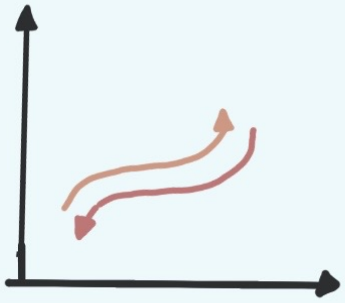
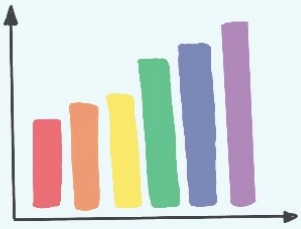
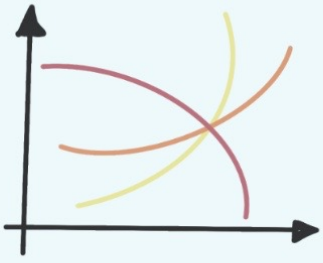
The Maths Society



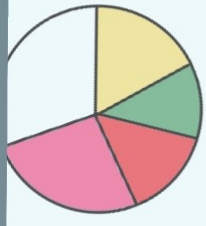
$$\text{SPEED} = \frac{\text{DISTANCE}}{\text{TIME}}$$

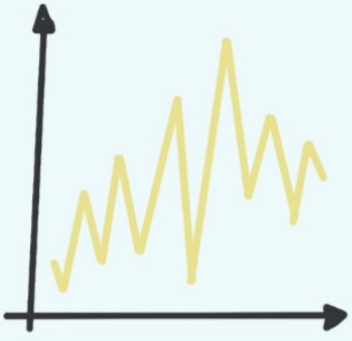




$$\text{TIME} = \frac{\text{DISTANCE}}{\text{SPEED}}$$

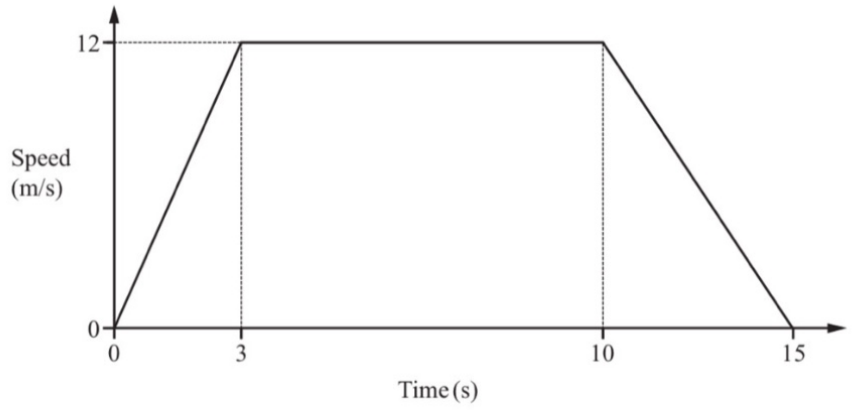
SPEED - TIME GRAPH





$$\text{DISTANCE} = \text{SPEED} \times \text{TIME}$$

Question 1



NOT TO SCALE

The diagram shows a speed-time graph.

Calculate the total distance travelled.

$A = \frac{1}{2}(a+b) \times h$

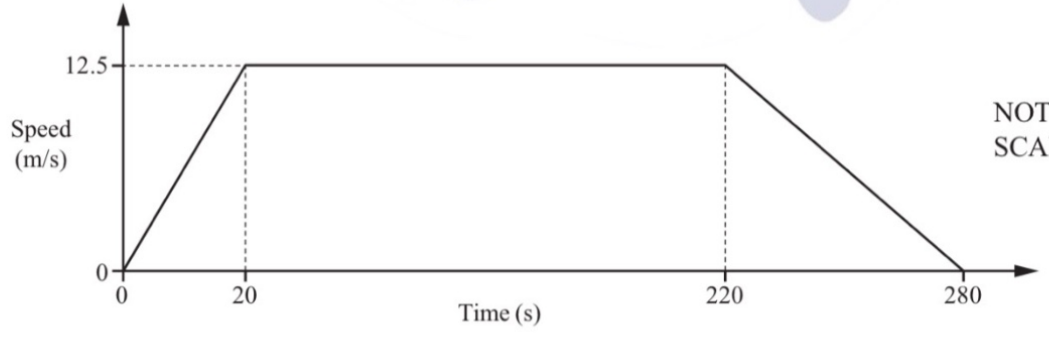
$= \frac{1}{2}(15+7) \times 12$

$= 132$ m

[3]

Question 2

The diagram shows a speed-time graph for the journey of a car.



NOT TO SCALE

Calculate the total distance travelled.

$\frac{1}{2}(a+b) \times h$

$= \frac{1}{2}(280+200) \times 12.5$

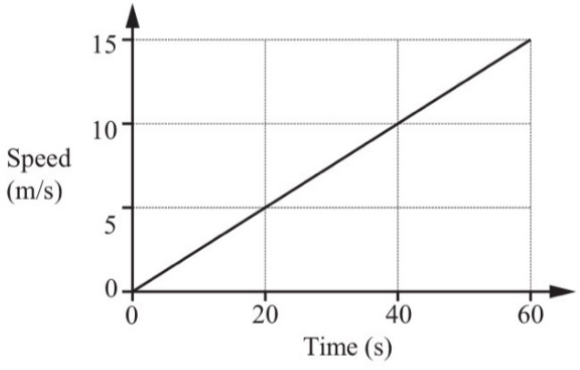
$= \frac{1}{2} \times 480 \times 12.5$

$= 3000$ m

[3]

Question 3

The speed-time graph shows the first 60 seconds of a train journey.



(a) Find the acceleration of the train. [1]

$m = \frac{15}{60} = \frac{1}{4}$

(b) Calculate the distance the train has travelled in this time. Give your answer in kilometres. [3]

$\frac{1}{2} \times b \times h = \frac{1}{2} \times 60 \times 15$

$= 450\text{m} = 0.45\text{ km}$

Question 4

Fritz drives a distance of 381 km in 2 hours and 18 minutes.
He then drives 75 km at a constant speed of 30 km/h.

