1. An object initially at rest breaks up into two pieces of unequal masses when a spring-loaded device is released. Let \( K_1 \) be the kinetic energy of the larger mass and \( K_2 \) that of the smaller mass right after they separate. Which of the following statements is correct?

(A) \( K_1 > K_2 \)  
(B) \( K_1 < K_2 \)  
(C) \( K_1 = K_2 \)

Equal magnitude of momentum \( K = \frac{1}{2} m v^2 \) and \( p = m v \) combine to form \( K = \frac{1}{2} p_m \) for smaller mass.

2. A railroad car of mass \( m \) and speed \( v \) collides and sticks to an identical railroad car that is initially at rest. After the collision, the kinetic energy of the system is

(A) \( \frac{1}{2} m v^2 \)  
(B) \( \frac{1}{2} m v^2 \)  
(C) \( \frac{1}{4} m v^2 \)  
(D) \( \frac{1}{6} m v^2 \)  
(E) \( m v^2 \)

\( \Sigma E_{ext} = 0 \rightarrow \Delta p = 0 \) \( p_i = p_f \), \( p_i = m v, \) \( p_f = 2m v \rightarrow v_f = \frac{v}{2} \)

\( K_i = \frac{1}{2} m v^2 \)  
\( K_f = \frac{1}{2} (2m)(\frac{v}{2})^2 = m \left( \frac{v}{2} \right)^2 = \frac{m v^2}{4} = \frac{1}{2} K_i \)

3. A red ball with a velocity of +3.0 m/s collides head-on with a yellow ball of equal mass moving with a velocity of -2.0 m/s. What is the velocity of the yellow ball after the collision?

(A) +3.0 m/s  
(B) 0  
(C) -2.0 m/s  
(D) +2.5 m/s  
(E) +5.0 m/s

Elastic Collision: Solve \( m_1 v_{1i} + m_2 v_{2i} = m_1 v_{1f} + m_2 v_{2f} \)

For \( m_1 = \text{Red}, m_2 = \text{Yellow}, m_1 = m_2 \) Obtain \( v_{2f} = 3 \text{ m/s}, \) \( v_{1f} = -2 \text{ m/s} \)

4. An elastic collision of two objects is characterized by the following

(A) Momentum is conserved  
(B) Kinetic Energy is conserved  
(C) Both (A) and (B)  
(D) Neither (A) nor (B)

5. A 75 Kg swimmer dives horizontally with speed 4 m/sec off an initially stationary 500 Kg raft. What is the speed of the raft immediately after the dive?

(a) 0 m/sec  
(b) 0.2 m/sec  
(c) 0.5 m/sec  
(D) 0.6 m/sec  
(e) 4.0 m/sec

\( \Sigma \vec{F}_{ext} = 0 \rightarrow \Delta \vec{p} = 0 \rightarrow \vec{p}_i = \vec{p}_f \), \( p_i = 0 \rightarrow p_f = 0 \)

\( \Sigma \vec{F}_{raft} = 0 \rightarrow v_{raft} = \frac{-75 \times 4}{500} = -0.6 \text{ m/s} \)

\( \text{speed} = 0.6 \text{ m/s} \)
1. If the mass of \( m_1 \) is 1 kg and \( m_2 \) is 3 kg in the figure and \( m_3 \) is 2 kg, what is the x coordinate of the center of mass?

(A) 0.67  (B) 1.17  (C) 1.33  (D) 1.67

\[
X_{CM} = \frac{\sum m_i x_i}{\sum m_i} = \frac{m_1 x_1 + m_2 x_2 + m_3 x_3}{m_1 + m_2 + m_3}
\]

\[
X_{CM} = \frac{1 \times 0 + 3 \times 1 + 2 \times 2}{1 + 3 + 2} = \frac{7 \text{ kg m}}{6 \text{ kg}} = 1.17 \text{ m}
\]

2. An inelastic collision of two objects is characterized by the following

(A) Momentum is conserved  (B) Kinetic Energy is conserved  
(C) Both (A) and (B)  (D) Neither (A) nor B

3. A firehose directs a steady stream of 15 kg/sec of water with velocity 28 m/sec against a flat plate. What force is required to hold the plate in place?

(A) 110 N  (B) 420 N  (C) 1100 N  (D) 4116 N

\[
\text{In 1 sec, } m = 15 \text{ kg/s} \times 1 \text{ sec} = 15 \text{ kg}
\]

\[
\mathbf{F}_{\text{avg}} \times 1 \text{ sec} = 15 \text{ kg} \times 28 \text{ m/sec} = 420 \text{ N}
\]

4. What is the magnitude of the impulse in the figure

(A) 100 Ns  (B) 900 Ns  (C) 1000 Ns  (D) 1100 Ns

\[
\mathbf{J} = \mathbf{F}_{\text{avg}} \times \Delta t = 100 \text{ N} \times (10 \text{ sec} - 1 \text{ sec})
\]

\[
= 100 \text{ N} \times 9 \text{ sec} = 900 \text{ Ns}
\]

5. A 12000 kg railroad car travelling at 10 m/s strikes and couples with a 6000 kg caboose moving towards it at a speed of 2 m/s. What is the speed of the combination of railroad cars after the collision

(A) 5.2 m/s  (B) 6.0 m/s  (C) 7.3 m/s  (D) 8 m/s

\[
\sum F_x = 0 \quad \Delta \mathbf{p} = \mathbf{0} \rightarrow \mathbf{p}_i = \mathbf{p}_f
\]

\[
\mathbf{p}_i = \mathbf{p}_f = (m_1 + m_2) \mathbf{v}_f
\]

\[
\mathbf{v}_f = \frac{108,000}{18,000} \text{ kg m/s} = 6 \text{ m/s}
\]