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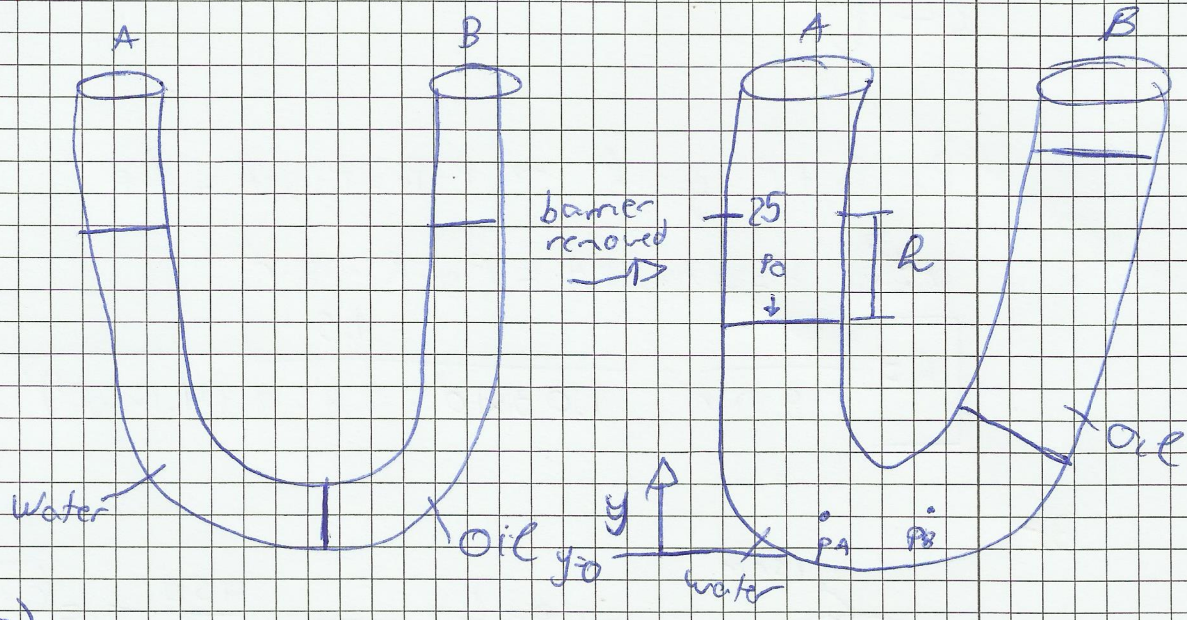
Phy 250
HW1

1.-



a)

$P_A = P_B$

$\cancel{P_0} + \cancel{\rho_A}\cdot \cancel{g} \cdot (25-h) = \cancel{P_0} + \rho_B \cdot \cancel{g} \cdot (25+h)$

1

$25-h = \rho_B \cdot (25+h)$

$25-h = \rho_B \cdot 25 + \rho_B \cdot h$

$25-\rho_B \cdot 25 = \rho_B \cdot h + h$

$25-\rho_B \cdot 25 = (\rho_B+1)\cdot h$

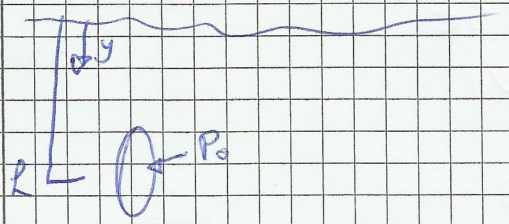
$h = \frac{25-\rho_B \cdot 25}{\rho_B + 1} = \frac{25-0.8\cdot 25}{0.8+1} = 2.7\text{cm}$

$$\boxed{\begin{array}{l}\text{Water height} = \text{Initial } h - h = 25\text{cm} - 2.7\text{cm} = 22.3\text{ cm} \\ \text{Oil height} = \text{Initial } h + h = 25\text{cm} + 2.7\text{cm} = 27.7\text{ cm}\end{array}}$$

b) i) if $\rho_A = \rho_B$, then the height would be the same because the preassure needs to be equal in both sides.

ii) if $\rho_A \gg \rho_B$, then the height of the oil would increase to compensate and make ~~both~~ the pressure in both sides equal.

