Document No : UniKL MFI_SD_AC41
Revision No: 02
Effective Date: 01 December 2008

CONFIDENTIAL

SET A

UNIVERSITI KUALA LUMPUR
Malaysia France Institute

FINAL EXAMINATION
SEPTEMBER 2014 SESSION

SUBJECT CODE	:	**FRB20103**
SUBJECT TITLE	:	**THERMODYNAMICS AND HEAT TRANSFER**
LEVEL	:	**BACHELOR**
TIME / DURATION	:	**9.00 AM – 12.00 PM (3 HOURS)**
DATE	:	**08 JANUARY 2015**

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 questions paper consists ONE (1) section. Answer any FOUR (4) questions.**
6. **Answer all questions in English.**

THERE ARE 4 PRINTED PAGES OF QUESTIONS, EXCLUDING THIS PAGE.

INSTRUCTION: Answer FOUR (4) questions only

Please use the answer booklet provided.

Question 1

Tank A with a volume of 1 m^3 and Tank B with a volume of 1 m^3 (in Figure Q1) are initially separated by a partition. The partition has a negligible volume. Tank A contains water with the quality of 0.1 while Tank B contains water with the quality of 0.15. The initial temperature of Tank A is 25 °C and Tank B is at 30 °C. Answer the questions below:

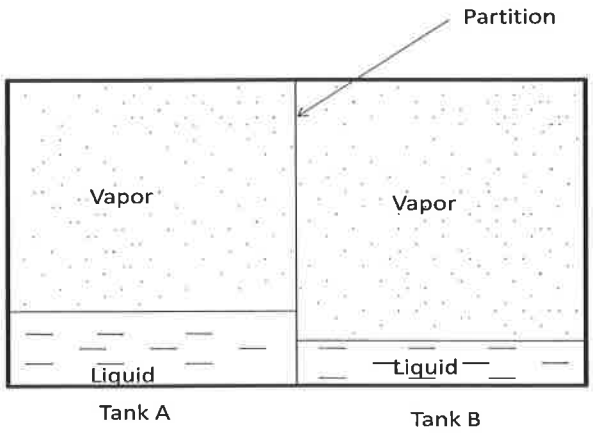

Figure Q1: Tank A and Tank B containing water (**drawing is not to scale**)

a) Calculate the mass of liquid water and water vapour in Tank A and Tank B

(12 marks)

Then, the partition was removed and the final temperature of Tank A and Tank B reached steady state at 30 °C,

b) Calculate the specific volume of water

(3 marks)

c) Calculate the quality of water in the tank

(3 marks)

d) Identify ONE (1) method to increase the quality of water in this tank

(2 marks)

Question 2

A mixing chamber (Figure Q2) is used to mix hot and cold water streams. The mixing chamber is exposed to ambient air temperature at 25°C. The outlet temperature (T_3) is 40°C. External surface area of this mixing chamber is 0.45 m^2. The heat transfer coefficient between the mixing chamber and surrounding air is 50 W/m^2 K. Estimate the temperature T_2 and evaluate the effect of heat transfer between mixing chamber and surrounding air the calculated T_2.

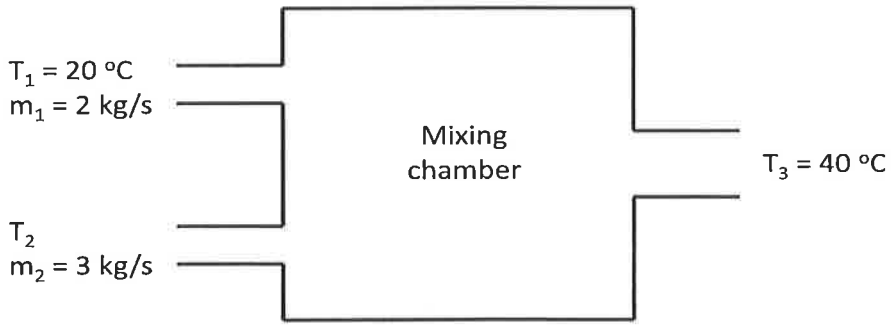

Figure Q2: Diagram of mixing chamber

(20 marks)

Question 3

A Carnot heat engine receives heat from a reservoir at 900 °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 which is maintained at -10 °C. Both heat engine and refrigerator reject heat to ambient air at 30 °C. Answer the following questions:

a) Draw the schematic diagram of this system

(4 marks)

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

(12 marks)

c) Calculate the total amount of heat rejected to ambient air

(4 marks)

Question 4

The wall of a room is required to only allow 1.5 W/m^2 of heat to flow for the conditions shown in Figure Q4. The wall has two layers of insulation separated by a metal sheet. External air temperature is 30 °C and -20 °C. Answer the following questions:

