

Kinematics

Quick revision notes [Open it online](#)

Name: _____

Date: _____

At a glance

Average speed, units, distance–time and speed–time graphs, acceleration, area as distance, and conversion graphs.

1. Speed, distance and time
2. Distance–time graphs
3. Speed–time graphs
4. Conversion graphs and rates

1. Speed, distance and time

☐ I revised this

- speed = distance $\div$ time; distance = speed $\times$ time; time = distance $\div$ speed.
- **Average speed** = total distance $\div$ total time, including stops. It is not the average of the speeds.
- Convert units first: 45 minutes = 0.75 h; km/h $\div$ 3.6 = m/s.

Formulas

speed = distance $\div$ time	
km/h $\rightarrow$ m/s	$\div$ 3.6
m/s $\rightarrow$ km/h	$\times$ 3.6

Worked example

A cyclist rides 30 km in 1 h, rests for 30 min, then rides 20 km in 1 h. Find the average speed.

1. Total distance 50 km.
2. Total time 2.5 h (the rest counts).
3. $50 \div 2.5$.

20 km/h

2. Distance–time graphs

☐ I revised this

- Gradient = speed. Steeper = faster.
- Horizontal line = stationary. Line sloping down = returning towards the start.
- A curve means the speed is changing; use a tangent for the speed at an instant.

Worked example

A straight line on a distance–time graph goes from (0 s, 0 m) to (40 s, 200 m). Find the speed.

1. Gradient = $200 \div 40$.

5 m/s

3. Speed–time graphs

☐ I revised this

- Gradient = acceleration (m/s²). Negative gradient = deceleration.
- Horizontal line = constant speed (not stopped!).
- **Area under the graph = distance travelled.** Split into triangles, rectangles and trapezia.

Formulas

acceleration = change in speed $\div$ time	gradient
distance = area under the graph	
trapezium area = $\frac{1}{2}(a + b)h$	

Worked example

A bus accelerates from 0 to 12 m/s in 8 s, keeps 12 m/s for 20 s, then stops in 6 s. How far does it go?

1. The shape is a trapezium with parallel sides 34 s and 20 s, height 12.
2. Area = $\frac{1}{2} \times (34 + 20) \times 12$.

324 m

4. Conversion graphs and rates

☐ I revised this

- A straight-line conversion graph through the origin means direct proportion: find the rate from one point.
- Use it to convert in either direction; for values off the graph, scale up.
- The gradient of any real-life graph is a rate (e.g. litres per minute, cost per kg).

Worked example

10 miles = 16 km. Convert 25 miles to km.

1. 1 mile = 1.6 km.
2. 25×1.6 .

40 km

Common mistakes

Don't write	Write instead
✗ 2 h 30 min = 2.3 h	✓ 30 min = 0.5 h, so 2.5 h
✗ Averaging the speeds of two parts	✓ Average speed = total distance $\div$ total time
✗ Reading distance from a speed–time graph's axis	✓ Distance is the AREA under it
✗ A flat line on a speed–time graph means stopped	✓ It means constant speed

In the exam

- Write the units: m/s, m/s², km/h.
- Split areas carefully and show each part.
- If the graph has different time units (minutes and hours), convert before calculating.

My notes

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