

2-1: $4_{\text{wp}}^{\vee}$; $\gamma_{\text{sat, water}} \rightarrow$ $\gamma_{\text{sat, water}}$ (5)

2-4: $P = \gamma_G h_G + \gamma_w h_w + \gamma_O h_O + \gamma_{EL} h_{EL} + \gamma_{Hg} h_{Hg}$

$$101 = 6.64 \times 4 + 9.81 \times 2 + \gamma_O (0.5) + 12.4 \times 0.2 + 133 \times 0.1 \Rightarrow$$

$$\gamma_O = 77.9 \text{ kN/m}^3 \quad (5)$$

$$P_A + \cancel{\gamma_w(a)} + \gamma_{Hg}(\gamma a) - \cancel{\gamma_w(a)} = P_B \xrightarrow{P_B - P_A = \gamma_0} a = \frac{\gamma_0}{\gamma \times 13.6 \times 10^3} = 0.001 \text{ (m)}$$

$$\sin \theta = \frac{\gamma \times 0.001}{0.141} = 0.007 \rightarrow \theta = 0.4^\circ$$

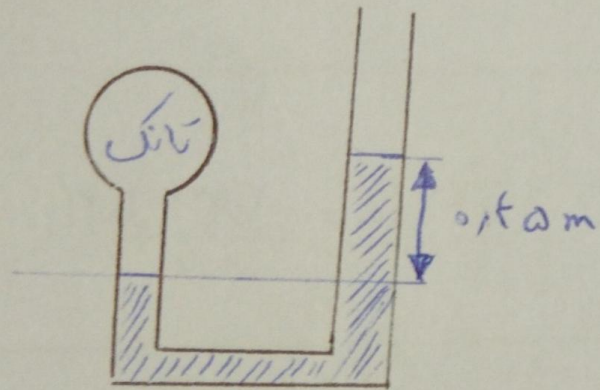
5

: ۲۲ سوال

$$\rho_{\text{روغن}} = 850 \text{ Kg/m}^3$$

$$P_{\text{ATM}} = 91 \text{ KPa}$$

☆ پاسخ سؤال (۱۵)



$$P_{\text{تانک}} = (850) (10) (0.15) + 91 \text{ KPa}$$

$\frac{\text{Kg}}{\text{m}^3} \quad \frac{\text{m}}{\text{s}^2} \quad \text{m}$

(B)

$$P_{\text{تانک}} = 101,450 \text{ KPa}$$

$$P_A - P_B = 0,4 \times 9810 - 0,1 \times 9810 \times 13,7 - \overbrace{h \times \gamma_g}^{0} + 0,7 \times 1,034 \times 9810 \quad (13,7 - 1)$$

$$= 2114 - 1373 \text{ ЕД, Г} + 686,18 \text{ ЕД} = - 672,82 \text{ ЕД, Г} \rightarrow P_B - P_A = 6,728 \text{ кПа}$$

6

$$P_A + (1 \dots \times 1 \dots \times 1, 0) + (1 \dots \times 1 \dots \times 0, 1) = (1 \dots \times 1 \dots \times 1, 1)$$

$$\Rightarrow P_A = r r \dots p a$$

4. 1

29-2

2 $\gamma_{\text{صیدو}}$

2 $\times 133.4$

2.110

0.268

(2-29)

$$\Rightarrow \gamma_{\text{صیدو}} \times 0.1 + \gamma_{\text{آب}} \times 0.5 + \gamma_{\text{روغن}} \times 1.5 = P_A$$

~~Handwritten scribbles~~

(5)

$$\Rightarrow 133.4 \times 0.1 + 9.81 \times 0.5 + 0.8 \times 9.81 \times 1.5 = -3.33 \text{ kPa}$$

(2-34)

$$\Rightarrow P_{\text{شیرین}} + \gamma_{\text{شیرین}} \times 0.6 - \gamma_{\text{صیدو}} \times 0.1 - \gamma_{\text{هوا}} \times 0.7 + \gamma_{\text{دریا}} \times 0.4 = P_{\text{دریا}}$$

$$\Rightarrow P_{\text{شیرین}} + 2.41 \times 0.6 - 133 \times 0.1 - 1.23 \times 9.81 \times 0.7$$

(5)

