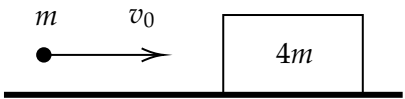
Problem 15

A bullet of mass m and velocity v_0 is fired toward a block of mass $4m$. The block is initially at rest on a frictionless horizontal surface. The bullet penetrates the block and emerges with a velocity of $\frac{v_0}{3}$



a) Determine the final speed of the block.

b) Determine the loss in kinetic energy of the bullet.

c) Determine the gain in the kinetic energy of the block.

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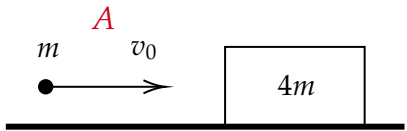

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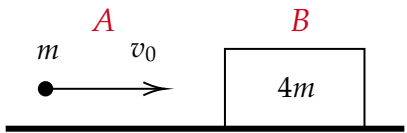

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Problem 15

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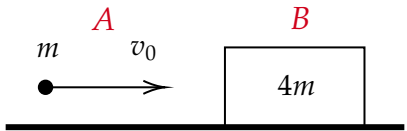
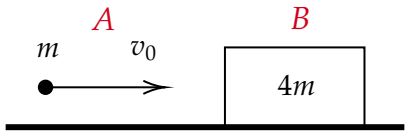


Problem 15

a) Determine the final speed of the block.



$$m_A v_A + m_B v_B = m_A v'_A + m_B v'_B$$

Problem 15

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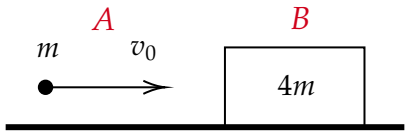

$$m_A v_A + \cancel{m_B v_B} = m_A v'_A + m_B v'_B$$

Problem 15

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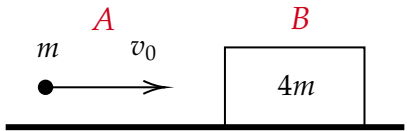

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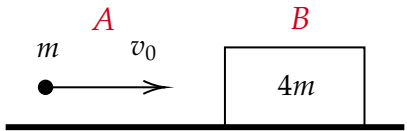

$$m_A v_A + m_B v_B = m_A v'_A + m_B v'_B$$

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$$\cancel{m} v_0 - \frac{6 > \cancel{m} m v_0}{3} = 4m v'_B$$

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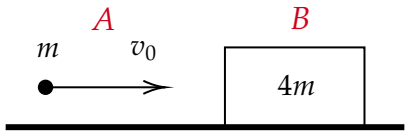

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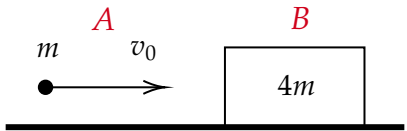

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$$v'_B = \frac{1}{4}(v_0 - \frac{v_0}{3})$$

Problem 15

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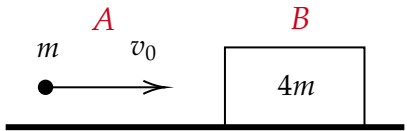


$$m_A v_A + m_B v_B = m_A v'_A + m_B v'_B$$

$$m v_0 = m(\frac{v_0}{3}) + (4m)v'_B$$

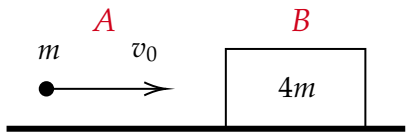
$$m v_0 - \frac{6 > \cancel{m} m v_0}{3} = 4m v'_B$$

$$v'_B = \frac{1}{4}(v_0 - \frac{v_0}{3})$$

$$\boxed{v'_B = \frac{v_0}{6}}$$

Problem 15

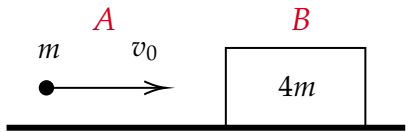
b) Determine the loss in kinetic energy of the bullet.



Problem 15

b) Determine the loss in kinetic energy of the bullet.

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

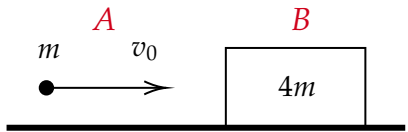


Problem 15

b) Determine the loss in kinetic energy of the bullet.

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

$$\boxed{K_A = \frac{1}{2}mv_0^2}$$



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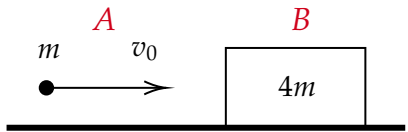
b) Determine the loss in kinetic energy of the bullet.

