

NAME:

SECTION:

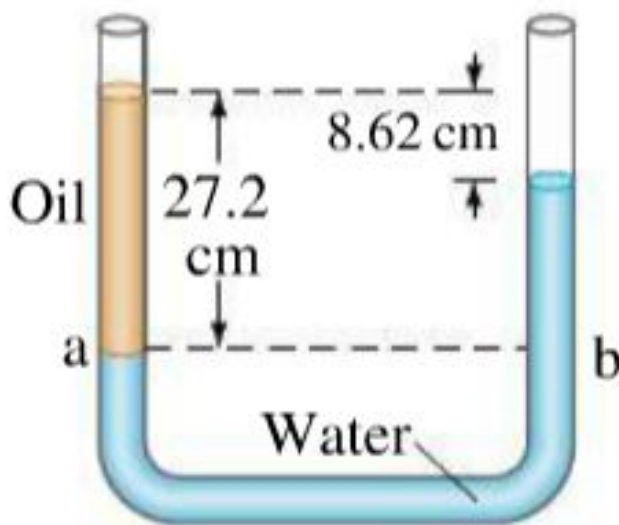
1. Consider a column of water of height h , radius r , and density ρ . The volume of the column is $V = \pi r^2 h$. Draw the column and label the variables.

i) Calculate the mass of the column $M = \rho V$ in terms of r and h .

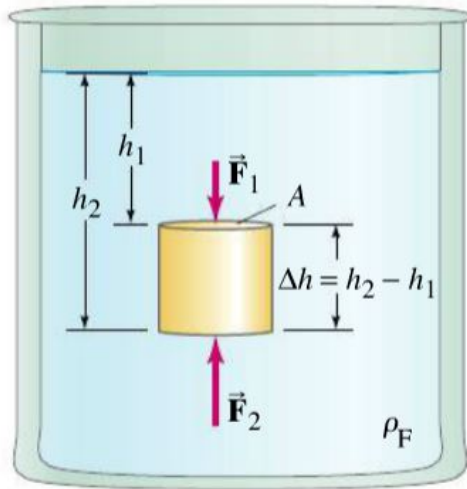
ii) What is the gravitational force F exerted by the column of water in terms of ρ, r, h, g ?

iii) If this force is distributed over an area $A = \pi r^2$, what is the pressure $P = F/A$ exerted by the column? Do you recognize the answer?

2. Water and then oil (which don't mix) are poured into a U-shaped tube, open at both ends. They come to equilibrium as shown below. What is the density of the oil, given that the density of water is 1000 kg/m^3 ? *Hint:* pressures at points a and b are equal. Why?



3. Below is a picture of a cylinder immersed in a fluid of density ρ . The top and bottom of the cylinder are distances h_1 and h_2 from the fluid interface and have areas A_1 and A_2 . The ambient fluid pressure exerts normal forces F_1 and F_2 directed as shown.



i) What are the pressures P_1 and P_2 exerted on the top and bottom of the cylinder in terms of the density of the fluid ρ and their heights relative to the interface?

ii) What are the forces F_1 and F_2 due to these pressures?

iii) What is the net force due to the ambient fluid pressure? Calculate it and simplify. Does it have a name?

2. A balloon is filled with helium of density $\rho_H = 0.164 \text{ kg/m}^3$. What is the minimum volume the balloon must be inflated to in order to lift itself and a payload of mass $m = 1 \text{ kg}$, given that the density of air is $\rho_A = 1.23 \text{ kg/m}^3$?