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CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
JANUARY 2014 SESSION

SUBJECT CODE	:	FRD 10103
SUBJECT TITLE	:	REFRIGERATION FUNDAMENTAL & TOOLS
LEVEL	:	DIPLOMA
TIME / DURATION	:	3.30 pm - 6.30 pm (3 HOURS)
DATE	:	28 MAY 2014

INSTRUCTIONS TO CANDIDATES

1. Please read the instructions given in the question paper CAREFULLY.
2. This question paper is printed on both sides of the paper.
3. Please write your answers on the answer booklet provided.
4. Answer should be written in blue or black ink except for sketching, graphic and illustration.
5. This question paper consists of TWO (2) sections. Section A and B. Answer all questions in Section A. For Section B, answer 3 questions only
6. Answer all questions in English.
7. Mollier and Psychrometric chart is appended must be submitted together with question booklet

THERE ARE 10 PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

SECTION A (Total: 25 marks)

INSTRUCTION: Answer ALL questions.
Please use the answer booklet provided.

1. What is the definition of temperature?
   A. The intensity of molecular motion.
   B. The measurement of heat in a liquid.
   C. The measurement of heat in gas.
   D. The measurement of heat in an object.

2. What are the four common temperature scales?
   A. Rankine, Fahrenheit, Celsius, and Centigrade
   B. Centigrade, Fahrenheit, Celsius, and Kelvin.
   C. Fahrenheit, Rankine, Celsius, and Kelvin.
   D. Absolute, Kelvin, Centigrade, and Fahrenheit.

3. Which temperature scale freezes water at 32o and boils water at 212o?
   A. Centigrade
   B. Fahrenheit
   C. Kelvin
   D. Absolute

4. Which temperature scale freezes water at 0o and boils water at 100o??
   A. Centigrade
   B. Fahrenheit
   C. Kelvin
   D. Absolute

5. One ton of refrigerant is:
   A. 33,000 Btu per hour
   B. 12,000 Btu per hour
   C. 746 Btu per hour
   D. 200 Btu per hour

6. What type of heat is absorbed or extracted from a substance when the substance change state?
   A. Specific heat
   B. Latent heat
   C. Sensible heat
   D. Super heat

7. When the substance change from a liquid to a gas, this is known as :
   A. Latent heat of condensation
   B. Sensible heat of a vapor
   C. Latent heat of sublimation
   D. Latent heat of vaporization

8. When the substance is change from the gas to a liquid, this is known as:
   A. Latent heat of condensation
   B. Sensible heat of a vapour
   C. Latent heat of sublimation
   D. Latent heat of vaporization

9. When the substance is change from a solid to a gas, this is known as:
   A. Latent heat of condensation
   B. Sensible heat of a vapour
   C. Latent heat of sublimation
   D. Latent heat of vaporization

10. In a refrigeration system, heat is absorbed by?
   A. The latent heat of condensation in the condenser.
   B. The latent heat of vaporization in the evaporator
   C. The latent heat of vaporization in the condenser.
   D. The latent heat of condensation in the evaporator.

11. In a refrigeration system, heat is rejected by?
   A. The latent heat of condensation in the condenser.
   B. The latent heat of vaporization in the evaporator
   C. The latent heat of vaporization in the condenser
   D. The latent heat of condensation in the evaporator

12. The part of an air conditioning system that changes the refrigerant from a low pressure gas to a high pressure gas is the:
    A. Compressor
    B. Condenser
    C. Metering device
    D. Evaporator

13. The part of an air conditioning system that changes the refrigerant from a high pressure gas to a high pressure liquid is the:
    A. Compressor
    B. Condenser
    C. Metering device
    D. Evaporator

14. Which part of the system stores refrigerant until it is needed in the evaporator?
    A. The accumulator
    B. The surge drum
    C. The receiver
    D. The heat exchanger

15. Which part of the system prevents liquid from entering the compressor?
    A. The moisture
    B. The receiver
    C. The accumulator
    D. The surge drum

