AP Physics – Sick'o Fluid'o Quiz'o

1. A silver bowl has a mass of 1.78 kg. It is shaped like a cylinder and has a diameter of 35.0 cm and a height of 8.00 cm. It is placed in water. Find (a) the volume of water it displaces, (b) the buoyant force exerted on it by the water, and (c) how deeply it sinks into the water.

buoy

to a

mg

$$F_{buoy} - mg = 0 \quad F_{buoy} = mg = \rho Vg \quad V = \frac{mg}{\rho g} = \frac{1.78 \ kg}{10.5 \ x \ 10^3} \frac{kg}{m^3} = 0.1696 \ x \ 10^{-3} m^3$$
$$V = \frac{mg}{\rho g} = 1.696 \ x \ 10^{-4} m^3$$
$$F_{buoy} = mg = 1.78 \left(9.8 \ \frac{m}{2}\right) = 17.4 \ N$$

 $V_{bowl} = Ah = V_{water} \quad h = \frac{V_{water}}{A} = \frac{1.696 \times 10^{-4} m^3}{\pi \left(\frac{0.35}{2} \,\mathrm{m}\right)^2} = \frac{1.76 \times 10^{-3} m}{1.76 \times 10^{-3} m}$

(c)

2. Water flows through a garden hose that has a diameter of 2.50 cm at a speed of 5.25 m/s. What is the speed of the water when it spurts out of a nozzle that has a diameter of 0.120 cm?

$$A_1 v_1 = A_2 v_2 \quad v_2 = \frac{\pi \left(\frac{2.5 \, cm}{\Sigma}\right)^2}{\pi \left(\frac{0.12 \, cm}{\Sigma}\right)^2} \left(5.25 \frac{m}{s}\right) = \frac{2280 \frac{m}{s}}{s}$$

3. A solid sphere has a radius of 22.0 cm and a mass of 1.05 kg. It sinks to the bottom of the ocean depth of 9 550 m. (a) Draw a FBD showing all the forces acting on the ball at this depth. (b) What is the pressure experienced by the ball at that depth? (c) What is the force exerted on the surface of the ball. (d) What is the buoyant force acting on the ball?

(b)

$$p = \rho gh = 1.025 \times 10^{3} \frac{kg}{m^{3/2}} \left(9.8 \frac{m}{s^{2}}\right) (9550 \text{ m}) = 9.59 \times 10^{7} Pa$$
(b)

$$p = \frac{F}{A} \quad F = pA = 9.59 \times 10^{7} \frac{N}{m^{2}} (4\pi) (0.22 \text{ m})^{2} = 5.83 \times 10^{7} N$$

(d)
$$F_{Buoy} = \rho V g = 1.025 \ x \ 10^3 \ \frac{kg}{m^3} \left(\frac{4}{3}\pi\right) \left(0.22 \ m\right)^3 \left(9.8 \ \frac{m}{s^2}\right) = 1.43 \ x \ 10^2 N$$

4. A spring (k=235 N/m) is set vertically in a container of water and its end is attached to the bottom of the container. A 5.25 kg block of wood is attached to the top of the spring. The system comes to equilibrium. What is the elongation (ΔL) of the spring? Assume that the entire system remains submerged.

$$0 = F_{Buoy} - mg - kx \quad kx = F_{Buoy} - mg \quad x = \frac{\rho Vg - mg}{k} \qquad \rho = \frac{m}{V} \quad V = \frac{m}{\rho}$$

$$x = \frac{\rho \left(\frac{m}{\rho_{wood}}\right)g - mg}{k} = \frac{1 \times 10^3 \frac{kg}{m_s^3} \left(\frac{5.25 \, kg}{0.5 \, x \, 10^3 \frac{kg}{m_s^3}}\right)9.8 \frac{m}{s^2} - 5.25 \, kg \left(9.8 \frac{m}{s^2}\right)}{235 \frac{N}{m}}$$

$$x = \boxed{0.219 \, m}$$