

Please write clearly in block capitals.

Centre number       Candidate number

Surname \_\_\_\_\_

Forename(s) \_\_\_\_\_

Candidate signature \_\_\_\_\_

# GCSE MATHEMATICS

# H

Higher Tier Paper 2 Calculator

Thursday 6 June 2019

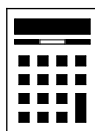
Morning

Time allowed: 1 hour 30 minutes

### Materials

For this paper you must have:

- a calculator
- mathematical instruments.



### 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.
- 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.

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	
24–25	
<b>TOTAL</b>	

### Advice

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



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 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](mailto:curtis@cgmaths.co.uk)

Answer **all** questions in the spaces provided

- 1 Circle the point that lies on the curve  $y = x^2 - 4x + 1$  [1 mark]

$(-1, 4)$        $(-1, -4)$        $(-1, -2)$        $(-1, 6)$

Substitute in the x-coordinate (which is the same for all options)  
 into the equation to work out which y-coordinate is correct

- 2 The height of a tree is 12 metres, correct to the nearest metre.  
 Circle the error interval. [1 mark]

11.5 m  $\leq$  height < 12.5 m

11.5 m  $\leq$  height  $\leq$  12.5 m

11.5 m < height  $\leq$  12.5 m

11.5 m < height < 12.5 m

The height can be equal to 11.5m as this rounds  
 up to 12m. Consider if it can be equal to 12.5m



3  $2a$  is five times bigger than  $b$ .

Circle the ratio  $a : b$

[1 mark]

~~10 : 1~~

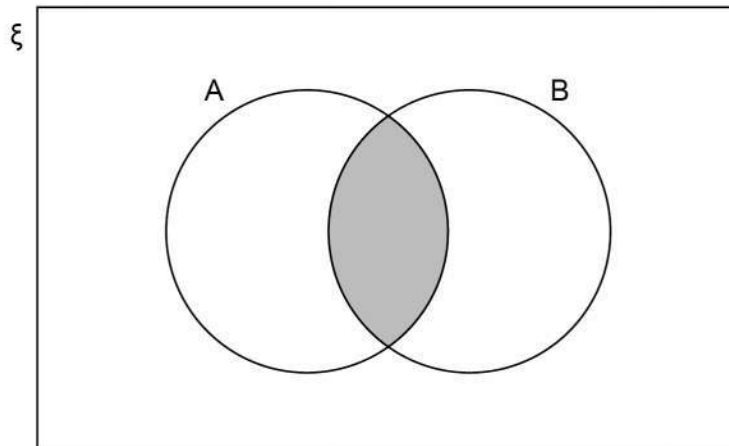
1 : 10

5 : 2

2 : 5

$2a = 5b$ . If  $a$  was 10 and  $b$  was 1, the equation wouldn't work so it can't be this one

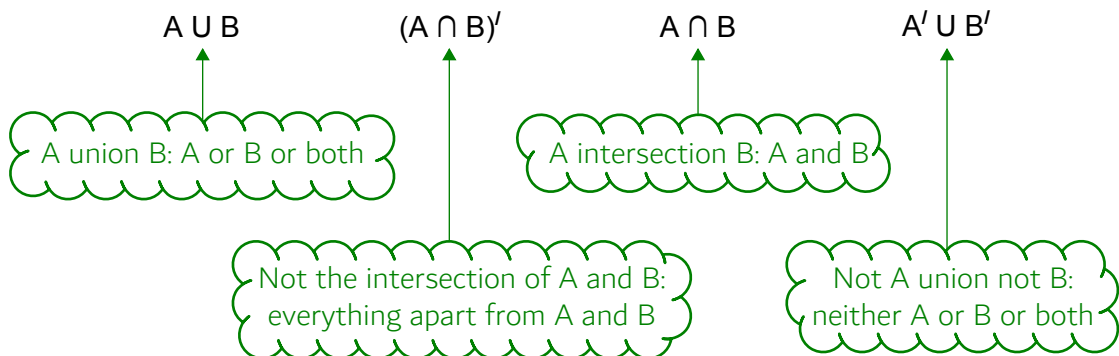
4



Which of these represents the shaded region?

Circle your answer.