16. Which of the following refrigerant is considered an HCFC?
    A. R-12
    B. R-22
    C. R-502
    D. R-134A

17. What are two most common type of compressor used in residential and light commercial air conditioning system?
    A. Reciprocating and rotary
    B. Rotary and scroll
    C. Centrifugal and reciprocating
    D. Reciprocating and scroll

18. Which type of compressor is completely sealed and must be replaced if it has internal damage?
    A. A semi-hermetic
    B. A hermetic
    C. An open type
    D. A centrifugal type

19. How are compressors cooled in residential and light commercial air conditioning systems?
    A. Air motion and water
    B. Refrigerant and water
    C. Refrigerant and air
    D. Refrigerant and oil

20. Which compressor is not internally driven by a motor?
    A. The hermetic
    B. The semi-hermetic
    C. The open type
    D. The closed type

21. What is the purpose of the condenser?
    A. It takes a low – pressure liquid and changes it into a high-pressure liquid
    B. It take a high-pressure gas and changes it into a high-pressure liquid
    C. It takes a low-pressure gas and changes it into a high-pressure gas
    D. It takes a high-pressure liquid and changes it into a high-pressure gas

22. Out of what materials are the tubes on a residential or light commercial air conditioning condenser fabricated? 0.5 to 3 HP are
    A. Aluminum and steel
    B. Iron and steel
    C. Steel and copper
    D. Aluminum or copper

23. A split system condensing unit contains
    A. The compressor, condenser, and metering device.
    B. The condenser, compressor and service valves
    C. The condenser, service valves, and metering device
    D. The condenser, evaporator and service valves

24. What is used to control the flow of water on a water cooled condenser?
    A. A check valve
    B. A pressure reducing valve
    C. A water regulating valve
    D. A float valve

25. The shell of a shell and tube or shell and coil condenser acts as a :
    A. Liquid receiver.
    B. Water storage tank
    C. Purge unit for non-condensable
    D. Sub-cool tank.

SECTION B (Total: 75 marks)

INSTRUCTION: INSTRUCTION: Answer THREE (3) questions only.
Please use the answer booklet provided

Question 1

(a) Describe the definition of air conditioning

(5 marks)

(b) Basic cycle :

I. State four (4) basic components in Air conditioning

(4 marks)

Ii. Describe the function or four (4) basic components in basic cycle

(16 marks)

Question 2

(a) What is the definition of Moiller diagram?

(5 marks)

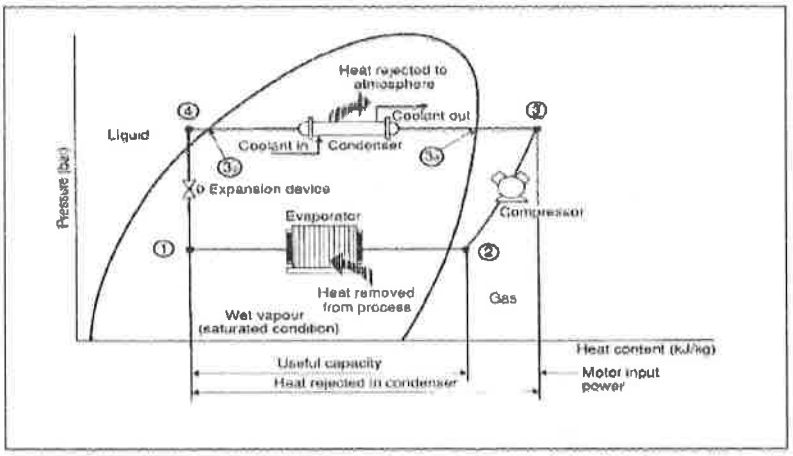


Figure Q2(b): Schematic of a Basic Vapor Compression System

(b) Refer to the figure Q2(b), explain briefly the refrigerant state and pressure for the each stage?

i. Stage 1 – 2

ii. Stage 2 – 3

iii. Stage 3o – 4

iv. Stage 4 – 1

(20 marks)

Question 3

A standard vapor compression cycle of 240V–1Ø/50Hz developing 10 kW of Refrigeration using R-134a operates with Condensing temperature = 45°C,
Evaporating temperature = -10°C
Super Heat = 5K, Sub Cool =5K and Compressor $_{DISCHARGE}$ = 60°C.
Neglect all the pressure losses.

a) Draw on the Refrigeration cycle diagram using Mollier chart (appendix 2) **(Please submit with the answer booklet)**

(7 marks)

b) Determine the compressor suction, saturated vapor temperature, saturated liquid temperature, low pressure and high pressure.

