

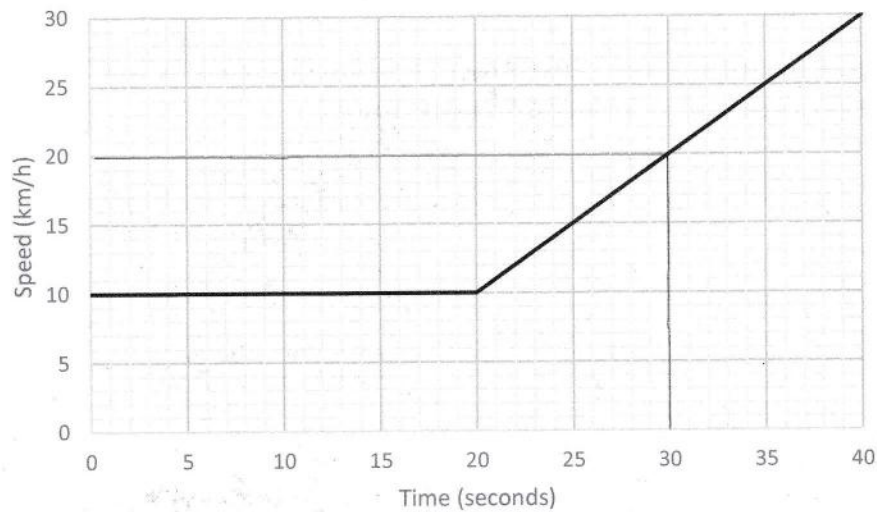
VELOCITY-TIME GRAPHS – PRACTICE QUESTIONS



metatutor

1.

The velocity-time graph below shows the journey of a car.



(a) Use the graph to estimate the speed of the car after 30 seconds.

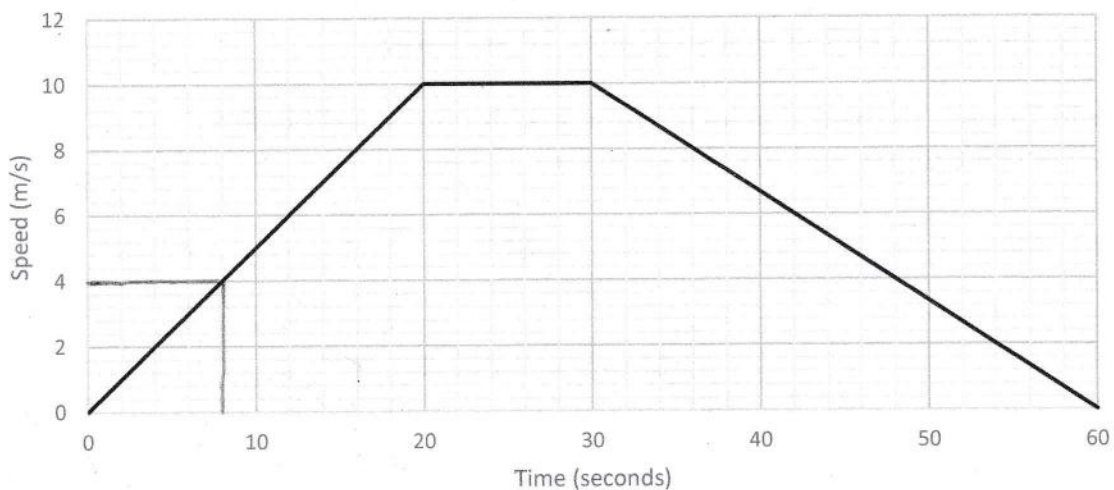
$$20 \text{ km/h}$$

(b) Use the graph to find the acceleration of the car between 20 and 40 seconds.

$$\frac{30-10}{40-20} = \frac{20}{20} = 1 \text{ km/h}^2$$

2.

The velocity-time graph below shows the run of a sprinter.



(a) Use the graph to find the sprinter's acceleration between 0 and 20 seconds.

$$10 \div 20 = 0.5 \text{ m/s}^2$$

(b) Use the graph to estimate the sprinter's speed after 8 seconds.

$$4 \text{ m/s}$$

(c) During which period was the sprinter's speed constant?

$$20 - 30 \text{ seconds}$$

3.

A train travelled from Bristol to Bath.

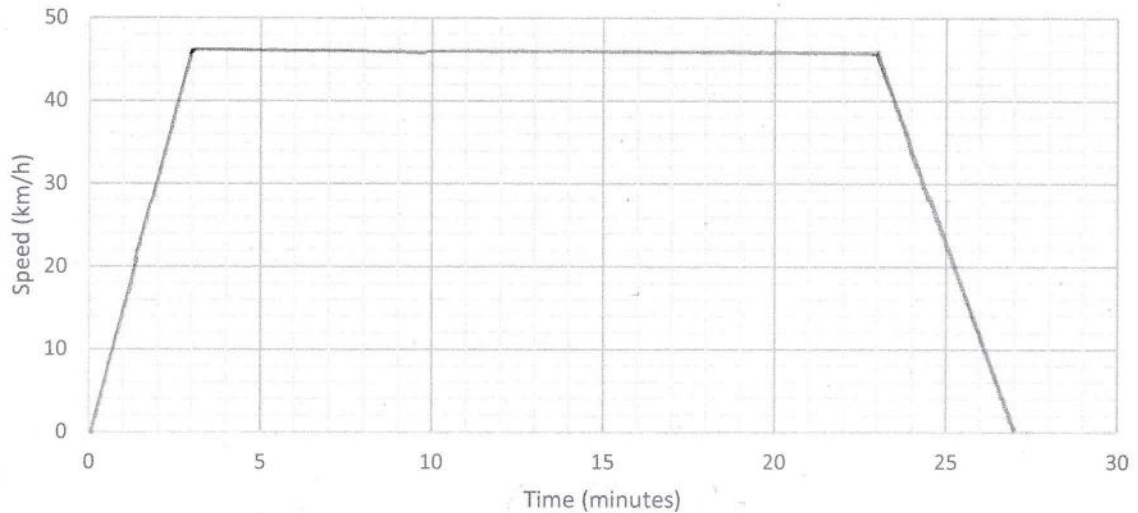
The train started from rest, and accelerated for 3 minutes to a speed of 46 km/h.

