

Speed

AS Level

9702 AS Ch.1

Chapter 1: Kinematics

Lesson 1.1

Sections 1.1

Goal: Calculate average speed in m s^{-1} and tell it apart from instantaneous speed.

01 The big picture

Average speed is the total distance travelled divided by the total time taken. In SI units it is measured in m s^{-1} .

Instantaneous speed is the speed at one moment. It is found from a distance measured over a very short time, for example a card cutting through a light gate, or from the gradient of a distance–time graph. Speed is a scalar: it has size but no direction.

Average speed [paraphrase]

Total distance travelled divided by total time taken.

Instantaneous speed [paraphrase]

The speed at a particular instant: distance over a very short time interval.

02 Key equations

Average speed

$$v = \frac{d}{t}$$

km h^{-1} to m s^{-1}

$$1 \text{ km h}^{-1} = \frac{1000 \text{ m}}{3600 \text{ s}} = \frac{1}{3.6} \text{ m s}^{-1}$$

Symbols and units

v speed m s^{-1} d distance travelled m t time taken s

03 Sample problems with solutions

Sample 1 · Average speed in SI units

A car travels 150 km in 2.5 hours. Calculate its average speed in m s^{-1} .

Step 1. Convert to metres and seconds first:

$$d = 150\,000 \text{ m}, \quad t = 2.5 \times 3600 = 9000 \text{ s}$$

Step 2. Divide:

$$v = \frac{150\,000}{9000} = 16.7 \text{ m s}^{-1}$$

Answer: $v = 17 \text{ m s}^{-1}$ (2 s.f.)

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

04 Practice problems

P1 A sprinter runs 100 m in 9.58 s. Calculate the average speed.
Answer: 10.4 m s^{-1}

P2 Convert 72 km h^{-1} to m s^{-1} .
Answer: 20 m s^{-1}

P3 A card 5.0 cm long cuts through a light gate in 0.020 s. Calculate the speed of the card.
Answer: 2.5 m s^{-1}

P4 A runner completes a 400 m lap in 50 s. Calculate the average speed.
Answer: 8.0 m s^{-1}

05 Other useful information

Common mistakes

- ✗ **Wrong:** Divide kilometres by hours and call it m s^{-1} .
- ✓ **Right:** Convert to metres and seconds first ($\div 3.6$ for km h^{-1}).

- ✗ **Wrong:** Average speed is the average of the speeds.
- ✓ **Right:** It is total distance $\div$ total time.

Exam tips

- Write the unit at every step; the unit check catches most conversion slips.

What the syllabus asks

- 9702 topic 2: define and use distance and speed. Coursebook 1.1.

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