CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
MALAYSIA FRANCE INSTITUTE

FINAL EXAMINATION
JANUARY 2014 SEMESTER

SUBJECT CODE	:	FRD 20103
SUBJECT TITLE	:	THERMODYNAMIC
LEVEL	:	DIPLOMA
TIME/DURATION	:	3 HOURS 9.00 am - 12.00 noon
DATE	:	3 0 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 two (2) question only.

6.   Answer all questions in English.

7.   A psychrometric chart is provided in the appendix section.

THERE ARE 9 PRINTED PAGES OF QUESTIONS EXCLUDING THIS PAGE AND APPENDIX

SECTION A (TOTAL : 60 MARKS)

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

Question 1

T °C	P kPa	h kJ/kg	x
	200		0.7
140		1800	
	950		0
80	500		
	800	3162.2	

TABLE Q1: Water Properties Table

Complete the Table Q1 for water:

(20 marks)

Question 2

A closed system containing 2kg of air undergoes an isothermal process from 600 kPa and 200 °C to 80 kPa. Determine

(a)   The initial volume of this system in m³.

(4 marks)

(b)   The work done in kJ.

(8 marks)

(c)   The heat transfer during the process in kJ.

(8 marks)

Question 3

Referring Figure Q3 a refrigerant-134a is throttled from the saturated liquid state at 700 kPa to a pressure of 160 kPa.

$$P_1 = 700 \text{ kPa}$$
$$\text{Sat. liquid}$$

R-134a

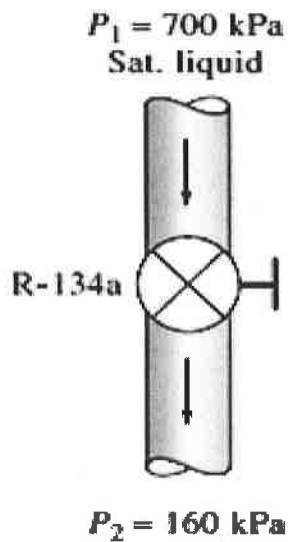$$P_2 = 160 \text{ kPa}$$

FIGURE Q3: Throttling Valve for Refrigerant R-134a

From Figure Q3 determine:

(a) T_1, and h_1

(6 marks)

(b)   Write the energy balance of the throttling process

(6 marks)

(c) T_2, x_2, v_2, and h_2

(8 marks)

SECTION B (TOTAL : 40 MARKS)

INSTRUCTION : Answer ONLY TWO (2) questions.
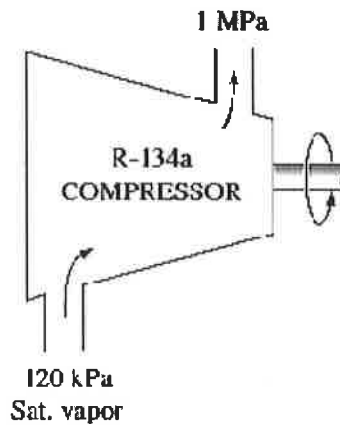
Please use the answer booklet provided.

Question 4

Figure Q4: Adiabatic Compressor

Referring Figure Q4 a refrigerant-134a enters an adiabatic compressor as saturated vapor at 120 kPa at a rate of 0.3 m³/min and exits at 1-MPa pressure. If the isentropic efficiency of the compressor is 80 %, determine:

(a) $T_{2\,is}$ and $h_{2\,is}$ at exit of the compressor

(5 marks)

(b)   The actual $h_{2\,act}$ and $T_{2\,act}$ at the exit of the compressor

(5 marks)

(c)   Isentropic and actual work input to the compressor (W_{is} and W_{act}) in kW

(10 marks)

Question 5

A refrigerator uses refrigerant-134a as the working fluid and operates on an ideal vapor-compression refrigeration cycle between 0.12 (evaporating pressure) and 0.7 MPa (condensing pressure). The mass flow rate of the refrigerant is 0.05 kg/s. From the P-h diagram in the appendix determine:

(a)   The rate of heat removal from the refrigerated space (Q_L) in kW

(5 marks)

(b)   Power input to the compressor (W_{in}) in kW

(5 marks)

(c)   The rate of heat rejection to the environment (Q_h) in kW and

(5 marks)