The train then stayed at 46 km/h for 20 minutes.

The train then decelerated for 4 minutes and came to a stop.

Use the information to draw a velocity-time graph on the axis below.

Assume all accelerations and decelerations are linear.



4.

Alice went for a bike ride.

She started from rest and accelerated for 8 seconds to a speed of 11 metres per second.

She then stayed at 11 metres per second for a further 16 seconds.

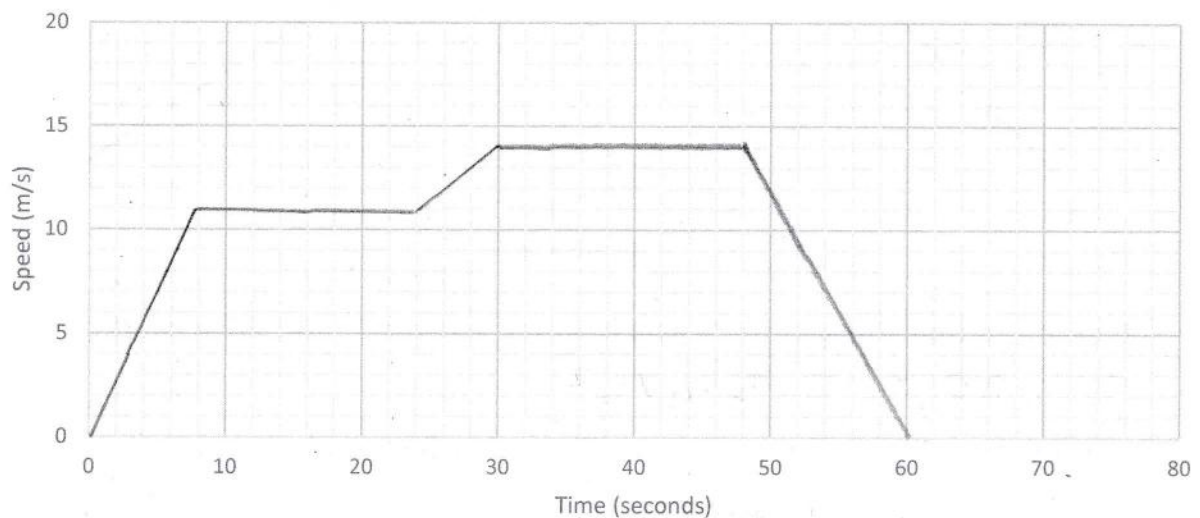
She then accelerated again for 6 seconds to a speed of 14 metres per second.

She then stayed at 14 metres per second for a further 18 seconds.

She then decelerated, coming to a stop after 12 seconds.

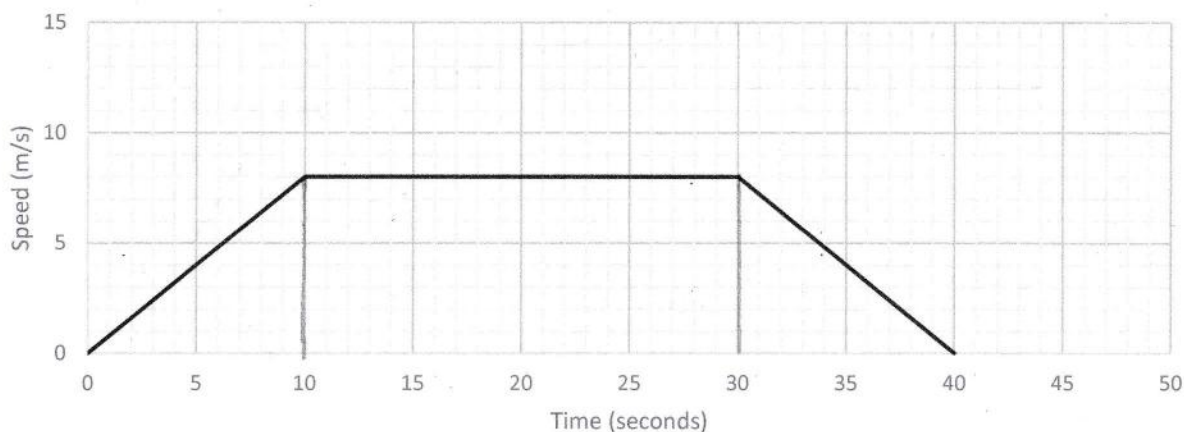
Use the information to draw a velocity-time graph on the axis below.

Assume all accelerations and decelerations are linear.



5.

The velocity-time graph below shows the run of a sprinter.



(a) What was the sprinter's maximum speed?

$$8 \text{ m/s}$$

(b) Use the graph to find the sprinter's acceleration between 0 and 10 seconds.