(10 marks)

c) Calculate :

i. The refrigeration effect in (kJ/kg)

(2 marks)

ii. The compressor compression ratio

(2 marks)

iii. The percentage of Flash gas in this system

(2 marks)

iv. Coefficient of performance (COP)

(2 marks)

Question 4

Figure Q4 below shown the cooling coil pass through in Air Handling Unit (AHU) where the volume flow rate is 720 m^3/h which in that temperature entering is 35 ^0C (DB) /75%RH and leaving cooling coil is 15 ^0C (DB) 100% RH

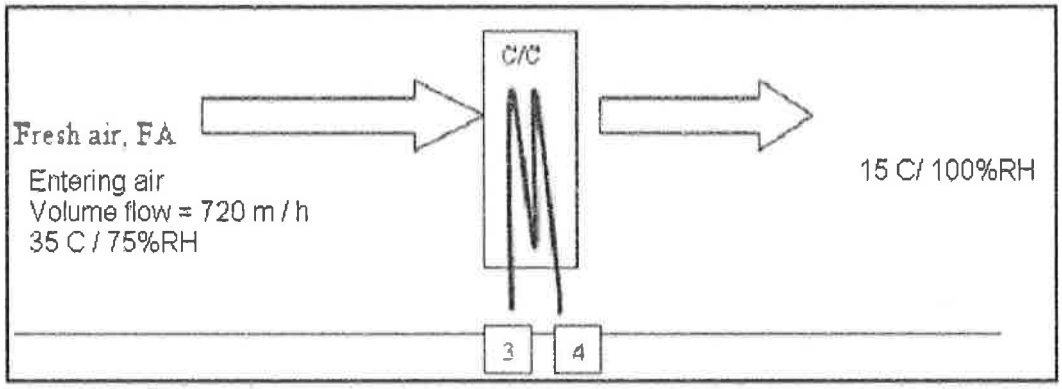


Figure Q4 : Air conditioning process at Cooling coil

(a) Determine the properties for specific volume, wet bulb and enthalpy for fresh air and leaving air by using psychrometric chart. (Appendix 3)
(Please submit with the answer booklet)

(8 marks)

(b) Calculate:

i. The mass flow rate, kg/s

ii. The rate of heat transfer, kW

iii. The rate of dehumidification, kg/h

(9 marks)

(c) Draw on the Refrigeration cycle diagram using Mollier chart R22 (appendix 4)
(Please submit with the answer booklet)

Operating data;

- temperature evaporator = 0 ^0C
- temperature condenser = 40 ^0C
- sub cooling = +5 ^0C
- superheat = +5 ^0C

*Energy balance and isentropic compression

(5 marks)

