**P16.4** (a) $\Delta T = 450°\text{C} = 450°\text{C}\left(\frac{212°\text{F} - 32.0°\text{F}}{100°\text{C} - 0.00°\text{C}}\right) = \boxed{810°\text{F}}$

(b) $\Delta T = 450°\text{C} = \boxed{450\text{ K}}$

**P16.11** (a) $\Delta A = 2\alpha A_i \Delta T: \quad \Delta A = 2\left(17.0 \times 10^{-6}\ °\text{C}^{-1}\right)(0.080\ 0\text{ m})^2 (50.0°\text{C})$

$$\Delta A = 1.09 \times 10^{-5}\text{ m}^2 = \boxed{0.109\text{ cm}^2}$$

(b) The length of each side of the hole has increased. Thus, this represents an $\boxed{\text{increase}}$ in the area of the hole.

**P16.21**

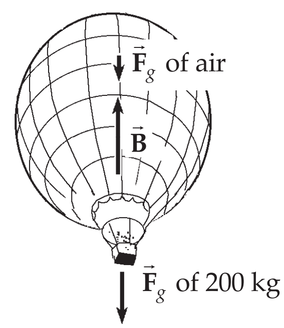


**FIG. P16.21**

$$\sum F_y = 0: \quad \rho_{\text{out}} gV - \rho_{\text{in}} gV - (200\text{ kg})g = 0$$

$$(\rho_{\text{out}} - \rho_{\text{in}})\left(400\text{ m}^3\right) = 200\text{ kg}$$

The density of the air outside is $1.25\ \text{kg/m}^3$.

From $PV = nRT$, $\quad \frac{n}{V} = \frac{P}{RT}$

The density is inversely proportional to the temperature, and the density of the hot air is

$$\rho_{\text{in}} = \left(1.25\ \text{kg/m}^3\right)\left(\frac{283\text{ K}}{T_{\text{in}}}\right)$$

Then $\quad \left(1.25\ \text{kg/m}^3\right)\left(1 - \frac{283\text{ K}}{T_{\text{in}}}\right)\left(400\text{ m}^3\right) = 200\text{ kg}$

$$1 - \frac{283\text{ K}}{T_{\text{in}}} = 0.400$$

$$0.600 = \frac{283\text{ K}}{T_{\text{in}}} \qquad T_{\text{in}} = \boxed{472\text{ K}}$$

**P16.24** At depth, $\quad P = P_0 + \rho gh \quad$ and $\quad PV_i = nRT_i$

At the surface, $\quad P_0 V_f = nRT_f: \quad \frac{P_0 V_f}{(P_0 + \rho gh)V_i} = \frac{T_f}{T_i}$

Therefore $\quad V_f = V_i\left(\frac{T_f}{T_i}\right)\left(\frac{P_0 + \rho gh}{P_0}\right)$

$$V_f = 1.00\ \text{cm}^3\left(\frac{293\ \text{K}}{278\ \text{K}}\right)\left(\frac{1.013\times10^5\ \text{Pa} + \left(1\,025\ \text{kg/m}^3\right)\left(9.80\ \text{m/s}^2\right)(25.0\ \text{m})}{1.013\times10^5\ \text{Pa}}\right)$$

$$V_f = \boxed{3.67\ \text{cm}^3}$$

**P16.35** (a) $\bar{K} = \frac{3}{2}k_BT = \frac{3}{2}\left(1.38\times10^{-23}\ \text{J/K}\right)(423\ \text{K}) = \boxed{8.76\times10^{-21}\ \text{J}}$

(b) $\bar{K} = \frac{1}{2}m_0v_{\text{rms}}^2 = 8.76\times10^{-21}\ \text{J}$

so
$$v_{rms} = \sqrt{\frac{1.75\times10^{-20}\ \text{J}}{m_0}} \qquad (1)$$

For helium,

$$m_0 = \frac{4.00\ \text{g/mol}}{6.02\times10^{23}\ \text{molecules/mol}} = 6.64\times10^{-24}\ \text{g/molecule}$$

$$m_0 = 6.64\times10^{-27}\ \text{kg/molecule}$$

Similarly for argon,

$$m_0 = \frac{39.9\ \text{g/mol}}{6.02\times10^{23}\ \text{molecules/mol}} = 6.63\times10^{-23}\ \text{g/molecule}$$

$$m_0 = 6.63\times10^{-26}\ \text{kg/molecule}$$

Substituting in (1) above,

we find for helium, $\boxed{v_{rms} = 1.62\ \text{km/s}}$

and for argon, $\boxed{v_{rms} = 514\ \text{m/s}}$