AQA

.CG Maths.
Hints

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

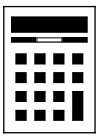
H

Higher Tier Paper 3 Calculator

Monday 8 June 2020 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.
- 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	
24–25	
26–27	
TOTAL	

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

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

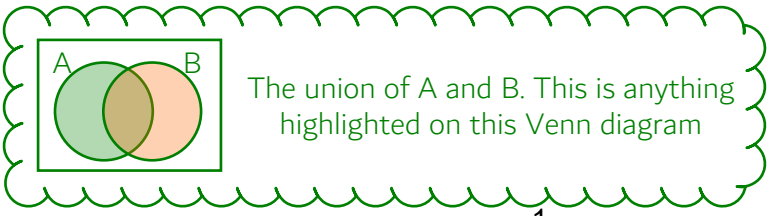
Do not write outside the box

1 What does A U B represent in P(A U B) ?

Circle your answer.

[1 mark]

A or B or both | A but not B | not A and not B | A and B



2 Circle the equation of the line that is parallel to $y = \frac{1}{2}x + 3$

[1 mark]

$y = -2x$ | $y = 2x$ | $y = \frac{1}{2}x$ | $y = -\frac{1}{2}x$

All of the equations are in the form y = mx + c, where m is the gradient and c is the y intercept. The gradient needs to be the same if they are parallel

3 Work out 320 as a percentage of 80

Circle your answer.

[1 mark]

25% | 75% | 300% | 400%

320/80 expresses 320 as a fraction of 80. Multiplying by 100 converts it into a percentage

Do not write outside the box

4 A fair coin is spun four times.

Circle the probability of getting four Heads.

[1 mark]

$\frac{1}{2}$ 2 $\frac{1}{8}$ $\frac{1}{16}$

Heads AND heads AND heads AND heads. AND means to multiply the probabilities. It is either head or tails and it is fair so each is equally likely

5 To the nearest 1000, there are 18 000 people at a festival.

5 (a) Write down the minimum possible number of people at the festival.

[1 mark]

Answer _____

The resolution is 1000. Halving this and subtracting it from the 18000 gives the lower bound, which is the minimum possible number of people

5 (b) Write down the maximum possible number of people at the festival.

[1 mark]

Answer _____

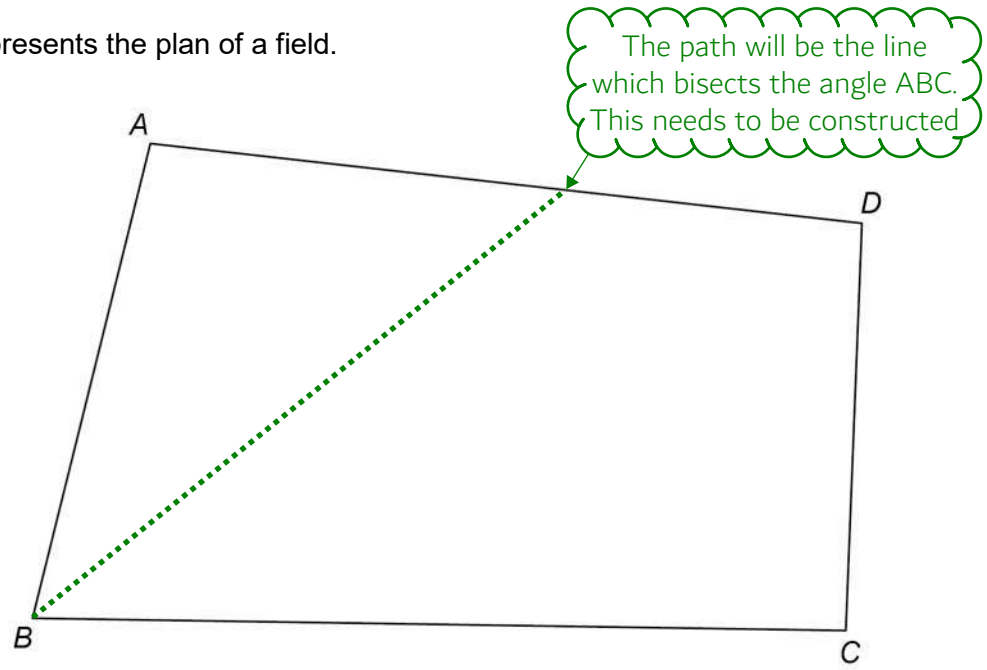
The resolution is 1000. Halving this and adding it from the 18000 gives the upper bound. However this rounds up to 19000 so it needs to be 1 fewer than this

