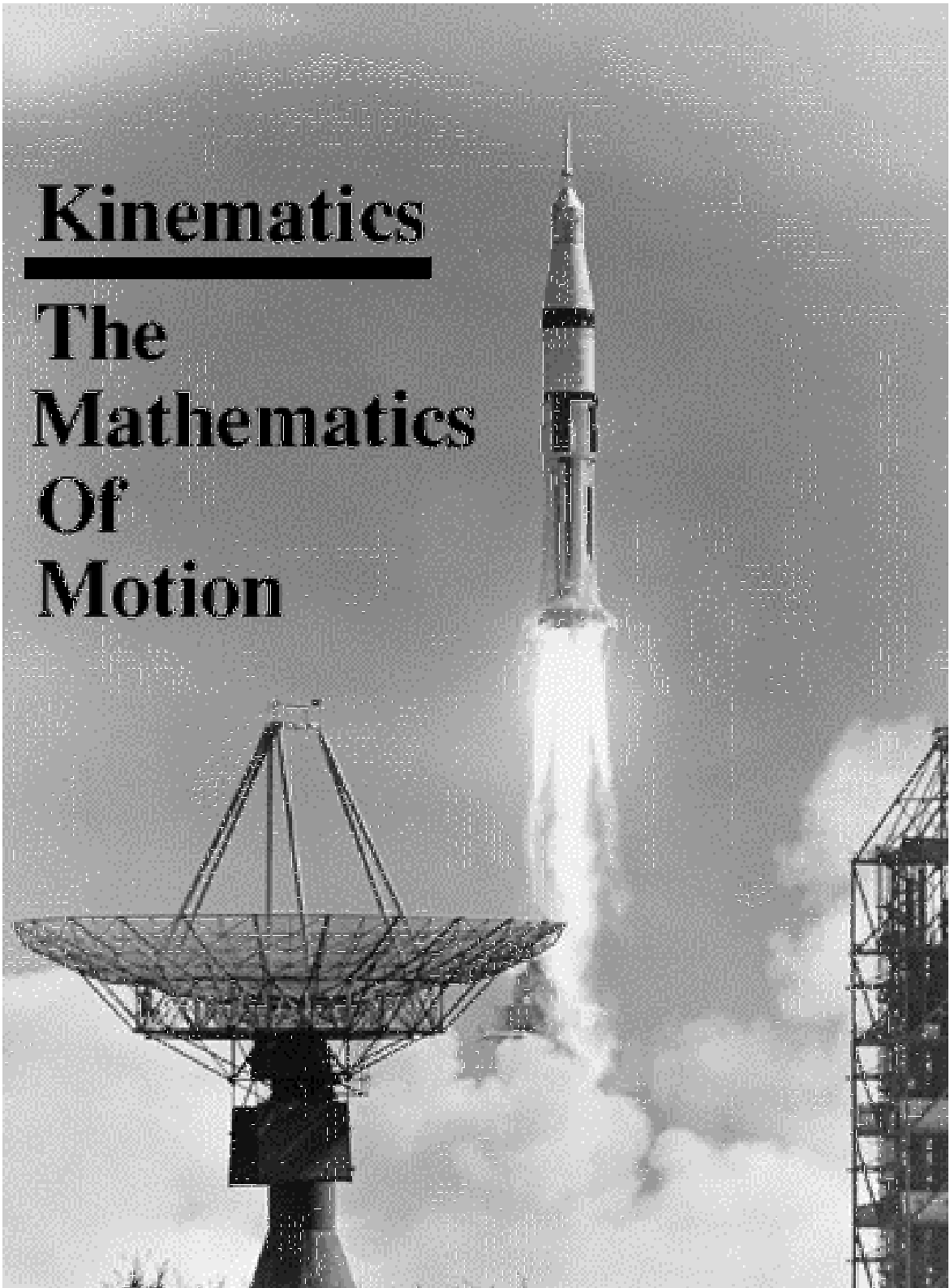


Kinematics

The Mathematics Of Motion



Apollo 7 lifts off from Cape Canaveral, Florida, with a crew of three on board, on October 11th 1968. Less than two years later, Apollo 11 landed the first humans on Earth's Moon. Five additional Apollo missions landed on the Moon between 1969 and 1972. No humans have been back to the Moon since.

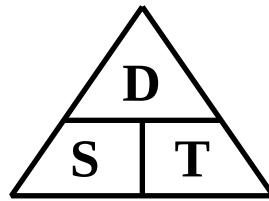
Kinematics

The Mathematics Of Motion

GCSE Mathematics
Kinematics

Lesson 1

1.1 The *Distance, Speed, Time* formula Triangle



$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\text{Speed} = \frac{\text{Distance}}{\text{Time}}$$

$$\text{Time} = \frac{\text{Distance}}{\text{Speed}}$$

These formulae are only true when the speed is constant.

i.e. When there is ZERO acceleration.

Distance is measured in metres, speed in metres per second, and time in seconds.

1.2 Example

A jogger travels at a constant speed of 3m/s for 6 minutes.

(i) How many seconds are in 6 minutes ?

(ii) How far does the jogger travel ?

(iii) Is this more or less than 1 km ?

1.3 Exercise

Question 1

Write these times in seconds.

- (i) 4 minutes.
- (ii) 1 hour.
- (iii) $2 \frac{1}{2}$ minutes.
- (iv) half an hour.

Question 2

Write these distances in metres.

- (i) 4 km.
- (ii) $\frac{1}{2}$ km.
- (iii) 0.7 km.
- (iv) $1 \frac{3}{4}$ km.

Question 3

A jogger travels at a constant speed of 4m/s for 4 minutes.

- (i) How many seconds are in 4 minutes ?
- (ii) How far does the jogger travel ?
- (iii) Is this more or less than 1 km ?

HINT : $D = S \times T$

Question 4

A walker travels at a constant speed of 1.5m/s for 11 minutes.

(i) How many seconds are in 11 minutes ?

(ii) How far does the walker travel ?

(iii) Is this more or less than 1 km ?

Question 5

A man leaves his house at 1:15pm.

He jogs at a constant speed of 2m/s returning home at 1:35pm.

(i) For how long did the man jog ?
Give your answer in seconds.

(ii) How far did the man travel ?
Give your answer in metres.

(iii) Change your part (ii) answer into km.

Question 6

A man runs 6 km at a steady speed in 40 minutes.

(i) How many metres is 6 km ?

(ii) How many seconds are in 40 minutes ?

(iii) Find the man's speed in m/s.

$$\text{HINT : } S = \frac{D}{T}$$

Question 7

A jogger runs $\frac{3}{4}$ km at a steady speed in 6 minutes and 15 seconds.

- (i) How many metres is $\frac{3}{4}$ km ?
- (ii) How many seconds are in 6 minutes and 15 seconds ?
- (iii) Find the jogger's speed in m/s.

Question 8

A car travels 21 km at a constant speed of 25m/s.

- (i) Write 21 km in metres.
- (ii) How long does the car take to travel the 21 km ?
Give your answer in seconds.

HINT : $T = \frac{D}{S}$

- (iii) How many minutes is this ?

Question 9

Here is a formula to convert speeds in km/h into speeds in m/s;

$$Speed\ in\ m/s = \frac{5}{18} \times Speed\ in\ km/h$$

Use this formula to convert the following km/h speeds into m/s speeds.

- (i) 54 km/h
- (ii) 90 km/h
- (iii) 45 km/h

Question 10

A car travels at a constant speed of 72 km/h for 6 km.

- (i) How many m/s is 72 km/h ?

HINT : Use the Question 9 formula

- (ii) How many metres is 6 km ?

- (iii) How long does the car take to travel the 6 km ?
Give your answer in seconds.

- (iv) How many minutes is this ?

Question 11

UK road speed signs are in miles per hour (mph).

Here is a formula to convert speeds in m/s into speeds in mph;

$$\text{Speed in mph} = 2.237 \times \text{Speed in m/s}$$

- (a) Use this formula to convert the following m/s speeds into mph speeds.

- (i) 1 m/s

- (ii) 10 m/s

- (iii) 5 m/s

- (b) Apollo 7 was moving at almost 2000 m/s at stage 1 separation.
Use the formula to express this speed in miles per hour.

Question 12

$$\text{Distance} = \text{Speed} \times \text{Time}$$

This formula only applies when there is zero acceleration.

When there's zero acceleration the speed does not vary over the journey.

If there is some constant acceleration then the finishing speed and the starting speed differ and a different formula applies;

$$\text{Distance} = \text{Average Speed} \times \text{Time}.$$

(a) Find the average (the mean) of the following pairs of numbers;

(i) 12 and 18

(ii) 25 and 45

(iii) 2 and 7

(iv) 26 and 54

(b) A car accelerates such that it's speed increases uniformly from 8m/s to 34 m/s over 6 seconds.

What distance does this car cover whilst accelerating ?

1.4 Solutions

GCSE Mathematics Kinematics

1.4.1 Answers (Example)

(i) 360 seconds (ii) 1080 metres (iii) More

1.4.2 Answers (Exercise)

Answer 1

(i) 240 seconds
(ii) 3600 seconds
(iii) 150 seconds
(iv) 1800 seconds

Answer 2

(i) 4000 metres
(ii) 500 metres
(iii) 700 metres
(iv) 1750 metres

Answer 3

(i) 240 seconds
(ii) 960 metres
(iii) Less

Answer 4

(i) 660 seconds
(ii) 990 metres
(iii) Less

Answer 5

(i) 1200 seconds
(ii) 2400 metres
(iii) 2.4 km

Answer 6

(i) 6000 metres
(ii) 2400 seconds
(iii) 2.5 m/s

Answer 7

(i) 750 metres
(ii) 375 seconds
(iii) 2 m/s

Answer 8

(i) 21 000 metres
(ii) 840 seconds
(iii) 14 minutes.

Answer 9

(i) 15 m/s
(ii) 25 m/s
(iii) 12.5m/s

Answer 10

(i) 20m/s
(ii) 6000 metres
(iii) 300 seconds
(iv) 5 minutes

Answer 11

(a) (i) 2.237 mph
(ii) 22.37 mph
(iii) 11.185 mph
(b) 4474 mph.

Answer 12

(a) (i) 15
(ii) 35
(iii) 4.5
(iv) 40
(b) 126 metres.

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

Lesson 2

GCSE Mathematics Kinematics

2.1 Big Number Arithmetic

Homework Exercise

Question 1 - *Do NOT use a calculator*

Calculate,

(i) 2000×300

(ii) 400×6000

(iii) 1300×300

(iv) 250×800

(v) 4000000×3

(vi) 5000^2

(vii) 6000×4000

(viii) 750×200

(ix) 450×3000

(x) 5500×110

Question 2 - *Do NOT use a calculator*

A Go-Kart moves at a constant speed of 20m/s for 30 minutes.

(i) How many seconds are in 30 minutes ?

(ii) How many metres does the Go-Kart travel ?

(iii) Write your part (ii) answer in km.

Question 3 - Do NOT use a calculator

A Mini moves at a constant speed of 25m/s for 50 minutes along the M54 motorway.

(i) How many seconds are in 50 minutes ?

(ii) How many metres does the Mini travel ?

(iii) Write your part (ii) answer in km.

Question 4 - Do NOT use a calculator

Calculate,

(i) $\frac{160}{40}$

(ii) $\frac{24000}{600}$

(iii) $\frac{7200}{3600}$

(iv) $\frac{44000}{110}$

(v) $\frac{250000}{50}$

(vi) $\frac{150000}{250}$

(vii) $\frac{8000}{16000}$

(viii) $\frac{12500}{200}$

(ix) $\frac{9000000}{300}$

(x) $\frac{3600000}{600}$

Question 5 - Do NOT use a calculator

A man drives 24 km at a steady speed for 20 minutes.

- (i) How many metres is 24 km ?

- (ii) How many seconds are in 20 minutes ?

- (iii) Find the man's speed in m/s.

Question 6 - Do NOT use a calculator

A missile covers 270 km at a steady speed in 15 minutes.

- (i) How many metres is 270 km ?

- (ii) How many seconds are in 15 minutes ?

- (iii) Find the missile's speed in m/s.

- (iv) The speed of sound in air is 340m/s.
Is the missile travelling faster than the speed of sound ?

2.2 Solutions

GCSE Mathematics Kinematics

Answer 1

- | | | | |
|---------|------------|----------|------------|
| (i) | 600 000 | (ii) | 2 400 000 |
| (iii) | 390 000 | (iv) | 200 000 |
| (v) | 12 000 000 | (vi) | 25 000 000 |
| (vii) | 24 000 000 | (viii) | 150 000 |
| (ix) | 1 350 000 | (x) | 605 000 |

Answer 2

- (i) 1800 seconds
- (ii) 36 000 metres
- (iii) 36 km

Answer 3

- (i) 3000 seconds
- (ii) 75 000 metres
- (iii) 75 km

Answer 4

- | | | | |
|---------|--------|----------|------|
| (i) | 4 | (ii) | 40 |
| (iii) | 2 | (iv) | 400 |
| (v) | 5000 | (vi) | 600 |
| (vii) | 0.5 | (viii) | 62.5 |
| (ix) | 30 000 | (x) | 6000 |

Answer 5

- (i) 24000 metres
- (ii) 1200 seconds
- (iii) 20 m/s

Answer 6

- (i) 270 000 metres
- (ii) 900 seconds
- (iii) 300 m/s
- (iv) A little below the speed of sound.

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

Lesson 3

GCSE Mathematics Kinematics

3.1 Big Number Mental Arithmetic

Each question will be read out twice by your teacher.

Listen carefully !

Write your answers on this sheet.

Question	Answer
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	

Your final mark :

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

Questions (+ Answers) for 3.1 Big Number Mental Arithmetic

GCSE Mathematics
Kinematics

3.2 Questions

3.3 Answers

- | | | |
|-----|---------------------------|---------------|
| 1) | 150×20 | 3000 |
| 2) | $40\,000 \times 11$ | 440 000 |
| 3) | 2000×400 | 800 000 |
| 4) | 800×600 | 480 000 |
| 5) | 4000^2 | 16 000 000 |
| 6) | Write down 30 000 | 30 000 |
| 7) | Write down 200 000 | 200 000 |
| 8) | $30\,000 \times 200\,000$ | 6 000 000 000 |
| 9) | $7\,000\,000 \times 60$ | 420 000 000 |
| 10) | 1300×4000 | 5 200 000 |

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

© 2025 Number Wonder

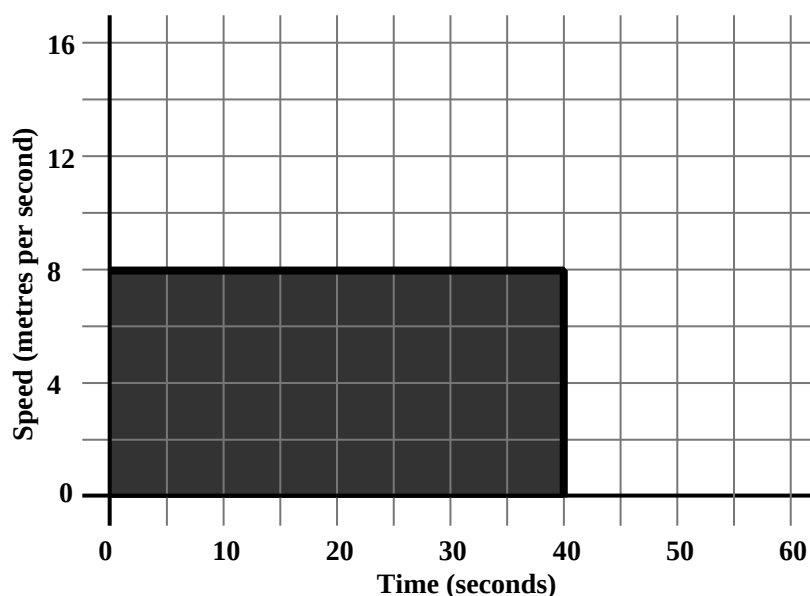
Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

Lesson 4

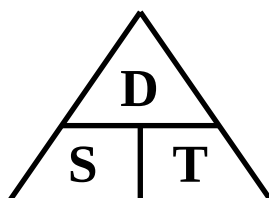
GCSE Mathematics Kinematics

4.1 Speed - Time graphs

The Speed- Time graph shows a cyclist travelling at a steady speed of 8 m/s for a time of 40 seconds.