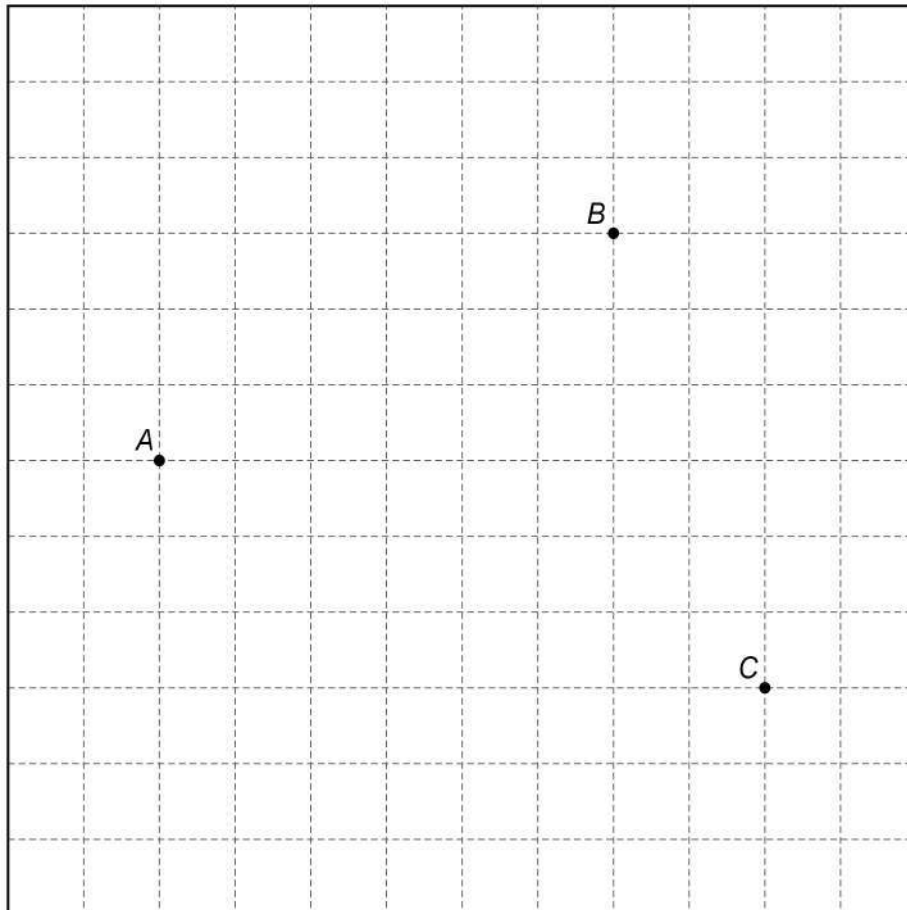
[1 mark]



Turn over for the next question



- 5** Using ruler and compasses, show the region inside the grid that is  
less than 4 cm from  $A$   
and  
nearer to  $B$  than to  $C$ .  
Label the region  $R$ .  
Show all your construction lines.

**[3 marks]**

Set the compass with a radius of 4cm and scribe an arc around  $A$  to indicate all points which are 4cm from  $A$ . The region is within this arc.

Construct the perpendicular bisector of line  $BC$  to indicate all points which are an equal distance from  $B$  and  $C$ . Set the compass to a radius which is greater than half of the distance from  $B$  to  $C$  then scribe arcs from  $B$  and  $C$ . Draw a straight line through both of the points where the arcs meet. The region is on the side of the line which is closer to  $B$ .



6

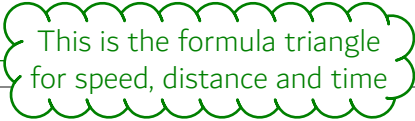
Beth drives 200 miles in 4 hours.

She drives the first 18 miles at an average speed of 36 mph

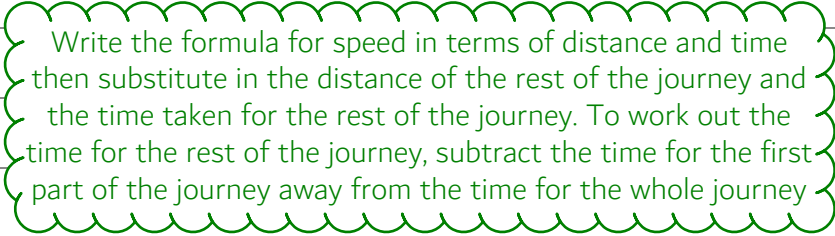
Work out her average speed for the rest of the journey.