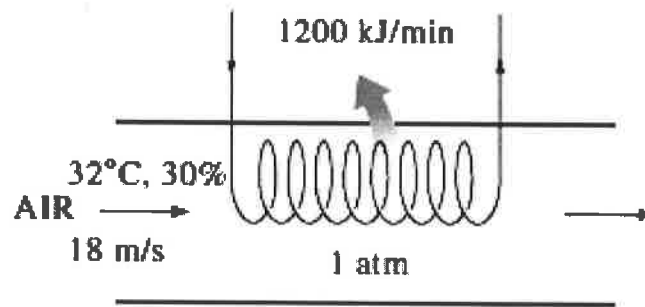(d)   Coefficient of Performance (COP)

(5 marks)

Question 6

FIGURE Q6: AHU Cooling Section

Referring Figure Q6 an air enters a 40-cm-diameter cooling section at 1 atm, 32°C and 30% relative humidity at 18 m/s. Heat is removed from the air at a rate of 1200 kJ/min and the moisture content of the air remains constant. Determine

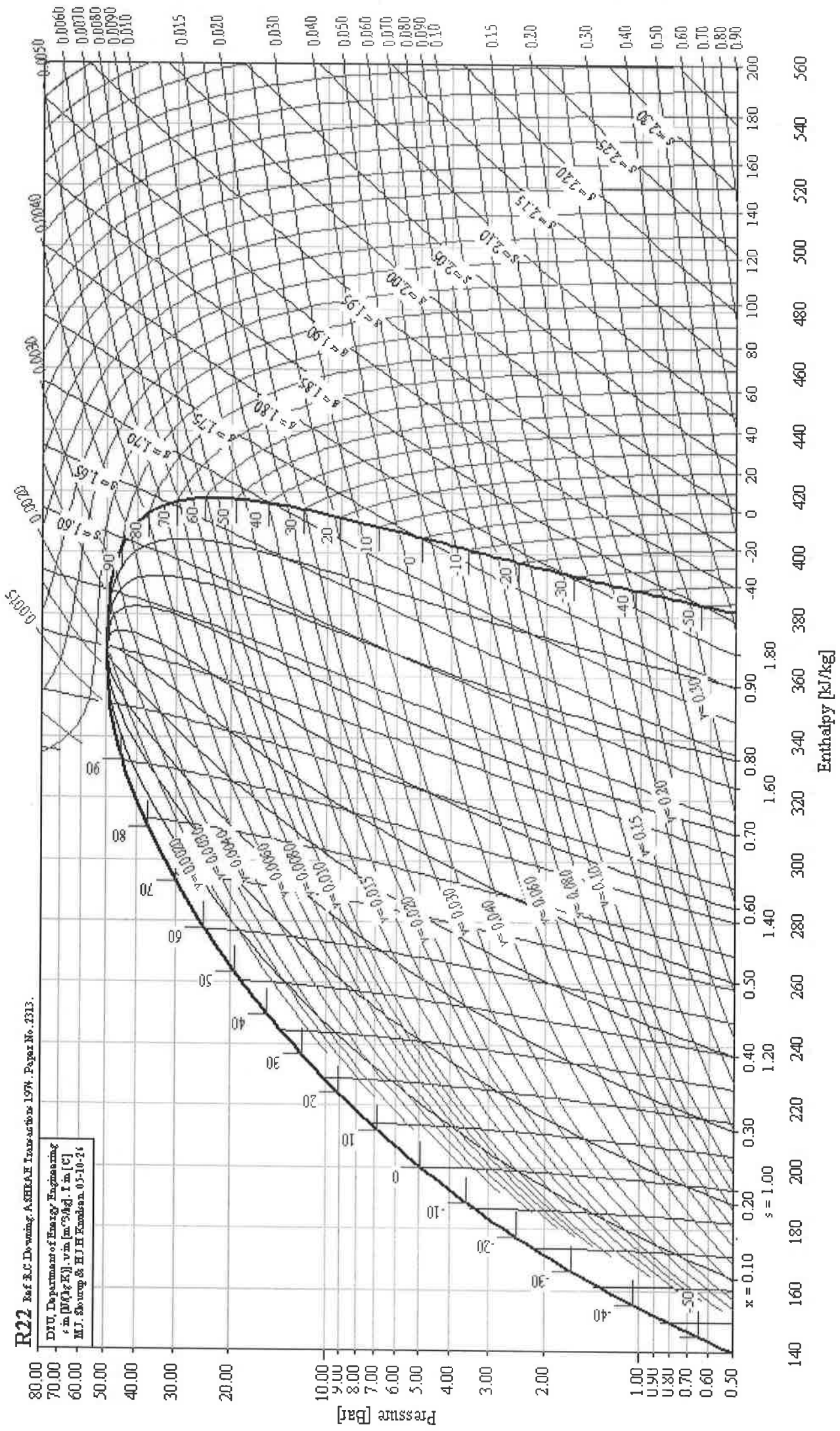a)　　Write down an energy balance for the process

