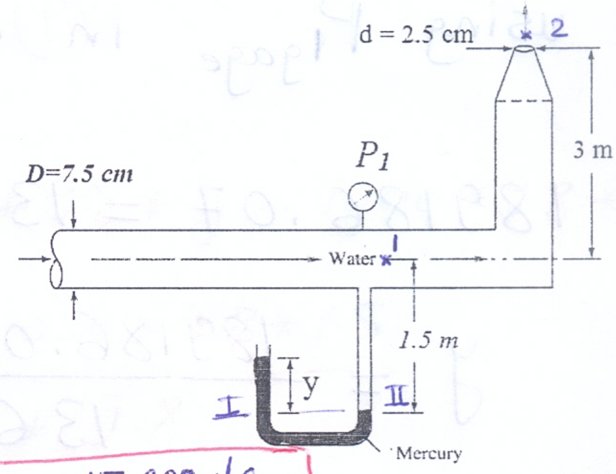
COLLEGE OF ENGINEERING & TECHNOLOGY

Department : MECHANICAL ENGINEERING
Lecturers : Prof. Dr. Kamal Abd- Elaziz – Dr. Rola Samir – Dr. Ahmed Khalifa Mehanna
Course : Hydraulics
Course No. : ME 362
Date : 09/05/2016
Time: 40 minutes
Name:
Reg. No.:

Model Answer 12th Week Exam

Answer the following questions:

1. For ideal flow of water as shown in the below Figure, the mass flow rate is 8.83 kg/s. Find the manometer reading (y) and the absolute pressure (P_1). The atmospheric pressure is 101.3 kPa.



$\dot{m} = 8.83 \text{ Kg/sec} = \rho Q$

$Q = \frac{8.83}{1000} = 8.83 * 10^{-3} \text{ m}^3/\text{sec}$

C.E. $Q = A_1 V_1 = A_2 V_2$

$8.83 * 10^{-3} = \frac{\pi}{4}(7.5 * 10^{-2})^2 V_1$

$= \frac{\pi}{4}(2.5 * 10^{-2})^2 V_2$

$\therefore V_1 = 1.999 \text{ m/sec}$

$V_2 = 17.988 \text{ m/sec}$

from u-tube manometer

$P_I = P_{II}$

$P_{atm}^{\,0} + \rho_m g y = \rho_w g * 1.5 + P_1$

$\therefore P_1 = \rho_m g y - \rho_w g * 1.5$

$= 13600 * 9.8 * y - 1000 * 9.8 * 1.5 \longrightarrow (1)$

B.E. 1→2 $E_1 = E_2$

$\frac{P_1}{\rho g} + Z_1 + \frac{V_1^2}{2g} = \frac{P_2}{\rho g} + Z_2 + \frac{V_2^2}{2g}$

($Z_1 \to 0$ datum; $P_2 = 0$ atm)

$\frac{P_1}{1000 * 9.8} + \frac{(1.999)^2}{2 * 9.8} = 3 + \frac{(17.988)^2}{2 * 9.8}$

$P_1 = 189186.07 \ Pa$

$P_{1_{abs}} = P_1 + P_{atm}$

$= 189186.07 + 101.3 * 10^3$

$= 290486.07 \ Pa_{abs}$

$P_{1_{abs}} = 2.9 \ bar_{abs}$

using $P_{1_{gage}}$ in eqn (1)

$189186.07 = 13600 * 9.8 * y - 1000 * 9.8 * 1.5$

$$y = \frac{189186.07 + 1000 * 9.8 * 1.5}{13600 * 9.8}$$

$= 1.529757$

$y = 1.53 \ m$

Name: **Reg. No.:**

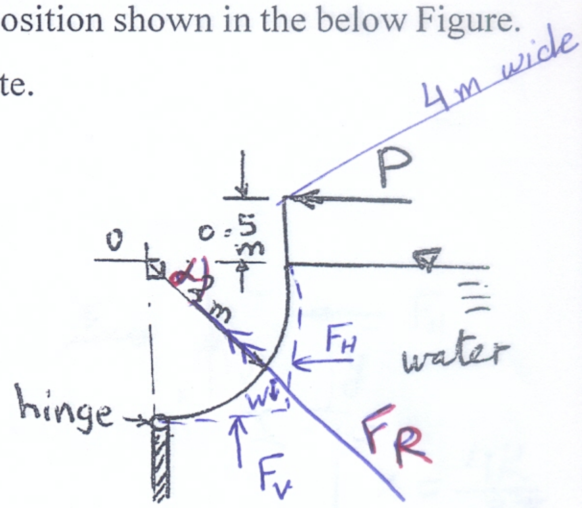
2. Find the force (P) required to hold the gate in the position shown in the below Figure. The gate is 4 m wide. Neglect the weight of the gate.

$F_H = P_o + \rho g (s + \frac{b}{2}) ab$

$= \rho g a \frac{b^2}{2}$

$= 1000 * 9.8 * 4 * \frac{2^2}{2}$

$= 78400$ Newton



$F_V = \rho g h A$

$= 1000 * 9.8 * 2 * 2 * 4 = 156800$ N

$W = \rho g V$

$= 1000 * 9.8 * [\square - D] * 4$

$= 9800 * [2^2 - \frac{1}{4} * \pi 2^2] * 4$

$= 33649.568$ Newton

$\rho = \frac{m}{V}$

$mg = \rho V g$

$F_y = F_V - W = 123150.432$ N

$F_R = \sqrt{F_x^2 + F_y^2} = 145988.3177$ N

$\alpha = \tan^{-1} \frac{F_y}{F_x} = 57.52°$

$\Sigma M_{hinge} = 0$ (+↺)

$F_R \cos\alpha * 2 + P * 2.5 = 0$

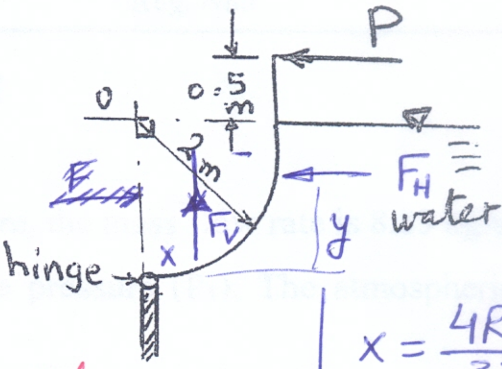
$P = -62720$ Newton

$= -62.72$ KN

Name: Another Solution **Reg. No.:**

2. Find the force (P) required to hold the gate in the position shown in the below Figure. The gate is 4 m wide. Neglect the weight of the gate.

$$F_H = \rho g h_c A$$
$$= 1000 * 9.8 * 1 * (2*4)$$
$$= 78400 \ N$$



$$x = \frac{4R}{3\pi} = \frac{4*2}{3\pi}$$
$$y = \frac{R}{3} = \frac{2}{3}$$

$$F_V = \rho g * wide * A = \gamma \, V_{missing\ Fluid}$$
$$= 1000 * 9.8 * 4 * (\frac{\pi}{4} * 2^2)$$
$$= 123150.43 \ N = 39200\pi N$$

$$\Sigma M_{hinge} = 0$$

$$F_V \, x + F_H \, y + P * 2.5 = 0$$

$$123150.43 * \frac{8}{3\pi} + 78400 * \frac{2}{3} + P * 2.5 = 0$$

$$P = -62.793 \ N$$