OCR
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.CG Maths.
Worked Solutions

F

Monday 8 November 2021 – Morning

GCSE (9–1) Mathematics

J560/03 Paper 3 (Foundation Tier)

Time allowed: 1 hour 30 minutes

You can use:
- a scientific or graphical calculator
- geometrical instruments
- tracing paper

Please write clearly in black ink. **Do not write in the barcodes.**

Centre number | | | | | | Candidate number | | | | |

First name(s) ____________________

Last name ____________________

INSTRUCTIONS
- Use black ink. You can use an HB pencil, but only for graphs and diagrams.
- Write your answer to each question in the space provided. You can use extra paper if you need to, but you must clearly show your candidate number, the centre number and the question numbers.
- Answer **all** the questions.
- Where appropriate, your answer should be supported with working. Marks might be given for using a correct method, even if your answer is wrong.
- Use the π button on your calculator or take π to be 3.142 unless the question says something different.

INFORMATION
- The total mark for this paper is **100**.
- The marks for each question are shown in brackets **[ ]**.
- This document has **24** pages.

ADVICE
- Read each question carefully before you start your answer.

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

Any writing in blue indicates what must be written in order to answer the questions and get the marks. The worked solutions have been designed to show the smallest amount of work which needs to be done to answer the question.

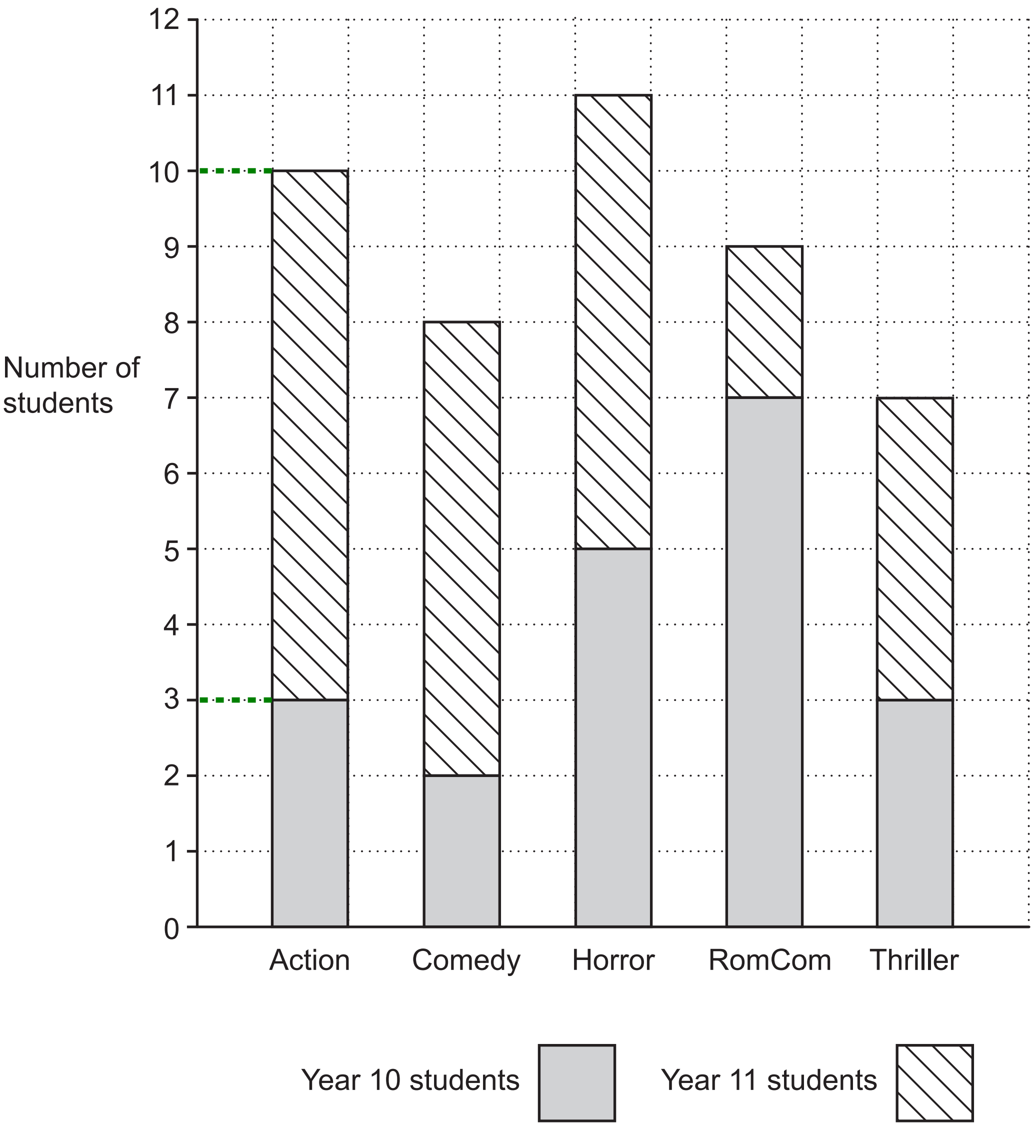
Anything written in green in a cloud doesn't have to be written in the exam.