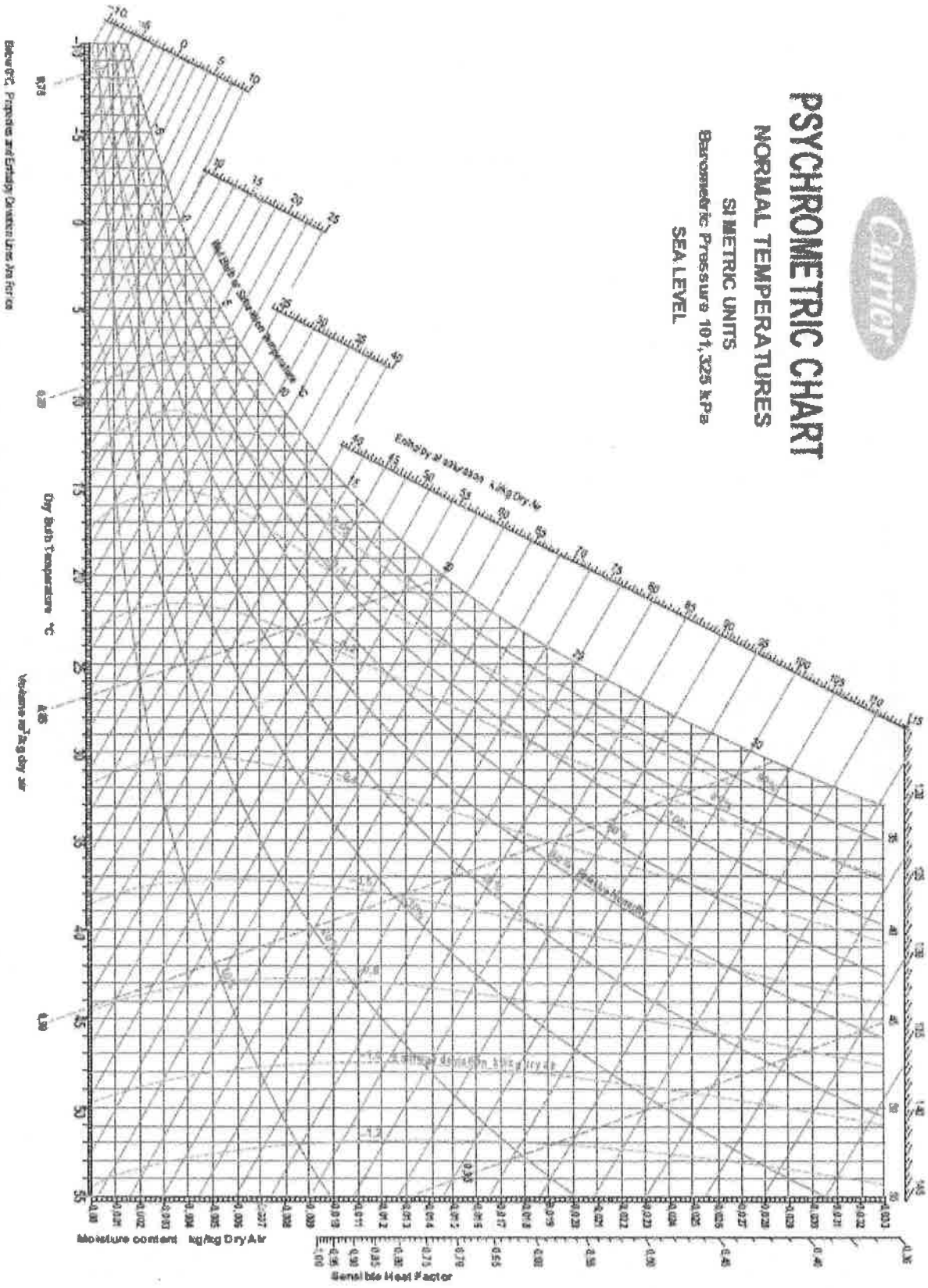
(d) From question 4(b)ii calculate the mass flow rate of refrigerant, kg/s

