

The idea of momentum

AS Level

9702 AS Ch.6

Chapter 6: Momentum

Lesson 6.1

Sections 6.1

Goal: Calculate momentum and the change in momentum, with the direction as a sign.

 velocity

01 The big picture

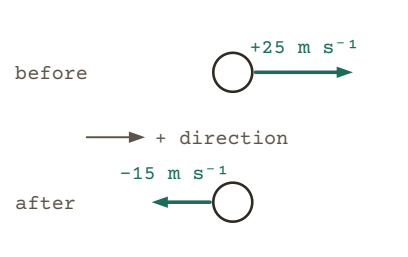
Momentum is mass $\times$ velocity. It is a vector: choose a positive direction, and an object moving the other way has negative momentum. Its unit is kg m s^{-1} (the same as N s).

When an object rebounds, its velocity changes sign, so the change in momentum is larger than either momentum on its own: $\Delta p = mv - mu$ with v negative.

Linear momentum [paraphrase]

The product of an object's mass and its velocity.

Fig. 1 · A ball rebounds from a wall



The velocity changes sign, so $\Delta p = m(v - u)$ is bigger than mu or mv .

02 Key equations

Momentum

$$p = mv$$

Change in momentum

$$\Delta p = mv - mu$$

Symbols and units

p	momentum	kg m s^{-1}	m	mass	kg	u, v	velocity before, after	m s^{-1}
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03 Sample problems with solutions

Sample 1 · A rebound

A 0.060 kg ball hits a wall at 25 m s^{-1} and rebounds along the same line at 15 m s^{-1} (Fig. 1). Calculate the change in its momentum.

Step 1. Towards the wall is positive, so $u = +25$ and $v = -15 \text{ m s}^{-1}$:

$$\Delta p = m(v - u) = 0.060(-15 - 25)$$

Step 2. Evaluate:

$$\Delta p = -2.4 \text{ kg m s}^{-1}$$

Answer: 2.4 kg m s^{-1} , directed away from the wall

Unit check: $\text{kg} \times \text{m s}^{-1} = \text{kg m s}^{-1} \checkmark$

04 Practice problems

P1 Find the momentum of a 70 kg runner moving at 8.0 m s^{-1} .

Answer: 560 kg m s^{-1}

P2 A 0.40 kg ball has momentum 6.0 kg m s^{-1} . Find its speed.

Answer: 15 m s^{-1}

P3 A 2.0 kg trolley moves at $+3.0 \text{ m s}^{-1}$ and a 1.5 kg trolley at -4.0 m s^{-1} . Find their total momentum.

Answer: Zero

P4 A 0.20 kg ball hits the floor at 5.0 m s^{-1} and bounces up at 3.0 m s^{-1} . Find the size of its change in momentum.

Answer: 1.6 kg m s^{-1}

05 Other useful information

Common mistakes

- ✗ **Wrong:** Rebound: $\Delta p = m(25 - 15)$
- ✓ **Right:** The velocity reverses: $\Delta p = m(-15 - 25)$

- ✗ **Wrong:** Add momenta as positive numbers.
- ✓ **Right:** Give each a sign for its direction first.

Explore: [Practice questions for this lesson](#)

Exam tips

- Draw an arrow for your positive direction before you write any velocity.

What the syllabus asks

- 9702 topic 3: define and use linear momentum. Coursebook 6.1.