UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2009/2010

SUBJECT NAME	:	FLUID MECHANICS 1
SUBJECT CODE	:	BDA 1052
COURSE	:	1 & 2 BDD
EXAMINATION DATE	:	APRIL/MEI 2010
DURATION	:	2 ½ HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS ONLY FROM **SIX (6)** QUESTIONS.

THIS EXAMINATION PAPER CONTAIN (6) PAGES

Q1 (a) Briefly explain the shear characteristics of the fluids for the curves in **Figure Q1 (a).**

(8 marks)

(b) Give a suitable example for

i. Bingham plastic fluid
ii. Pseudoplastic fluid.

(2 marks)

(c) Referring to **Figure Q1 (c)**, determine z_4 if the pressure difference between pipe A and B is given by 114 kN/m^2. Take $z_1 = 0.45$ m, $z_2 = 0.225$ m, and $z_3 = 0.675$ m.

(10 marks)

Q2 (a) Define the following terms:

i. magnitude of the resultant force
ii. centre of pressure, CP

(4 marks)

(b) A long solid cylinder of radius 0.8 m hinged at point *A* is used as an automatic gate, as shown in **Figure Q2 (b)**. When the water level reaches 5 m, the gate opens by turning about the hinge at point *A*. Determine the hydrostatic force if the length of the cylinder is 5 m and its line of action when the gate opens.

(16 marks)

Q3 (a) Archimedes' principle stated that the magnitude of buoyancy force is equal to the weight of the fluid displaced by the body. Proof this statement.

(6 marks)

(b) The uniform rod in **Figure Q3 (b)** is hinged at point B on the waterline and is in static equilibrium when 2 kg of lead with SG of 11.4 are attached to its end. Determine the specific gravity of the rod material.

(14 marks)

Q4 (a) Define the following terms :

i. Steady flow
ii. Uniform flow

(4 marks)

(b) Starting with the Bernoulli and Continuity equations, show that the following expression gives the flowrate measured by a venturi meter.

$$Q = C_d A_1 A_2 \sqrt{\frac{2g\left(\frac{P_1 - P_2}{\rho g} + z_1 - z_2\right)}{A_1^2 - A_2^2}}$$

(8 marks)

(c) A venturi meter is used to measure the flow of water in a pipe of diameter 100 mm. The throat diameter of the venturi meter is 60 mm with a discharge coefficient of 0.9. Determine the density of the manometric fluid if the manometer shows a head difference of 60 cm when the volume flowrate is 100 litre/s.

(8 marks)

Q5 (a) Describe body forces and surface forces acting on a control volume. Give two examples for each force.

(6 marks)

(b) A 12 cm diameter pipe, containing water flowing at 20.4 kg/s, is capped by an orifice plate as shown in **Figure Q5 (b)**. The exit jet is 25 mm in diameter. The pressure in the pipe at section 1 is 800 kPa. Calculate the force required to hold the orifice plate.

(14 marks)

Q6 (a) The flow rate Q through an orifice plate is a function of pipe diameter D, pressure drop Δp across the orifice, fluid density ρ and viscosity μ, and orifice dimeter d. Using D, ρ and Δp as repeating variables, express this relationship in dimensionless form.

(15 marks)

(b) The aerodynamic drag of a new sports car is to be predicted at a speed of 80 km/hr at an air temperature of 25°C. Automotive engineers build a onefifth scale model of the car to test in a wind tunnel. It is winter and the wind tunnel is located in an unheated building; the temperature of the wind tunnel air is only about 5°C. Determine how fast the engineers should run the wind tunnel in order to achieve similarity between the model and the prototype.

Given are properties of air at 5°C and 25°C.

At 5°C : $\rho_{air} = 1.269$ kg/m^3 and $\mu_{air} = 1.754 \times 10^{-5}$ kg/m.s
while at 25°C : $\rho_{air} = 1.184$ kg/m^3 and $\mu_{air} = 1.849 \times 10^{-5}$ kg/m.s

(5 marks)

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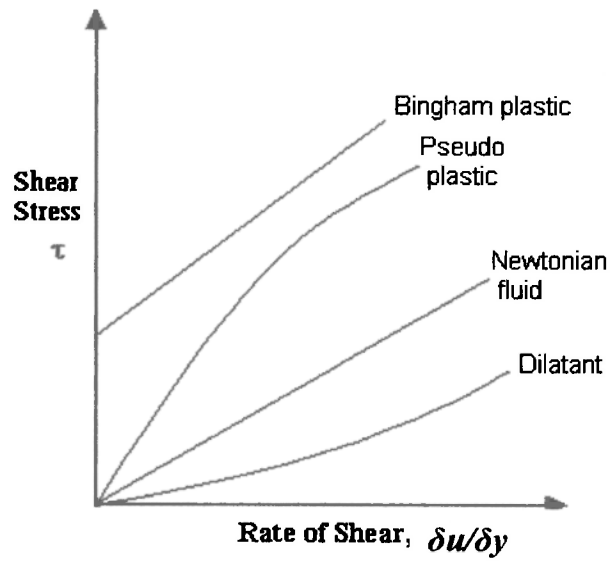

