Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	DAM 23903
PROGRAMME CODE	:	DAM
EXAMINATION DATE	:	JULY / AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **FIVE** QUESTIONS **ONLY**. 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**. 3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **SEVEN** (7) PAGES

Q1 (a) Define the formula for the fluid properties below.

(i) Specific weight

(1 mark)

(ii) Specific volume

(1 mark)

(iii) Specific gravity

(1 mark)

(iv) Kinematic viscosity

(1 mark)

(b) Bathyscapes in **Figure Q1(b)** are capable of submerging to great depths in the ocean. Assuming that seawater has a constant specific weight of 10.1 kN/m^3, standard atmospheric pressure is 101.3 kPa and take 1 kgf/cm^2 = 98.1 kPa.

(i) Determine the absolute pressure at a depth of 7.3 km in pascals and kgf/cm^2.

(4 marks)

(ii) Sketch a schematic diagram of this problem.

(2 marks)

(c) Two water tanks are connected to each other through a mercury manometer with inclined tubes, as shown in **Figure Q1(c)**. If the pressure difference between the two tanks $(P_B - P_A)$ is 25 kPa, calculate a and θ.

(10 marks)

Q2 (a) An informative and useful graphical interpretation can be made for the force developed by a fluid acting on a plane area. Describe with a graphical representation of hydrostatic forces on a vertical rectangular surface.

(6 marks)

(b) The rectangular gate CD of **Figure Q2(b)** is 1.6 m wide and 2.0 m long. Neglecting friction at the hinge C, determine the weight of the gate necessary to keep it shut until the water level rises to 2.2 m above the hinge. Draw the Free Body Diagram (FBD) to show the direction and location of all the forces acting on the gate.

(14 marks)

Q3 (a) Explain **three (3)** restrictions or limitations in using the Bernoulli equation.

(6 marks)

(b) A pitot-static tube is used to measure the air flowrate in a duct. A manometer contains water is connected to the device to measure a pressure difference between static and dynamic pressure.

(i) If the flowrate in the pipe is 3.5 m^3/s, diameter of the duct is 30 cm and the density of air is 1.2 kg/m^3, determine the water column height in the manometer.

(11 marks)

(ii) Sketch an appropriate diagram for the above system and label clearly point *1*, point *2* and the height of water column.

(3 marks)

Q4 (a) Describe body forces and surface forces acting on a control volume. Give an example for each forces with an aided of appropriate sketches.

(3 marks)

(b) Water flows steadily through a reducing pipe bend as shown in **Figure Q4(b).** Known condition are $P_1 = 400$ kPa, $d_1 = 20$ cm, $V_1 = 2.5$ m/s and $d_2 = 10$ cm. If height difference between inlet and outlet is 30 cm, estimate the total force that must be resisted by the flange bolt. Neglect the bend and water weight in your calculation.

(17 marks)

Q5 (a) Briefly describe any **three (3)** factors affecting the major losses in pipes.

(3 marks)

(b) Water is pumped through a 100 m long, 0.25 m diameter pipe from a lower reservoir which is located at elevation of 100 m to a higher reservoir which is located at elevation of 110 m. A piping system consists of a reentrant entrance (K_L = 1.0), two screwed 90° long-radius elbows (K_L = 0.41 each), a screwed-open gate valve (K_L = 0.16) and a 6° well-designed conical expansion (K_L = 0.3) at the exit. When the pump adds 42 kW power to the water, the flowrate is 0.22 m^3/s. Determine the potential pipe material used in the system. Use Moody Chart in **Figure Q5(b)** to find the related information.

(17 marks)

Q6 (a) Explain the difference between dimensions and units. Provide **three (3)** examples of each.

(5 marks)

(b) The drag force, F exerted on a body in a moving fluid can be said to be a function of the following parameters

fluid density, ρ
fluid viscosity, μ
diameter, d
velocity, u

Show that an expression for the drag force is $F = d^2u^2\rho\emptyset\ (Re)$ where $\emptyset$ is some unknown function and Re is the Reynolds number.

(15 marks)

-END OF QUESTIONS-

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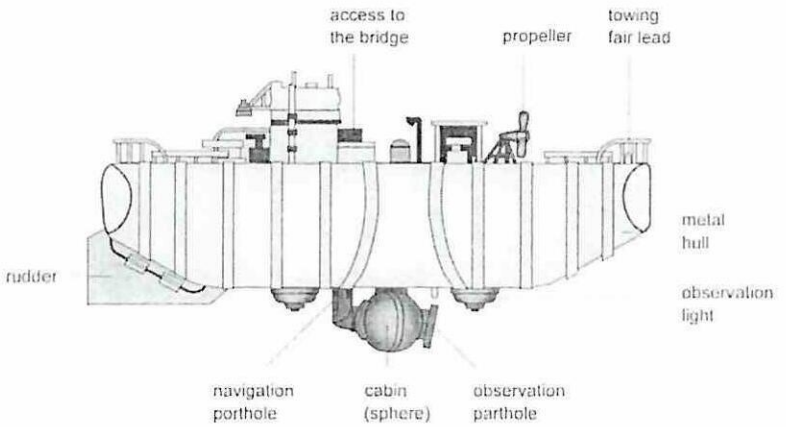

Figure Q1(b)