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

$$\boxed{K_A = \frac{1}{2}mv_0^2}$$

$$K'_A = \frac{1}{2}mv'_A$$



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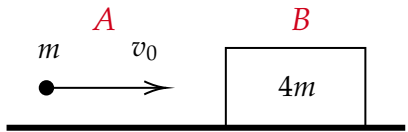

$$\boxed{K_A = \frac{1}{2}mv_0^2}$$

$$K'_A = \frac{1}{2}mv'_A$$

$$= \frac{1}{2}m\left(\frac{v_0}{3}\right)^2$$

Problem 15

b) Determine the loss in kinetic energy of the bullet.

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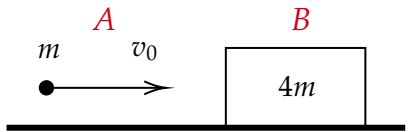

$$\boxed{K_A = \frac{1}{2}mv_0^2}$$

$$K'_A = \frac{1}{2}mv'_A$$

$$= \frac{1}{2}m\left(\frac{v_0}{3}\right)^2$$

$$\boxed{K'_A = \frac{mv_0^2}{18}}$$

Problem 15

b) Determine the loss in kinetic energy of the bullet.

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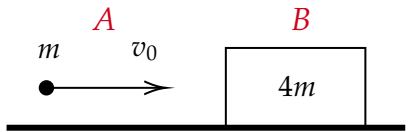


$$\boxed{K_A = \frac{1}{2}mv_0^2}$$

$$K'_A = \frac{1}{2}mv'_A$$

$$= \frac{1}{2}m\left(\frac{v_0}{3}\right)^2$$

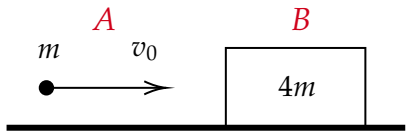
$$\boxed{K'_A = \frac{mv_0^2}{18}}$$

$$\Delta K_A = K'_A - K_A$$

Problem 15

b) Determine the loss in kinetic energy of the bullet.

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



$$\boxed{K_A = \frac{1}{2}mv_0^2}$$

$$K'_A = \frac{1}{2}mv'_A$$

$$= \frac{1}{2}m\left(\frac{v_0}{3}\right)^2$$

$$\boxed{K'_A = \frac{mv_0^2}{18}}$$

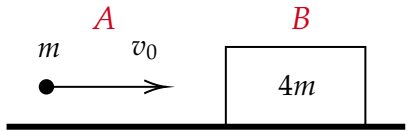
$$\Delta K_A = K'_A - K_A$$

$$= \frac{1}{18}mv_0^2 - \frac{1}{2}mv_0^2$$

Problem 15

b) Determine the loss in kinetic energy of the bullet.

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



$$\boxed{K_A = \frac{1}{2}mv_0^2}$$

$$K'_A = \frac{1}{2}mv'_A$$

$$= \frac{1}{2}m\left(\frac{v_0}{3}\right)^2$$

$$\boxed{K'_A = \frac{mv_0^2}{18}}$$

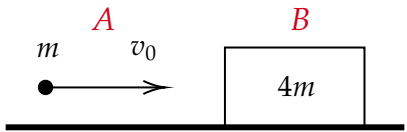
$$\Delta K_A = K'_A - K_A$$

$$= \frac{1}{18}mv_0^2 - \frac{1}{2}mv_0^2$$

$$\boxed{\Delta K_A = -\frac{4}{9}mv_0^2}$$

Problem 15

c) Determine the gain in the kinetic energy of the block.



Problem 15

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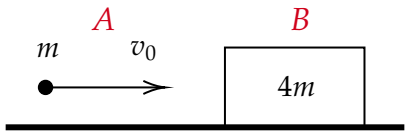
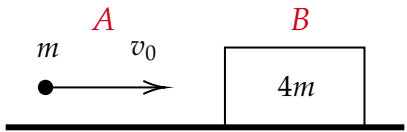


$K_B = 0$

Problem 15

c) Determine the gain in the kinetic energy of the block.

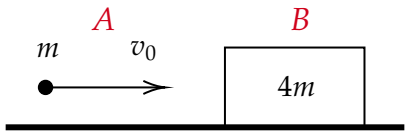


$$K_B = 0$$

$$K'_B = \frac{1}{2} m_B v_B^2$$

Problem 15

c) Determine the gain in the kinetic energy of the block.



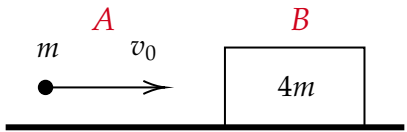
$$K_B = 0$$

$$K'_B = \frac{1}{2} m_B v_B^2$$

$$= \frac{1}{2}(4m)\left(\frac{v_0}{3}\right)^2 = \frac{1}{18} m v_0^2$$

Problem 15

c) Determine the gain in the kinetic energy of the block.



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$$= \frac{1}{2}(4m)\left(\frac{v_0}{3}\right)^2 = \frac{1}{18} m v_0^2$$

$$\boxed{\Delta K_B = K'_B - K_B = \frac{1}{18} m v_0^2}$$