

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier Paper 2 Calculator

Monday 3 June 2024

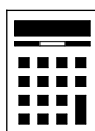
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



Instructions

- Use black ink or black ball-point pen. Draw diagrams in pencil.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information

- The marks for questions are shown in brackets.
- The maximum mark for this paper is 80.
- You may ask for more answer paper, graph paper and tracing paper. These must be tagged securely to this answer book.

Advice

In all calculations, show clearly how you work out your answer.

For Examiner's Use

Pages	Mark
2–3	
4–5	
6–7	
8–9	
10–11	
12–13	
14–15	
16–17	
18–19	
20–21	
22–23	
24	
TOTAL	



J U N 2 4 8 3 0 0 2 H 0 1

Please note that these worked solutions have neither been provided nor approved by AQA and may not necessarily constitute the only possible solutions. Please refer to the original mark schemes for full guidance.

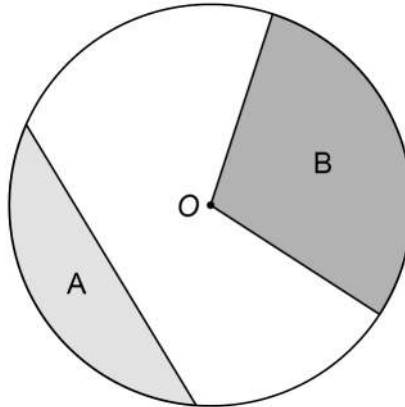
Any writing in blue should be written in the exam.

Anything written in green in a rectangle doesn't have to be written in the exam.

If you find any mistakes or have any requests or suggestions, please send an email to curtis@cgmaths.co.uk

Answer **all** questions in the spaces provided.

- 1 The diagram shows a circle, centre O , and three straight lines.



Use **one** word to describe each shaded region.

Choose from

arc chord sector segment tangent

[2 marks]

Region A segment

Region B sector



2

The mass of an iceberg is 2 200 000 kg

This value is a 12% reduction from the **original** mass of the iceberg.

Work out the **original** mass of the iceberg.

Give your answer in standard form.

[3 marks]

$100 - 12$ ← Subtracting 12% from the original 100% works out that it has decreased to 88%

$2200000 \div 88$ ← Dividing the mass of the iceberg by 88 works out that 1% of the original mass is 25000 kg

25000×100 ← Multiplying 1% of the original mass by 100 works out that 100% of the original mass is 2500000 kg

Answer 2.5×10^6 kg

↑
Formatting 2500000 in ENG notation using the calculator converts it into standard form in this case

Turn over for the next question

Turn over ►



- 3** A chef has a tub of blueberries.
She wants to
use all the blueberries
put the same number of blueberries on each dessert.

$$D = \frac{k}{b}$$

D is the number of desserts.

b is the number of blueberries on each dessert.

- 3 (a)** What does the constant k represent?

Tick the correct box.

[1 mark]

☒

The number of blueberries in the tub

☐

The number of desserts

☐

The number of blueberries on each dessert

☐

None of the above

Dividing the number of blueberries in the tub (k) by the number of blueberries on each dessert (b) gives the number of desserts (D)

- 3 (b)** Complete the table.

[2 marks]

b	2	6	8
D	120	40	30

D is inversely proportional to b so when b multiplies by 3 from 2 to 6, D must do the opposite so divide by 3 from 120 to 40. When D divides by 4 from 120 to 30, b must do the opposite by multiplying by 4 from 2 to 8

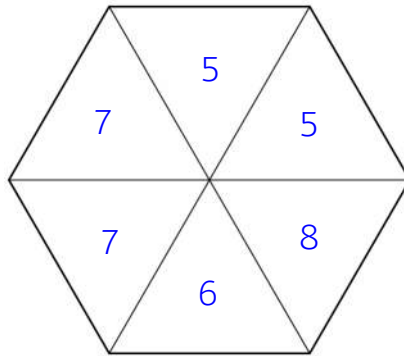


- 4 (a) A fair spinner has six equal sections, each with the number 5, 6, 7 or 8
Each number appears at least once.
 $P(\text{even number}) = P(7)$

Work out $P(5)$

You may use the blank spinner to help you.

[3 marks]



If 5 appeared once, there would be five sections remaining for the other numbers. This is not possible as there needs to be the same number of even numbers and 7, and five does not divide by 2 to get a whole number.

