Assignment XI, HONS 157 (Honors Physics I)
Fall 2015
Due Friday, 11/20/15 at start of class

1. A little googling told me that it takes about 6.5 GPa of pressure to crush a human skull. (I'm sure I'm on a watch-list now). Some more googling told me that it takes about 300 psi to completely crush a (full) soda can. The depth of the ocean at its deepest point is about 11000 meters.

   a) If we believe the numbers above, is it possible to crush a human skull by bringing it to the bottom of the ocean? Justify your answer with an appropriate calculation.

   b) How deep would you have to place a full soda-can in the ocean so that it would be crushed?

   c) How deep would have have to go in the ocean so that the total pressure above you (atmospheric + water pressure) would equal twice standard atmospheric pressure?

2. The highest sea-level-equivalent atmospheric pressure ever recorded on Earth was about 108380 Pa. If you wanted to reliably measure this pressure with a water barometer, how tall would the barometer have to be (at minimum, in feet)?

3. The density of wood (ash) can vary from tree to tree, but we'll treat it as about 580 kg/m^3. The density of gasoline is about 770 kg/m^3. If you have a piece of ash wood floating in a pool of gasoline, what fraction of the wood would be visible above the water?

4. The density of aluminum is about 2700 kg/m^3. What is the magnitude of the buoyant force on a 4.0 cm x 4.0 cm x 4.0 cm cube of aluminum submerged in a pool of glycerol (density of 1250 kg/m^3).

5. A long, cylindrical pipe has radius $r = 8$ cm.

   a) If this pipe has water flowing in it at a rate of 200 Liters/minute, how fast is the water moving?

   b) The pipe suddenly constricts from $r = 8$ cm to a smaller radius, similar to the geometry shown below. What would the smaller radius (R_2) be if the water now starts moving at half the speed of sound in air? (In other words, now the water will be moving at 172 m/s).

   c) If the pressure in the pipe is equal to 0.1 atm when it is at the thinner radius (your solution to part (b)), what is the pressure in the pipe when it is at radius 8 cm? (You may assume the pipe remains horizontal).