Turn over for the next question

6

Do not write outside the box

6 *ABCD* represents the plan of a field.



There is a path across the field that

starts at *B*

is the same distance from *BA* and *BC*.

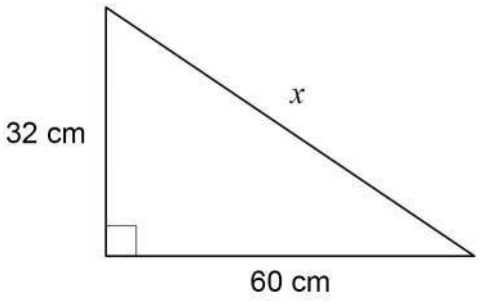
Using ruler and compasses, show the position of the path.

[2 marks]

Scribe two arcs of equal radius from B which cut AB and BC. Then draw arcs from both of these using the same radius which meet with a cross. Then draw a straight line from B through this cross

Do not write outside the box

7 Use Pythagoras' theorem to work out the value of x.



Not drawn accurately

[3 marks]

$a^2+b^2=c^2$ ← Pythagoras' Theorem where a and b are the shorter sides and c is the longest side

Answer _____ cm

Turn over for the next question

5

Do not write outside the box

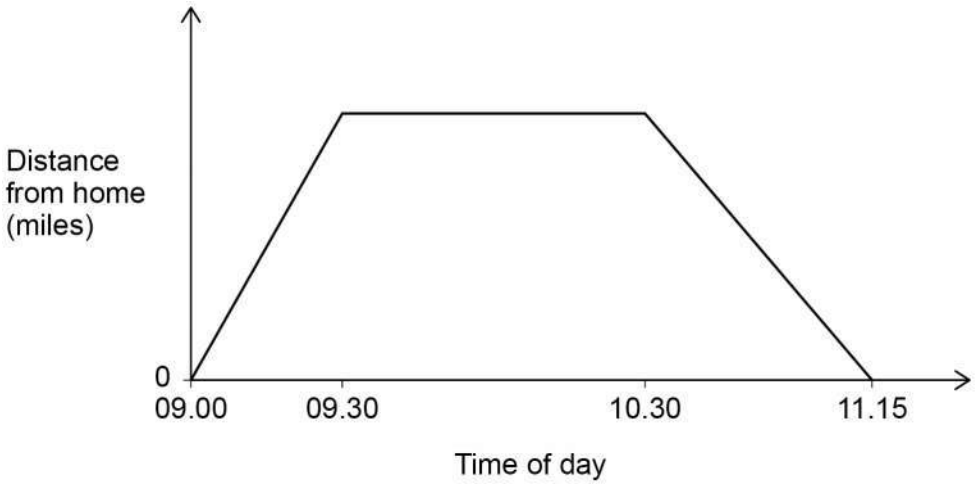
8 Chris visits a library.

He cycles to the library in half an hour at a speed of 12 miles per hour.

He stays at the library for one hour.

He then cycles home.

The sketch graph represents his visit.



Work out the speed, in miles per hour, at which Chris cycles home.

