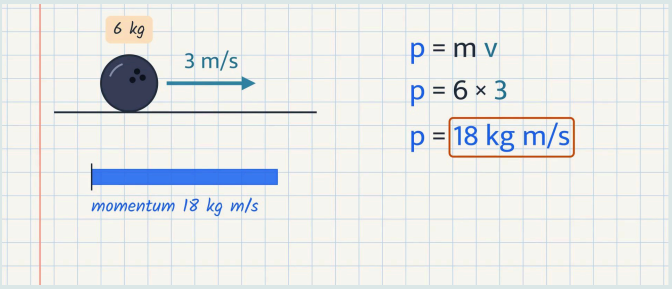
Momentum

Mass in motion, before and after

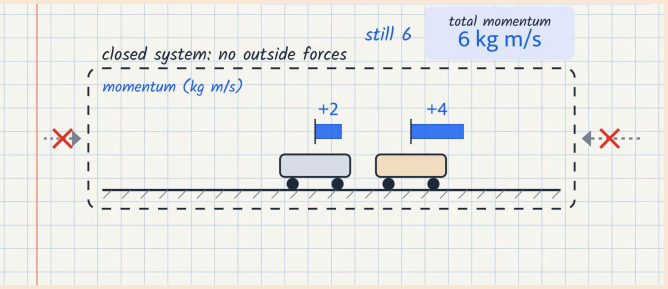
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Summary sheet

1 What momentum is



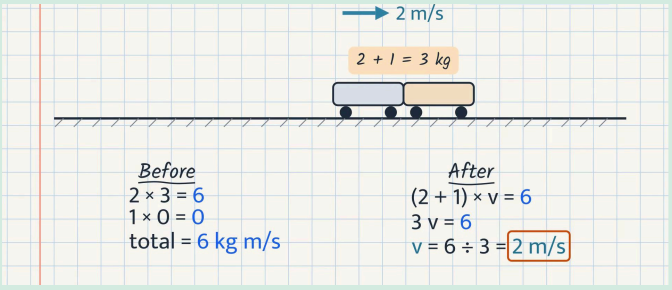
- **Momentum = mass × velocity**: p = m v. Mass in kg, velocity in m/s, so momentum is in **kg m/s**.
- Momentum is a **vector**: call moving right positive and moving left negative. A 6 kg ball at 3 m/s has p = 6 × 3 = 18 kg m/s.

2 Conservation



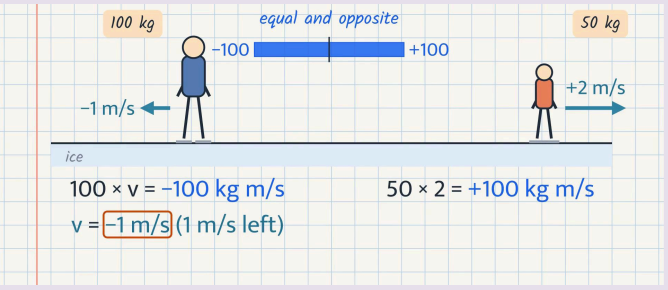
- In a **closed system**, total momentum before an event = total momentum after it: **conservation of momentum**.
- Closed system: nothing from outside pushes or pulls on the objects, so whatever happens between them, the total stays the same.

3 A collision



- 2 kg at 3 m/s hits a still 1 kg trolley; they stick. Before: 2 × 3 + 1 × 0 = 6 kg m/s.
- After: (2 + 1) × v = 6, so **v = 2 m/s**. Write the total before, set it equal to after, solve for the unknown.

4 Pushing apart



- From rest the total is **zero**, so after pushing apart the momenta are **equal and opposite**.
- 50 kg at +2 m/s = +100 kg m/s, so the 100 kg skater has −100 kg m/s: v = −1 m/s (1 m/s left). Guns recoil for the same reason.

$$p = m\,v$$

momentum = mass × velocity

Exam tip

First line: total momentum before = total momentum after. Then fill in the numbers.

Check yourself

- 1 Momentum of a 70 kg runner at 4 m/s?
- 2 3 kg trolley at 2 m/s hits a still 3 kg trolley; they join. Speed after?

Answers: 1. p = 70 × 4 = 280 kg m/s 2. 6 = 6 × v, so v = 1 m/s