AQA

.CG Maths.
Hints

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

GCSE MATHEMATICS

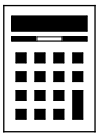
H

Higher Tier Paper 2 Calculator

Thursday 7 June 2018 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.

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	
28–29	
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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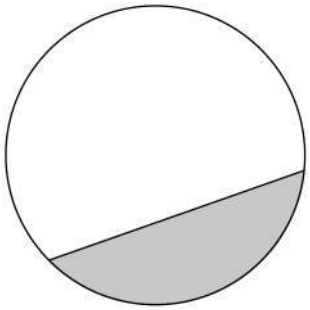
Answer **all** questions in the spaces provided

Do not write outside the box

1 Here is a circle.



Circle the word that describes the shaded part.

[1 mark]

segment chord sector arc

The area enclosed between a chord and the circumference

2 Circle the number that is in standard form.

[1 mark]

0.25×10^4 6×10^7 38×10^{-3} $4 \times 10^{\frac{1}{2}}$

Standard form is a x 10^n, where $1 \leq a < 10$ and n is an integer

Do not write outside the box

3 y is $1\frac{1}{2}$ times x.

Circle the ratio that is equivalent to $y : x$

[1 mark]

~~2 : 5~~ 5 : 2 3 : 2 2 : 3

y could be 2 and x could be 5. 2 is not $1^1/_2$ x 5

4 Work out 40 as a percentage of 10

Circle your answer.

[1 mark]

4% 25% 300% 400%

Express 40 as a fraction of 10. Multiplying a fraction by 100 converts it into a percentage

