UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2023/2024

COURSE NAME	:	FLUID MECHANICS
COURSE CODE	:	DAM 23903
PROGRAMME CODE	:	DAM
EXAMINATION DATE	:	JULY 2024
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **FIVE (5)** QUESTIONS ONLY 2. THIS FINAL EXAMINATION IS CONDUCTED VIA ☐ Open book ☒ 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 **SIX (6)** PAGE

Q1 (a) Define Newtonian and non-Newtonian fluids and give an example for each.
(3 marks)

(b) Show the difference between Newtonian and non-Newtonian on a stress-strain graph.

(2 marks)

(c) The submarine KRI Nanggala 402 was sunk at 839 m below sea level. Determine the pressure at this depth in the unit of
(i) kPa, and
(ii) m H_2O.

Take the density of sea water as 1030 kg/m^3.

(4 marks)

(d) Referring to the manometer in **Figure Q1.1**, compute the height H if the $p_A - p_B$ is -50.7 kPa.

(11 marks)

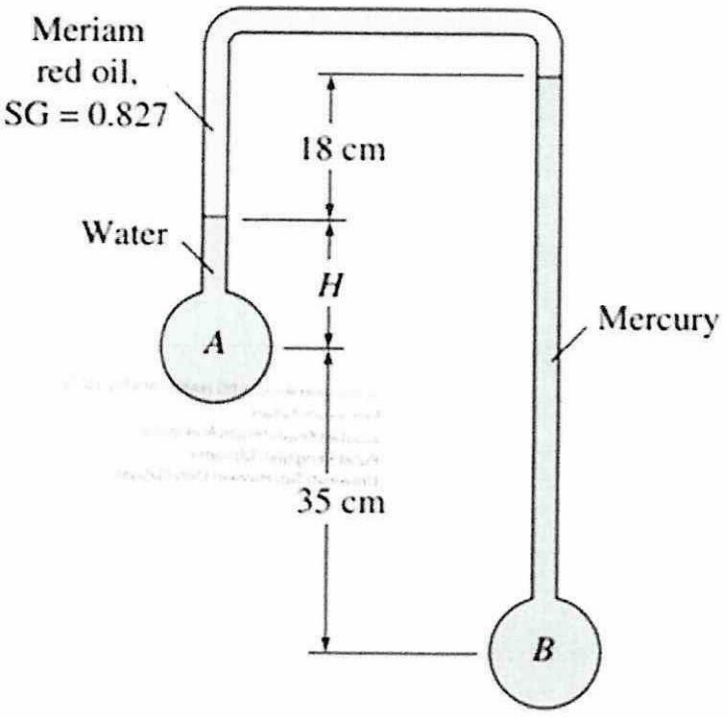

Figure Q1.1

Q2 (a) Distinguish between centroid and center of pressure.

(2 marks)

(b) Explain the method to describe the location of the center of pressure on the vertical plane.

(2 marks)

(c) As shown in **Figure Q2.1,** gate *AB* has 200 kg mass and 3 m width, hinged at *B*, and makes an angle θ with the horizontal axis. If the water level, *h* is 4 m and length *L* is 5 m, determine the tension force, *P* at point *A* acting perpendicular to gate *AB*.

(16 marks)

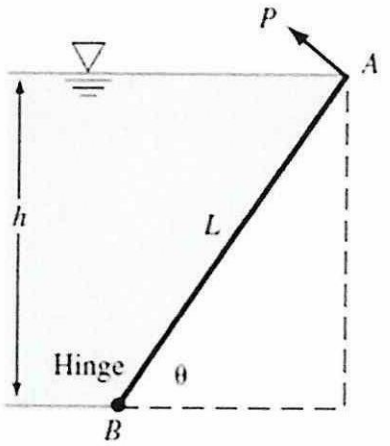

Figure Q2.1

Q3 (a) The Bernoulli equation is derived from the Euler equation, which considers several predefined estimates. State the four (4) assumptions.

(4 marks)

(b) A pipe carries oil of density 800 kg/m^3. At a given point (1) the pipe has a bore diameter of 0.008 m and the oil flows with a mean velocity of 4 m/s with a gauge pressure of 800 kPa. Point (2) is further along the pipe, there the bore diameter is 0.005 m and the level is 50 m above point (1).

(i) Sketch the condition explained by the sentences.

