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**CONFIDENTIAL**

**SET A**

# UNIVERSITI KUALA LUMPUR

## MALAYSIA FRANCE INSTITUTE

## FINAL EXAMINATION

## SEPTEMBER 2014 SESSION

| | | |
|---|---|---|
| **SUBJECT CODE** | : | **FRB20102** |
| **SUBJECT TITLE** | : | **BASIC THERMODYNAMICS** |
| **LEVEL** | : | **BACHELOR** |
| **TIME/DURATION** | : | **2.00 PM – 4.00 PM (2 HOURS)** |
| **DATE** | : | **10 JANUARY 2015** |

### INSTRUCTIONS TO CANDIDATES

1. **All questions carry equal marks. Answer ANY FOUR (4) questions in English.**
2. **Please write your answers on the answer booklet provided.**
3. **Answer should be written in blue or black ink except for sketching, graphic and illustration.**
4. **This question paper consists one section only.**

**THERE ARE 2 PRINTED PAGES OF QUESTIONS EXCLUDING THIS PAGE.**

**INSTRUCTION: Answer ONLY FOUR (4) questions**
**Please use the answer booklet provided.**

## Question 1

A 1 $m^3$ tank contains air at 25 $^oC$ and 500 kPa is connected through a valve to another tank that contains 5 kg of air at 35 $^oC$ and 200 kPa. The valve is then opened and the entire system is allowed to reach thermal equilibrium with surrounding at 20 $^oC$. Calculate the volume of the second tank and the final equilibrium pressure of air.

(25 marks)

## Question 2

A frictionless piston-cylinder device initially contains 1 kg saturated liquid of refrigerant 134a (R-134a) at 40 $^oC$. The piston is free to move, and its mass is such that it maintains a pressure of 900 kPa on the refrigerant. The refrigerant is now heated to 75 $^oC$. Calculate the work done during this process.

(25 marks)

## Question 3

Figure Q3 below shows that refrigerant-134a at 1 MPa and 90°C is to be cooled to 1 MPa and 30°C in a condenser by air. The air enters at 100 kPa and 27°C with a volume flow rate of 600 m3/min and leaves at 95 kPa and 60°C. Determine the mass flow rate of the refrigerant.

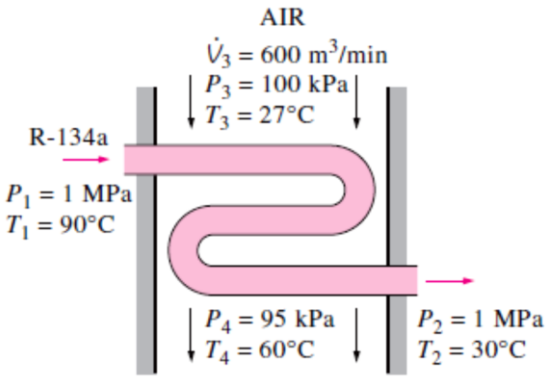


Figure Q3: Heat Exchanger

(25 marks)

**Question 4** (25 marks)

A Carnot heat engine receives heat from a reservoir at 900 $^{o}$C at a rate of 1000 kJ/minute. The work output from the heat engine is used to drive a reversible refrigerator that removes heat from the refrigerated space at -10 $^{o}$C. Both heat engine and refrigerator reject heat to ambient at 30 $^{o}$C. Answer the following questions:

a) Draw the schematic diagram of this system

(5 marks)

b) Calculate the rate of heat removal from the refrigerated space, kW

(10 marks)

c) Calculate the total amount of heat rejected to ambient, kW

(10 marks)

**Question 5** (25 marks)

Steam enters an adiabatic steam turbine steadily at 8 MPa and 450 $^{o}$C and leaves at 50 kPa and 100 $^{o}$C as shown in Figure Q5 below. If the power output of the turbine is 5 MW, answer the following questions:

a) Draw the schematic diagram of the system and its T-s diagram

(5 marks)

b) Calculate the isentropic efficiency of the turbine

(10 marks)

c) Calculate the mass flow rate of the steam flowing through the turbine, kg/s

(10 marks)

**END OF QUESTION**