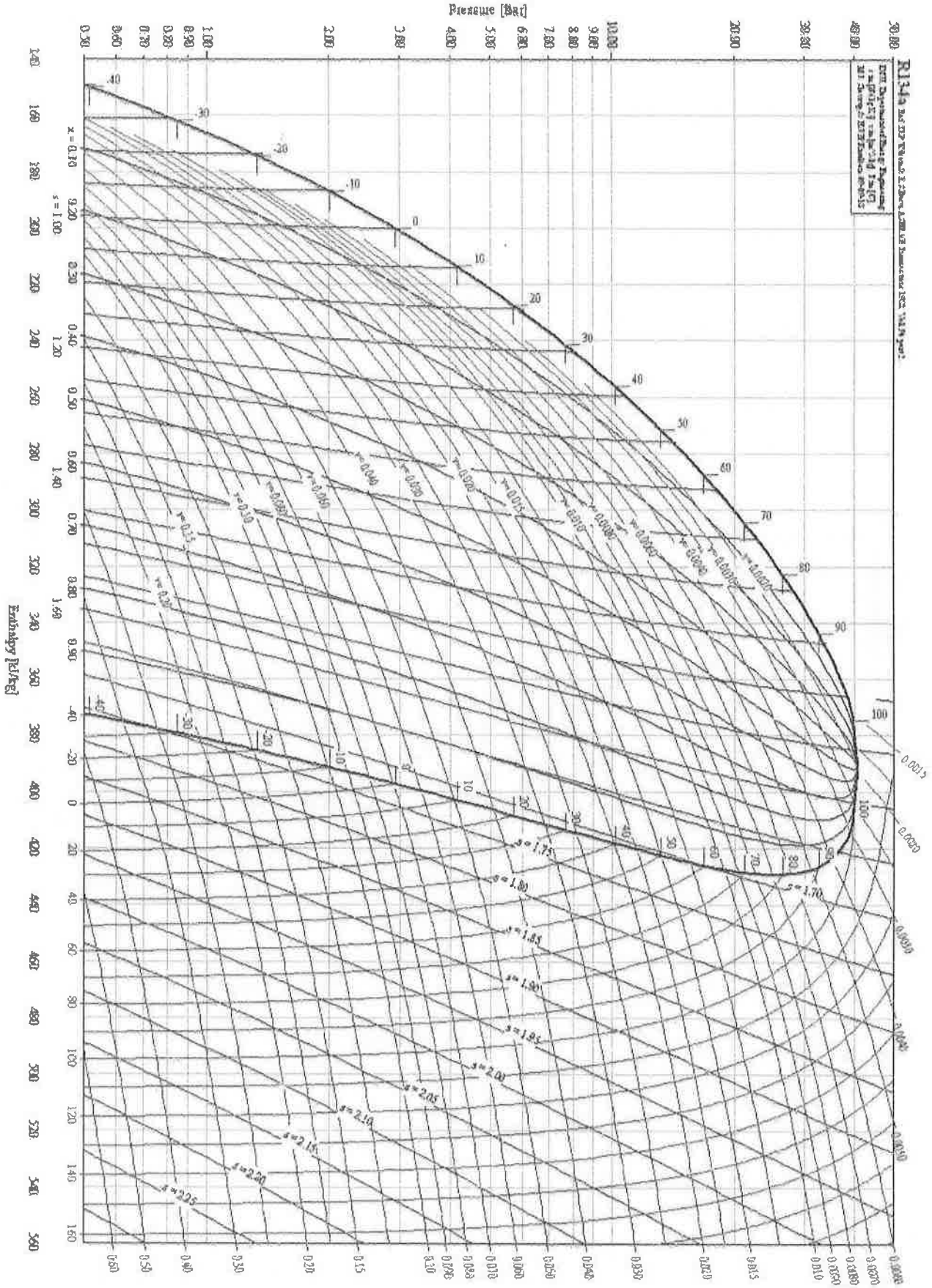
*Capacity from cooling coil (kW) are equal with capacity in refrigeration cycle

