# 4. Linear Momentum

**Starter Quiz · 课前小测**

AP Physics 1 Name: _____ Score: _____

1. What is the momentum of a 1500 kg car moving at 20 $\frac{\text{m}}{\text{s}}$, in $\text{kg} \cdot \frac{\text{m}}{\text{s}}$?

   _____ $\text{kg} \cdot \text{m/s}$

2. The impulse–momentum theorem says impulse equals the change in _____.

   _____

3. A 2 kg trolley at 3 $\frac{\text{m}}{\text{s}}$ hits a stationary 1 kg trolley and they stick. What is their common speed after, in $\frac{\text{m}}{\text{s}}$?

   _____ m/s

4. In an **elastic** collision, which quantity is conserved besides momentum?

   ☐ temperature

   ☐ kinetic energy

   ☐ mass only

   ☐ nothing else

5. Momentum is a vector, so its direction matters.

   ☐ True ☐ False

6. A force of 20 N acts for 0.5 s. What is the impulse, in $\text{N} \cdot \text{s}$?

   _____ $\text{N} \cdot \text{s}$

7. Momentum is conserved only when the system is:

   ☐ moving fast

   ☐ isolated (no external net force)

   ☐ made of identical objects

   ☐ at rest

8. Momentum is conserved in both elastic and inelastic collisions (for an isolated system).

   ☐ True ☐ False

9. Momentum equals mass times _____.

   _____

10. How does an airbag reduce the force on a passenger in a crash?

    ☐ by reducing the change in momentum

☐ by making the stop take longer

☐ by adding momentum

☐ by removing all the energy

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**Answers · 答案**

AP Physics 1

1. **30000 kg · m/s**

   $p = mv = 1500 \times 20 = 30\,000$ kg · $\frac{\text{m}}{\text{s}}$.

2. **momentum**

   $\vec{J} = \Delta\vec{p}$ — impulse equals the change in **momentum**.

3. **2 m/s**

   Before: $p = 2(3) = 6$. After: $3v = 6$, so $v = 2$ $\frac{\text{m}}{\text{s}}$.

4. **kinetic energy**

   An elastic collision conserves **kinetic energy** as well as momentum.

5. **True**

   $\vec{p} = m\vec{v}$ points along the velocity; opposite directions give opposite signs.

6. **10 N · s**

   $J = F\Delta t = 20 \times 0.5 = 10$ N · s.

7. **isolated (no external net force)**

   With no external net force, the internal forces cancel and total momentum stays constant.

8. **True**

   Momentum is always conserved in an isolated collision. Kinetic energy is the quantity that distinguishes the two types.

9. **velocity**

   $\vec{p} = m\vec{v}$ — mass times **velocity**.

10. **by making the stop take longer**

    The change in momentum is fixed. A longer stopping time $\Delta t$ makes $F = \Delta p/\Delta t$ smaller.