

Real-Life and Distance-Time Graphs - Higher

Solutions

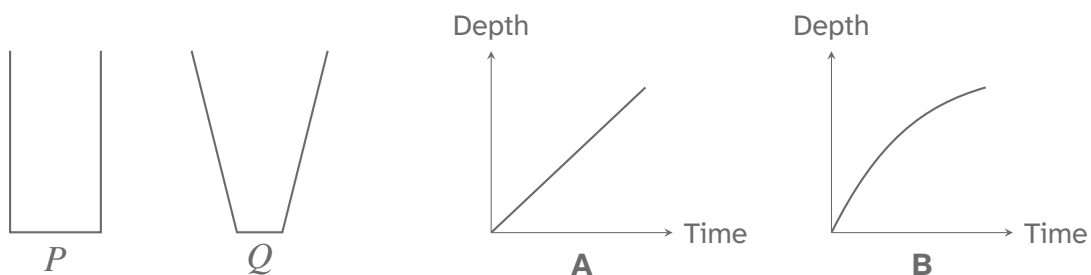
For Pearson Edexcel GCSE Mathematics (1MA1) • Higher tier

Each question is shown in grey, followed by the working, one step per line. The final answer is in a box. *Marks* shows how the marks are usually given in the exam, and **Tip** points out a common mistake.

1 (2 marks)

Water is poured at a constant rate into each container.

Match each container to the graph showing how the depth of water changes over time.



Container *P* has straight vertical sides. Container *Q* is wider at the top.
Which graph matches each container?

P has vertical sides, so it is the same width all the way up.

The depth rises at a steady rate, which gives a straight line: graph A.

Q gets wider towards the top.

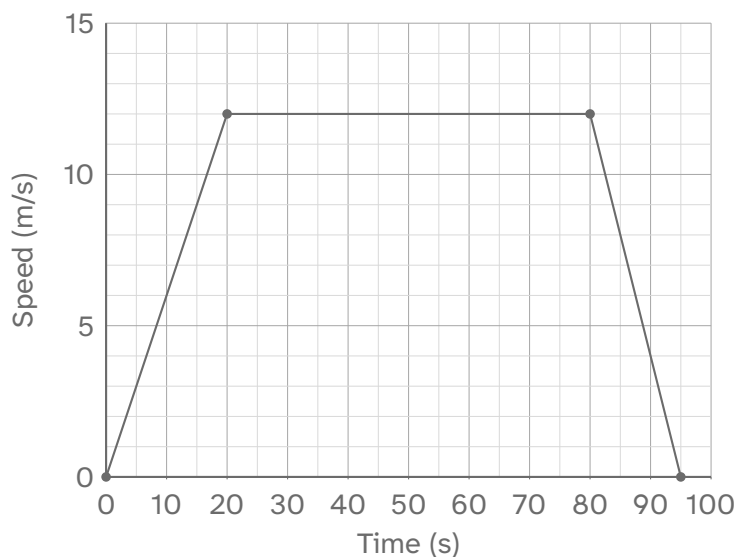
The depth rises quickly at first, then more and more slowly, which gives a curve that gets less steep: graph B.

Answer: *P*: A, *Q*: B

Marks: 1 mark for *P* with A. 1 mark for *Q* with B.

2 (7 marks)

The speed-time graph shows the journey of a bus from one bus stop to the next.



- (a) Work out the deceleration of the bus in the last 15 seconds.

Deceleration is the gradient of the speed-time graph (ignoring the minus sign).

In the last 15 seconds the speed falls from 12 m/s to 0.

$$\text{Deceleration} = 12 \div 15$$

$$= 0.8$$

Answer: 0.8

Marks: 1 mark for $12 \div 15$. 1 mark for 0.8.

- (b) Work out the total distance travelled by the bus.

The distance travelled is the area under the speed-time graph.