Turn over for the next question

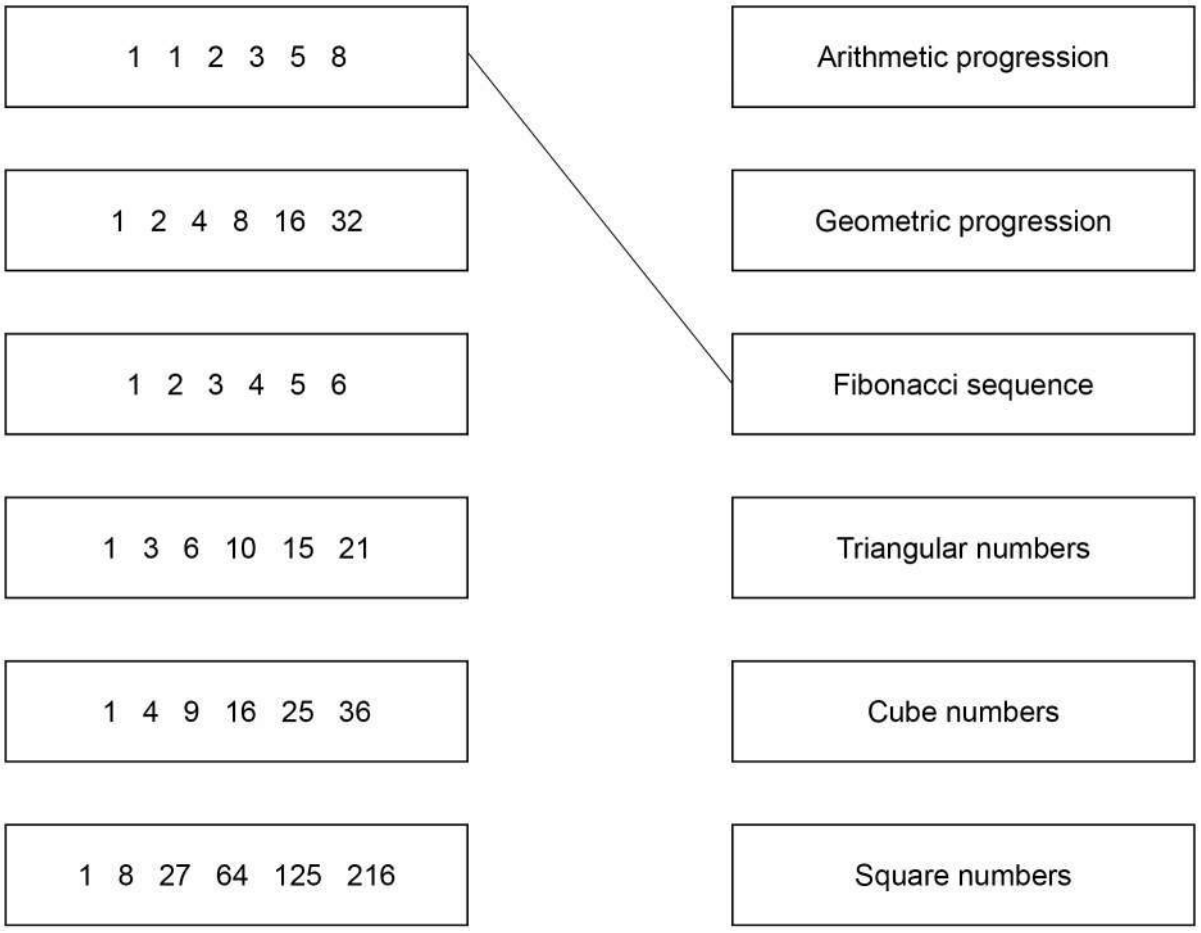
4

Do not write outside the box

5 Match each sequence to its description.

One has been done for you.

[4 marks]



Arithmetic progressions add the same amount between each term. Geometric progressions multiply by the same amount between each term. Triangular numbers start with 1, then add 2, then add 3, then add 4... Cube numbers are 1^3, 2^3, 3^3... Square numbers are 1^2, 2^2, 3^2...

Do not write outside the box

6 The table shows information about the population of a city.

Population in 2001	Population in 2011
420 000	480 000

Liam claims,

"From 2011 to 2021 the population of the city will increase by the same percentage as from 2001 to 2011"

He works out,

population increase from 2001 to 2011 = 480 000 – 420 000
= 60 000

population in 2021 = 480 000 + 60 000
= 540 000

Does the population of 540 000 match his claim?

You **must** show your working.

[3 marks]

Liam increased by 60000 for both 2001 to 2011 and 2011 to 2021. Work out the percentage increase for both of these to see if they are the same. Percentage change = (change/original) x 100

Answer _____

Turn over for the next question

7

Do not write outside the box

7 On three days, Ali throws darts at a target.

Here are his results.

	Number of throws	Number of hits	Number of misses
Monday	20	15	5
Tuesday	30	22	8
Wednesday	40	17	23
Total	90	54	36

7 (a) Work out **two** different estimates for the probability of Ali hitting the target.

[2 marks]

Answer _____ and _____

Express the number of hits as a fraction of the total number of throws for one of the days or for the total of all three days

7 (b) Which of your two answers is the better estimate for the probability of Ali hitting the target?

Give a reason for your answer.

[1 mark]

Answer _____

Reason It was based on more throws

Do not write outside the box

8 Theo starts with savings of £18
James starts with no savings.

Each week from now,

Theo will save £4.50 and James will save £4

In how many weeks will Theo and James have savings in the ratio 15 : 8 ?

[3 marks]

Using table mode by pressing MENU then 3. f(x) = 18 + 4.50x. g(x) = 4x. Start: 1. End: 30. Step: 1

This lists out the amount of money each person has each week. The x column is the number of weeks. The f(x) column is the amount of money Theo has. The g(x) column is the amount of money James has. Scrolling down until the amount Theo has to the amount James has simplifies to 15 : 8. Ratios simplify by dividing both sides by the same amount to get smaller whole numbers

Answer _____

6

Do not write outside the box

9 The length of each side of a regular pentagon is 8.4 cm to 1 decimal place.

9 (a) Complete the error interval for the length of one side.

[2 marks]

_____ cm ⩽ length < _____ cm

Adding and subtracting half of the resolution works out the upper and lower bound. The resolution is the place value of the first decimal place

9 (b) Complete the error interval for the perimeter.

[1 mark]

Pentagons have 5 sides. The perimeter is found by multiplying the side length by 5

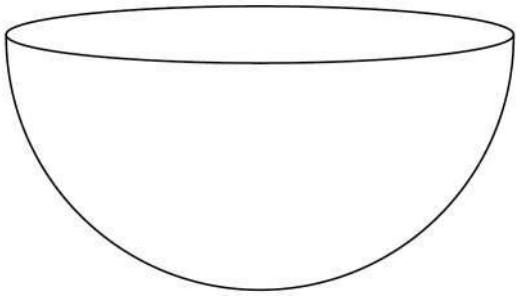
_____ cm ⩽ perimeter < _____ cm

Do not write outside the box

10

Volume of a sphere = $\frac{4}{3}\pi r^3$ where r is the radius

A container is a hemisphere of radius 30 cm



Sand fills the container at a rate of 4000 cm^3 per minute.