The distance travelled can be found using the Distance, Speed, Time formula triangle;



$$\text{Distance} = \text{Speed} \times \text{Time}$$

$$\begin{aligned} D &= 8 \times 40 \\ &= 320 \text{ m} \end{aligned}$$

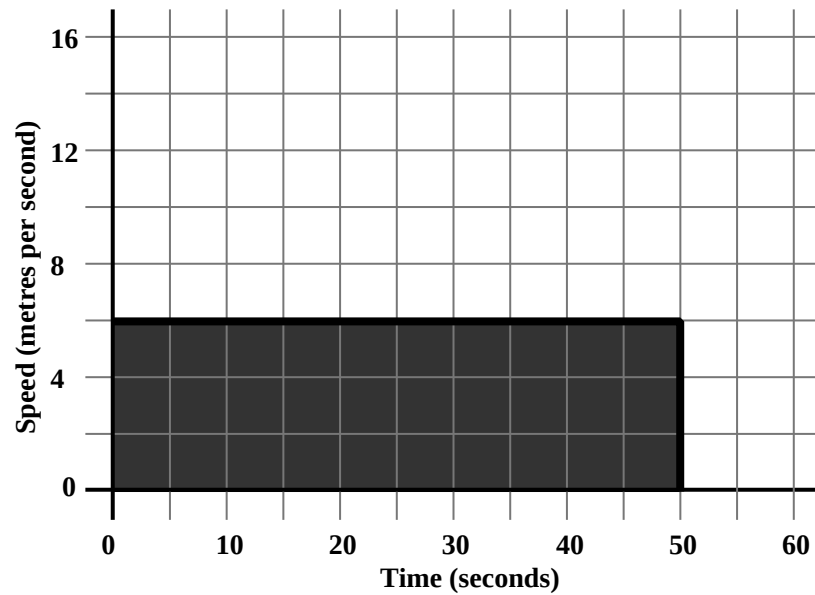
Alternatively, the distance can be found directly from the Speed - Time graph.

Can you see how ?

4.2 Exercise

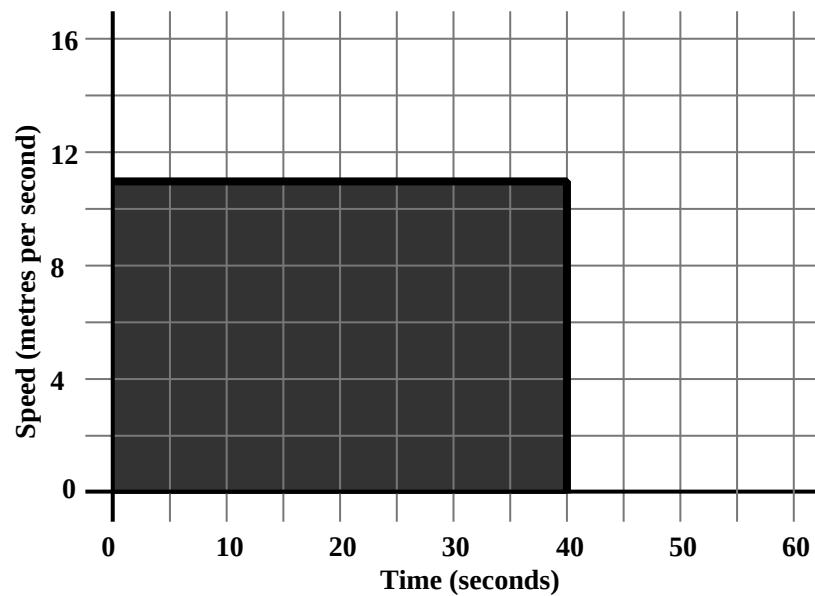
Take care with reading the deliberately awkward scales, especially on the y-axis.

Question 1



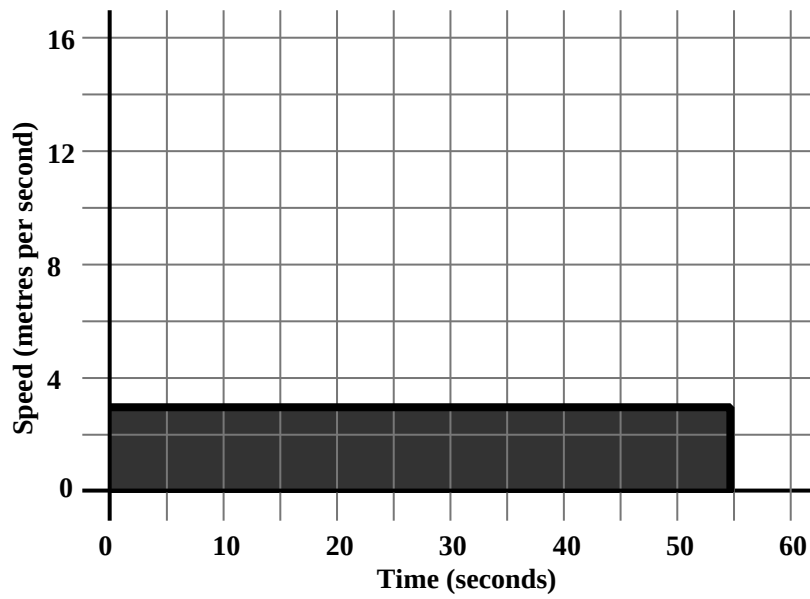
What distance is represented by the shaded region of this Speed - Time graph ?

Question 2



What distance is represented by the shaded region of this Speed - Time graph ?

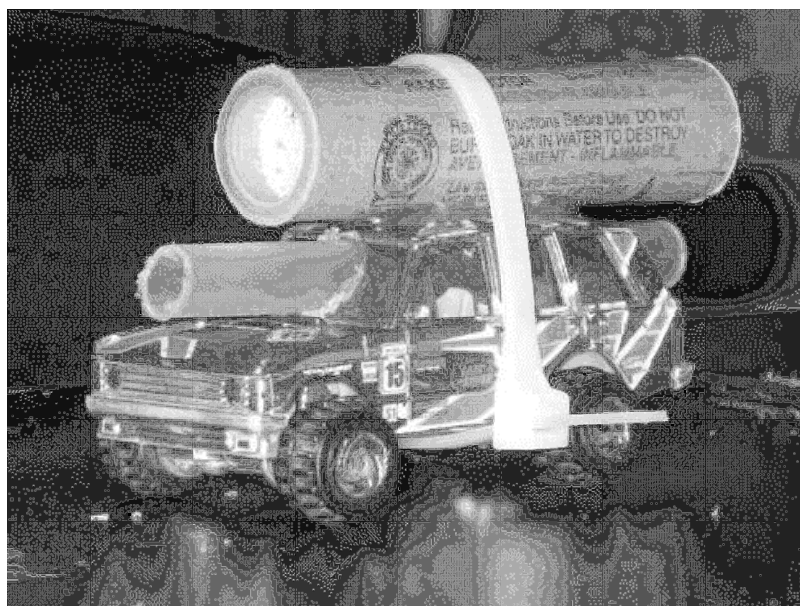
Question 3



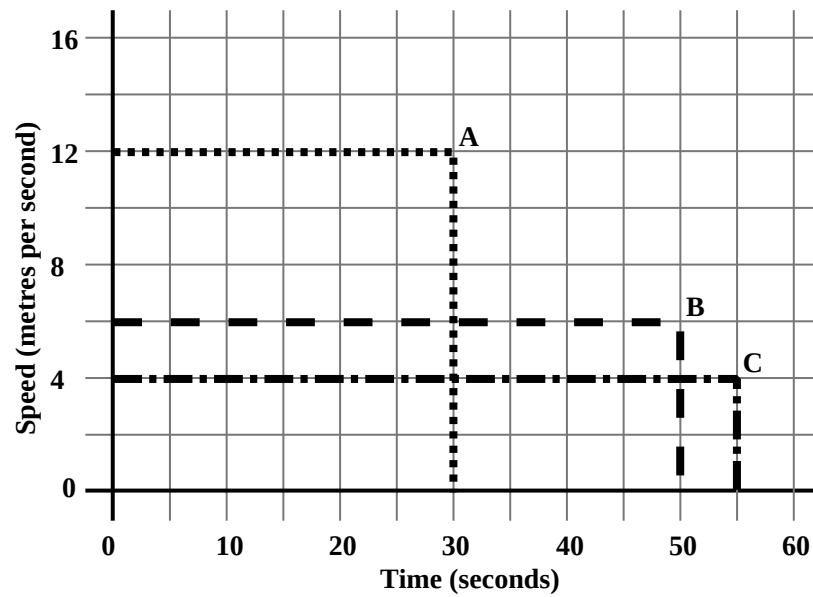
What distance is represented by the shaded region of this Speed - Time graph ?

Question 4

At a firework research facility, scientists are testing various 'rockets' by strapping them to toy cars to measure the time and intensity of the 'burn'.



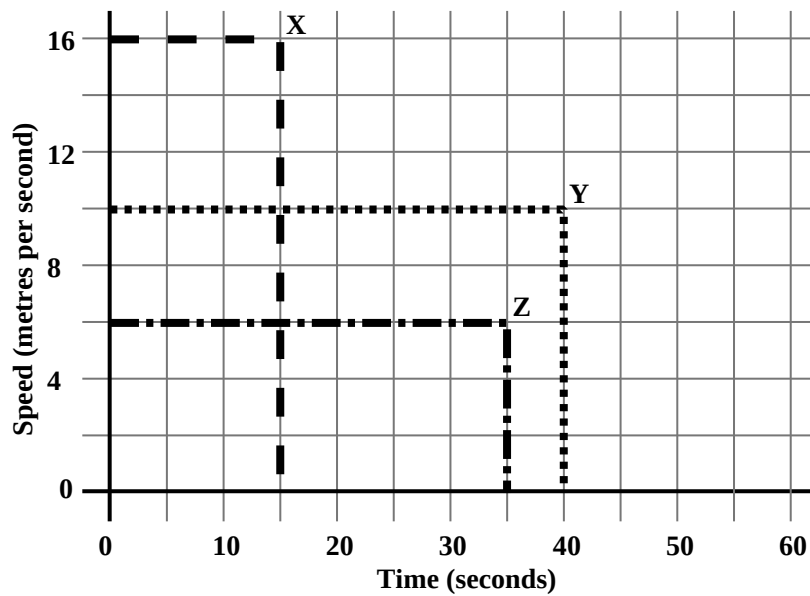
The performance of three rockets, *A*, *B* and *C* are shown on the graph below.



- (i) Which rocket had the longest burn time ?
- (ii) Which rocket achieved the greatest speed ?
- (iii) Which rocket powered a car along at 6 m/s ?
- (iv) What is the 'burn distance' of rocket *A* ?
- (v) What is the 'burn distance' of rocket *B* ?
- (vi) What is the 'burn distance' of rocket *C* ?
- (vii) Which rocket had the largest 'burn distance' ?
- (viii) A fourth rocket, *D*, is tested.
It powers the car along at a steady 10 m/s for 20 seconds.

Add the rocket *D* result to the Speed - Time graph.

Question 5

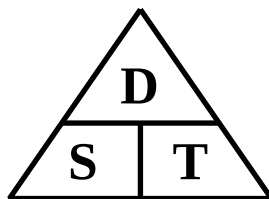


Three more rockets, X, Y and Z are tested.

- (i) Which rocket had the longest burn time ?
- (ii) Which rocket achieved the greatest speed ?
- (iii) Which rocket powered a car along at 10 m/s ?
- (iv) What is the 'burn distance' of rocket X ?
- (v) What is the 'burn distance' of rocket Y ?
- (vi) What is the 'burn distance' of rocket Z ?
- (vii) Which rocket had the largest 'burn distance' ?
- (viii) A fourth rocket, W, is tested.
It powers the car along at a steady 5 m/s for 60 seconds.
(Be careful with that 5 m/s !)
Add rocket W result to the Speed - Time graph.

Question 6

TRUE FOR ZERO ACCELERATION



$$\text{Distance} = \text{Speed} \times \text{Time}$$

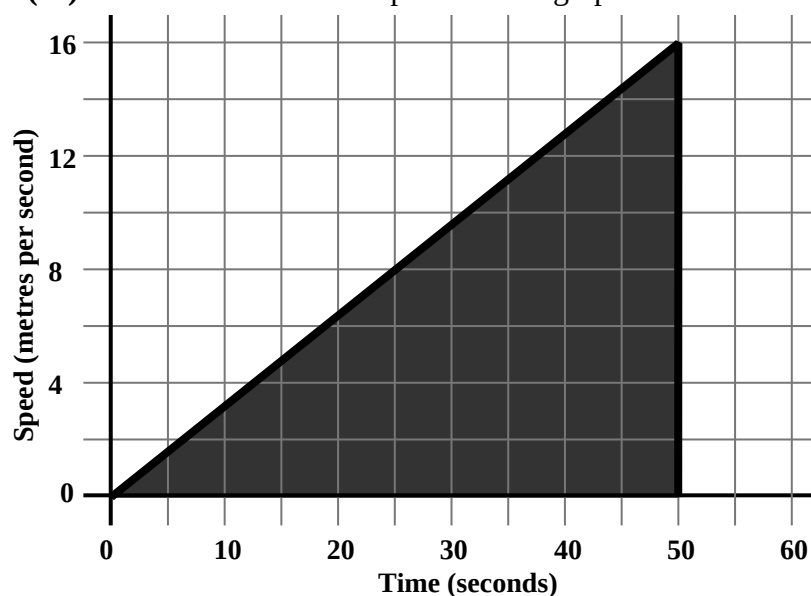
TRUE FOR ZERO ACCELERATION

With constant NON-ZERO acceleration: $\text{Distance} = \text{Average Speed} \times \text{Time}$

- (i) Find the average (the mean) of the following pairs of numbers;
- (a) 23 and 37 (b) 15 and 71
- (c) 5.5 and 8.5 (d) 0 and 44
- (ii) A train accelerates with such that it's speed increases uniformly from 0 m/s to 16 m/s over 50 seconds.

- (a) What is the average (the mean) of 0 and 16 ?
- (b) Find the distance the train moves whilst accelerating by using
- $$\text{Distance} = \text{Average Speed} \times \text{Time}$$

- (c) Here is the train's Speed - Time graph.



Find the area shaded using $\text{Area } \Delta = \frac{1}{2} \times \text{base} \times \text{height}$.