[3 marks]

$s\ d\ t$

Writing the formula triangle for speed, distance and time

The distance on the way back is the same as the distance on the way there. Work out the distance on the way there then use this and the time on the way back to work out the speed on the way back

Answer _____ mph

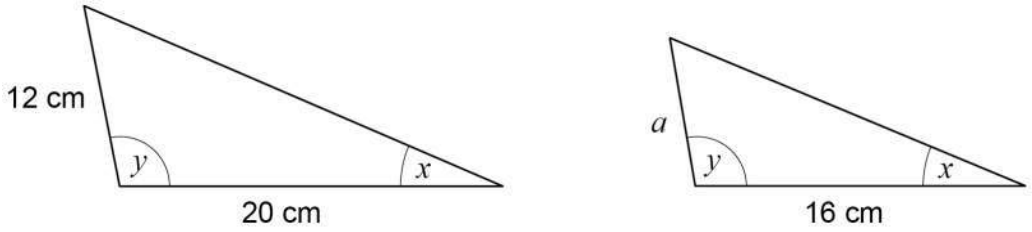
FACT 8 o , ,,

To enter time in the calculator: enter the hours, press the button on the left, enter the minutes, press the button on the left. 9:30 will appear as 9°30°

Do not write outside the box

9 These two triangles are similar.

Not drawn accurately



Work out the value of a.

[2 marks]

Work out the fraction the smaller triangle is of the larger triangle. Then work out this fraction of the 12

Answer _____ cm

10 Expand and simplify fully $4(2c + 3) - (5c - 1)$

[2 marks]

Answer _____

7

Do not write outside the box

11 A spinner can land on red, blue or green.

After 350 spins

relative frequency of red = 0.18

relative frequency of blue = 0.62

Work out the number of times the spinner landed on green.

[3 marks]

It is either red, blue or green so the relative frequency of all three must be 1 as it was always one of them. Subtracting the relative frequency for red and blue leaves the relative frequency for green. Multiplying the relative frequency of green by the number of spins gives the number of times it landed on green

Answer _____

Do not write outside the box

12 Here is some information about 26 houses.

a, b and c are all **different** numbers.

Number of bedrooms	Number of houses
1	7
2	a
3	b
4	c
5	8

The median number of bedrooms is 3.5

Work out a possible set of values for a, b and c.

[3 marks]

$\frac{26+1}{2} = 13.5$

Using the formula (n + 1)/2, where n is the number of houses, tells us that the median is halfway between the 13th value, which must be 3, and 14th value, which must be 4, in order for the median to be 3.5

13 houses are after the median and 13 houses are before

$a =$ _____

$b =$ _____

$c =$ _____

6

Do not write outside the box

13 (a) Simplify $\frac{25a}{8} \times \frac{2a}{5}$

Give your answer as a single fraction in its simplest form.

[2 marks]

To multiply fractions, the numerators and denominators can be multiplied. This can be written as (25 x 2 x a x a)/(8 x 5)

The numbers in the fraction can be simplified by entering them into the calculator

Answer _____

13 (b) Sofia is trying to simplify $\frac{6c+10}{2}$

Her method is

divide $6c$ by 2

then

add 10

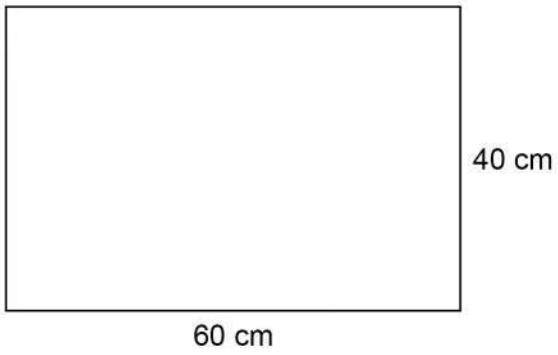
Evaluate her method.

[1 mark]

Only 6c has been divided by 2

Do not write outside the box

14 A rectangle has length 60 cm and width 40 cm



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The length decreases by 15%

The width decreases by 10%

Sue says,

"The perimeter decreases by 25% because 15% + 10% is 25%"

Is she correct?

