CAMBRIDGE IGCSE™ PHYSICS 0625 | TOPIC 1.2

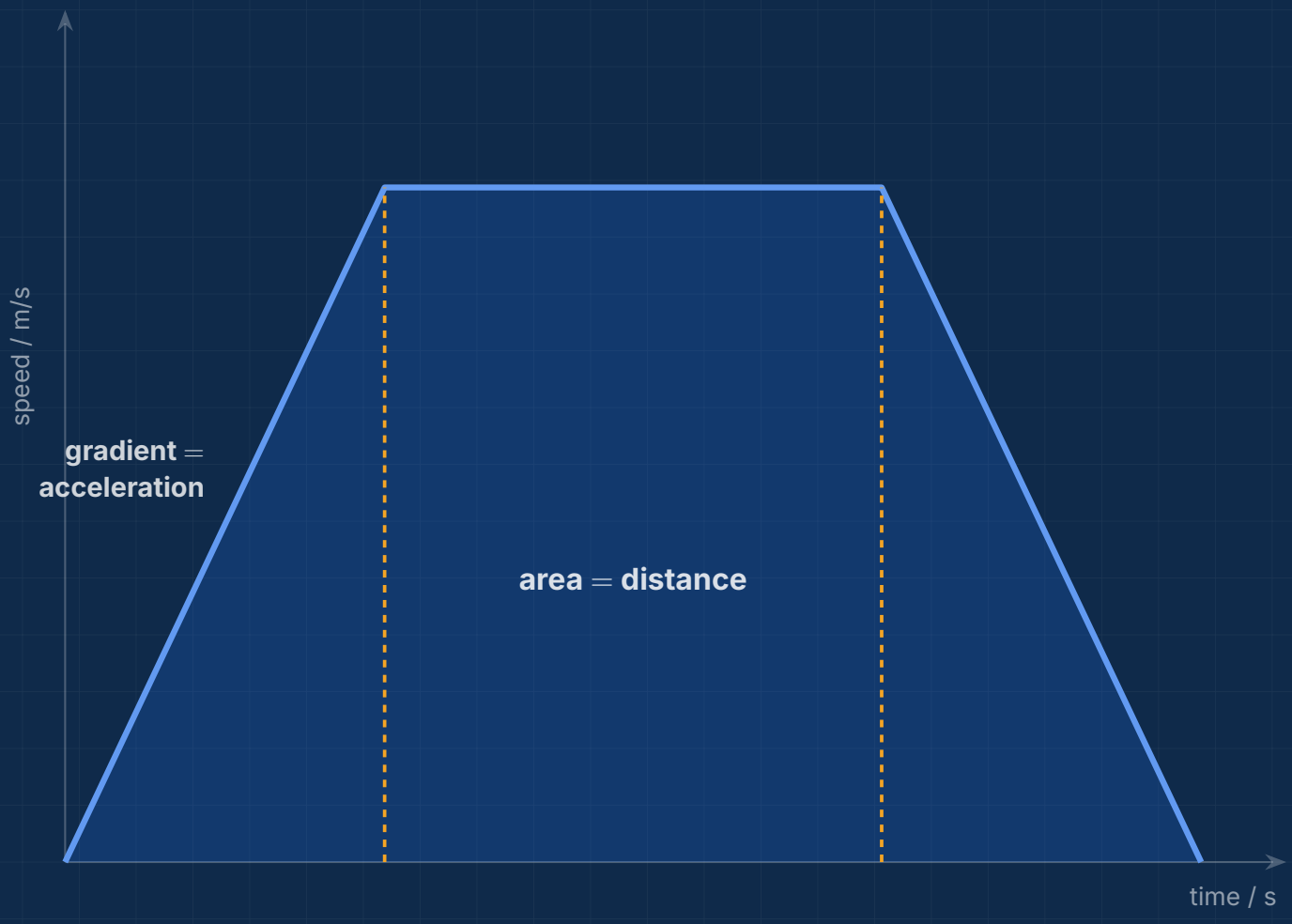
FREE SAMPLE

Motion

Free sample: knowledge organiser and Worksheet 1 with answers

Speed & average speed | Distance–time graphs | Speed–time graphs | Acceleration

Free fall & terminal velocity | Exam-style questions



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Physics that finally makes sense.

Free sample

Full pack: worksheets, exam paper, answers

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Knowledge organiser

Key words

Speed – distance travelled per unit time. *Scalar.*

Velocity – speed in a given direction. *Vector.*

Acceleration SUPPLEMENT – change in velocity per unit time. *Vector.*

Deceleration SUPPLEMENT – slowing down; a *negative* acceleration.

Terminal velocity SUPPLEMENT – the constant velocity reached when air (or liquid) resistance balances the weight.

