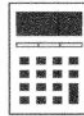


# GCSE MATHEMATICS

## Speed/Time Graphs



**AQA** These questions have been taken or modified from previous AQA GCSE Mathematics Papers.

### Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Answer all questions.
- You must answer the questions in the spaces provided.
- If your calculator does not have a  $\pi$  button, take the value of  $\pi$  to be 3.14 unless another value is given in the question.

### Information

- The marks for questions are shown in brackets.
- The quality of your written communication is specifically assessed in questions that are indicated with an asterisk (\*).

### Advice

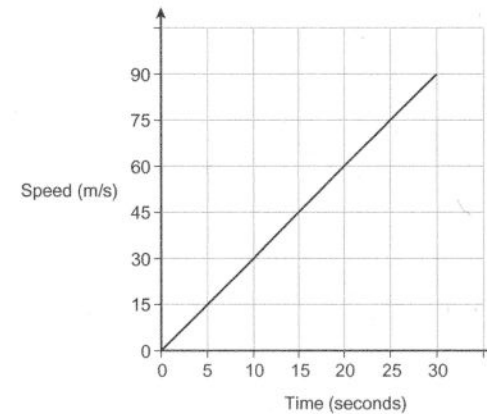
- Read each question carefully before you start to answer it.
- In all calculations, show clearly how you work out your answer.
- Use the number of marks for the question as a guide to the amount of time you need to spend.
- Look at previous parts of the question, e.g. a), b), c) i) as there may be information there you need to answer later parts.
- Check your answer is realistic and appropriate.
- For calculator decimal numbers always write your full calculator display in the working out area and then, if you need to, round the answer on the answer line.

This booklet was curated and modified using AQA examination papers between 2010-2016, for thecalculatorguide.com, where you can find many more booklets on further topics. All questions used are reproduced for educational purposes only.



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- 1 A plane accelerates along a runway for 30 seconds. The graph shows the speed-time graph for the plane.



- 1 (a) The plane takes off after 30 seconds. What is the speed of the plane when it takes off?

Answer ..... 90 ..... m/s (1 mark)

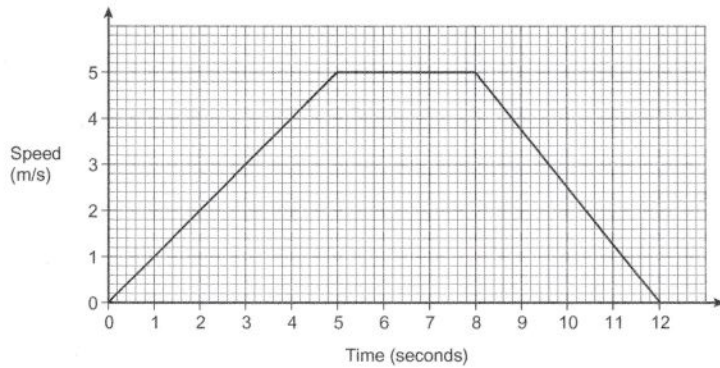
- 1 (b) Work out the distance the plane travels on the runway. Give your answer in kilometres.

$\frac{1}{2} \times 30 \times 90 = 1350$   
 $1350 \div 1000$   
 Answer ..... 1.35 ..... km (3 marks)

- 1 (c) Work out the acceleration of the plane. State the units of your answer.

$\frac{90}{30} = 3 \text{ m/s}^2$   
 Answer .....  $3 \text{ m/s}^2$  ..... (3 marks)

- 2 Meera runs for 12 seconds.  
Her speed, in metres per second, is shown on the graph.



- 2 (a) For how many seconds does she run at a constant speed?

Answer ..... 3 ..... seconds (1 mark)

- 2 (b) Work out the total distance she runs.

