Chapter 9 Homework

5. $L_0 = 50m$

$d = 1.0cm$

$m = 90kg$

$\Delta L = 1.6m$

$$A = \pi r^2 = \pi d^2/4 = \frac{\pi (10^{-2} m)^2}{4} = 7.85 \times 10^{-5} m^2$$

$$Y = \frac{F/A}{\Delta L / L_0} = \frac{mg/A}{\Delta L/L_0} = \frac{mg L_0}{A \Delta L}$$

$$Y = \frac{(90kg)(9.8 m/s^2)(50m)}{(7.85 \times 10^{-5} m^2)(1.6m)} = 3.5 \times 10^8 Pa$$

13. ρ_0 = average density of the original 2 worlds

$$\rho_0 = \frac{M}{V} = \frac{M}{\frac{4}{3}\pi R^3} = \frac{3M}{4\pi R^3}$$

$$R' = \frac{3}{4} R$$

∴ Combined world density = ρ

$$\rho = \frac{2M}{\frac{4}{3}\pi \left(\frac{3}{4}R\right)^3} = \frac{32M}{9\pi R^3}$$

∴ ratio $$\frac{\rho}{\rho_0} = \frac{\frac{32M}{9\pi R^3}}{\frac{3M}{4\pi R^3}} = \frac{128}{27} = 4.74 \quad \therefore \rho = 4.74 \rho_0$$

16. $m_{\text{man + chair}} = 95.0kg$

each leg supports 1/4 total weight of man + chair

$r = 0.500cm$

$P = ?$

$$P = F/A = \frac{mg/4}{\pi r^2} = \frac{(95.0kg)(9.8 m/s^2)/4}{\pi (.500cm)^2 \left(\frac{m}{10^2 cm}\right)^2}$$

$P = 2.96 \times 10^6$ Pa

28. $d_1 = 0.25\,in$ $\quad P_1 = P_2$ by Pascal's Principle

$d_2 = 1.5\,in$

$F_2 = 500\,lb$

$$\frac{F_1}{A_1} = \frac{F_2}{A_2} \quad \therefore \quad \frac{F_1}{\pi d_1^2/4} = \frac{F_2}{\pi d_2^2/4}$$

$$F_1 = \frac{F_2 d_1^2}{d_2^2} = \frac{(500\,lb)(0.25\,in)^2}{(1.5\,in)^2} = 13.9\,lb \approx 14\,lb$$

Jack handle (take $\Sigma \tau = 0$ using the left end)

$$\Sigma \tau = 0 = (13.9\,lb)(2\,in) - F(12\,in) \quad \therefore \quad F = 2.3\,lb$$

31. $W = 4.00\,m$, $L = 6.00\,m$ $\}$ $A = 24.0\,m^2$

$\Delta H = 4.00\,cm = 0.0400\,m$

$\Delta V = A \Delta H = 0.960\,m^3$ = Volume of water displaced

$$F_B = W_{fd} = W_{truck} = \rho_f V_{fd}\, g = (10^3\,kg/m^3)(.960\,m^3)(9.80\,m/s^2)$$

$\therefore F_B = 9.41 \times 10^3\,N$ (due to the additional water displaced when W_{truck} is added to boat)

41. $W_{air} = 300\,N$

$W_{alcohol} = 200\,N$

$S.G. = 0.700$

$\rho_{alcohol} = .700\,g/cm^3 = 700\,kg/m^3$

$m_{material} = 300\,N / 9.80\,m/s^2 = 30.6\,kg$

$F_B = W_{air} - W_{alcohol} = 300\,N - 200\,N = 100\,N$

$F_B = W_{alcohol\ displaced} = \rho_{alcohol} V_{alcohol\ displaced}\, g$

The material is submerged $\therefore V_{alcohol\ displaced} = V_{material}$

a) $100\,N = (700\,kg/m^3) V_{material} (9.80\,m/s^2) \quad \therefore V_{material} = 1.46 \times 10^{-2}\,m^3$

b) $\rho = m/V = 30.6 / 1.46 \times 10^{-2}\,kg/m^3 = 2.10 \times 10^3\,kg/m^3$

42. $W_{air} = 300N$ a) $F_B = W_{air} - W_{water} = 300N - 265N$

$W_{water} = 265N$ $= 35.0N$

$W_{oil} = 275N$

$$F_B = \rho_w V_w g$$

$$\therefore V_w = \frac{35.0N}{(10^3 kg/m^3)(9.80 m/s^2)} = 3.57 \times 10^{-3} m^3$$