**[3 marks]**

s d t



This is the formula triangle  
for speed, distance and time



Write the formula for speed in terms of distance and time then substitute in the distance of the rest of the journey and the time taken for the rest of the journey. To work out the time for the rest of the journey, subtract the time for the first part of the journey away from the time for the whole journey

Answer \_\_\_\_\_ mph

Turn over for the next question

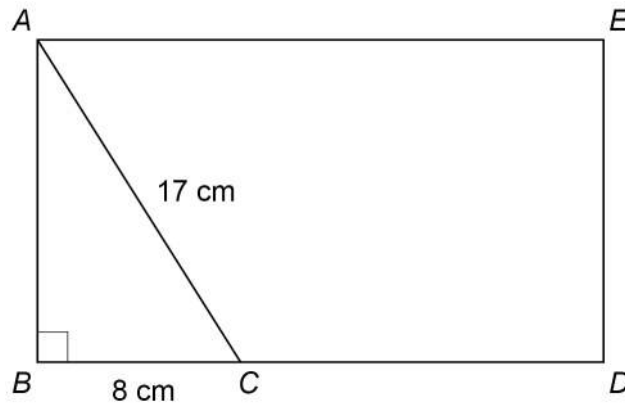
Turn over ►



7 The diagram shows rectangle  $ABDE$  and right-angled triangle  $ABC$ .

$$AC = 17 \text{ cm}$$

$$BC = 8 \text{ cm}$$



Not drawn  
accurately

$$BC : CD = 1 : 2$$

Work out the area of rectangle  $ABDE$ .

[4 marks]

$$a^2 + b^2 = c^2$$

Pythagoras' Theorem can be used to work out side  $AB$  as there are two sides in the right-angled triangle  $ABC$ .  $a$  and  $b$  are the shorter sides and  $c$  is the longest side

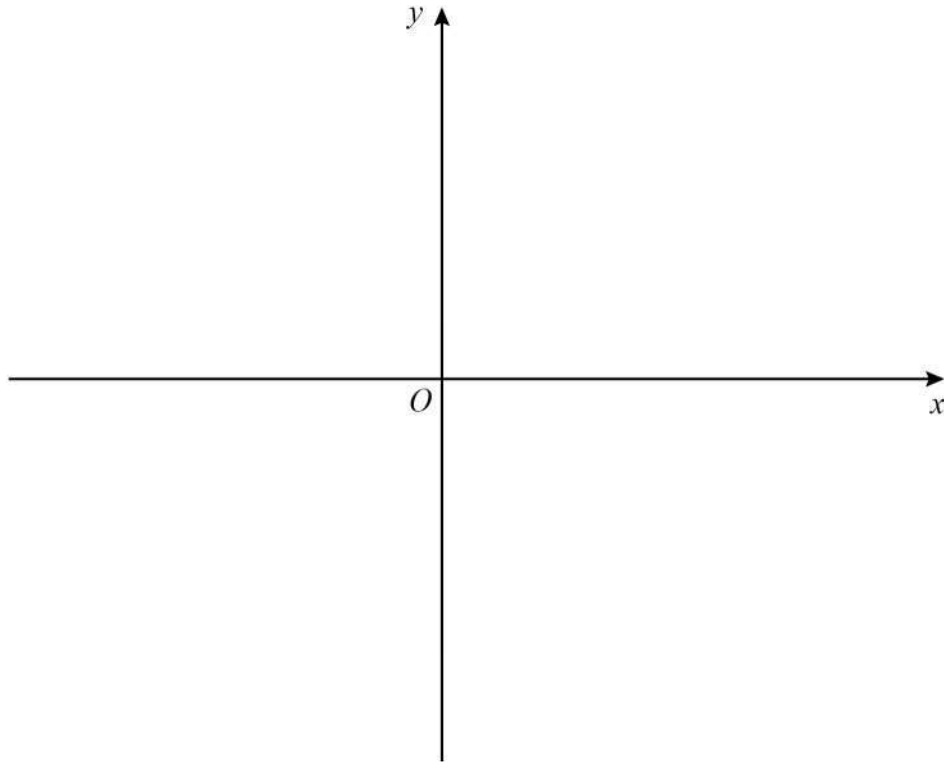
Area of rectangle = length  $\times$  width  
 $AB$  is the width and  $BD$  is the length.  $BD$  is represented by the total number of parts in the ratio and  $BC$  is represented by 1 part

Answer \_\_\_\_\_  $\text{cm}^2$



- 8 On the axes, sketch the curve  $y = x^3 - 2$   
You **must** show the coordinates of the  $y$ -intercept.