Anything written in orange in a rectangle doesn't have to be written in the exam and is there to show what should be put into a calculator or measured using a ruler or protractor.

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

Answer **all** the questions.

1 In a survey, some students chose their favourite type of film from a list of five.
The bar chart shows the results.



(a) **(i)** How many students chose Action films?

The bar for Action is 10 tall in total. This includes both the Year 10 and Year 11 students

(a)(i) ....10........ **[1]**

(ii) How many Year 11 students chose Action films?

(ii) ....7........ **[1]**

Subtracting the Year 10 students who chose Action from the total number of students who chose Action leaves the number of Year 11 students who chose Action. 10 - 3 = 7

(b) What type of film was chosen by the most Year 10 students?

This bar was tallest for the Year 10 students

(b) ......RomCom...... **[1]**

(c) How many Year 10 students took part in the survey?

3+2+5+7+3 ← Adding the heights of all of the dark grey bars for the Year 10 students

(c) ......20...... **[2]**

(d) 45 students took part in the survey.

Write the ratio

number of Year 10 students taking part : number of Year 11 students taking part

in its simplest form.

45-20 ← Subtracting the 20 Year 10 students from the 45 total number of students leaves 25 Year 11 students

20:25 ← Writing the ratio of number of Year 10 students taking part : number of Year 11 students taking part

20/25 = 4/5 ← Ratios simplify in a similar way to fractions. The calculator simplifies the fraction 20/25 to 4/5 so the ratio must simplify to 4 : 5

(d) ......4...... : ......5...... **[3]**

Turn over

2 Use your calculator to work out.

(a) $\sqrt{196} + 29$

Type into the calculator exactly as above. Make sure the +29 is outside the square root

(a) ....43...................... **[1]**

(b) 4^5

Type into the calculator

(b) ....1024...................... **[1]**

3 There are 150 coins in a jar.
20% of the coins are 10p coins.
$\frac{3}{10}$ of the coins are 20p coins.
The rest of the coins are 50p coins.

Work out the total value, in £, of the 150 coins.
You must show your working.

$\frac{20}{100} \times 150 = 30$

Putting the 20 over 100 converts 20% into a fraction, which when multiplied by finds 20%. Multiplying this by the 150 coins works out 20% of 150. So there are 30 10p coins

$\frac{3}{10} \times 150 = 45$

'Of' means to multiply so this works out that there are 45 20p coins

$150 - 30 - 45 = 75$

Subtracting the 30 10p coins and the 45 20p coins from the 150 coins leaves 75 50p coins

$30 \times 0.10 + 45 \times 0.20 + 75 \times 0.50$

Adding the value of the 10p coins, the value of the 20p coins and the value of the 50p coins gives the total value of the coins

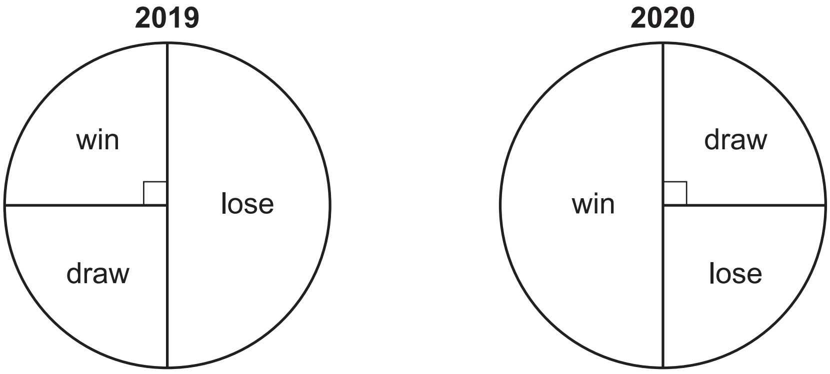
The value of 30 10p coins in £

The value of 45 20p coins in £

The value of 75 50p coins in £

£ ....49.50...................... **[6]**

4 A sports team played the same number of matches in 2019 and 2020.
The two pie charts summarise their results.



(a) What fraction of the matches did the team win in 2019?

The angle for win was a right-angle, which is 90°. There are 360° in total in a pie chart. 90° out the 360° were for win in 2019

(a) $\frac{90}{360}$ **[1]**

(b) Did the team's results improve in 2020?
Explain how you know.

