Pikes Peak near Denver, Colorado has an elevation of 14,110 ft. (a) Determine the pressure at this elevation, based on Eq. 2.12. (b) If the air is assumed to have a constant specific weight of 0.07647 lb/ft³, what would the pressure be at this altitude? (c) If the air is assumed to have a constant temperature of 59 °F what would the pressure be at this elevation? For all three cases assume standard atmospheric conditions at sea level (see Table 2.1).

\[
\rho = \rho_a \left(1 - \frac{g'z}{T_a} \right)^{\frac{g'z}{R}} \tag{Eqs. 2.12}
\]

For \( \rho_a = 2116.2 \frac{lb}{ft^2} \), \( g = 32.174 \frac{ft}{s^2} \), \( T_a = 518.67 °F \), \( R = 1716 \frac{ft \cdot lb}{slug \cdot °F} \) and

\[
\frac{g'z}{R} = \frac{32.174 \frac{ft}{s^2}}{1716 \frac{ft \cdot lb}{slug \cdot °F}} \left( \frac{0.00357 \frac{lb}{ft^2}}{518.67 °F} \right) = 5.252
\]

then

\[
\rho = (2116.2 \frac{lb}{ft^2}) \left[1 - \frac{(0.00357 \frac{lb}{ft^2})(14,110 \text{ ft})}{518.67 °F} \right]
\]

\[= 1240 \frac{lb}{ft^2} \text{ (abs)} \]

(b) \( \rho = \rho_a - \rho h \)

\[= 2116.2 \frac{lb}{ft^2} - (0.07647 \frac{lb}{ft^3})(14,110 \text{ ft}) \]

\[= 1040 \frac{lb}{ft^2} \text{ (abs)} \]

(c) \( \rho = \rho_a e^{-\frac{g'z}{RT_a}} \)

\[
= (2116.2 \frac{lb}{ft^2}) e^{-\left[\frac{(32.174 \frac{ft}{s^2})(14,110 \text{ ft})}{1716 \frac{ft \cdot lb}{slug \cdot °F} (518.67 °F)}\right]}
\]

\[= 1270 \frac{lb}{ft^2} \text{ (abs)} \]

2-15