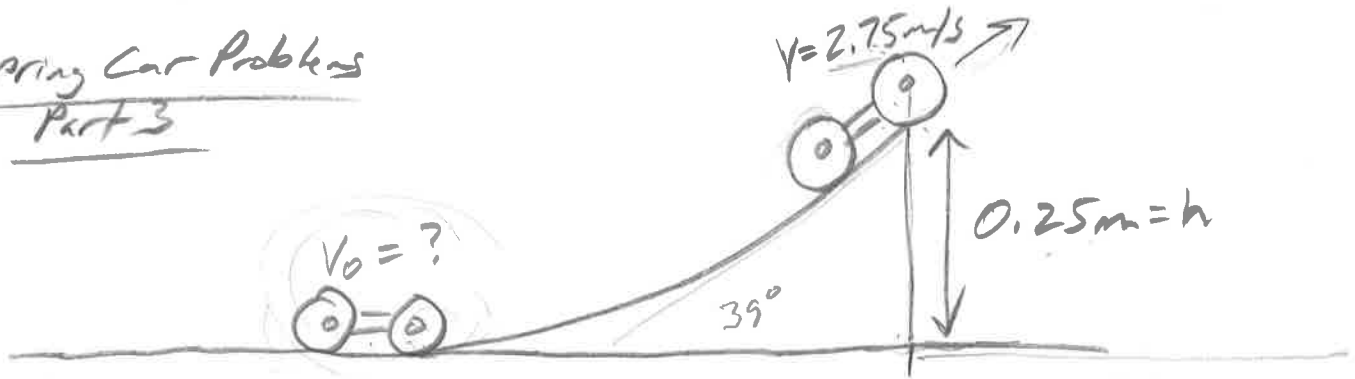


Spring Car Problems

Part 3



Axle radii = Assume
 Axle mass = negligible
 Wheel radii = 3.81 cm
 Wheel mass = 12g each

$$I_{\text{cylinder}} = \frac{1}{2} m r^2$$

Total Car Mass = 160g

$$PE_i + KE_i = PE_f + KE_f$$

\uparrow zero \uparrow mgh

$$0 + \frac{1}{2} m_{\text{car}} v_i^2 + \frac{1}{2} I_{\text{wheels}}^2 = m_{\text{car}} g h + \frac{1}{2} m_{\text{car}} v_f^2 + \frac{1}{2} I_{\text{wheels}}^2$$

$$\frac{1}{2} m_{\text{car}} v_i^2 + \frac{1}{2} \left(\frac{m r^2}{2} \right) \left(\frac{v_i^2}{r^2} \right) = m_{\text{car}} g h + \frac{1}{2} m_{\text{car}} v_f^2 + \frac{1}{2} \left(\frac{m r^2}{2} \right) \left(\frac{v_f^2}{r^2} \right)$$

$$v_i^2 \left(\frac{m_{\text{car}}}{2} + \frac{m_{\text{wheels}}}{4} \right) = m_{\text{car}} g h + v_f^2 \left(\frac{m_{\text{car}}}{2} + \frac{m_{\text{wheels}}}{4} \right)$$

$$v_i^2 = \frac{m_{\text{car}} g h}{\left(\frac{m_{\text{car}}}{2} + \frac{m_{\text{wheels}}}{4} \right)} + v_f^2$$

$$v_i^2 = \frac{(0.16 \text{ kg})(9.8 \text{ m/s}^2)(0.25 \text{ m})}{\left(\frac{0.16 \text{ kg}}{2} + \frac{0.048 \text{ kg}}{4} \right)} + (2.75 \text{ m/s})^2$$

$$v_i^2 = \frac{0.392 \text{ J}}{0.092 \text{ kg}} + 7.56 \text{ m}^2/\text{s}^2 = 11.8 \text{ m}^2/\text{s}^2$$

$$v_i = \sqrt{11.8 \text{ m}^2/\text{s}^2} = 3.43 \text{ m/s}$$