Yes because The fraction of wins increased and the draws stayed the same

There are now 180/360 for win in 2020 **[1]**

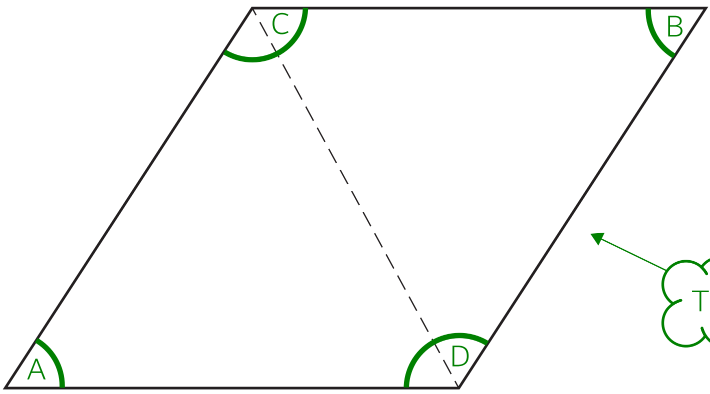
5 Increase 600 by 17%.

$600 \times \frac{100+17}{100}$

100 + 17 expresses the percentage it increases to. Putting this over 100 converts it into a fraction, which increases the 600 by 17% when multiplied by

702 **[3]**

6 The diagram shows how a rhombus is made by joining two **equilateral** triangles.



Not to scale

The interior angles are shown in green

(a) Find the size of each interior angle of the rhombus.

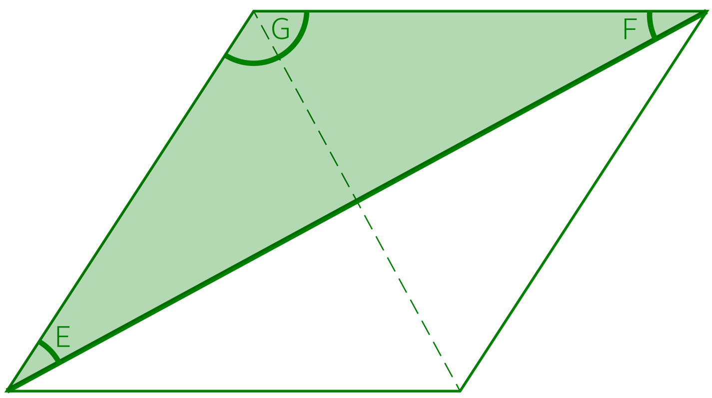
$180 \div 3 = 60$
$60 \times 2 = 120$

There are 180° in total in a triangle. Dividing this by 3 works out the size of each interior angle of an equilateral triangle, which is angle A and B. Multiplying this by 2 works out angle C and D

(a) ....60....°, ...60....°, ...120....°, ...120....° **[1]**

(b) The same rhombus can be made by joining two copies of an **isosceles** triangle.

Find the size of each angle of the isosceles triangle.



The green triangle is an isosceles triangle which makes the rhombus when two copies are joined together

Angle G is the same as angle C

Angle E and F are half of angle A and B. 60/2 = 30

(b) ....30....°, ...30....°, ...120....° **[2]**

7 Rowan's bath has a hot tap and a cold tap.
When turned on full, each tap on its own will fill the bath in 6 minutes.

Rowan turns **both** taps on full.

How long will it take to fill the bath?

$6 \div 2$ ← There are 6 minutes worth of work to be done. Dividing this by the 2 taps works out how long it will take each one when working at the same time

..........3.......... minutes **[2]**

8 Simplify.

$5t - 3u - t + 5u$

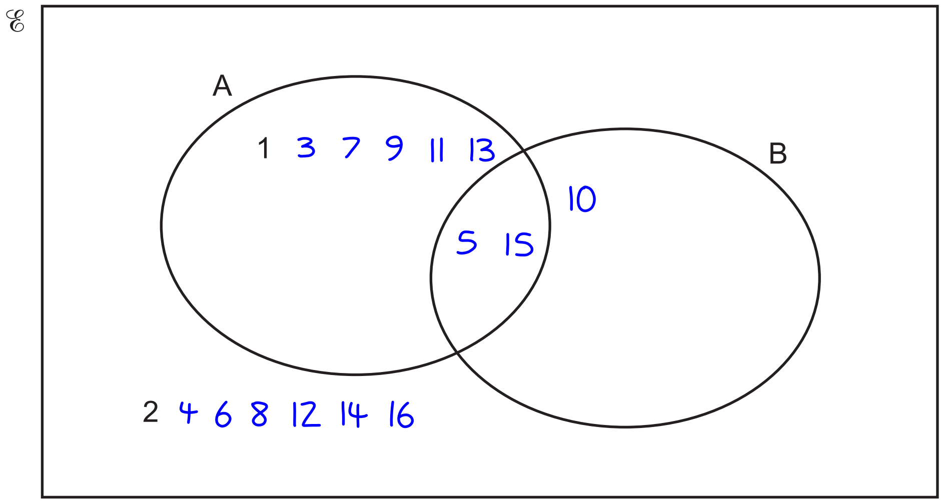
Collecting like terms.
5t - t = 4t
5u - 3u = 2u

..........4t+2u.......... **[2]**

9 $\mathscr{E}$ = {1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16}
Set A = {odd numbers}
Set B = {multiples of 5}

(a) The elements 1 and 2 have been entered on this Venn diagram.

