PHY250
HW_1

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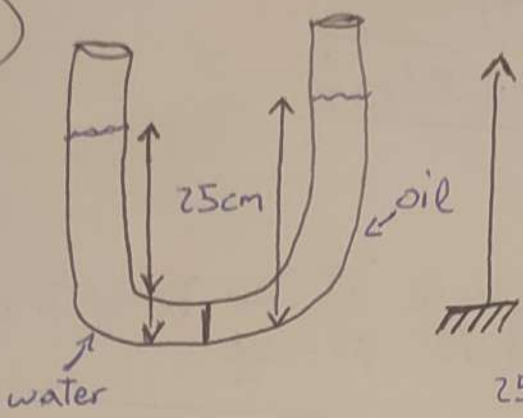
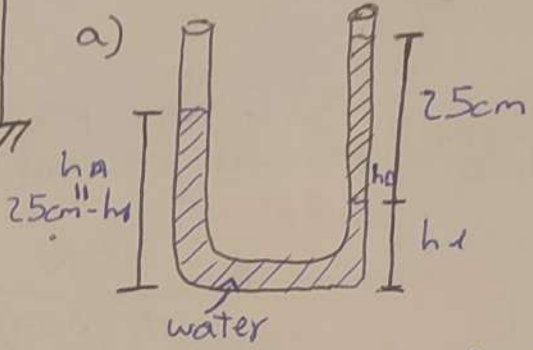
(1)



$\rho_{oil} = 0,8$

a)



Pressure at bottom will be equal.

$$\boxed{h_A = 22,5cm \quad h_B = 27,5cm}$$

$$\rho_w \cdot g(25cm - h_1) = \rho_{oil} \cdot g \cdot 25cm + \rho_w \cdot g \cdot h_1$$

$$\rho_w \cdot g \cdot 25cm - \rho_{oil} \cdot g \cdot 25cm = 2\rho_w \cdot g \cdot h_1$$

$$\rho_w \cdot g(25cm - 0,8 \cdot 25cm) = 2h_1$$

$$\frac{25 \cdot 0,2}{2} = \frac{2h_1}{2}$$

$$\boxed{h_1 = 2,5cm}$$

b) If equal densities, the pressure applied at the bottom by water as well as by oil will remain the same. Hence, they will have the same height.

$$\boxed{h_A = 25cm \quad h_B = 25cm}$$

c) If the density of the oil is much lower as compared to water, then the pressure would have been applied only by the water. Hence, h_A will be lower and h_B greater. $\boxed{h_A > h_B}$

(2) The hydrostatic pressure at depth "h" below sea level, where pressure is atmospheric pressure P_0, is given by:

$$\boxed{P = P_0 + \rho g h}$$

That means the increase of pressure at depth "h" is:

$$\boxed{\Delta P = \rho g h}$$

Relation between force and pressure is given as:

$$\boxed{P = \frac{F}{A}}$$

From the above equation: $\frac{F}{A} = \rho g h \Rightarrow \boxed{h = \frac{F}{A\rho g}}$

Area is calculated as: $A = \pi r^2 = \pi\left(\frac{8,2\,mm}{2}\right)^2 = 52,81\cdot10^{-6}\,m^2$

$$h = \frac{1,5\,\frac{kg\,m}{s^2}}{(52,81\cdot10^{-6}\,m^2)(10^3\,\frac{kg}{m^3})(9,8\,m/s^2)} \Rightarrow \boxed{h = 2,81\,m}$$

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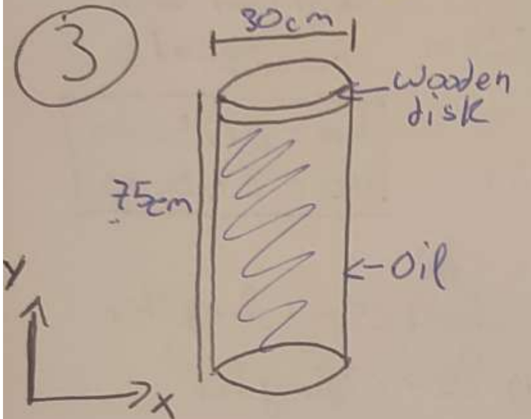

a) Gauge pressure at the top of the oil column is: $P = \frac{w}{A}$

$$P = \frac{45N}{\pi(\frac{1}{2}0{,}3m)^2} \Rightarrow \boxed{P = 636,62\,Pa}$$

b) Change in pressure at the bottom of the oil is:

$$\Delta P = \frac{W_1}{A} \qquad P = \frac{83N}{\pi(\frac{1}{2}0{,}3m)^2} = \boxed{1174,21\,Pa}$$

c) From the pascals law, the increase in pressure is same at all points in the oil. Change in pressure at half down is same as at the bottom as 1174,21Pa.

4 a) At any given depth, the fish is completely submerged in water, so the buoyant force must be equal to the weight of the fish. Therefore, weight of displaced water is equal to the weight of the fish. Therefore, density of fish is equal to density of water.

b) Buoyant force acting on fish: $F_B = 2,75\,kg\cdot9,8\,m/s^2$

$$\boxed{F_B = 26,95N}$$

Now, after the volume has changed % 10:

$F_B' = 0,1\cdot F_B$

So,

b $F(net) = 26,95N + 0,1\cdot26,95N = 29,645N$ (force exerted by water)

c) Now, net external force:

$F_{ext} = 29,645N - 26,95N = 2,695N$ (net external force)

The f.

The fish will move upwards.

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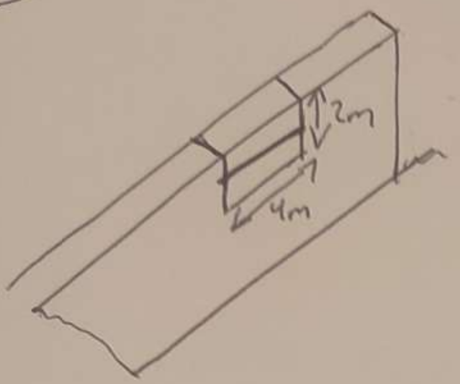
- The height of The gate is $H = 2m$
- the width of the gate is $w = 4m$



The force on a strip of vertical Thickness "dh" at a depth "h" is Then:

$$\boxed{dF = \rho g h (w\,dh)}$$

The formula for The torque about hinge is:

$$\boxed{d\tau = \rho g h w \left(h - \frac{H}{2}\right)} \qquad \tau = \text{Torque}$$

Now on integrating This equation in between the limits $h=0$ to $h=H$ gives: $\int d\tau = \int_0^H \rho g h w \left(h - \frac{H}{2}\right) dh$

$$\tau = \int_0^H \rho g h^2 w\,dh - 0 = \frac{\rho g w H^3}{12} = \cancel{\frac{1\cdot 10^3 \cdot 9{,}8\,m/s^2 \cdot 4m \cdot 2m}{12}}$$

$$\tau = \frac{1\cdot 10^3 \frac{kg}{m^3} \cdot 9{,}8\,m/s^2 \cdot 4m \cdot (2m)^3}{12} = \boxed{26{,}1 \cdot 10^3\,Nm}$$