Calculate his average speed for the whole journey. [4]

$s = \frac{d}{t}$

$t = \frac{d}{s} = \frac{75}{30} = 2.5$

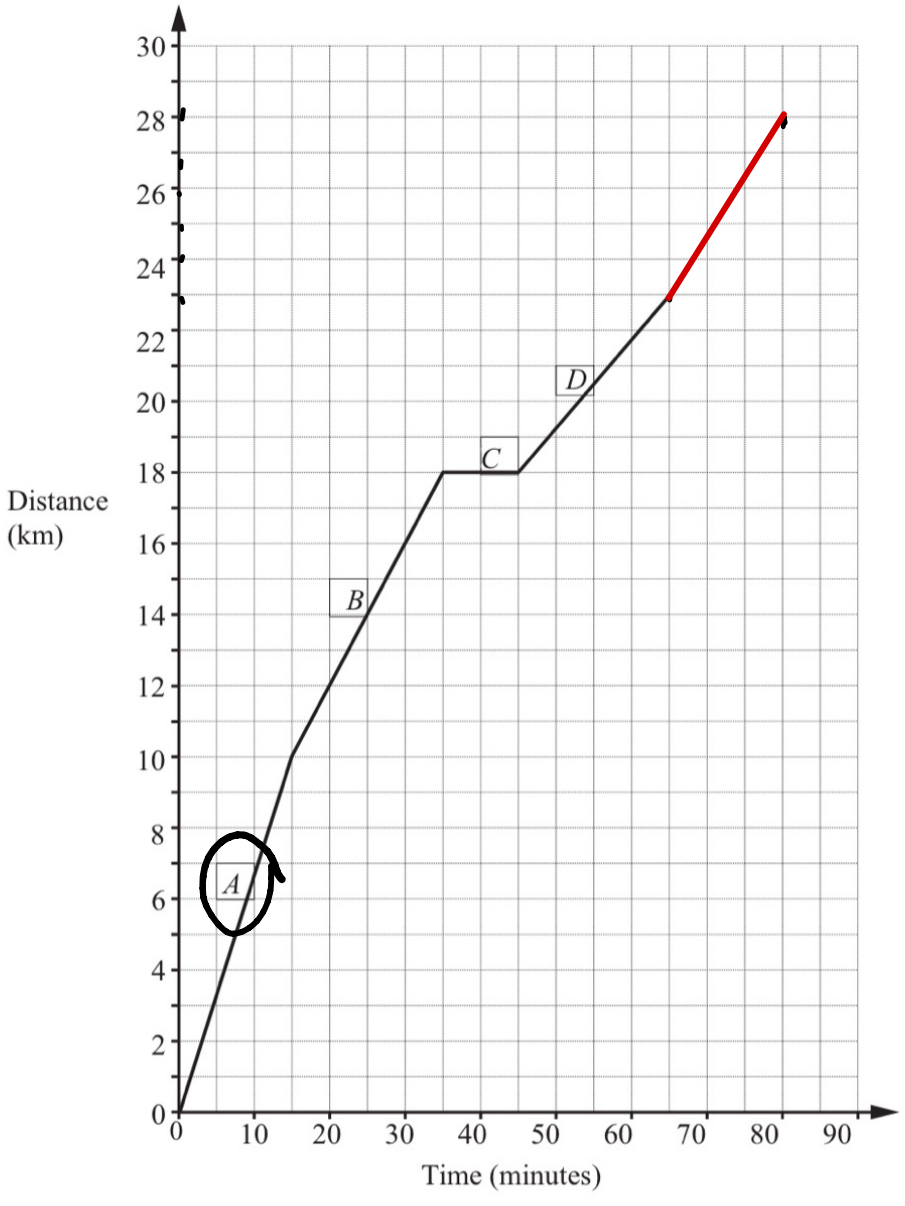
$381 + 75 = 456$

$tt = 2.5 + 2.3 = 4.8\text{ h}$

$s = \frac{td}{tt} = \frac{456}{4.8} = 95\text{ km/h}$

THE MATHS SOCIETY

Question 5



The diagram shows the distance-time graph for the first 65 minutes of a bicycle journey.

(a) There are four different parts to the journey labelled *A*, *B*, *C* and *D*.

Write down the part of the journey with the fastest speed. [1]

A

(b) After the first 65 minutes the bicycle travels at a constant speed of 20 km/h for 15 minutes.

Draw this part of the journey on the diagram. [1]

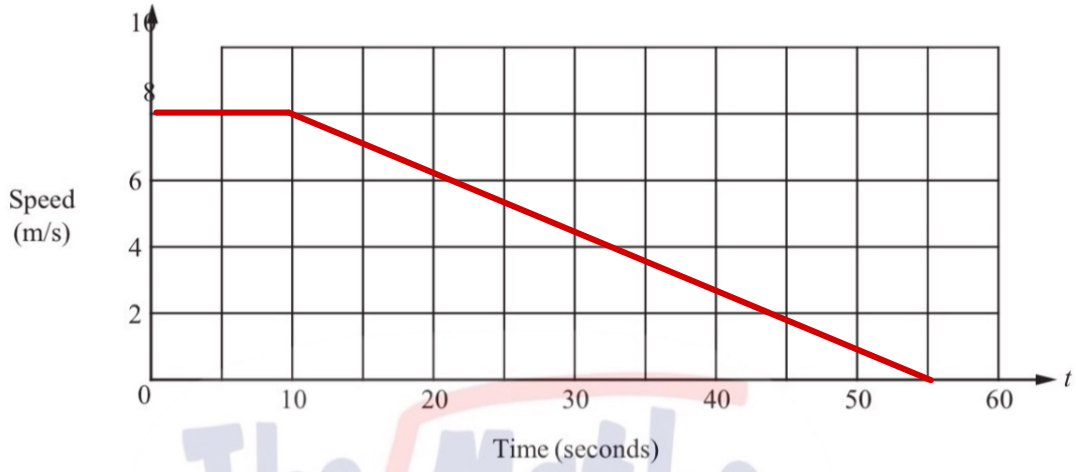
$d = s \times t = 20 \times \frac{1}{4} = 5\,km$

THE MATHS SOCIETY

Question 6

A car passes through a checkpoint at time $t = 0$ seconds, travelling at 8 m/s.
It travels at this speed for 10 seconds.
The car then decelerates at a constant rate until it stops when $t = 55$ seconds.

(a) On the grid, draw the speed-time graph.