Complete the Venn diagram to show **all** of the elements.



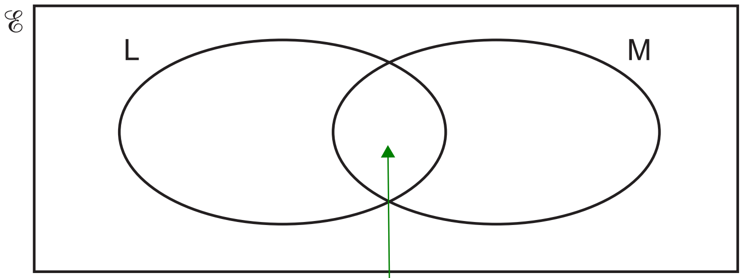
[3]

(b) $\mathscr{E}$ = {all positive integers}
Set L = {odd numbers}
Set M = {multiples of 2}

Three Venn diagrams, numbered 1 to 3, are shown below.

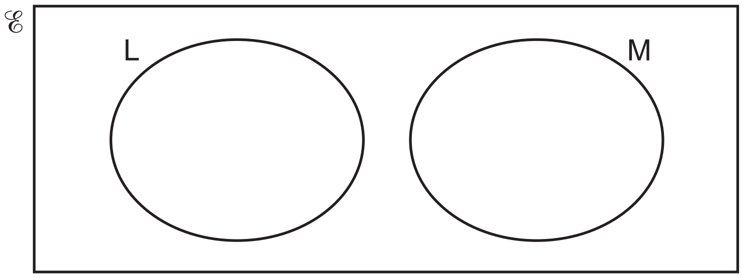
Which diagram best shows the relationship between Set L and Set M?
Give a reason for your choice.

Venn diagram 1:



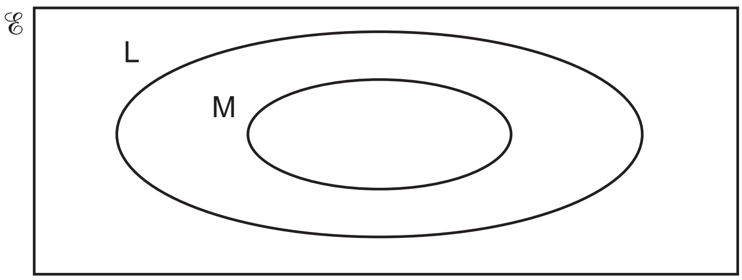
This cross over indicates that there could be odd multiples of 2

Venn diagram 2:



There is no cross over so this would indicate that there can be no odd multiples of 2

Venn diagram 3:



Set M is in Set L so this would indicate that every multiple of 2 is odd

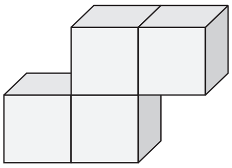
Venn diagram ....2.... because ....odd numbers cannot be even....

.... **[2]**

So diagram 1 is not the best as there is a cross over of the two sets. Diagram 3 is not correct as multiples of 2 are not odd

10 A student has some cubes that are all the same size.
Each cube is 3 cm by 3 cm by 3 cm.

They put 4 of these cubes together to make this shape.



Calculate the surface area of the shape.

$3 \times 3 = 9$ ← Area of square = length x width. The length and width are both 3cm. So the area of each square face is 9cm^2

$6 \times 4 - 1 - 2 - 2 - 1 = 18$ ← There are 4 cubes and there are 6 square faces on each cube. So 6 x 4 works out how many square faces there are in total on the 4 cubes. Subtracting the number of faces which are not on the surface for each cube leaves 18 square faces which are on the surface

9×18 ← Multiplying the 9cm^2 area of each square face by the 18 square faces on the surface works out the surface area

..................162.................. cm^2 **[4]**

11 Here are some algebraic statements.

$v = u + at$ $\quad a + 2b$ $\quad 3(x + 2) = 3x + 6$ $\quad 2y < x$ $\quad 2x = 5$

From the list above, write down an example of each of the following.

(a) An expression.

v = u + at is a formula. 3(x + 2) = 3x + 6 is an identity as it is always true for all values of x

(a) .... $a+2b$ .... **[1]**

(b) An inequality.