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

[4 marks]

Perimeter is all of the outside sides added together. Find the original perimeter and decrease it by 25%. Decrease the 60cm by 15% and the 40cm by 10% then work out the new perimeter. Compare the two values to decide if Sue is correct. To decrease by x%, multiply the value by (100 - x)/100

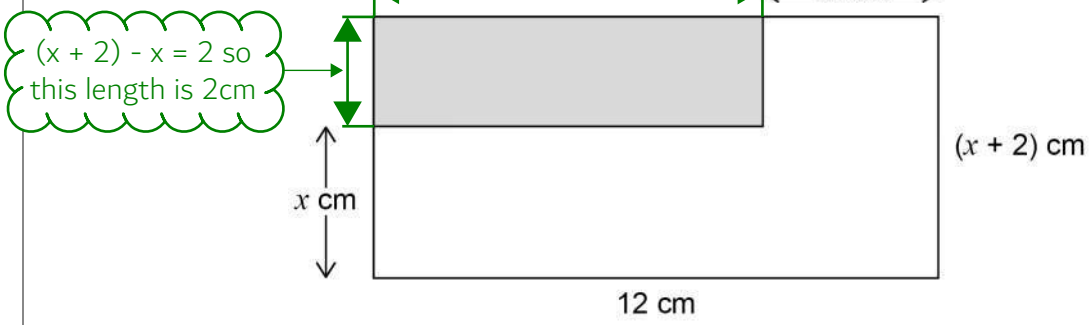
7

Do not write outside the box

17 Here are two rectangles.

Express this length in terms of x

Not drawn accurately



The area of the shaded rectangle is $\frac{1}{4}$ the area of the large rectangle.

Work out the value of x.

[4 marks]

Area of rectangle = length x width. Set the area of the shaded rectangle equal to 1/4 of the area of the large rectangle. Expand any brackets, bring all the terms involving x to one side and everything else to the other then make x the subject

Answer _____

9

Do not write outside the box

18 The pressure in a tyre is 30 pounds per square inch.

Convert the pressure into kilograms per square centimetre.

Use	1 pound = 0.45 kilograms and 1 inch = 2.54 centimetres

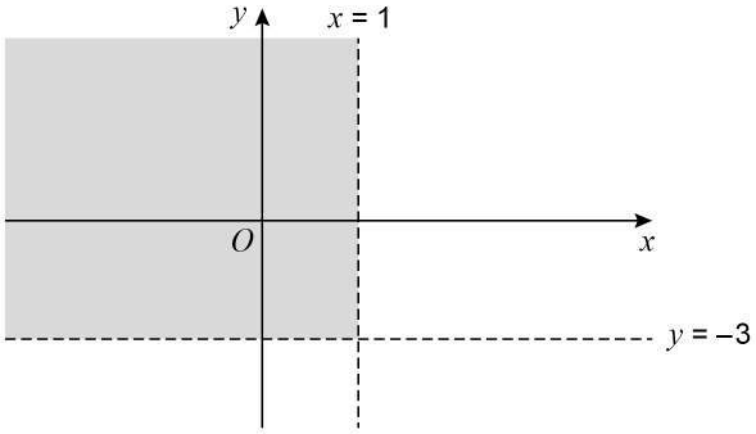
[3 marks]

There are 30 lots of 1 pound therefore there are 30 lots of 0.45 kilograms. 1 square inch is 2.54^2 square centimetres. Per means to divide

Answer _____ kg/cm^2

Do not write outside the box

19 The sketch shows the lines $x = 1$ and $y = -3$



Which pair of inequalities describes the shaded region?

Tick **one** box.

[1 mark]

☐ $x < 1$ and $y < -3$

☐ $x < 1$ and $y > -3$

☐ $x > 1$ and $y > -3$

☐ $x > 1$ and $y < -3$

The region is on the left of the line x = 1 so x must be less than 1.
The region is above the line y = -3 so y must be...

Turn over for the next question

4

Do not write outside the box

20 Amari and Ben each play a game.

20 (a) Here is some information about Amari's scores.