(b) Calculate the total distance travelled by the car after passing through the checkpoint. [2]

$\frac{1}{2} \times 55 \times 8$

$= 220$ m

Question 7

A car travels a distance of 1280 **metres** at an average speed of 64 kilometres per hour.

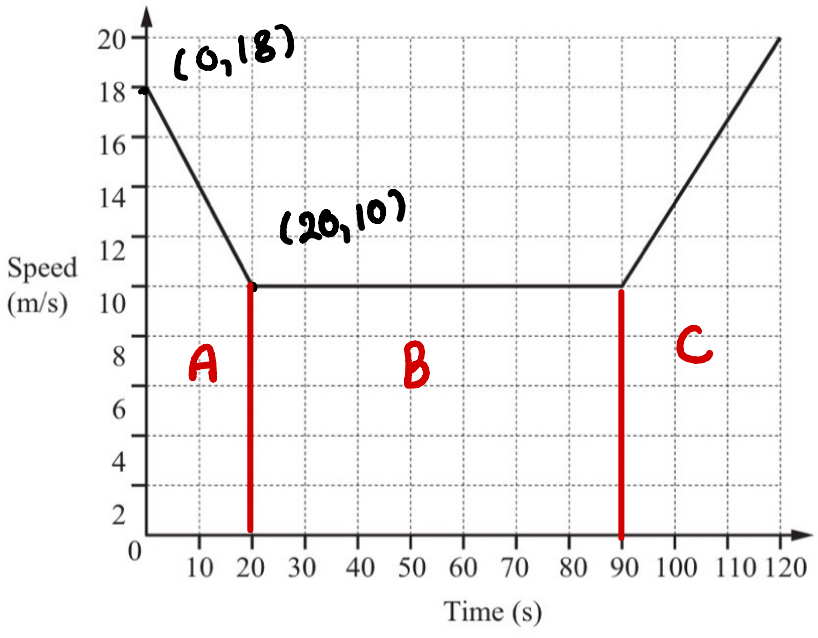
Calculate the time it takes for the car to travel this distance.
Give your answer in **seconds**. [3]

$s = \frac{d}{t}$

$t = \frac{d}{s} = \frac{1280\text{m}}{64} = \frac{1.28}{64} = 0.02\text{h}$

$= 72$ sec

Question 8



The diagram shows the speed-time graph for 120 seconds of a car journey.

(a) Calculate the deceleration of the car during the first 20 seconds.

$$m = \frac{10-18}{20-0} = \frac{-8}{20} = -\frac{2}{5} = -0.4$$

[1]

(b) Calculate the total distance travelled by the car during the 120 seconds.

$$A = \frac{1}{2} \times (18+10) \times 20 \; 10$$
$$= 280$$
$$B = 700$$
$$C = \frac{1}{2} \times (20+10) \times 30$$
$$= 450$$

1430 m

[3]

(c) Calculate the average speed for this 120 second journey.

$$s = \frac{d}{t} = \frac{1430}{120} = 11\frac{11}{12} \; ms^{-1}$$

[1]

Question 1

A train takes 65 minutes to travel 52 km.

Calculate the average speed of the train in kilometres per hour. [2]

$$s = \frac{d}{t} = \frac{52}{13/12} = 48 \text{ km/h}$$

(a) Convert 144 km/h into metres per second. [2]

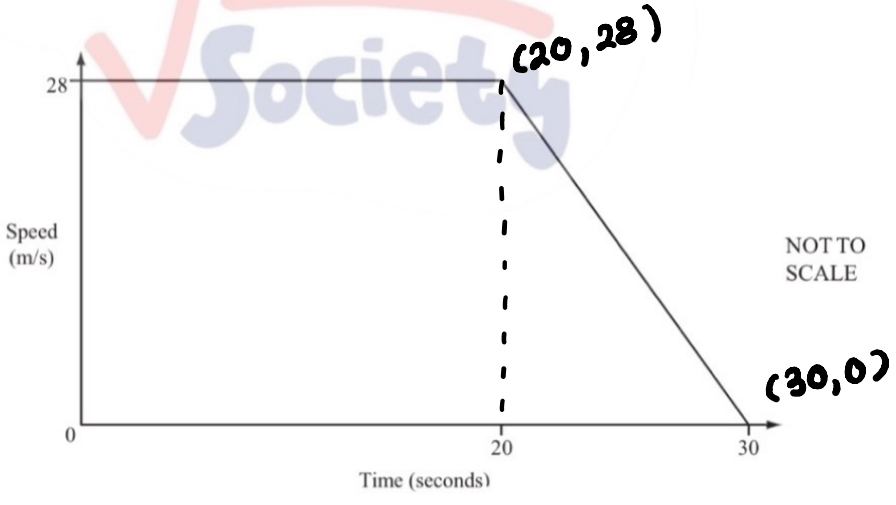
$$\frac{144 \text{ km}}{\text{h}} = \frac{144000}{3600} = 40 \text{ ms}^{-1}$$

(b) A train of length 120 m is travelling at 144 km/h.
It passes under a bridge of width 20 m. [2]

Find the time taken for the whole train to pass under the bridge.
Give your answer in seconds.

$$t = \frac{d}{s} = \frac{0.14}{144} = 3.5 \text{ s}$$

Question 2



The diagram shows the speed-time graph of a car.
It travels at 28 m/s for 20 seconds and then decelerates until it stops after a further 10 seconds.

(a) Calculate the deceleration of the car. [1]

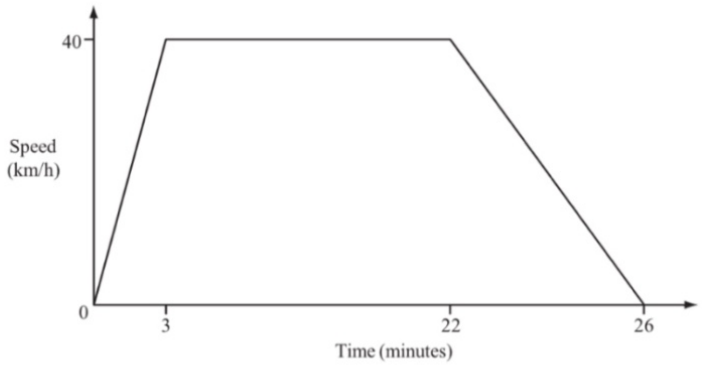
$$2.8 \text{ ms}^{-2}$$

(b) Calculate the distance travelled during the 30 seconds. [3]

$$\frac{1}{2}(30 + 20) \times 28$$

$$= 700 \text{ m}$$

Question 3



NOT TO SCALE

The diagram shows the speed-time graph of a train journey between two stations.