[2 marks]



$y = x^3$  is a typical graph. Subtracting 2 translates the graph downward 2 in the  $y$  direction

We could use the calculator to create a table of values, roughly plot the points on the graph then join them up with a curve.

Press Menu then 3 to go to table mode. Set  $f(x) = x^3 - 2$ , ignore  $g(x)$ , start: -5, end: 5, step: 1

Turn over for the next question





- 9 In a sport, injury time is added time played at the end of a match.  
The table shows the injury time,  $t$  (minutes) played in 380 matches.

Injury time, $t$ (minutes)	Frequency
$0 < t \leq 2$	59
$2 < t \leq 4$	158
$4 < t \leq 6$	106
$6 < t \leq 8$	45
$8 < t \leq 10$	12

- 9 (a) Circle the **two** words that describe the data.

[1 mark]

continuous

discrete

grouped

ungrouped

It is either continuous or discrete and grouped or ungrouped. It can't be continuous and discrete at the same time and can't be grouped and ungrouped at the same time. Continuous means it could be any value. Discrete means it can only be certain values (such as whole numbers)

- 9 (b) Which class interval contains the median?

You **must** show your working.

[2 marks]

Use the formula  $(n + 1)/2$ , where  $n$  is the number of data points, to work out which value is the median. Write down the cumulative frequency (the frequencies added up as they go). As soon as the cumulative frequency is above the number of the value which is the median, that category is the median

Answer \_\_\_\_\_  $< t \leq$  \_\_\_\_\_



9 (c) What percentage of the matches had **more than 6** minutes of injury time?

[2 marks]

Both the  $6 < t \leq 8$  and  $8 < t \leq 10$  are more than 6 minutes.  
Express the total of both of these categories as a fraction of the total number of games then convert the fraction into a percentage

Answer \_\_\_\_\_ %

10  $x$  is an integer.

$$-4 < x \leq 2$$

and

$$2 \leq x + 3 < 9$$

Rearrange this inequality to get  $x$  by itself in the middle by getting rid of the  $+3$  from the middle.  
Do the opposite operation to all sides to do this

Work out all the possible values of  $x$ .

[3 marks]

Integers are whole numbers. List all the integers which satisfy both inequalities at the same time

Answer \_\_\_\_\_



- 11 Joe and Kyle share an amount of money in the ratio  $7 : n$   
Joe gets 35% of the money.

Work out the value of  $n$ .

[2 marks]

Express the ratio of the percentage Joe gets to the percentage Kyle gets. Divide the percentage Kyle gets by the same amount as 35 has been divided by to get 7; this finds  $n$

Answer \_\_\_\_\_

- 12 A biased coin is thrown 250 times.  
The relative frequency of Heads is worked out after every 50 throws.

<b>Total number of throws</b>	50	100	150	200	250
<b>Relative frequency</b>	0.4	0.29	0.4	0.32	0.3

Circle the best estimate of the probability of Heads.

[1 mark]

0.3

0.32

0.342

0.4

The more times it is thrown, the more likely the relative frequency will be an accurate probability



13

The amounts spent on clothes by 40 boys and 40 girls in one month were recorded. The table shows information about the amounts spent by the boys.

Amount, $x$ (£)	Midpoint	Number of boys	
$0 \leq x < 20$		22	
$20 \leq x < 40$		9	
$40 \leq x < 60$		6	
$60 \leq x < 80$		3	
		Total = 40	

The mean for the girls was £35

Estimate the mean for the girls as a percentage of the mean for the boys.

[5 marks]

Mean = total/number. The number is 40 as there are 40 boys. The total (amount spent by all the boys combined) can be found by multiplying the midpoints by the frequency (number of boys) for each category then adding all the totals for each category together. To find the midpoints, add on half of the difference between the highest and lowest values for each category.

Express the mean for the girls as a fraction of the mean for the boys then convert it into a percentage

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Answer \_\_\_\_\_ %



14 Ali and Mel are making 3-digit codes.

The digit 0 is **not** used.

Ali only uses odd digits.

Mel only uses even digits.

14 (a) Ali can make  $x$  more codes than Mel.

Assume that digits **cannot** be repeated.

Work out the value of  $x$ .

[3 marks]

Use the product rule for counting to work out how many possible codes each person can make. Multiply the number of possibilities for the first digit by the number of possibilities for the second digit and by the number of possibilities for the third digit. Digits cannot be repeated so there is one fewer possibility for the second digit than the first digit

Answer \_\_\_\_\_

14 (b) In fact, digits **can** be repeated.

