Homework 6 - Aidan Sharpe

1

A hose lying on the ground has water coming out of it at a speed of 5.4 meters/sec. You lift the nozzle of the hose to a height of 1.3 meters above the ground. At what speed does the water now come out of the hose? (Note: Atmospheric pressure acts on the fluid at both points). List any assumptions.

$$v_1 = 5.4[\text{m/s}]$$

$$h_1 = 0[\text{m}]$$

$$h_2 = 1.3[\text{m}]$$

$$\frac{1}{2}\rho v_1^2 + \rho g h_1 = \frac{1}{2}\rho v_2^2 + \rho g h_2$$

$$\frac{1}{2}(5.4^2) + 9.81(0) = \frac{1}{2}v_2^2 + 9.81(1.3)$$

Solve for v_2 algebraically:

$$v_2 = 1.911[\text{m/s}]$$

2

A dam is holding back the water in a lake. There is a small hole 1.4 meters below the surface of the lake. At what speed does water exit the hole? List any assumptions. (Note: if the hole is small, what is a safe assumption for the particles at the top of the lake)

$$P = \rho g h$$

$$\rho = 1000\left[\frac{\text{kg}}{\text{m}^3}\right]$$

$$h = 1.4[\text{m}]$$

$$P = 9.81(1000)(1.4) = 13720[\text{Pa}]$$

$$P_1 + \frac{1}{2}\rho v_1^2 + \rho g h_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g h_2$$

$$\frac{1}{2}\rho v_2^2 = P_1$$

$$v_2 = 5.23[\text{m/s}]$$

3

A basketball is floating in a bathtub full of water. The basketball has a mass of 0.5 kg and a diameter of 22 cm.

a)

What is the buoyancy force? Draw a Free Body Diagram and apply equations.

$$F_b = mg = 4.9[\text{N}]$$

b)

What is the volume of water displaced by the ball? (consider it a sphere and use Archimedes principle)

$$F_b = \rho v g$$
$$v = \frac{4.9}{\rho g} = 5 \times 10^{-4}[\text{m}^3]$$

c)

What is the average density of the basketball?

$$d = \frac{0.5}{\frac{4}{3}\pi r^3} = \frac{0.5}{\frac{4}{3}\pi 0.11^3} = 89.68 \left[\frac{\text{kg}}{\text{m}^3}\right]$$

4

You need to extend a 2 cm diameter pipe, but you have only a 1.10 cm diameter pipe on hand. You make a fitting to connect these pipes end to end. If the water is flowing at 2.50 cm/sec in the wide pipe, how fast will it be flowing through the narrow one?

$$v_1 A_1 = v_2 A_2$$
$$0.025(\pi 0.02^2) = v_2(\pi 0.0055^2)$$
$$v_2 = 0.083[\text{m/s}] = 8.3[\text{cm/s}]$$