

## Physics 10154 - Exam #9D

Answer the following two questions. Be sure to clearly indicate your answer with a circle or box. Show all work. If I cannot see how you arrived at an answer, I will deduct points!

1. An object weighs 450 N in air. In water, the object appears to weigh 380 N. In an unknown liquid, the object appears to weigh 410 N.

Find the density of the object and the density of the unknown liquid.

$$\rho_0 V_0 g = 450$$

$$450 - \rho_w V_0 g = 380$$

$$(1000) V_0 (9.8) = 70$$

$$V_0 = .00714 \text{ m}^3$$

$$\rho_0 = \frac{450}{(.00714)(9.8)} = \boxed{6400 \text{ kg/m}^3}$$

$$450 - \rho_u V_0 g = 410$$

$$\rho_u (.00714)(9.8) = 40$$

$$\rho_u = 570 \text{ kg/m}^3$$

2. A large water tank is open to the air and springs a leak 3.2 meters below the surface. Water flows from the hole such that it fills up a 1.0 gallon jug in 22 seconds. Find the diameter of the hole, in mm.

Assume the external pressure on top and bottom are equal, and you can also assume that the area of the top of the tank is much larger than the area of the hole.

$$(P_t - P_b) + \rho g(y_t - y_b) + \frac{1}{2}\rho(v_t^2 - v_b^2) = 0$$

$$0 + \rho g(3.2) + 0 - \frac{1}{2}\rho v_b^2 = 0$$

$$v_b = \sqrt{2gh} \Rightarrow v_b = 7.9 \text{ m/s}$$

$$A_b v_b = \frac{1.0 \text{ gal} \cdot 3.786 \times 10^{-3} \text{ m}^3}{22 \text{ sec} \cdot 1 \text{ gal}}$$

$$= 1.72 \times 10^{-4} \text{ m}^3/\text{s}$$

$$A_b = \frac{1.72 \times 10^{-4}}{7.9} = 2.2 \times 10^{-5} \text{ m}^2$$

$$\frac{\pi d^2}{4} = 2.2 \times 10^{-5}$$

$$d = 5.3 \times 10^{-3} \text{ m}$$

$$= \boxed{5.3 \text{ mm}}$$