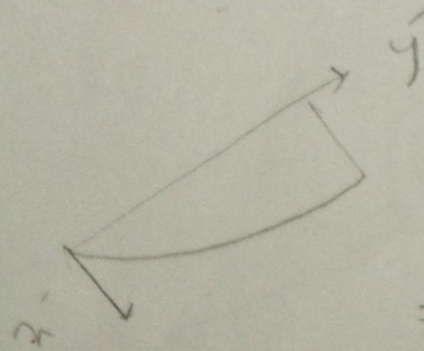
$$+ 101.53 \times 0.4 = P_{\text{دریا}} \Rightarrow \Delta P = 3.33 \text{ kPa}$$

$$\Rightarrow F_R = \gamma_w 5 (A_{\text{مربع}} - A_{\text{کند}}) = 9.81 \times 5 (11^2 - 0.1^2)$$

(2-37) (5)

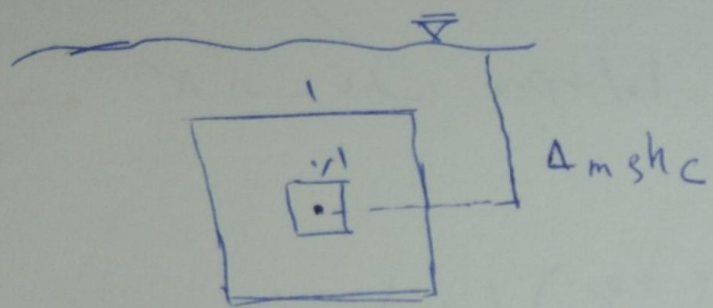
$$= 4.95 \gamma_w \rightarrow \text{گزینه 3}$$

(2-45)



$$dA = n' dy' = \frac{\sqrt{y}}{2} dy' \Rightarrow A = \frac{1}{2} \int_{-\frac{1}{2}}^{\frac{3}{2}} y' dy'$$

$$= \frac{1}{3} y'^{\frac{3}{2}} \Rightarrow \dots = \int y_c dA$$



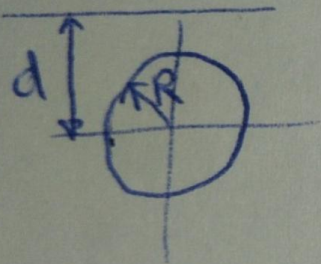
$$F_R = \gamma h_c A \Rightarrow F_R = \gamma_w \times 0.5 \times (1 - 0.1)^2$$

۳۷-۲

$$\rightarrow F_R = 1.92 \gamma_w \quad (5)$$

۳/۳۰

☆ پاسخ سوال (۵۷)



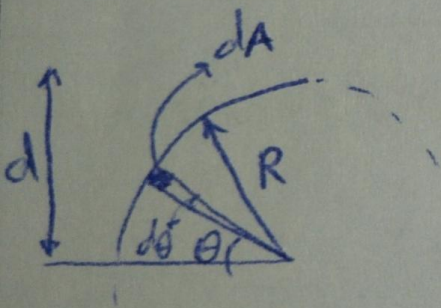
$$dA = (\pi R \cos \theta)(R d\theta) = \pi R^2 \cos \theta d\theta$$

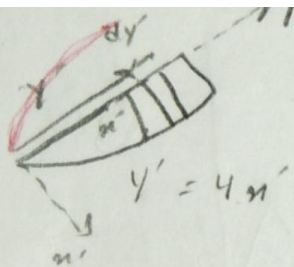
$$h = d - R \sin \theta$$

(5)

$$F_z = \int -\gamma h \sin \theta dA \rightarrow F_z = -\pi R^2 \gamma d \left[\frac{1}{\gamma} \sin^2 \theta \right]_{-\pi/4}^{\pi/4} + \pi R^2 \gamma \left[\frac{1}{\gamma} \sin^3 \theta \right]_{-\pi/4}^{\pi/4}$$

$$F_z = -\pi R^2 \gamma d (1-1) + \pi R^2 \gamma \left\{ \frac{1}{\gamma} [1 - (-1)] \right\}_{-\pi/4}^{\pi/4} = \frac{4}{\gamma} \pi R^2 \gamma$$





