Exercise walk-through

E2.9
Graphs in practical situations

IGCSE Mathematics

You must be able to

- find a speed from the gradient of a distance–time graph
- find an acceleration from the gradient of a speed–time graph
- find the distance travelled from the area under a speed–time graph

1 The method

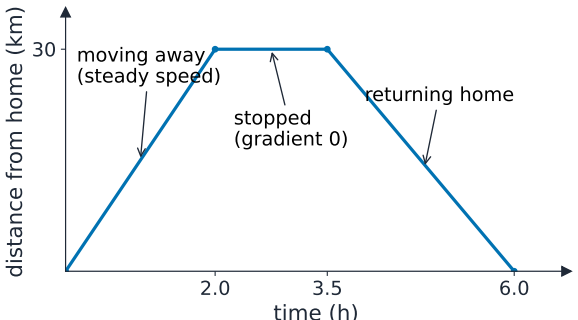
Method — Gradient is a rate; area under a speed–time graph is a distance

- **Distance–time:** gradient = speed. A steeper line is faster; a horizontal line means stopped. 90 km in 1.5 h is 60 km/h.
- **Speed–time:** gradient = acceleration. From 0 to 20 m/s in 8 s is $20 \div 8 = 2.5$ m/s^2. A negative gradient is a deceleration.
- **Area under a speed–time graph = distance.** Split it into triangles and rectangles. That first stage covers $\frac{1}{2} \times 8 \times 20 = 80$ m.
- **Average speed = total distance ÷ total time**, never the average of the speeds.

Answer shapes (marked by **method marks** — M1 for a correct method, A1 for the correct answer): the triangle or rectangle you use for a gradient or an area is the method mark, so show it on the graph.

Method — Gradient is a rate; area under a speed–time graph is a distance

Answer shapes (marked by method marks — M1 for a correct method, A1 for the correct answer): the triangle or...

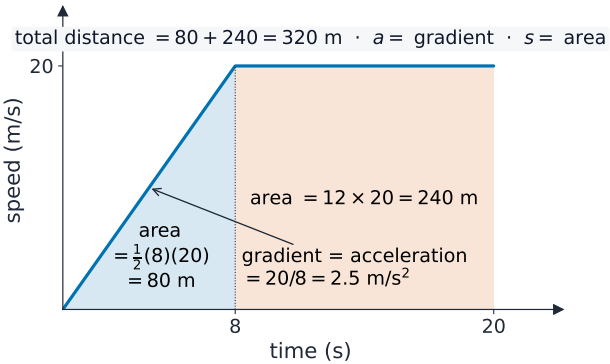


speed = gradient of distance–time graph · flat ⇒ speed = 0

A distance–time graph with sections of different gradient

Method — Gradient is a rate; area under a speed–time graph is a distance

Answer shapes (marked by method marks — M1 for a correct method, A1 for the correct answer): the triangle or...



A speed–time graph made of straight sections

2 Practice

Practice 2.1 ▪ 2 marks

On a distance–time graph, a car travels 90 km in 1.5 hours. Find its speed in km/h.

Solution 2.1

Method: Gradient is a rate; area under a speed–time graph is a distance — p.4

Worked steps

- speed $=$ distance $\div$ time $= 90 \div 1.5$ M1

$$= \mathbf{60} \text{ km/h} \quad \text{A1}$$

Practice 2.2 ▪ 2 marks

On a speed–time graph, the speed rises uniformly from 0 to 20 m/s in 8 seconds. Find the acceleration.

Solution 2.2

Method: Gradient is a rate; area under a speed–time graph is a distance — p.4

Worked steps

- acceleration = change in speed $\div$ time $= 20 \div 8$ M1

$$= \mathbf{2.5}\ \text{m/s}^2$$ A1

Practice 2.3 ▪ 2 marks

Find the distance travelled during those 8 seconds.

Solution 2.3

Worked steps

- the area is a triangle: $\frac{1}{2} \times 8 \times 20$ M1

$$= \mathbf{80} \text{ m}$$ A1

3 Exam-style

Exam-style 3.1 ▪ 8 marks

A car accelerates uniformly from rest to 24 m/s in 12 seconds. It then travels at 24 m/s for 30 seconds, and finally decelerates uniformly to rest in a further 8 seconds.

Exam-style 3.1 (a) ▪ 2 marks

Calculate the acceleration during the first stage.

Solution 3.1 (a)

Method: Gradient is a rate; area under a speed–time graph is a distance — p.4

Worked steps

- $24 \div 12$ M1

$$= \mathbf{2}\ \text{m/s}^2$$ A1

Exam-style 3.1 (b) ▪ 4 marks

Calculate the total distance travelled.

Solution 3.1 (b)

Worked steps

- first stage, a triangle: $\frac{1}{2} \times 12 \times 24 = 144$ m M1
- middle stage, a rectangle: $30 \times 24 = 720$ m M1
- last stage, a triangle: $\frac{1}{2} \times 8 \times 24 = 96$ m M1

$$144 + 720 + 96 = \mathbf{960} \text{ m} \quad \text{A1}$$

Exam-style 3.1 (c) ▪ 2 marks

Calculate the average speed for the whole journey.

Solution 3.1 (c)

Worked steps

- total time $= 12 + 30 + 8 = 50$ s, so average speed $= 960 \div 50$ M1

$$= \mathbf{19.2} \text{ m/s} \quad \text{A1}$$

- note this is NOT the average of 0, 24 and 0