$\frac{1}{2}(3+12) \times 5$   
.....  
.....  
.....  
Answer ..... 37.5 ..... metres (3 marks)

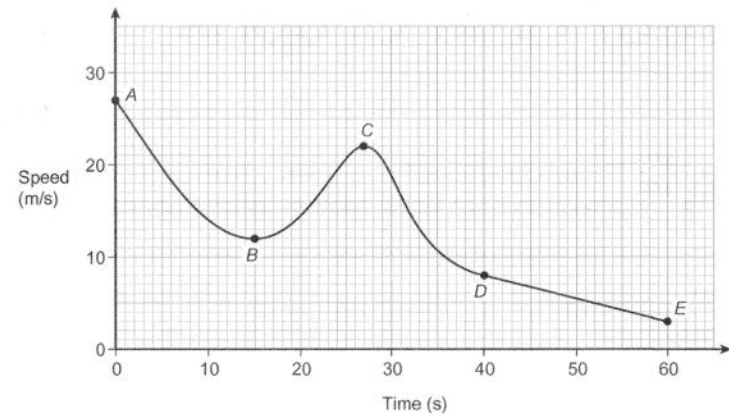
- 2 (c) Work out the gradient of the graph during the first 5 seconds.

Answer ..... 1 .....  $\text{m/s}^2$  (1 mark)

- 2 (d) What does the gradient in part (c) represent?  
Circle your answer.

time      speed      distance      acceleration (1 mark)

- 3 (a) The diagram shows the speed-time graph of a car for 60 seconds.



Which **two** points on the graph show when the car has an acceleration of zero?

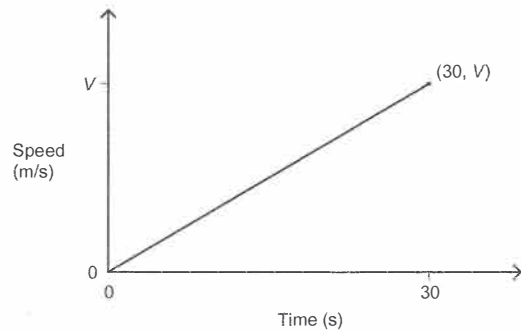
Circle your answers below.

[1 mark]

A      B      C      D      E

3 (b) This diagram shows the speed-time graph of a lorry for 30 seconds.

After 30 seconds the speed of the lorry is  $V$  m/s



The lorry travels a distance of 270 metres in these 30 seconds.

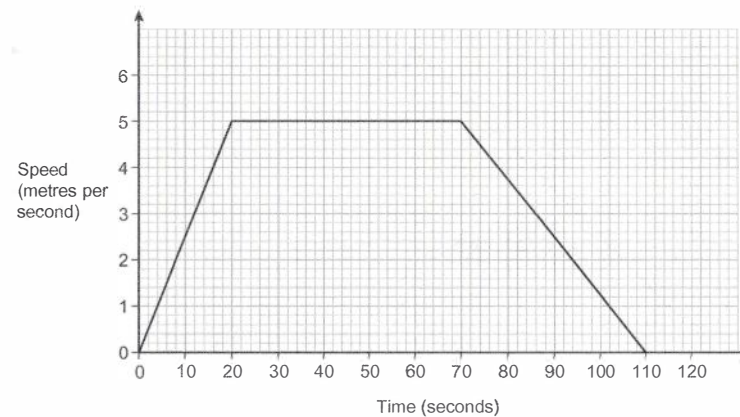
Work out  $V$ .

[2 marks]

Area under graph = 270m  
 $\frac{1}{2} \times 30 \times V = 270$   
 $15V = 270 \quad V = \frac{270}{15}$   
18  
Answer ..... 18 ..... m/s

4 The distance around a cycle track is 400 metres.

Robin cycles on the track.  
Here is his speed-time graph.



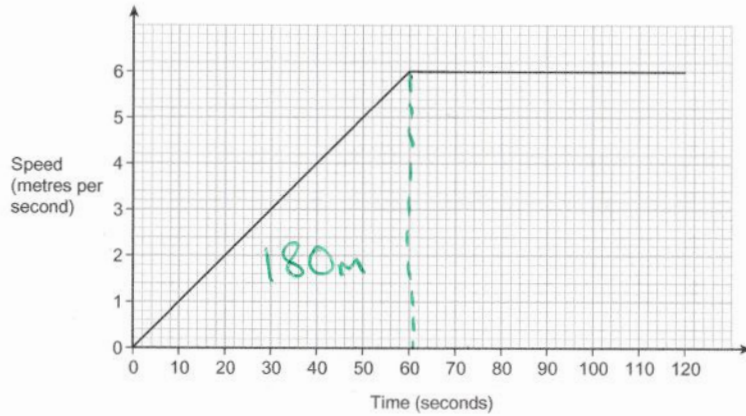
4 (a) Show that Robin cycles **exactly** once around the track in 110 seconds.