If 5 appears twice, there would be four sections remaining for the other numbers. This works as then there are two sections for 7 and then two sections for the even numbers

Answer _____ $\frac{2}{6}$

2 out of the 6 sections are 5 so the probability of getting 5 is $2/6$

- 4 (b) A different spinner has ten sections, each labelled A, B, C or D.

	A	B	C	D
Probability	0.1	0.5	0.2	0.3

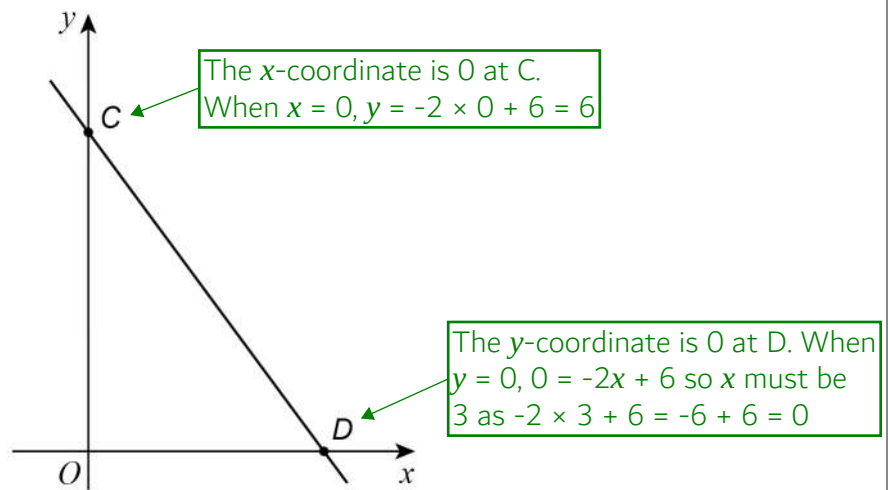
Give **one** reason why there **must** be a mistake in the table.

[1 mark]

They do not add to 1 $\leftarrow 0.1 + 0.5 + 0.2 + 0.3 = 1.1$. They must add to 1 as it is certain to get one of the letters and the probability of something which is certain is 1



- 5 (a) Here is a sketch of the graph $y = -2x + 6$

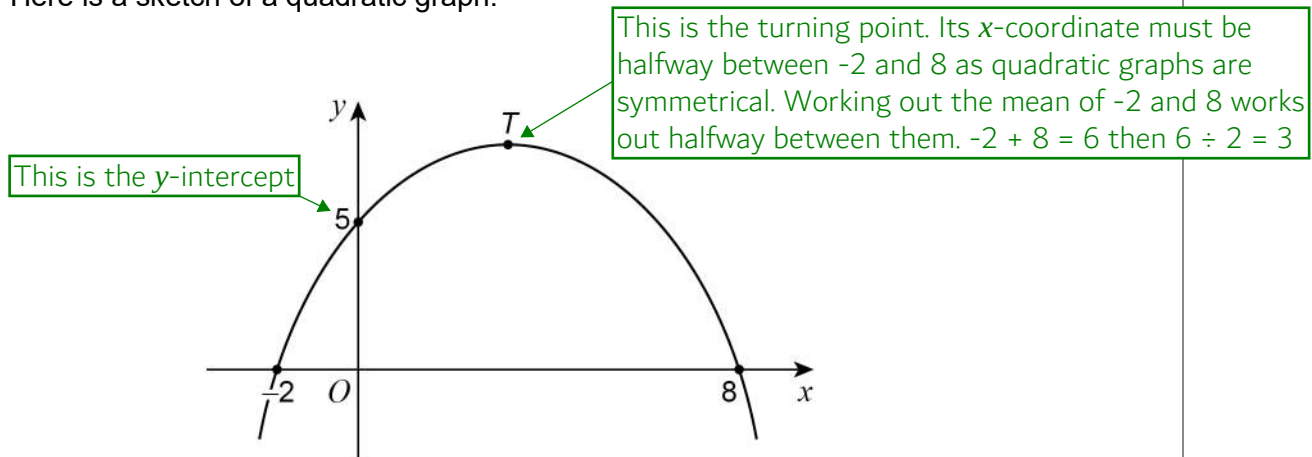


Complete the coordinates of C and D.

[2 marks]

$C(\overset{\text{x-coordinate}}{0} , \overset{\text{y-coordinate}}{6})$
 $D(\overset{\text{x-coordinate}}{3} , \overset{\text{y-coordinate}}{0})$

- 5 (b) Here is a sketch of a quadratic graph.



Complete the following statements.

