HW 7-8 Soln)

The solution has two parts, the collision and the swinging. Let b label the bullet and W label the wood.

I) Use conservation of momentum in the horizontal direction. The collision is completely inelastic.

$$m_b v_{bi} + m_W v_{Wi} = (m_b + m_W) v_f$$

Starts from rest

$$v_{bi} = \frac{(m_b + m_W)}{m_b} v_f$$

since the wood is initially at rest.

II) Use work-energy theorem for the swinging part.

$W_T = 0$ since the tensions are always perpendicular to the path.

W_g – conservative

$$0 = \frac{1}{2}(m_b + m_W)v_f^2 - \frac{1}{2}(m_b + m_W)v_i^2 + g(m_b + m_W)y_f - g(m_b + m_W)y_i$$

Stops $\qquad$ $y_i = 0$

We can cancel the mass terms to get

$$\frac{1}{2}v_i^2 = g y_f$$

$$v_i = \sqrt{2 g y_f}$$

This initial velocity is the final velocity from Part I, so

$$v_{bi} = \frac{(m_b + m_W)}{m_b}\sqrt{2 g y_f} = \frac{(0.002 + 2.5)}{0.002}\sqrt{2(10)(0.06)} = 1370\ \text{m/s}$$