[2 marks]

Look for area of a trapezium  
 $\frac{1}{2}(110+50) \times 5$   
 $\frac{1}{2}(160) \times 5$   
 $80 \times 5 = 400m$

4 (b) Sanjay cycles on the same track.

Here is his speed-time graph.



Does Sanjay cycle the first 400 metres in a quicker time than Robin?  
You **must** show your working.

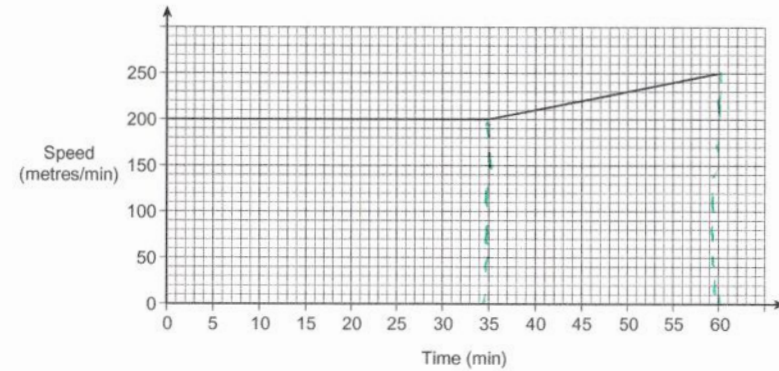
[3 marks]

$$\begin{aligned} \text{Robin} &= 110 \text{ seconds} \\ \frac{1}{2} \times 60 \times 6 &= 180 \\ 400 - 180 &= 220 \text{ m left} \\ t &= \text{time} \\ 6t &= 220 \\ t &= 36.7 \text{ s} \\ 60 + 36.7 &= 96.7 \text{ seconds} \\ \text{Sanjay is quicker than Robin} \end{aligned}$$

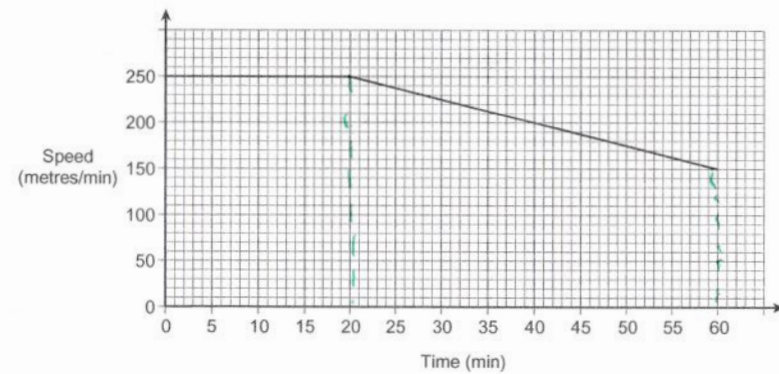
5

Chloe is training for a marathon.  
These speed-time graphs model her training runs on Monday and Wednesday.

Monday



Wednesday



On which day did Chloe run further?  
You **must** show your working.

[4 marks]