[2 marks]

The value of the **y-intercept** is 5

The **x-coordinate** of the turning point, T, is 3



6

Work out $(2.5 \times 10^4)^{-3}$

Give your answer in standard form.

[1 mark]

Answer 6.4×10^{-14}

Typing it into the calculator should give the answer in standard form

7

Archie flips a biased coin 200 times.

Here is some information about the outcomes after each 50 flips.

Total number of flips	50	100	150	200
Number of heads	10	27	37	52

Work out the best estimate for the probability of flipping a head.

Give a reason for your answer.

[2 marks]

 Answer $\frac{52}{200}$ ← 52 out of the 200 flips were heads

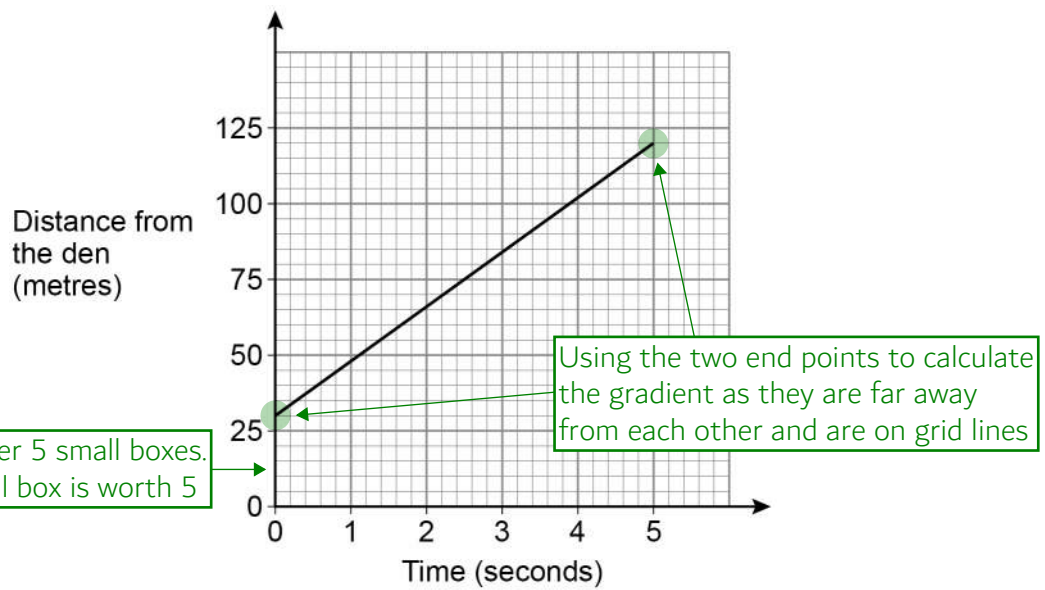
Reason More flips ← This makes it a better estimate of the probability



8

A lion is sprinting in a straight line away from its den.

The graph shows the lion's distance from the den.



Work out the speed of the lion in metres per second.

[3 marks]

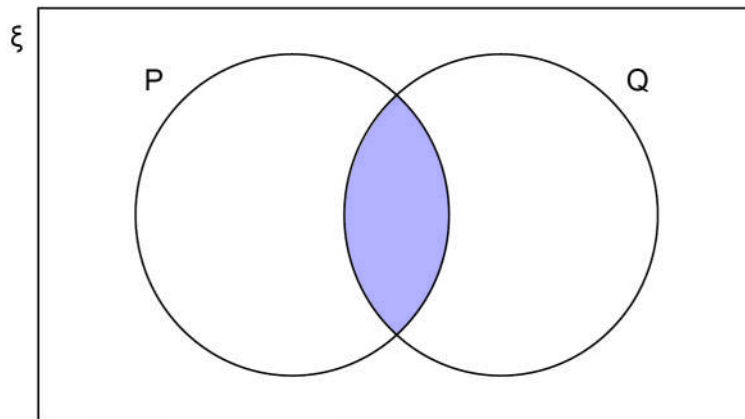
$$\frac{120 - 30}{5 - 0}$$

The gradient on a distance-speed graph represents the speed. Gradient of a straight line = (change in y)/(change in x). y changes from 30 to 120 so $120 - 30$ expresses the change in y. x changes from 0 to 5 so $5 - 0$ expresses the change in x

Answer 18 m/s



- 9 On the Venn diagram, shade the section represented by $P \cap Q$ [1 mark]



The intersection of P and Q is where they cross

- 10 A bus route had 90 000 passengers last year.
The number of passengers was predicted to increase
by 3% this year
and then
by 8% next year.
Is the predicted number of passengers for **next** year more than 100 000 ?
You **must** show your working.

