

1.6 Momentum

Name: _____ Class: _____ Date: _____

Total: 11 marks

KEY WORDS momentum 动量 • impulse 冲量 • conservation of momentum 动量守恒 • force 力 • mass 质量

Objective

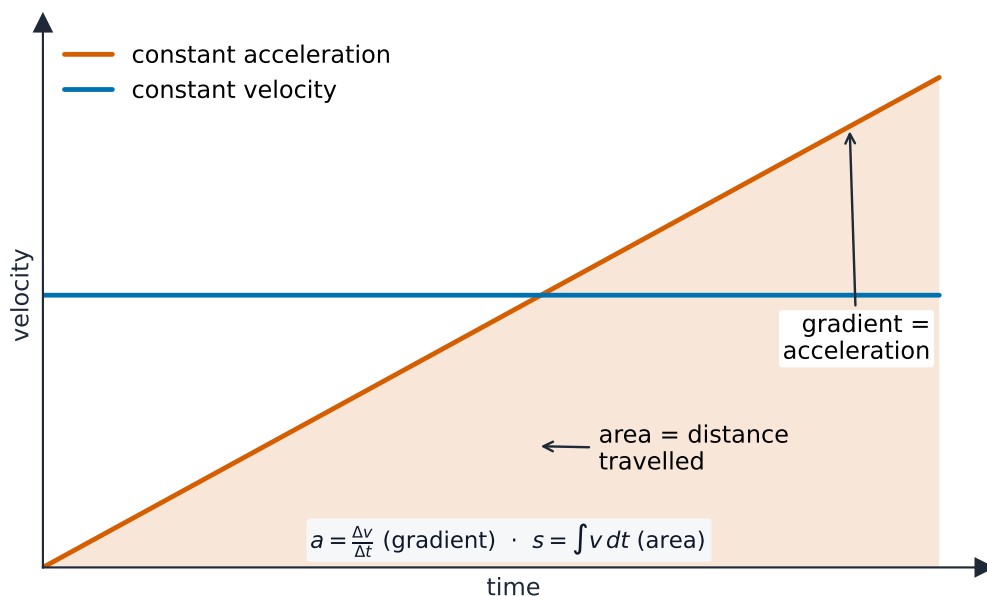
Build the skills to answer exam questions on **momentum** 动量 — $p = mv$, $F = \frac{\Delta p}{\Delta t}$, and the **conservation of momentum** 动量守恒.

You must be able to:

- calculate momentum $p = mv$ (a vector — mind the direction)
- use $F = \frac{\Delta p}{\Delta t}$ (impulse)
- apply conservation of momentum to a collision

1 Worked examples

■ Conservation of momentum



Momentum $p = mv$ combines mass and velocity; in a collision the total is conserved

2.0 kg at 3.0 m/s hits stationary 1.0 kg, they stick: $(2.0 \times 3.0) + (1.0 \times 0) = (3.0)v \Rightarrow v = 2.0 \text{ m/s}$.

2 Practice

2.1 Find the momentum of a 0.40 kg ball moving at 5.0 m/s. [2]

2.2 State the principle of conservation of momentum. [1]

3 Exam-style questions

3.1 The momentum of an object is its mass multiplied by its: [1]

- **A** acceleration
- **B** velocity
- **C** weight
- **D** density

3.2 A 3.0 kg trolley moving at 4.0 m/s collides with a stationary 1.0 kg trolley and they move off together.

(a) Find the total momentum before the collision. [2]

(b) Find their common velocity after the collision. [2]

3.3 A force acts on a 2.0 kg ball for 0.10 s and changes its velocity from 0 to 6.0 m/s. Find the force. [3]

Solutions

2.1 $p = mv = 0.40 \times 5.0 = 2.0 \text{ kg m/s}$.

2.2 when no external force acts, the total momentum before a collision equals the total momentum after.

3.1 B. Momentum = mass $\times$ velocity.

3.2 (a) before = $3.0 \times 4.0 + 1.0 \times 0 = 12 \text{ kg m/s}$.

(b) $12 = (3.0 + 1.0)v \Rightarrow v = 3.0 \text{ m/s}$.

3.3 $F = \frac{\Delta p}{\Delta t} = \frac{2.0 \times 6.0}{0.10} = \frac{12}{0.10}; = 120 \text{ N}$.