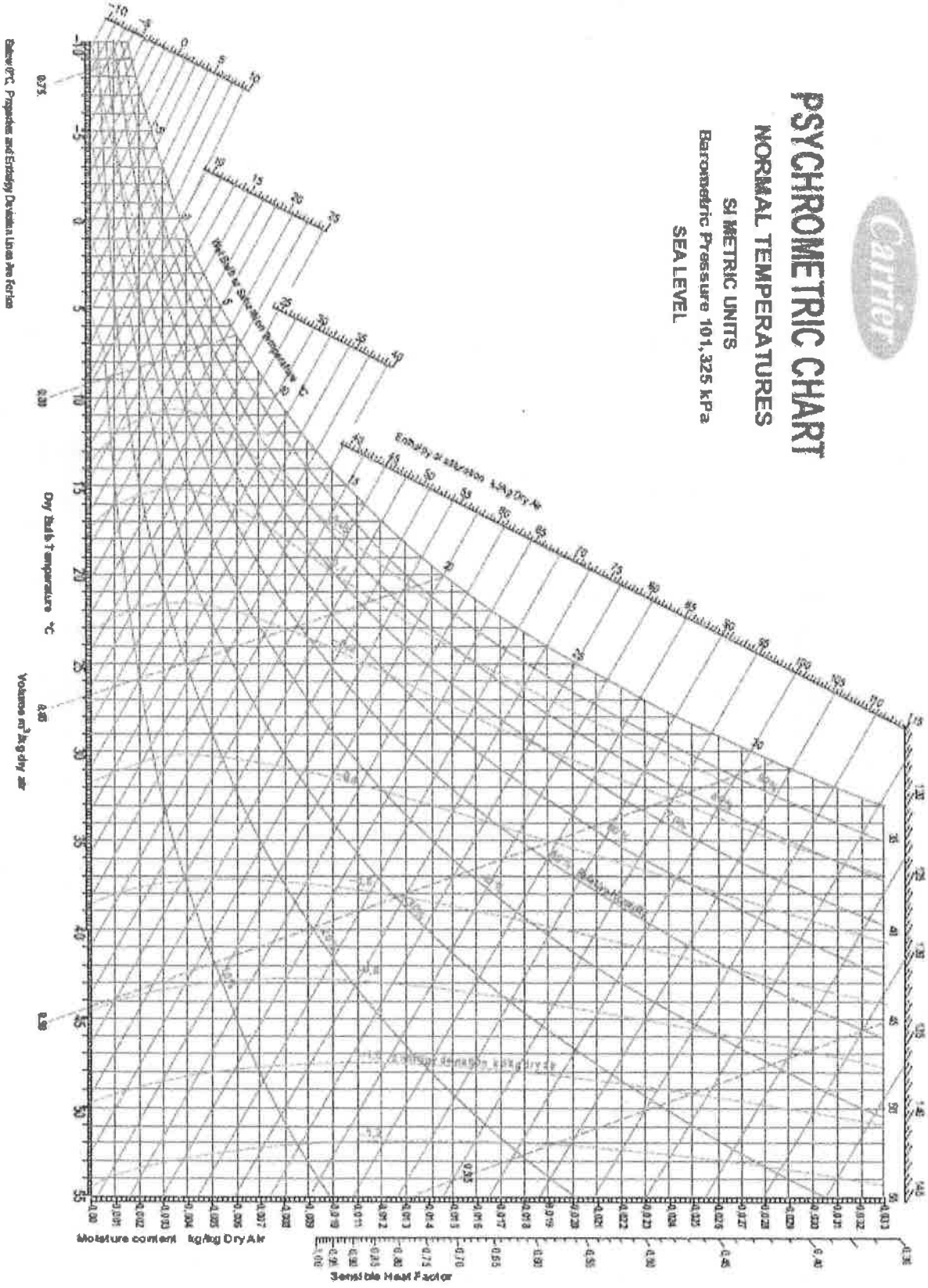
(3 marks)