[3 marks]

$$90000 \times 1.03 \times 1.08 = 100116$$

Multiplying 90000 by 1.03 increases it by 3% then multiplying the result by 1.08 increases it by 8%. To work out the decimal multipliers: adding 3% to 100% gives 103%, which when divided by 100 gives 1.03 and adding 8% to 100% gives 108%, which when divided by 100 gives 1.08

Yes

100116 is more than 100000



- 11 A map has a scale of 1 : 20 000
Two churches are 15 cm apart on the map.
Work out the actual distance between them.
Give your answer in **kilometres**.

[3 marks]

15×20000

The 20000 is 20000 times greater than the 1 so multiplying the 15 cm by 20000 works out that the actual distance is 300000 cm

$300000 \div 100$

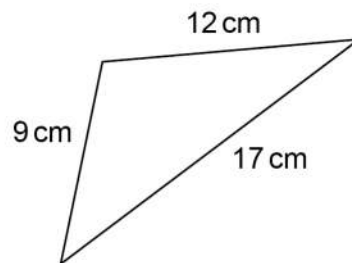
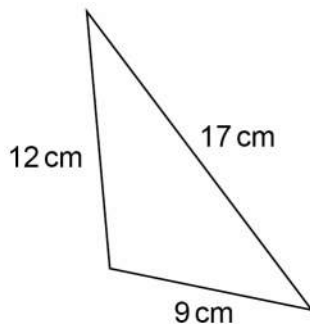
There are 100 cm in 1 m so dividing the 300000 cm by 100 converts it into 3000 m

$3000 \div 1000$

There are 1000 m in 1 km so dividing the 3000 m by 1000 converts it into 3 km

Answer 3 km

12



Not drawn
accurately

Circle the reason why these triangles are congruent.

[1 mark]

ASA

RHS

SAS

SSS

All three sides are the same on both triangles so they must be congruent (the same shape and size). This reason is SSS, which stands for side-side-side



13

Liam takes part in long jump competitions.

Here is some information about 40 of his jumps.

Length of jump, d metres	Number of jumps	Midpoint	
$7.0 \leq d < 7.4$	15	7.2	108
$7.4 \leq d < 7.8$	18	7.6	136.8
$7.8 \leq d < 8.2$	7	8	56
Total = 40			$300.8 \div 40$

Work out an estimate of the mean distance of these 40 jumps.

Give your answer as a decimal.

[3 marks]

A: Working out the midpoints of the upper and lower bound of each interval. This could be done by doing the mean of the upper and lower bounds.

$$7.0 + 7.4 = 14.4 \text{ then } 14.4 \div 2 = 7.2$$

$$7.4 + 7.8 = 15.2 \text{ then } 15.2 \div 2 = 7.6$$

$$7.8 + 8.2 = 16 \text{ then } 16 \div 2 = 8$$

B: Multiplying the number of jumps by the midpoint of each interval works out an estimated total length for all of the jumps combined for each interval.

C: Adding all of the estimated totals gives an overall estimated total for all of the jumps combined. Dividing this by the 40 jumps estimates the mean

Answer 7.52 m

Turn over ►



14 A graph passes through the points (3, 15) and (7, w)

14 (a) Assume that the equation of the graph has the form $y = x^2 + c$

Work out the value of w that this would give.

[3 marks]

$15 = 3^2 + c$ ← First using the point (3, 15) in the equation. Substituting 15 for y and 3 for x

$c = 6$ ← Subtracting 3^2 from both sides finds that c is 6

$w = 7^2 + 6$ ← Substituting w for y , 7 for x and 6 for c in the equation

$w =$ 55

14 (b) In fact, the graph is a straight line.

What does this mean about the actual value of w ?

Tick **one** box.

[1 mark]

☐

It must be the same as the value in part (a)

☐

It must be different to the value in part (a)

☒

It is impossible to tell

The straight line could have a steep positive gradient meaning that w could be greater than part (a). The straight line could have a shallow or even negative gradient meaning that w would be less than part (a). The straight line could possibly go through (3, 15) and (7, 55). So it is not possible to tell



15

Concrete from a truck is poured at 10.9 kg **per second** for 30 minutes.

$$1000 \text{ kg} = 1 \text{ tonne}$$

Is more than 20 tonnes of concrete poured?

