

Speed

4.5.6.1.2 · Forces · revision notes

Speed is how fast something is moving, without direction. You need to use $s = v t$, calculate average speeds for journeys where the speed changes, and recall typical speeds for walking, running, cycling, transport and sound. Expect short calculations and estimates.

Key facts

- $s = v t$ (distance travelled = speed $\times$ time)
- Average speed = total distance $\div$ total time
- Speed of sound in air ~ 330 m/s
- km/h $\div 3.6 =$ m/s
- Units: s in m, v in m/s, t in s
- Walking ~ 1.5 m/s, running ~ 3 m/s, cycling ~ 6 m/s
- Car ~ 13 m/s in a town, ~ 30 m/s on a motorway
- Speed is a scalar

Notes

What speed is

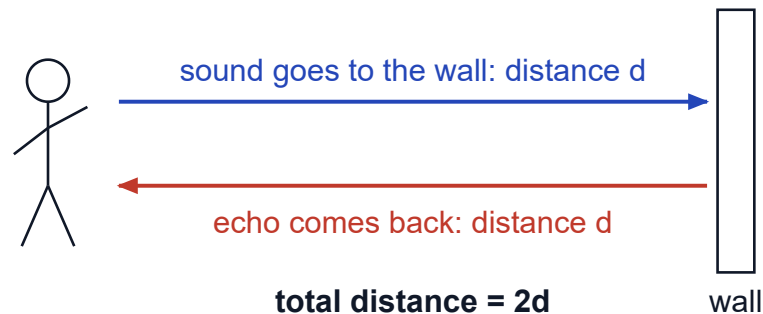
- Speed is the distance travelled per unit time. It does not involve direction, so it is a **scalar** quantity.
- The speed of a moving object is rarely constant. When people walk, run or travel in a car, their speed is constantly changing.
- The speed at which a person can walk, run or cycle depends on many factors, including their age, their fitness, the terrain and the distance travelled.

Calculating speed

- distance travelled = speed $\times$ time: **$s = v t$** (for an object moving at constant speed).
- s in metres (m), v in metres per second (m/s), t in seconds (s).
- When the speed changes during a journey, use **average speed = total distance $\div$ total time**.
- To measure a speed, measure a distance (e.g. with a tape measure) and the time taken (e.g. with a stopwatch or light gates), then divide.

Typical speeds to recall

- Walking ~ 1.5 m/s; running ~ 3 m/s; cycling ~ 6 m/s.
- Car in a town ~ 13 m/s (30 mph); car on a motorway ~ 30 m/s (70 mph); fast train ~ 50 m/s; passenger jet ~ 250 m/s.
- Sound in air ~ 330 m/s. The speed of sound and the speed of the wind both vary.



For an echo, the sound travels there and back: use distance = $2 \times$ the distance to the wall.

- The symbol $\sim$ means 'approximately'.

How to answer each type of question

Calculate with $s = v t$

2 to 3 marks

Grade 4

1. Convert the time to seconds (and the distance to metres).
2. Write $s = v t$, or its rearranged form, and substitute.
3. Give the answer with a unit.

Example. A cyclist rides at a constant speed of 6.0 m/s for 8.0 minutes.
Calculate the distance travelled.

Model answer. $t = 8.0 \times 60 = 480$ s (1)

$s = 6.0 \times 480$ (1)

$s = 2880$ m (1)

Calculate an average speed

3 marks

Grade 5

1. Add up the total distance.
2. Add up the total time, including any stops that are part of the journey.
3. Divide, and convert to the units asked for.

Example. A bus travels 3.6 km in 6.0 minutes, stops for 2.0 minutes, then travels 2.4 km in 4.0 minutes.

Calculate the average speed of the bus for the whole journey, in m/s.

Model answer. total distance = $3.6 + 2.4 = 6.0$ km = 6000 m (1)

total time = $6.0 + 2.0 + 4.0 = 12.0$ min = 720 s (1)

average speed = $6000 \div 720 = 8.3$ m/s (1)

Don't lose marks

- ✗ Not converting minutes or hours into seconds.
- ✗ Averaging the speeds of the parts of a journey instead of dividing the total distance by the total time.
- ✗ Leaving out the time spent stopped when the question asks for the average speed of the whole journey.
- ✗ Forgetting to double the distance in echo questions.

More tips

Memory tricks

- Formula triangle: s on top, v and t underneath.
- m/s to km/h: $\times 3.6$. km/h to m/s: $\div 3.6$.
- Sense check with typical speeds: a car at 300 m/s means something has gone wrong.
- Echo questions: the sound goes there and back, so double the distance.

Exam technique

- $s = v t$ must be recalled. Here s stands for distance, not speed.
- In estimates, state the typical value you used; any sensible value earns the mark.
- Check the units the question asks for (m/s, km/h, minutes) before giving your final answer.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

State that speed is a scalar

Speed is the distance travelled per unit time and has no direction.

Grade 4

Calculate distance using $s = v t$

For example, 1.5 m/s for 60 s gives 90 m.

Grade 4

Recall typical speeds of everyday motion

Walking ~ 1.5 m/s, running ~ 3 m/s, cycling ~ 6 m/s, sound in air ~ 330 m/s.

Grade 5

Find speed or time using $s = vt$

$v = s \div t$ and $t = s \div v$.

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