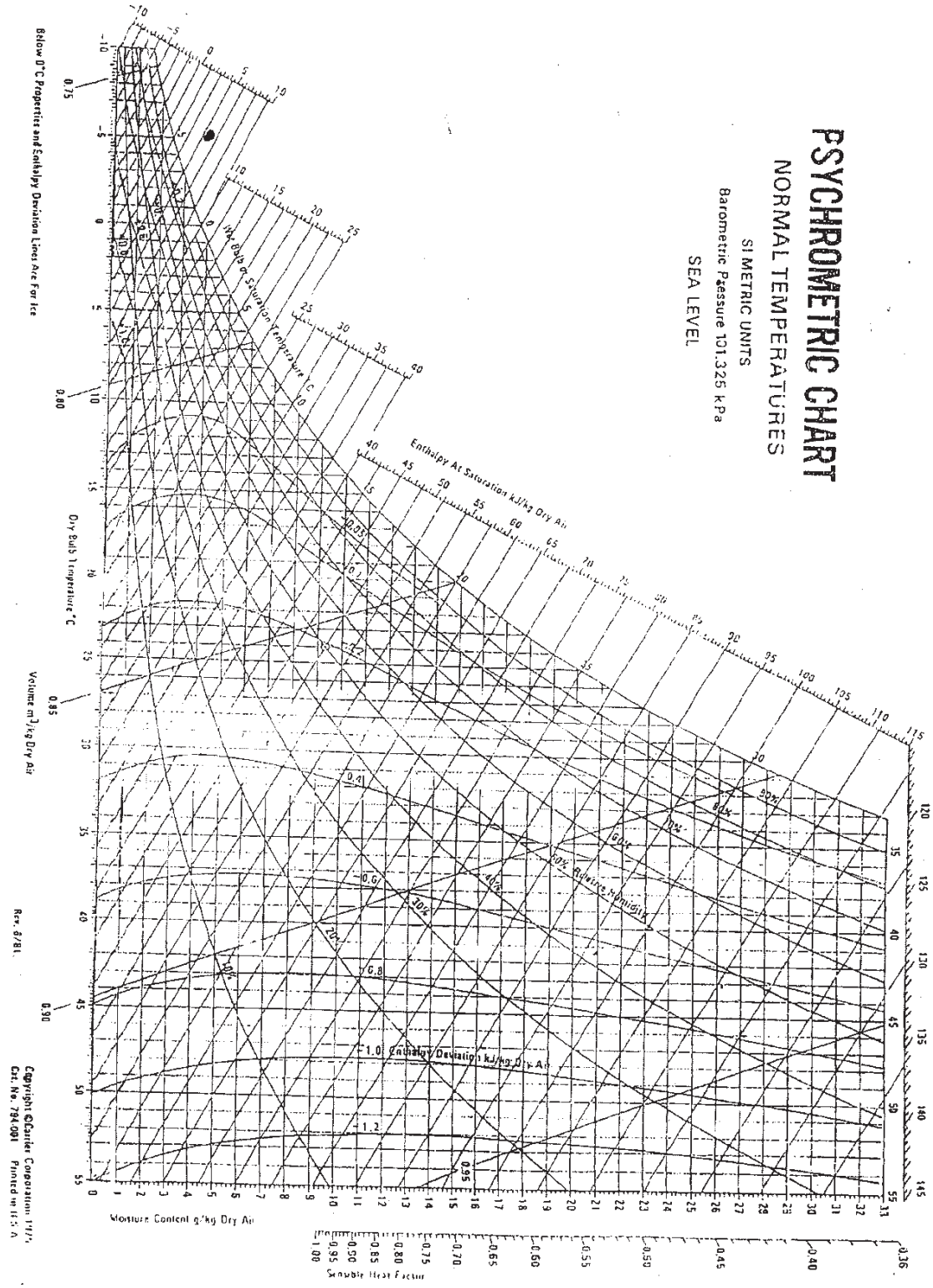
b) Prove that for a rectangular duct of side a and b, the equivalent diameter D of a circular duct for same flow velocity is given by **[6]**

$$D = \frac{2ab}{a+b}$$

c) Discuss the various methods of food preservation. **[6]**


Absolute pressure, bar
Pressure - Enthalpy (p-h) Chart
for
Dichlorodifluoromethane (CCl2F2)
(Refrigerant - 12)
At -40°C; h1 = 0, s1 = 0
Saturated Liquid
Saturated Vapour
Dryness fraction=0·5
Specific Entropy=0·5 kJ/kg
Critical point
Specific enthalpy, kJ/kg
Specific Entropy kJ/kg K
Absolute pressure, bar


pressure, bar
Specific enthalpy, kJ/kg
Pressure - Enthalpy (p-h) Chart
for
Ammonia (NH_3)
(Refrigerant - 717)
At −40°C: $h_f = 0$, $s_f = 0$


PSYCHROMETRIC CHART
NORMAL TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL
Below 0°C Properties and Enthalpy Deviation Lines Are For Ice
Wet Bulb or Saturation Temperature °C
Enthalpy At Saturation kJ/kg Dry Air
Dry Bulb Temperature °C
Volume m³/kg Dry Air
Relative Humidity
Enthalpy Deviation kJ/kg Dry Air
Moisture Content g/kg Dry Air
Sensible Heat Factor
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