Tick a box.

Yes

☐

No

☒
You **must** show your working.**[4 marks]**

10.9×60

There are 60 seconds in a minute so multiplying the 10.9 kg per second by 60 works out that 654 kg is poured in a minute

654×30

Multiplying the 654 kg poured in a minute by 30 works out that 19620 kg is poured in 30 minutes

$19620 \div 1000$

1000 kg = 1 tonne so dividing the 19620 kg by 1000 converts it into 19.62 tonnes

19.62

19.62 tonnes is not more than 20 tonnes



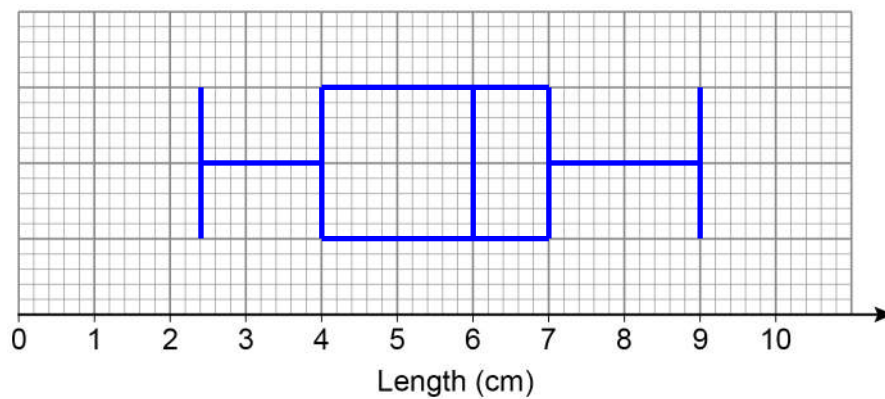
16

Here is some information about the lengths, in cm, of leaves.

- Shortest length = 2.4
- Longest length = 9
- Upper quartile = 7
- Median length = 6
- Interquartile range = 3

Draw a box plot to show this information.

[3 marks]

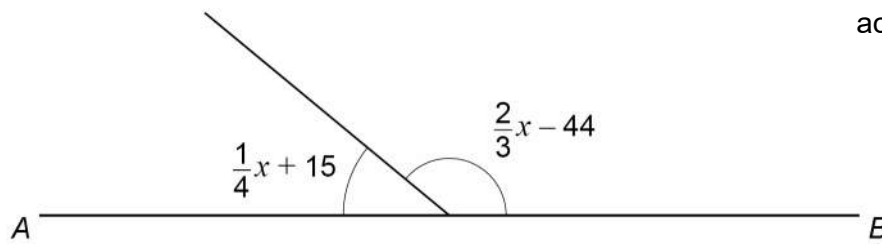


Drawing vertical lines for the shortest, lower quartile, median, upper quartile and longest then joining them up in a box plot. The lower quartile must be 4 in order for the interquartile range (the distance between the quartiles) to be 3

17

 AB is a straight line.

Both angles are given in degrees.

Not drawn
accuratelyBy working out the value of x ,

work out the ratio smaller angle : larger angle

[4 marks]

$$\frac{1}{4}x + 15 + \frac{2}{3}x - 44 \leftarrow \text{Adding both angles together}$$

$$\frac{11}{12}x - 29 = 180 \leftarrow \text{Simplifying by collecting like terms. } \frac{1}{4} + \frac{2}{3} = \frac{11}{12} \text{ so this is the coefficient of } x. \text{ Angles around a point on a straight line add up to } 180^\circ \text{ so the expression of the sum of the angles must equal to } 180$$

$$\frac{11}{12}x = 209 \leftarrow \text{Adding 29 to both sides to get the } x \text{ term on its own}$$

$$x = 228 \leftarrow \text{Dividing both sides by } 11/12 \text{ gets } x \text{ on its own}$$

$$\frac{1}{4} \times 228 + 15 = 72 \leftarrow \text{Substituting 228 for } x \text{ in the expression of the smaller angle finds that it is } 72^\circ$$

$$\frac{2}{3} \times 228 - 44 = 108 \leftarrow \text{Substituting 228 for } x \text{ in the expression of the larger angle finds that it is } 108^\circ$$

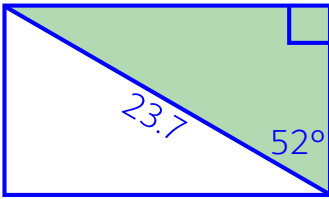
Answer 72 : 108

↑
The ratio can be expressed without simplifying it



18

A diagonal of a rectangle is 23.7 cm long.