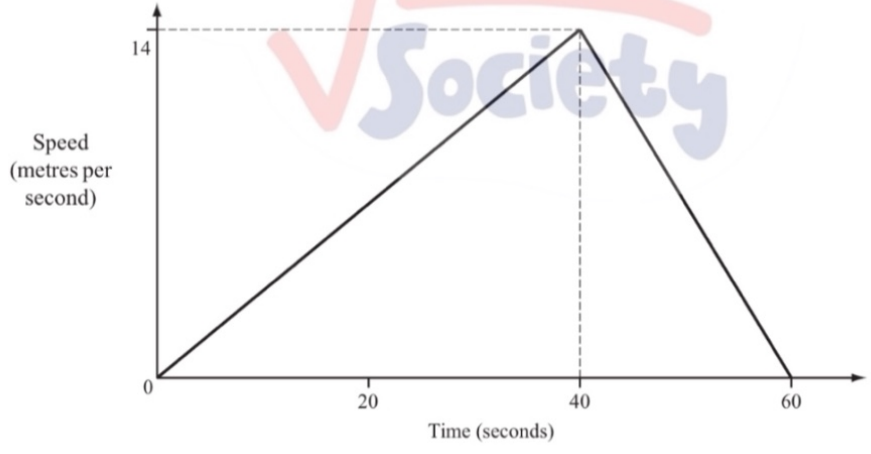
The train accelerates for 3 minutes, travels at a constant maximum speed of 40 km/h, then takes 4 minutes to slow to a stop.

Calculate the distance in kilometres between the two stations. [4]

$\frac{1}{2}\left(\frac{26}{60}+\frac{19}{60}\right)\times 40$

$=\frac{1}{2}\times\frac{3}{4}\times 40 = 15\text{ km}$

Question 4



The diagram shows the speed-time graph of a bus journey between two bus stops.
Hamid runs at a constant speed of 4 m/s along the bus route.
He passes the bus as it leaves the first bus stop.
The bus arrives at the second bus stop after 60 seconds.

How many metres from the bus is Hamid at this time?

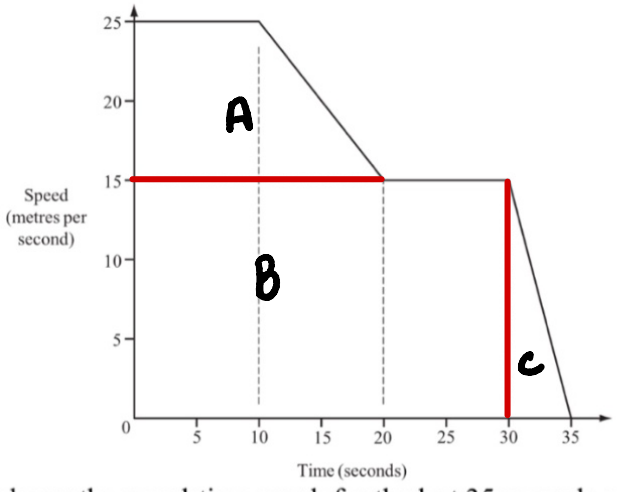
bus distance $=\frac{1}{2}\times 60\times 14\ 7 = 420\text{m}$

Hamid distance $= 60\times 4 = 240\text{m}$

Hamid from bus $= 180\text{m}$

[3]

Question 5



The diagram shows the speed-time graph for the last 35 seconds of a car journey.

(a) Find the deceleration of the car as it came to a stop.

$\frac{15}{5} = 3ms^{-2}$

[1]

(b) Calculate the total distance travelled by the car in the 35 seconds.

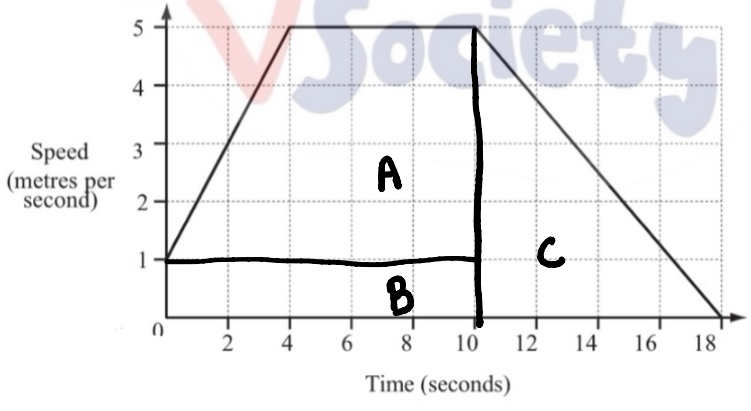
$A = \frac{1}{2}(20+10)\times 10$ | $B = 30\times 15 = 450m$

$= 30\times 5 = 150m$ | $C = \frac{1}{2}\times 5\times 15 = 37.5m$

$total = 637.5m$

[3]

Question 6



The diagram shows the speed-time graph for the last 18 seconds of Roman's cycle journey.

(a) Calculate the deceleration. $\frac{5}{8}ms^{-2}$ [1]

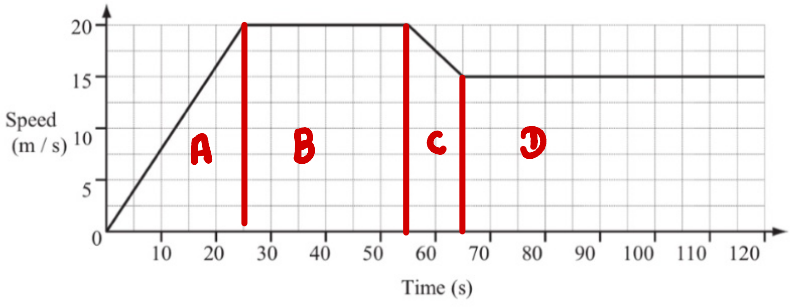
(b) Calculate the total distance Roman travels during the 18 seconds. [3]

$A = \frac{1}{2}\times(10+6)\times 4$ | $B = 10m$ | $C = \frac{1}{2}\times 8\times 5$

$= 32m$ | | $= 20m$

$total = 62m$

Question 7



The diagram shows the speed-time graph for the first 120 seconds of a car journey.