Does it take **less than** a quarter of an hour to fill the container?

You **must** show your working.

[3 marks]

s d t ← This is basically a speed, distance, time problem. The speed is the rate the sand fills the container and the distance is the volume of the container

Answer _____

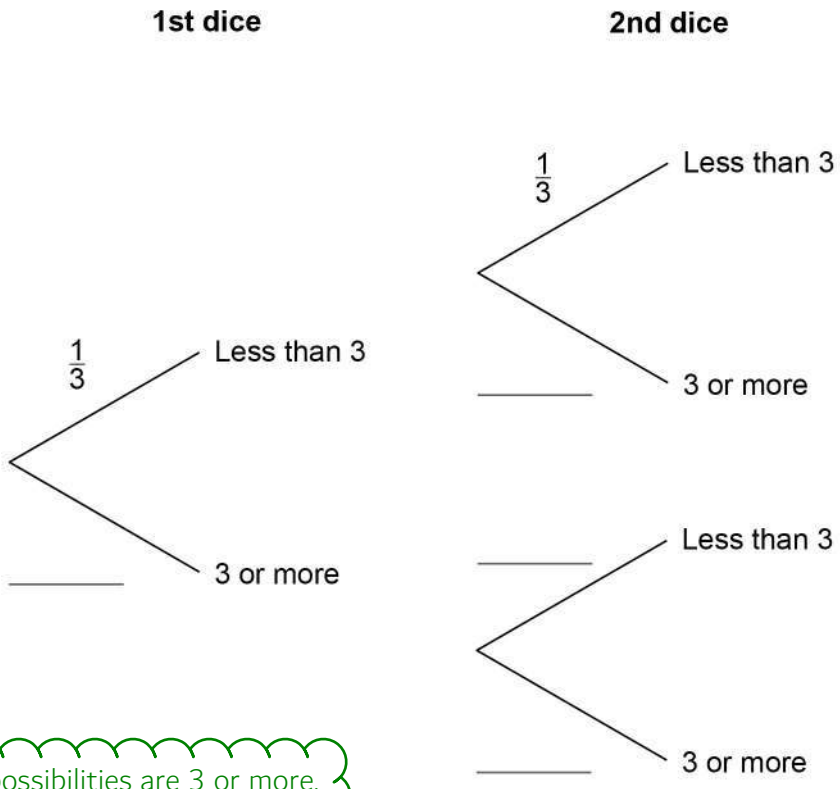
6

Do not write outside the box

11 Two ordinary fair dice are rolled.

11 (a) Complete the tree diagram.

[1 mark]



4 out of the 6 possibilities are 3 or more.
2 out of the 6 possibilities are less than 3

11 (b) Work out the probability that **both** dice land on a number less than 3

[1 mark]

Less than 3 AND less than 3. AND means to multiply the probabilities

Answer _____

Do not write outside the box

11 (c) Work out the probability that **exactly one** of the dice lands on a number less than 3

[2 marks]

Less than 3 AND 3 or more OR 3 or more AND less than 3. AND means to multiply the probabilities. OR means to add the probabilties

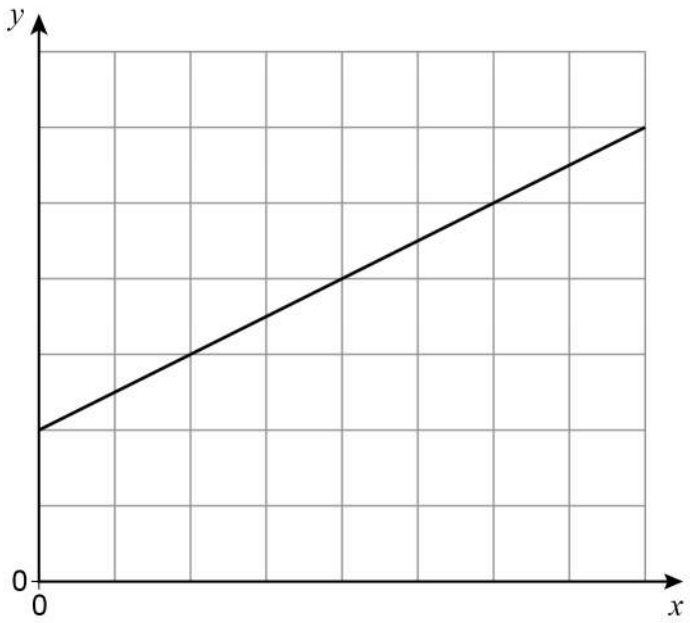
Answer _____

Turn over for the next question

4

Do not write outside the box

12 A straight line is drawn on the centimetre grid.



Fay assumes that the scale is 1 cm represents 1 unit.

