

AP Physics

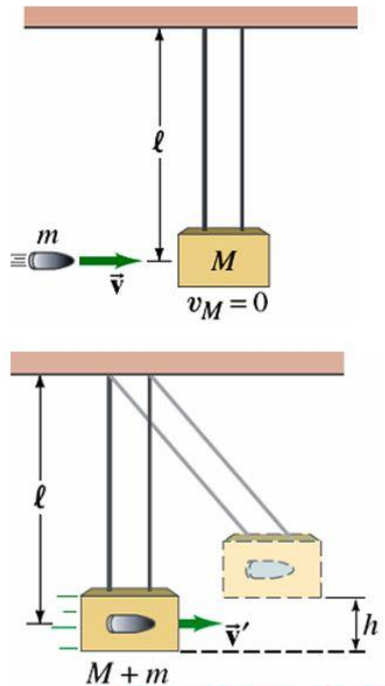
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The Ballistic Pendulum

Applying Momentum-Energy Conservation

Using Momentum and Energy Conservation Principles

Example 7-10: Ballistic pendulum



The ballistic pendulum is a device used to measure speeds of projectiles, such as a bullet.

A projectile, mass m , is fired into a large block, mass M , which is suspended like a pendulum. After the collision, pendulum & projectile swing up to a maximum height h .

Find the relation between the initial horizontal speed of the projectile, v & the maximum height h .

The Ballistic Pendulum

Just click on the screen at any pause to continue.

Knowing only the mass of the bullet and the height of the wood block we can find the speed of the bullet using the Conservation of Energy and Momentum Principle.

Using the Conservation of Energy when the bullet is in the block

Using the Conservation of Momentum

Momentum Before = Momentum After

$$m_b v_{ob} + m_w v_{os} = (m_b + m_w) v_{fs}$$

$$v_{ob} = \frac{(m_b + m_w) v_{fs}}{m_b}$$

v_{fs} is v_{os}

General Solution

$$v_{ob} = \frac{(m_b + m_w)}{m_b} \sqrt{2gh_f} = \frac{3.020 \text{ kg}}{.020 \text{ kg}} \sqrt{2(9.8 \frac{\text{m}}{\text{s}^2}) 32 \text{ m}} = 380 \text{ m/s}$$

Plug 'n' Shove

Using the

Conservation of Energy

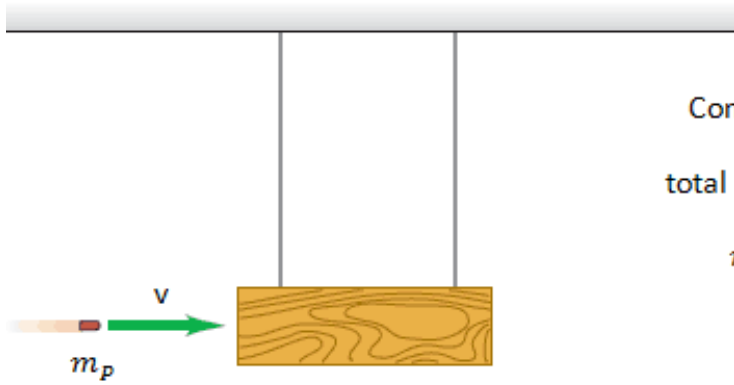
when the bullet is in the block

$$\text{Energy Before} = \text{Energy After}$$

$$PE + KE = PE + KE$$

$$\frac{1}{2}(m_b + m_w) v_{os}^2 = (m_b + m_w) gh_f$$

$$v_{os} = \sqrt{2gh_f}$$

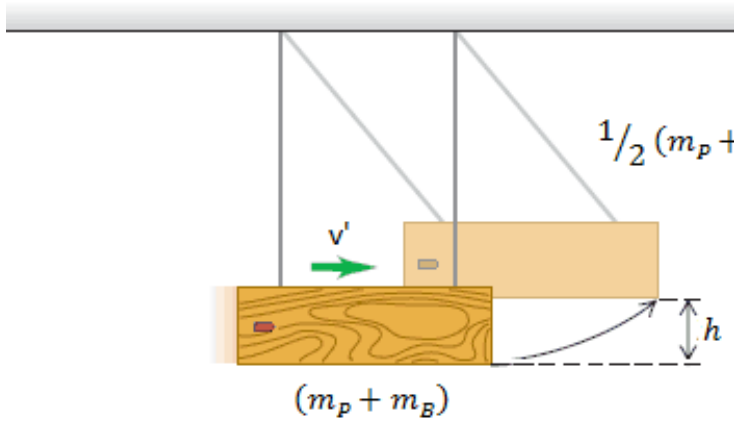


Conservation of Momentum

total P before = total P after

$$m_p v = (m_p + m_B) v'$$

$$v' = \frac{m_p}{(m_p + m_B)} v$$



Conservation of Energy

$$\frac{1}{2} (m_p + m_B) v'^2 + 0 = 0 + (m_p + m_B) gh$$

$$v = \frac{(m_p + m_B)}{m_p} \sqrt{2gh}$$