(b) .... $2y<x$ .... **[1]**

(c) An equation.

(c) .... $2x=5$ .... **[1]**

12 Rearrange this formula to make *w* the subject.

$P = 2w + 2h$

$P-2h=2w$ ← Subtracting 2h from both sides to get the w term on its own

Dividing both sides by 2 to get w on its own

.... $\frac{P-2h}{2}=w$ .... **[2]**

13 Ellis has 28 m of ribbon.
They cut the ribbon into lengths of 60 cm.

What is the least length of ribbon, in cm, that can be left over?
You must show your working.

$\frac{28\times100}{60}=46\frac{2}{3}$ ← There are 100cm in 1m so multiplying the 28 converts it into cm. Dividing this by the 60cm works out how many lots of the lengths can be cut

$\frac{2}{3}\times60$ ← The 2/3 is not a whole length so will be a remainder. 2/3 of a 60cm length is 40cm

..........40.......... cm **[5]**

14 This table shows the names and areas of five lakes.

Name of Lake	Area in km^2	
Ladoga	1.81×10^4	18100
Mweru	5.12×10^3	5120
Tana	3.20×10^3	3200
Topozero	9.86×10^2	986
Victoria	6.89×10^4	68900

Converting all of the areas into ordinary form to compare their areas. It is possible to compare them without doing this as they are all in standard form

(a) Write the area of Lake Mweru as an ordinary number.

Typing the standard form into the calculator converts it into ordinary form

(a) ....5120.......... km^2 **[1]**

(b) Write the lakes in the order of their area, starting with the **smallest**.

Topozero ..... Tana ..... Mweru ..... Ladoga ..... Victoria **[2]**

smallest *largest*

(c) Calculate the difference between the areas of Lake Ladoga and Lake Tana. Give your answer in standard form, correct to **2** significant figures.

$1.81 \times 10^4 - 3.20 \times 10^3 = 14900$

Difference = largest - smallest. The answer of 14900 needs to be divided by 10 4 times to get a decimal between 1 and 10. So 1.49×10^4 is the difference in standard form. The second significant figure is the 4. The 9 after this causes the 4 to round up to a 5 then everything after it is set to 0 and ignored

(c) ....1.5×10^4.......... km^2 **[4]**

15 Azmi, Beth and Callum share a flat.

(a) The monthly rent is £760.
They share the rent in the ratio 2 : 3 : 3.

How much does Beth pay for rent each month?

$\frac{760}{2+3+3} \times 3$

2 + 3 + 3 expresses how many parts there are in total in the ratio. This many parts represent the total monthly rent so dividing the £760 by this many parts works out the value of 1 part of the ratio. Multiplying this by the 3 parts representing the rent Beth pays works out how much Beth pays for rent each month

(a) £ ....285............ **[2]**

(b) Azmi, Beth and Callum also share the fuel bill in the ratio 2 : 3 : 3.
Callum pays £36 for fuel each month.