Equations to recall

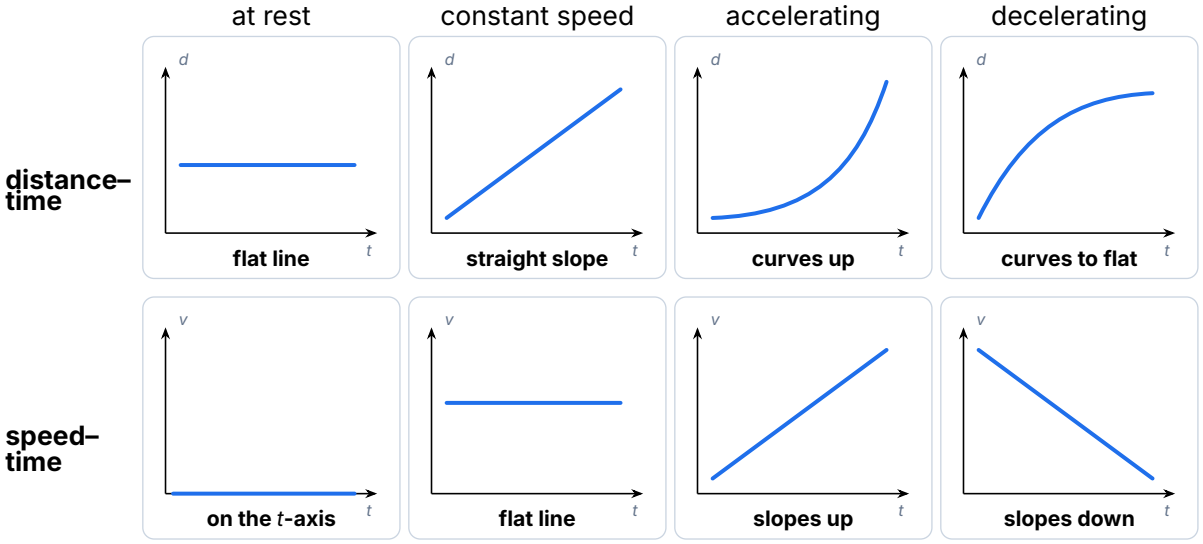
$v = \frac{s}{t}$ speed = distance ÷ time

average speed $= \frac{\text{total distance}}{\text{total time}}$

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

Units: s in m, t in s, v in m/s, a in m/s^2

Reading the graphs



Gradient of *d*–*t* graph = speed

SUPPLEMENT **Gradient of *v*–*t* graph** = acceleration

Area under *v*–*t* graph = distance travelled

SUPPLEMENT **Curved *v*–*t* line:** changing acceleration

Falling objects

Near the Earth's surface, the acceleration of free fall is $g \approx 9.8\,\text{m/s}^2$.

No air resistance: every object falls with the same constant acceleration g.

With air resistance SUPPLEMENT: air resistance grows with speed, so acceleration *decreases* until it is zero. The object then falls at terminal velocity.

Common mistakes

Units: convert km → m and min/h → s first. 1 m/s = 3.6 km/h.

Average speed is *not* the average of the speeds – use total distance ÷ total time, including stops.

Area of a triangle $= \frac{1}{2} \times$ base $\times$ height – don't forget the $\frac{1}{2}$.

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Interactive simulations

TRY IT LIVE

Explore the physics before (or after) you try the worksheets. Each simulation runs in any web browser on a phone, tablet or computer, with nothing to install. Scan the QR code, or click the link in the PDF.

Scan or click

1.2 MOTION

Distance–Time and Speed–Time Graphs

Drive a car through three stages and watch both motion graphs draw themselves.

Use with: Worksheet 2: Distance–time graphs; Worksheet 3: Speed–time graphs

benfizikyapamiyorum.com/icdp/motion-graphs.html

Scan or click

1.2 MOTION

Free Fall and Terminal Velocity

Drop a skydiver with and without air resistance, then open the parachute.

Use with: Worksheet 5: Free fall and terminal velocity

benfizikyapamiyorum.com/icdp/motion-freefall.html

How to get the most from them Make a prediction first, then test it in the simulation. Change one thing at a time and note what happens to the readings. Each simulation ends with a quick *Check yourself* question.

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Speed and average speed

WORKSHEET 1

CORE SUPPLEMENT

You will: define speed and velocity, use $v = s/t$ with correct units, and find the average speed of a journey with several stages.

CORE all students SUPPLEMENT Extended (Supplement) students CHALLENGE stretch question

1 CORE State what is meant by **speed**. [1]

.....

2 CORE Velocity and speed are different quantities. State **one** way in which velocity is different from speed. [1]

.....

3 CORE A cyclist rides 4.5 km in 15 minutes. Calculate the cyclist's average speed in m/s. [3]

.....