12 (a) Use her assumption to work out the gradient of the line.

[1 mark]

Gradient = (change in y)/(change in x)

Answer _____

Do not write outside the box

12 (b) In fact, the scale is 1 cm represents 2 units.

Which statement is correct?

Tick **one** box.

[1 mark]

☐ The answer to part (a) is too big

☐ The answer to part (a) stays the same

☐ The answer to part (a) is too small

The change in y doubles and the change in x doubles

Turn over for the next question

2

Do not write outside the box

13 Show that, for $x \neq -1$

$$\frac{8x^2 - 8}{4x + 4}$$ simplifies to the form $ax + b$ where a and b are integers.

[3 marks]

To simplify a fraction the numerator and denominator need to be divided by the same amount. Factorising the numerator and denominator then cancelling out common factors does this

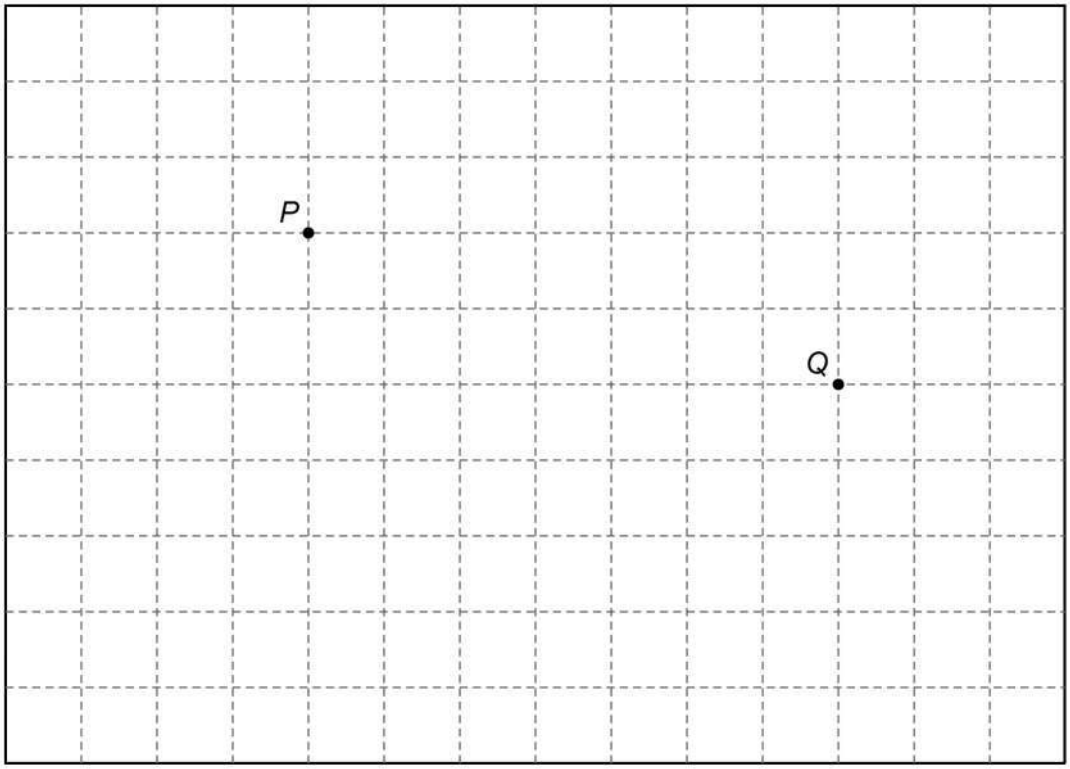
Do not write outside the box

14 The scale drawing represents a garden.

Water from a sprinkler at *P* reaches up to 20 metres from *P*.

Water from a sprinkler at *Q* reaches up to 25 metres from *Q*.

Scale: 1 cm represents 5 m



Using a pair of compasses,

show the region that water from **both** sprinklers reaches.

[2 marks]

Turn over for the next question

20/5 = 4 so the water from P reaches 4cm on the scale drawing. Drawing a circle around P using this radius shows the region which the water reaches. Do a similar method for Q. The area within both circles is the area which can be reached by both

5

Do not write outside the box

15 100 men and 100 women took a test.

