Experiment #11 Hydrostatics Pre-lab Questions

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 kPa and ρ = 1000 kg/m^3 (density of water)

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

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

**** 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 multipled 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 m?

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

$$P(-0.1m) = \left[\left(1000\ \frac{kg}{m^3}\right)\left(-9.81\frac{m}{s^2}\right)(-0.1m)\right] + \left(100\times10^3\ Pa\right)$$

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

b. h = 3 m (the bottom of a average swimming pool)?

$$P(-3.0\,m)=\left[\left(1000\ \frac{kg}{m^3}\right)\left(-9.81\frac{m}{s^2}\right)(-3.0\,m)\right]+\left(100\times10^3\ Pa\right)$$

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

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

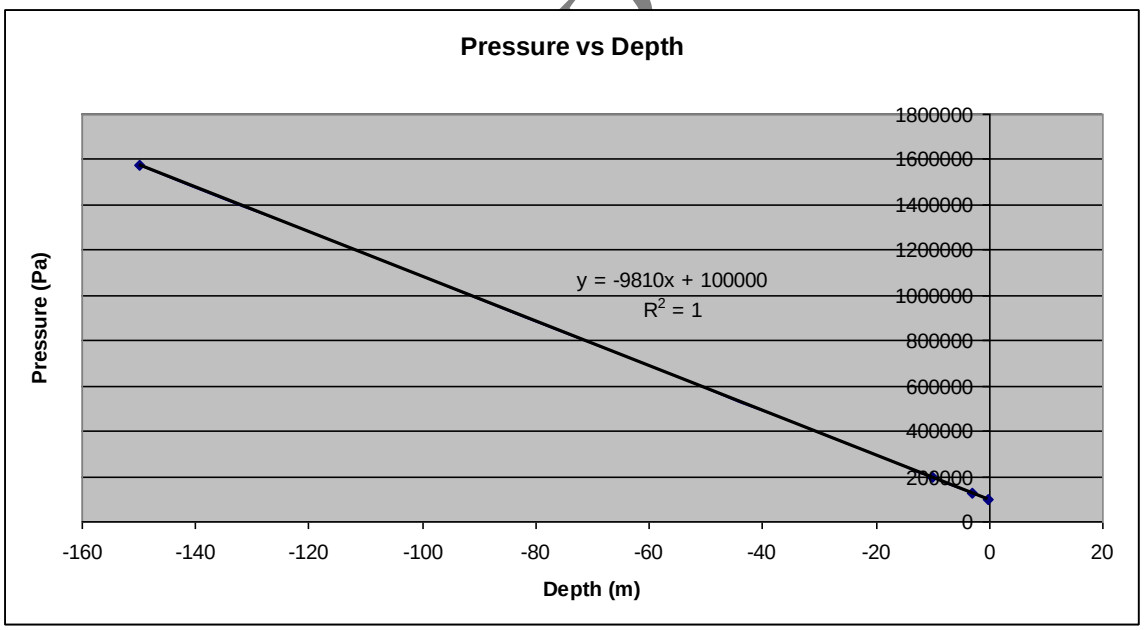
$$P(-10.0\,m)=\left[\left(1000\ \frac{kg}{m^3}\right)\left(-9.81\frac{m}{s^2}\right)(-10.0\,m)\right]+\left(100\times10^3\ Pa\right)$$

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

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

$$P(-150.0\,m)=\left[\left(1000\ \frac{kg}{m^3}\right)\left(-9.81\frac{m}{s^2}\right)(-150.0\,m)\right]+\left(100\times10^3\ Pa\right)$$

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



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.