College of Engineering & Technology

Department: Mechanical Engineering Marks: 8
Lecturer: Dr. Rola Afify Time: 9:30 – 10:10
Course Code: ME362 Date: 5/12/2016

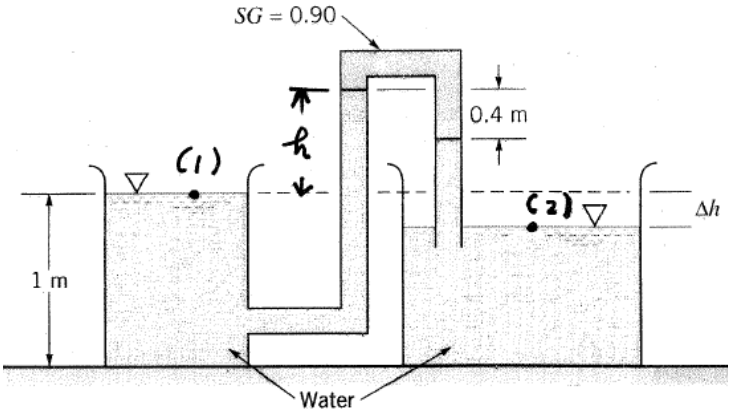
8

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

Answer the following questions:

Question one (4 marks)

Determine the elevation difference, Δh, between the water levels in the two tanks show in figure.



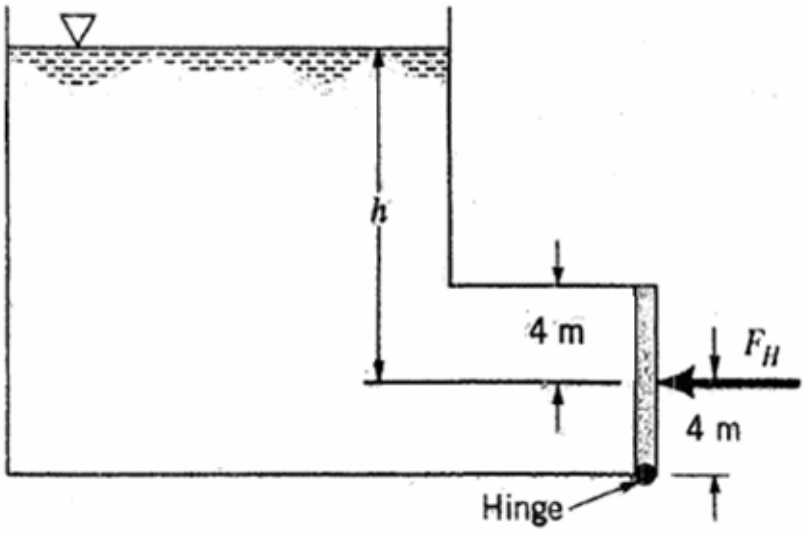
$$p_1 - \gamma_{H_2O} h + (SG)\gamma_{H_2O}(0.4m) + \gamma_{H_2O}(h - 0.4m) + \gamma_{H_2O}(\Delta h) = p_2$$

Since $p_1 = p_2 = 0$

$$\Delta h = 0.4m - (0.9)(0.4m) = \underline{\underline{0.040\,m}}$$

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.



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

$\sum M_H = 0$

so that

$(4m)\, F_H = \ell\, F_R$ (see figure) (1)

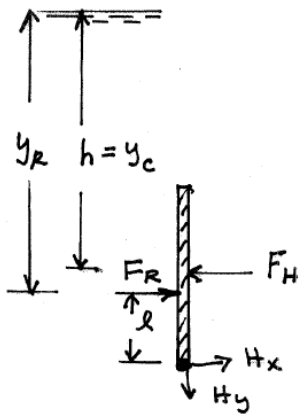
and

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

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

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

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



$\ell = h + 4 - y_R$

Thus,

$$\ell(m) = h + 4 - \left(\frac{5.33}{h} + h\right) = 4 - \frac{5.33}{h}$$

and from Eq. (1)

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

so that

$$\underline{\underline{h = 16.2\ m}}$$