Scores

	Median	Interquartile range	Range
Men	28	7.5	31
Women	30	9	37

Using this data, which statement **must** be true?

Tick **one** box.

[1 mark]

☐ Men had a higher average score than women

☐ Men had more consistent scores than women

☐ A woman had the highest score

☐ A man had the lowest score

The median is a type of average. The lower the interquartile range the more consistent the data is

Do not write outside the box

16 Some concrete has volume 3.8 m^3

16 (a) The density of the concrete is 2400 kg/m^3

Work out the mass of the concrete.

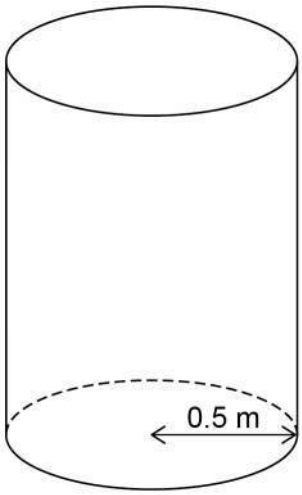
[2 marks]

d m V ← This is the formula triangle for density, mass and volume

Answer _____ kg

16 (b) The 3.8 m^3 of concrete is made into the shape of a cylinder.

The base has radius 0.5 metres.



Work out the height of the cylinder.

[2 marks]

A cylinder is similar to a prism so its volume = cross sectional area x length. The cross section is a circle and its area is found using π x radius^2. The length is the height. Express the volume in terms of the height and set this equal to the volume. Then rearrange to find the height

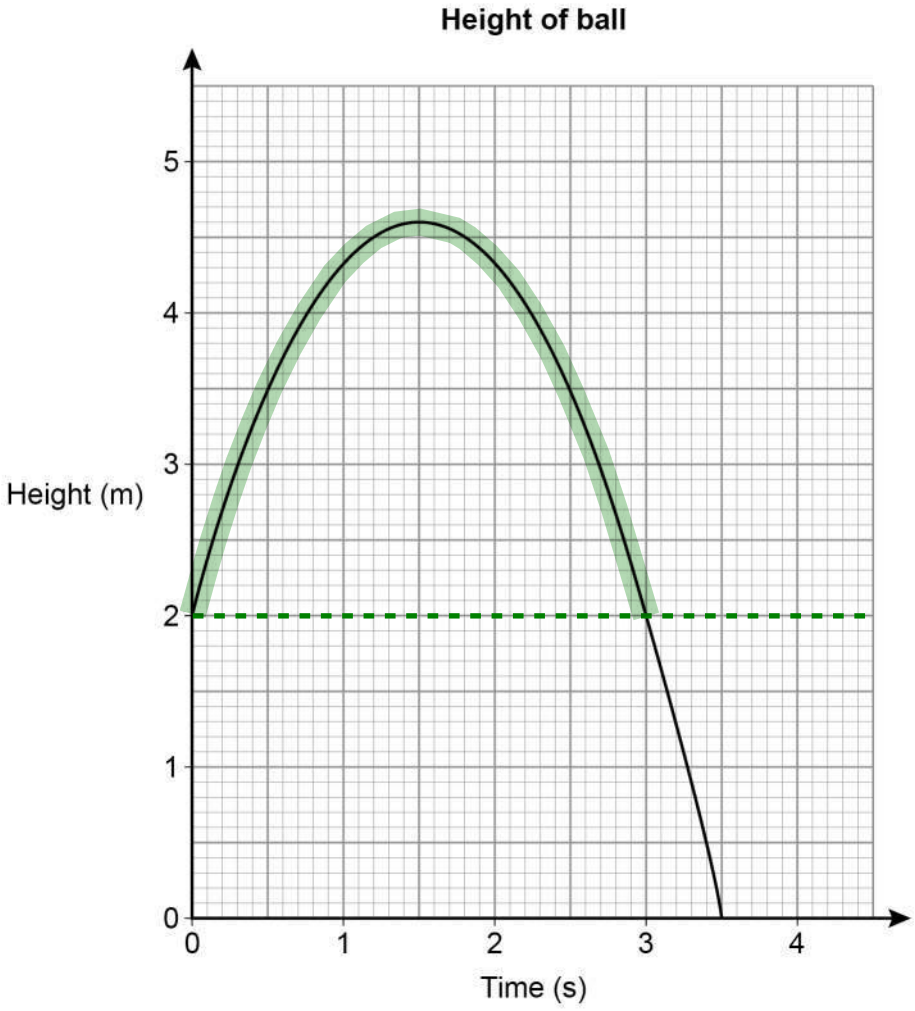
Answer _____ m

5

Do not write outside the box

17 A ball is thrown vertically upwards.

The graph shows the height of the ball above the ground after it is thrown.



