Physics 10154 - Exam #9A

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. A wooden platform is 45 cm thick with a density of 640 kg/m3. 3,0 m per side. $V_0 = 4.05\ m^3$

a) When the platform is put into water (density of 1000 kg/m3), how many cm above the surface of the water is the top of the platform?

b) If an average child has a mass of 39 kg, how many children can stand on the platform before it sinks?

Floating, so $\rho_o V_o g = \rho_f V_f g$

$$\frac{V_f}{V_o} = \frac{\rho_o}{\rho_f} = \frac{640}{1000}$$

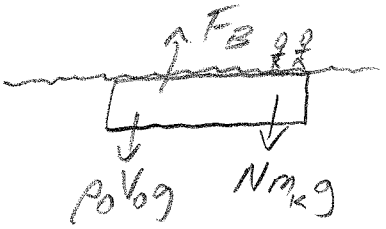
$$= 0.64$$

So object is 64% submerged, 36% exposed,

36% of 45cm is 16, so top of platform.

is **16 cm** above water

Max # of kids = submerged platform



$F_B - \rho_o V_o g - N m_k g = 0$

$N m_k g = F_B - \rho_o V_o g$

$$N = \frac{\rho_f V_o g - \rho_o V_o g}{m_k g} = \frac{(1000)(4.05) - (640)(4.05)}{39}$$

$$= \boxed{37}$$

2. A filled, large water tank is open to the air (so that the external pressure everywhere is the same) and develops a small hole in the side with a diameter of 0.22 inches, 3.5 meters below the surface of the water.

How many gallons of water per minute flow from the hole (assuming the height of the water remains roughly constant while the tank drains, since the velocity of the water at the top of the tank is effectively zero)?

$$(P_{top} - P_{bot}) + \rho g(y_{top} - y_{bot}) + \frac{1}{2}\rho(v_{top}^2 - v_{bot}^2) = 0$$

$$0 + \rho g(3.5) + 0 - \frac{1}{2}\rho v_{bot}^2 = 0$$

$$v_{bot} = \sqrt{2gh} = 8.28 \text{ m/s}$$

$$A_{bot} = \frac{\pi d^2}{4} \qquad d = .22 \text{ in.} \cdot \frac{1 \text{ m}}{39.37 \text{ in}}$$

$$= .00559 \text{ m}$$

$$A = \frac{\pi(.00559)^2}{4} = 2.45 \times 10^{-5} \text{ m}^2$$

$$\text{Flow} = Av = 2.03 \times 10^{-4} \frac{\text{m}^3}{\text{s}}$$

$$2.03 \times 10^{-4} \frac{\text{m}^3}{\text{s}} \cdot \frac{60 \text{ s}}{\text{min}} \cdot \frac{1 \text{ gal}}{3.786 \times 10^{-3} \text{ m}^3} = \boxed{3.2 \text{ gal}}$$