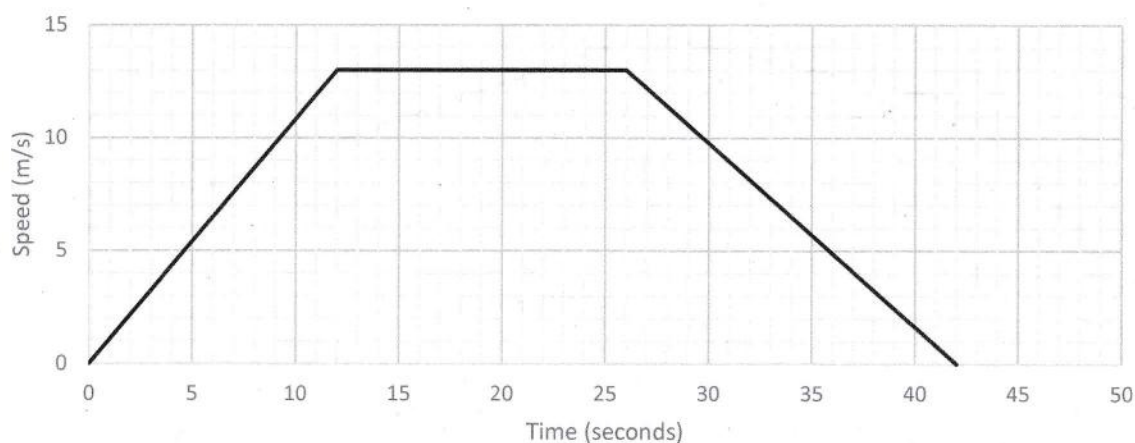
$$8 \div 10 = 0.8 \text{ m/s}^2$$

(c) How many metres did the sprinter run?

$$\frac{8 \times 10}{2} + 20 \times 8 + \frac{8 \times 10}{2} = \underline{240 \text{ metres}}$$

6.

The velocity-time graph below shows the journey of a car between two sets of traffic lights.



(a) Calculate the car's deceleration between 26 and 42 seconds.

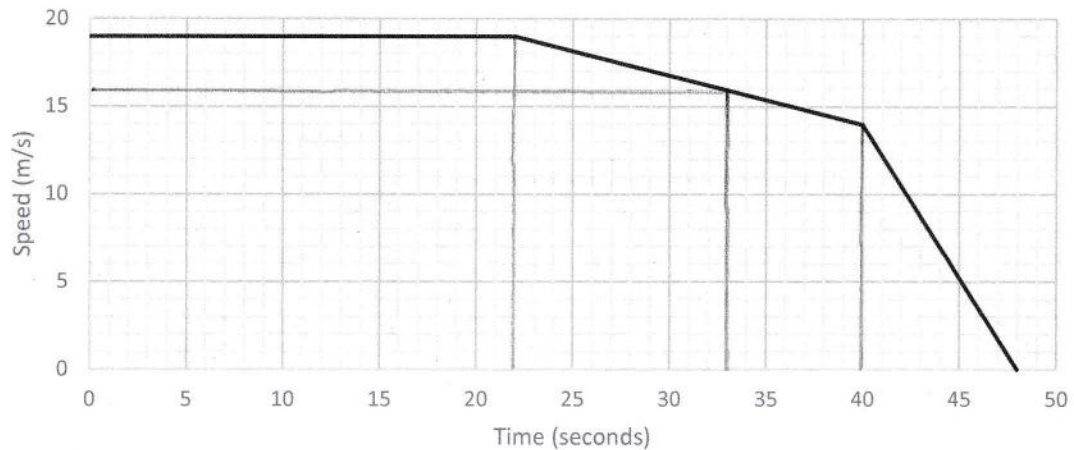
$$13 \div 16 = \frac{13}{16} \text{ m/s}^2$$

(b) How many metres did the car travel?

$$\frac{13 \times 12}{2} + 14 \times 13 + \frac{13 \times 16}{2} = \underline{364 \text{ metres}}$$

7.

The velocity-time graph shows the last 48 seconds of a motorcyclist's journey.



(a) What was the motorcyclist's speed after 33 seconds?

$$16 \text{ m/s}$$

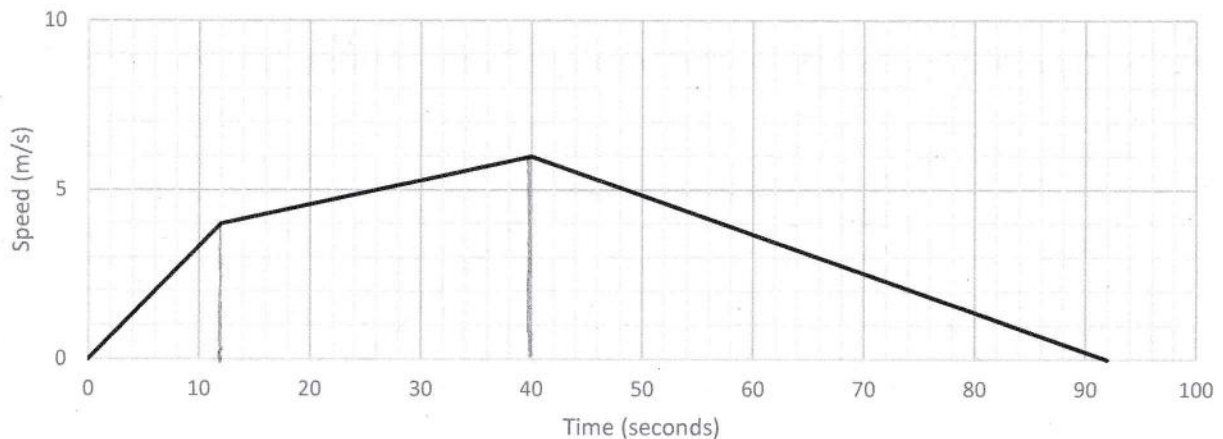
(b) How many metres did the motorcyclist travel in the final 26 seconds?

$$\frac{1}{2}(19+14) \times 18 + \frac{14 \times 8}{2} = \underline{353 \text{ metres}}$$

8.

Sam went for a swim.

The velocity-time graph below shows how his speed changed over the swim.



(a) Find Sam's acceleration between 12 and 40 seconds.

$$\frac{6-4}{40-12} = \frac{2}{28} = \frac{1}{14} \text{ m/s}^2$$

(b) How many metres did Sam swim?

$$\frac{4 \times 12}{2} + \frac{1}{2}(4+6) \times 28 + \frac{6 \times 52}{2} = \underline{320 \text{ metres}}$$

9.