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(10 marks)

b)　　The temperature at the exit of the cooling system

　　　　　　　　　　　　　　　　　　　　　　　　　　　　　(5 marks)

c)　　The relative humidity at the exit of the cooling system
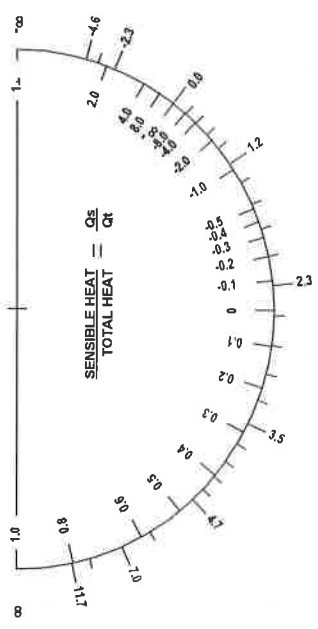
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END OF QUESTION

APPENDIX

R22

Pressure [Bar] (vertical axis)

80.00, 70.00, 60.00, 50.00, 40.00, 30.00, 20.00, 10.00, 9.00, 8.00, 7.00, 6.00, 5.00, 4.00, 3.00, 2.00, 1.00, 0.90, 0.80, 0.70, 0.60, 0.50

Enthalpy [kJ/kg] (horizontal axis)

140, 160, 180, 200, 220, 240, 260, 280, 300, 320, 340, 360, 380, 400, 420, 440, 460, 480, 500, 520, 540, 560

$x = 0.10$, $s = 1.00$

Entropy lines: $s=1.60$, $s=1.65$, $s=1.70$, $s=1.75$, $s=1.80$, $s=1.85$, $s=1.90$, $s=1.95$, $s=2.00$, $s=2.05$, $s=2.10$, $s=2.15$, $s=2.20$, $s=2.25$, $s=2.30$

Temperature lines: 90, 80, 70, 60, 50, 40, 30, 20, 10, 0, -10, -20, -30, -40, -50

Specific volume lines: 0.0050, 0.0060, 0.0070, 0.0080, 0.0090, 0.010, 0.015, 0.020, 0.030, 0.040, 0.050, 0.060, 0.070, 0.080, 0.090, 0.10, 0.15, 0.20, 0.30, 0.40, 0.50, 0.60, 0.70, 0.80, 0.90

PSYCHROMETRIC CHART
Normal Temperature
SI Units

SEA LEVEL
BAROMETRIC PRESSURE: 101.325 kPa

$$\frac{\text{SENSIBLE HEAT}}{\text{TOTAL HEAT}} = \frac{Qs}{Qt}$$

$$\frac{\text{ENTHALPY}}{\text{HUMIDITY RATIO}} = \frac{\Delta h}{\Delta W}$$

ENTHALPY - KJ PER KILOGRAM OF DRY AIR

VAPOR PRESSURE - MM OF MERCURY

SENSIBLE HEAT RATIO = Qs / Qt

DEW POINT TEMPERATURE - °C

SENSIBLE HEAT RATIO = Qs / Qt

30 WET BULB TEMPERATURE - °C

HUMIDITY RATIO - GRAMS MOISTURE PER KILOGRAM DRY AIR

RELATIVE HUMIDITY

VOLUME - CUBIC METER PER KG DRY AIR

SATURATION TEMPERATURE - °C

ENTHALPY - KJ PER KILOGRAM OF DRY AIR

DRY BULB TEMPERATURE - °C

10% RELATIVE HUMIDITY