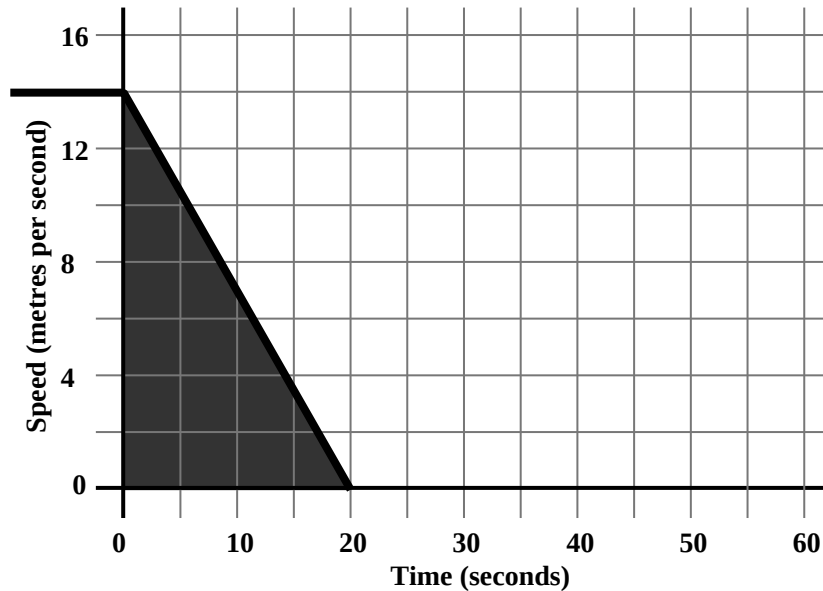
- (d) Comment:

Question 7

A car is travelling along at a steady speed.

It then applies its brakes in order to stop for a Zebra Crossing †.

Here is the Speed - Time graph for the car.



- (i) What was the speed of the car before the brakes were applied ?
- (ii) How many seconds did it take for the car to stop ?
- (iii) Work out the area of the shaded triangle.
(*This will be distance taken by the car to stop*)
- (iv) Show how you would get the part (iii) answer by using the formula;
$$\text{Distance} = \text{Average Speed} \times \text{Time}$$

† It was not really a zebra crossing the road but a small girl carrying her dolly.

Question 8

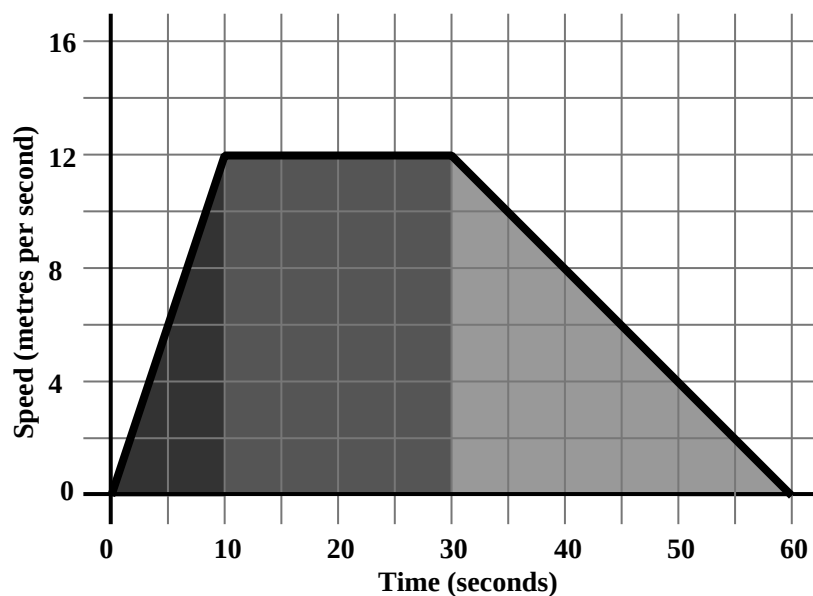
A car is waiting at a red traffic light.

It turns green, and the car accelerates at a constant rate for 10 seconds.

The car then travels at 12 m/s for twenty seconds.

Finally, with another red light ahead the car decelerates and stops.

Here is a graph showing the car's speed and time as it moves between the red lights.



The distance between the two red traffic lights will be the area shaded. One way of finding this, is to think of the area as being in three parts.

- (i) Find the area of the acceleration triangle.
It has a base of 10 seconds and a height of 12 m/s.

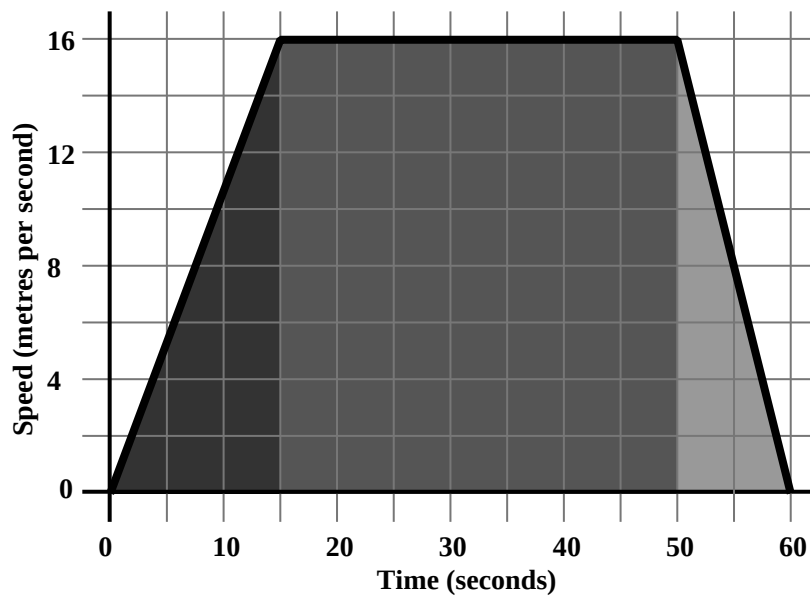
- (ii) Find the area of the constant speed rectangle.
It has a length of 20 seconds and a height of 12 m/s.

- (iii) Find the area of the deceleration triangle.
It has a base of 30 seconds and a height of 12 m/s.

- (iv) Get the total distance by adding together answers (i), (ii) and (iii).

Question 9

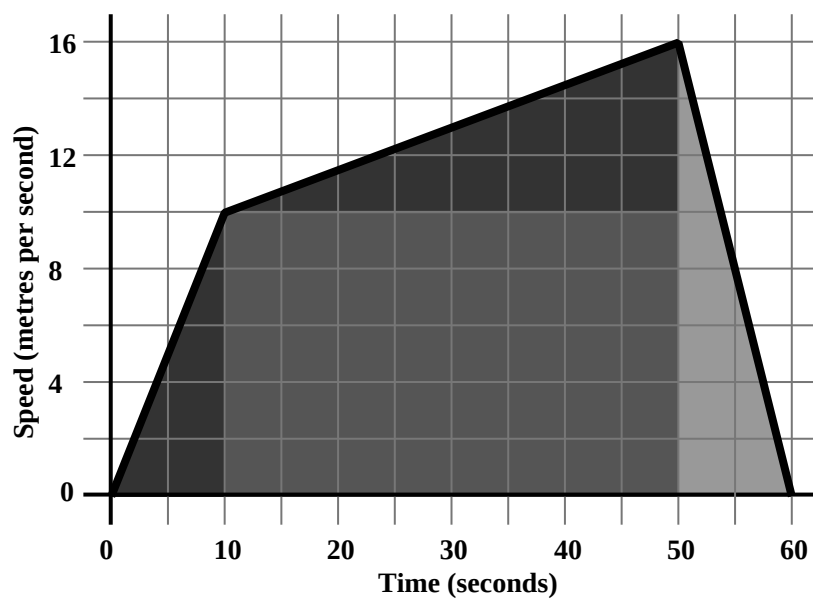
Here is a graph showing a car's speed and time as it moves between traffic lights.



The distance between the traffic lights will be the area shaded.
One way of finding this, is to think of the area as being in three parts.

- (i) Find the area of the acceleration triangle.
- (ii) Find the area of the constant speed rectangle.
- (iii) Find the area of the deceleration triangle.
- (iv) Get the total distance by adding together answers (i), (ii) and (iii).

Question 10



Find the distance represented by the area on this Speed - Time graph.

You may wish to split the area into four bits to help you do this.

4.3 Answers

4.3.1 Solutions (Introduction)

$$\begin{aligned}\text{Area Rectangle} &= \text{Base} \times \text{Height} \\ &= 40 \times 80 \\ &= 320 \text{ m}\end{aligned}$$

On a Speed -Time graph, the Area Under The Graph represents Distance

4.3.2 Solutions (4.2 Exercise)

Answer 1

300 m

Answer 2

440 m

Answer 3

165 m

Answer 4

(i) C

(ii) A

(iii) B

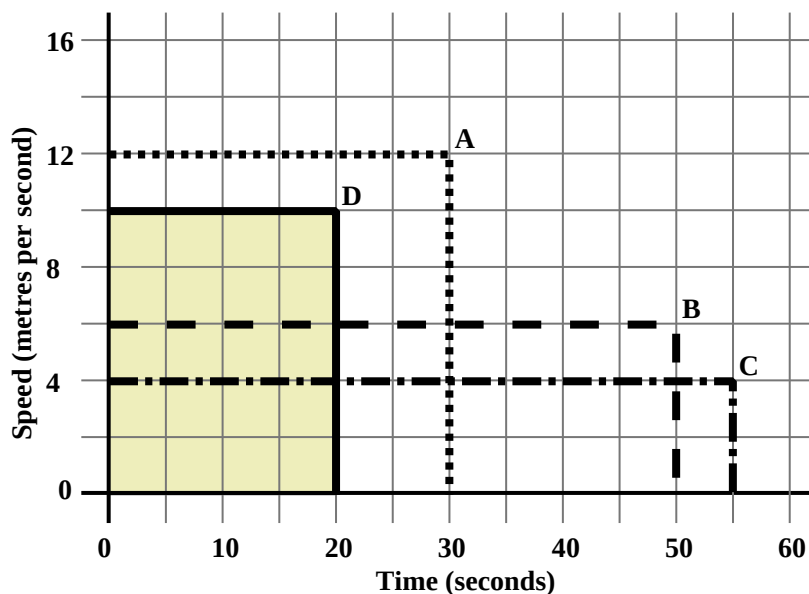
(iv) 360 m

(v) 300 m

(vi) 220 m

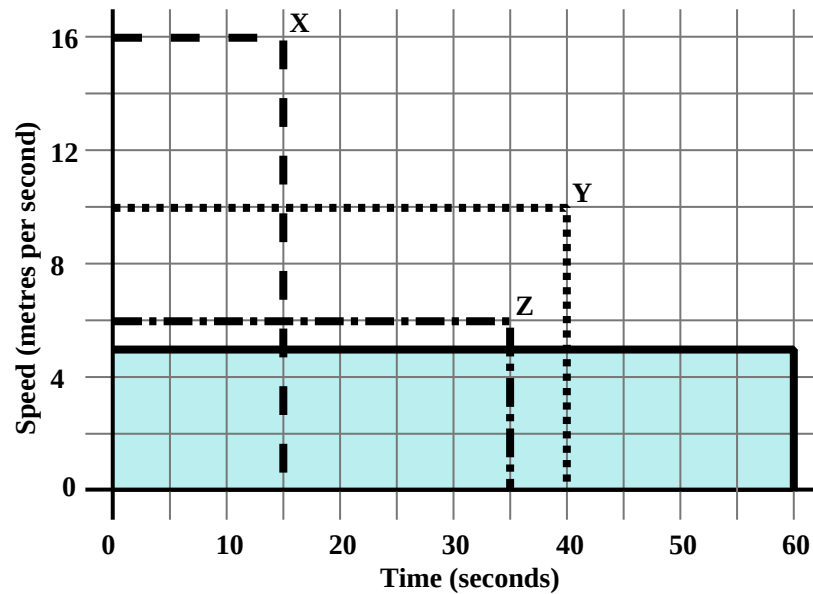
(vii) A

(viii)



Answer 5

- (i) Y
- (ii) X
- (iii) Y
- (iv) 240 m
- (v) 400 m
- (vi) 210 m
- (vii) Y
- (viii)



Answer 6

- (i) (a) 30 (b) 43
- (c) 7 (d) 22
- (ii) (a) 8
- (b) 400 m
- (c) 400 m
- (d) The Answers to part (b) is the same as to part (c)
This illustrates that;
On a Speed -Time graph, Area Under Graph represents Distance

Answer 7

- (i) 14 ms^{-1}
- (ii) 20 s
- (iii) 140 m
- (iv)

$$\begin{aligned}
 D &= A_v S \times T \\
 &= \left(\frac{14 + 0}{2} \right) \times 20 \\
 &= 140 \text{ m}
 \end{aligned}$$

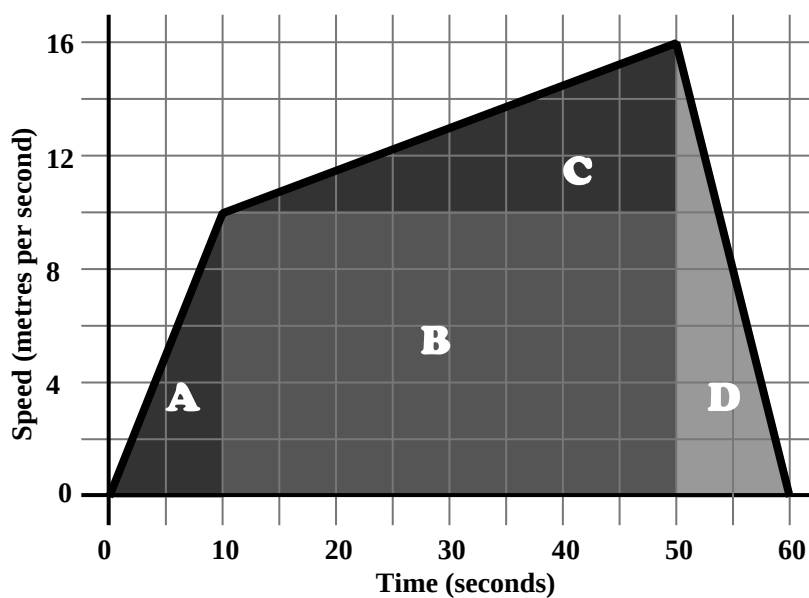
Answer 8

- (i) 60 m
- (ii) 240 m
- (iii) 180 m
- (iv) 480 m

Answer 9

- (i) 120 m
- (ii) 560 m
- (iii) 80 m
- (iv) 760 m

Answer 10



With the regions labelled as shown above...

Area A represents 50 m

Area B represents 400 m

Area C represents 120 m

Area D represents 80 m

Giving a total distance of 650 m

Lesson 5

GCSE Mathematics Kinematics

5.1 Change, Δ

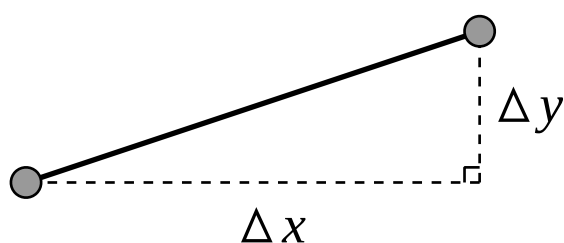
In mathematics the Greek upper case letter delta, Δ , is used to mean *change*.