17 (a) For how many seconds is the ball at a height of **more than** 2 metres?

The highlighted part of the line is when it had a height of more than 2 metres

[1 mark]

Answer _____ s

17 (b) After how many seconds is the ball at instantaneous rest when it is in the air?

When the gradient was 0 it had no speed and therefore wasn't moving

[1 mark]

Answer _____ s

Do not write outside the box

17 (c) Work out the average speed of the ball when it is moving downwards.

[2 marks]

The units of m/s means to divide the distance in metres by the time in seconds

Answer _____ m/s

18 The solution of $3^x = 300$ lies between two consecutive integers.

Work out the two integers.

[1 mark]

Using table mode by pressing MENU then 3. f(x) = 3^x. Ignore g(x). Start: 1. End: 30. Step: 1

This lists out the powers of 3 from 3^1 to 3^{30}. It is a continuous increasing function

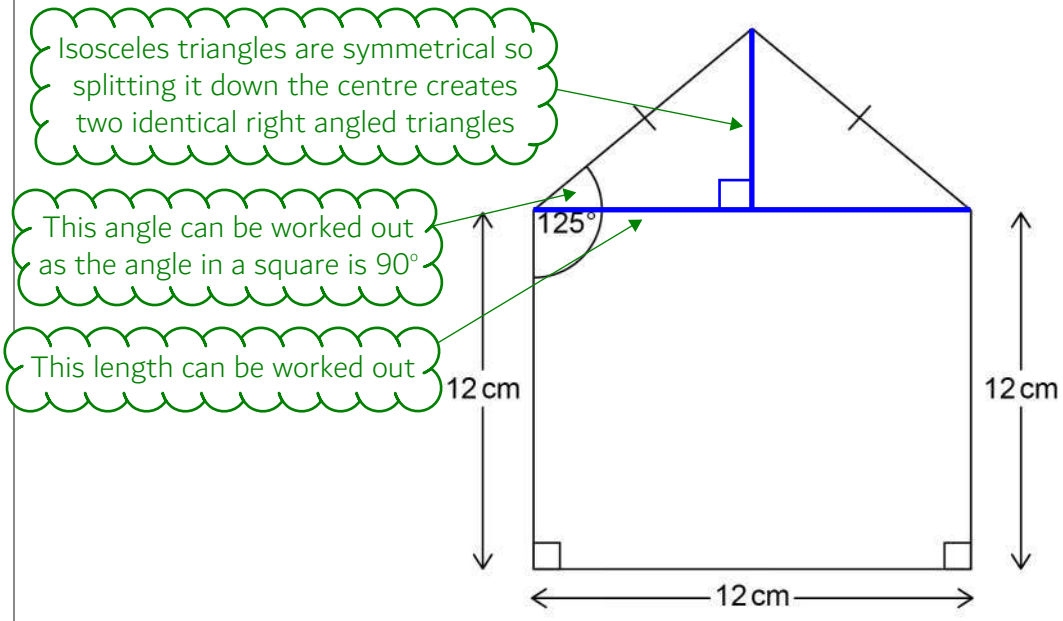
Answer _____ and _____

Turn over for the next question

5

Do not write outside the box

19 A pentagon is made from a square and an isosceles triangle.



Not drawn accurately

Work out the perimeter of the pentagon.

[4 marks]

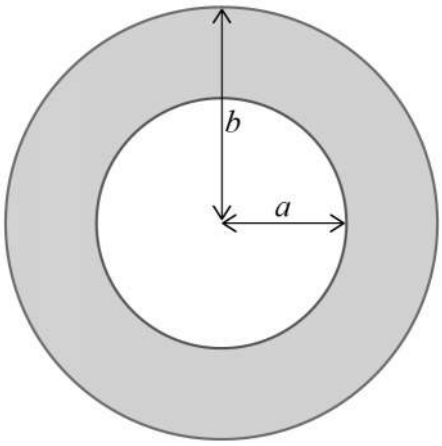
SOH CAH TOA

Writing out SOH CAH TOA as formula triangles. Tick what sides we are trying to find and what sides we have. If there are two ticks on a formula triangle, that one can be used. S: sin of the angle. C: cos of the angle. T: tan of the angle. O: opposite. A: adjacent. H: hypotenuse. Once the missing sides of the isosceles triangles are found, the perimeter can be found by adding together all of the outside sides