(a) Calculate the acceleration of the car during the first 25 seconds. [1]

$\frac{20}{25} = \frac{4}{5} = 0.8\ ms^{-2}$

(b) Calculate the distance travelled by the car in the first 120 seconds. [4]

$A = \frac{1}{2} \times 25 \times 20 = 250m$

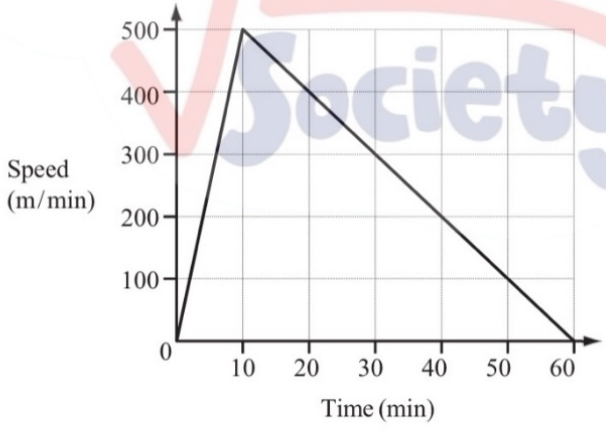
$B = 30 \times 20 = 600m$

$C = \frac{1}{2} \times (15+20) \times 10 = \frac{350}{2} = 175m$

$D = 55 \times 15 = 825m$

$250 + 600 + 175 + 825 = 1850m$

Question 1



The diagram shows the speed-time graph for a boat journey.

(a) Work out the acceleration of the boat in metres /minute^2. [1]

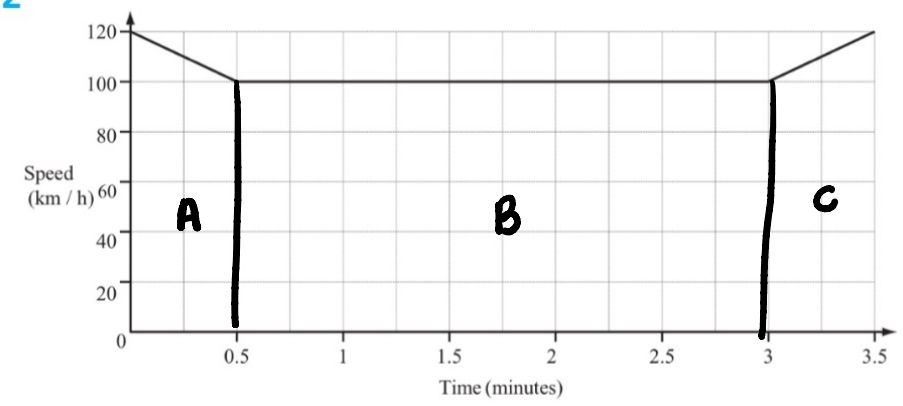
$50\ ms^{-2}$

(b) Calculate the total distance travelled by the boat.
Give your answer in **kilometres**. [2]

$\frac{1}{2} \times \overset{30}{60} \times 500 = 15000m$

$= 15\ km$

Question 2



The diagram shows the speed-time graph for part of a car journey.
The speed of the car is shown in kilometres / hour.

Calculate the distance travelled by the car during the 3.5 minutes shown in the diagram.
Give your answer in kilometres. [4]

$A = \frac{1}{2} \times (120 + 100) \times \frac{1}{120}$

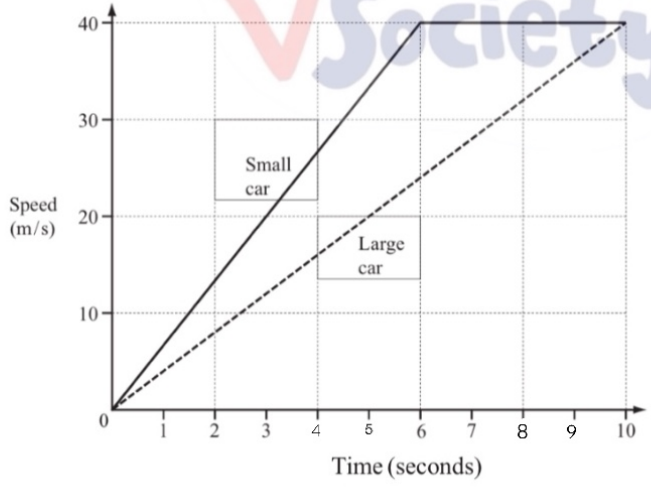
$= \frac{220}{2 \times 120} = \frac{11}{12}$ km

$B = \frac{2.5}{60} \times 100 = \frac{25}{6}$ km

$C = \frac{11}{12}$ km

total = 6 km

Question 3



A small car accelerates from 0 m/s to 40 m/s in 6 seconds and then travels at this constant speed.
A large car accelerates from 0 m/s to 40 m/s in 10 seconds.

Calculate how much further the small car travels in the first 10 seconds. [4]

$A_{small} = \frac{1}{2}(10 + 4) \times 40$ (20)

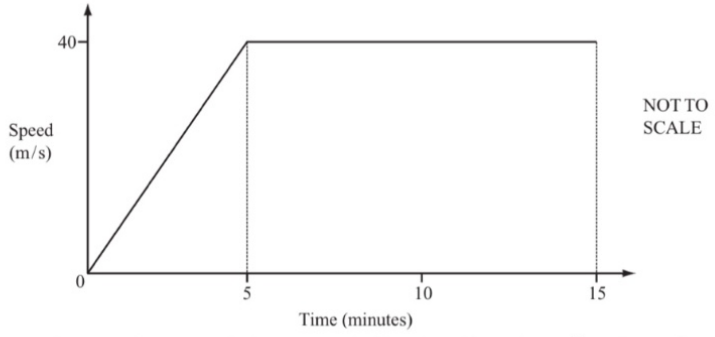
$= 14 \times 20 = 280$ m

$A_{large} = \frac{1}{2} \times 10 \times 40$ (20)

$= 200$ m

Further = 80 m

Question 4



The diagram shows the speed-time graph for the first 15 **minutes** of a train journey.
The train accelerates for 5 minutes and then continues at a constant speed of 40 metres/**second**.