Area for Monday

$$35 \times 200 = 7000$$

$$\frac{1}{2} \times (200 + 250) \times 25 = 5625 \text{ m}$$

$$7000 + 5625 = 12,625 \text{ m}$$

Area for Wednesday

$$20 \times 250 = 5000$$

$$\frac{1}{2} \times (250 + 150) \times 40 = 8000$$

$$5000 + 8000 = 13,000 \text{ m}$$

13,000 vs 12,625

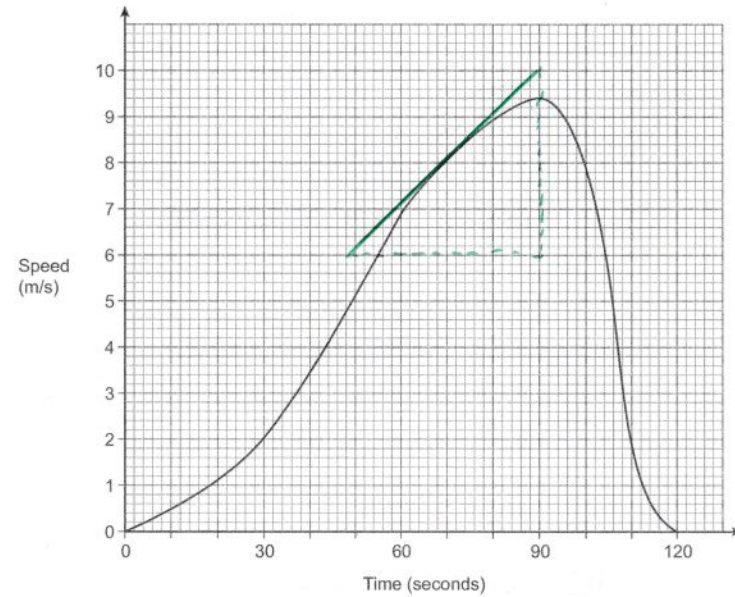
She ran further on Wednesday

Answer

Wednesday

6

The graph shows the speed of a snowboarder for 2 minutes.



- 6 (a) Estimate the distance travelled by the snowboarder.  
State the units of your answer.

Area is approximately triangular

Base = 120

Height = 9.4

$\frac{1}{2} \times 120 \times 9.4 = 564$

Range is 545 - 565

Answer ..... (4 marks)

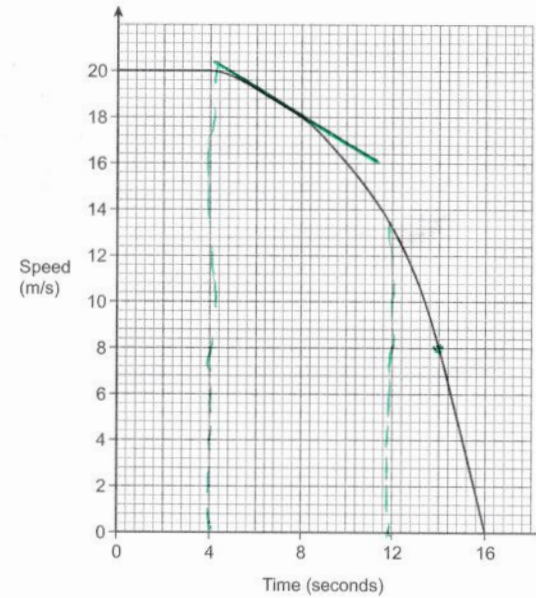
- 6 (b) Work out the gradient of the graph at 70 seconds.

$\frac{10-6}{90-48} = \frac{4}{42} = \frac{2}{21}$  or 0.095

Range between 0.06 and 0.14

Answer ..... m/s<sup>2</sup> (3 marks)

- 7 The graph shows the speed of a train for 16 seconds.



- 7 (a) For how many seconds is the train travelling at a speed of less than 8 m/s?

Answer ..... 2 ..... seconds (1 mark)

7 (b) Work out an estimate of the average speed of the train during the 16 seconds.

Work out the distance (Area under the graph). This will be an estimate.

$$20 \times 4 = 80$$

$$\frac{1}{2} \times (20 + 13) \times 8 = 132$$

$$\frac{1}{2} \times 4 \times 13 = 26$$

$$80 + 132 + 26 = 238$$

$$238$$

$$\text{Time} \rightarrow 16 = 14.875 \quad \text{Range } 14.75 \text{ to } 15.625$$

Answer ..... m/s (6 marks)

7 (c) (i) Work out an estimate for the gradient of the graph after 8 seconds.

$$\frac{16 - 20.4}{11 - 4} = -0.733$$

$$11 - 4$$

Must be between -0.5 and -1

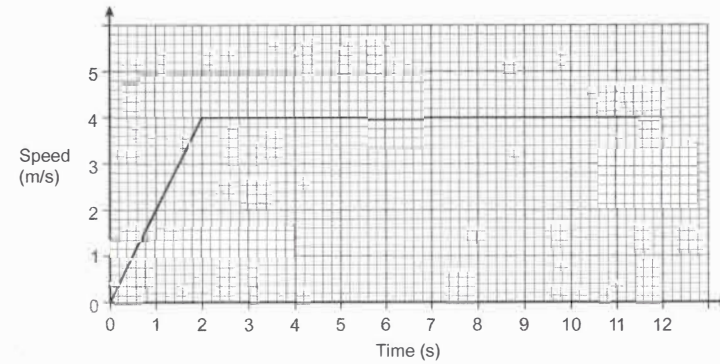
Answer ..... (3 marks)

7 (c) (ii) What does this gradient represent?

