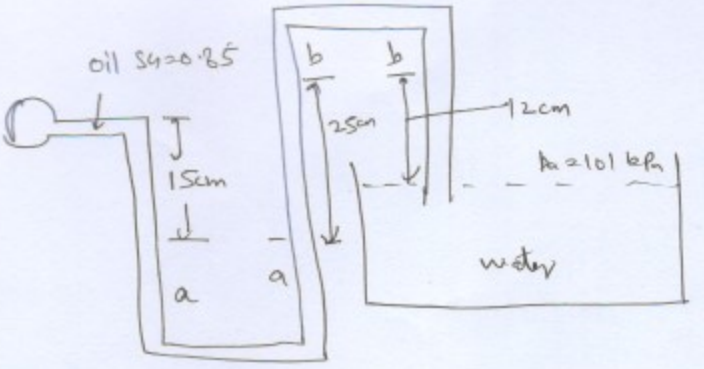
Tutorial 2

2.46



$\rho_{water} = 1000\ kg/m^3$

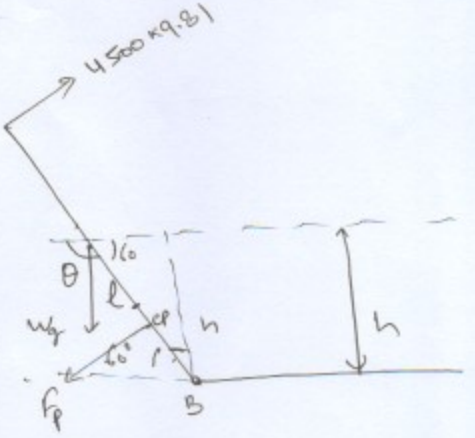
$\rho_{Hg} = 13.6 \times 10^3\ kg/m^3$

$\rho_{oil} = 850\ kg/m^3$

$P_A = 101000 + 0.12 \times 1000 \times 9.81 + 0.25 \times 13.6 \times 10^3 \times 9.81 -$

$0.15 \times 850 \times 9.81 = 131926\ Pa$

2.49



~~$\sin(180-\theta) = h$~~ $\theta = 120°$

$l = \frac{h}{\sin 60} =$

$W_g = 4.5 \times 2.5 \times 0.025 \times 7.85 \times 1000 \times 9.81 = 21658.64\ N$

$y_{cp} = \frac{-I_{xx} \sin\theta}{h_{cg} A} = \frac{-\frac{2.5 \times l^3}{12} \sin 120}{(h/2) \times 2.5} = \frac{\frac{-2.5}{12} \frac{l^3}{\sin^3 60} \sin 120}{\times \left(\frac{h}{2}\right) \frac{h}{\sin 60} 2.5}$

$$\frac{-\frac{2.5}{12}\ \frac{h}{8m\theta}}{\frac{1}{2}(2.5)} = -\frac{1}{6}\,\frac{2h}{\sqrt{3}} = -0.1925h$$

$$\therefore \left(\frac{l}{2} - 0.1925h\right) = \frac{h}{\frac{\sqrt{3}}{2}}$$

$$= \frac{h}{2\frac{\sqrt{3}}{2}} - 0.1925h = 0.3848h$$

$$F_p = P_{cg}A = \left(\frac{h}{2}\right)\rho g(2.5)\,l = \left(\frac{h}{2}\right)1000\times 9.81\times 2.5\,\frac{h}{8m\theta}$$

$$= 14159.515\,h^2$$

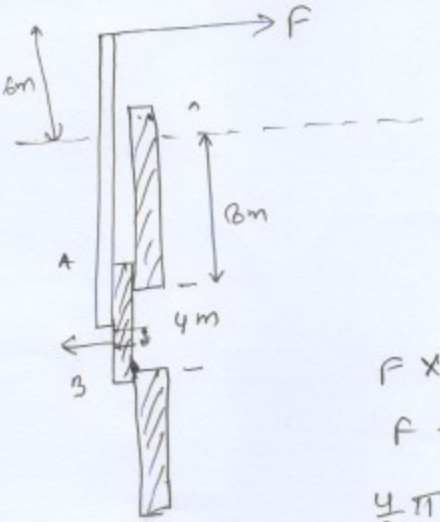
moment at equilibrium

$$-4500\times 9.81\times 4.5 + (14159.515h^2)(0.3848h) + 21658.64\times 2.25\cos\theta = 0$$

$$5448.58h^3 = 174286.53$$

$$h = 3.174\,m$$

2.80



$$F_p = 1000\times 9.81\times 10 = 98100\times 12 = 1177200$$

$$y_{cp} = -\frac{I_{xx}\sin\theta}{h_{cg}A} = \frac{\frac{3\times 4^3}{12}\times 1}{10\times 4\times 3} = -0.133$$

$$F\times 18 = 98100\times(2-0.133)\ 1177200$$

$$F = 122101.8\ N$$

$$\frac{4}{3}\pi\left(\frac{d}{2}\right)^3\times 2.4\times 1000\times 9.81 = 122101.8$$

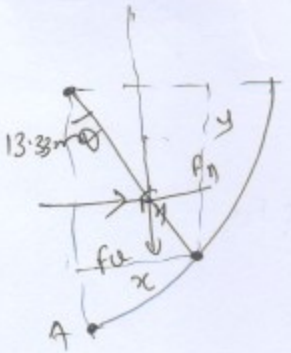
$$d^3 = 9.9047$$

$$d = 2.15\,m$$

2.92 2.92

$F_H = \rho g h_{cen} A = 1000 \times 9.81 \times 10 \times 20 \times 50 = 9.81 \times 10^7 N$

$y_{cp} = -\frac{I_{xx} \sin\theta}{h_{cen} A} = -\frac{\frac{50 \times (20)^3}{12}}{10 \times 20 \times 50} = -3.33 m$



$F_V = \rho V g = 1000 \times \frac{\pi}{4}\left(\frac{40}{4}\right)^2 \times 9.81 \times 50 = 154.4 \times 10^6 N$

Vertical component acts through centroid

$\frac{4R}{3\pi} = \frac{4 \times 20}{3\pi} = 8.49 m$

$\tan\theta = \frac{8.49}{13.33} \Rightarrow \theta \Rightarrow 32.5^0$

$x = 20 \sin\theta = 10.74 m$

$y = 20 \cos\theta = 16.8678 m$

from A = $20 - 16.878 = 3.13 m$

2.94

$f_H = P_{CG}\ A_{proj} = 1000 \times 9.81 \left[0.25 + \frac{0.75}{2}\right] \times 0.75 \times 1.5$

$= 6897.6\ N$

$f_V =$

$F_V = \rho \left[1 \times 0.4 - \frac{2}{3} \times 0.75\right) \times g \times b$

$= 1000\left[0.4 - \frac{2}{3} \times 0.4 \times 0.75\right] \times 9.81 \times 1.5 = 3939.2\ N$

$= 2943\ N$

or

$f_V = \rho \times \left[0.25 \times 0.4 + \frac{1}{3} \times 0.75\right] \times 9.81 \times 1.5$

$= 1000\left[0.25 \times 0.4 + \frac{1}{3} \times 0.4 \times 0.75\right] \times 9.81 \times 1.5 = 2943$