(a) Calculate the acceleration of the train during the first 5 minutes.
Give your answer in m/s^2. [2]

$$\frac{2\cancel{40}}{5\times\cancel{60}_{3}} = \frac{2}{15}\ m/s^2$$

(b) Calculate the average speed for the first 15 minutes of the train journey.
Give your answer in m/s. [3]

$$td = \frac{1}{\cancel{2}}\times\cancel{30}_{60}\times(15+10)\times 40$$

$$= 30\times 25\times 40$$

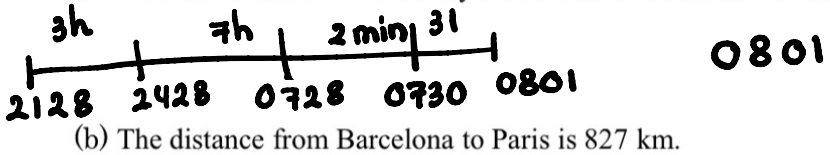
$$= 30000\,m$$

$$AS = \frac{30000}{15\times 60} = 33.\dot{3}\ m/s$$

Question 5

A train leaves Barcelona at 21 28 and takes 10 hours and 33 minutes to reach Paris.

(a) Calculate the time the next day when the train arrives in Paris. [1]



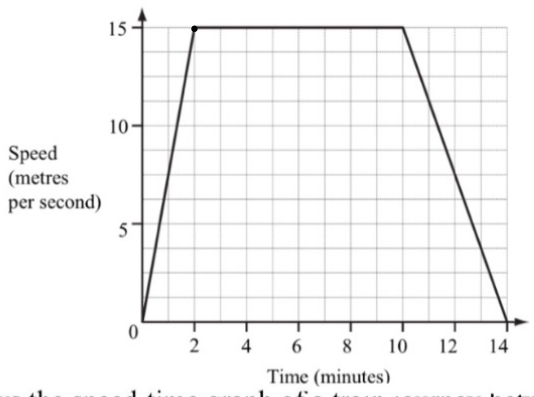
0801

(b) The distance from Barcelona to Paris is 827 km.

Calculate the average speed of the train in kilometres per hour. [3]

$$AS = \frac{827}{10\frac{33}{60}} = 78.4\ km/h$$

Question 6



The diagram shows the speed-time graph of a train journey between two stations.
The train accelerates for two minutes, travels at a constant maximum speed, then slows to a stop.

(a) Write down the number of seconds that the train travels at its constant maximum speed. [1]

8 sec

(b) Calculate the distance between the two stations in metres. [3]

$\frac{1}{2} \times 60 \times (14 + 8) \times 15 = 9900\ m$

(c) Find the acceleration of the train in the first two minutes.
Give your answer in m/s^2. [2]

$\frac{15}{2 \times 60} = 0.125\ m/s^2$

Question 1

A train journey takes one hour.
The diagram shows the speed-time graph for this journey.

(a) Calculate the total distance of the journey.

Give your answer in kilometres. [3]

$\frac{1}{2} \times (60 + 46) \times 3 = 159\ km$

(b) (i) Convert 3 kilometres / minute into metres / second. [2]

$\frac{3\ km}{1\ min} = \frac{3000}{60} = 50\ m/s$

(ii) Calculate the acceleration of the train during the first 4 minutes.

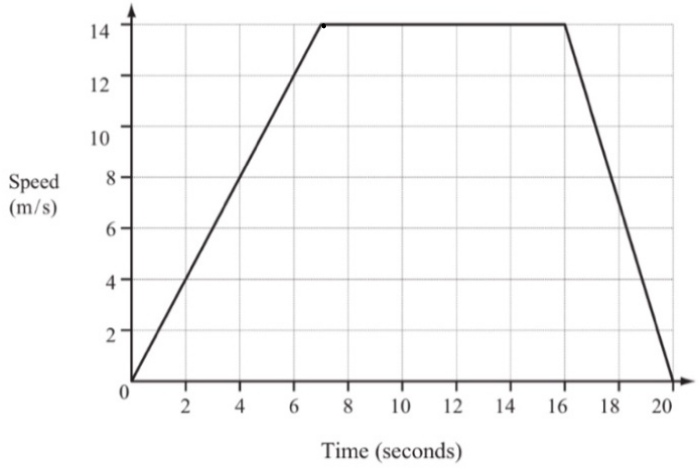
Give your answer in metres /second^2. [2]

$0.75\ km/m^2 = \frac{0.75\ km}{1\ min^2} = \frac{750}{60 \times 60} = \frac{5}{24}\ m/s^2$

Question 2

An animal starts from rest and accelerates to its top speed in 7 seconds. It continues at this speed for 9 seconds and then slows to a stop in a further 4 seconds.

The graph shows this information.



(a) Calculate its acceleration during the first seven seconds. [1]

$2 m/s^2$

(b) Write down its speed 18 seconds after the start. [1]

7m/s

(c) Calculate the total distance that the animal travelled. [3]

$\frac{1}{2}(20+9)\times 14 = 203m$

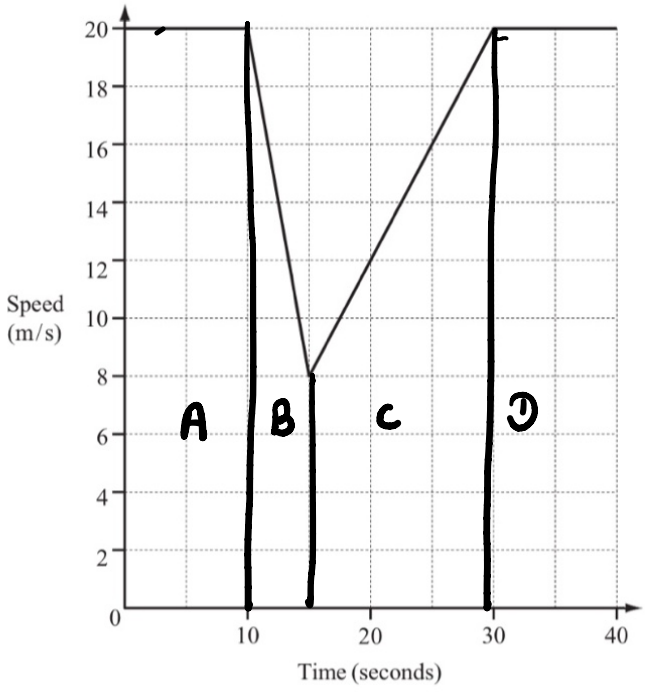
Question 3

Priyantha completes a 10 km run in 55 minutes 20 seconds.
Calculate Priyantha's average speed in km/h.