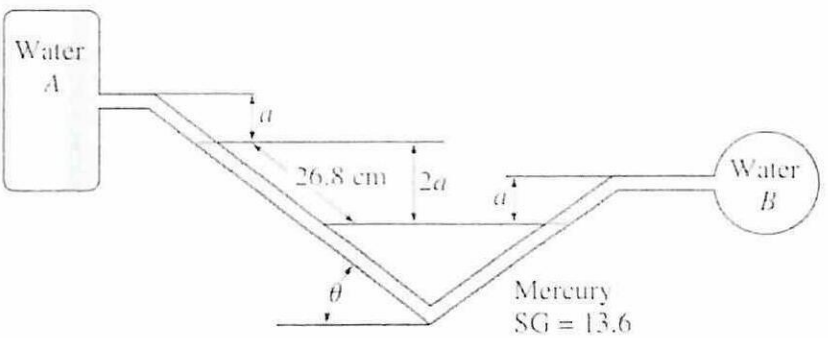

Figure Q1(c)

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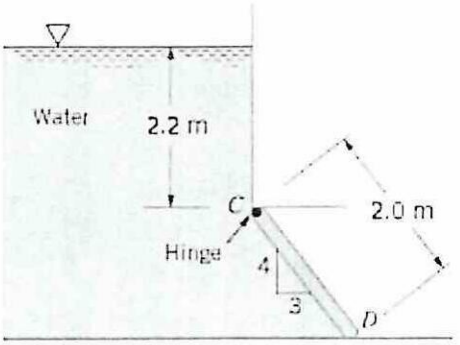

Figure Q2(b)

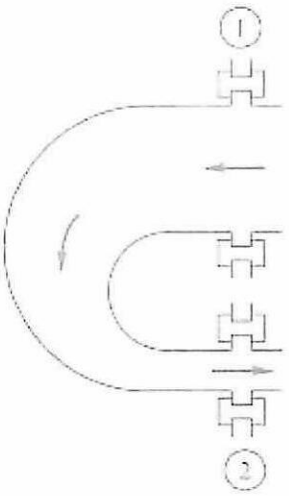

Figure Q4(b)

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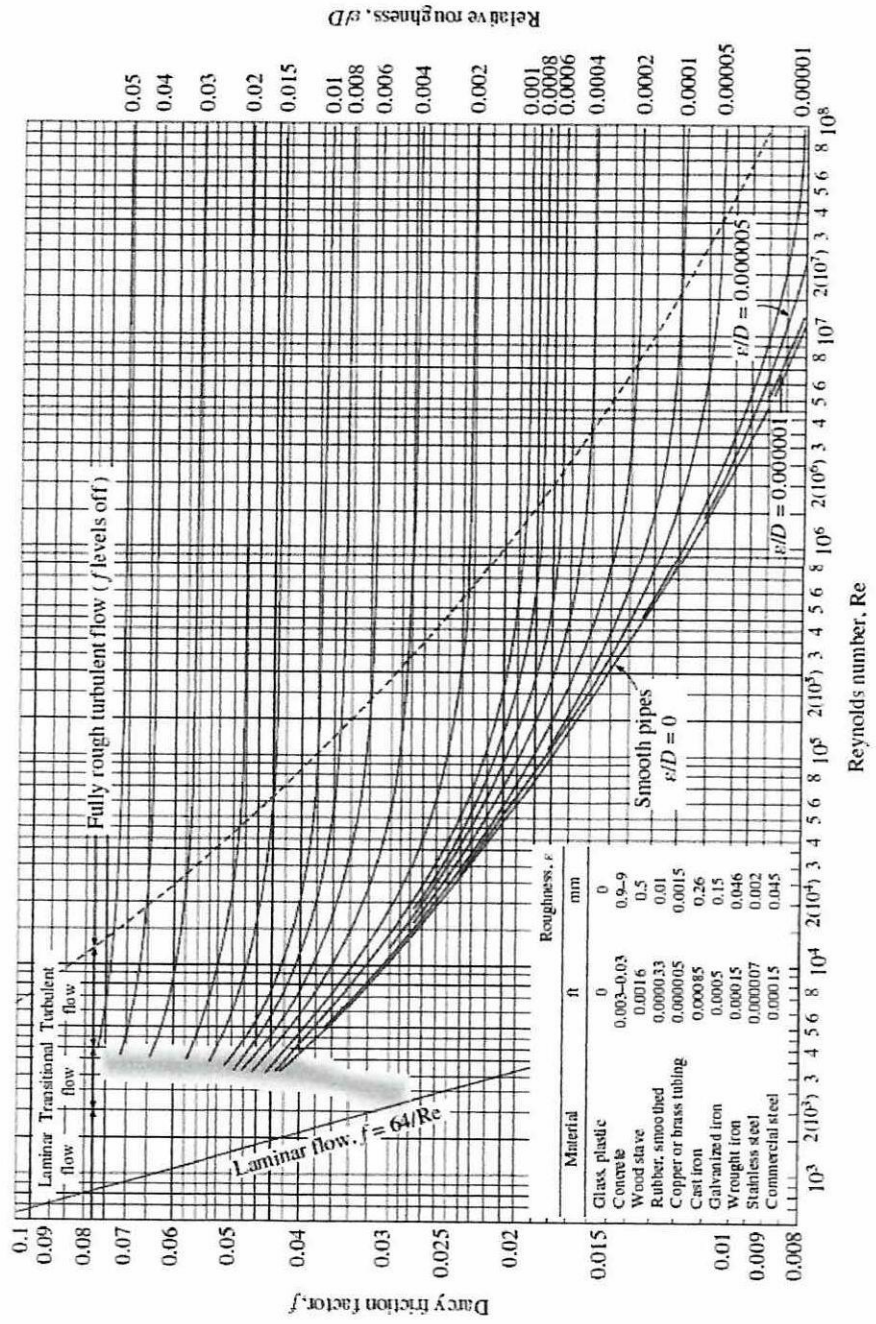

Figure Q5(b)