Example

A car increases its speed, S , from 3 ms^{-1} to 11 ms^{-1}

What is ΔS ?

5.2 Definition of Gradient



For the solid line shown,

$$m = \frac{\Delta y}{\Delta x}$$

where;

m is the gradient

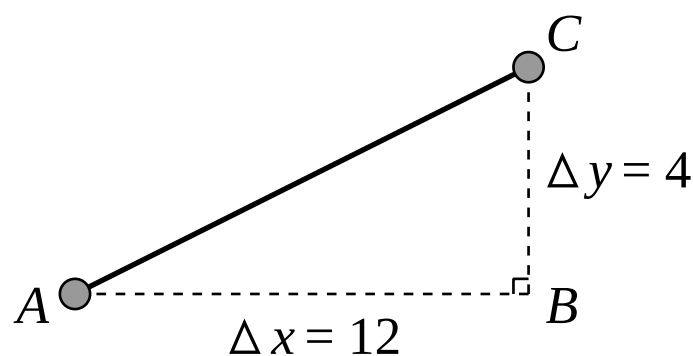
Δy is the change in y

Δx is the change in x

Example

Consider the triangle ABC .

What is the gradient of the line between the points A and C ?



5.3 Exercise

Question 1

A train increases its speed, S , from 7 ms^{-1} to 31 ms^{-1}

What is ΔS ?

Question 2

A man's weight, W , increases from 67.8 kg to 71.7 kg

What is ΔW ?

Question 3

A DJ on Radio 1 gives a time check: 6. 08 am

A little later, the DJ gives another time check: 6.33 am

What is the change in time, ΔT , between the two time checks ?

Question 4

A jogger's speed, S , decreases from 8.3 ms^{-1} to 3.1 ms^{-1}

What is ΔS ?

(Your answer should have a minus sign in it !)

Question 5

A sunflower's height, H , changes by 45 cm .

i.e. $\Delta H = 45 \text{ cm}$

It used to be 57 cm high.

How high is it now ?

Question 6

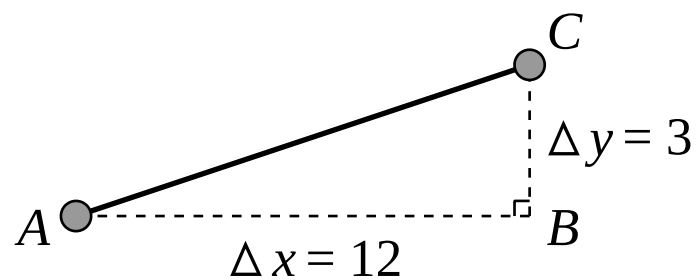
In a triangle, Δy is 39 cm , and Δx is 13 cm .

Use the appropriate formula to calculate the gradient associated with the triangle.

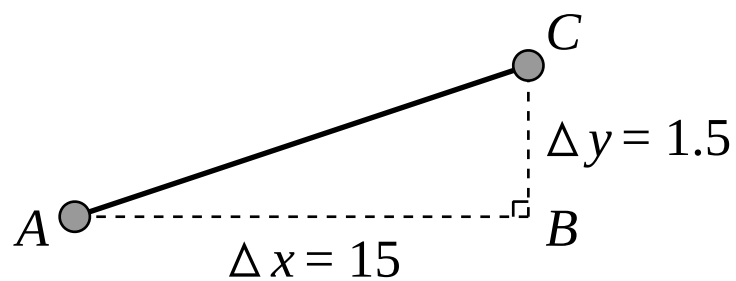
Question 7

Determine the gradient associated with the line AC on each of the following triangles;

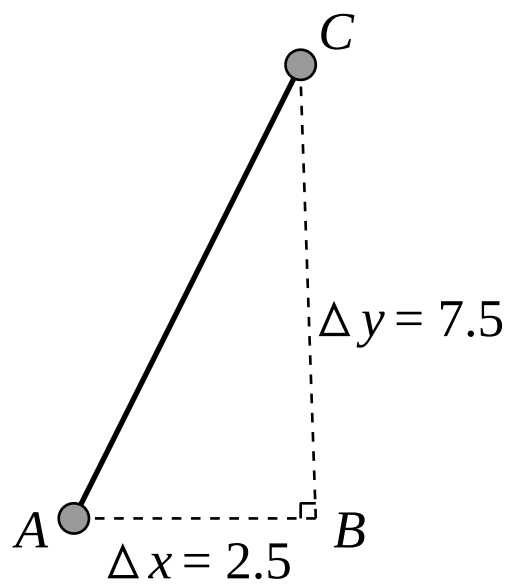
(i)



(ii)



(iii)



Question 8

- (i) I move from a point with x coordinate 3 to a point with x coordinate 11.
What is Δx ?
- (ii) I move from a point with y coordinate 8 to a point with y coordinate 32.
What is Δy ?
- (iii) Use your part (i) and part (ii) answers to help calculate the gradient between the points with coordinates (3, 8) and (11, 32).

Question 9

- (i) I move from a point with x coordinate 4 to a point with x coordinate 7.
What is Δx ?
- (ii) Use your part (i) answer to help calculate the gradient between the points with coordinates (4, 10) and (7, 25).

Question 10

- (i) I move from a point with y coordinate 6 to a point with y coordinate 42.
What is Δy ?
- (ii) Use your part (i) answer to help calculate the gradient between the points with coordinates (1, 6) and (10, 42).

Question 11

Calculate the gradient between the points $(4, 12)$ and $(11, 26)$.

Question 12

Calculate the gradient between the points $(-2, 1)$ and $(3, 21)$.

Question 13

Calculate the gradient between the points $(-4, 4)$ and $(2, 7)$.

Question 14

Calculate the gradient between the points $(8, -4)$ and $(10, 6)$.

Question 15

Calculate the gradient between the points $(-8, -4)$ and $(-2, 2)$.

5.4 Answers

5.4.1 Solutions to Introductory Examples

1st Example

$$\begin{aligned}\Delta S &= 11 - 3 \\ &= 8 \text{ ms}^{-1}\end{aligned}$$

2nd Example

$$\begin{aligned}m &= \frac{\Delta y}{\Delta x} \\ &= \frac{4}{12} = \frac{1}{3}\end{aligned}$$

5.4.2 Solutions to the Exercise (5.3 Exercise)

Answer 1

$$\Delta S = 24 \text{ ms}^{-1}$$

Answer 2

$$\Delta W = 3.9 \text{ kg}$$

Answer 3

$$\Delta T = 25 \text{ minutes}$$

Answer 4

$$- 5.2 \text{ ms}^{-1}$$

Answer 5

$$102 \text{ cm}$$

Answer 6

$$3$$

Answer 7

$$(i) \quad 0.25$$

$$(ii) \quad 0.1$$

$$(iii) \quad 3$$

Answer 8

$$(i) \quad \Delta x = 8$$

$$(ii) \quad \Delta y = 24$$

$$(iii) \quad m = 3$$

Answer 9

$$(i) \quad \Delta x = 3$$

$$(ii) \quad \Delta y = 15 \Rightarrow m = 5$$

Answer 10

$$(i) \quad \Delta y = 36$$

$$(ii) \quad \Delta x = 9 \Rightarrow m = 4$$

$$\text{Answer 11} \quad \Delta x = 7 \quad \Delta y = 14 \Rightarrow m = 2$$

$$\text{Answer 12} \quad \Delta x = 5 \quad \Delta y = 20 \Rightarrow m = 4$$

$$\text{Answer 13} \quad \Delta x = 6 \quad \Delta y = 3 \Rightarrow m = 0.5$$

$$\text{Answer 14} \quad \Delta x = 2 \quad \Delta y = 10 \Rightarrow m = 5$$

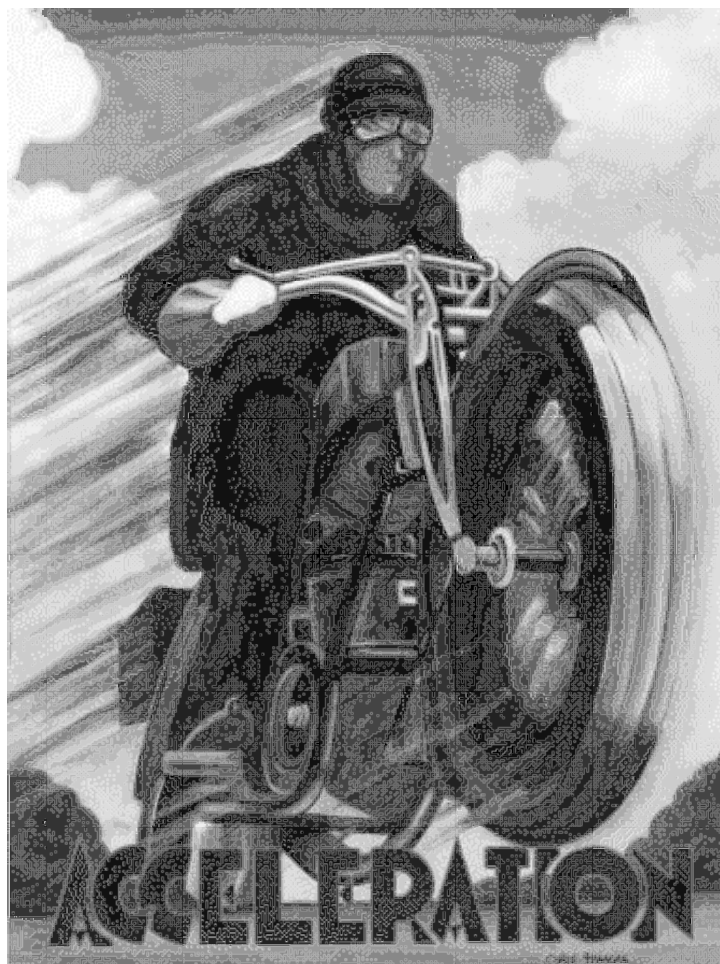
$$\text{Answer 15} \quad \Delta x = 10 \quad \Delta y = 6 \Rightarrow m = 0.6$$

Lesson 6

GCSE Mathematics Kinematics

6.1 Acceleration

A motorbike accelerates from a speed of 4ms^{-1} at a constant rate of 1.5ms^{-2}



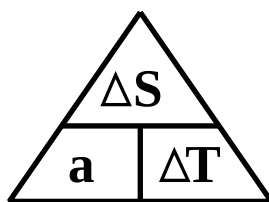
After 1 second its change in speed is : $\therefore$ speed =

After 2 seconds its change in speed is : $\therefore$ speed =

After 3 seconds its change in speed is : $\therefore$ speed =

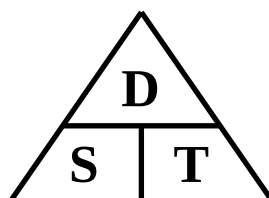
After 4 seconds its change in speed is : $\therefore$ speed =

After t seconds its change in speed is : $\therefore$ speed =



6.2 Formulae for constant acceleration

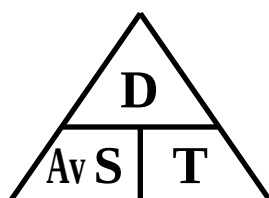
TRUE FOR ZERO ACCELERATION



$$\text{Distance} = \text{Speed} \times \text{Time}$$

TRUE FOR ZERO ACCELERATION

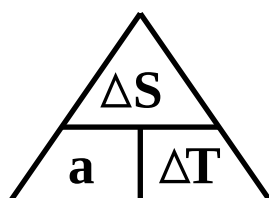
TRUE FOR CONSTANT NON-ZERO ACCELERATION



$$\text{Distance} = \text{Average Speed} \times \text{Time}$$

TRUE FOR CONSTANT NON-ZERO ACCELERATION

TRUE FOR CONSTANT NON-ZERO ACCELERATION



$$\text{acceleration} = \frac{\text{change in Speed}}{\text{change in Time}}$$

TRUE FOR CONSTANT NON-ZERO ACCELERATION

6.3 Example

A motorbike accelerates uniformly from 6 ms^{-1} to 24 ms^{-1} in 3 seconds.

(i) What is the motorbike's change in speed ?

(ii) What is its rate of acceleration ?

6.4 Exercise

Question 1

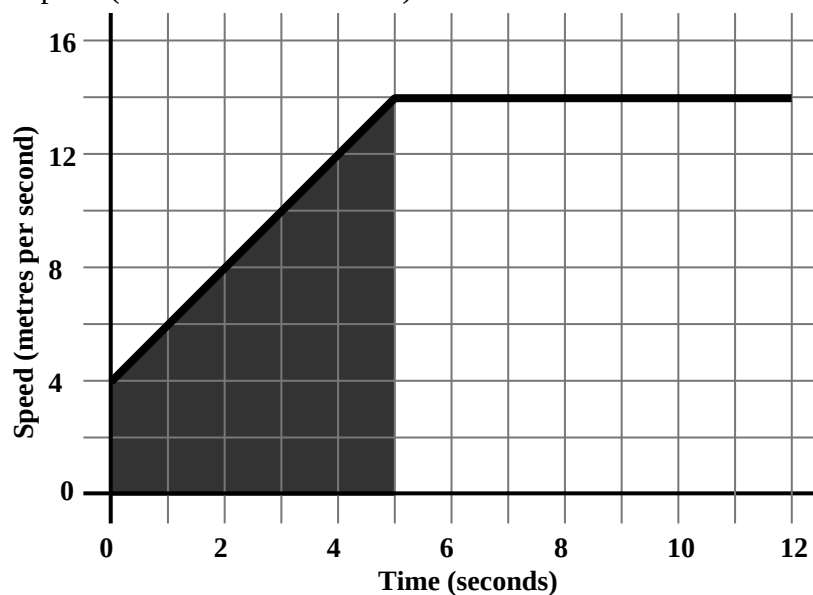
A motorbike accelerates uniformly from 5m/s to 14m/s in 3 seconds.

(i) What is the motorbike's change in speed ?

(ii) What is its rate of acceleration ?

Question 2

The Speed-Time graph shows a car accelerating for 5 seconds, then moving at a constant speed (with zero acceleration).



(i) What is the car's speed when $t = 0$ seconds ?

(ii) What is the car's speed when $t = 5$ seconds ?

(iii) What is the change in speed between $t = 0$ and $t = 5$?

(iv) Calculate the rate of acceleration over the five seconds.

HINT : $a = \frac{\Delta S}{\Delta T}$

(v) Calculate the area shaded, which is the distance travelled whilst accelerating.

Question 3

A pushbike accelerates uniformly from 2.5m/s to 7.5m/s in 10 seconds.

(i) What is the pushbike's change in speed ?