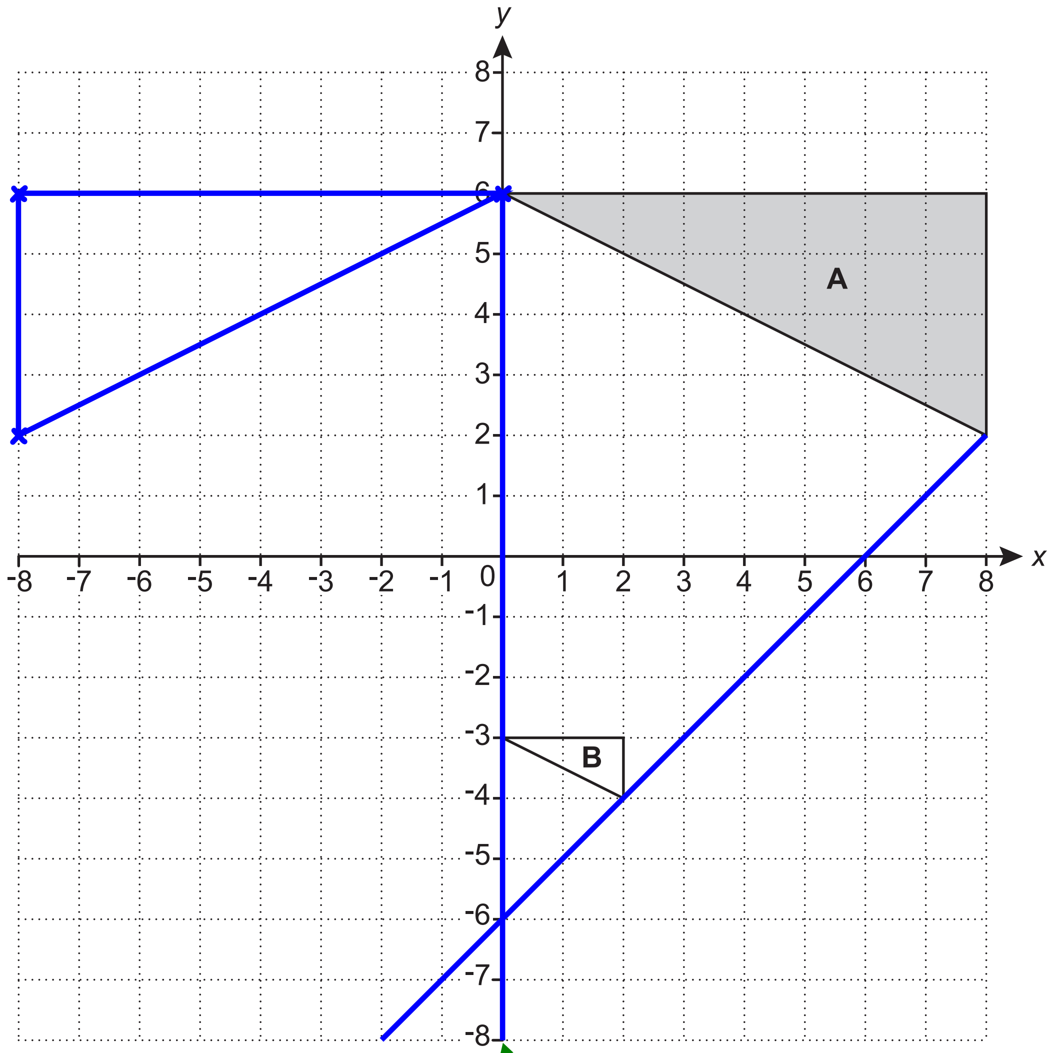
How much does Azmi pay for fuel each month?

$\frac{36}{3} \times 2$

3 parts of the ratio represent the amount Callum pays for fuel each month. Dividing the £36 by the 3 parts works out what 1 part of the ratio represents. Multiplying the value of 1 part by the 2 parts representing Azmi works out how much Azmi pays

(b) £ ....24............ **[2]**

16 Triangle **A** and triangle **B** are drawn on the coordinate grid.



(a) Reflect triangle **A** in the line $x = 0$. **[2]**

The y-axis is the line x = 0

(b) Describe fully the **single** transformation that maps triangle **A** onto triangle **B**.

Enlargement, scale factor 1/4, centre (0 , -6)

.... **[3]**

To reflect, count the number of jumps to the line for each corner then do the same number of jumps on the other side

It is an enlargement as it has changed size. The scale factor is 1/4 as the sides on B are 1/4 of the size of the sides on A. The centre of enlargement is found by drawing straight lines through the corners of both shapes and seeing where they meet

The fraction (or proportion, which can be expressed as a decimal) of the times it lands on each number is the relative frequency

17 Ling throws a six-sided dice 300 times.
The table shows the frequencies of their results.

(a) Complete the table to show the relative frequencies.

Number on dice	1	2	3	4	5	6
Frequency	42	27	57	60	39	75
Relative frequency	$\frac{42}{300}$	$\frac{27}{300}$	0.19	$\frac{60}{300}$	$\frac{39}{300}$	$\frac{75}{300}$

[2]

(b) Ling thinks that the dice may be biased.

(i) Explain why evidence from the table could support their opinion.

It didn't land on each number the same number of times

We could expect the frequencies to all be similar if it was not biased

[1]

(ii) Explain why the dice may, in fact, **not** be biased.

Any frequencies are possible as long as there is a chance for landing on each number

For example we could toss a fair coin 5 times in a row and all could be heads. This does not mean it is biased as there is a chance of this happening. Probabilities are only estimates of the relative frequency we should expect and relative frequencies are only estimates of probability

[1]

18 A carpenter measures the length, *k* metres, of a piece of wood.

They write

$3.35 \leqslant k < 3.45$.

The length must be greater than or equal to 3.35 but less than 3.45

(a) Put rings around all possible values of *k* in the list below.

It can't be equal to 3.45

3.349   (3.39)   (3.44)   3.45   3.55

This is less than 3.35

This is more than 3.45

[2]

(b) The carpenter says

$3.35 \leqslant k < 3.45$ means that the length of the piece of wood is 3.4 metres correct to the nearest centimetre.

(i) Explain how you know that she is incorrect.

3.35m does not round to 3.4m to the nearest centimetre

3.35m is already to the nearest centimetre (as 0.01m is 1cm) so rounds to 3.35m ...... **[1]**

(ii) Complete the interval for 3.4 m, correct to the nearest centimetre.

