

Allowable: None

**ANSWER ALL QUESTIONS:: " Assume any missing data "**

**Question one:**

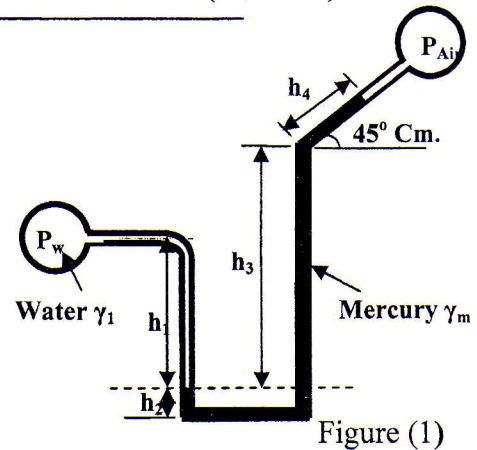
(a) Describe with the aid of diagrams the following phenomena explaining why and when they occur.

- (i) Metacentric height and its importance.
- (ii) The flow occurs due to the difference of energy
- (iii) The boundary layer thickness and establishment zone.
- (iv) The Reynolds number and its utilization.

(8 Marks)

(b) For the set-up shown in Figure make calculations for the pressure difference between tank A and tank B, see Figure (1). Neglecting pressure due to the presence of air column in the inclined tube and take  $h_1 = 30$  Cm.,  $h_2 = 15$  Cm.,  $h_3 = 45$  Cm. and  $h_4 = 20$  Cm. take  $S_m = 13.6$ .

(8 Marks)



(c) A 75 mm diameter pipe, 1.2 m long is just filled with oil  $S_{oil} = 0.822$  and then capped. Placed in horizontal position, it is rotated at 27.5 rad /sec about a vertical axis 0,3 m from one end. What pressure is developed at the far end of the pipe.

(10 Marks)

**Question two:**

(a) Show how we can use the pitot-tube and pitot-static-tube can be used to measure the flow velocity?

(6 Marks)

(b) A block of wood 30 cm square in cross section and 60 cm long weighs 318 N. Will the block float with sides vertical as shown in Figure (2)?

(10 Marks)

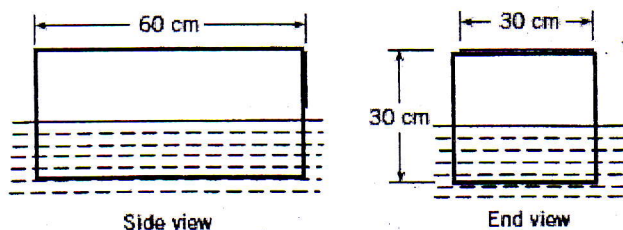


Figure (2)

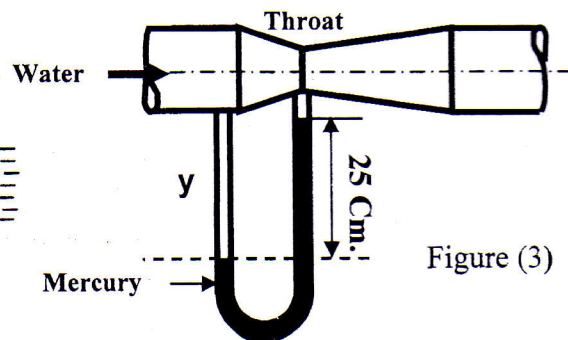


Figure (3)

(c) A U-tube mercury differential manometer has been used to measure the pressure difference across the inlet and throat of venturimeter that conveys water, see the Figure (3) below. Calculate the pressure difference when the venturimeter is laid horizontally and the manometer reading is 25 Cm. Find the flow rate if the inlet diameter is  $d_1 = 30$  cm and  $d_2 = 15$  cm. Take  $C_d = 0.96$ .

(10 Marks)

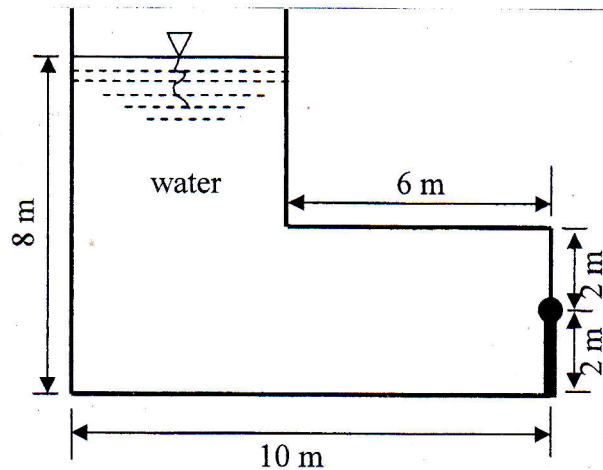
**Question three:**

(a) Drive the equation of continuity in fluid mechanics in general form, and then state the special cases. **(8 Marks)**

(b) Show how the equation blew can be used to obtain the friction losses in different flow's types of flow and pipe's roughness.

$$h_L = f \frac{L}{D} \frac{v^2}{2g} \quad \text{(8 Marks)}$$

(c) A 5m wide tank with an L-shaped cross section, as shown in Figure 4, has a gate which is hinged at the top at it right hand end. If the tank is filled with water to a level of 8 m determine the torque required at the hinge to just keep the gate closed. Determine also the force on the base of the tank and comment on why this is not the same as the weight of the water. **(10 Marks)**



(d) Calculate the flow Q and the velocity v. Consider H = 25 m. Writing the energy equation between points 1 and 2. Take  $K_{ENTRANCE} = 1.0$ ,  $K_{Global VALVE} = 10$ ,  $K_{90^\circ ELBOW} = 0.9$ ,  $K_{EXIT} = 1.0$  and  $f = 0.02$ . Draw the H.G.L. and E.L. for system with secondary losses and without secondary losses. **(12 Marks)**

