College of Engineering & Technology

Department: Mechanical Engineering | Marks: 8
Lecturer: Dr. Rola Afify | Time: 9:30 – 10:10
Course Code: ME362 | Date: 3/12/2016

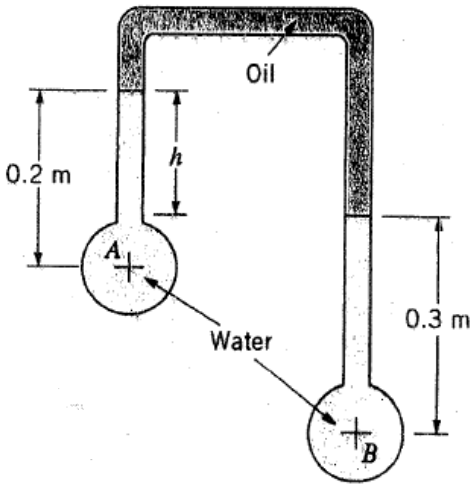
8

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

Answer the following questions:

Question one (4 marks)

The inverted U-tube manometer contains water and oil (SG. = 0.9), as shown in figure. The pressure difference between pipes A and B, $P_A - P_B = -5$ kPa. Determine the differential reading h.



$$p_A - \gamma_{H_2O}(0.2m) + \gamma_{oil}(h) + \gamma_{H_2O}(0.3m) = p_B$$

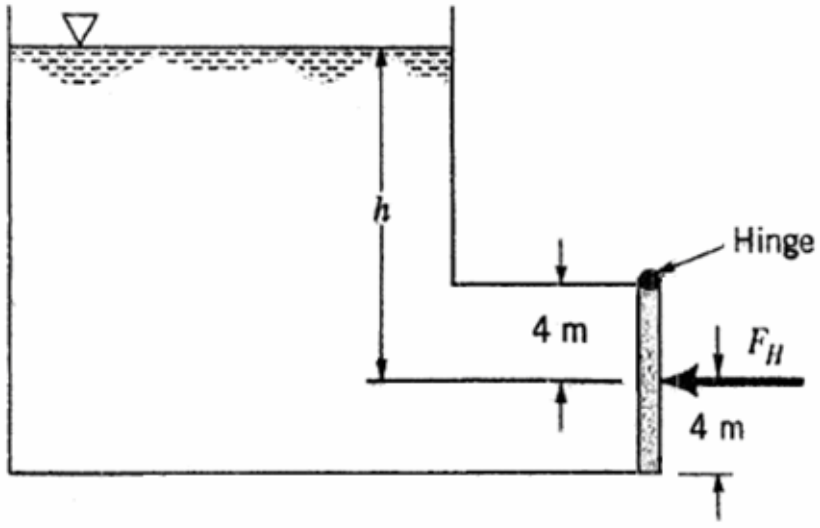
Thus,

$$h = \frac{(p_B - p_A) + \gamma_{H_2O}(0.2m) - \gamma_{H_2O}(0.3m)}{\gamma_{oil}}$$

$$= \frac{5\times10^3 \frac{N}{m^2} - \left(9.80\times10^3 \frac{N}{m^3}\right)(0.1m)}{8.95\times10^3 \frac{N}{m^3}} = 0.449\ m$$

Question two (4 marks)

A rectangular gate, 3m wide and 8m high, is located at the end of a rectangular passage that is connected to a large open tank filled with water, as shown in figure. The gate is hinged at its bottom and held closed by a horizontal force, F_H, located at the center of the gate. The maximum value of F_H is 3500 kN. Determine the maximum water depth, h, above the center of the gate that can exist without the gate opining.

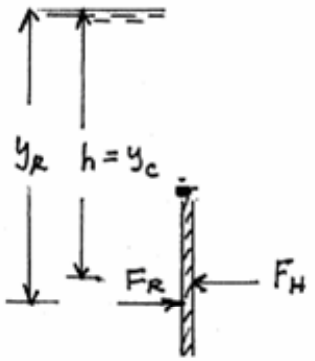


$$F_R = \gamma h_c A = \left(9.80 \frac{kN}{m^3}\right)(h)(3m \times 8m)$$

$$= (9.80 \times 24\, h)\, kN$$

$$y_R = \frac{I_{xc}}{y_c A} + y_c = \frac{\frac{1}{12}(3m)(8m)^3}{h\,(3m \times 8m)} + h$$

$$= \frac{5.33}{h} + h$$



For gate hinged at <u>top</u>

$$\sum M_H = 0$$

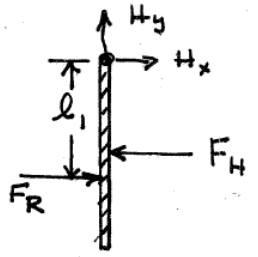
so that

$$(4m)F_H = \ell_1 F_R \quad \text{(see figure)} \qquad (1)$$

where

$$\ell_1 = y_R - (h-4) = \left(\frac{5.33}{h} + h\right) - (h-4)$$

$$= \frac{5.33}{h} + 4$$



$\ell_1 = y_R - (h-4)$

Thus, from Eq. (1)

$$(4m)(3500\,kN) = \left(\frac{5.33}{h} + 4\right)(9.80 \times 24)(h)\, kN$$

and

$$\underline{\underline{h = 13.5\,m}}$$