Answer _____ cm

Do not write outside the box

20 Here is an inflated swimming ring with dimensions in centimetres.



The volume of the ring, V cm^3, is given by

$$V = 0.25\pi^2(b - a)^2(b + a)$$

Work out the volume when $a = 20$ and $b = 30$

Give your answer to 3 significant figures.

[3 marks]

V is the subject so no rearranging is needed. Substituting 20 for a and 30 for b in the formula gives the volume. To round to 3 significant figures, use the fourth figure to decide whether to round the third up or down then everything after the third figure is set to 0 and everything after the decimal point is ignored

Answer _____ cm^3

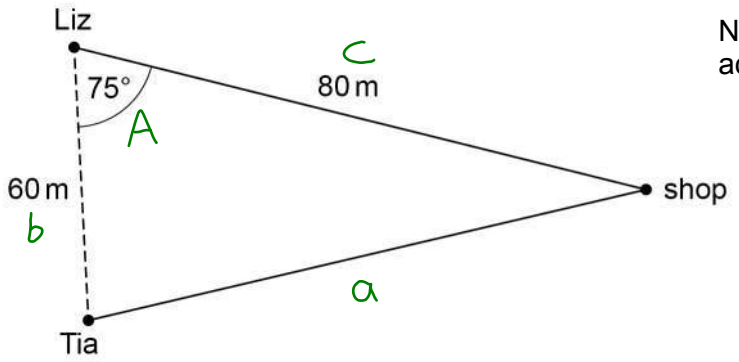
Turn over for the next question

7

Do not write outside the box

21 Liz and Tia are walking towards a shop along different straight paths.

The diagram shows their positions at 2 pm



Not drawn accurately

21 (a) Assume they walk at the same speed.

Who will arrive at the shop first?

You **must** show your working.

[3 marks]

$a^2 = b^2 + c^2 - 2bc\cos A$

The distance between Tia and the shop needs to be found. There isn't a right angle in the triangle so right angled trigonometry can't be used. There aren't opposite pairs of sides and angles so the sine rule can't be used. Therefore the cosine rule must be used

Answer _____

21 (b) In fact, Liz walks at a faster speed than Tia.

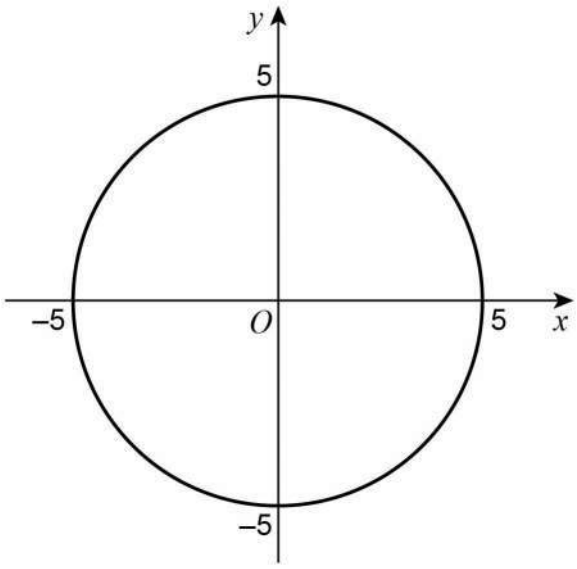
How does this affect the answer to part (a)?

[1 mark]

Liz will get there in less time

Do not write outside the box

22 A circle, centre O, passes through (5, 0).



What is the equation of the circle?

Circle your answer.

[1 mark]

$x^2 + y^2 = 25$ $x^2 + y^2 = 5$ $x^2 + y^2 = 10$ $x^2 + y^2 = 100$

Turn over for the next question

The general equation of a circle with its centre at the origin is $x^2 + y^2 = r^2$, where r is the radius. Alternatively, substituting in the coordinates of any of the points where the circle crosses the axis finds that only one of the equations is satisfied

5

Do not write outside the box

23 Solids X and Y are similar.

X has volume 64 cm^3

Y has volume 343 cm^3

The surface area of X is 176 cm^2

Work out the surface area of Y.