Calvin cycled to his friend's house.

He accelerated at a constant rate of 1.2 metres per second per second for 5 seconds.

He then accelerated at a constant rate of 0.5 metres per second per second for 8 seconds.

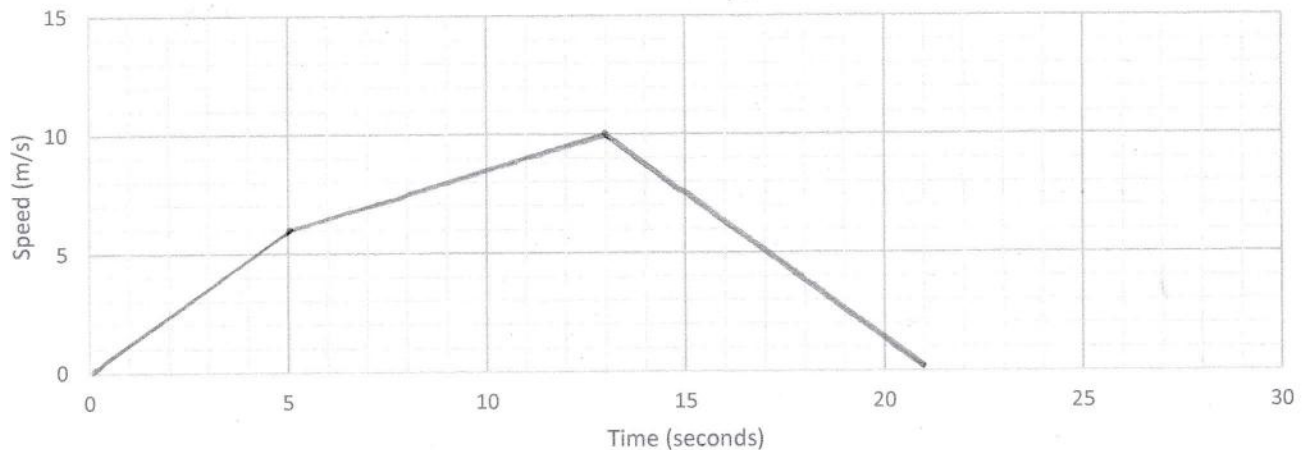
He then decelerated at a constant rate of 1.25 metres per second per second before coming to a stop.

Use the information to plot a velocity-time graph on the axis below.

$$1.2 \times 5 = 6$$

$$10 \div 1.25 = 8$$

$$0.5 \times 8 = 4$$



10.

Matt cycled to a friend's house.

He accelerated at a constant rate of 2 metres per second per second for 8 seconds.

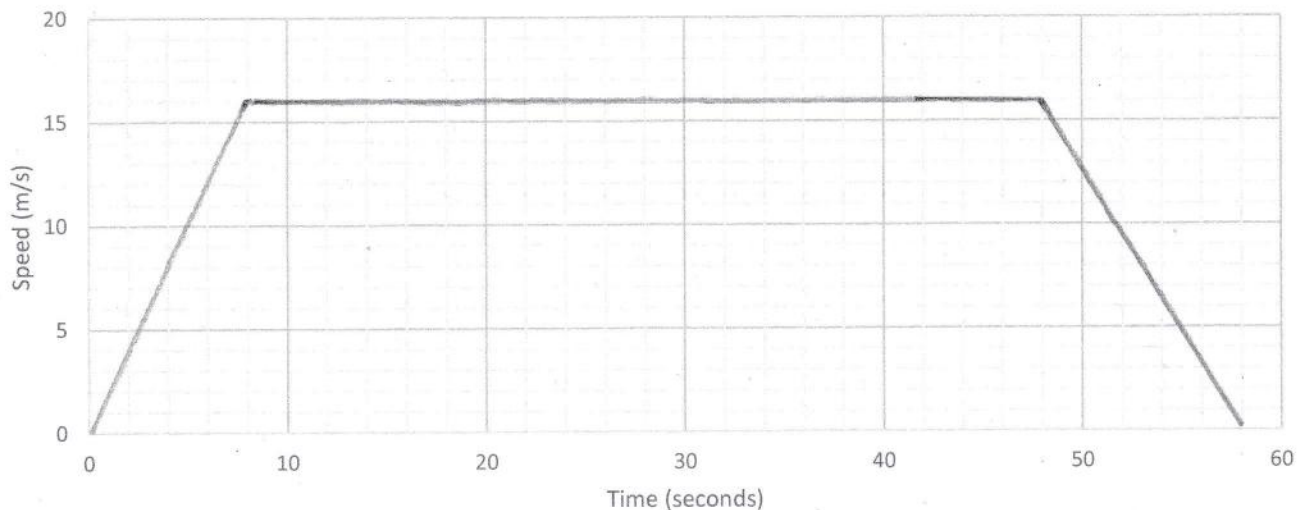
He then remained at the same speed for 40 seconds.

He then decelerated at a constant rate of 1.6 metres per second per second until coming to a stop as he arrived at his friend's house.

Use this information to draw a velocity-time graph on the axis below.

$$2 \times 8 = 16$$

$$16 \div 1.6 = 10$$



11.

Tara ran 450 metres.

She accelerated at a rate of 1.5 metres per second per second until she reached a speed of 9 metres per second.

She stayed at that speed for 36 seconds before decelerating at a constant rate until she came to a stop.