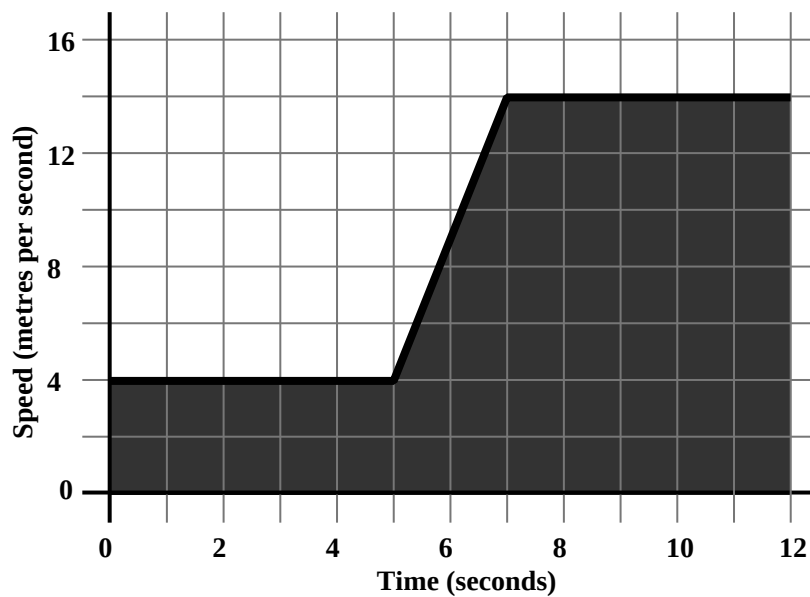
(ii) What is its rate of acceleration ?

Question 4

A truck accelerates uniformly from 3m/s to 17m/s in 7 seconds.

(i) What is the truck's change in speed ?

(ii) What is its rate of acceleration ?

Question 5

A car's speed over a twelve second period is given by the Speed - Time graph.

(i) Between which two times was the car accelerating ?

(ii) Calculate the rate of acceleration.

(iii) Calculate the total distance travelled by the car over the twelve seconds.

Question 6

A sports car accelerates at 3m/s^2 for 4 seconds.

- (i) What is its change in speed ?

HINT : $\Delta S = a \times \Delta T$

The sports car was moving at 8m/s at the start of the acceleration.

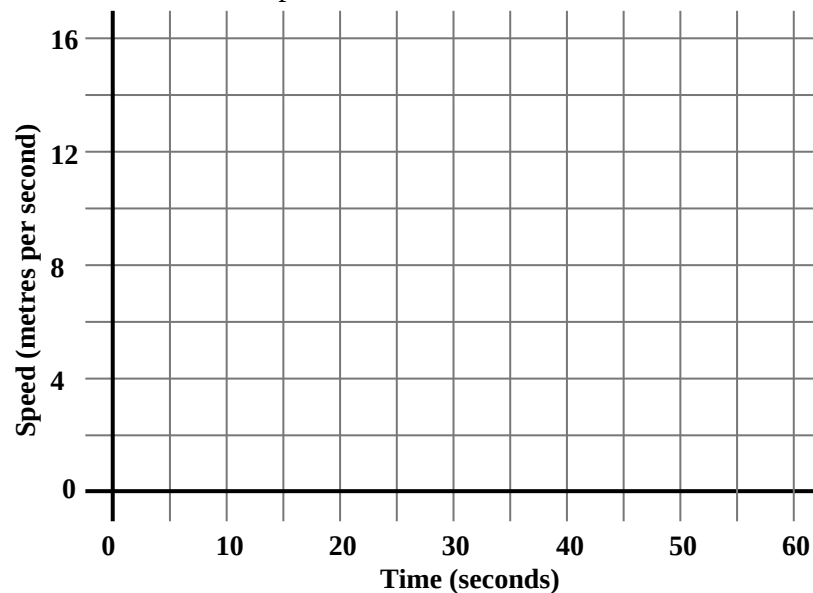
- (ii) What was its speed at the end of the acceleration ?

Question 7

A car is moving at a constant speed of 6m/s between $t = 0$ and $t = 10$ seconds.

Then, over 40 seconds, it accelerates uniformly to a speed of 16m/s .

It then moves at a constant speed of 16m/s for 10 seconds.



- (i) Draw the Speed - Time graph for the car movements described.
- (ii) What is the rate of acceleration between $t = 0$ and $t = 10$?
- (iii) What is the rate of acceleration between $t = 10$ and $t = 50$?
- (iv) What is the rate of acceleration between $t = 50$ and $t = 60$?
- (v) Calculate the distance travelled over the 60 seconds.

Question 8

A bus accelerates at 0.5m/s^2 for 24 seconds.

(i) What is its change in speed ?

HINT : $\Delta S = a \times \Delta T$

The bus was moving at 5.5m/s at the start of the acceleration.

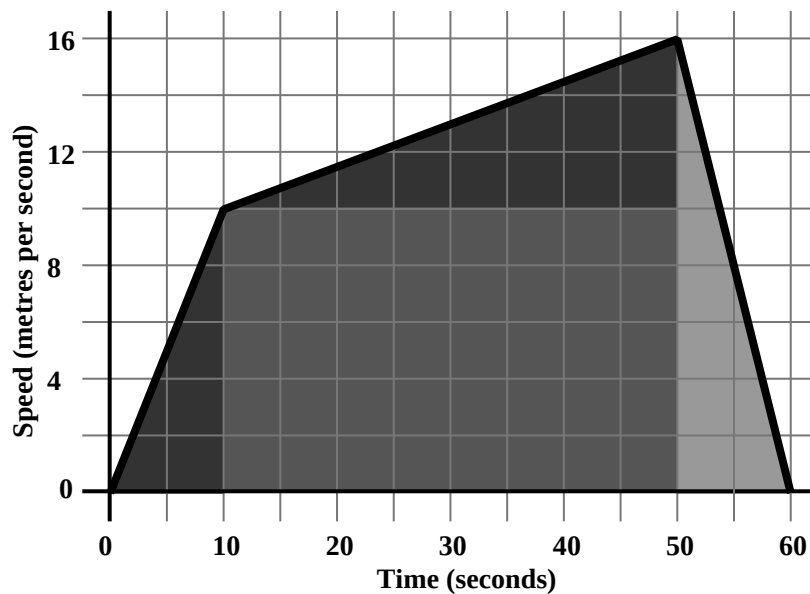
(ii) What was its speed at the end of the acceleration ?

Question 9

How long will it take a car, accelerating uniformly at 2m/s^2 to increase its speed from 3m/s to 21m/s ?

HINT : $\Delta T = \frac{\Delta S}{a}$

Question 10



Calculate the rate of acceleration between;

(i) $t = 0$ and $t = 10$

(ii) $t = 10$ and $t = 50$

(iii) $t = 50$ and $t = 60$

Question 11

A car can slow down at a rate of 5m/s^2 .

- (a) It is travelling at 10m/s . (About 22mph)
(i) How many seconds will it take to stop ?

$$\text{HINT : } \Delta T = \frac{\Delta S}{a}$$

- (ii) How far will it move in that time ?

$$\text{HINT : } D = Av S \times T$$

- (b) It is travelling at 20 m/s . (About 45mph)
(i) How many seconds will it take to stop ?

- (ii) How far will it move in that time ?

- (c) It is travelling at 30 m/s . (About 67mph)
(i) How many seconds will it take to stop ?

- (ii) How far will it move in that time ?

- (d) It is travelling at 40 m/s . (About 90mph)
(i) How many seconds will it take to stop ?

- (ii) How far will it move in that time ?

- (e) Put your part (a), (b), (c) and (d) answers into the table;

speed m/s (mph)	10 (22)	20 (45)	30 (67)	40 (90)
time to stop seconds				
distance to stop metres				

- (f) Comment :

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

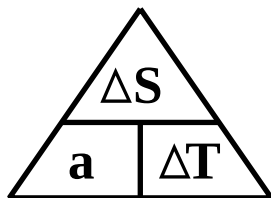
© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

6.5 Answers

GCSE Mathematics Kinematics

6.5.1 Solutions (Introduction)



$$\text{After 1 s, } \Delta S = 1.5 \text{ ms}^{-1} \quad \therefore \text{ speed} = 4 + 1.5 = 5.5 \text{ ms}^{-1}$$

$$\text{After 2 s, } \Delta S = 3 \text{ ms}^{-1} \quad \therefore \text{ speed} = 4 + 3 = 7 \text{ ms}^{-1}$$

$$\text{After 3 s, } \Delta S = 4.5 \text{ ms}^{-1} \quad \therefore \text{ speed} = 4 + 4.5 = 8.5 \text{ ms}^{-1}$$

$$\text{After 4 s, } \Delta S = 6 \text{ ms}^{-1} \quad \therefore \text{ speed} = 4 + 6 = 10 \text{ ms}^{-1}$$

$$\text{After } t, \Delta S = 1.5 t \quad \therefore \text{ speed} = 4 + 1.5t$$

(In physics, this will be taught as $v = u + at$)

6.5.2 Solutions (6.3 Example)

(i) 18 ms^{-1} Emphasise units: ms^{-1} or m/s "metres per second"

(ii) 6 ms^{-2} Emphasise units: ms^{-2} or m/s^2 "metres per second squared"

6.5.3 Solutions (6.4 Exercise)

Answer 1

(i) 9 ms^{-1}

(ii) 3 ms^{-2}

Answer 2

(i) 4 ms^{-1}

(ii) 14 ms^{-1}

(iii) 10 ms^{-1}

(iv) 2 ms^{-2}

(v) 45 m

Answer 3

(i) 5 ms^{-1}

(ii) 0.5 ms^{-2}

Answer 4

- (i) 14 ms^{-1}
- (ii) 2 ms^{-2}

Answer 5

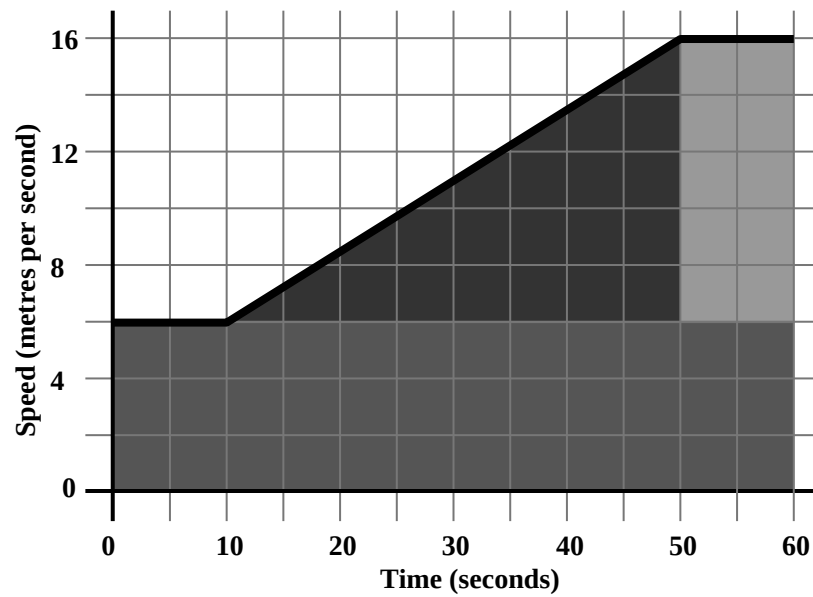
- (i) Between $t = 5 \text{ s}$ and $t = 7 \text{ s}$
- (ii) 5 ms^{-2}
- (iii) $48 + 10 + 50 = 108 \text{ m}$

Answer 6

- (i) 12 ms^{-1}
- (ii) 20 ms^{-1}

Answer 7

- (i)



- (ii) 0 ms^{-2}
- (iii) 0.25 ms^{-2}
- (iv) 0 ms^{-2}
- (v) $360 + 200 + 100 = 660 \text{ m}$

Answer 8

- (i) 12 ms^{-1}
- (ii) 17.5 ms^{-1}

Answer 9

9 s

Answer 10

- (i) 1 ms^{-2}
(ii) 0.15 ms^{-2}
(iii) 1.6 ms^{-2}

Answer 11

- (a) (i) 2 s
(ii) 10 m
- (b) (i) 4 s
(ii) 40 m
- (c) (i) 6 s
(ii) 90 m
- (d) (i) 8 s
(ii) 160 m

(e)

speed m/s (mph)	10 (22)	20 (45)	30 (67)	40 (90)
time to stop seconds	2	4	6	8
distance to stop metres	10	40	90	160

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted “**Independent School of the Year 2020**”

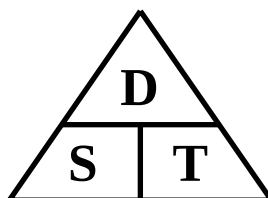
© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

7.1 REVISION

You May Use A Calculator

Question 1



By using the constant speed formula triangle, or otherwise, write down a formula for *time* in terms of *speed* and *distance*

time =

[2 marks]

Question 2

(i) How many metres are in a kilometre ?

(ii) How many seconds are in an hour ?

[2 marks]

Question 3

Brian, my pet snail, moves at a constant speed of 0.2 ms^{-1} for 20 minutes.

(i) How many seconds are in 20 minutes ?

(ii) How far does Brian travel in this time ?

(iii) Is this more or less than $\frac{1}{4} \text{ km}$?

[4 marks]

Question 4

A woman leaves her house at 2.25 pm.

She jogs at a steady speed of 3 m/s returning home at 2.40 pm.

- (i) For how long did the woman jog ?
Give your answer in seconds.

[2 marks]

- (ii) How far did the woman travel ?
Give your answer in metres.

[2 marks]

- (iii) Change your part (ii) answer into km.

[1 mark]

Question 5

A speed boat accelerates uniformly from a speed of 2 ms^{-1} to a speed of 24 ms^{-1} over 10 seconds.

- (i) What is the average speed of the speed boat over the 10 seconds ?

[1 mark]

- (ii) Use the formula;

$$\text{Distance} = \text{Average Speed} \times \text{Time}.$$

to calculate the distance the speed boat covers whilst accelerating.

[1 mark]

Question 6

In mathematics the Greek letter delta, Δ , is used for the word *change*

A man's weight, W , increases from 65.7 kg to 72.6 kg

What is ΔW ?

[1 mark]

Question 7

On a speed-time graph;

(i) What does the “area under the graph” represent ?

[1 mark]

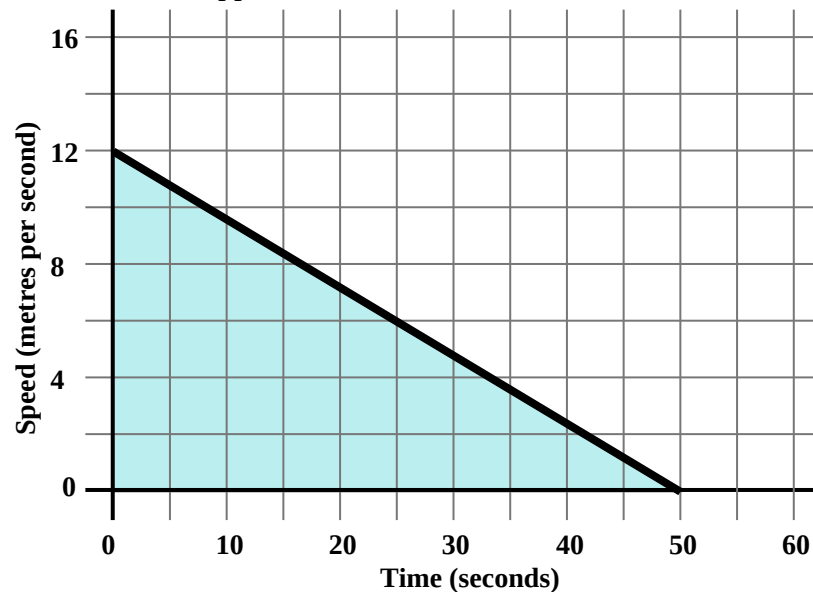
(ii) What does the “gradient of a line” represent ?

[1 mark]

Question 8

The Speed-Time graph is of a train approaching a STOP sign.

At $t = 0$ the train first applies the brakes.



