SOLUTIONS TO PROBLEMS

P8.5  \[ U_i + K_i = U_f + K_f: \quad mgh + 0 = mg(2R) + \frac{1}{2}mv^2 \]
\[ g(3.50R) = 2g(R) + \frac{1}{2}v^2 \]
\[ v = \sqrt{3.00gR} \]
\[ \sum F = m\frac{v^2}{R}: \quad n + mg = \frac{m v^2}{R} \]
\[ n = m\left[\frac{v^2}{R} - g\right] = m\left[\frac{3.00gR}{R} - g\right] = 2.00mg \]
\[ n = 2.00(5.00 \times 10^{-3} \text{ kg})(9.80 \text{ m/s}^2) = 0.0980 \text{ N downward} \]

P8.14  \[ m_1 > m_2 \]
(a)  \[ E_{\text{initial}} = E_{\text{final}} \]
\[ m_1gh = \frac{1}{2}(m_1 + m_2)v^2 + m_2gh \]
\[ v = \sqrt{\frac{2(m_1 - m_2)gh}{m_1 + m_2}} \]
(b)  Since \( m_2 \) has kinetic energy \( \frac{1}{2}m_2v^2 \), it will rise an additional height \( \Delta h \) determined from
\[ m_2g \Delta h = \frac{1}{2}m_2v^2 \]
or from (a),
\[ \Delta h = \frac{v^2}{2g} \left(\frac{m_1 - m_2}{m_1 + m_2}\right) \]
The total height \( m_2 \) reaches is \( h + \Delta h = \frac{2m_1h}{m_1 + m_2} \).

P8.24  (a)  \[ (\Delta K)_{A \rightarrow B} = \sum W = W_g = mg\Delta h = mg(5.00 - 3.20) \]
\[ \frac{1}{2}mv_B^2 - \frac{1}{2}mv_A^2 = m(9.80)(1.80) \]
\[ v_B = 5.94 \text{ m/s} \]
Similarly, \[ v_C = \sqrt{v_A^2 + 2g(5.00 - 2.00)} = 7.67 \text{ m/s} \]
(b)  \[ W_s|_{A \rightarrow C} = mg(3.00 \text{ m}) = 147 \text{ J} \]

P8.26  (a)  \[ U_f = K_i - K_f + U_i \]
\[ U_f = 30.0 - 18.0 + 10.0 = 22.0 \text{ J} \]
\[ E = 40.0 \text{ J} \]
(b)  Yes, \( \Delta E_{\text{mech}} = \Delta K + \Delta U \) is not equal to zero. For conservative forces \( \Delta K + \Delta U = 0 \).