Split it into a triangle, a rectangle and a triangle.

$$\text{First 20 seconds: } \frac{1}{2} \times 20 \times 12 = 120$$

$$\text{Next 60 seconds: } 60 \times 12 = 720$$

$$\text{Last 15 seconds: } \frac{1}{2} \times 15 \times 12 = 90$$

$$\text{Total: } 120 + 720 + 90 = 930$$

Answer: 930 m

Tip: The area under a speed-time graph gives the **distance**. Remember the $\frac{1}{2}$ in each triangle.

Marks: 1 mark for one correct area. 1 mark for a full method for the total area. 1 mark for 930.

- (c) Work out the average speed of the bus for the whole journey.
Give your answer correct to 1 decimal place.

Average speed = total distance $\div$ total time

$$= 930 \div 95$$

$$= 9.789 \dots$$

$$= 9.8 \text{ (to 1 decimal place)}$$

Answer: 9.8 m/s

Tip: Divide by the total time, 95 seconds, including the time spent speeding up and slowing down.

Marks: 1 mark for your answer to part (b) $\div 95$. 1 mark for 9.8.

3 (6 marks)

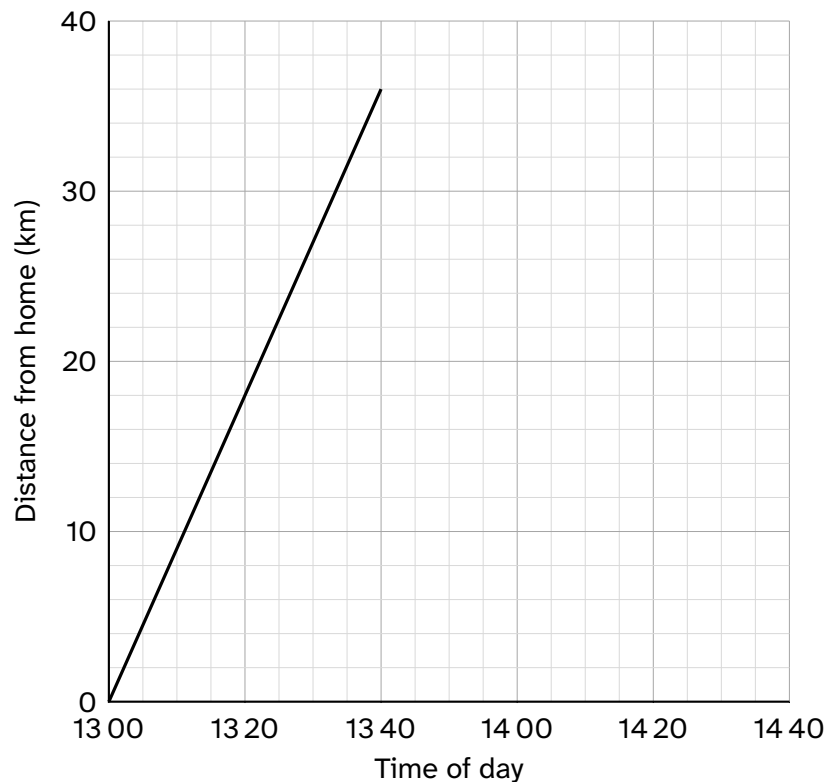
Carys drives 36 km from her home to a garden centre. She leaves home at 13 00 and drives at a constant speed of 54 km/h.

- (a) On the grid, draw the travel graph for Carys's journey to the garden centre.

$$\text{Time} = \text{distance} \div \text{speed} = 36 \div 54 = \frac{2}{3} \text{ hour}$$

$$\frac{2}{3} \text{ hour} = 40 \text{ minutes, so she arrives at 13 40.}$$

Draw a straight line from (13 00, 0) to (13 40, 36).



Tip: $36 \div 54 = 0.666 \dots$ hours. This is 40 minutes, not 66 or 67 minutes: multiply by 60 to change hours into minutes.

