

The meaning of acceleration

AS Level

9702 AS Ch.2

Chapter 2: Accelerated motion

Lesson 2.1

Sections 2.1

Goal: Say what acceleration is, and recognise speeding up, slowing down and changing direction as acceleration.

01 The big picture

An object accelerates whenever its velocity changes. Acceleration is the rate of change of velocity: how much the velocity changes each second.

Velocity is a vector, so acceleration is a vector too. Speeding up, slowing down and changing direction (even at constant speed) are all accelerations. Slowing down is a negative acceleration (a deceleration) when the positive direction is the direction of motion.

Acceleration [paraphrase]

The rate of change of velocity: change in velocity divided by the time taken.

Uniform acceleration [paraphrase]

The velocity changes by the same amount every second.

02 Key equations

Acceleration

$$a = \frac{\Delta v}{\Delta t}$$

Symbols and units

a	acceleration	m s^{-2}	Δv	change in velocity	m s^{-1}	Δt	time taken	s
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03 Sample problems with solutions

Sample 1 · Speeding up and slowing down

A car speeds up from rest to 24 m s^{-1} in 8.0 s. Later it slows from 24 m s^{-1} to 6.0 m s^{-1} in 3.0 s. Calculate the acceleration in each case.

Step 1. Speeding up:

$$a = \frac{24 - 0}{8.0} = 3.0 \text{ m s}^{-2}$$

Step 2. Slowing down: the change in velocity is negative.

$$a = \frac{6.0 - 24}{3.0} = -6.0 \text{ m s}^{-2}$$

Answer: $+3.0 \text{ m s}^{-2}$, then -6.0 m s^{-2} (a deceleration of 6.0 m s^{-2})

Unit check: $\frac{\text{m s}^{-1}}{\text{s}} = \text{m s}^{-2} \checkmark$

04 Practice problems

P1 A sprinter goes from rest to 10 m s^{-1} in 2.5 s. Calculate the acceleration.

Answer: 4.0 m s^{-2}

P2 A bus slows from 15 m s^{-1} to 5.0 m s^{-1} in 4.0 s. Calculate its acceleration.

Answer: -2.5 m s^{-2}

P3 A train travels at a steady 30 m s^{-1} in a straight line. What is its acceleration?

Answer: Zero

P4 A car goes round a roundabout at a constant 8.0 m s^{-1} . Is it accelerating? Why?

Answer: Yes: its direction, so its velocity, changes

05 Other useful information

Common mistakes

- ✗ **Wrong:** A fast object has a large acceleration.
- ✓ **Right:** Acceleration is how quickly the velocity changes, not how big it is.

- ✗ **Wrong:** Constant speed means zero acceleration.
- ✓ **Right:** Only in a straight line; a change of direction is an acceleration.

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

Exam tips

- Choose a positive direction first; then the sign of a tells you which way it points.

What the syllabus asks

- 9702 topic 2: define and use acceleration. Coursebook 2.1.