00368

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering

Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	**: DMX3401 Fluid Mechanics and Thermodynamics**
Academic Year	: 2020/21
Date	: 25th Friday , February 2022
Time	: 0930hrs -1230 hrs
Duration	: **3 hours**

General Instructions

1. Read all instructions carefully before answering the questions.
2. Answer **five (05)** Questions only. All questions carry equal marks.
3. Relevant charts/ codes are provided.
4. This is a Closed Book Test (CBT).
5. Answers should be in clear handwriting.
6. Do not use Red colour pen.
7. Take the specific gas constant (R) for air as $0.287 kJ/\ kg\ K$.
8. Density of Water is $1000 kg/m^3$
9. For air $C_v = 0.718\ kJ/kgK$ and $C_p = 1.005\ kJ/kg\ K$

Q1 (a) Name four thermodynamic processes. (4 marks)

(b) Helium is contained in a rigid container of volume 2 m^3 at 50 ^{0} C and 200 kPa. Calculate the heat transfer needed to increase the pressure to 800 kPa. (8 marks)
For Helium R = 2.077 kJ/kg K, Cv = 3.116 kJ/kg K

(c) Air in a cylinder of an air compressor is adiabatically compressed from 100 kPa to 10 MPa. Estimate the final temperature and the work required if the air is initially at 100 ^{0}C. (8 marks)

Q2 (a) Draw a block diagram for a vapour compression refrigeration cycle and name all the components. (4 marks)

(b) Explain the term "refrigerant" in the context of vapour compression refrigeration. (3 marks)

(c) Discuss the environment impact of refrigerants. (3 marks)

(d) explain the following terns in the context of air conditioning. (10 marks)

(i) Dry Bulb Temperature
(ii) Wet bulb temperature
(iii) Dew point temperature
(iv) Humidity Ratio
(v) Saturation Partial Pressure

Q3 (a) State the second law of thermodynamics. (5 marks)

(b) Draw $p - V$ diagram for Carnot cycle and name all the processes. (4 marks)

(c) Draw T -s diagram for Carnot cycle and indicate all the processes named in section (b) (4 marks)

(d) A Carnot engine is operating between 400 °C and 15 °C. The work produced is 200 kJ. Determine the heat to be supplied to the engine (7 marks)

Q4 A composite wall is shown in figure Q4. The thermal conductivities of materials, A, B, C, D and E are 50, 10, 6.67, 20 and 30 W/m K respectively. The cross sectional areas of each material in the composite wall are as follows:
$A = D = E = 1\ m^2$
$B = C = 0.5\ m^2$
The temperatures at the outer walls are 800 ° C and 100 ° C as shown in the figure.

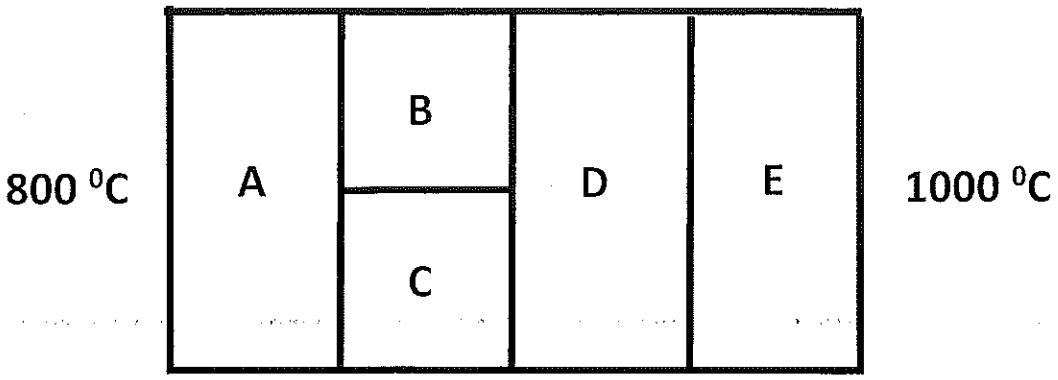


Figure Q4

(a) Determine the overall thermal resistance of the composite wall. (15 marks)

