Physics 180A Chapter 8 Problem 68 *Solution*

A rifle bullet with mass 8.00 g strikes and embeds itself in a block with a mass of 0.992 kg that rests on a frictionless, horizontal surface and is attached to a coil spring. The impact compresses the spring 15.0 cm. Calibration of the spring shows that a force of 0.750 N is required to compress the spring 0.250 cm. (30 pts)

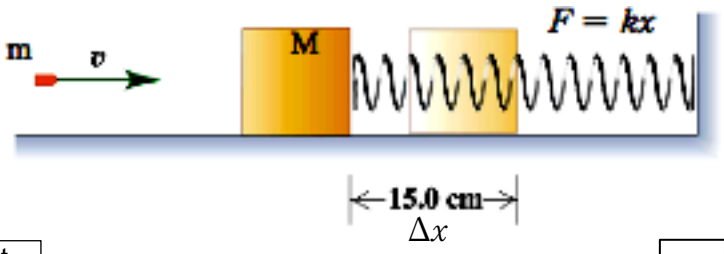
Momentum Before

mv_B

Problem 2pts

Momentum After (2 pts)

What kind of collision is this? (2 pts)



What is the value of the spring constant k? (2 pts)

Energy Before bullet enters block. (2 pts)

After bullet enters block
Energy Before $\frac{1}{2}(m+M)v_A^2$

Energy After spring is compressed. (2 pts)

Conservation of Momentum (2 pts)
mom. before = mom. after

$mv_B =$

Conservation of Energy (2 pts)
energy before = energy after

$\frac{1}{2}(m+M)v_A^2$ **=**

Solve for the initial speed of the bullet then plug in given values? (4 pts)

Solve for the magnitude of the bullet-block velocity just after impact then plug in the given values? (4 pts)

How much energy was lost (transformed) in this collision? (4 pts)

$KE_{before} =$

Energy Lost (transformed)

Where did the lost energy go? (2 pts)

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Momentum Before

$$mv_B$$

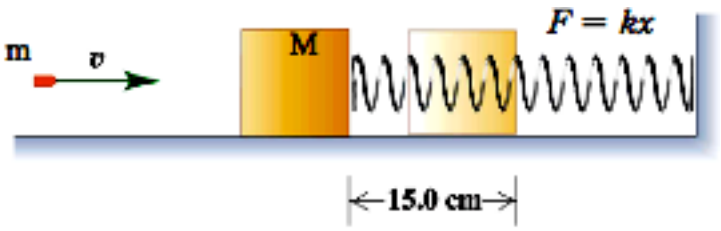
Ballistic Pendulum Problem

Momentum After

$$(m+M)\,v_A$$

What kind of collision is this?

Inelastic



What is the value of the spring constant k?

$$k = \frac{F}{x} = \frac{0.750N}{0.250m}$$

$$k = 300N/m$$

Energy Before bullet enters block.

$$\frac{1}{2}mv^2$$

Energy after bullet enters block

$$\frac{1}{2}(m+M)\,v_A^2$$

Energy After spring is compressed.

$$\frac{1}{2}kx^2$$

Conservation of Momentum

Mom. before = Mom. after

$$mv_B = (m+M)\,v_A$$

Solve for the initial speed of the bullet then plug in given values?

$$v_B = \frac{(m+M)\,v_A}{m}$$

$$v_B = \frac{(0.008kg + 0.992kg)\,2.60\,m/s}{0.008kg} = 325m/s$$

Conservation of Energy

energy before = energy after

$$\frac{1}{2}(m+M)\,v_A^2 = \frac{1}{2}kx^2$$

Solve for the magnitude of the bullet-block velocity just after impact then plug in the given values?

$$v_A = \sqrt{\frac{kx^2}{m+M}}$$

$$v_A = \sqrt{\frac{300N/m\,(0.150m)^2}{(0.008+0.992)\,kg}} = 2.60\frac{m}{s}$$

How much energy was lost (transformed) in this collision?

$$KE_{before} = \frac{1}{2}mv^2 = \frac{1}{2}(0.008kg)\,(325m/s)^2 = 423\ Joules$$

$$PE_{spring} = \frac{1}{2}kx^2 = \frac{1}{2}300N/m\,(0.150m)^2 = 3.38\ Joules$$

Energy Lost (transformed)

420 *Joules*

Where did the lost energy go?

Bullet Deformation of the block, Massive Heat and a Loud Sound