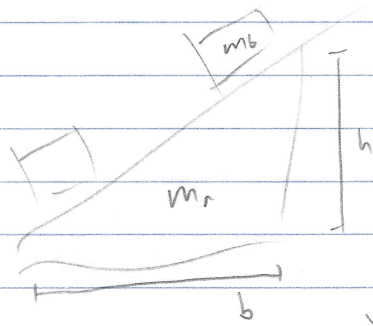
MOM-DY-16



$$T_1 + V_1 = T_2 + V_2$$

$$m_b g h = \frac{1}{2} m_r v_r^2 + \frac{1}{2} m_b v_b^2$$

$$m_b g h - \frac{1}{2} m_b v_b^2 = \frac{1}{2} m_r v_r^2$$

$$\sqrt{\frac{2 m_b g h - m_b v_b^2}{m_r}} = v_r$$

$$v_b = v_r + v_{b/r}$$

$$= v_r \hat{i} + (-v_{b/r}\cos\theta \hat{i} - v_{b/r}\sin\theta \hat{j})$$

$$= (v_r - v_{b/r}\cos\theta)\hat{i} - v_{b/r}\sin\theta \hat{j}$$

$$m_r v_r + m_b (v_b)_x = 0$$

$$m_r v_r + m_b (v_r - v_{b/r}\cos\theta) = 0$$

$$v_{b/r} = \frac{v_r (m_r + m_b)}{m_b \cos\theta}$$

$$v_b^2 = (v_r - v_{b/r}\cos\theta)^2 + (-v_{b/r}\sin\theta)^2$$

$$= v_r^2 + v_{b/r}^2 \cos^2\theta - 2 v_r v_{b/r}\cos\theta + v_{b/r}^2 \sin^2\theta$$

$$v_r^2 + v_{b/r}^2 - 2 v_r v_{b/r}\cos\theta$$

$$= v_r^2 + v_r^2 \left(\frac{(m_r + m_b)}{m_b \cos\theta}\right)^2 - 2 v_r \left(\frac{v_r (m_r + m_b)}{m_b \cos\theta}\right)\cos\theta$$

$$= v_r^2 \left(1 + \left(\frac{(m_r + m_b)}{m_b \cos\theta}\right)^2 - 2\left(\frac{(m_r + m_b)}{m_b}\right)\right)$$

$$v_b^2 = \left(\frac{2 m_b g h - m_b v_b^2}{m_r}\right) x$$

$$\theta = 27.98 = \tan^{-1}\left(\frac{h}{b}\right)$$

$$v_b^2 + x\frac{m_b}{m_r} v_b^2 = \frac{2 m_b g h}{m_r} x$$

$$x = 55.148$$

$$v_b = \sqrt{\frac{\frac{2 m_b g h}{m_r} x}{\left(1 + x\frac{m_b}{m_r}\right)}}$$

$$v_b = 5.47$$

$$v_r = 0.737$$

$$v_{b/r} = 6.1097$$