(i) What speed was the train doing when it first applies the brakes ?

[1 mark]

(ii) How long did it take for the train to stop ?

[1 mark]

(iii) What distance does the train travel whilst stopping ?

[2 marks]

(iv) The train first applied the brakes when the STOP sign was 0.4 km away.
Does it stop before or after reaching the STOP sign ?

[1 mark]

(v) What was the train's rate of deceleration ?

[2 marks]

Question 9

GCSE Examination Question from January 2014, Q2

A plane flew from Frankfurt to Hong Kong.

The flight time was 10 hours 45 minutes.

The average speed was 852 km/h.

Work out the distance, in km, the plane flew.

[3 marks]

Question 10

- (i) I move from a point with x coordinate 13 to a point with x coordinate 21.
What is Δx ?

[1 mark]

- (ii) I move from a point with y coordinate 5 to a point with y coordinate 29.
What is Δy ?

[1 mark]

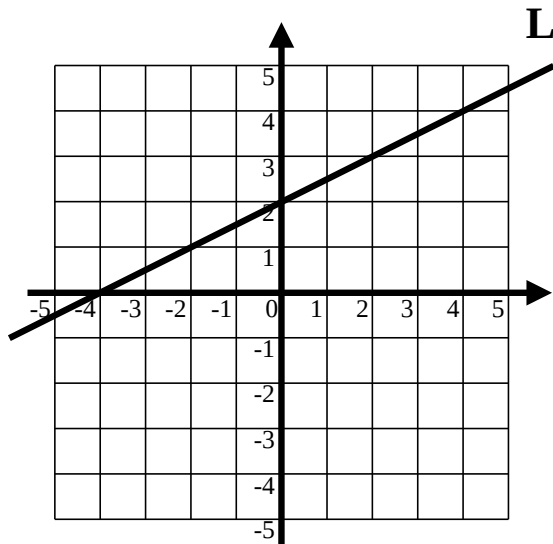
- (iii) Use your part (i) and part (ii) answers to help calculate the gradient
between the points with coordinates (13, 5) and (21, 29).

[2 marks]

Question 11

GCSE Examination Question from June 2009, Q12 (a)

The straight line, **L**, passes through the points $(0, 2)$ and $(2, 3)$



Work out the gradient of **L**

[2 marks]

Question 12

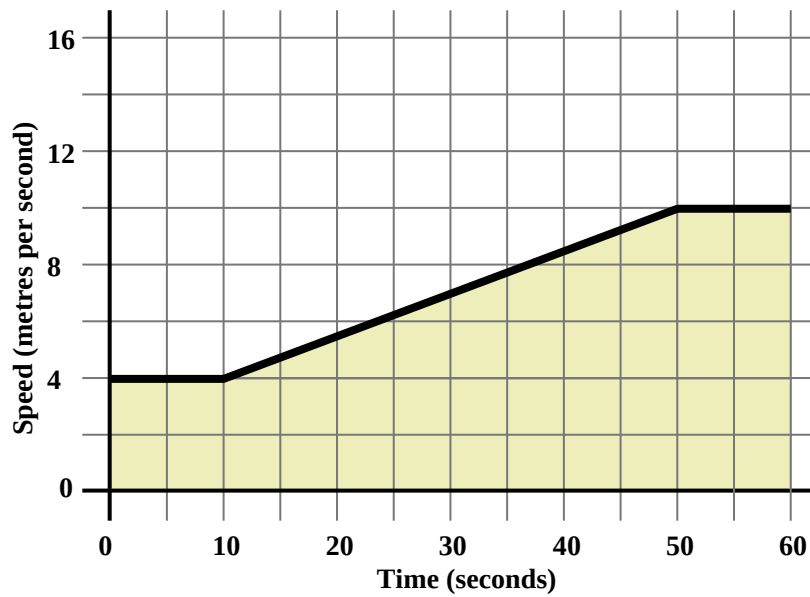
GCSE Examination Question from June 2011, Q4

The length of Rachael's journey from her home to work is 72 km.
The journey takes 1 hour 20 minutes.

Work out her average speed in km/h

[3 marks]

Question 13



A car's speed over a sixty second period is given by the Speed - Time graph.

(i) Between which two times was the car accelerating ?

[1 mark]

(ii) Calculate the rate of acceleration.

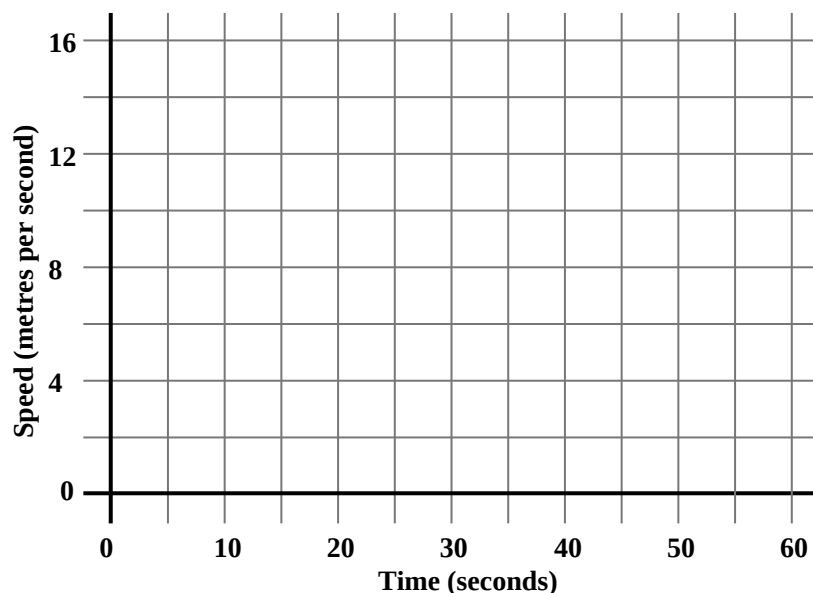
[2 marks]

(iii) Calculate the total distance travelled by the car over the sixty seconds.
Clearly show your working.

[4 marks]

Question 14

A car is moving at a constant speed of 2 ms^{-1} between $t = 0$ and $t = 20$ seconds.
Then, over 25 seconds, it accelerates uniformly to a speed of 12 ms^{-1}
It then moves at a constant speed of 12 ms^{-1} for 15 seconds.



Draw the Speed - Time graph for the car movements described.

[3 marks]

Question 15

GCSE Examination Question from January 2012, Q2

An aeroplane flew from Qatar to Bahrain.
The distance flown was 135 km
The average speed was 180 km/h.

Work out the time taken.

Give your answer in minutes.

[3 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

7.2 Answers

GCSE Mathematics Kinematics

Answer 1 $time = \frac{distance}{speed}$

Answer 2

(i) 1000

(ii) 3600

Answer 3

(i) 1200 seconds

(ii) 240 metres

(iii) less

Answer 4

(i) 900 seconds

(ii) 2700 metres

(iii) 2.7 km

Answer 5

(i) 13 m/s

(ii) 130 m

Answer 6

6.9 kg

Answer 7

(i) distance

(ii) acceleration

Answer 8

(i) 12m/s

(ii) 50 s

(iii) 300m

(iv) before

(v) (–) 0.24 m/s²

Answer 9

$852 \times 10.75 = 9159$ km

Answer 10

(i) 8

(ii) 24

(iii) 3

Answer 11

0.5

Answer 12

$72 \div 1\frac{1}{3} = 54$ km/h

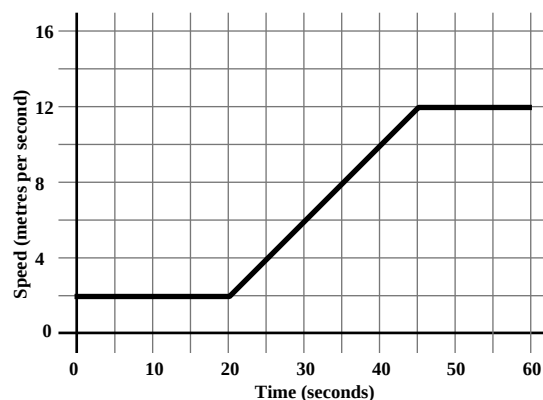
Answer 13

(i) $t = 10$ s and $t = 50$ s

(ii) $6 \div 40 = 0.15$ m/s²

(iii) 420 m

Answer 14



Answer 15 : 45 minutes

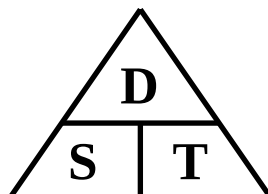
Lesson 8

GCSE Mathematics Kinematics

8.1 TEST

You May Use A Calculator

Question 1



By using the constant speed formula triangle, or otherwise, write down a formula for *speed* in terms of *time* and *distance*

speed =

[2 marks]

Question 2

(i) How many metres are in a kilometre ?

(ii) How many minutes are in a day ?

[2 marks]

Question 3

Slider, my pet snake, moves at a constant speed of 0.4 ms^{-1} for 15 minutes.

(i) How many seconds are in 15 minutes ?

(ii) How far does Slider travel in this time ?

(iii) Is this more or less than $\frac{1}{4} \text{ km}$?

[4 marks]

Question 4

A woman leaves her house at 5.04 pm.

She jogs at a steady speed of 2 m/s returning home at 5.31 pm.

- (i) For how long did the woman jog ?
Give your answer in seconds.

[2 marks]

- (ii) How far did the woman travel ?
Give your answer in metres.

[2 marks]

- (iii) Change your part (ii) answer into km.

[1 mark]

Question 5

A speed boat accelerates uniformly from a speed of 8 ms^{-1} to a speed of 26 ms^{-1} over 10 seconds.

- (i) What is the average speed of the speed boat over the 10 seconds ?

[1 mark]

- (ii) Use the formula;

$$\text{Distance} = \text{Average Speed} \times \text{Time}.$$

to calculate the distance the speed boat covers whilst accelerating.

[1 mark]

Question 6

In mathematics the Greek letter delta, Δ , is used for the word *change*

A man's weight, W , increases from 61.9 kg to 72.4 kg

What is ΔW ?

[1 mark]

Question 7

On a speed-time graph;

- (i) What does the “gradient of a line” represent ?

[1 mark]

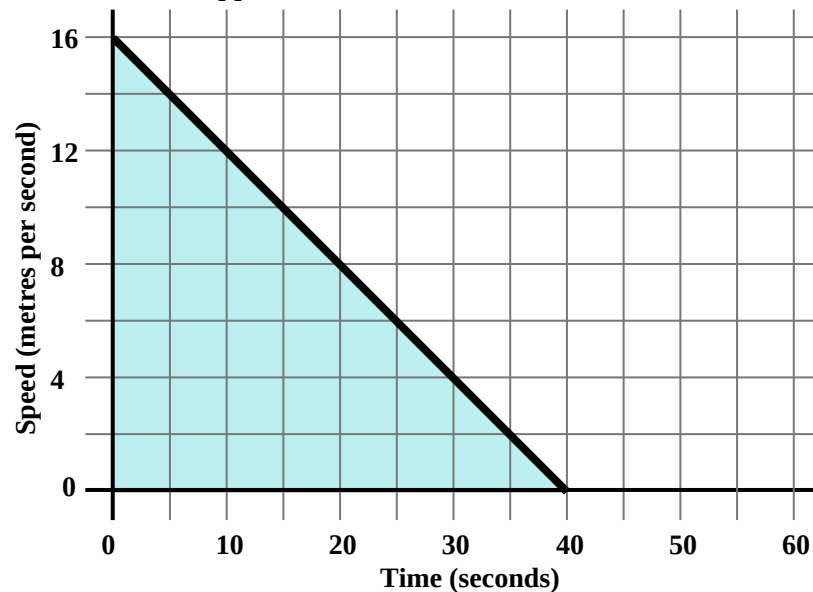
- (ii) What does the “area under the graph” represent ?

[1 mark]

Question 8

The Speed-Time graph is of a train approaching a STOP sign.

At $t = 0$ the train first applies the brakes.



- (i) What speed was the train doing when it first applies the brakes ?

[1 mark]

- (ii) How long did it take for the train to stop ?

[1 mark]

- (iii) What distance does the train travel whilst stopping ?

[2 marks]

- (iv) The train first applied the brakes when the STOP sign was 0.5 km away.
Does it stop before or after reaching the STOP sign ?

[1 mark]

- (v) What was the train's rate of deceleration ?

[2 marks]

Question 9

GCSE Examination Question from May 2009, Q2

Omar travelled from Nairobi to Mombasa by train.

The journey took 13 hours 15 minutes.

The average speed was 40 km/h.

Work out the distance, in km, from Nairobi to Mombasa.

[3 marks]

Question 10

- (i) I move from a point with x coordinate 9 to a point with x coordinate 15.
What is Δx ?

[1 mark]

- (ii) I move from a point with y coordinate 8 to a point with y coordinate 32.
What is Δy ?

[1 mark]

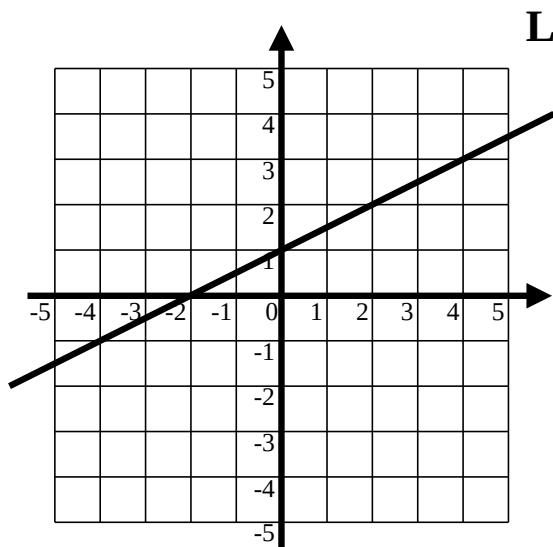
- (iii) Use your part (i) and part (ii) answers to help calculate the gradient
between the points with coordinates (9, 8) and (15, 32).

[2 marks]

Question 11

GCSE Examination Question from May 2008, Q14 (a) (i)

A line, **L**, passes through the points (0, 1) and (4, 3)



Find the gradient of the line **L**

[2 marks]

Question 12

GCSE Examination Question from November 2006, Q5

Bridget flew from the UK to Dubai.

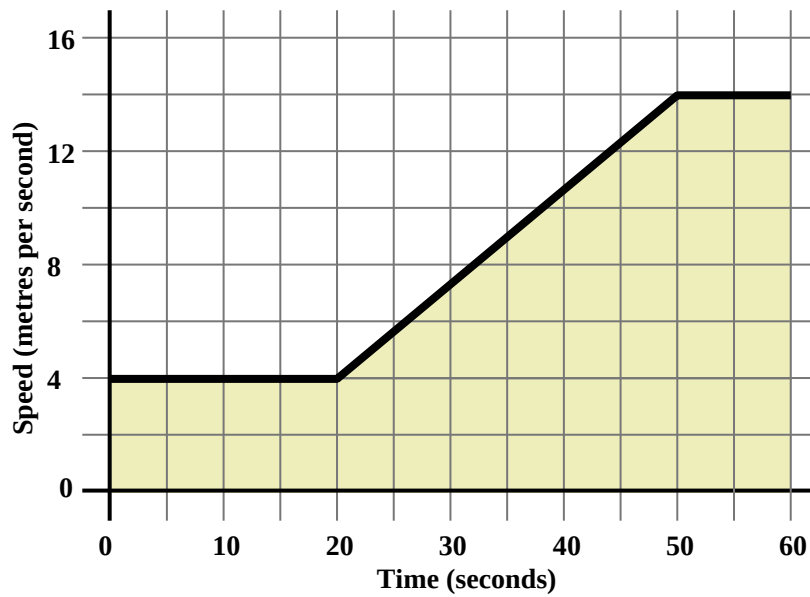
Her flight from the UK to Dubai covered a distance of 5456 km.