45-2 نصف شیب را در نظر می گیریم و y' را به سمت عمق دریم

$$dA = x' dy' = \frac{\sqrt{y'}}{2} dy' \Rightarrow A = \frac{1}{2} \int y'^{\frac{1}{2}} dy' = \frac{1}{2} \times \frac{2}{3} y'^{\frac{3}{2}} = \frac{1}{3} y'^{\frac{3}{2}}$$

$$y' = 4 \text{ m}^2 \Rightarrow x' = \frac{\sqrt{y'}}{2}$$

$$y'_c = \frac{\int y'_c dA}{A} = \frac{\int y' \frac{\sqrt{y'}}{2} dy'}{\frac{1}{3} y'^{\frac{3}{2}}} = \frac{\frac{1}{2} \int y'^{\frac{3}{2}} dy'}{\frac{1}{3} y'^{\frac{3}{2}}}$$

$$y'_c = \frac{\frac{1}{5} y'^{\frac{5}{2}}}{\frac{1}{3} y'^{\frac{3}{2}}} = \frac{3}{5} y'$$

$$y' = 1.22$$

$$\Rightarrow y'_c = 0.732$$

$$y'_a = 1.22 - 0.732$$

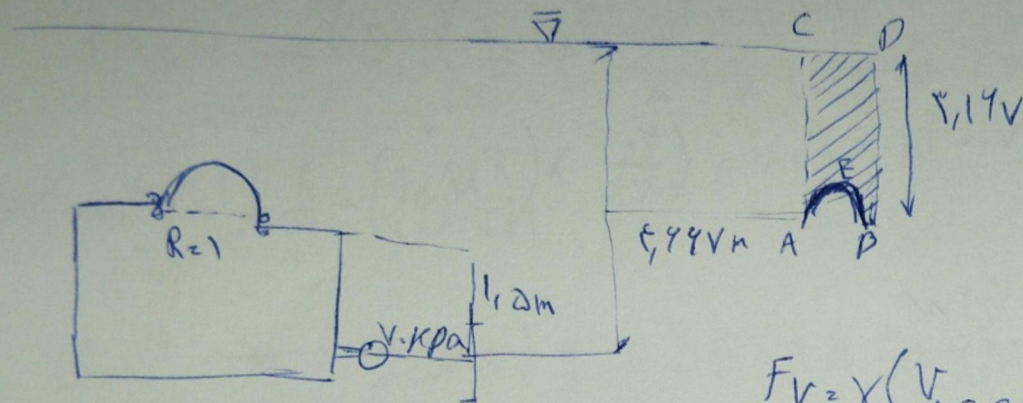
دیگر می خدایم

$$y' = 0.488$$

$$h_c = y' \sin 30 = (0.488 + 0.61) \sin 30 = 0.549 \text{ m} \quad h_c = 0.549$$

$$F_R = \gamma h_c A = 9810 \times 0.549 \times \left(\frac{2}{3} \times (1.22)^{\frac{3}{2}} \right) = 4838.26 \text{ N}$$

5

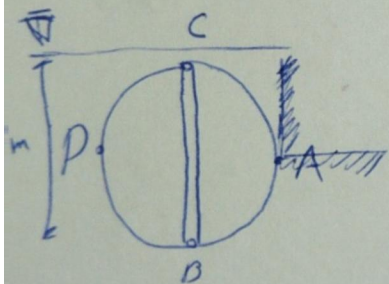


$$h = \frac{p}{\gamma} = \frac{10000 \text{ Pa}}{12000 \text{ N/m}^3} ; h = 0.83 \text{ m}$$

$$F_V = \gamma (V_{AEBCD}) = \gamma (V_{ABCD} - V_{AEB}) =$$

$$9810 \frac{\text{N}}{\text{m}^3} \times \left[\frac{1}{2} \left(\frac{r_m}{r} \right)^2 (1.4 \text{ m}) \right] - \frac{1}{2} \left[\frac{1}{2} \left(\frac{r_m}{r} \right)^2 \right] = 11182.8 \text{ N}$$

$$F_b = \frac{1}{2} (F_V - W) ; F_b = \frac{1}{2} (11182.8 \text{ N} - 12000 \text{ N}) ; F_b = 2494 \text{ N} = 2.49 \text{ kN}$$



$$N_B = W - F_V = W - \gamma V_{BPC}$$

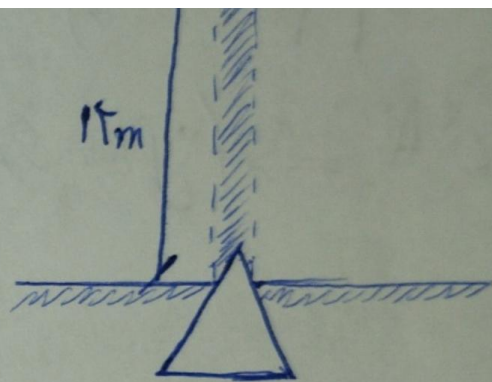
$$\rightarrow N_B = 12000 - (12000 \times 1.0 \times \left(\frac{1}{2} \left(\frac{r_m}{r} \right)^2 \times 1 \right))$$