Lowest 12

Highest 20

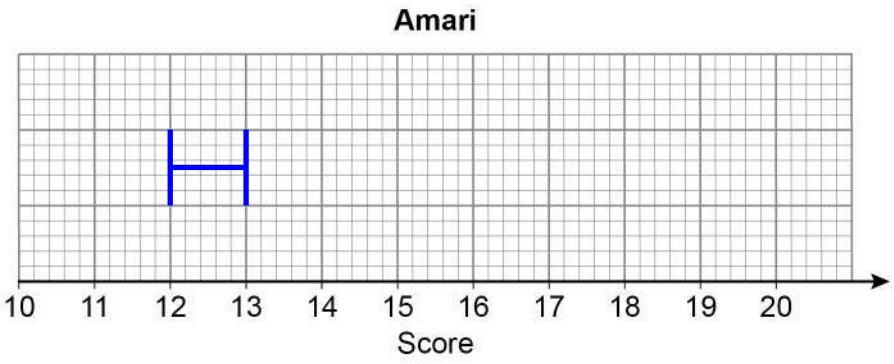
Lower quartile 13

Upper quartile 19

Median 17

Draw a box plot to represent his scores.

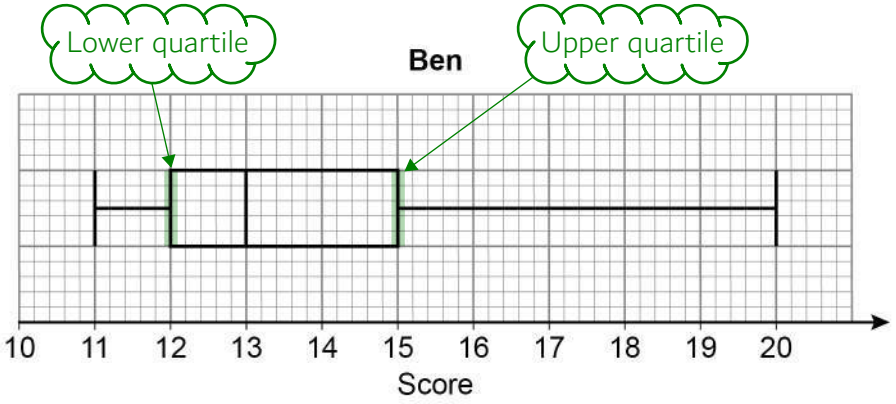
[2 marks]



Vertical lines drawn for the lowest, highest, lower quartile, upper quartile and median. Joining the lowest and lower quartile with a horizontal line and the upper quartile and highest with a horizontal line. Drawing a box around the quartiles. There is a box plot on the next question and it should look similar to this one

Do not write outside the box

20 (b) This box plot represents Ben's scores.



Who had more consistent scores, Amari or Ben?

Work out the interquartile ranges to support your answer.

[2 marks]

Interquartile range = upper quartile - lower quartile. Whoever has the lowest interquartile range was more consistent

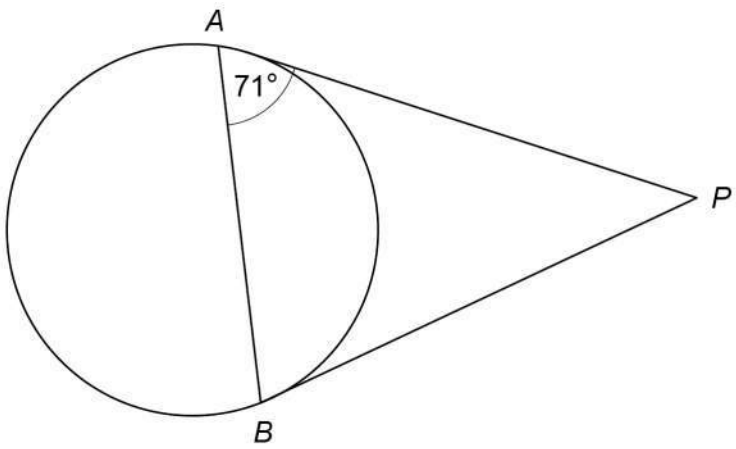
Turn over for the next question

4

Do not write outside the box

21 (a) *A* and *B* are points on a circle.

PA and *PB* are tangents.