(b) Determine the heat transfer through the composite wall. (5 marks)

Q5 (a) Write the continuity equation for a fluid flow in a pipe. (4 marks)

(b) A nozzle is attached to a 60 mm diameter hose and it turns the water through an angle of 90^0 as shown in figure Q5. The nozzle exit is 30 mm in diameter and the flow rate is 500 *l*/min. The pressure in the hose is 400 kPa and the water exits to the atmosphere
Determine:
(i) the force components of the water on the nozzle (8 marks)
(ii) the magnitude of the resultant force. (8 marks)

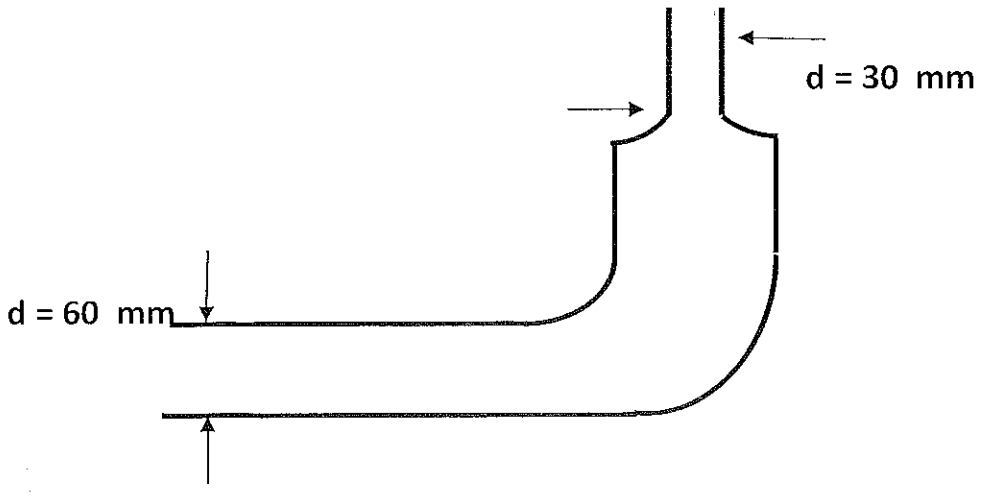


Figure Q5

Q6 (a) Name four flow measuring devices. (4 marks)

(b) The flow rate in a pipe of diameter 100 mm is determined by using a Venturi meter of throat diameter 60 mm, as shown in figure Q6. If the difference between mercury column heights is 4 mm, calculate the flow rate assuming uniform flow and no losses. (16 marks)

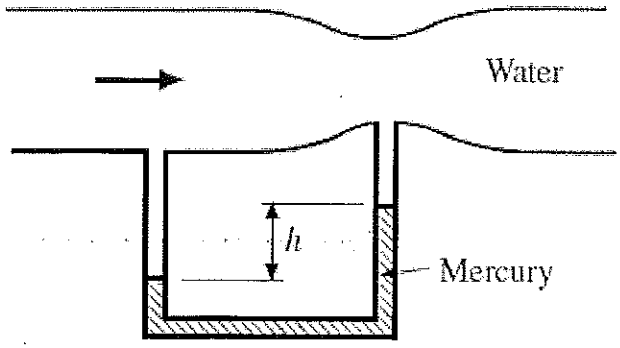
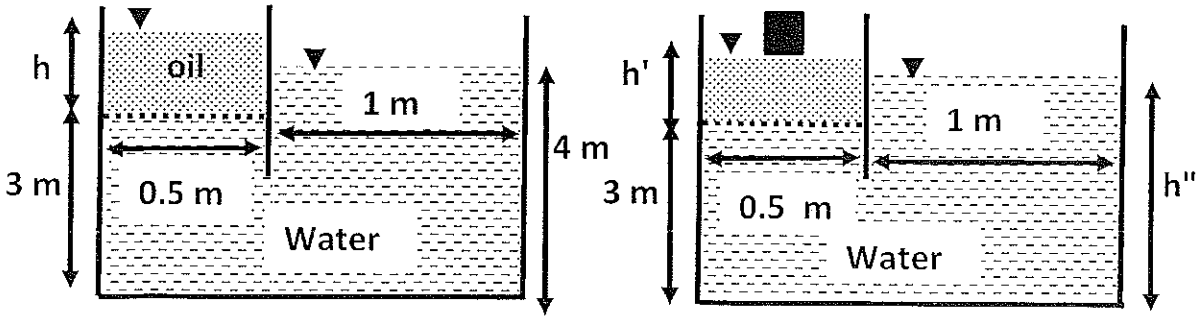