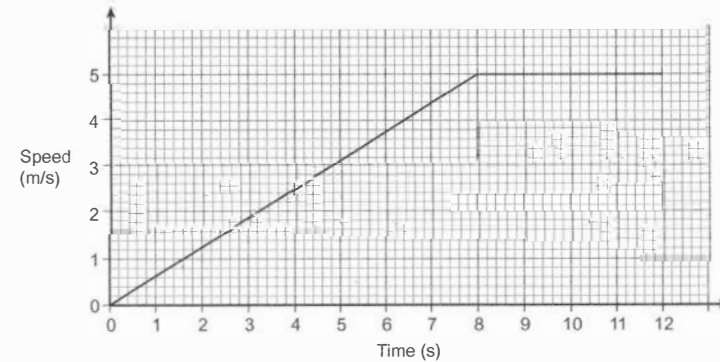
Answer acceleration (or deceleration) (1 mark)

8 Amy and Sue run a race. The race is won in exactly 12 seconds.

The graph shows Amy's speed in metres per second.



This graph shows Sue's speed in metres per second.



Who won the race?

You **must** show your working and give reasons for your answer.

Work out the distance.

$$\text{Amy} = \frac{1}{2} \times (10 + 12) \times 4 = 44$$

$$\text{Sue} = \frac{1}{2} \times (4 + 12) \times 5 = 40$$

Amy wins as she travels the greatest distance.

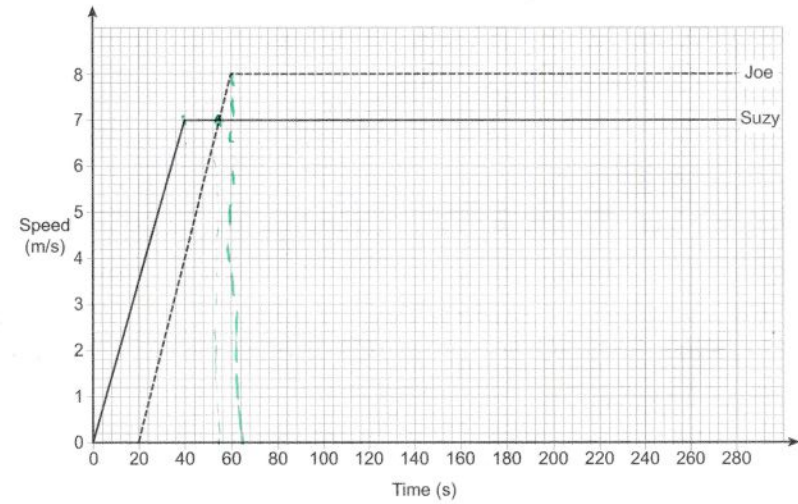
Answer ..... Amy ..... (5 marks)

9

Suzy and Joe cycle round a track.  
One lap of the track measures 400 metres.

They both start from the same place.  
Joe starts 20 seconds after Suzy starts.

Here are the speed-time graphs for their journeys.





9 (a) Show that Joe overtakes Suzy when they are on their third lap of the track. [4 marks]

If it is on the third lap, the distance will be between 800 and 1200.