Not drawn accurately

Work out the size of angle *APB*.

[2 marks]

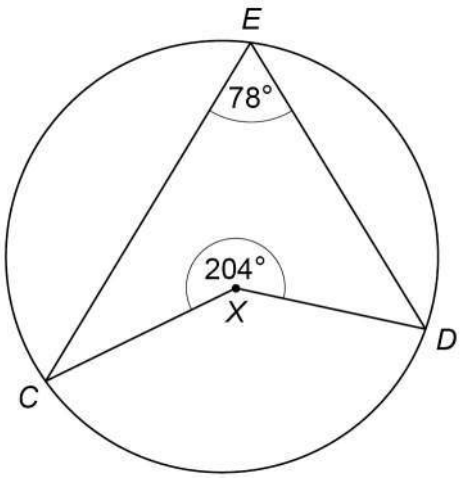
Tangents from the same point are equal in length. The base angles of an isosceles triangle are equal. There are 180° in total in a triangle

Answer _____ degrees

Do not write outside the box

21 (b) *C*, *D* and *E* are points on a different circle.

Not drawn accurately



Is *X* the centre of the circle?

Tick a box.

☐ Yes ☐ No

Show working to support your answer.

[2 marks]

Assume that X is the centre of the circle. The angle at the centre is double the angle at the circumference. Use this theorem to see if it holds. If it doesn't, the assumption was incorrect and X isn't the centre

Turn over for the next question

4

Do not write outside the box

22 Visitors to a museum buy a child ticket or an adult ticket.

Here is some information about two groups of visitors.

Group X	250 visitors, including 120 children
Group Y	number of children : number of adults = 17 : 15

One visitor from each group is picked at random.

Is this statement correct?

Probability of picking two children > probability of picking two adults

You **must** show your working.

[4 marks]

Work out the probabilities of picking two adults and the probability of picking two adults then compare them. Child AND child. AND means to multiply the probabilities. The probability of picking a child from Group X is the fraction of visitors who were children. The probability of picking a child from Group Y is 17 as a fraction of the total number of parts in the ratio

Do not write outside the box

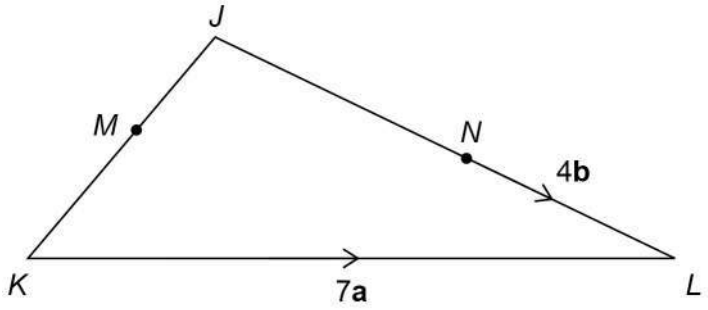
23 In triangle JKL

M is the midpoint of JK

$JN : NL = 3 : 2$

$\overrightarrow{KL} = 7\mathbf{a}$ $\overrightarrow{NL} = 4\mathbf{b}$

Not drawn accurately



Work out $\overrightarrow{JM}$ in terms of **a** and **b**.

Give your answer in its simplest form.

[3 marks]

$\overrightarrow{JM} = 1/2\ \overrightarrow{JK}$ as M is the midpoint of JK. $\overrightarrow{JK} = \overrightarrow{JL} + \overrightarrow{LK}$. $\overrightarrow{LK} = -7a$ as it is in the opposite direction to $\overrightarrow{KL}$. $\overrightarrow{JL}$ is represented by 5 parts in the ratio JN : NL. $\overrightarrow{NL}$ is two parts and is 4b. Dividing this by 2 works out what 1 part is worth then multiplying by 5 works out the 5 parts

