

Answer on Question #41221, Physics, Mechanics

Question:

A 10-g bullet of unknown speed is shot horizontally into a 2-kg block of wood suspended from the ceiling by a cord. The bullet hits the block and becomes lodged in it. After the collision, the block and the bullet swing to a height 30cm above the original position. What was the speed of the bullet? (This device is called the ballistic pendulum). Take $g=9.8\text{ms}^{-2}$

Answer:

The law of conservation of momentum:

$$mv = (M + m)u$$

$$u = \frac{m}{m + M}v$$

where m is mass of the bullet, M is mass of the block, u is speed of the block and the bullet after collision.

The law of conservation of energy:

$$\frac{(m + M)u^2}{2} = (m + M)gh$$

$$\frac{m^2v^2}{2(m + M)} = (m + M)gh$$

$$v = \frac{m + M}{m} \sqrt{2gh} = \left(1 + \frac{M}{m}\right) \sqrt{2gh} \cong 490 \frac{m}{s}$$

Answer: $490 \frac{m}{s}$