Marks: 1 mark for working out 40 minutes (or an arrival time of 13 40). 1 mark for a line from (13 00, 0) to (13 40, 36).

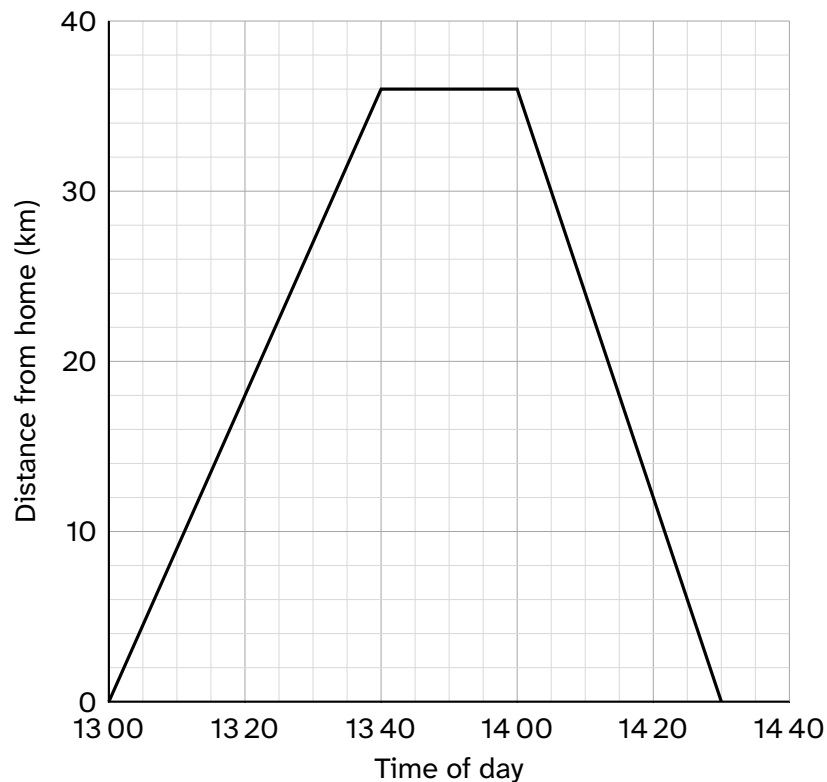
- (b) Carys stays at the garden centre for 20 minutes.
She then drives straight home.

She gets home at 14 30

On the grid, complete the travel graph for Carys's journey.

She stays from 13 40 to 14 00, so draw a horizontal line at 36 km.

Draw a straight line from (14 00, 36) down to (14 30, 0).



Tip: The graph shows distance **from home**, so the line for the drive home goes back down to 0. Each small square on the time axis is 5 minutes.

Marks: 1 mark for a horizontal line at 36 km from 13 40 to 14 00. 1 mark for a line from (14 00, 36) to (14 30, 0).

- (c) Work out Carys's average speed, in km/h, on her way home.

She drives 36 km home, from 14 00 to 14 30.