Area for Suzy

$$\text{Triangle} = \frac{1}{2} \times 40 \times 7 = 140$$

$$\text{Rectangle} = 7(t-40) + 140$$

Area for Joe

$$\text{Triangle} = \frac{1}{2} \times 40 \times 8 = 160$$

$$\text{Rectangle} = 8(t-60) + 160$$

$$8(t-60) + 160 = 7(t-40) + 140$$

$$8t - 480 + 160 = 7t - 280 + 140$$

$$8t - 320 = 7t - 140$$

$$t = 180$$

Use either area for Suzy or Joe

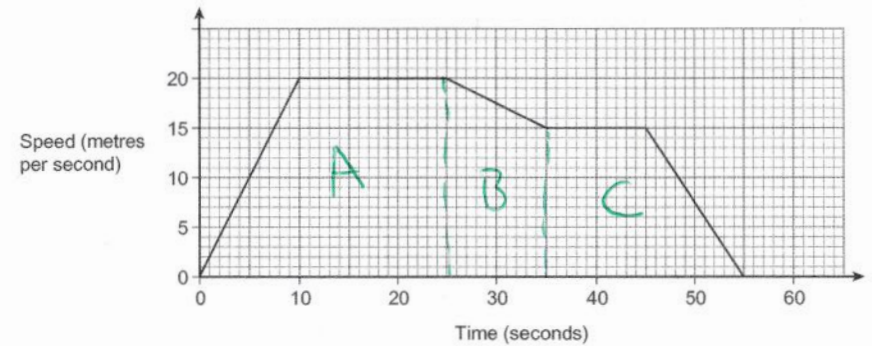
$$\frac{1}{2} \times 40 \times 7 + 7(180-40) = \underline{1120}$$

9 (b) Work out Suzy's acceleration during the first 40 seconds. State the units of your answer. [2 marks]

$$\frac{7-0}{40-0} = \frac{7}{40} \text{ or } 0.175$$

Answer 0.175 m/s<sup>2</sup>

10 This speed-time graph shows the journey of a bus as it travels between two bus stops.



After how many seconds does the bus pass the halfway point between the bus stops?

Total area

$$A = \frac{1}{2} \times (25+15) \times 20 = 400$$

$$B = \frac{1}{2} \times (20+15) \times 10 = 175$$

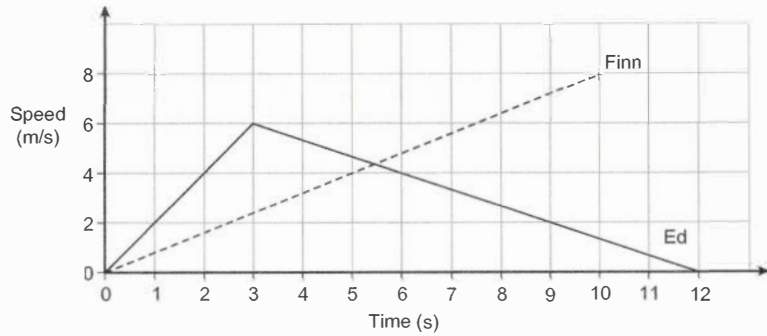
$$C = \frac{1}{2} \times (20+10) \times 15 = 225 = 800 \text{ m}$$

$$\frac{1}{2} \text{ of } 800 = 400 \text{ m}$$

Bus is at 400 m at 25 seconds

Answer 25 seconds (5 marks)

- 11 Ed and Finn both run along the same track.  
Ed runs for 12 seconds.  
Finn runs for 10 seconds.  
The graphs show their runs.



- \*11 (a) Who runs the further distance? You **must** show your working. [3 marks]

Ed =  $\frac{1}{2} \times 6 \times 12 = 36\text{m}$   
 Finn =  $\frac{1}{2} \times 8 \times 10 = 40\text{m}$   
 Finn runs the furthest

