

Experiment #11 Hydrostatics Pre-lab Questions

**** Disclaimer: This pre-lab is *not* to be copied, in whole or in part, unless a proper reference is made as to the source. (It is strongly recommended that you use this document *only* to generate ideas, or as a reference to explain complex physics necessary for completion of your work.) Copying of the contents of this web site and turning in the material as “original material” is *plagiarism* and will result in serious consequences as determined by your instructor. These consequences may include a failing grade for the particular pre-lab or a failing grade for the entire semester, at the discretion of your instructor. ****

Using the information in the Background Information section of this lab, calculate the pressure of a fluid at the given depth h , where:

$$P_o = 100 \text{ kPa and } \rho = 1000 \text{ kg/m}^3 \text{ (density of water)}$$

Don't forget to first convert the data we are give to SI Units!

$$P_o = 100,000 \frac{\text{kg}}{\text{m s}^2} \quad \rho = 1000.0 \frac{\text{kg}}{\text{m}^3}$$

**** NOTE: Everyone messes up on the simple fact that h is a measure of *depth*. Because of such, in a standard coordinate frame, it is pointing *down* ... and thus should be negative when measured. Notice how the negative signs cancel out when it's multiplied by gravity (which consequently is also pointing *down* ... and thus also is negative). I bet you messed that up, too, huh. ☺ Truth be told, you'll probably mess it up in the lab write-up, too! ****

**** NOTE #2: At STP, atmospheric pressure is 101 kPa at sea-level. You can see already the data provided in the question above is a little flawed. ****

a. $h = 0.1 \text{ m}$?

$$P(h) = \rho gh + P_o$$

$$P(-0.1\text{m}) = \left[\left(1000 \frac{\text{kg}}{\text{m}^3} \right) \left(-9.81 \frac{\text{m}}{\text{s}^2} \right) (-0.1\text{m}) \right] + (100 \times 10^3 \text{ Pa})$$

$$\boxed{P(-0.1\text{m}) = 100981 \text{ Pa}}$$

b. $h = 3 \text{ m}$ (the bottom of a average swimming pool)?

$$P(-3.0\text{ m}) = \left[\left(1000 \frac{\text{kg}}{\text{m}^3} \right) \left(-9.81 \frac{\text{m}}{\text{s}^2} \right) (-3.0\text{ m}) \right] + (100 \times 10^3 \text{ Pa})$$

$$P(-3.0\text{ m}) = 129430 \text{ Pa}$$

c. h = 10 m (painful for most humans)?

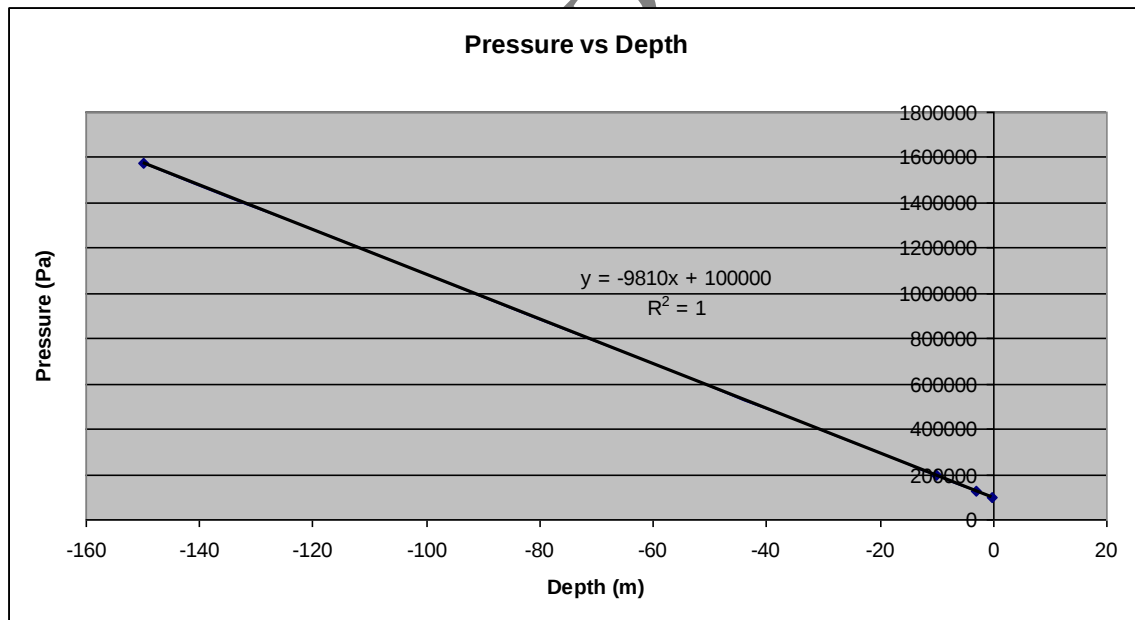
$$P(-10.0\text{ m}) = \left[\left(1000 \frac{\text{kg}}{\text{m}^3} \right) \left(-9.81 \frac{\text{m}}{\text{s}^2} \right) (-10.0\text{ m}) \right] + (100 \times 10^3 \text{ Pa})$$

$$P(-10.0\text{ m}) = 198100 \text{ Pa}$$

d. h = 150 m (world-record range for free-diving)?

$$P(-150.0\text{ m}) = \left[\left(1000 \frac{\text{kg}}{\text{m}^3} \right) \left(-9.81 \frac{\text{m}}{\text{s}^2} \right) (-150.0\text{ m}) \right] + (100 \times 10^3 \text{ Pa})$$

$$P(-150.0\text{ m}) = 1571500 \text{ Pa}$$



Notice that the slope of the line above is gravity times the density of the material (in this case water). Also note that the y-intercept is the value of the recorded atmospheric pressure.