$s = \frac{td}{tt} = \frac{10\ km}{\frac{83}{90}\ h} = 10.8\ km/h$

[3]

Question 4



The graph shows 40 seconds of a car journey.

The car travelled at a constant speed of 20 m/s, decelerated to 8 m/s then accelerated back to 20 m/s.

Calculate

(a) the deceleration of the car. [1]

$\frac{12}{5} = 2.4\ m/s^2$

(b) the total distance travelled by the car during the 40 seconds. [3]

$A = 200$

$B = \frac{1}{2} \times (28) \times 5$

$= 70$

$C = \frac{1}{2} \times (28) \times 15$

$= 210$

$D = 200$

$total = 680m$

Question 5

A person in a car, travelling at 108 kilometres per hour, takes 1 second to go past a building on the side of the road.

Calculate the length of the building in metres.

1 hour = 108000 m

3600 s = 108000m

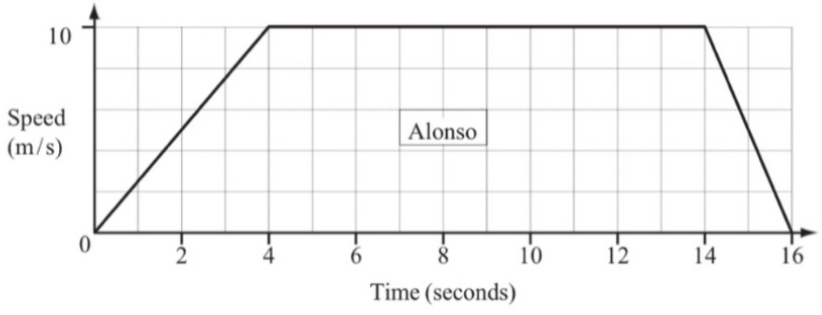
1s = 30m

[2]

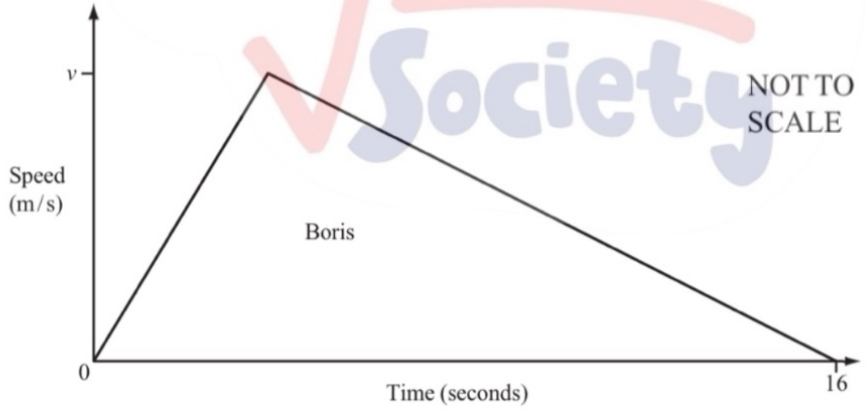
Question 6

The graphs show the speeds of two cyclists, Alonso and Boris.

Alonso accelerated to 10 m/s, travelled at a steady speed and then slowed to a stop.



Boris accelerated to his maximum speed, v m/s, and then slowed to a stop.



Both cyclists travelled the same distance in the 16 seconds.

Calculate the maximum speed for Boris.
Show all your working.

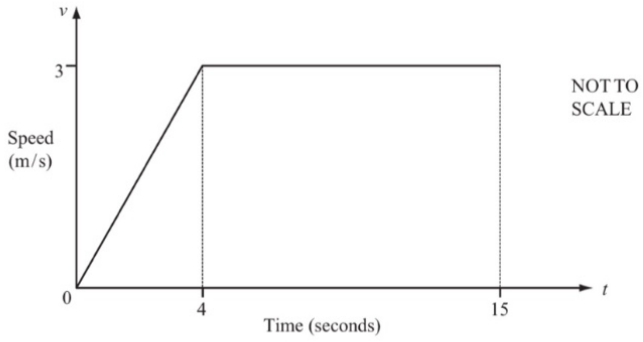
$\text{distance}_A = \frac{1}{2}(16+10) \times 10 = 130\text{ m}$

$\text{distance}_B = \frac{1}{2} \times 16 \times v$

$8v = 130$

$v = 16.25\text{ m/s}$

Question 1



The diagram shows the speed-time graph for 15 seconds of the journey of a cyclist.

(a) Calculate the acceleration of the cyclist during the first 4 seconds. [1]

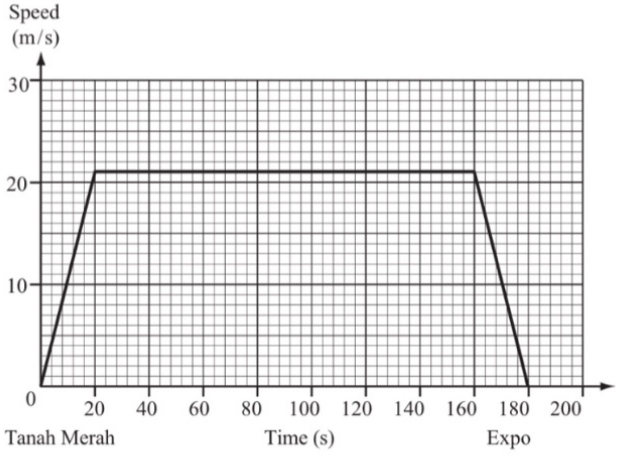
$\frac{3}{4} = 0.75 \text{ m/s}$

(b) Calculate the average speed for the first 15 seconds. [3]

$td = \frac{1}{2}(15+11)\times 3 = \frac{1}{2}\times 26\times 3 = 39 \text{ m}$

$AS = \frac{39}{15} = 2.6 \text{ m/s}$

Question 2



The graph shows the train journey between Tanah Merah and Expo in Singapore.

