Answer on Question #75464-Physics-Other

A 0.0135-kg bullet is fired straight up at a falling wooden block that has a mass of 4.02 kg. The bullet has a speed of 809 m/s when it strikes the block. The block originally was dropped from rest from the top of a building and had been falling for a time t when the collision with the bullet occurs. As a result of the collision, the block (with the bullet in it) reverses direction, rises, and comes to a momentary halt at the top of the building. Find the time t.

Solution

Before collision:

$$MgH = \frac{1}{2}Mv_1^2 \to gH = \frac{1}{2}v_1^2$$

The collision:

$$mv_0 - Mv_1 = (m + M)v_2.$$

After collision:

$$(M + m)gH = \frac{1}{2}(M + m)v_2^2 \to gH = \frac{1}{2}v_2^2$$

So,

$$v_1 = v_2$$

Thus,

$$mv_0 - Mv_1 = (m + M)v_1.$$

$$v_1 = \frac{m}{m + 2M}v_0$$

The time is

$$t = \frac{v_1}{g} = \frac{m}{m + 2M}\frac{v_0}{g} = \frac{0.0135}{0.0135 + 2(4.02)}\frac{809}{9.81} = 0.14\ s.$$

Answer: $0.14\ s$.