PHYS262 Homework 2 (Ch 15) Spring '03

1.(SB 8) Refering to Fig. 15.5, $A_1 = 3.00\,cm^2$, $A_2 = 200\,cm^2$, $F_2 = 15.0\,kN$

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

$$F_1 = F_2 \frac{A_1}{A_2} = 225\,N \;\#$$

2.(SB 27) Let V = volume of sphere
ρ_s = density of sphere
ρ_w = density of water ($= 1000\,kg\,m^{-3}$)
ρ_g = density of glycerin

$\because$ the sphere is floating in water
By Archimede's Principle,

Weight of sphere = Buoyant Force

$$\rho_s V g = \rho_w \frac{V}{2} g$$

$$\therefore \quad \rho_s = \frac{\rho_w}{2} = 500\,kg\,m^{-3} \;\#$$

Similarly, in the glycerin,

$$\rho_s V g = \rho_g \frac{2}{5} V g$$

$$\therefore \quad \rho_g = \frac{5}{2}\rho_s$$

$$= \frac{5}{4}\rho_w = 1250\,kg\,m^{-3} \;\#$$

3(SB 33)

$$\text{flow rate} = \frac{(20)(1000\ cm^3)}{60s}$$

$\because$ flow rate $= vA$, therefore

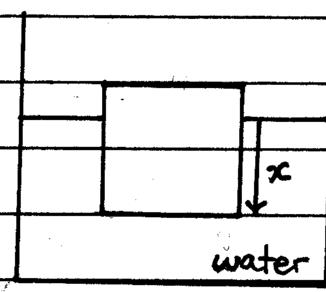
(a) $$v = \frac{(20)(1000\ cm^3)}{60s} \frac{1}{\pi(1.00cm)^2} = 1.06\ ms^{-1}$$ #

(b) $$v_{nozzle} = \frac{(20)(1000\ cm^3)}{60s} \frac{1}{\pi(0.5cm)^2} = 4.24\ ms^{-1}$$ #

4(SB 65) Let

ρ_i = density of ice (= 917 $kg\,m^{-3}$)
ρ_w = density of water (= 1000 $kg\,m^{-3}$)
ρ_a = density of alcohol (= 806 $kg\,m^{-3}$)
L = edge of the cube
x = distance from water surface to cube bottom
h = thickness of alcohol

(a) By Archimede's Principle,

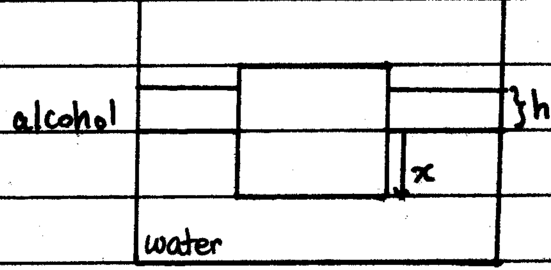


$$\rho_i L^3 g = \rho_w L^2 x g$$

$$x = L\frac{\rho_i}{\rho_w}$$

$$= 18.3\ mm$$ #

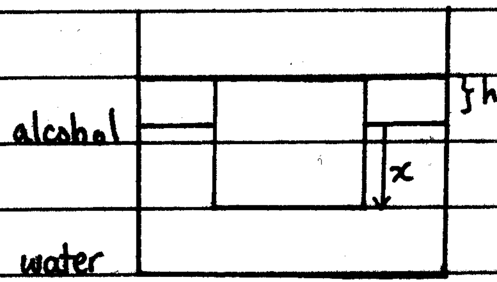
(b) $\rho_i L^3 g = \rho_w L^2 x g + \rho_a L^2 h g$



$$x = \frac{\rho_i L - \rho_a h}{\rho_w}$$

$$= 14.3 \text{ mm} \ \#$$

(c) $\because \ x + h = L$



$\therefore$ from (b),

$$\rho_w (L - h) = \rho_i L - \rho_a h$$

$$h = \frac{\rho_w - \rho_i}{\rho_w - \rho_a} L$$

$$= 8.56 \text{ mm} \ \#$$