The diagonal makes an angle of 52° with a side of length x cmWork out the value of x .**[3 marks]**

Drawing a diagram of the information given. It forms a right-angled triangle, which is highlighted in green

SOH CAH TOA

Using right-angled trigonometry. Listing SOH CAH TOA as formula triangles. Ticking H as the hypotenuse is involved. Ticking A as the adjacent is involved. There are two ticks on the CAH formula triangle so this one can be used

$$\cos(52) \times 23.7$$

Covering A in the CAH formula triangle finds that adjacent = cos of the angle $\times$ hypotenuse

$$x = 14.6$$



19 (a) Show that $4x(3x + 2) - 2x^2\left(6 - \frac{5}{x}\right) - 6x\left(3 + \frac{7}{x}\right)$ simplifies to an integer.

[3 marks]

$$12x^2 + 8x - 12x^2 + 10x - 18x - 42 \leftarrow \text{Expanding all three brackets}$$

$$-42 \leftarrow \text{Collecting like terms to simplify. The } x^2 \text{ and } x \text{ terms cancel out leaving } -42, \text{ which is an integer}$$

19 (b) Factorise $8x^2 - 18x - 35$

[2 marks]

$$8 \times -35 = -280 \leftarrow \text{It is in the form } ax^2 + bx + c. \text{ Multiplying } a \text{ by } c \text{ to give } -280$$

$$8x^2 + 10x - 28x - 35 \leftarrow \begin{array}{l} +10 \text{ and } -28 \text{ multiply to the } -280 \text{ and add to } b \text{ (which is } -18\text{). Splitting the} \\ \text{middle } x \text{ term into these numbers of } x. \text{ Table mode could be used on the} \\ \text{calculator to help find the two numbers. Enter } f(x) = 280/x. \text{ Start: 1. End:} \\ \text{30. Step: 1. This lists out the factor pairs of 280 (ignoring the decimals)} \end{array}$$

$$2x(4x + 5) - 7(4x + 5) \leftarrow \text{Factorising the left two terms and right two terms separately}$$

Answer $(2x - 7)(4x + 5)$

↑
Bringing it into the factorised form



20 $(x - 9) = \frac{2(6 - x^2)}{x + 3}$ and $x = \frac{d \pm \sqrt{e}}{f}$

Work out one set of possible values for d , e and f .

[4 marks]

$$(x - 9)(x + 3)$$

Multiplying both sides by $x + 3$ to eliminate the denominator on the right. Just writing the left side of the equation and ignoring the right side for now

$$x^2 + 3x - 9x - 27$$

Expanding the brackets

$$x^2 - 6x - 27 = 12 - 2x^2$$

Simplifying by collecting like terms. Now writing the right side of the equation. Expanding the $2(6 - x^2)$

$$3x^2 - 6x - 39 = 0$$

Bringing into the quadratic form $ax^2 + bx + c = 0$ by adding $2x^2$ to both sides and subtracting 12 from both sides

$$x = \frac{6 \pm \sqrt{(-6)^2 - 4 \times 3 \times -39}}{2 \times 3}$$

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

x can be found using the quadratic formula. d is highlighted in pink. e is highlighted in orange. f is highlighted in green

$$d = 6$$

$$e = 504$$

$$(-6)^2 - 4 \times 3 \times -39 = 504$$

$$f = 6$$

$$2 \times 3 = 6$$



21

People in a stadium are in the North Stand, East Stand, South Stand or West Stand.

Of the people in the stadium,

$\frac{1}{4}$ are in the North Stand

$\frac{3}{10}$ are in the East Stand

number in South Stand : number in West Stand = 2 : 7

There are 4480 people in the West Stand.

How many people are in the stadium?

[4 marks]

$$4480 \div 7$$

The 4480 people in the West Stand is represented by 7 parts of the ratio 2 : 7. Dividing the 4480 by 7 works out that 1 part of the ratio is worth 640 people

$$640 \times 9 = 5760$$

2 + 7 = 9 parts in total in the ratio. Multiplying the value of 1 part of the ratio by 9 works out that there are 5760 people in the South and West Stand combined

$$\frac{1}{4} + \frac{3}{10}$$

Adding the fraction in the North Stand and the fraction in the East Stand works out that $\frac{11}{20}$ of the people are in the North and East Stand combined

$$1 - \frac{11}{20}$$

Subtracting the $\frac{11}{20}$ from 1 lot of people works out that $\frac{9}{20}$ of the people are in the South and West Stand combined

$$\frac{9}{20}x = 5760$$

Let x be the total number of people in the stadium. $\frac{9}{20}$ of the total number of people in the stadium is 5760, as these are both describing the number of people in the South and West Stand combined. Writing this as an equation

$$x = 5760 \div \frac{9}{20}$$

Dividing both sides by $\frac{9}{20}$ gets x on its own so works out how many people are in the stadium