2.-



$d = 8.2\,mm$

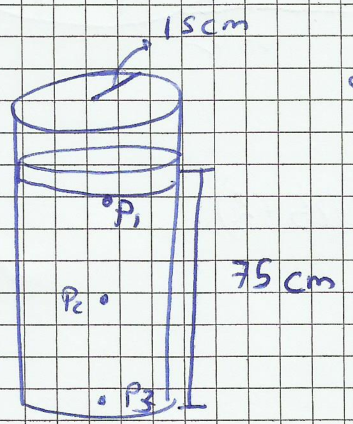
$r = \frac{d}{2} = \frac{8.2}{2} = 4.1\,mm = 4.1\times10^{-3}\,m$

$P = P_0 + \rho \cdot g \cdot h \rightarrow P - P_0 = \rho \cdot g \cdot h = \Delta p$

$F = p\,A = \Delta p\,A = \rho g \cdot h \cdot \pi \cdot r^2$

$$\boxed{h = \frac{F}{\rho \cdot g \cdot \pi \cdot r^2} = \frac{1.5}{1.03\times10^{3} \cdot 9.8 \cdot \pi \cdot (4.1\times10^{-3})^2} = 2.81\,m}$$

3.-



a) $P_1 = \frac{F}{A} = \frac{F}{\pi r^2} = \frac{45N}{\pi\cdot(0.15m)^2} = \boxed{636.62\,Pa}$

b) <u>Top</u>

$P_1 = \frac{F}{A} = \frac{F}{\pi r^2} = \frac{83N}{\pi\cdot(0.15m)^2} = \boxed{1174.2\,Pa}$

<u>Bottom</u>

$P_3 = P_1 + \rho \cdot g \cdot h = 1174.2 + 8.5\cdot10^{-4}\cdot 9.8 \cdot 0.75$

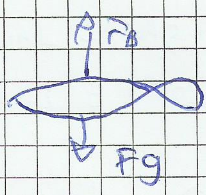
$= \boxed{1174.2\,Pa}$

<u>Middle</u>

$P_2 = P_1 + \rho \cdot g \cdot h = 1174.2 + 8.5\cdot10^{-4}\cdot 9.8 \cdot \frac{0.75}{2} = \boxed{1174.2\,Pa}$

4.-

Arquimedes prciple



$F_B = \rho_w \cdot g \cdot V$

$Fg = m \cdot g = \rho_{fish} \cdot g \cdot V$

To stay in place $F_B = Fg \Leftrightarrow \rho_w \cdot \cancel{g} \cdot \cancel{V} = \rho_{fish} \cdot \cancel{g} \cdot \cancel{V}$

$\boxed{\rho_w = \rho_{fish}}$

a) The density of the fish is equal, or close, to the density of the water.

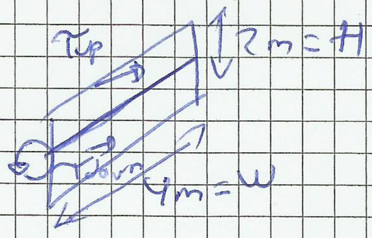
b) $V_{fish_2} = 1.1\,V_{fish\,old}$

$F_{B\,new} = \rho_w \cdot g \cdot V \cdot 1.1 = m \cdot g \cdot 1.1 = 2.75\,kg \cdot 9.8\,m/s^2 \cdot 1.1 = 29.64\,N$

c) $\Sigma F = F_B - Fg = 29.64N - 2.75\,kg \cdot 9.8\,m/s^2 = +2.69\,N$

it goes up.

5.-



$$dF = \rho \cdot g \cdot y \cdot w\,dy$$

step done with calculator.

$$\tau_{up} = \int_0^{H/2} d\tau = \int_0^{H/2} \rho \cdot g \cdot w\left(\frac{H}{2} - y\right) \cdot y\,dy = \rho \cdot g \cdot w\left(\frac{H^3}{16} - \frac{H^3}{64}\right) =$$

$$= \rho \cdot g \cdot w \cdot \left(\frac{H^3}{48}\right) = (1000\,kg/m^3) \cdot (9.8\,m/s^2) \cdot (4m) \cdot \left(\frac{2^3 m^3}{48}\right) =$$

$$\tau_{up} = 6533.\overline{3}\ Nm$$

step done with calculator

$$\tau_{down} = \int_0^{H/2} d\tau = \int_0^{H/2} \rho \cdot g \cdot w\left(\frac{H}{2} + y\right) y\,dy = \rho \cdot g \cdot w\left(\frac{H^3}{16} + \frac{H^3}{24}\right) =$$

$$= \rho \cdot g \cdot w\left(\frac{5H^3}{48}\right) = (1000\,kg/m^3) \cdot (9.8\,m/s^2) \cdot (4m) \cdot \left(\frac{5 \cdot 2^3 m^3}{48}\right) =$$

$$\tau_{down} = 32666.\overline{6}$$

$$\boxed{\tau = \tau_{down} - \tau_{up} = 32666.\overline{6} - 6533.\overline{3} = 26,133.\overline{3}\ Nm}$$