What does this tell you about the actual value of  $x$ ?

Tick **one** box.

Use the same calculation before to calculate  $x$  except the number of possibilities for the second and third digits is the same as the first digit

[1 mark]

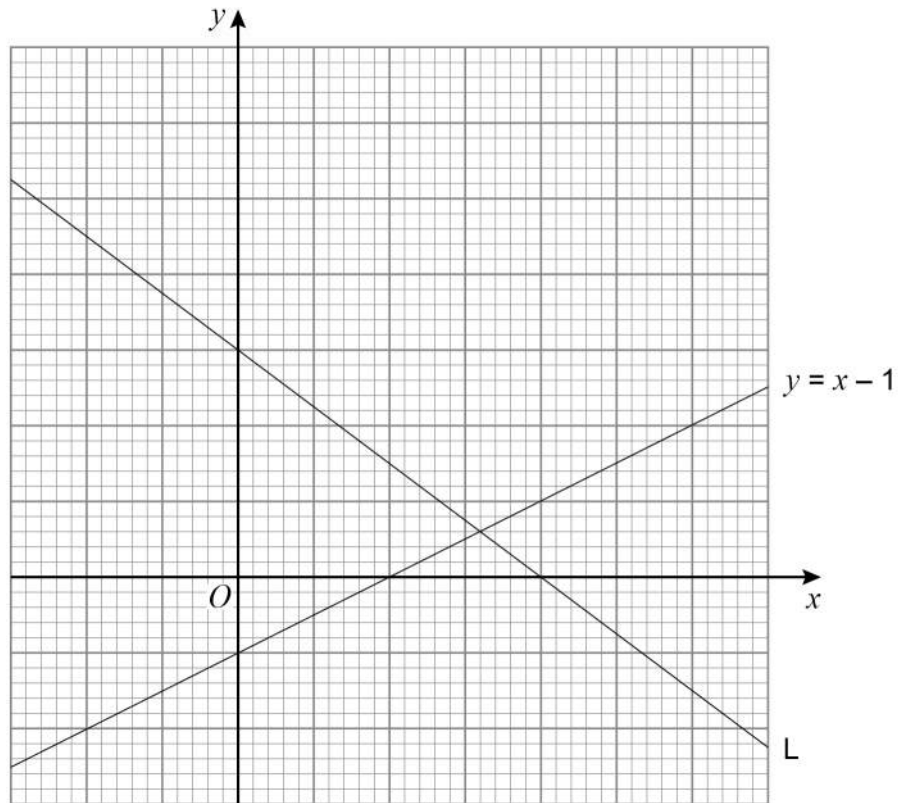
It is bigger than my answer to part (a)

It is smaller than my answer to part (a)

It is the same as my answer to part (a)



- 15 Here is line L and the graph of  $y = x - 1$   
The scales of the axes are not shown.



Work out the equation of line L.

[4 marks]

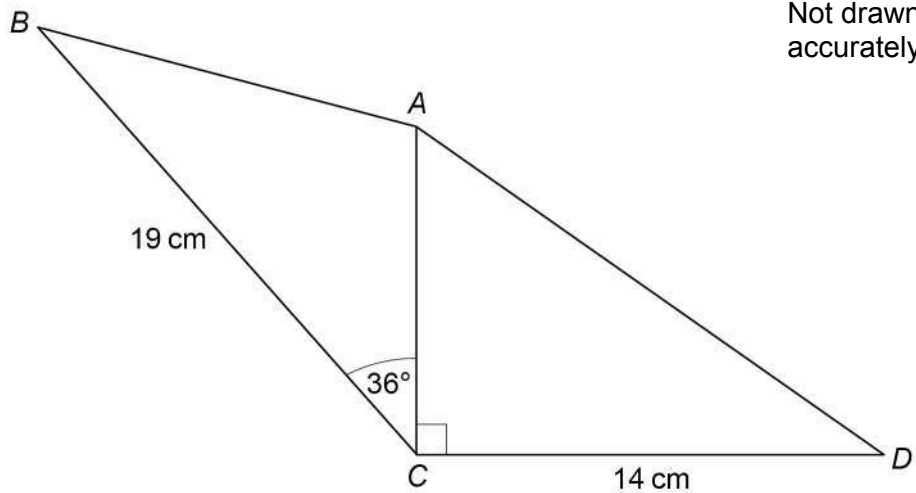
The general equation of a straight line is  $y = mx + c$ , where  $m$  is the gradient and  $c$  is the  $y$ -intercept. The gradient is  $(\text{change in } y)/(\text{change in } x)$ .