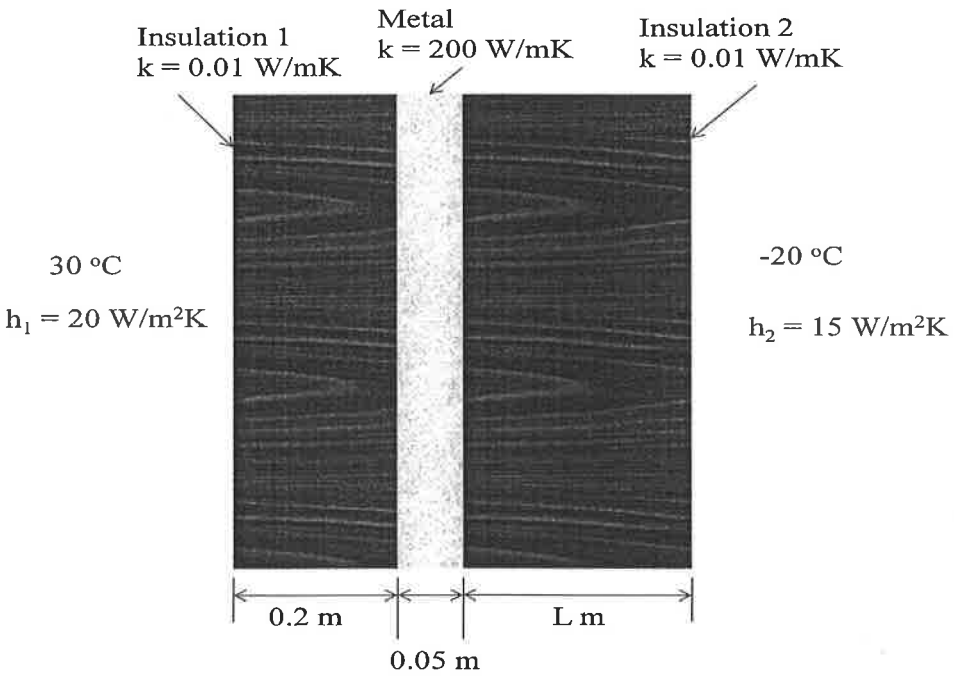

Figure Q4: Schematic of wall

a) Calculate the required thickness of Insulation 2.

(16 marks)

b) Recommend TWO (2) possible methods to reduce the thickness of insulation 2.

(4 marks)

Question 5

In an air-conditioning system, chilled water at the average temperature of 10 °C is transported throughout the building using pipes. It is proposed to use a pipe with 0.1 m outer diameter and 0.05 m inner diameter (Figure Q5). The pipe is made of a material which has thermal conductivity of 0.1 W/m K. The temperature of air outside the pipe is 35 °C. If the heat transfer coefficient at the outside surface of this pipe is 10 W/m^2 K, and the maximum allowable heat gain per unit length is 0.5 W,

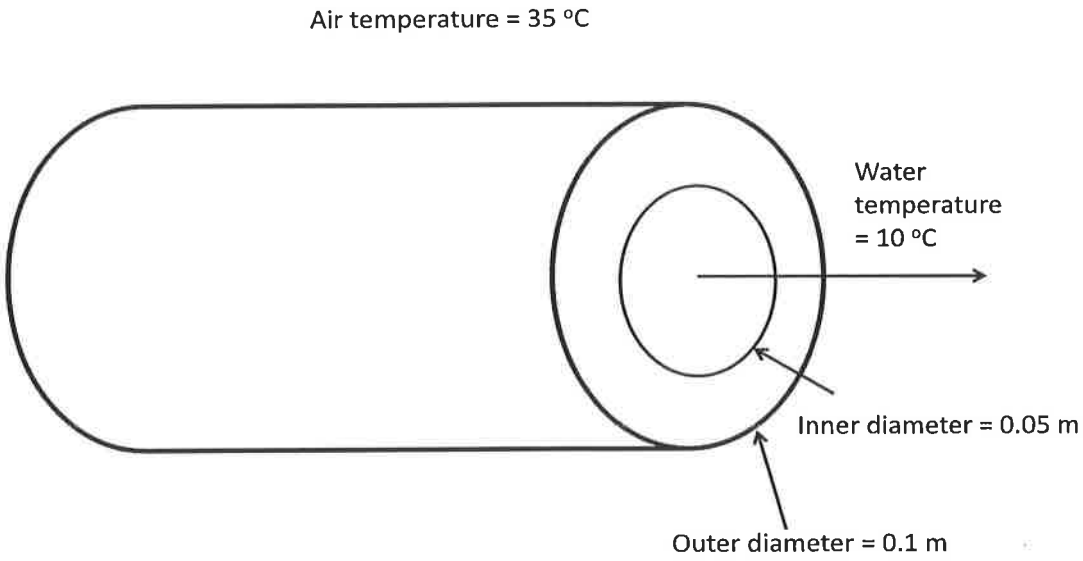

Figure Q5: Water flowing through pipe

a) Calculate the heat transfer coefficient at the inside surface of the pipe

(12 marks)

b) Calculate the outside surface temperature of the pipe

(4 marks)

c) Evaluate the thickness of this pipe appropriate in reducing heat gain?

(4 marks)

END OF QUESTION