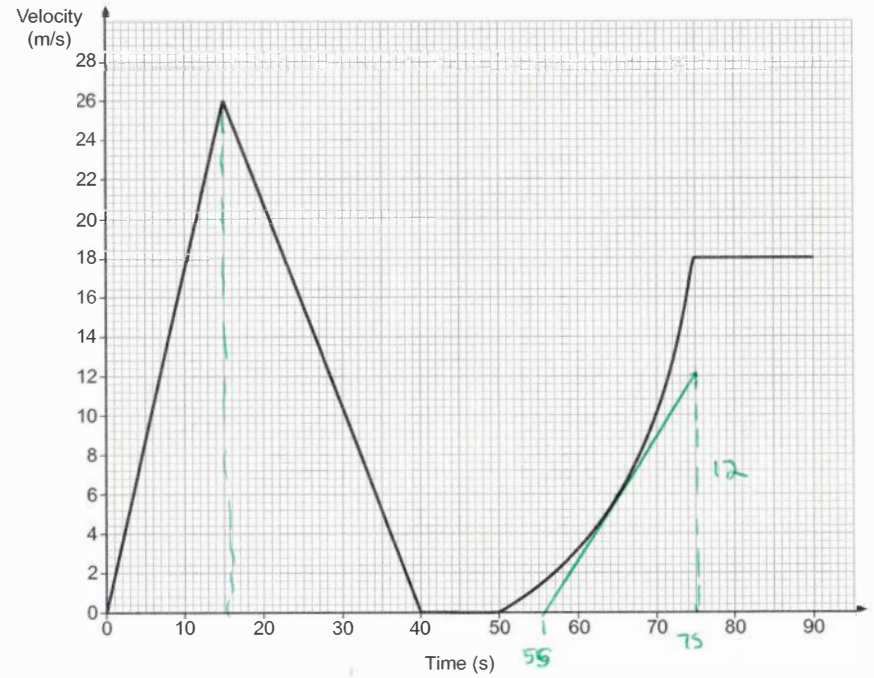
Answer ..... metres

- 11 (b) Work out Finn's acceleration. State the units of your answer. [3 marks]

$\frac{8}{10} = 0.8 \text{ m/s}^2$

Answer  $0.8 \text{ m/s}^2$

- 12 The graph shows the velocity-time graph for the first 90 seconds of a car journey.



12 (a) Here is a statement about the first 40 seconds of the car journey.

When decelerating, the car travelled over 100 metres further than when accelerating.

Is the statement correct?  
You must show your working.

[3 marks]

Accelerating for 15 seconds  
 $\frac{1}{2} \times 26 \times 15 = 195\text{m}$   
 Decelerating for 25 seconds  
 $\frac{1}{2} \times 26 \times 25 = 325\text{m}$   
 $325 - 195 = 130\text{m}$   
 The statement is correct.

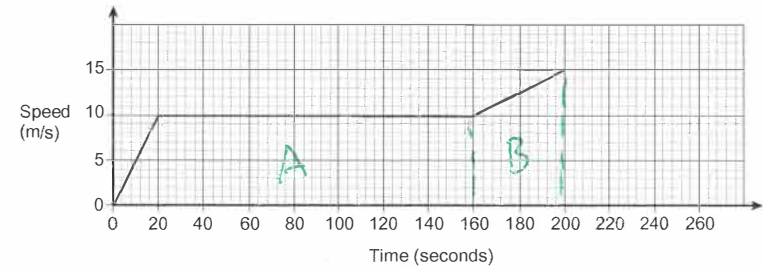
12 (b) Estimate the acceleration of the car at 65 seconds.  
You must show your working.

[3 marks]

$\frac{12}{20} = \frac{6}{10} = 0.6 \text{ ms}^{-2}$   
 Approximately

Answer ..... 0.6 .....  $\text{m/s}^2$

13 Terri wins a cycle race in 200 seconds.  
This is her speed-time graph.



Jane is in the same race.

She starts by accelerating at a constant rate.  
She then cycles at constant speed to the finish.

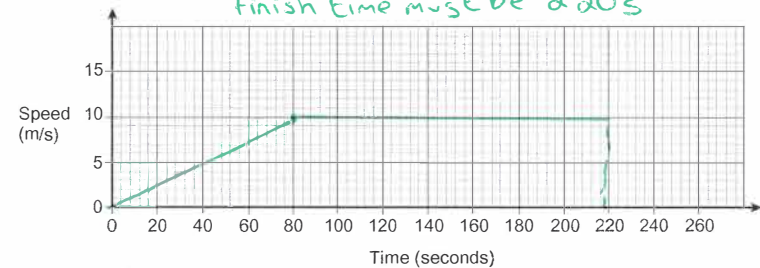
She finishes 20 seconds after Terri.

On the grid below, complete a possible speed-time graph for Jane.  
You must show your working.

[6 marks]

Total distance of race  
 $A = \frac{1}{2} \times (160 + 140) \times 10$      $B = \frac{1}{2} \times (10 + 15) \times 40$   
 $1500 + 300 = 1800\text{m}$

Example Area must be 1800  
 Finish time must be 220s



$\frac{1}{2} \times (220 + 220 - t) \times 10 = 1800$   
 $\frac{1}{2} \times (440 - t) \times 10 = 1800$   
 $5(440 - t) = 1800$   
 $440 - t = 360$   
 $t = 80$