

4. Linear Momentum

Starter Quiz · 课前小测

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 elastic collision
☐ an inelastic collision
☐ a perfectly inelastic collision
☐ all collisions
9. An airbag reduces injury by...
☐ reducing the change in momentum
☐ increasing the stopping time, which lowers the average force
☐ increasing the force
☐ removing all momentum instantly
10. Momentum is conserved only when...
☐ no forces act at all
☐ the net external force is zero

- ☐ kinetic energy is also conserved
- ☐ the objects are identical

4. Linear Momentum

Answers · 答案

AP Physics C: Mechanics

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. 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.

10. the net external force is zero

An isolated system – zero *net external* force – conserves momentum. Internal forces are fine.