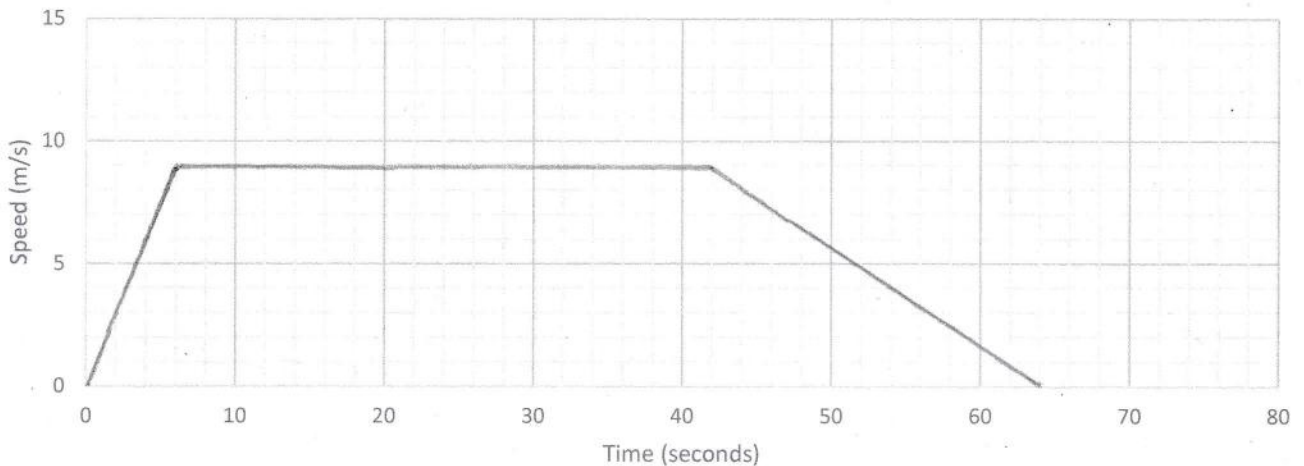
Use the information to draw a velocity-time graph on the axis below.

$$9 \div 1.5 = 6$$

$$\frac{9 \times 6}{2} + 36 \times 9 = 351 \text{ metres}$$

$$450 - 351 = 99$$

$$99 \div 9 = 11 \times 2 = 22 \text{ secs}$$



12.

The incomplete velocity-time graph below shows the journey of a car between a garage and a supermarket.

The car accelerates for the first 6 seconds, then continues at constant speed until 26 seconds. The car then decelerates at a constant rate before arriving at the supermarket. The distance between the garage and the supermarket is 275 metres.

Use this information to complete the velocity-time graph.