Work out the scale for the  $y$ -axis and  $x$ -axis (they could be different scales) by working out the  $y$  and  $x$ -intercepts of the line  $y = x - 1$ . Then the gradient and  $y$ -intercept of line L can be found

Answer \_\_\_\_\_



16

 $ABC$  and  $ACD$  are triangles.The area of  $ACD$  is  $80.5 \text{ cm}^2$ Work out the area of  $ABC$ .

Give your answer to 3 significant figures.

**[4 marks]**

Area of triangle =  $\frac{1}{2} ab \sin C$   
This is useful for  $ABC$ .

Area of triangle =  $\frac{1}{2} \times \text{base} \times \text{height}$   
This is useful for  $ACD$  as it can be rearranged  
to find the height  $CA$ , where  $CD$  is the base

Answer \_\_\_\_\_  $\text{cm}^2$ 

17

$$m = \frac{p - 2b}{2}$$

 $p = 68.3$  correct to 1 decimal place. $b = 8.7$  correct to 1 decimal place.Work out the lower bound for  $m$ .**[3 marks]**

The resolution (how much it goes up by) of 1 decimal place is 0.1. Dividing this by 2 then adding and subtracting it from  $p$  and  $b$  works out their upper and lower bounds. Consider if the upper or lower bounds are needed for  $p$  and  $b$  to get the lower bound for  $m$

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Answer \_\_\_\_\_

Turn over for the next question

Turn over ►





18

In a bag there are blue discs, green discs and white discs.

There are four times as many blue discs as green discs.

number of blue discs : number of white discs = 3 : 5

One disc is selected at random.

Work out the probability that the disc is either blue or white.

[3 marks]

B	G	W
4	1	
3		5

Writing the ratios of blue to green (which is 4:1 as there are four times as many blue discs as green discs) and blue to white. Both ratios have blue in common. Combine the ratios together by finding a common multiple of 4 and 3 and multiplying all sides of the ratios by the same amount to get it

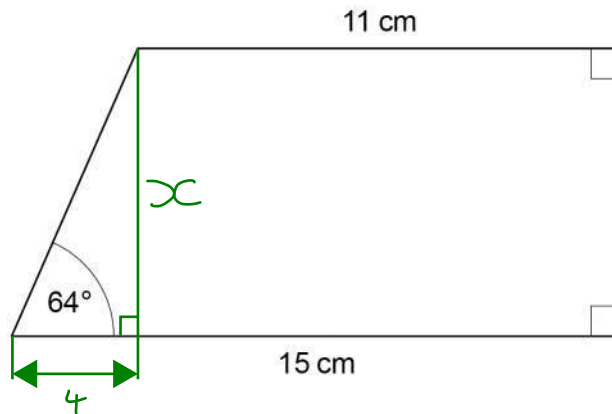
The combined ratio represents possible numbers of blue, green and white disks. Express the number which are either blue or white as a fraction of the total number of counters; this is the probability

Answer \_\_\_\_\_



19

Work out the area of the trapezium.

Not drawn  
accurately**[4 marks]**

Area of trapezium =  $\frac{1}{2}(a + b)h$ , where  $a$  and  $b$  are the parallel sides and  $h$  is the distance between them. Right-angled trigonometry can be used to work out  $x$

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Answer \_\_\_\_\_  $\text{cm}^2$ 

Turn over for the next question

Turn over ►



20

Expressions for consecutive triangular numbers are

$$\frac{n(n+1)}{2} \quad \text{and} \quad \frac{(n+1)(n+2)}{2}$$

Prove that the sum of two consecutive triangular numbers is always a square number.