$$30 \text{ minutes} = \frac{1}{2} \text{ hour}$$

$$\text{Speed} = 36 \div \frac{1}{2}$$

$$= 72$$

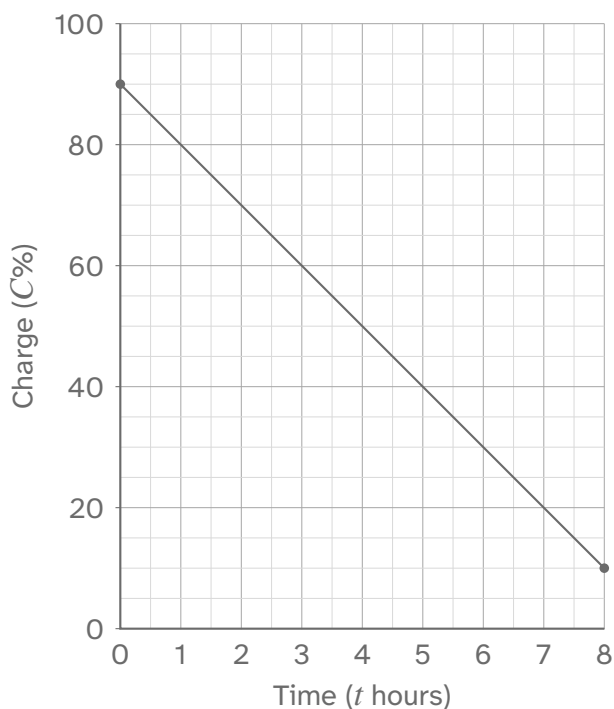
Answer: 72 km/h

Tip: Do not divide by 30. The answer must be in km per **hour**, so change 30 minutes into $\frac{1}{2}$ an hour.

Marks: 1 mark for $36 \div \frac{30}{60}$ or $36 \div 30 \times 60$. 1 mark for 72.

4 (3 marks)

The graph gives information about the charge, $C\%$, of the battery in Leon's phone t hours after he unplugs it from the charger.



- (a) Find the gradient of the graph.

Use two points on the line: (0, 90) and (8, 10).

$$\text{Change in } C \text{ (up)} = 10 - 90 = -80$$

$$\text{Change in } t \text{ (across)} = 8 - 0 = 8$$

$$\text{Gradient} = \frac{-80}{8}$$

$$= -10$$

Answer: -10

Tip: The line goes down from left to right, so the gradient is negative. Do not lose the minus sign.

Marks: 1 mark for change in $C \div$ change in t . 1 mark for -10 .

- (b) Interpret what the gradient of the graph represents.

The gradient is percentage charge $\div$ hours.

–10 means the charge goes down by 10% for every hour.

So the gradient is the rate at which the battery loses its charge.

Answer: The charge of the battery goes down by 10% every hour

Tip: Give the gradient as a rate with units (per cent per hour). Saying “the battery goes down” does not get the mark.

5 (5 marks)

A car is tested on a straight track.

Here is a sketch of its speed-time graph.

For the first 20 seconds, the car has a constant acceleration of 1.5 m/s^2

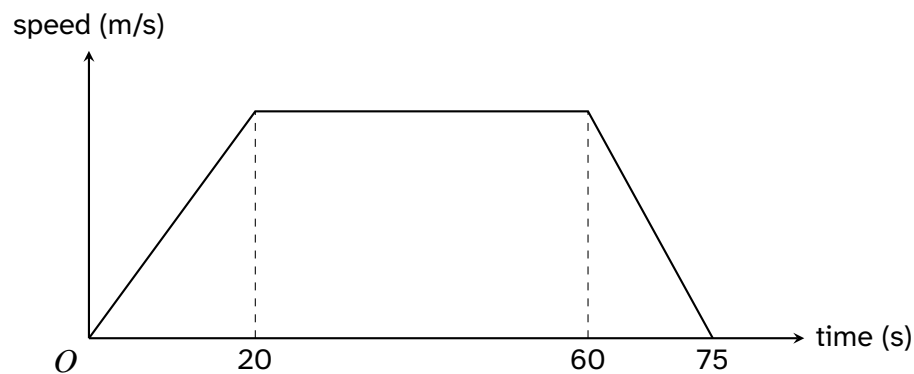


Diagram **NOT** accurately drawn

- (a) Work out the total distance the car travelled.

First find the top speed, V .

Acceleration = gradient, so $V \div 20 = 1.5$

$$V = 1.5 \times 20 = 30 \text{ m/s}$$

The distance is the area under the speed-time graph.

$$\text{First 20 seconds (triangle): } \frac{1}{2} \times 20 \times 30 = 300 \text{ m}$$

$$\text{From 20 to 60 seconds (rectangle): } 40 \times 30 = 1200 \text{ m}$$

$$\text{Last 15 seconds (triangle): } \frac{1}{2} \times 15 \times 30 = 225 \text{ m}$$

$$\text{Total} = 300 + 1200 + 225 = 1725 \text{ m}$$

Answer: 1725 m

Tip: The top speed is not given on the graph. Use the acceleration to find it first.