Answer _____

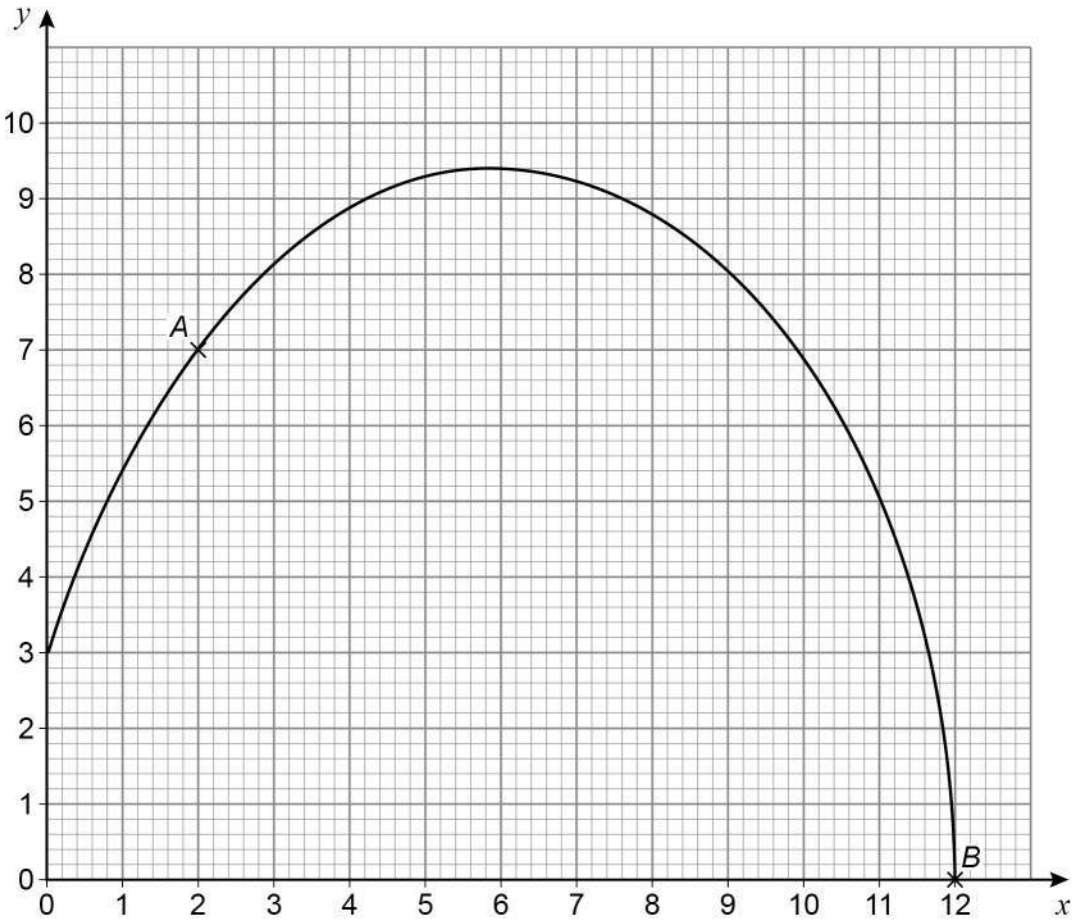
Turn over for the next question

7

Do not write outside the box

24 *A* and *B* are points on a curve.

A is (2, 7) *B* is (12, 0)



24 (a) Work out the instantaneous rate of change of y with respect to x at point *A*.

[2 marks]

Instantaneous rate of change is the gradient. Draw a tangent at point A. Gradient = (change in y)/(change in x). Pick two points which are on grid lines and as far away from each other as possible to get the most accurate gradient

Answer _____

Do not write outside the box

24 (b) The average rate of change of y with respect to x between points *A* and *B* is worked out.

Which statement is correct?

Tick **one** box.

[1 mark]

- ☐ It is positive.
- ☐ It is zero.
- ☐ It is negative.
- ☐ You cannot tell if it is positive or negative.

The average rate of change is worked out by drawing a straight line from A to B and working out its gradient

25 The equation of a circle is $x^2 + y^2 = 9$

Work out the length of the **diameter**.

Circle your answer.