$3.4 \pm \frac{0.01}{2}$

$3.395 \leqslant k <$ ....3.405........ **[1]**

There are 100cm in 1m so dividing 1cm by 100 converts it into 0.01m. This is the resolution of the measurement. Halving this and adding and subtracting it from the 3.4 works out the bounds

19 **(a)** Amit says

My normal typing speed is 40 words per minute.
Therefore, I estimate that my normal typing speed is about 210 characters per minute.

Each letter, space and piece of punctuation counts as a character.

How many letters per word is Amit most likely to have used in making the estimate?
Show how you decide.

$\frac{210-40}{40} = 4.25$

There will be at least 40 spaces and pieces of punctuation as there is a space after each word and a full stop at the end of a sentence. Subtracting these 40 characters leaves the maximum number of characters which are letters in words. Dividing this by the 40 words works out the maximum number of letters per word. 4.25 is an overestimate as there will most likely be more punctuation such as commas and 40 words would be a very long sentence so there will most likely be more full stops. Also the number of letters needs to be a whole number so it is sensible to round down to 4

(a) ....4.................. **[3]**

(b) Amit starts some homework at their normal typing speed.
Amit types 52 words in 1 minute 12 seconds.

What may be true about the length of the words that Amit has just typed?
Show how you decide.

$\frac{52}{1°12°} = 43.\dot{3}$

Dividing the number of words by the time in minutes works out that Amit has typed at just over 43 words per minute

Time can be put into the calculator

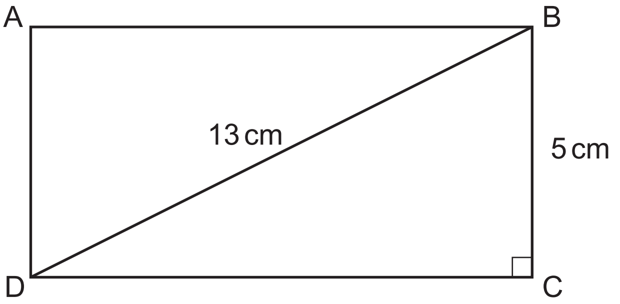
The average word length may be less than 4

As he has typed more than the 40 words per minute, the words must be shorter than 4.25 on average and may be shorter than 4 on average as Amit is using their normal typing speed

....

.... **[3]**

20 The diagram shows rectangle ABCD.



Not to scale

DB = 13 cm and BC = 5 cm.

Calculate the area of the rectangle.
You must show your working.

$a^2+b^2=c^2$ ← Triangle DCB is a right-angled triangle so Pythagoras' Theorem can be used to work out the missing length DC

$a^2=c^2-b^2$ ← a and b are the two shorter sides and c is the longest side. Setting a as the length DC. Subtracting b^2 from both sides get a^2 on its own

$a=\sqrt{c^2-b^2}$ ← Square rooting both sides gets a on its own

$=\sqrt{13^2-5^2}$ ← Substituting 13 for c and 5 for b

$=12$ ← Length DC is 12cm

12×5 ← Area of rectangle = length x width

.........................60......................... cm^2 **[5]**

21 **(a)** A straight line has the equation $y = 2x - 1$.

Write down the gradient of the line.

The equation is in the form y = mx + c, where m is the gradient and c is the y-intercept

(a) ....2.................. **[1]**

(b) Here are the equations of four straight lines.

$y = 2x + 3$ $\quad y = 1 - x$ $\quad y = \frac{1}{2}x + 4$ $\quad y = x - 1$

(i) Which of the four straight lines is parallel to $y = 2x - 1$?

As they have the same gradient of 2 → **(b)(i)** ....$y=2x+3$.................. **[1]**

(ii) A student says

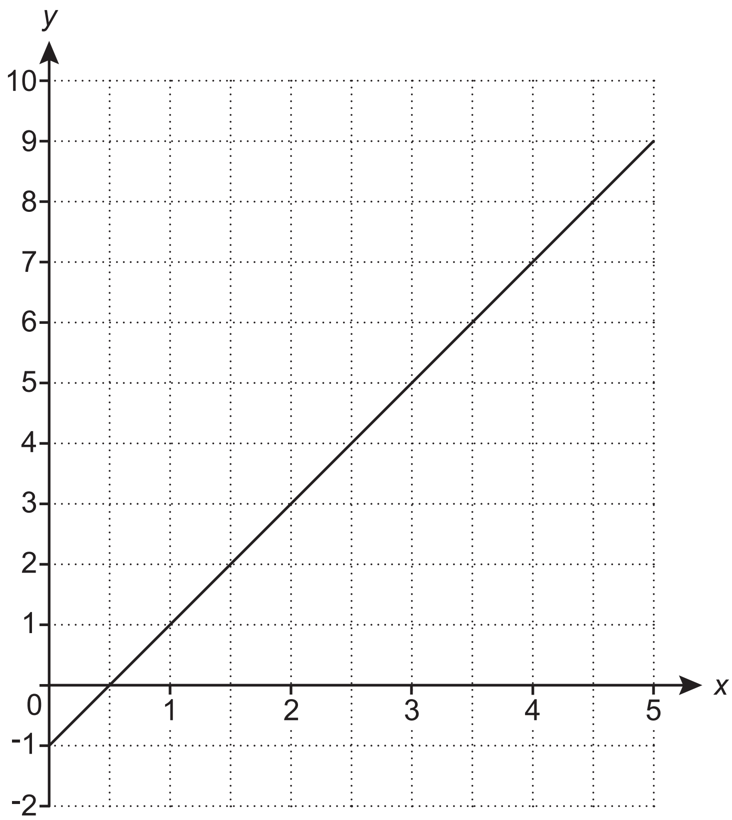
$y = \frac{1}{2}x + 4$ is the steepest of the four straight lines because it has the largest number added.