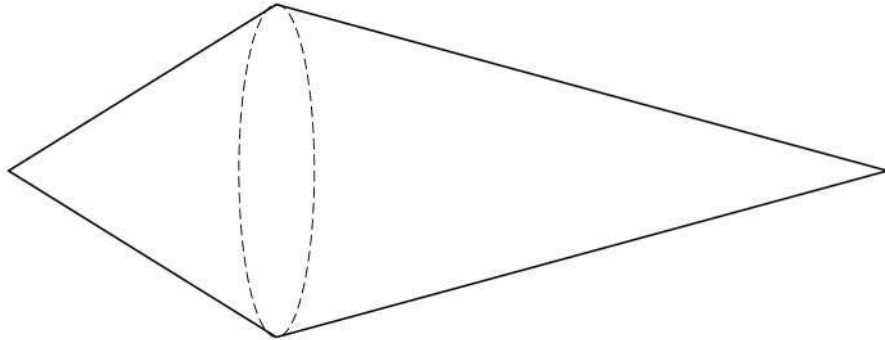
**[4 marks]**

Add both of the fractions to express them as a sum. Expand the brackets and simplify. We should get a quadratic which can be factorised to get a bracket squared (which is a square number)



21

A solid shape is made by joining two cones.  
Each cone has the same radius.



One cone has slant height =  $2 \times$  radius

The other cone has slant height =  $3 \times$  radius

The total surface area of the shape is  $57.8\pi \text{ cm}^2$

Curved surface area of a cone =  $\pi r l$  where  $r$  is the radius and  $l$  is the slant height

Work out the radius.

[3 marks]

Express the total surface area of the shape in terms of the radius,  $r$ .  
Substitute the slant lengths for  $2r$  and  $3r$ . Simplify the expression and set it  
equal to the given surface area. Rearrange to make the radius,  $r$ , the subject

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Answer \_\_\_\_\_ cm

7

Turn over ►



22 Show that  $(5\sqrt{3} - \sqrt{12})^2$  simplifies to an integer.

[3 marks]

Expand the square bracket using 'square the first term, double the product of the two terms, square the last term'. Or write out the square bracket as two of the same bracket multiplied together.

$$\sqrt{a} \times \sqrt{a} = a$$

$$\sqrt{a} \times \sqrt{b} = \sqrt{ab}$$

If the root is of a square number, it can be square rooted

23 A and B are similar cuboids.

surface area of A : surface area of B = 16 : 25

Work out volume of A : volume of B

Circle your answer.

[1 mark]

4 : 5

16 : 25

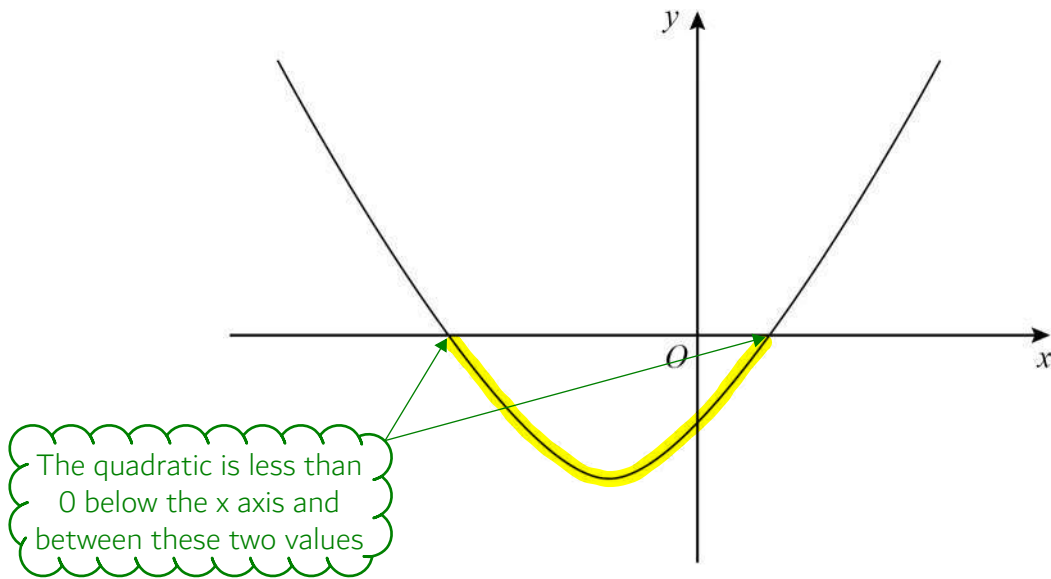
64 : 125

256 : 625

Surface area is a squared dimension. Square rooting both sides of the ratio to get the ratio of the lengths gives 4 : 5. Volume is a cubed dimension



24 Here is a sketch of the curve  $y = x^2 + 4x - 12$



Work out the values of  $x$  for which  $x^2 + 4x - 12 < 0$

Give your answer as an inequality.