.....

speed = _____

4 CORE In 2009, Usain Bolt ran 100 m in 9.58 s. Calculate his average speed. Give your answer to 3 significant figures. [2]

.....

average speed = _____

5 CORE Sound travels through air at 340 m/s. A thunderclap is heard 2.5 s after the lightning is seen. Calculate how far away the lightning struck. (Assume the light arrives instantly.) [2]

.....

distance = _____

6 CORE A car travels at a constant speed of 25 m/s. Calculate the time it takes to travel 1.2 km. [2]

.....

time = _____

7 CORE Complete the conversions. Hint: 1 m/s = 3.6 km/h [3]

72 km/h = _____ m/s

15 m/s = _____ km/h

90 km/h = _____ m/s

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8 CORE A bus makes a journey in three stages:

Stage		Distance	Time	Speed / m/s
A	travels along the main road	6.0 km	10 min	
B	stops at a bus station	0	8 min	0
C	travels along the motorway	9.0 km	12 min	

(a) Calculate the speed of the bus, in m/s, during stage A and during stage C. Write your answers in the table. [2]

.....

.....

(b) Calculate the average speed of the bus for the whole journey, in m/s. [3]

.....

.....

average speed = _____

(c) A student says: *"The average speed is just the two speeds added together and divided by 2."* Explain why the student is wrong. [2]

.....

.....

9 CORE A student measures how long a trolley takes to roll 2.0 m down a ramp. She repeats the measurement three times:

	Trial 1	Trial 2	Trial 3
time / s	1.62	1.58	1.65

(a) Suggest why she repeats the measurement. [1]

.....

(b) Calculate the mean time. [1]

.....

mean time = _____

(c) Calculate the average speed of the trolley. Give your answer to 2 significant figures. [2]

.....

average speed = _____

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10 CORE SUPPLEMENT An athlete runs one lap of a 400 m track in 50 s, finishing exactly where she started.

(a) CORE Calculate her average speed. [1]

.....

average speed = _____

(b) SUPPLEMENT She runs at a constant speed for the whole lap. Explain why her velocity is **not** constant. [2]

.....

.....

11 CORE **Spot the mistake.** A student was asked for the speed of a car that travels 3.0 km in 2.0 minutes. Here is the student's answer:

$$v = \frac{s}{t} = \frac{3.0}{2.0} = 1.5 \quad \textit{so the speed is } 1.5 \text{ m/s.}$$

Explain the mistake and calculate the correct speed in m/s. [3]

.....

.....

speed = _____

Exam tip Before you put numbers into an equation, write every quantity in SI units: distance in **m**, time in **s**. Then the speed comes out in **m/s**.

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Answers: Worksheet 1

Mark codes: B1 independent mark C1 method mark, implied by a correct final answer A1 correct answer with unit. Accept answers that round correctly; allow error carried forward from earlier parts.

Worksheet 1 – Speed and average speed

1 Distance travelled per unit time. B1

2 Velocity has a direction / velocity is a vector, speed is a scalar. B1

3 $s = 4500$ m, $t = 15 \times 60 = 900$ s C1
$v = 4500 \div 900$ C1
$= 5.0$ m/s A1

4 $v = 100 \div 9.58$ C1 $= 10.4$ m/s A1

5 $s = vt = 340 \times 2.5$ C1 $= 850$ m A1

6 $t = s/v = 1200 \div 25$ C1 $= 48$ s A1

7 20 m/s; 54 km/h; 25 m/s B1 B1 B1

8 **(a)** A: $6000 \div 600 = 10$ m/s B1
C: $9000 \div 720 = 12.5$ m/s (accept 13) B1
(b) total distance $= 15\,000$ m C1
total time $=$ 30 min $=$ 1800 s (includes the stop) C1
$15\,000 \div 1800 = 8.3$ m/s A1
(c) The stages take different times / the bus spends longer at some speeds than others B1; it ignores the 8 minutes when the bus is stopped. (Their method gives 11.25 m/s, too high.) B1

9 **(a)** To reduce the effect of random errors / to find a reliable mean / to spot anomalies. B1
(b) $(1.62 + 1.58 + 1.65) \div 3 = 1.62$ s B1
(c) $2.0 \div 1.62$ C1 $= 1.2$ m/s A1

10 **(a)** $400 \div 50 = 8.0$ m/s B1
(b) Velocity is speed in a given direction (velocity is a vector) B1; her direction keeps changing as she runs round the track, so her velocity changes. B1

11 The distance was in km and the time in minutes, so the answer is in km/min, not m/s B1.
$3000 \div 120$ C1 $= 25$ m/s A1

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Get the full pack

You have just used Worksheet 1. The full Motion pack contains:

- **Worksheet 1:** Speed and average speed
- **Worksheet 2:** Distance–time graphs
- **Worksheet 3:** Speed–time graphs
- **Worksheet 4:** Acceleration
- **Worksheet 5:** Free fall and terminal velocity
- **Multiple-choice practice:** 10 Paper 1/2-style questions
- **Practical skills:** an Alternative to Practical (Paper 6) question
- **Exam-style questions:** a 40-mark paper
- **Revision checklist** and knowledge organiser

3 files in every pack

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