Ch. 11 Examples

11.1 $d = 0.617\ mm$ $L = 0.984\ m$ $F = (8.00\ kg)g$

$\Delta L = 1.30\ mm$

$$E = \frac{F/A}{\Delta L/L} = \frac{(8.00\ kg)(9.8\ m/s^2)/(0.617\ mm \times 10^{-3}/2)^2 \pi}{1.30\ mm \times 10^{-3}/0.984\ m}$$

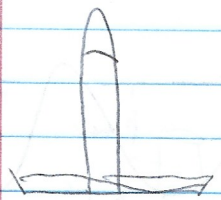
$$= 1.94 \times 10^{11}\ N/m^2$$

11.2 $y = -3.00 \times 10^3\ m$ $\rho = 1.025 \times 10^3\ kg/m^3$

$$P = P_0 - \rho g y = -(1.025 \times 10^3\ kg/m^3)(9.8\ m/s^2)(-3.00 \times 10^3\ m)$$

$$= 3.01 \times 10^7\ Pa \times \frac{1\ atm}{101325\ Pa} = \boxed{2.97 \times 10^2\ atm}$$

11.3 $h = 76.0\ cm$



$P(y) = P_0 - \rho g y$

$P_0 = P(y) + \rho g y$

$= (13534\ kg/m^3)(9.8\ m/s^2)(0.76\ m)$

$= 100801\ Pa$

11.4

$$\text{Scale height} = \frac{P_0}{\rho_0 g}$$

$$h_s = \frac{101325\ Pa}{1.29\ kg/m^3 \cdot 9.8\ m/s^2} = 8015\ m$$

11.5 $P(y) = P_0 e^{-\frac{\rho_0}{P_0} g y}$

$$\frac{P_{denver}}{P_{seattle}} = \frac{P_0 e^{\left(-\frac{1.29\ kg/m^3}{(101325\ Pa)}(9.8\ m/s^2)(1600\ m)\right)}}{P_0}$$

$= 0.82$

11.6 $\frac{F_1}{A_1} = \frac{F_2}{A_2}$ (car, small)

$$F_2 = \frac{A_2}{A_1} F_1 = \frac{(0.025\ m)^2 \pi}{(0.65\ m)^2 \pi}(2000\ kg)(9.8\ m/s^2)$$

$= \boxed{544\ N}$

11-7 $F_b = \rho_{fluid} V' g$

$W = m_{rock} g$ $\quad W_{sub} = m_{rock} g - \rho_{water} V_{rock} g$

$W_{sub} = W - \rho_{water} V_{rock} g$

$m_{rock} = \frac{W}{g}$

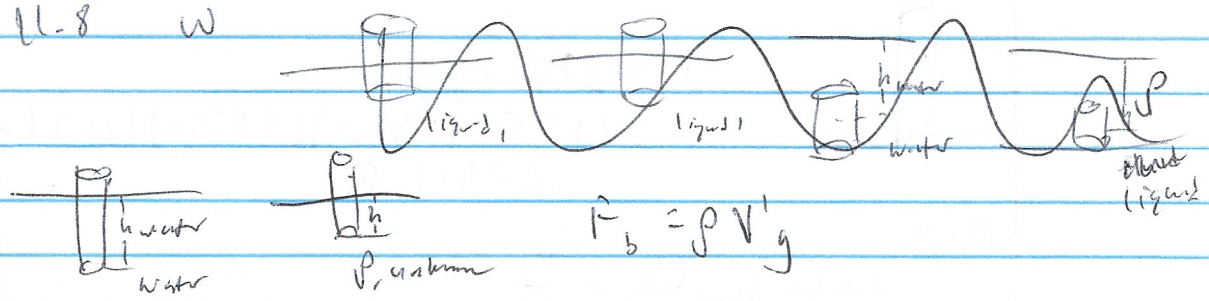
$V_{rock} = \frac{W - W_{sub}}{\rho_{water} g}$

$\frac{m_{rock}}{V_{rock}} = \rho_{rock}$

$= \frac{W}{g} \cdot \frac{\rho_{water} g}{W - W_{sub}}$

$= \frac{W \cdot \rho_{water}}{W - W_{sub}}$ $\quad \rho_{water} = \frac{W - W_{sub}}{W} \cdot \rho_{rock}$

11-8 W



$F_b = \rho V' g$

$V' = \pi r^2 h$ $\quad F_{b\,water} = \rho_{water} \pi r^2 h_{water} g = mg$

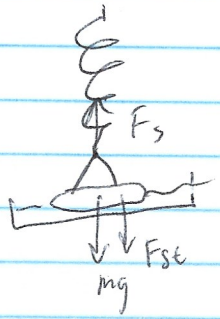
$F_{b\,unk} = \rho \pi r^2 h g = mg$

$\rho_{water} \pi r^2 h_{water} g = \rho \pi r^2 h g$

$\rho = \rho_{water} \cdot \frac{h_{water}}{h}$

11.9 $k = 0.75\ N/m$ $\Delta x = 3.4\ cm$

$r = 2.0\ cm$, $m = 0.70\ g$



$F_{st} = \gamma l$

$kx = mg + \gamma l$

$$\gamma = \frac{kx - mg}{l} = \frac{kx - mg}{2\pi r} = \frac{(0.75\ N/m)(0.034\ m) - (0.70\ g \times 10^{-3}\ kg/g)(9.8\ m/s^2)}{(4.0\ cm)\pi}$$

$$= 0.0018\ N/m$$

$$\gamma = \frac{kx - mg}{2l} = \frac{kx - mg}{4\pi r} = \frac{(0.75\ N/m)(0.034\ m) - (0.70\ g \times 10^{-3})(9.8\ m/s^2)}{4\pi(0.02\ m)}$$

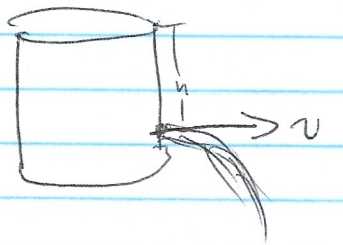
$$= 0.074\ N/m$$

11.10 $r = 0.50\ mm$, wet.

$$h = \frac{2\gamma \cos\theta}{\rho g r} = \frac{2(0.074\ N/m)\cos 0}{(998\ kg/m^3)(9.8\ m/s^2)(0.5 \times 10^{-3}\ m)}$$

$$= 0.03\ m = \boxed{3\ cm}$$

11.11



$P_1 + \frac{1}{2}\rho v_1^2 + \rho g y_1 = P_2 + \frac{1}{2}\rho v_2^2 + \rho g y_2$

$P_1 = P_2 = 1\ atm$

$v_1 = 0$ Since speed is negligible compared to the speed of the fluid out of the hole

$y_2 = 0$, $y_1 = h$

$gh = \frac{1}{2} v_2^2$

$$\boxed{v_2 = \sqrt{2gh}}$$