College of Engineering & Technology

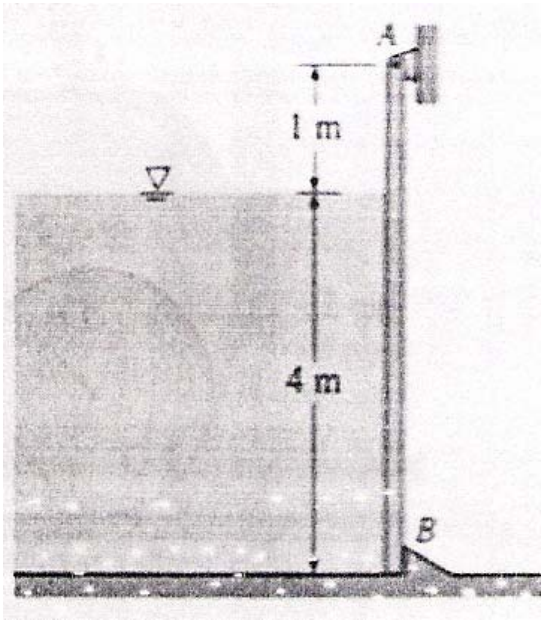
Department: Mechanical Engineering Marks: 20
Lecturer: Dr. Rola Afify Time: 8:30 – 10:10
Course Code: ME362 Date: 22/4/2015

Name: **Model Answer** R. N.:

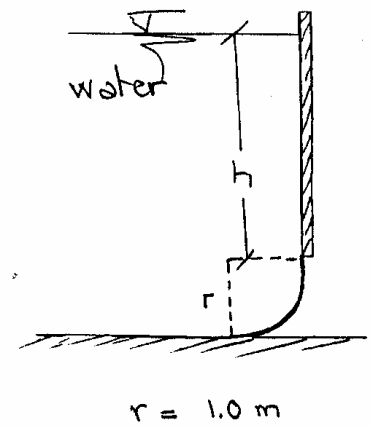
Answer the following questions:

Question one (10 marks)

A) A 5 m high and 5 m wide rectangular plate blocks the end of a 4 m deep freshwater channel as shown in Figure. The plate is hinged about a horizontal axis along its upper edge through a point A and is restrained from opening by a fixed ridge at point B. Determine the force exerted on the plate by the ridge.

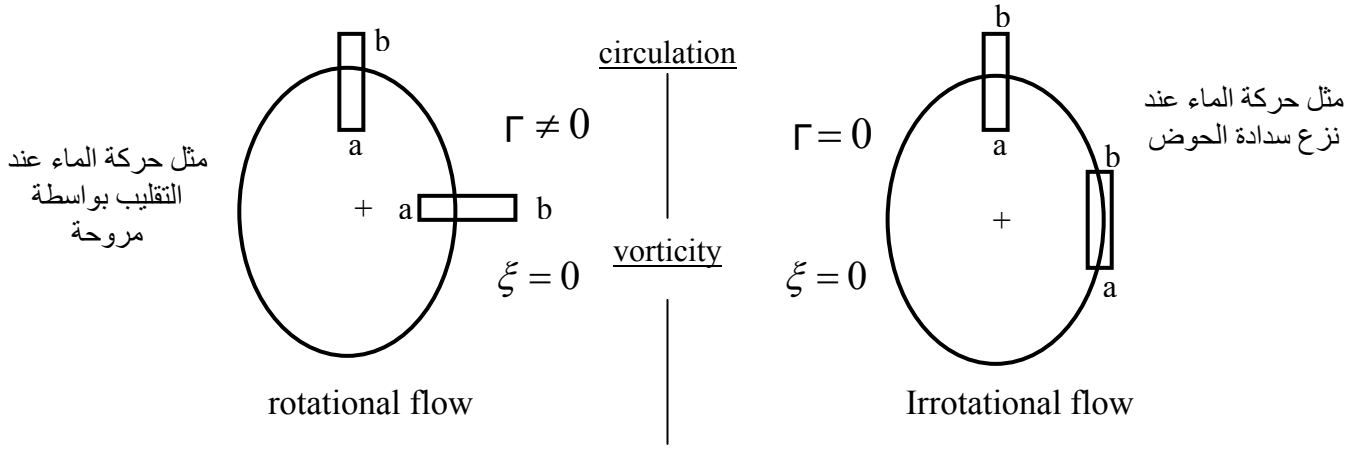


B) If the resultant pressure force on the circular gate shown in Figure is inclined 50^{o} to the horizontal. Calculate the height of water in the tank 'h' and the magnitude of the resultant pressure force on the gate. Given that gate width = 0.5 m.

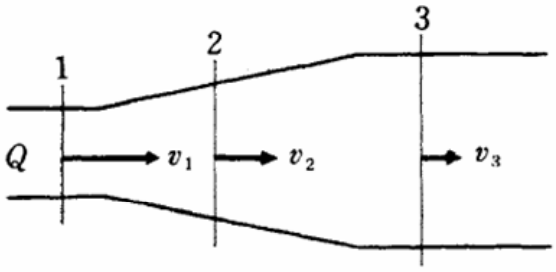


Question two (10 marks)

A) Compare between Rotational and Irrotational flows.



B) Water is flowing in the conduit shown in figure. If the flow rate Q is 8 lit/s and the diameters d_1, d_2 and d_3 at sections 1, 2 and 3 are 50, 60 and 100 mm respectively, find the flow velocities v_1, v_2 and v_3. If the pressure P_1 at section 1 is 24.5 kPa, what is the pressure P_3 at sections 3?



To get flow velocities v_1, v_2 and v_3

$$Q = A_1 v_1 = A_2 v_2 = A_3 v_3$$

$$8x10^{-3} = (\frac{\pi}{4} d_1^2) v_1 = (\frac{\pi}{4} d_2^2) v_2 = (\frac{\pi}{4} d_3^2) v_3$$

$$8x10^{-3} = (\frac{\pi}{4} (50x10^{-3})^2) v_1 = (\frac{\pi}{4} (60x10^{-3})^2) v_2 = (\frac{\pi}{4} (100x10^{-3})^2) v_3$$

$$v_1 = \frac{8x10^{-3}}{\frac{\pi}{4}(50x10^{-3})^2} = 4.07 \ m/s,$$

$$v_2 = \frac{8x10^{-3}}{\frac{\pi}{4}(60x10^{-3})^2} = 2.83 \ m/s,$$

$$v_3 = \frac{8x10^{-3}}{\frac{\pi}{4}(100x10^{-3})^2} = 1.02 \ m/s$$

To get the pressures P_3 at sections 3

$$\frac{P_1}{w} + Z_1 + \frac{v_1^2}{2g} = \frac{P_3}{w} + Z_3 + \frac{v_3^2}{2g}$$

$Z_1 = Z_3$ at the same horizontal level

$$\frac{P_1}{w}+\frac{v_1^2}{2g}=\frac{P_3}{w}+\frac{v_3^2}{2g}$$

$$\frac{P_3}{w}=\frac{P_1}{w}+\frac{v_1^2}{2g}-\frac{v_3^2}{2g}$$

$$\frac{P_3}{9800}=\frac{24.5x10^3}{9800}+\frac{(4.07)^2}{2x9.8}-\frac{(1.02)^2}{2x9.8}$$

C) What diameter orifice hole, *d*, is needed if under ideal conditions the flowrate through the orifice meter is to be 0.4 m^3/sec of seawater with P_1- P_2 = 2.37 kPa. The contraction coefficient is assumed to be 0.63.