Marks: 1 mark for $V = 30$. 1 mark for a full method for the area. 1 mark for 1725.

- (b) Work out the deceleration of the car in the last 15 seconds.

In the last 15 seconds the speed falls from 30 m/s to 0.

$$\text{Deceleration} = 30 \div 15$$

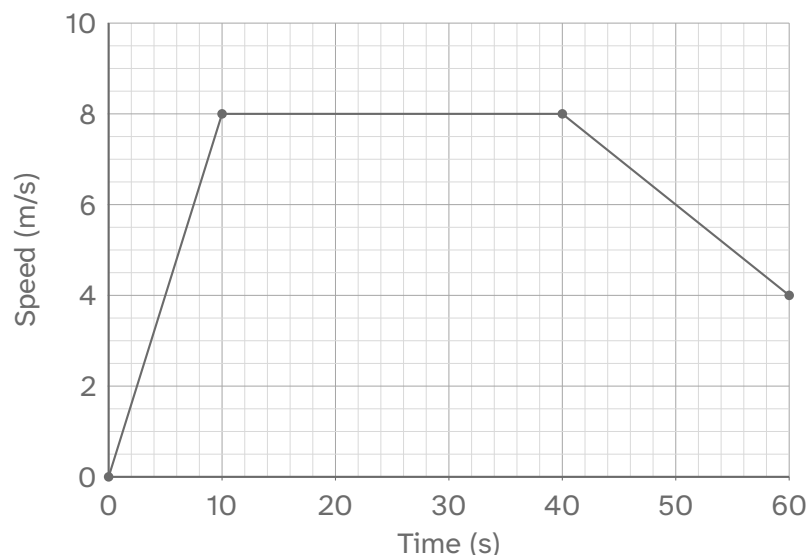
$$= 2$$

Answer: 2

Marks: 1 mark for your top speed $\div 15$. 1 mark for the answer (follow-through from your top speed).

6 (5 marks)

Here is a speed-time graph for the first 60 seconds of a cyclist's ride.



- (a) Work out the time the cyclist takes to travel the first 200 metres.

The distance is the area under the speed-time graph.

First 10 seconds (triangle): $\frac{1}{2} \times 10 \times 8 = 40$ m

After 10 seconds she still needs $200 - 40 = 160$ m.

She is now going at a steady 8 m/s.

Time for 160 m = $160 \div 8 = 20$ seconds

Total time = $10 + 20 = 30$ seconds

Answer: 30 seconds

Tip: Do not work out $200 \div 8 = 25$. For the first 10 seconds she is slower than 8 m/s, so find the area of the triangle first.

Marks: 1 mark for 40. 1 mark for $(200 - 40) \div 8$. 1 mark for 30.

- (b) Is the average speed of the cyclist for the 60 seconds more than 7 m/s?
You must show all your working.

Total distance = area under the whole graph.

First 10 seconds: 40 m

From 10 to 40 seconds: $30 \times 8 = 240$ m

Last 20 seconds (trapezium): $\frac{1}{2}(8 + 4) \times 20 = 120$ m

Total = $40 + 240 + 120 = 400$ m

Average speed = $400 \div 60 = 6.67$ m/s (to 2 d.p.)

$6.67 < 7$, so the average speed is **not** more than 7 m/s.

Answer: No. The average speed is $400 \div 60 = 6.67$ m/s, which is less than 7 m/s.

Tip: The last part is a trapezium, not a triangle, because the speed only falls to 4 m/s.

Marks: 1 mark for the total distance, 400 m. 1 mark for 6.67 and the conclusion "No".