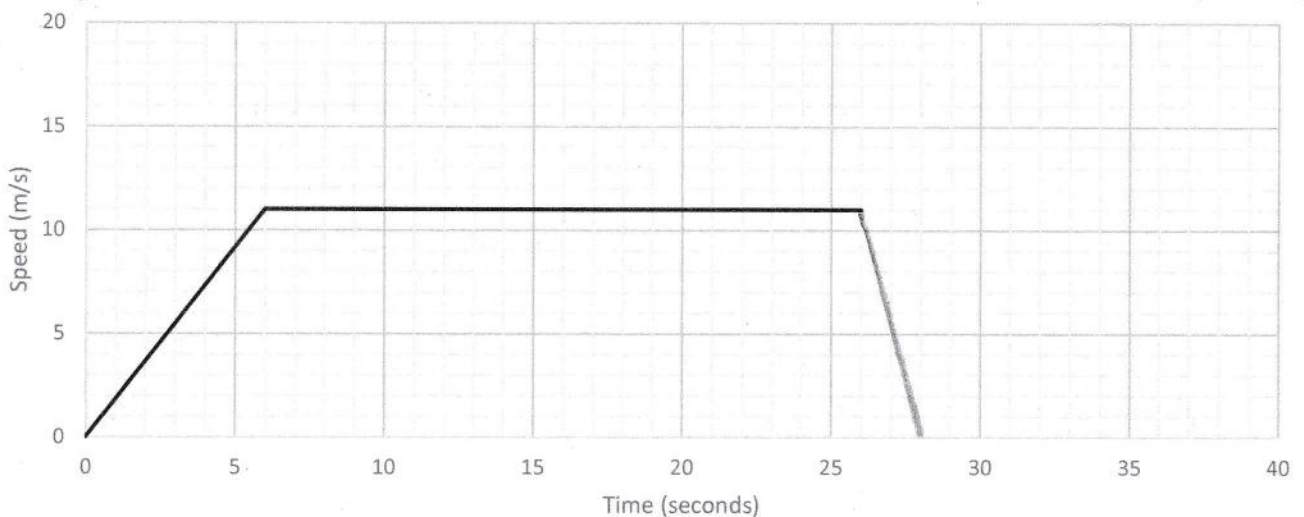
$$\frac{6 \times 11}{2} = 33$$

$$20 \times 11 = 220$$

$$220 + 33 = 253$$

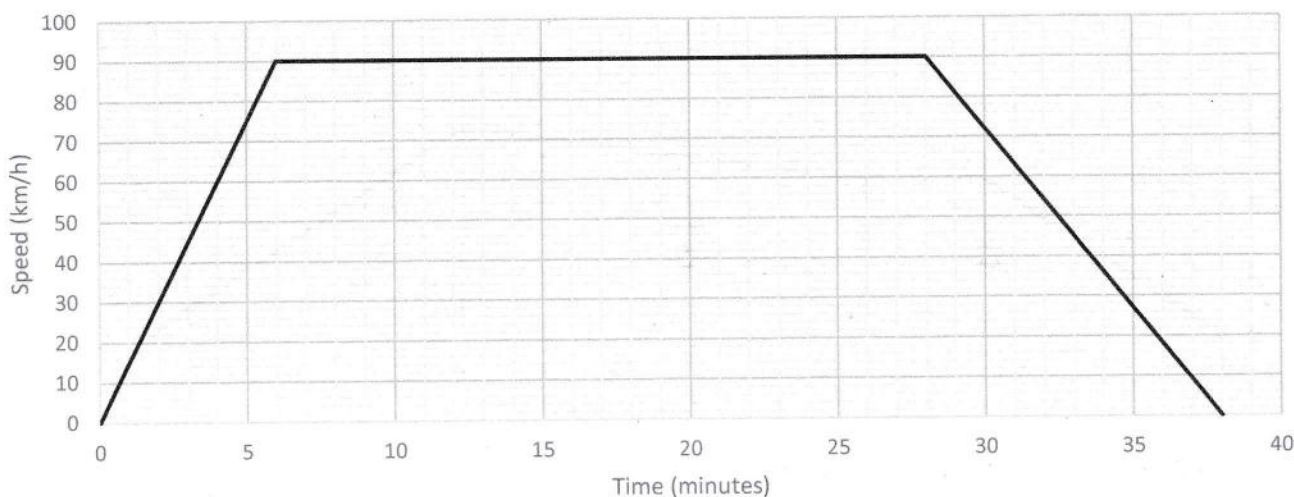
$$275 - 253 = 22$$

$$22 \div 11 = 2 \text{ sec}$$



13.

A train travelled direct from Bristol to Cardiff.
The velocity-time graph below shows its journey.

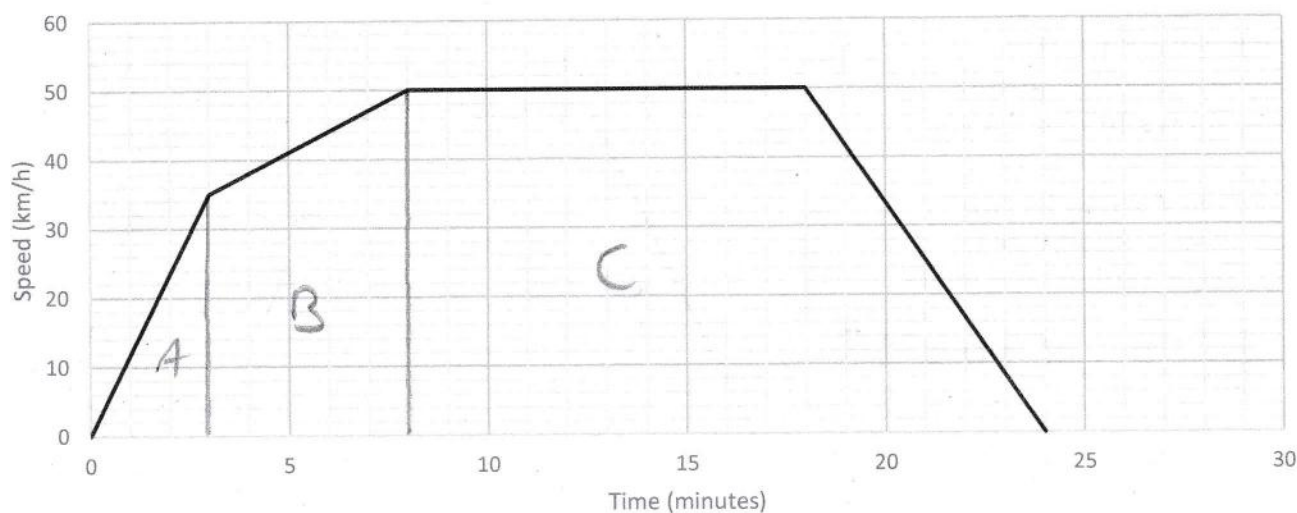


How many kilometres did the train travel?

$$\text{Area} = \frac{1}{2}(22 + 38) \times 90 = 2700 \div 60 = \underline{45 \text{ kilometres}}$$

14.

The velocity-time graph below shows the journey of a vehicle between two points.



Did the vehicle travel more than 15 kilometres?

$$A = \frac{36 \times 3}{2} = 54$$

$$B = \frac{1}{2}(36 + 50) \times 5 = 215$$

$$C = \frac{1}{2}(10 + 16) \times 50 = 650$$

$$54 + 215 + 650 = 919$$

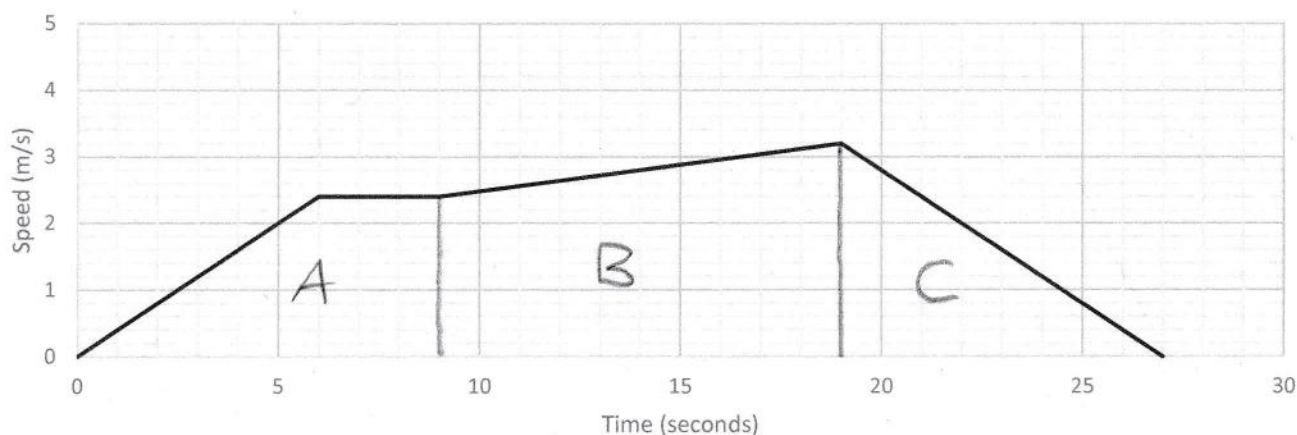
$$919 \div 60 = 15.31\bar{6} \text{ km}$$

Yes, it travelled more than 15 km.

