Physics 10154 - Exam #9A

Each problem is worth 50 points. Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. A 12-kg block of aluminum (density of 2100 kg/m^3) is completely submerged in water of density 1000 kg/m^3. What is the apparent weight of the aluminum? Answer with 2 SF.

$$V_{fluid} = V_{Al} = \frac{m}{\rho} = 5.714 \times 10^{-3}\ m^3$$

$$App\ wt = mg - \rho_f g V_{Al}$$

$$= (12)(9.8) - (1000)(9.8)(5.714 \times 10^{-3})$$

$$= 117.6 - 56.0$$

$$= \boxed{62\ N}$$

2. Water is stored in a large water tower that has a very large cross-sectional area compared to the area of the pipe that carries water away from the tower at ground level. The top of the water supply is 15 meters above ground level. Inside the closed tower, the chamber is pressurized to help speed the flow of water, and the pressure here is 1.5 atm. The water supply at ground level is open to regular atmospheric pressure.

If the pipe at ground level can supply 1600 gallons/minute of water to the city, what is the diameter of the pipe (in cm)? For reference, 1 gallon = 0.003786 m^3.

$$P_{top} = 1.5\,atm = 151950$$

$$P_{bot} = 1.0\,atm = 101300$$

$$V_{top} = 0 \text{ since } A_{top} \gg A_{bot}$$

$$y_{top} = 15$$

$$y_{bot} = 0$$

$$\Delta P + \rho g \Delta y + \frac{1}{2}\rho \Delta v^2 = 0$$

$$50650 + 147000 - 500 v_{bot}^2 = 0$$

$$v_{bot} = 19.88\ m/s$$

$$A_{bot} v_{bot} = 1600 \frac{gal}{min} \cdot .003786 \frac{m^3}{1\,gal} \cdot \frac{1\,min}{60\,sec}$$

$$= .0101$$

$$A_{bot} = \frac{.0101}{19.88} = 5.078 \times 10^{-3} = \frac{\pi d^2}{4}$$

$$\boxed{d = 8.0\ cm}$$