$\because V_{\text{water displaced}} = V_{object} \therefore \rho_{object} = \dfrac{W_{air}/g}{V_{obj}} = \dfrac{(300N)/9.80 m/s^2}{3.57 \times 10^{-3} m^3}$

$$= 8.57 \times 10^3 kg/m^3$$

b) $F_B = W_{air} - W_{oil} = (300N) - (275N) = 25.0N$

$$F_B = \rho_{oil} V_{\text{oil displaced}}\, g$$

$$25.0N = \rho_{oil} (3.57 \times 10^{-3} m^3)(9.80 m/s^2)$$

$$\therefore \rho_{oil} = 714 kg/m^3$$

Note: The volume of the object remains the same $\therefore V_{\text{fluid displaced}}$ is the same for all fluids.

45. $\rho = 1.0\ g/cm^3$

$A_1 = 2.0\ cm^2$

$V_1 = 40\ cm/s$

$A_2 = 3.0 \times 10^3\ cm^2$

a) $R = V_1 A_1 = (40\ cm/s)(2.0\ cm^2)$
$= 80\ cm^3/s$

$80\ \frac{cm^3}{s}\left(\frac{1.0\ g}{cm^3}\right) = 80\ g/s$

b) Equation of Continuity:

$$A_1 V_1 = A_2 V_2$$

$$\therefore\ V_2 = \frac{A_1 V_1}{A_2} = \frac{80\ cm^3/s}{3.0 \times 10^3\ cm^2} = 2.7 \times 10^{-2}\ \frac{cm}{s}$$

46. $\rho = 1.65\ g/cm^3$

$A_1 = 10.0\ cm^2$

$V_1 = 275\ cm/s$

$P_1 = 1.20 \times 10^5\ Pa$

$A_2 = 2.50\ cm^2$

$h_1 = h_2$

a) $V_2 = ?$

$$A_1 V_1 = A_2 V_2$$

$$\frac{(10.0\ cm^2)(275\ cm/s)}{(2.50\ cm^2)} = V_2$$

$$\therefore\ V_2 = 1100\ \frac{cm}{s} = 11.0\ \frac{m}{s}$$

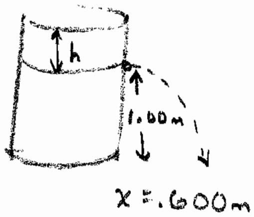
b) $P_2 = ?$ Bernoulli's Eqn:

$$P_1 + \frac{1}{2}\rho V_1^2 = P_2 + \frac{1}{2}\rho V_2^2\ \therefore\ P_2 = P_1 + \frac{1}{2}\rho\left[V_1^2 - V_2^2\right]$$

$$P_2 = 1.20 \times 10^5\ Pa + \frac{1}{2}(1.65 \times 10^3\ kg/m^3)(2.75^2 - 11.0^2)\frac{m^2}{s^2}$$

$$= 2.64 \times 10^4\ Pa$$

53.



Torricelli's Equation $\Rightarrow V = \sqrt{2gh}\ \therefore h = \frac{V^2}{2g}$

Projectile Theory $\Rightarrow y = \frac{1}{2}a_y t^2$

$$-1.00\ m = \frac{1}{2}(-9.80\ m/s^2)t^2\ \therefore\ t = 0.452\ s$$

$$x = V_{0x} t\ \therefore\ .600\ m = V_{0x}(.452\ s) \Rightarrow V_{0x} = 1.328\ m/s \approx 1.33\ m/s$$

$$h = \frac{V^2}{2g} = \frac{(1.328\ m/s)^2}{2(9.80\ m/s^2)} = .0900\ m$$