Density, Pressure & Pascal's Principle Worksheet

1. Caleb is filling up water balloons for the Physics Olympics balloon toss competition. Caleb sets a 0.50-kg spherical water balloon on the kitchen table and notices that the bottom of the balloon flattens until the pressure on the bottom is reduced to 630 $\frac{N}{m^2}$. What is the area of the flat spot on the bottom of the balloon?

$P = \frac{F}{A}$ $\quad F_g = m_g = 0.5(10) = 5\ N$

$630 = \frac{5}{A} \rightarrow A = \frac{5}{630} = 0.0079\ m^2$

2. Wanda watches the fish in her fish tank and notices that the angelfish like to feed at the water's surface, while the catfish feed 0.300 m below at the bottom of the tank. If the average density of the water in the tank is 1000. kg/m^3, what is the pressure on the catfish?

$P_{ABSOLUTE} = P_{Atm} + \rho g h$

$= 1 \times 10^5 + 1000(10)(0.3)$

$= 1.03 \times 10^5\ Pa$

3. Diamond has a density of 3500 kg/m^3. During a physics lab, a diamond drops out of Virginia's necklace and falls into her graduated cylinder filled with 5.00×10^{-5} m^3 of water. This causes the water level to rise to the 5.05×10^{-5} m^3 mark. What is the mass of Virginia's diamond?

$\rho = \frac{m}{V} \rightarrow m = \rho V = 3500(5.05 \times 10^{-5} - 5 \times 10^{-5})$

$= 0.00175\ kg$

Jefferson

4. The difference in pressure between the atmosphere and the human lungs is 1.05×10^5 Pa. What is the longest straw you could use to draw up milk whose density is 1030 kg/m³?

$\Delta P = \rho g \Delta h$

$1.05 \times 10^5 = 1030(10)\,h$

$\boxed{h = 10.2\ m}$

5. Nancy is basting a roast turkey with a meat baster that creates a pressure of 9.980×10^4 Pa when the plastic bulb if squeezed and released. If Turkey juice rises 0.0900 m up the tube of the baster, what is the density of the juice?

$\Delta P = \rho g h$

$1 \times 10^5 - 9.98 \times 10^4 = \rho \cdot 10 \cdot 0.09$

$\boxed{\rho = 222\ \frac{kg}{m^3}}$

6. Rex, an auto mechanic, is raising a 1200 kg car on his hydraulic lift so that he can work underneath. If the area of the input piston is 12.0 cm², while the output piston has a area of 700 cm², what force must be exerted on the input piston to lift the car?

$\frac{F_1}{A_1} = \frac{F_2}{A_2}$

$\frac{F_1}{12} = \frac{12000}{700} \rightarrow \boxed{F_1 = 206\ N}$

7. Ben's favorite ride at the Barrel-O-Fun Amusement Park is the Flying Umbrella, which is lifted by a hydraulic jack. The operator activates the ride by applying a force of 72 N to a 3.0 cm wide cylindrical piston, which holds the 20,000 N ride off the ground. What is the diameter of the piston that holds the ride?

$\frac{F_1}{A_1} = \frac{F_2}{A_2} \Rightarrow \frac{F_1}{\pi r_1^2} = \frac{F_2}{\pi r_2^2}$

$r_2 = \sqrt{\frac{(1.5)^2(20{,}000)}{72}}$

$= 25$

$\frac{72}{(1.5)^2} = \frac{20{,}000}{r_2^2}$

$\boxed{d_2 = 50\ cm}$

$= 0.5\ m$