



**UNIVERSITI KUALA LUMPUR**  
**MALAYSIA FRANCE INSTITUTE**

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**FINAL EXAMINATION**  
**JULY 2010 SEMESTER**

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**SUBJECT CODE** : FRD 20103  
**SUBJECT TITLE** : THERMODYNAMIC  
**LEVEL** : DIPLOMA  
**TIME/DURATION** : 9.00 am – 12.00 noon  
( 3 HOURS )  
**DATE** : 13 NOVEMBER 2010

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**INSTRUCTIONS TO CANDIDATES**

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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.
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THERE ARE 4 PAGES OF QUESTIONS AND 1 PAGE OF APPENDIX, EXCLUDING THIS PAGE.

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## SECTION A (TOTAL : 60 MARKS)

**INSTRUCTION: Answer ALL questions.****Please use the answer booklet provided.****Question 1**

Refrigerant-134a is throttled from the saturated liquid state at 700 kPa to a pressure of 160 kPa as shown in Figure Q1. (Refer to the appendix section for the properties of R134a). Find:

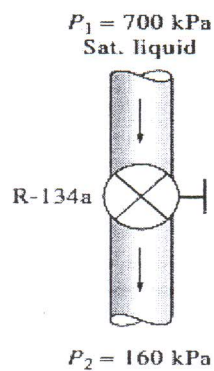


Figure Q1 Throttling valve

- (a).  $T_1$ , and  $h_1$ .

(6 marks)

- (b). Write the energy balance of the throttling process.

(8 marks)

- (c).  $T_2$ ,  $x_2$ ,  $v_2$ , and  $h_2$ .

(6 marks)

**Question 2**

A rigid tank contains 10 kg of air at 350 kPa and 27° C. The air is now heated until its pressure doubles (2X). Calculate:

(a) The tank's volume in m<sup>3</sup>.

(10 marks)

(b) The amount of heat transfer (Q) in kJ.

(10 marks)

**Question 3**

Fill in the empty spaces. The substance is water. (The properties are given in the thermodynamic tables given by the Invigilator. Rewrite the table in the answer sheet).

| T °C | P kPa | h kJ/kg | x   |
|------|-------|---------|-----|
|      | 200   |         | 0.7 |
| 140  |       | 1800    |     |
|      | 950   |         | 0.0 |
| 80   | 500   |         |     |
|      | 800   | 3162.2  |     |

(20 marks)

**SECTION B (TOTAL : 40 MARKS)****INSTRUCTION : Answer ONLY TWO (2) questions.****Please use the answer booklet provided.****Question 4**

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. Answer these questions:

- (a). Sketch the cycle on a  $P - h$  diagram. (4 marks)
- (b). The rate of heat removal from the refrigerated space ( $Q_L$ ). (4 marks)
- (c). Power input to the compressor ( $W_{in}$ ). (4 marks)
- (d). The rate of heat rejection to the environment ( $Q_h$ ). (4 marks)
- (e). Coefficient of performance (COP). (4 marks)

**Question 5**

Air enters a window air conditioner at 1 atm, 32°C, and 70 percent relative humidity at a rate of 2 m<sup>3</sup>/min, and it leaves as saturated air (100 % RH) at 15°C. Part of the moisture in the air that condenses during the process is also removed at 15°C as shown in Figure Q5. By using the psychrometric chart attached in the appendix section, answer these questions. (Note that at 15 deg C,  $h_f = 62.98$  kJ/kg and  $h_g = 2528.3$  kJ/kg):

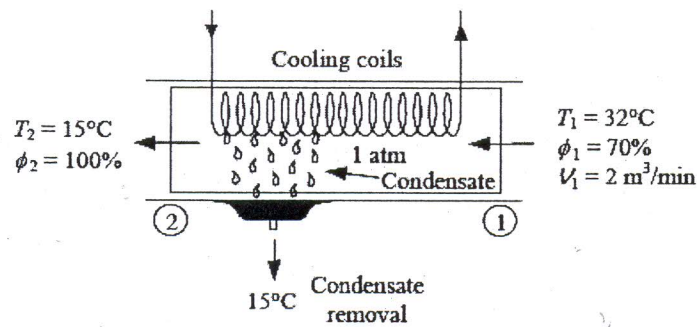


Figure Q5 : Schematic for question 2

- Plot the process on the psychrometric chart attached. (4 marks)
- Write down the water mass balance for the process. (4 marks)
- Rate of moisture removed. (4 marks)
- Write down energy balance for the process. (4 marks)
- Rate of heat removed. (4 marks)

**Question 6**

A refrigerating machine utilising carbon dioxide as refrigerant enter an adiabatic compressor with the inlet condition of 100 kPa and 300 K with mass flow rate of 1.8 kg/sec and exit at 600 kPa. Determine ( $C_p = 0.917$  kJ/kg K and  $k = 1.26$ ):

- The exit temperature in Kelvin if the compression process is isentropic. (10 marks)
- If the actual exit temperature is 450K, what shall be the compressor isentropic efficiency ( $\eta_{is}$ )? (10 marks)

**END OF QUESTION**

# APPENDIX



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