

AP Physics C: Mechanics

Name: _____ Score: _____

1. A 4 kg cart moves at $5 \frac{\text{m}}{\text{s}}$. What is its momentum (in $\text{kg} \cdot \text{m/s}$)?
_____ $\text{kg} \cdot \text{m/s}$
2. A force of 50 N acts for 0.4 s. What impulse does it deliver (in $\text{N} \cdot \text{s}$)?
_____ $\text{N} \cdot \text{s}$
3. A 50 kg skater at rest throws a 5 kg ball at $8 \frac{\text{m}}{\text{s}}$. The skater's recoil speed (in m/s)?
_____ m/s
4. A 3 kg cart at $4 \frac{\text{m}}{\text{s}}$ sticks to a stationary 1 kg cart. Their common speed afterward (in m/s)?
_____ m/s
5. Two objects moving toward each other can have a total momentum of zero.
☐ True ☐ False
6. An impulse of $12 \text{ N} \cdot \text{s}$ acts on a 3 kg cart at rest. Its final speed (in m/s)?
_____ m/s
7. An internal explosion inside a floating system changes the system's total momentum.
☐ True ☐ False
8. In which collision is kinetic energy conserved?
☐ an inelastic collision
☐ all collisions
☐ a perfectly inelastic collision
☐ an elastic collision
9. Momentum is a _____ quantity, pointing the same way as the velocity.

10. An airbag reduces injury by...
☐ removing all momentum instantly
☐ reducing the change in momentum
☐ increasing the stopping time, which lowers the average force
☐ increasing the force

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1. **20 kg · m/s**

$$p = mv = 4 \times 5 = 20 \frac{\text{kg} \cdot \text{m}}{\text{s}}.$$

2. **20 N · s**

$$J = F\Delta t = 50 \times 0.4 = 20 \text{ N} \cdot \text{s}.$$

3. **0.8 m/s**

$$0 = 5(8) + 50v, \text{ so } v = -40/50 = -0.8 \frac{\text{m}}{\text{s}} - \text{the skater recoils at } 0.8 \frac{\text{m}}{\text{s}}.$$

4. **3 m/s**

$$3(4) = (3 + 1)v_f, \text{ so } v_f = 12/4 = 3 \frac{\text{m}}{\text{s}}.$$

5. **True**

Momentum is a vector – opposite directions carry opposite signs, which can cancel to zero.

6. **4 m/s**

$$J = \Delta p = m\Delta v, \text{ so } \Delta v = 12/3 = 4 \frac{\text{m}}{\text{s}} \text{ from rest.}$$

7. **False**

Explosion forces are internal (third-law pairs), so the total momentum is unchanged.

8. **an elastic collision**

Only an elastic collision conserves kinetic energy. Momentum, though, is conserved in all of them.

9. **vector**

$\vec{p} = m\vec{v}$ is a vector – it has both size and direction.

10. **increasing the stopping time, which lowers the average force**

The momentum change is fixed; the airbag stretches the time, so the average force $F = \Delta p / \Delta t$ drops.