[3 marks]

Set the left side equal to 0. Factorise and solve to work out the values of  $x$  where the quadratic meets the  $x$ -axis

Answer \_\_\_\_\_



25

A sample of 50 eggs is taken from Farm A.

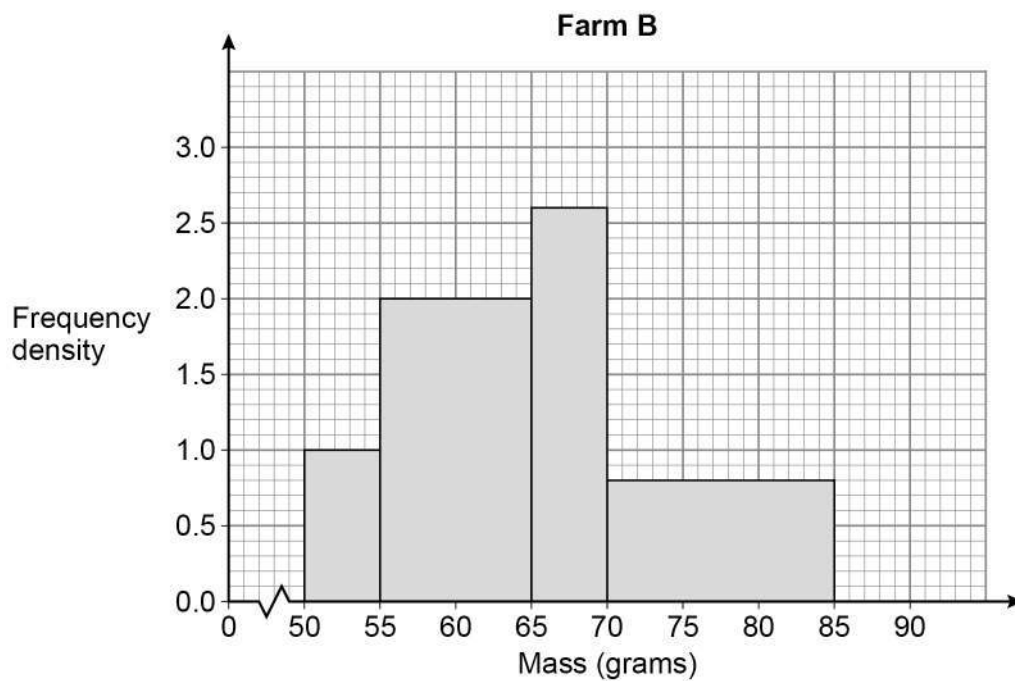
The table shows information about the masses of the eggs from Farm A.

Farm A

Mass, $m$ (grams)	Frequency
$53 < m \leq 58$	8
$58 < m \leq 63$	19
$63 < m \leq 68$	15
$68 < m \leq 73$	8

A sample of 50 eggs is taken from Farm B.

The histogram shows information about the masses of the eggs from Farm B.



For medium eggs,  $53 \text{ g} < \text{mass} \leq 63 \text{ g}$

The Farm A sample has more medium eggs than the Farm B sample.

Using the table and the histogram, estimate how many more.

You **must** show your working.

[4 marks]

For Farm A, add together the frequencies of each category which lies within the interval of the mass of the medium eggs.

For Farm B, split the bars so that we can estimate the frequency of the medium eggs. Frequency = class width  $\times$  frequency density

Answer \_\_\_\_\_

Turn over for the next question





26

$$(x + 5)(x + 2)(x + a) \equiv x^3 + bx^2 + cx - 30$$

Work out the values of the integers  $a$ ,  $b$  and  $c$ .

**[3 marks]**

Expanding the triple brackets by first expanding two of the brackets then expanding that with the third. Bring into the same form as the right side of the identity then equate coefficients

$$a = \underline{\hspace{4cm}}$$

$$b = \underline{\hspace{4cm}}$$

$$c = \underline{\hspace{4cm}}$$



27

$$f(x) = \frac{2x}{5} - 1$$

Work out the value of  $f^{-1}(3) + f(-0.5)$ **[5 marks]**

Find the inverse function  $f^{-1}(x)$  by switching  $f(x)$  for  $x$  and  $x$  for  $y$ , making  $y$  the subject then switching  $y$  back for  $f^{-1}(x)$ . Then substitute 3 for  $x$  in  $f^{-1}(x)$  and  $-0.5$  for  $x$  in  $f(x)$  and add them together

Answer \_\_\_\_\_

**END OF QUESTIONS**