Figure Q6

Q7 (a) Explain what is meant by "centre of buoyancy" of an object floating in a liquid. (5 marks)

(b) A rectangular tank of 7m breadth is partitioned into two compartments and contains oil and water as shown in figure Q7 (a). If the specific gravity of oil is 0.84, find the height "h" of oil. (8 marks)

(c) If a block of wood of weight 900 N, is floated on the oil, as shown in figure Q 7 (b), what is the new height (h'') of water? (7 marks)



(a) (b)

Figure Q7

Q8 (a) Write the Bernoulli's equation and explain each term. (5 marks)

(b) An open tank of water has a pipeline of uniform diameter leading from it as shown in figure Q8. Neglecting all frictional losses, determine the velocity of water in the pipe and the pressure at points A, B and C. (15 marks)

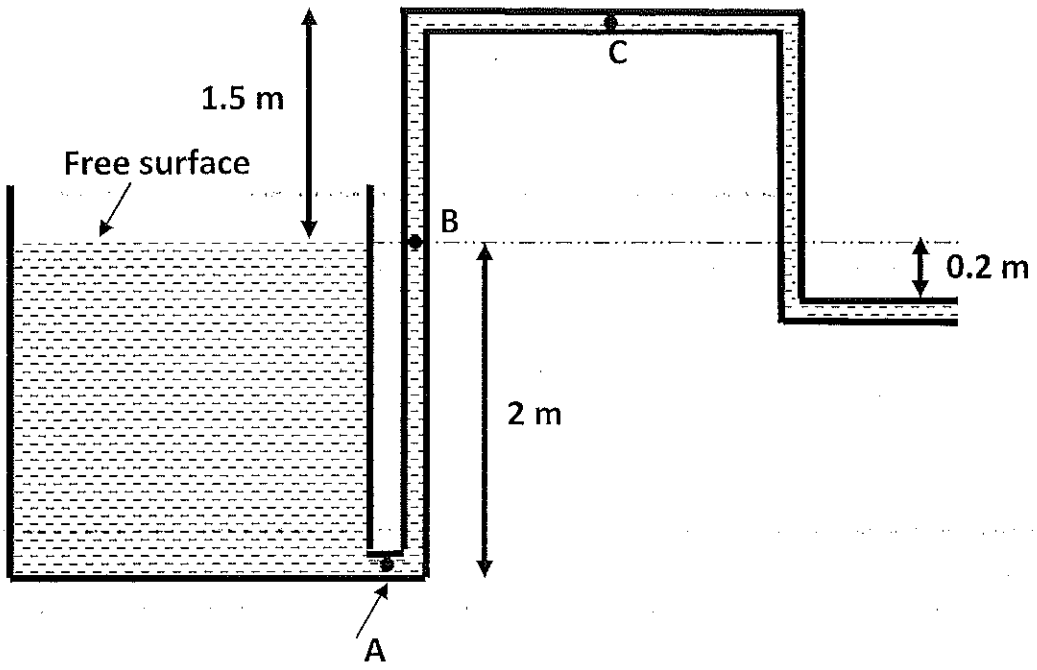


Figure Q8

END