END OF QUESTION

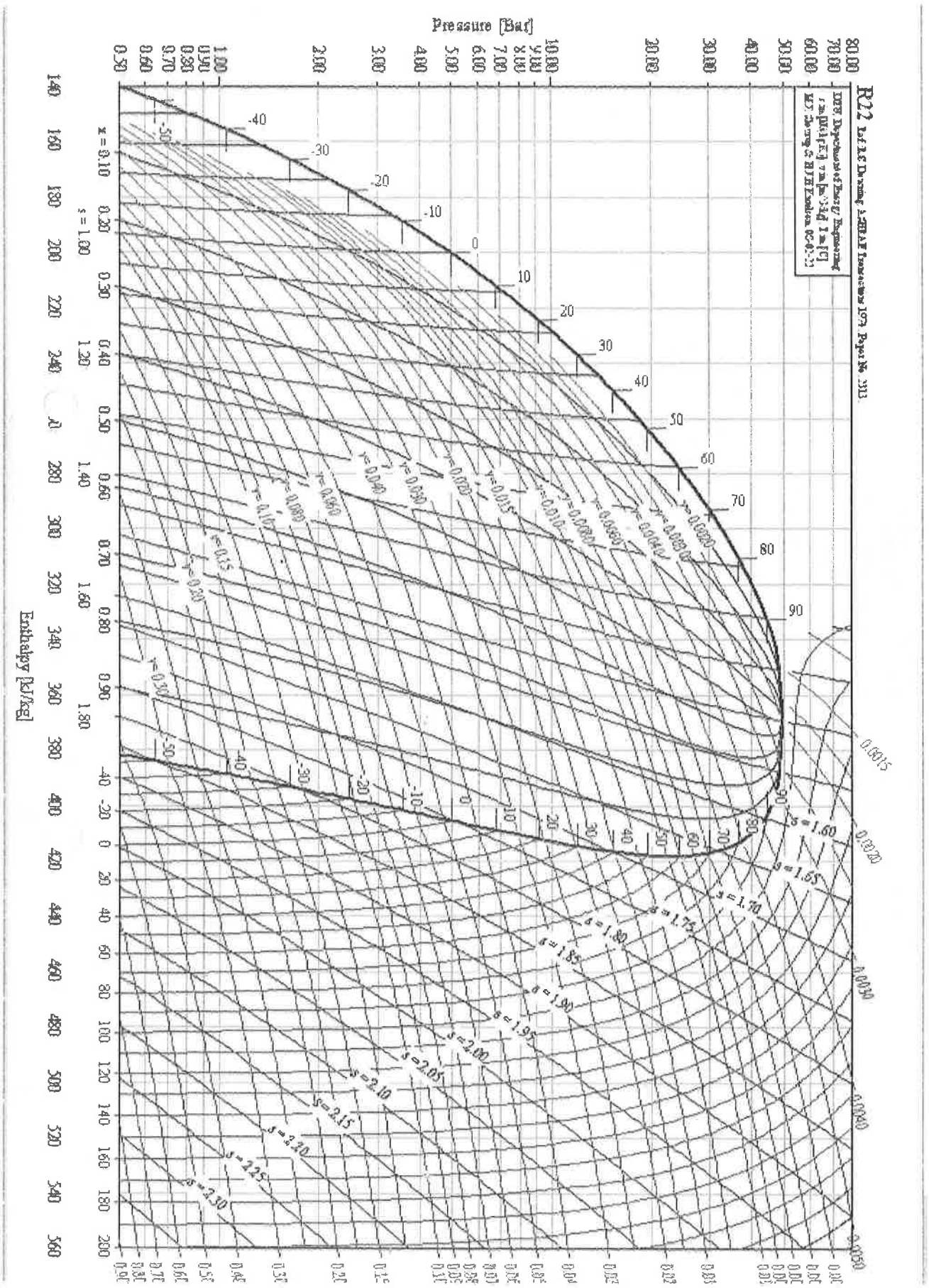
APPENDIX


PSYCHROMETRIC CHART
NORMAL TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL
Carrier
Dry Bulb Temperature °C
Moisture content kg/kg Dry Air
Sensible Heat Factor


Pressure [Bar]
Enthalpy [kJ/kg]
R134a


PSYCHROMETRIC CHART
NORMAL TEMPERATURES
SI METRIC UNITS
Barometric Pressure 101.325 kPa
SEA LEVEL
Carrier
Below 0°C Properties and Enthalpy Deviation Lines Are Kinks
Dry Bulb Temperature °C
Volume m³/kg dry air
Moisture content kg/kg Dry Air
Sensible Heat Factor

Appendix 4



FORMULA

Mollier chart

a. Compression ratio
= High pressure / Low pressure

b. Flash gas
= (h4 – h4') / (h1 – h4')

c. Refrigerant effect
= (h1 – h4)

d. Circulation rate of refrigerant
= refrigerating capacity / refrigerant effect

e. Power at compressor
= circulation rate x (h2 - h1)

f. COP
= Refrigerating capacity / Power at compressor
or
= (h1 – h4) / (h2 – h1)

Psychrometric chart

IP unit

a. Volume flow rate = Area x Velocity

b. Q sensible = 1.08 x cfm x Δt

c. Q latent = 0.68 x cfm x Δw

d. Q total = Q sensible + Q latent

SI / metric unit

a. The rate of heat transfer(Kw)
Q = mass flow rate (kg/s)x Δ enthalpy(kJ/kg) = ma ($h_{entering} - h_{leaving}$)
($Q_{cooling\ coil\ (air)} = Q_{refrigeration\ cycle\ (Refrigerant)}$)

b. Q_{de} = mass flow rate x Δ ratio moisture = ma ($W_{entering} - W_{leaving}$)