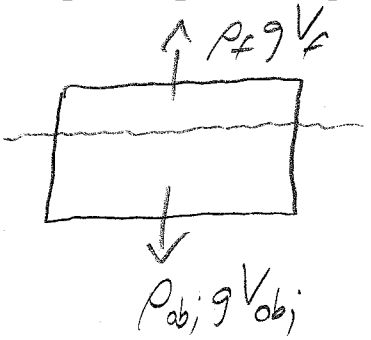
Physics 10154 - Exam #9B

Each problem is worth 50 points. Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work (or if some parts are incorrect) even if you get the right answer. Clearly indicate your answer with a circle or box and remember to include correct units and significant figures.

1. A wooden platform (density 650 kg/m^3) has a cross-sectional area of 1.5 meters on a side, and a vertical height of 45 cm. Answer with 2 SF.

a) When placed in water (density 1000 kg/m^3), how high above the bottom of the platform is the water line?

b) How much additional weight can the platform support before it is completely submerged?



$$\Sigma F_y = \rho_f g V_f - \rho_{obj} g V_{obj} = 0$$

$$1000 V_f - 650 V_{obj} = 0$$

$$\frac{V_{obj}}{V_f} = 0.65$$

Platform is 65% submerged on 45 cm tall,

so water line is $(0.65)(45) =$ **29 cm above bottom**

b) $\Sigma F_y = \rho_f g V_{obj} - \rho_{obj} g V_{obj} - mg = 0$

$V_{obj} = .675 m^3$

$(1000)(.675) - (650)(.675) = m$

$m = 240$ kg

platform completely submerged

extra weight

2. A container with a wide opening on top is filled with liquid of density 1200 kg/m^3 to a depth of 22 cm. A small circular hole is at the bottom of the container, and the liquid flows out of this hole at a rate of 1.0 gallons every 15 seconds. You may assume that the velocity of the water at the top of the container is zero and that the external pressure in this problem is 1.0 atmospheres everywhere. What is the diameter of the hole?

1 gallon = 0.003786 m^3.

$\Delta P = 0$

$y_{top} = .22m$

$y_{bot} = 0$

$V_{top} = 0$

$$\Delta P + \rho g \Delta y + \frac{1}{2}\rho \Delta v^2 = 0$$

$$0 + g(.22) - \frac{1}{2} V_{bot}^2 = 0$$

$$V_{bot} = \sqrt{2gh} = 2.0765$$

$$A_{bot} V_{bot} = \frac{.003786 m^3}{15 sec} = 2.524 \times 10^{-4}$$

$$A_{bot} = \frac{2.524 \times 10^{-4}}{2.0765} = 1.216 \times 10^{-4} m^2$$

$$1.216 \times 10^{-4} = \frac{\pi d^2}{4}$$

$$d = 1.2 \times 10^{-2} m \text{ or } \boxed{1.2 cm}$$