## Answer on Question #53378, Physics / Mechanics | Kinematics | Dynamics

An 0.007 kg bullet is fired into a 0.23 kg block that is initially at rest at the edge of a table of height h = 1.05 meter. The bullet remains in the block, and after the impact the block lands 1.84 meters from the bottom of the table. What is the initial speed of the bullet?

**Solution:**

The equation that denotes the conservation of momentum is:

$$m_1 v_{1i} + m_2 v_{2i} = (m_1 + m_2) v_f$$

where, $m_1$ = mass of body 1

$m_2$ = mass of object or body 2

$v_{1i}$ = initial velocity of body 1

$v_{2i}$=0 initial velocity of body 2

$v_f$ = final velocity of both the objects

Thus,

$$m_1 v_{1i} = (m_1 + m_2) v_f$$

Equations related to trajectory motion after the impact are given by

$$\text{Horizontal distance,} \quad d = v_f t$$

$$\text{Vertical distance,} \quad y = y_0 + v_{0y} t - \frac{1}{2} g t^2$$

At end of trajectory $y = 0$.

Thus,

$$0 = h + 0 \cdot t - \frac{1}{2} g t^2$$

$$h = \frac{1}{2} g t^2$$

$$t = \sqrt{\frac{2h}{g}}$$

So,

$$d = v_f t = v_f \sqrt{\frac{2h}{g}}$$

$$v_f = d\sqrt{\frac{g}{2h}} = 1.84 * \sqrt{\frac{9.81}{2 * 1.05}} = 3.977 \text{ m/s}$$

The initial speed of bullet

$$v_{1i} = \frac{(m_1 + m_2) v_f}{m_1} = \frac{(0.007 + 0.23) * 3.977}{0.007} \approx 135 \text{ m/s}$$

**Answer:** $135 \text{ m/s}$