Explain why the student is wrong.

4 is not the gradient ....

.... **[1]**

(c) Here is part of the graph of $y = 2x - 1$.



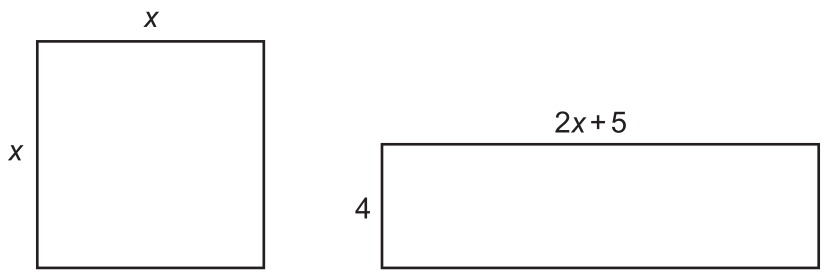
The line continues to the right.

Will the line pass above, below or through the point (45, 90)?
Show how you decide.

The line $y = 2x - 1$ will pass ......below...... the point (45, 90) because $2 \times 45 - 1 = 89$

The y-coordinate of the line will be 89 when the x-coordinate is 45. This is below the y-coordinate of the point, which is 90 **[2]**

22 In this question, all measurements are in centimetres.



Not to scale

The square and the rectangle have the same area.

(a) Show that $x^2 - 8x - 20 = 0$. **[3]**

$x \times x = 4(2x+5)$ ← Area of square or rectangle = length x width. Multiplying the length and width of the square and the length and width of the rectangle to express their areas. Setting these equal to each other as they have the same area

$x^2 = 8x + 20$ ← Simplifying and expanding the bracket

$x^2 - 8x - 20 = 0$ ← Subtracting 8x and 20 from both sides

(b) Solve $x^2 - 8x - 20 = 0$.

1, 20
2, 10

$(x-10)(x+2)=0$ ← The equation has more than one different power of x so cannot be solved by rearranging. Factorising by finding two numbers which multiply to -20 and add to -8 and putting these in brackets with x. Listing out the factor pairs of 20 until they add to -8 when one is negative. The two numbers are -10 and 2

Either x - 10 = 0 or x + 2 = 0 as one of the two brackets must equal to 0 in order to multiply to 0. When x - 10 = 0, x = 10. When x + 2 = 0, x = -2

(b) $x =$ ....10........ or $x =$ ....-2........ **[3]**

(c) Explain why one of the answers in part **(b)** is not possible in the context of the question.

Length cannot be negative

The length of the square is x and cannot be -2 **[1]**

(d) Write down the following.

(i) The area of the square.

Area of square = length x width. Both the length and width are 10. 10 x 10 = 100

(d)(i) 100 cm^2 **[1]**

(ii) The length of the rectangle.

Substituting 10 for x in 2x + 5
2 x 10 = 20
20 + 5 = 25

(ii) 25 cm **[1]**

Turn over for Question 23

23 A bag of sweets contains jellies, mints and toffees.

The ratio of jellies to mints is $n : 2$.
The ratio of mints to toffees is $5 : 3n$.

Work out the ratio of jellies to toffees.
Give your answer in its simplest form.

J	M	T
n	2	
	5	3n
5n	10	6n

Writing the given ratios in a column. Mints is in common to both ratios. 10 is a common multiple of 2 and 5. Multiplying both sides of the first ratio by 5 gives 10 parts for mints and multiplying both halves of the second ratio by 2 gives 10 parts for mints. The combined ratio is 5n : 10 : 6n

Ignoring the mints leaves the ratio of jellies to toffees as 5n : 6n, which can be simplified by dividing both sides by n

..........5.......... : ....6.......... **[4]**

END OF QUESTION PAPER