Work out

(a) the acceleration of the train when it leaves Tanah Merah, [2]

$\frac{21}{20} \text{ m/s}^2$

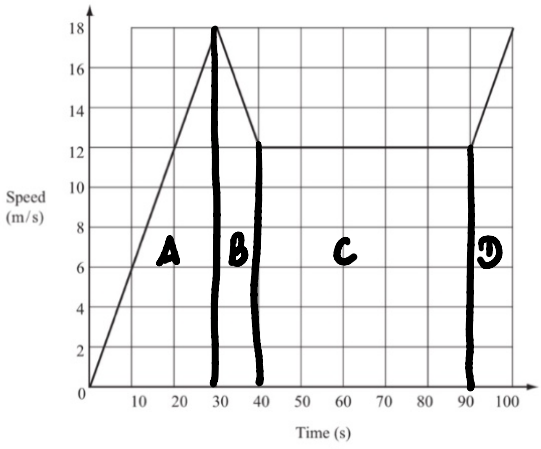
(b) the distance between Tanah Merah and Expo, [3]

$\frac{1}{2}(180+140)\times 21 = \frac{320}{2}\times 21 = 160\times 21 = 3360 \text{ m}$

(c) the average speed of the train for the journey. [1]

$AS = \frac{3360}{180} = 18.\dot{6} \text{ m/s}$

Question 3



The diagram shows part of a journey by a truck.

(a) The truck accelerates from rest to 18 m/s in 30 seconds.
Calculate the acceleration of the truck. [1]

$\frac{18}{30} = \frac{3}{5} = 0.6\ m/s^2$

(b) The truck then slows down in 10 seconds for some road works and travels through the road works at 12 m/s.
At the end of the road works it accelerates back to a speed of 18 m/s in 10 seconds.
Find the total distance travelled by the truck in the 100 seconds. [3]

$A = \frac{1}{2} \times 30 \times 18 = 270\ m$

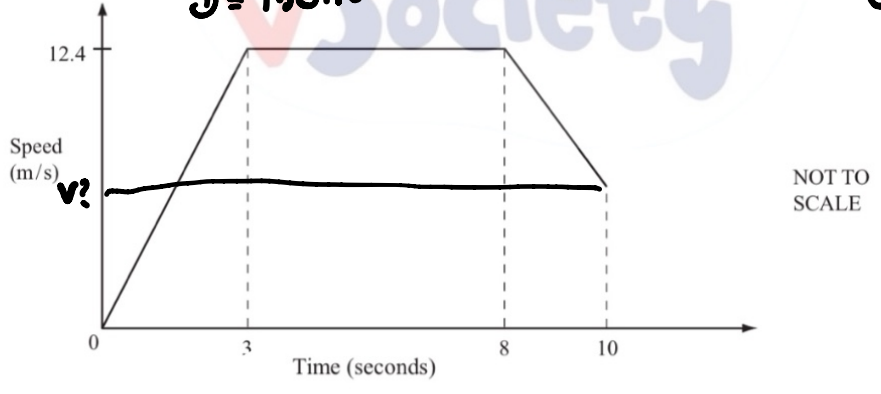
$B = \frac{1}{2} \times (12+18) \times 10 = \frac{1}{2} \times 30 \times 10 = 150\ m$

$C = 50 \times 12 = 600\ m$

$D = 150\ m$

$1170\ m$

Question 4



An athlete, in a race, accelerates to a speed of 12.4 metres per second in 3 seconds.
He runs at this speed for the next 5 seconds and slows down over the last 2 seconds as shown in the speed-time graph above.
He crosses the finish line after 10 seconds.
The total distance covered is 100 m.

(a) Calculate the distance he runs in the first 8 seconds. [2]

$\frac{1}{2} \times (8+5) \times 12.4 = 80.6\ m$

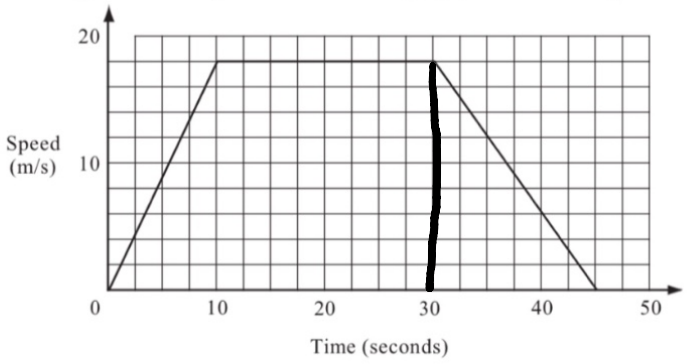
(b) Calculate his speed when he crosses the finish line. [2]

$\frac{1}{2}(v + 12.4) \times 2 = 19.4$

$v = 7\ m/s$

Question 5

A cyclist is training for a competition and the graph shows one part of the training.



(a) Calculate the acceleration during the first 10 seconds. [2]

$1.8\ m/s^2$

(b) Calculate the distance travelled in the first 30 seconds. [2]

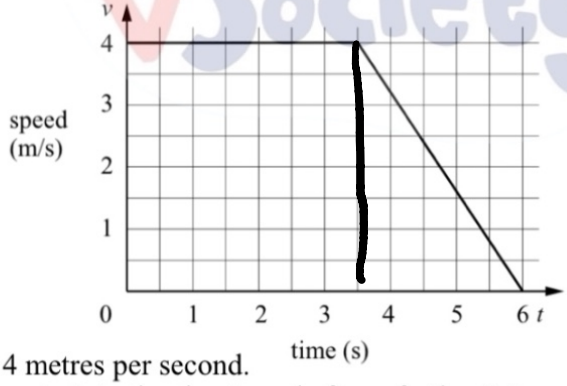
$\frac{1}{2}(30+20)\times 18 = 50\times 9 = 450\ m$

(c) Calculate the average speed for the entire 45 seconds. [3]

$\frac{1}{2}\times(45+20)\times 18 = 585$

$AS = \frac{585}{45} = 13\ m/s$

Question 6



Ameni is cycling at 4 metres per second.
After 3.5 seconds she starts to decelerate and after a further 2.5 seconds she stops. The diagram shows the speed-time graph for Ameni.
Calculate

(a) the constant deceleration, $\frac{4}{2.5} = 1.6\ m/s^2$ [1]

(b) the total distance travelled during the 6 seconds. [2]

$\frac{1}{2}(6+3.5)\times 4 = 19\ m$