[3 marks]

Express the volume scale factor. Cube rooting this expresses the length scale factor. Squaring this expresses the area scale factor. Multiplying the surface area of X by this works out the surface area of Y

Answer _____ cm^2

Do not write outside the box

24 A tank is a cuboid measuring 50 cm by 35 cm by 20 cm

All lengths are to the **nearest centimetre**.

A container has a capacity of **exactly** 34 litres.

1 litre = 1000 cm^3

Which has the greater capacity?

Tick **one** box.

☐ Tank ☐ Container ☐ Cannot tell

Show working to support your answer.

[4 marks]

Adding and subtracting half of the resolution to each measurement works out the upper and lower bound of each of them. The resolution is 1cm. Volume of cuboid = length x width x height. Dividing the volume in cubic centimetres by 1000 converts it into litres. Work out the upper and lower bound of the volume of the tank in litres and compare this to the 34 litres of the container

Turn over for the next question

7

Do not write outside the box

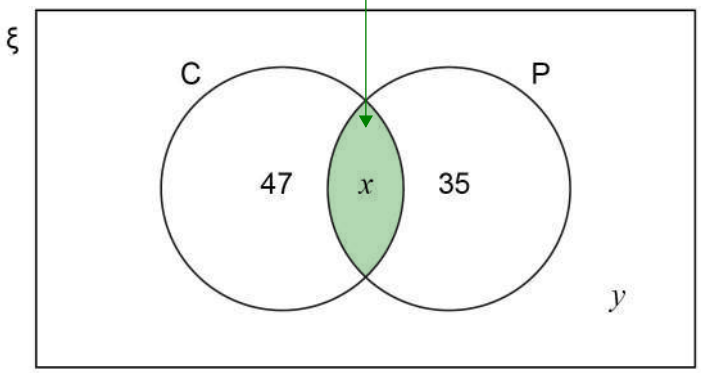
25 The Venn diagram shows some information about 150 students.

ξ = 150 students

C = students who study Chemistry

P = students who study Physics

The intersection of C and P is the number of students who studies Physics and also Chemistry



The probability that a Physics student, chosen at random, also studies Chemistry is $\frac{5}{12}$

One of the 150 students is chosen at random.

Work out the probability that the student does **not** study either Chemistry or Physics.

[4 marks]

Express the fraction of the Physics students who also study Chemistry. This is the probability that a Physics student, chosen at random, also studies Chemistry. So the expression must equal to 5/12. Multiplying both sides by the denominators cancels them out and leaves an equation which can be rearranged to find x. Then y can be found using the fact that there are 150 students in total. Expressing y as a fraction of the total number of students finds the probability that the student does not study either Chemistry or Physics

Answer _____

Do not write outside the box

26 A curve has equation $y = 4x^2 + 5x + 3$

A line has equation $y = x + 2$

Show that the curve and the line have **exactly** one point of intersection.

Do **not** use a graphical method.

[4 marks]

Solve the equations simultaneously to show that there is only one solution of x. Subtracting the equations from each other eliminates the y terms and leaves an equation just in terms of x, which can be solved using the quadratic formula. The solution of $ax^2 + bx + c = 0$ is

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

Turn over for the next question

8

Do not write outside the box

27 Prove algebraically that $2.7\dot{5}$ converts to the fraction $\frac{124}{45}$

[3 marks]

$x = 2.7\dot{5}$ ← Setting x equal to the recurring decimal

As there is 1 recurring digit, multiplying by 10 once lines up the recurring digit in the same decimal place. Subtracting x from 10x eliminates the recurring digit. Rearrange to express x as a fraction. Entering the fraction into the calculator simplifies it to the desired fraction

Do not write outside the box

28 $f(x) = 5 - x$ and $g(x) = 3x + 7$

28 (a) Simplify $f(2x) + g(x - 1)$

[3 marks]

Substitute 2x for x in f(x). Substitute (x - 1) for x in g(x). Add the two expressions, expand any brackets and collect like terms to simplify

Answer _____

28 (b) Solve $g^{-1}(x) = 2x$

[3 marks]

$x = 3y + 7$ ← Replacing g(x) with x and x with y. Inverse functions are basically when the x and y swap

Make y the subject. What y is equal to is $g^{-1}(x)$. Set this equal to 2x. There is now an equation in terms of x which can be solved

$x =$ _____

END OF QUESTIONS

9