Answer 12800

Turn over for the next question

Turn over ►



22

$$x_{n+1} = 5 - \frac{1}{x_n}$$

Use $x_1 = 1$ to work out an approximate solution to $x = 5 - \frac{1}{x}$

Give your answer to 4 significant figures.

[3 marks]

Press 1 then press = or exe. Enter $5 - 1/\text{Ans}$ and keep pressing = or exe until all of the digits on the display stop changing. This substitutes 1 for x_n in the right side of the formula then keeps substituting in the previous iteration of x_n to get the next iteration of x_{n+1} and keeps getting a more accurate approximate solution to the equation

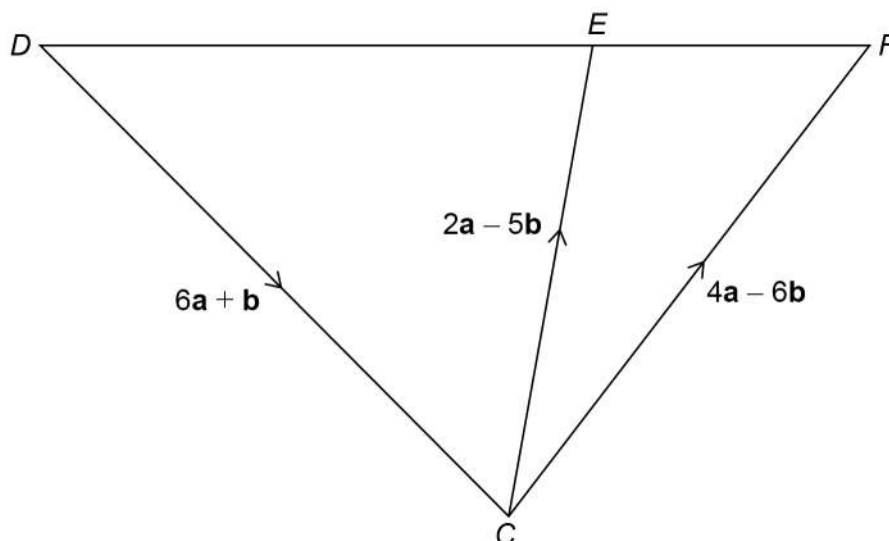
$$x = \underline{\hspace{2cm}} \quad \text{4.791}$$

↑

4.7912... is rounded to 4 significant figures



23

Not drawn
accuratelyDo not write
outside the
boxProve that DEF is a straight line.

[4 marks]

$$\vec{DE} = 6a + b + 2a - 5b \quad \leftarrow \vec{DE} = \vec{DC} + \vec{CE}$$

$$= 8a - 4b \quad \leftarrow \text{Simplifying by collecting like terms}$$

$$= 4(2a - b) \quad \leftarrow \text{Factorising}$$

$$\vec{DF} = 6a + b + 4a - 6b \quad \leftarrow \vec{DF} = \vec{DC} + \vec{CF}$$

$$= 10a - 5b \quad \leftarrow \text{Simplifying by collecting like terms}$$

$$= 5(2a - b) \quad \leftarrow \text{Factorising}$$

$\vec{DE}$ is parallel to $\vec{DF}$ $\leftarrow$ As they are both multiples of the same vector, $2a - b$. DEF must be a straight line as both $\vec{DE}$ and $\vec{DF}$ are going in the same direction and both start at D