The flight time was 7 hours 45 minutes.

Work out the average speed of the flight in km/h

[3 marks]

Question 13



A car's speed over a sixty second period is given by the Speed-Time graph.

(i) Between which two times was the car accelerating ?

[1 mark]

(ii) Calculate the rate of acceleration.

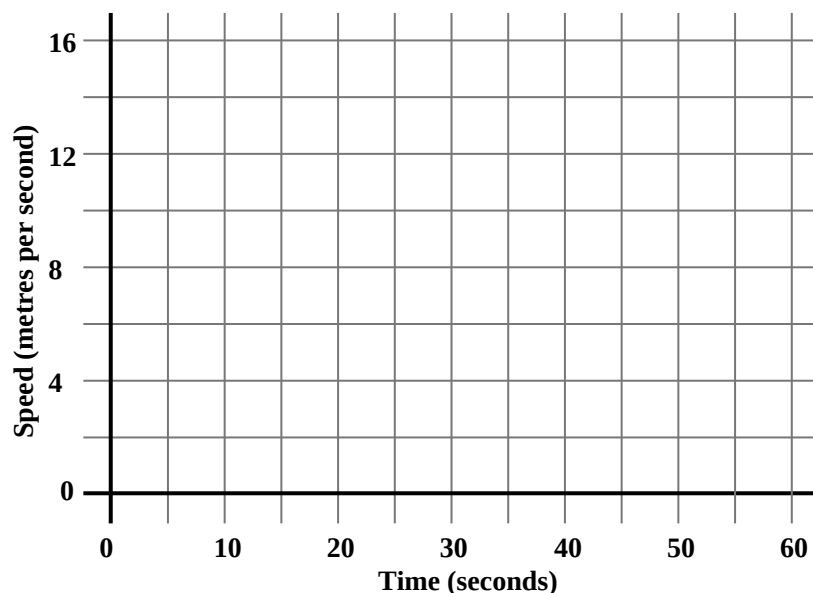
[2 marks]

(iii) Calculate the total distance travelled by the car over the sixty seconds.
Clearly show your working.

[4 marks]

Question 14

A car is moving at a constant speed of 4 ms^{-1} between $t = 0$ and $t = 30$ seconds.
Then, over 20 seconds, it accelerates uniformly to a speed of 14 ms^{-1}
It then moves at a constant speed of 14 ms^{-1} for 10 seconds.



Draw the Speed - Time graph for the car movements described.

[3 marks]

Question 15

GCSE Examination Question from November 2008, Q4

A train travels 165 km.
The average speed for the journey is 60 km/h.

Work out the time that this journey takes.
Give your answer in hours and minutes.

[3 marks]

This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

8.2 Answers

GCSE Mathematics Kinematics

Answer 1 $speed = \frac{distance}{time}$

Answer 2

- (i) 1000
- (ii) 1440 minutes

Answer 3

- (i) 900 seconds
- (ii) 360 metres
- (iii) more

Answer 4

- (i) 1620 seconds
- (ii) 3240 metres
- (iii) 3.24 km

Answer 5

- (i) 17 m/s
- (ii) 170 m

Answer 6

10.5 kg

Answer 7

- (i) acceleration
- (ii) distance

Answer 15 : 2 hours 45 minutes

Answer 8

- (i) 16 m/s
- (ii) 40 s
- (iii) 330m
- (iv) before
- (v) (–) 0.4 m/s²

Answer 9

$40 \times 13.25 = 530 \text{ km}$

Answer 10

- (i) 6
- (ii) 24
- (iii) 4

Answer 11

0.5

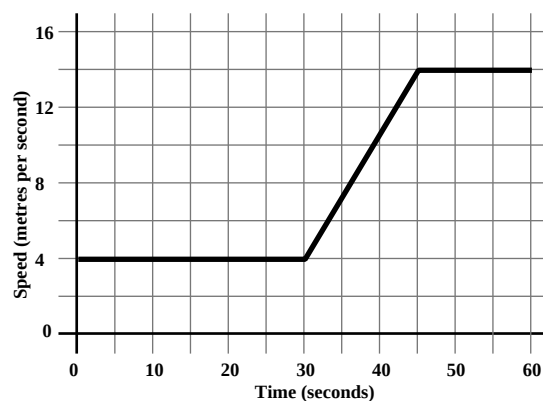
Answer 12

$5456 \div 7.75 = 704 \text{ km/h}$

Answer 13

- (i) $t = 20 \text{ s}$ and $t = 50 \text{ s}$
- (ii) $10 \div 30 = 0.333 \text{ m/s}^2$
- (iii) 490 m

Answer 14



This document is a part of a **Mathematics Community Outreach Project** initiated by Shrewsbury School

It may be freely duplicated and distributed, unaltered, for non-profit educational use

In October 2020, Shrewsbury School was voted "**Independent School of the Year 2020**"

© 2025 Number Wonder

Teachers may obtain detailed worked solutions to the exercises by email from MHHShrewsbury@Gmail.com

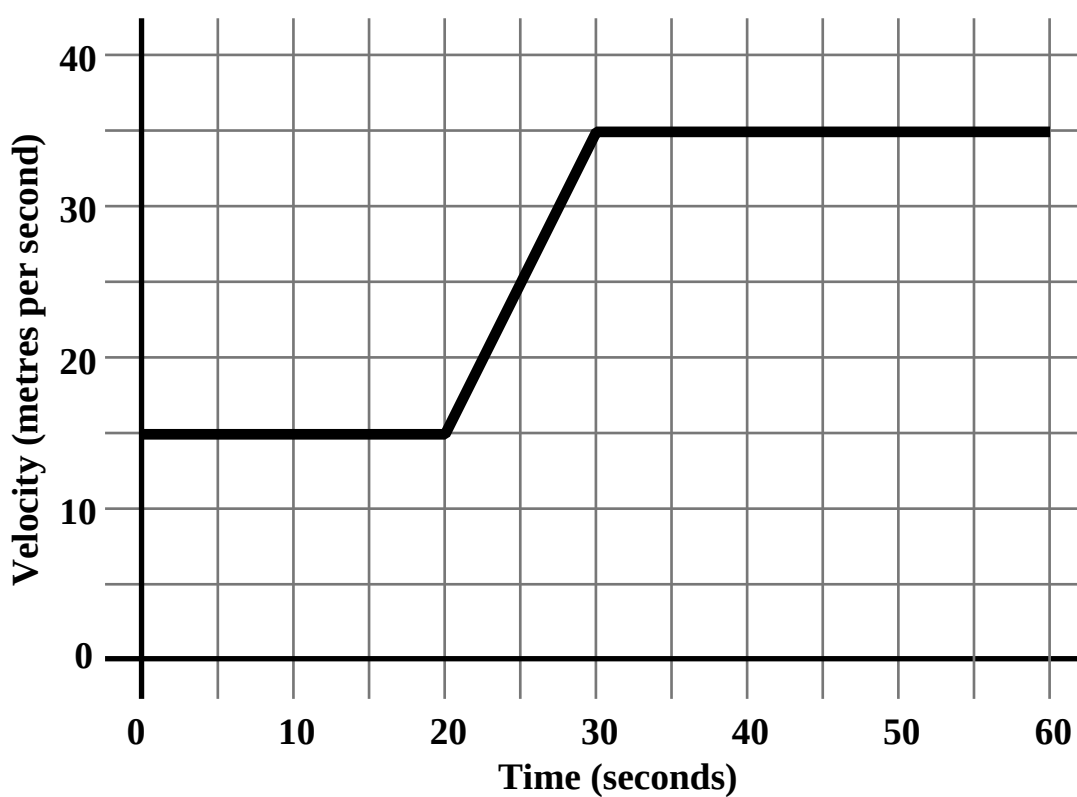
9.1 Velocity-Time Graph Work-Out (Homework)

*You May Use A Calculator***Question 1**

A car travels at a steady 15 m/s for 20 seconds before accelerating uniformly for 10 seconds to a speed of 35 m/s.

This speed is maintained for half a minute.

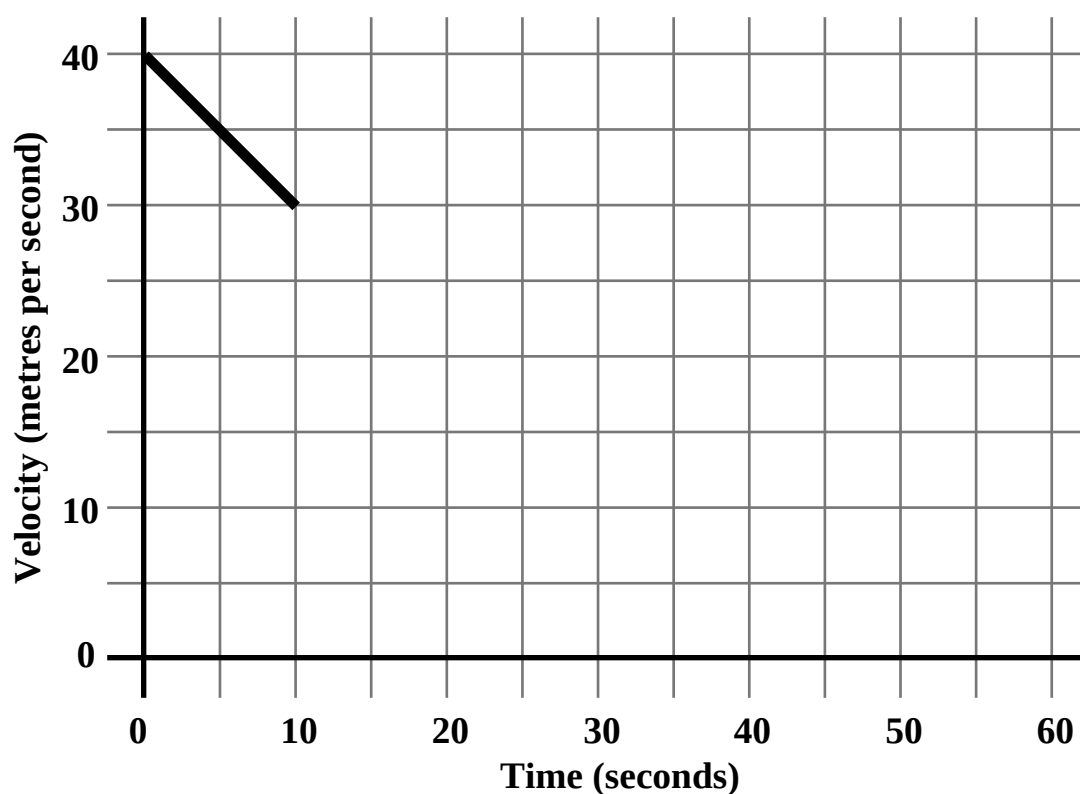
This information is shown on the velocity-time graph presented below:



- (i) Calculate the total distance covered over the 60 second period.
- (ii) What, in m/s^2 is the acceleration ?

Question 2 : Trouble Ahead

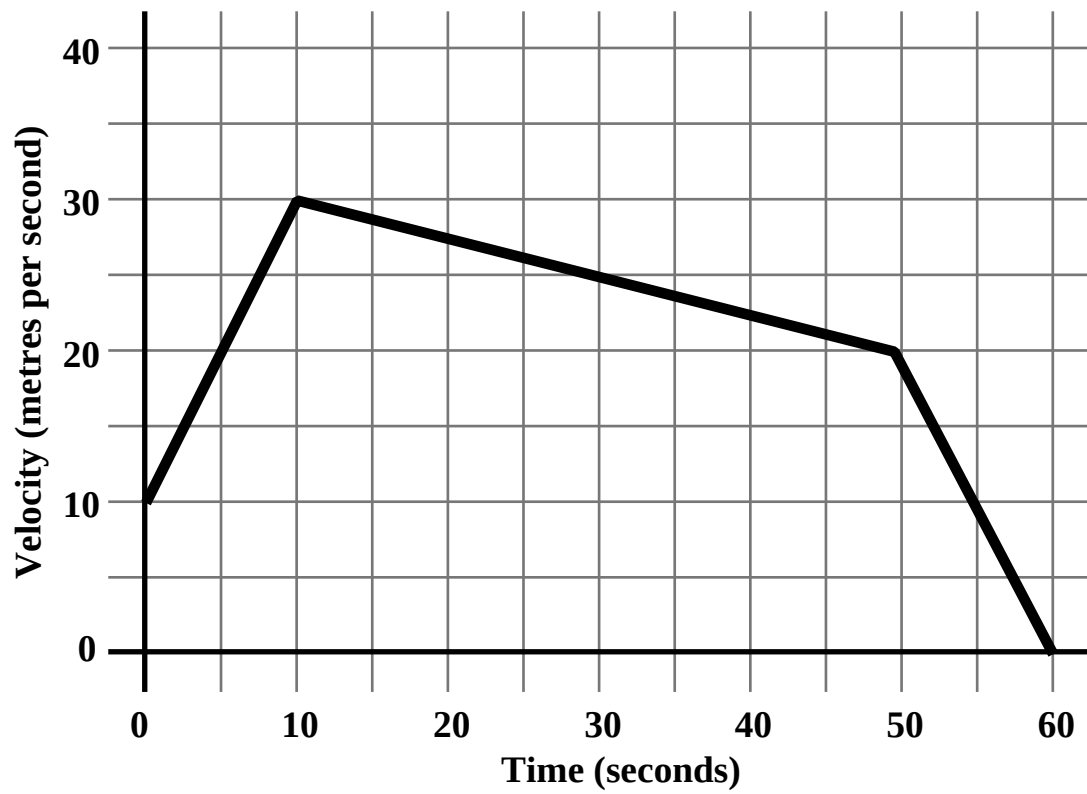
A car is travelling down a motorway at 40 m/s when its driver sees trouble ahead. She slows down to 30 m/s over ten seconds as shown in the graph below:



She then travels at a constant speed for twenty seconds before slowing at a constant rate over thirty seconds to come to a stop just in front of the trouble.

- (i) Complete the above velocity-time graph to show the additional information.
- (ii) How far was the lady from the trouble ahead when she first saw it ?
- (iii) Calculate her first deceleration.
- (iv) Calculate her second deceleration.

Question 3



(i) Calculate the area under the above velocity-time graph.

(ii) What does this area represent ?