(3 marks)

(ii) Calculate the pressure and flow rate at this point (2) and neglect friction.

(13 marks)

Q4 (a) Explain body forces and surface forces acting on a control volume. By using a sketch, explain and give an example for each force with an aid of appropriate sketches.

(3 marks)

(b) A pipe bend in the horizontal plane in **Figure Q4.1** deflects water through a 45° taper from a 150 mm diameter at the inlet section to a 300 mm diameter at the outlet section. The pressure at the inlet is 100 kPa and the water flow rate is 0.3 m^3/s where the pipe axis at the inlet is horizontal and the outlet is 1m higher. If the volume of the pipe is 0.075 m^3, neglecting friction, determine:

(i) total force in the x and y directions;

(6 marks)

(ii) the pressure force in the x and y directions;

(5 marks)

(iii) the resultant force and direction of action in x and y axis;

(6 marks)

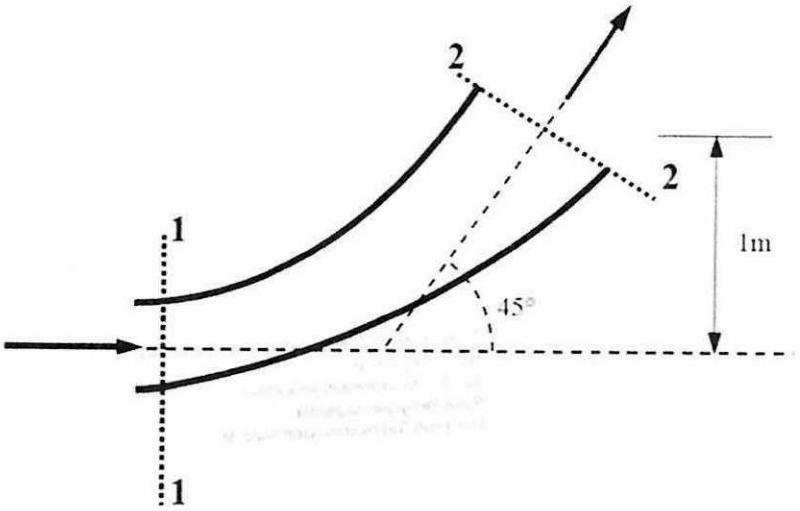

Figure Q4.1

Q5 (a) Explain how surface roughness may affect pipe losses.

(2 marks)

(b) Water was pumped from lower to upper reservoir at a rate of 0.23 m^3/s shows in **Figure Q5.1** . The pipe friction factor is same along the length of the pipeline. Minor head loss coefficients for pipe entrance, pipe exit and bends are K_{ent}= 0.5, K_{exit}= 1, K_{bend}=0.4 respectively. Referring to the Moody Chart in **Figure APPENDIX A.1**, calculate the pump power requirement.

(18 marks)

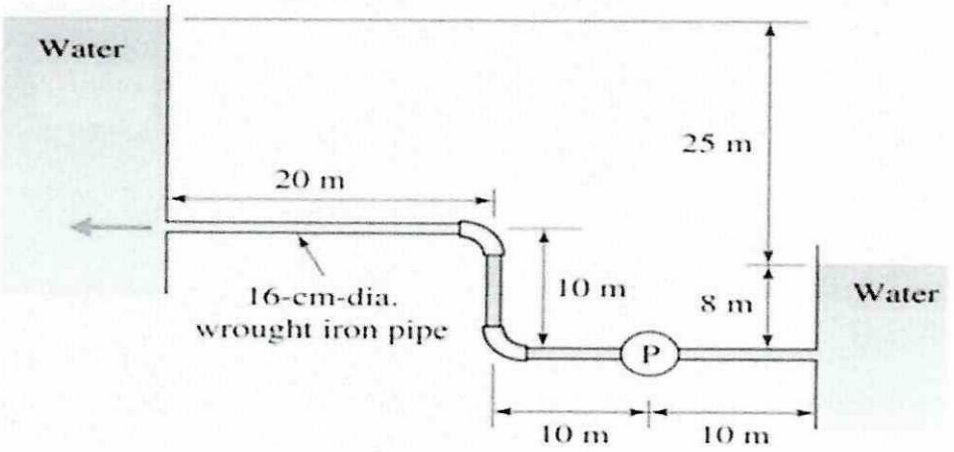

Figure Q5.1

Q6 (a) Discuss two (2) benefits of dimensional analysis.