FIGURE Q1 (a)

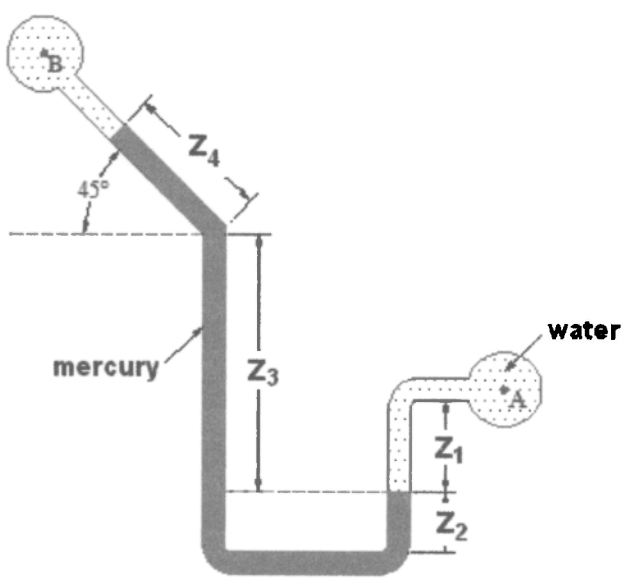

FIGURE Q2 (a)

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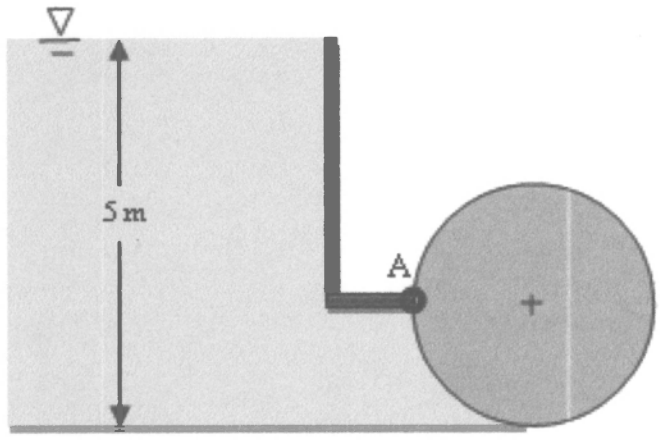

FIGURE O2 (b)

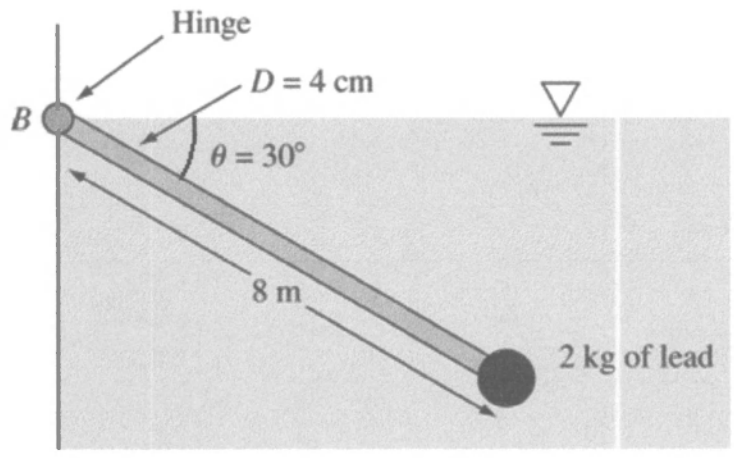

FIGURE O3 (b)

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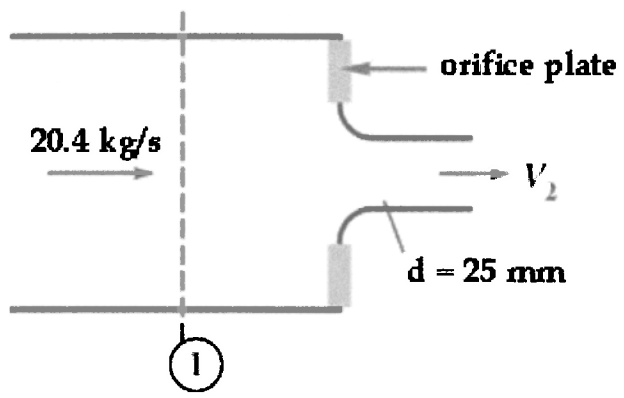

FIGURE Q5 (b)