Question 4 : Bank Robbery

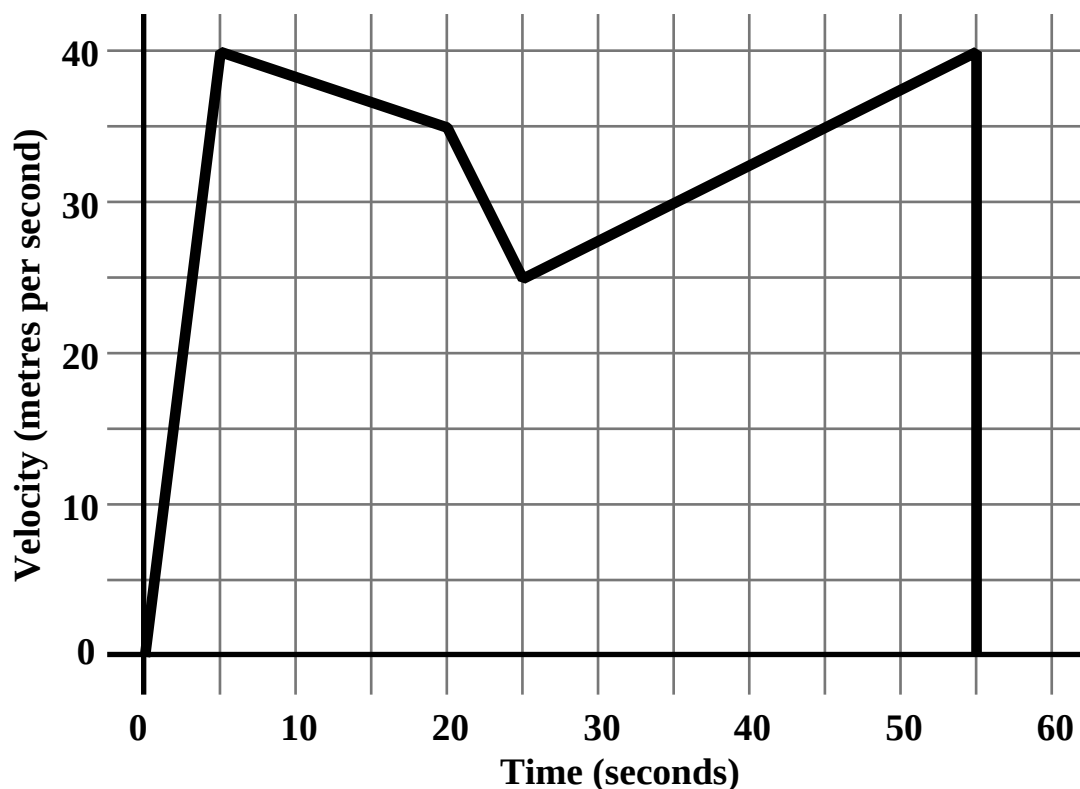
In trying to get away after a bank robbery, a car accelerates from rest to 40 m/s in five seconds.

A mother pushing a baby in a pram across the road causes first a gentle, then a more savage application of the brakes.

The baby safe, the car again accelerates to 40m/s.

Too late, the driver sees a red light, and crashes into a petrol tanker at a cross-roads. Kaargh-boom !

The failed get-away is shown on the velocity-time graph below.



- (i) How far from the bank did the crash occur ?
- (ii) Calculate the two accelerations and the two decelerations.

9.2 Brief Answers

GCSE Mathematics Kinematics

Answer 1

- (i) 1600 metres
- (ii) 2 m/s

Answer 2

- (i)
- (ii) 1400 metres
- (iii) 1 m/s^2
- (iv) It's the same as is obvious from the graph, 1 m/s^2

Answer 3

- (i) 1300 m
- (ii) distance

Answer 4

- (i) 1787.5 m
- (ii) 8 m/s^2 $-\frac{1}{3} \text{ m/s}^2$ -2 m/s^2 0.5 m/s^2

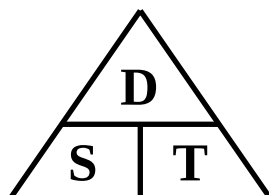
Lesson 10

GCSE Mathematics Kinematics

10.1 Later Date Revision

You May Use A Calculator

Question 1



By using the constant speed formula triangle, or otherwise, write down a formula for *distance* in terms of *time* and *speed*

distance =

[2 marks]

Question 2

(i) How many metres are in a kilometre ?

(ii) How many seconds are in a day ?

[2 marks]

Question 3

Tickles, my pet spider, moves at a constant speed of 0.6 ms^{-1} for 12 minutes.

(i) How many seconds are in 12 minutes ?

(ii) How far does Tickles travel in this time ?

(iii) Is this more or less than $\frac{1}{2} \text{ km}$?

[4 marks]

Question 4

A cyclist leaves her house at 6.48 am.

She peddles at a steady speed of 7 m/s returning home at 7.33 am.

(i) For how long did the cyclist peddle ?

Give your answer in seconds.

[2 marks]

(ii) How far did the cyclist travel ?

Give your answer in metres.

[2 marks]

(iii) Change your part (ii) answer into km.

[1 mark]

Question 5

A train accelerates uniformly from a speed of 4 ms^{-1} to

a speed of 28 ms^{-1} over 32 seconds.

(i) What is the average speed of the train over the 32 seconds ?

[1 mark]

(ii) Use the formula;

$$\text{Distance} = \text{Average Speed} \times \text{Time}.$$

to calculate the distance the train covers whilst accelerating.

[1 mark]

Question 6

In mathematics the Greek letter delta, Δ , is used for the word *change*.

A child's mass, M , increases from 15.8 kg to 18.1 kg

What is ΔM ?

[1 mark]

Question 7

On a speed-time graph;

(i) What does the “gradient of a line” represent ?

[1 mark]

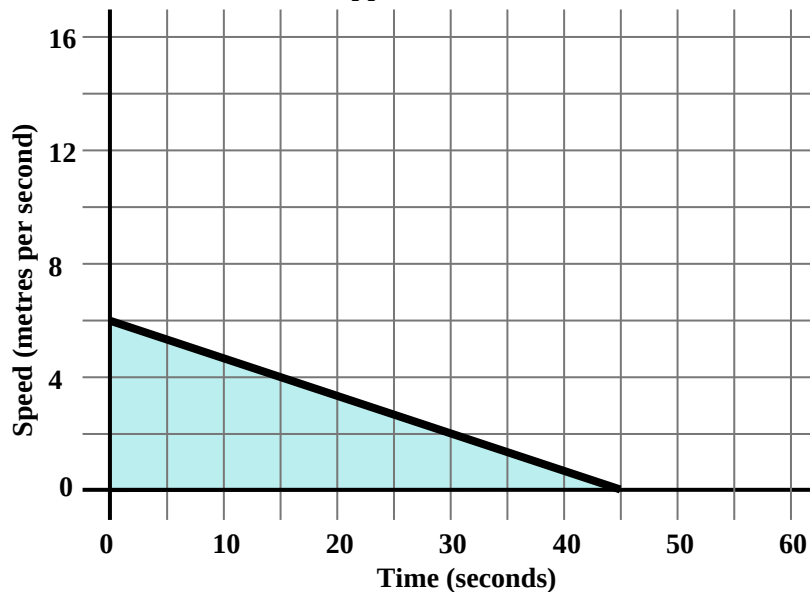
(ii) What does the “area under the graph” represent ?

[1 mark]

Question 8

The Speed-Time graph is of a mobility scooter approaching a STOP sign.

At $t = 0$ the scooter's driver first applies the brakes.



(i) What speed was the driver doing when he first applies the brakes ?

[1 mark]

(ii) How long did it take for the mobility scooter to stop ?

[1 mark]

(iii) What distance does the mobility scooter travel whilst stopping ?

[2 marks]

(iv) The driver first applied the brakes when the STOP sign was 0.25 km away.
Does it stop before or after reaching the STOP sign ?

[1 mark]

(v) What was the mobility scooter's rate of deceleration ?

[2 marks]

Question 9

GCSE Examination Question from May 2022, Paper 2H, Q3 (Edexcel)

An aeroplane travelled from New York City to Los Angeles.

The aeroplane travelled a distance of 3980 kilometres 5 hours 24 minutes.

Work out the average speed of the aeroplane.

Give your answer in kilometres per hour correct to the nearest whole number.

[3 marks]

Question 10

- (i) I move from a point with x coordinate 5 to a point with x coordinate 9.
What is Δx ?

[1 mark]

- (ii) I move from a point with y coordinate 11 to a point with y coordinate 23.
What is Δy ?

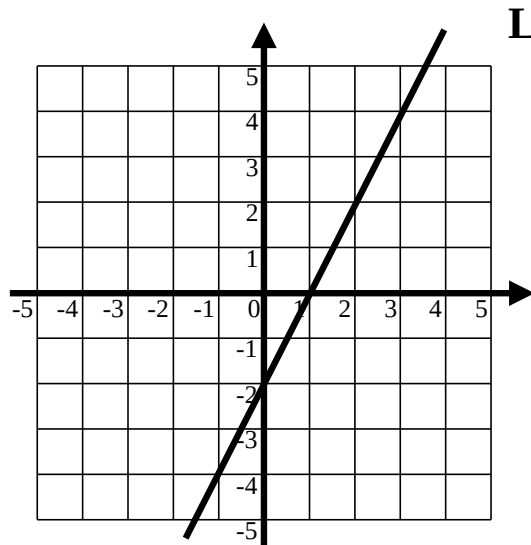
[1 mark]

- (iii) Use your part (i) and part (ii) answers to help calculate the gradient
between the points with coordinates (5, 11) and (9, 23).

[2 marks]

Question 11

A line, **L**, passes through the points $(0, -2)$ and $(3, 4)$



Find the gradient of the line **L**

[2 marks]

Question 12

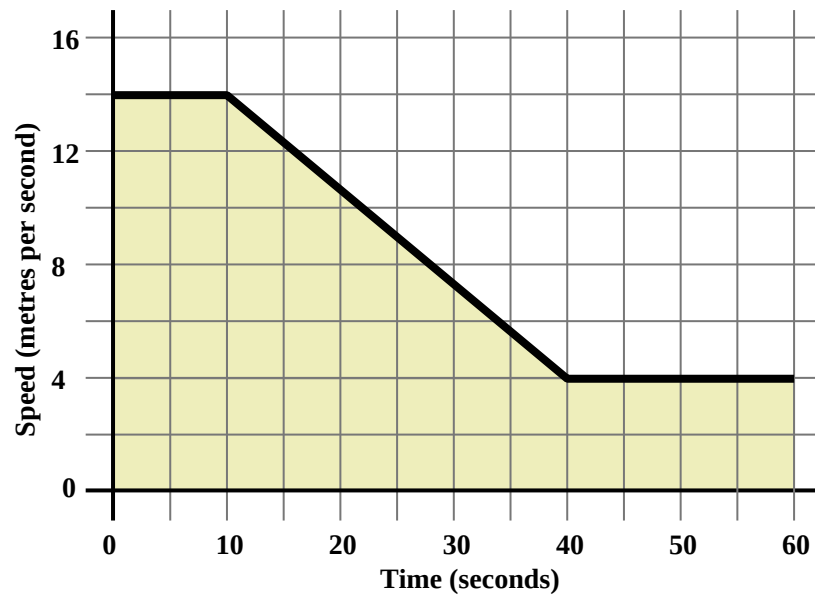
GCSE Examination Question from January 2021, Paper 1H, Q4 (Edexcel)

A train journey from Paris to Amsterdam took 3 hours 24 minutes.
The total distance the train travelled was 433.5 km.

Work out the average speed of the train.
Give your answer in kilometres per hour.

[3 marks]

Question 13



A car's speed over a sixty second period is given by the Speed-Time graph.

(i) Between which two times was the car decelerating ?

[1 mark]

(ii) Calculate the rate of deceleration.

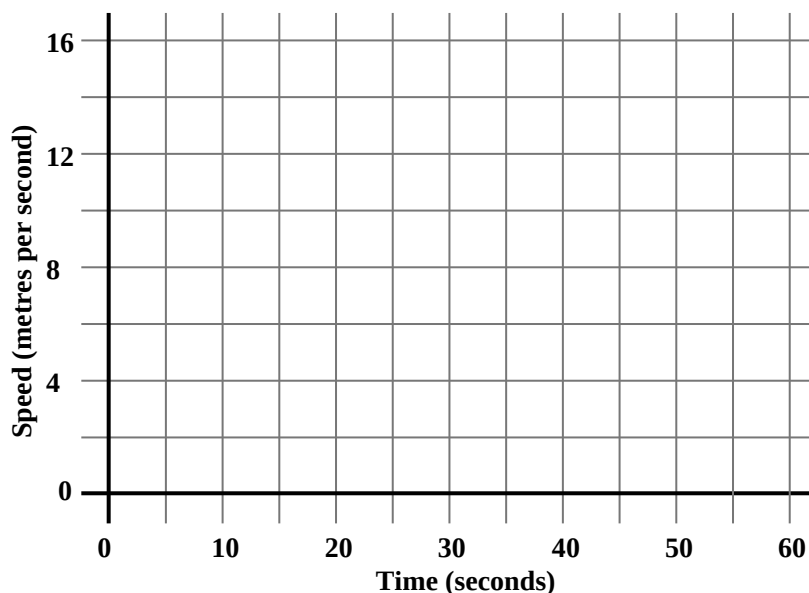
[2 marks]

(iii) Calculate the total distance travelled by the car over the sixty seconds.
Clearly show your working.

[4 marks]

Question 14

A car is moving at a constant speed of 6 ms^{-1} between $t = 0$ and $t = 10$ seconds.
Then, over 30 seconds, it accelerates uniformly to a speed of 12 ms^{-1}
It then moves at a constant speed of 12 ms^{-1} for 20 seconds.



Draw the Speed - Time graph for the car movements described.

[3 marks]

Question 15

GCSE Examination Question from January 2020, Paper 2H, Q10 (Edexcel)

Change a speed of 50 metres per second to a speed in kilometres per hour.

[3 marks]

10.2 Answers

GCSE Mathematics Kinematics

Answer 1

$$\text{distance} = \text{speed} \times \text{time}$$

Answer 2

- (i) 1000
- (ii) 86 400 seconds

Answer 3

- (i) 720 seconds
- (ii) 432 metres
- (iii) less

Answer 4

- (i) 2700 seconds
- (ii) 18900 metres
- (iii) 18.9 km

Answer 5

- (i) 16 m/s
- (ii) 512 m

Answer 6

2.3 kg

Answer 7

- (i) acceleration
- (ii) distance

Answer 8

- (i) 6 m/s
- (ii) 45 s
- (iii) 135 m
- (iv) before
- (v) (–) 0.133... m/s²

Answer 9

$$3980 \div 5.4 = 737 \text{ km/h}$$

Answer 10

- (i) 4
- (ii) 12
- (iii) 3

Answer 11

2

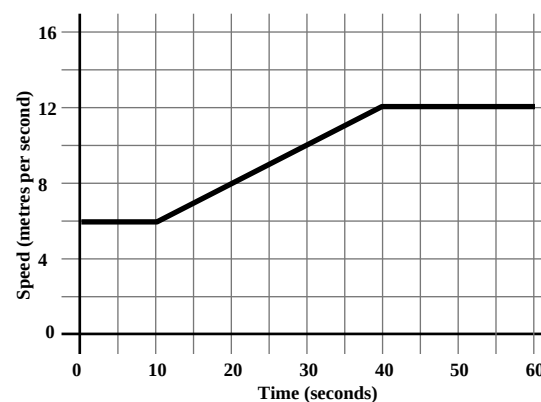
Answer 12

$$433.5 \div 3.4 = 127.5 \text{ km/h}$$

Answer 13

- (i) $t = 10 \text{ s}$ and $t = 40 \text{ s}$
- (ii) (–) $10 \div 30 = \text{(–)} 0.333 \text{ m/s}^2$
- (iii) 490 m

Answer 14



Answer 15 : 180 km/h