$$\rightarrow N_B = 2494 \text{ N} = 2.49 \text{ kN}$$

نتیجه

$$h = \frac{\rho}{\gamma} \Rightarrow h = \frac{100\,000 \text{ N/m}^2}{10\,000 \text{ N/m}^2} = 10 \text{ m} \Rightarrow$$

ارتفاع
مستوی

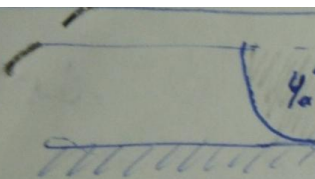


$$F = \gamma(V) = 10\,000 \left[\left[\pi (1)^2 (10) \right] - \left[\frac{1}{3} \pi (1)^2 (10) \right] \right]$$

$$\Rightarrow F = 10\,000 \pi \text{ N}$$

نیوتن

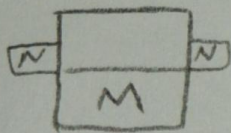
(5)


 40° $r = 1\text{m}$ $F = 1000 \times 9.81 \times \left(\frac{40}{360} \times \pi \times 1^3 \times \left(1 - \frac{1}{1} \times \sin 40^\circ \times \cos 40^\circ \right) \right)$

$= 1012.4\text{N}$

وزن

2-92



$$V_M = V_N$$

$$F_B = W$$

$$2 \times 0,1 \times 0,1 = (2 \times 0,15 + 2 \times 0,1) \times 0,05y \Rightarrow x = 2,5y$$

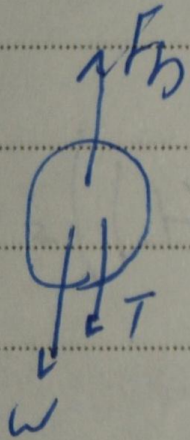
$$8 \times (0,1 \times 0,1) \times (x+y) = 5 \Rightarrow$$

$$\Rightarrow (0,8 \times 9810) \times (0,1 \times 0,1) \times (2,5y+y) = 5 \Rightarrow y = 0,018 \text{ m} = 18 \text{ mm}$$

5

بالنسبة لـ $0,08 + y$ جالسا كير ارتفاع بالانكس مسير 98 mm

2.97



$$F_b - W = 5.3 \text{ (kN)} \quad (1)$$

$$F_b = \gamma_w V = 9.81 \times \frac{4}{3} \pi \times \left(\frac{1.5}{2}\right)^3 = 17.32 \text{ N} \quad (2)$$

$$\text{BQ, } W = 12.03 \text{ kN}$$

$$S_0 = 0,1 \quad R = 0,12 \quad h = 0,1 \quad F_B = W \rightarrow \rho_f \times g \times V_{sub} = \rho_{body} \times g \times V_{total}$$

$$\rightarrow \cancel{\rho_w} \times \left(\cancel{\frac{1}{\rho_w}} \pi \times R^2 \times h \right) = 0,1 \times \cancel{\rho_w} \times \left(\cancel{\frac{1}{\rho_w}} \pi \times r^2 \times (0,1) \right) \rightarrow R^2 \cdot h = 0,1 \times r^2$$

$$\left. \begin{array}{l} (0,90) \\ (0,1, 0,12) \end{array} \right\} \rightarrow m = \frac{0,12}{0,1} = 0,12 \rightarrow R = 0,12 \times m \xrightarrow{m=1} R = 0,12 \times 1 = 0,12 \times 0,12 = 0,0144$$

$$\rightarrow (0,12 \times 1)^2 \times 0,12 = 0,0144 \Rightarrow Y^2 = 0,0144 \Rightarrow Y = 0,12 \times 1 \Rightarrow \boxed{Y = 0,12 \times 1}$$

$$I = \frac{\pi R^4}{8} = \frac{\pi \times (0,12)^4}{8} = 0,00012 \quad V = \frac{1}{4} \pi (0,12)^2 \times 0,12 = 0,00144 \quad BG = \frac{r}{8} \times h = \frac{0,12}{8} \times 0,12$$

$$\rightarrow \frac{r}{8} (0,12 - 0,12) = 0,0108 \rightarrow GM = \frac{I}{A} - BG = \frac{0,00012}{0,00144} - 0,0108 = \boxed{0,0192}$$