Turn over ►

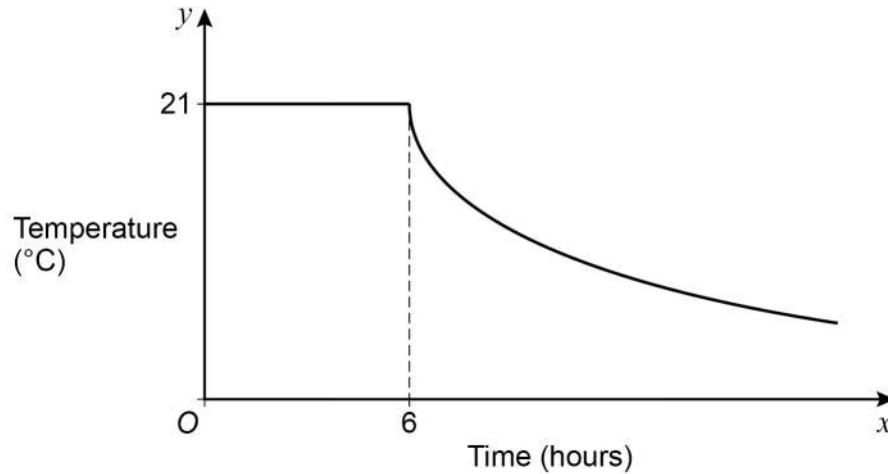


24

A room is kept at a constant temperature of 21°C for 6 hours.

The heating is then turned off and the room begins to cool.

Here is a sketch graph showing the temperature, $y^{\circ}\text{C}$, of the room at time x hours.



- 24 (a) Assume the equation of the curved part is $y = \frac{k}{x}$ where k is a constant.

Work out the value of y when $x = 12$

[2 marks]

$$21 = \frac{k}{6} \leftarrow (6, 21) \text{ is a known point on the curve. Substituting 21 for } y \text{ and 6 for } x \text{ in the equation}$$

$$k = 126 \leftarrow \text{Multiplying both sides by 6 gets } k \text{ on its own and finds that } k \text{ is 126}$$

$$y = \frac{126}{12} \leftarrow \text{Substituting 126 for } k \text{ and 12 for } x \text{ in the equation}$$

$$y = \underline{\hspace{2cm}} 10.5$$



24 (b) In fact,

the equation of the curved part is $y = A \times \left(\frac{1}{3}\right)^{\frac{1}{6}x}$ where A is a **different** constant.

How does this affect the value of y when $x = 12$?

Tick **one** box.

You **must** show working to support your answer.

[2 marks]

☐

The value of y is greater than the answer to part (a).

☒

The value of y is less than the answer to part (a).

☐

The value of y is the same as the answer to part (a).

$$A = \frac{21}{\left(\frac{1}{3}\right)^{\frac{1}{6} \times 6}}$$

Rearranged to make A the subject of the equation and substituted 21 for y and 6 for x to find that A is 63

$$y = 63 \times \left(\frac{1}{3}\right)^{\frac{1}{6} \times 12}$$

Substituted 63 for A and 12 for x in the equation to find that y is 7

$$= 7$$

7 is less than 10.5

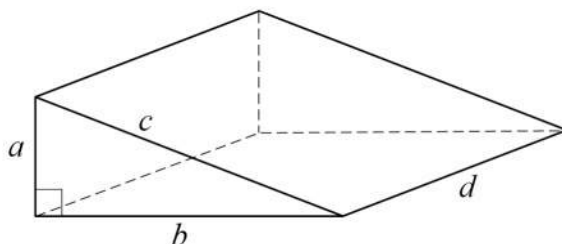
Turn over for the next question

Turn over ►



25

Here is a right-angled triangular prism.

The ratio of the edges is $a : b : c : d = 3 : 4 : 5 : 12$ The **volume** of the prism is 1125cm^3 Work out the total length of **all** of the edges of the prism.**[5 marks]**

$$\frac{1}{2} \times 4p \times 3p \times 12p$$

Let p be 1 part of the ratio. a is $3p$, b is $4p$ and d is $12p$. Expressing the volume of the prism. Volume of prism = area of cross section $\times$ length. d is the length. The cross section is a triangle. Area of triangle = $\frac{1}{2} \times \text{base} \times \text{height}$. The base is b and the height is a

$$72p^3 = 1125$$

Simplifying the expression and setting it equal to the value of the volume

$$p^3 = 15.625$$

Dividing both sides by 72 to get p^3 on its own

$$p = 2.5$$

Cube rooting both sides finds that 1 part of the ratio is worth 2.5 cm

$$3 + 3 + 4 + 4 + 5 + 5 + 12 + 12 + 12$$

Working out that 60 parts of the ratio represent the total length of all of the edges of the prism. There are 2 of a , 2 of b , 2 of c and 3 of d

$$2.5 \times 60$$

Multiplying the value of 1 part of the ratio by the 60 parts which represent the total length of all of the edges of the prism works out that the total length of all of the edges of the prism is 150 cm

Answer 150 cm**END OF QUESTIONS**