15.

Robert rowed across a river.

The velocity-time graph shows his journey.



(a) How many metres wide is the river?

$$A = \frac{1}{2}(3+0) \times 2.4 = 14.4 \quad C = \frac{3.2 \times 8}{2} = 12.8$$

$$B = \frac{1}{2}(2.4+3.2) \times 10 = 28$$

$$14.4 + 28 + 12.8 = \underline{55.2 \text{ m}}$$

(b) Work out Robert's average speed across the journey. Give your answer in metres per second and to 1 decimal place.

$$55.2 \div 27 = \underline{2.0 \text{ m/s}}$$

16.

Carlos went for a run.

The distance-time graph below shows his journey.

(a) Carlos wanted to run more than 4 kilometres.

Did Carlos achieve his goal?

Did Carlos achieve his goal?

$$A = \frac{1}{2}(9+5) \times 4.4 = 30.8$$

$$B = \frac{1}{2}(4.4+3) \times 6 = 22.2$$

$$C = \frac{3 \times 2}{2} = 3$$

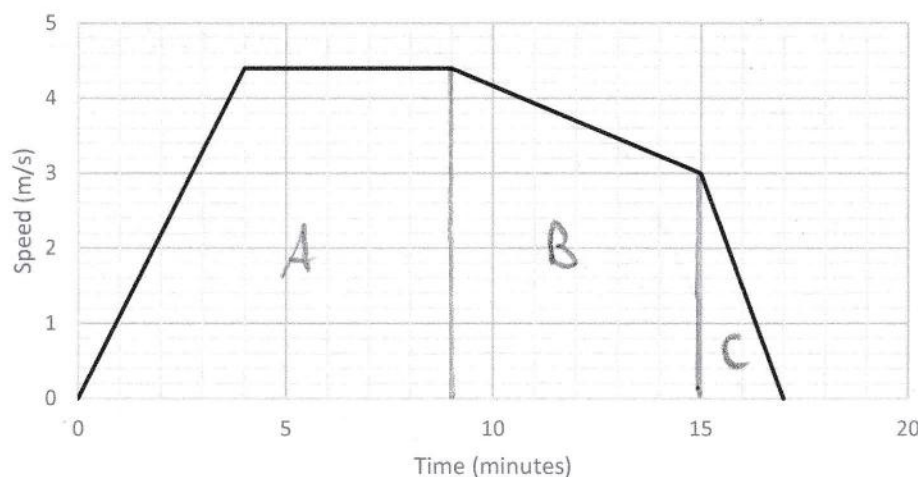
$$30.8 + 22.2 + 3 = 56 \times 60 = 3,360 \text{ m}$$

No, he did not achieve his goal.

(b) What was Carlos's average speed across the run? Give your answer in metres per second and to 1 decimal place.

$$3360 \div 17 = 197.6 \dots$$

$$197.6 \dots \div 60 = \underline{3.3 \text{ m/s}}$$



17.

Yasmin went for a run.

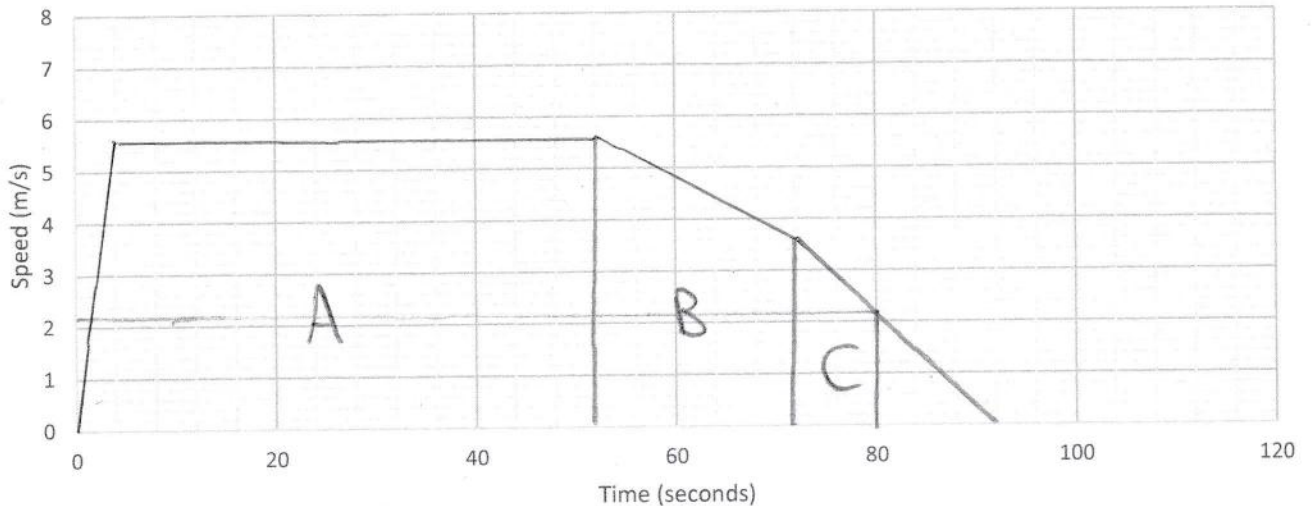
She accelerated at a constant rate of 1.4 metres per second per second until she reached a speed of 5.6 metres per second.

She then continued running at constant speed for 48 seconds.

She then decelerated at a constant rate of 0.1 metres per second per second for 20 seconds.

Finally, she decelerated at a constant rate, coming to a stop after 20 seconds.

(a) Use the information to plot a velocity-time graph on the axis below.