6

$\omega_1, \omega_2 \leftarrow \Theta \omega_0$

$$\vec{V}_{\text{rel}} = \vec{V}_{\text{obj}} \rightarrow (0,12 \times 0,14) \times b = (0,12 \times 0,14 - \left(\frac{0,12 \times u}{r}\right)) \times b \rightarrow 0,12 = 0,12 - 0,14 u \rightarrow \boxed{u = 0,12 m}$$

: $\vec{V}_{\text{rel}} = \vec{V}_{\text{obj}}$

$$\tan \theta = - \frac{a_u}{g} = - \frac{0,12}{0,12} \Rightarrow a_u = \frac{r}{r} \times (9,11) \rightarrow a_u = 1,12 \text{ m/s}^2$$

(B)

$$\tan \theta = \frac{dz}{dy} = -\frac{a_y}{g} = -\frac{2,0}{9,11} \rightarrow \tan \theta = -0,220$$

(21-8)

سطح جلوي $\rightarrow \varepsilon \times 0,220 = 1,02 \times 10^{-2} \text{ m} \rightarrow \omega: 2 - 1,02 = 0,98 \text{ m}$

سطح عقبی $\rightarrow$ ارتفاع: $0,102 \text{ m}$

$$\rightarrow \left\{ \begin{array}{l} F_f = \rho h c A = 9110 \times \frac{0,98}{4} \times (0,98 \times 2) \rightarrow 9244 \text{ N} \\ F_b = \rho h c A = 9110 \times \frac{0,102}{4} \times (0,102 \times 2) \rightarrow 4944 \text{ N} \end{array} \right\} \xrightarrow{\ominus} \Delta F = 10000 \text{ N} \checkmark$$

$$F = Ma = \rho V a = 1000 \times (1 \times 2 \times 2) \times 2,0 = 10000 \text{ N} \checkmark$$

$$P_B - P_A = \frac{\rho \omega^2 r_B^2}{\gamma} - \gamma z_B + C_D - \left(\frac{\rho \omega^2 r_A^2}{\gamma} - \gamma z_A + C_D \right) = \frac{\rho \omega^2}{\gamma} (r_B^2 - r_A^2)$$

$$P_B - P_A = \frac{(0.19 \times 9810) \times 10^4}{\gamma} (0.12 - 0) = 151.5 \text{ Pa} = 151.5 \text{ kPa}$$

~~0.19 x 9810 x 10^4~~ ~~0.12 - 0~~ 2+3

$$z = \frac{\omega^2 r^2}{2g} + C$$

$$(7 \text{ m}) = \frac{(10 \frac{\text{rad}}{\text{s}})^2 (-1 \text{ m})^2}{2 (10 \text{ m/s}^2)} + C \Rightarrow C = 2 \text{ m}$$

$$\Rightarrow z = \frac{\omega^2 r^2}{2g} + 2 \rightarrow U_f = \int_0^R 2\pi r z \, dr = \int_0^R 2\pi r \left(\frac{\omega^2 r^2}{2g} + 2 \right) dr$$

$$U_f = \frac{2\pi\omega^2}{2g} \int_0^R r^3 \, dr + 4\pi \int_0^R r \, dr = \frac{\pi\omega^2 R^4}{4g} + 2\pi R^2$$

$$U_f = \frac{\pi (10 \text{ rad/s})^2 (1 \text{ m})^4}{4 (10 \text{ m/s}^2)} + 2\pi (1 \text{ m})^2 = 4.5\pi \text{ m}^3$$

$$U_i = \pi R^2 z_i = \pi (1)^2 (5) = 5\pi \text{ m}^3$$

$$\left\{ \Delta U = 0.5\pi = 1.57 \text{ m}^3 \right\}$$

سوال ۵۲: گزینه (۳) چون لولا در ~~موقع~~ A در وسط قرار گرفته است فشار متقارن وارد می شود و پس در B چون لولا در بالا است

با افزایش ۲ ب فشار بیشتر به نبش وارد می شود و در نتیجه نیاز به لنگر بیشتری است. (B)