

September 16, 2013

NAME

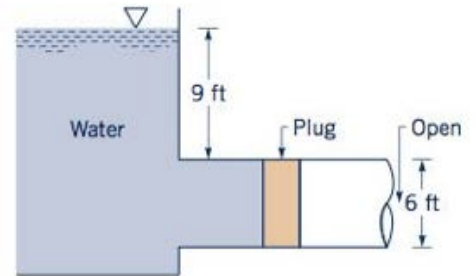
Fluids-ID

Quiz 2.

A large, open tank contains water and is connected to a 6-ft-diameter conduit as shown the Figure. A circular plug is used to seal the conduit. (Hints:  $I_{xc} = \pi R^4/4$ ,  $\gamma = 62.4 \text{ lb/ft}^3$ )

- (a) Determine the magnitude of the force of the water ( $F_R$ ) on the plug. (+4 points)  
 (b) Determine the location ( $y_R$ ) and direction of the force of the water on the plug. (+3 points)

Note: Attendance (+2 points), Format (+1 points)



Solution:

a)

$$F_R = p_c \cdot A \quad (+2 \text{ points})$$

$$p_c = \gamma \cdot h_c, \text{ where } h_c = 12 \text{ ft} \quad (+1 \text{ point})$$

$$A = \frac{\pi D^2}{4} \quad (+0.5 \text{ point})$$

$$F_R = \left(62.4 \frac{\text{lb}}{\text{ft}^3}\right) (12 \text{ ft}) \left(\frac{\pi(6 \text{ ft})^2}{4}\right) = 21,200 \text{ lb} \quad (+0.5 \text{ point})$$

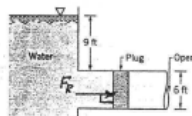
b)

$$y_R = y_c + \frac{I_{xc}}{y_c \cdot A} \quad (+2 \text{ points})$$

$$I_{xc} = \frac{\pi R^4}{4} = \frac{\pi(3 \text{ ft})^4}{4} = 63.6 \text{ ft}^4$$

$$y_R = 12 \text{ ft} + \frac{63.6 \text{ ft}^4}{(12 \text{ ft})\pi(3 \text{ ft})^2} = 12.19 \text{ ft} \quad (+0.5 \text{ point})$$

The force acts below the water surface and is perpendicular to the plug surface as shown in the Figure below.



(+0.5 point)