(b) Use your graph to find Yasmin's speed after 80 seconds.

$$2.2 \text{ m/s}$$

(c) How many metres did Yasmin run?

$$A = \frac{1}{2}(48+52) \times 5.6 = 280$$

$$B = \frac{1}{2}(3.6+5.6) \times 20 = 92$$

$$C = \frac{20 \times 3.6}{2} = 36$$

$$280 + 92 + 36 = \underline{408 \text{ m}}$$

(d) Find Yasmin's average speed across the whole run,

$$408 \div 92 = \underline{4.4 \text{ m/s}}$$

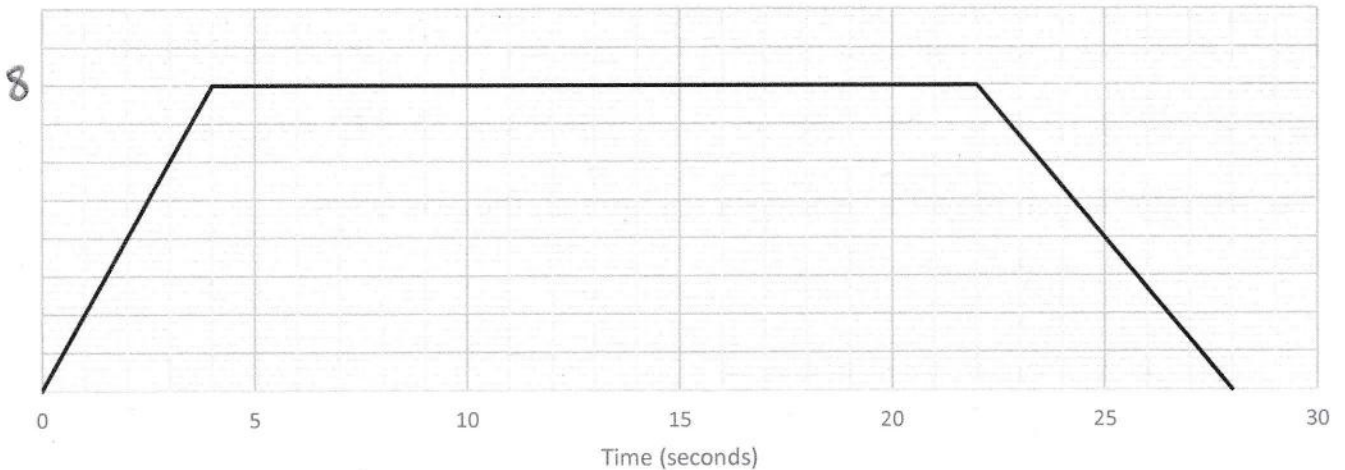
(e) Find Yasmin's rate of deceleration for the last 20 seconds of the run.

$$3.6 \div 20 = \underline{0.18 \text{ m/s}^2}$$

18.

The velocity-time graph below shows the journey of a car between two sets of traffic lights.

The distance between the sets of traffic lights is 184 metres.



(a) What was the car's maximum speed? Give your answer in metres per second.

$$184 = \frac{1}{2}(28+18) \times x \quad 184 = 23x \quad x = \underline{8 \text{ m/s}}$$

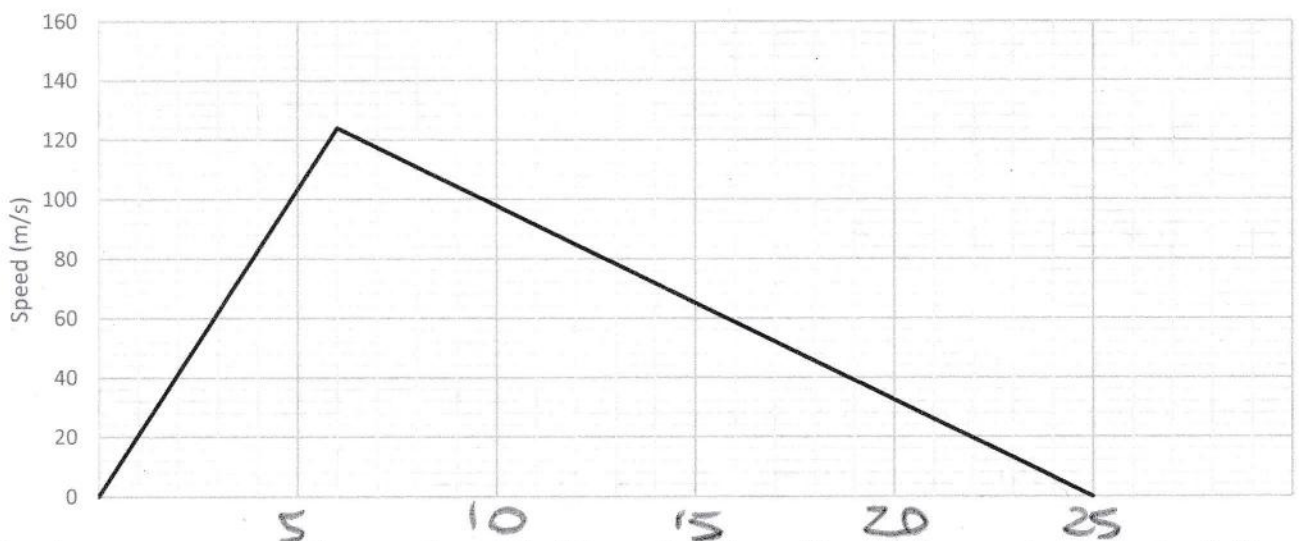
(b) Find the car's acceleration in the first 4 seconds.

$$8 \div 4 = \underline{2 \text{ m/s}^2}$$

19.

The velocity-time graph below shows a rocket launch.

The rocket launcher travelled 1,550 metres.



After how many seconds was the rocket launcher travelling at its maximum velocity?

$$1550 = \frac{124 \times x}{2}$$

$$1550 \div 62 = 25s$$

6 seconds