107E (a)

$$T(^\circ F) = 1.8T(^\circ C) + 32$$

$$V\left(\frac{miles}{h}\right) = 1.609\ \frac{km}{h}$$

The coefficient 0.0203 has units of $\frac{hr}{mi}$

$\therefore$ it changes to $\frac{0.0203}{1.609} = 0.0126$

and the coefficient 0.304 changes to

$$\frac{0.304}{\sqrt{1.609}} = 0.240$$

$$T(^\circ F) = 91.4 - [91.4 - T_{amb}]\left[0.475 - 0.0203V + 0.304\sqrt{V/\cancel{1.609}}\right]$$

$$\Rightarrow\ 33.0 - (33.0 - T^{\circ C}_{amb})(0.475 - 0.0126V + 0.240\sqrt{V})$$

(b)

$$1\ \frac{km}{h} = 6.28\ m/s$$

$$33.0 - (33.0 - T^{\circ C}_{amb})(0.475 - 0.04536V + 0.84\sqrt{V})$$

110

$$D = 10m$$

$$V = 4/3\ \pi R^3 = \frac{1}{6}\pi D^3 = \frac{1}{6}\cdot 3.14\cdot 1000\ (m^3)$$

$$= 523.6\ m^3$$

$$F_B = \rho_{air}\ g\ V_{balloon}$$

$$= (1.16\ \frac{kg}{m^3})(9.81\ m/s^2)(523.6\ m^3)$$

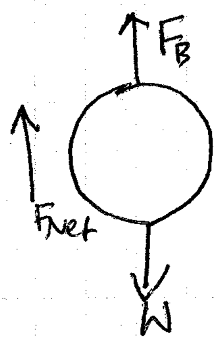
$$= 5958.4\ \frac{kg\,m}{s^2} = 5958.4\ N \quad (\because 1\ \frac{kg\,m}{s^2} = 1N)$$

$$M = m_{balloon} + m_{people} = \rho_{He}\ V_{Balloon} + 2\times 70\ kg$$

Pset #2

(2)

$$\rho_{He} = \frac{1}{7}\rho_{air} = \frac{1.16}{7}\ kg/m^3$$
$$= 0.166\ kg/m^3$$



$$M = \underset{(\frac{kg}{m^3})}{(0.166)}\ \underset{(m^3)}{523.6}\ (kg) + 140\,kg$$
$$= \underline{226.8\,kg}$$

$$F_{Net} = Ma \Rightarrow a = \frac{F}{M}\ (m/s^2) =$$

$$F_{Net} = 5928 - (226.8)(9.81) = 2225\,N$$
$$a = \frac{2225}{226.8} = 16.5\ m/s^2$$

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118) $P_{atm} = 101.325(1 - 0.022562)^{5.256}$

Simple substitution:

Atlanta 97.7 kpa
Denver 83.4 kPa
M. city 76.5 kPa
Mt. Ev. 31.4 kPa

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119) $\rho_{Liq} = 0.81\ kg/L = 0.81 \times 1000\ \frac{kg}{m^3}$
$$= 810\ \frac{kg}{m^3}$$

$$P_{gage} = P_{abs} - P_{atm}$$
$$= \rho g h$$
$$= (810)(9.81)(0.08) \qquad \left(\frac{kg \cdot m}{s^2}\right)\left(\frac{1}{m^2}\right) = Pa$$
$$= \underline{636\ Pa}$$

$$L = \frac{h}{\sin\theta} = 13.9\,cm$$

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123) $T = T_0 - \beta z$ $\qquad T_0 = 288.15\,K$
$\beta = 0.0065\ K/m$

Pset #2

3

$$g(z) = \frac{g_0}{(1 + z/6,370,320)^2} \qquad g_0 = 9.807 \ m/s^2$$

(a) $g = g_0$

$$dP = -\rho g\, dz \qquad \rho = \frac{P}{RT} = \frac{P}{R(T_0 - \beta z)}$$

$$dP = -\frac{P}{R(T_0 - \beta z)} \cdot g\, dz$$

$$\int_{P_0}^{P} \frac{dP}{P} = -\int_0^z \frac{c\, dz}{(T_0 - \beta z)} = \frac{c}{\beta} \ln\left(\frac{T_0 - \beta z}{T_0}\right) = \ln P/P_0$$

$$c = \frac{g}{R} \qquad \frac{P}{P_0} = \left(\frac{T_0 - \beta z}{T_0}\right)^{g/\beta R}$$

$$P = P_0 \left[1 - \beta z/T_0\right]^{g/\beta R}$$

(b) $$dP = -\frac{P}{R(T_0 - \beta z)} \frac{g_0}{\left(1 + \frac{z}{c_1}\right)^2} dz$$

$$\int_{P_0}^{P} \frac{dP}{P} = -\int_0^z \frac{g_0}{R(T_0 - \beta z)} \frac{1}{(1 + z/c_1)^2} dz$$

Two approaches. Use Integral table for exact answer.

(2) Use Numerical Integration (easier) if z is given and generate a table for z.