(4 marks)

(b) A flat piece of diameter, D rotates in a fluid of viscosity, μ and density, ρ. As a result of rotation at speed N, the flow in the fluid becomes turbulent. The twisting moment of friction between the wedge and the fluid is T. Using dimensional analysis, show that:

$$T = \rho N^2 D^5 f(\mu / \rho N D^2)$$

(16 marks)

-END OF QUESTIONS-

APPENDIX A

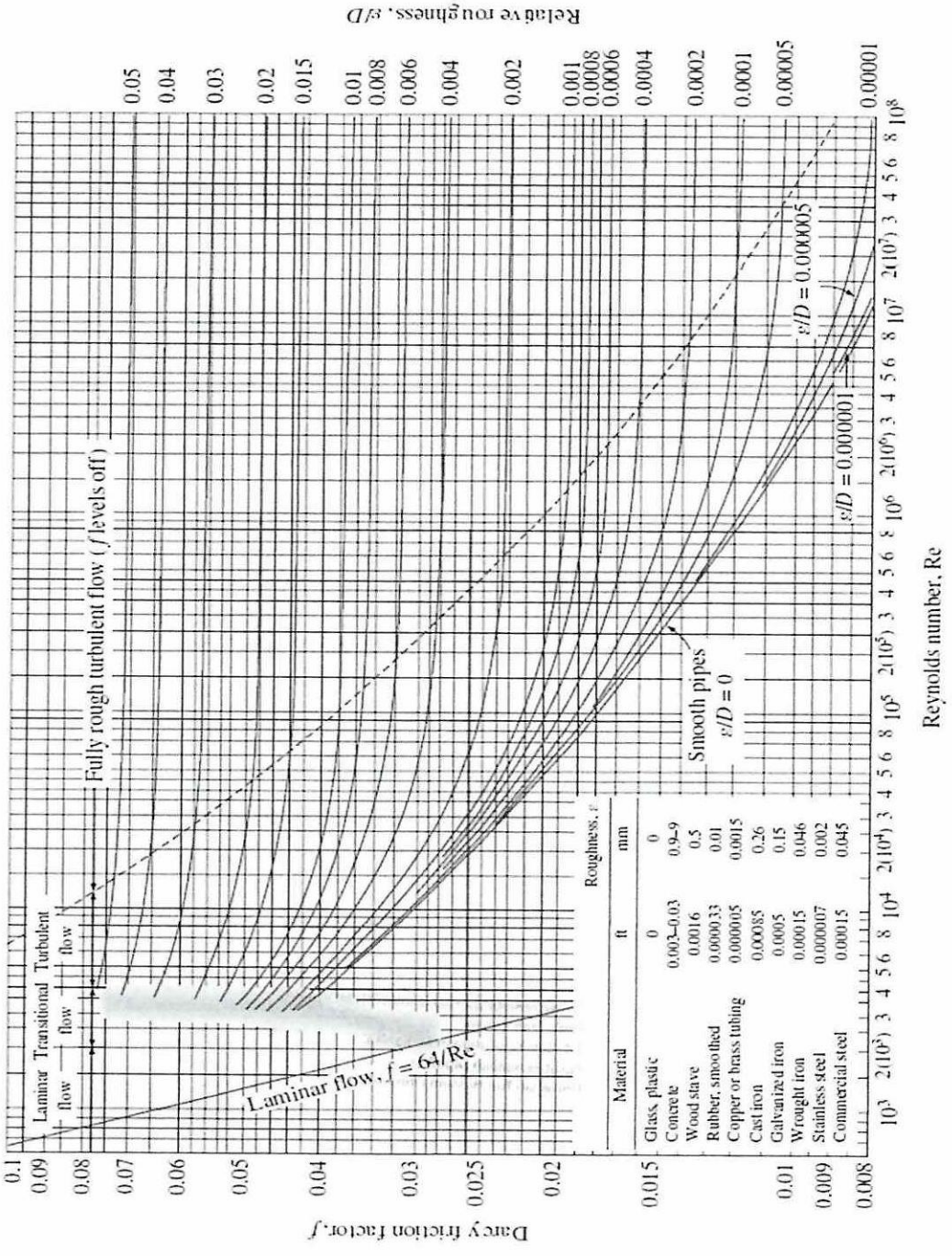

Figure APPENDIX A.1