[1 mark]

3 6 9 18

The general equation of a circle with its centre at the origin is $x^2 + y^2 = r^2$, where r is the radius

Turn over for the next question

4

Do not write outside the box

26 Prove algebraically that $3.4\dot{7} = \frac{313}{90}$

[3 marks]

Let x be the recurring decimal. There is one recurring digit so multiplying by ten once allows the recurring digit to be written in the same decimal place. Subtracting the x from 10x leaves 9x and cancels out the recurring digit. This can be rearranged to express x as a fraction, which can be simplified to give 313/90

27 The equation of a curve is $y = (x - 1)^2 - 6$

Circle the coordinates of the turning point.

[1 mark]

(–1, –6) (1, 6) (–1, 6) (1, –6)

The equation is in completed the square form. The turning point occurs when the square bracket is equal to 0. Work out what x and y are in the equation when this is the case

Do not write outside the box

28 Line A has equation $y = 4x - 1$

Line B is

perpendicular to line A

and

passes through the point (8, 5)

Work out the coordinates of the point where line B intersects the x-axis.

[4 marks]

$y = mx + c$ ← This is the general equation of a straight line, where m is the gradient and c is the y intercept

y must be 0 when the line B is intersecting the x-axis. Rearrange the general equation of a straight line to make x the subject to find the x coordinate. Substitute in y, m and c. m is the gradient and the gradients of perpendicular lines are the negative reciprocal of each other. c can be found by rearranging the general equation of a straight line to make c the subject then substituting in m and the x and y coordinates from the point (8 , 5)

Answer (_____ , _____)

Turn over for the next question

8

Do not write outside the box

29 A shape is made by joining triangle *ABC* to a semicircle with diameter *AC*.

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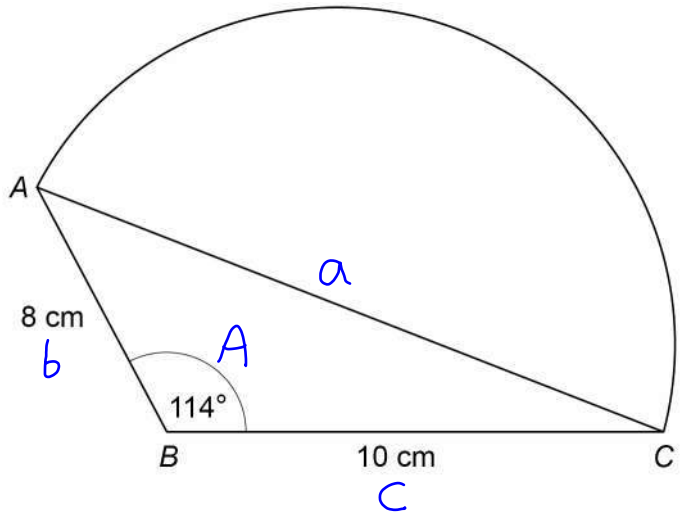

Work out the **total** area of the shape.

[5 marks]

$a^2 = b^2 + c^2 - 2bc\cos A$ ← Quoting the cosine rule so that it can be used to work out side AC in triangle ABC

Adding the area of the triangle to the area of the semicircle gives the total area of the shape. Area of a triangle = 1/2 x a x b x sinC, where a and b are sides of the triangle and C is the angle between them. Area of semicircle = 1/2 x π x r^2, where r is the radius. The radius is half of the diameter AC, which is found by rearranging the cosine rule to make a the subject

Answer _____ cm^2

Do not write outside the box

30 $f(x) = \frac{1}{2}x$ $g(x) = x - x^2$

Solve $f^{-1}(x) = gf(x)$

[4 marks]

The inverse function $f^{-1}(x)$ is found by switching f(x) with x and x with y then rearranging to make y the subject. The composite function gf(x) means to put the function f into the function g. 1/2 x is substituted for all x in g(x). Set $f^{-1}(x)$ equal to gf(x) then simplify, bring into the quadratic form $ax^2 + bx + c$ and factorise to solve

Answer _____

END OF QUESTIONS

9