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

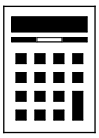
H

Higher Tier Paper 3 Calculator

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	
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

.CG Maths.

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

Do not write outside the box

1 b is 3 more than the square root of a.

Circle the correct equation.

[1 mark]

$b = \sqrt{a} + 3$ $b = \sqrt{a} - 3$ $b = \sqrt{a+3}$ $b = \sqrt{a-3}$

2 Circle the largest number.

[1 mark]

$0.\dot{5}$ 0.55 0.545 $0.5\dot{4}\dot{5}$

0.555...

Writing the numbers to 3 decimal places is enough for the largest to be identified

3 A line has equation $3y = 3x - 2$

Circle the coordinates of the intercept of the line with the y-axis.

[1 mark]

(0, 1) (0, –1) $\left(0, \frac{2}{3}\right)$ $\left(0, -\frac{2}{3}\right)$

Bring it into the form y = mx + c, where m is the gradient and c is the y intercept, which is the y coordinate where it crosses the y axis

Do not write outside the box

4 Factorise $x^2 - 64$

Circle your answer.

[1 mark]

$(x + 8)^2$ $(x - 8)^2$ $(x + 8)(x - 8)$ $x(x - 64)$

Difference of two squares can be used here. $a^2 - b^2 = (a + b)(a - b)$

5 Six positive numbers have

a mean of 10

a range of 19

Four of the numbers are 12 7 15 3

Work out the other two numbers.

[3 marks]

Mean = total/number so total = mean x number. Work out the total of all six of the numbers. Subtracting the four numbers leaves the total of the other two numbers. Adding the range to the smallest number gives the largest number. First assume that 3 is the smallest number and see if this assumption will work. If it doesn't, let x be the smallest number, create an equation in terms of x and the largest number and the total of the two other numbers then solve it to work out the smallest number. Then add the range to this to get the largest number

Answer _____ and _____

7

Do not write outside the box

6 At a country park there is a house, a museum and a garden.

The table shows the prices per person to visit the park.

	Price per person
Garden only	Free
House and museum	£12.50
House only	£8
Museum only	£7

One day, 480 people visit the park.

67 visit the garden **only**.

40% visit the house **and** the museum.

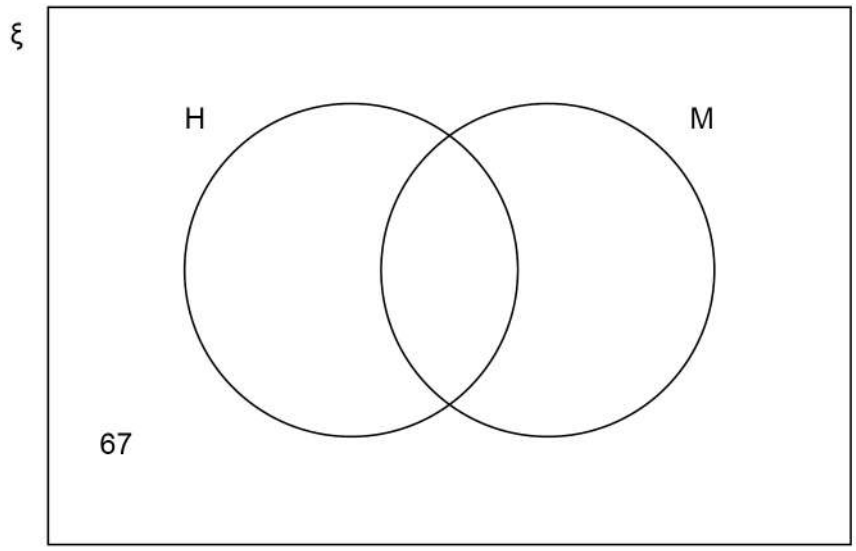
$\frac{3}{8}$ visit the house **only**.

The rest visit the museum **only**.

In total, how much do the 480 people pay to visit the park?

You may use the Venn diagram to help you.

[5 marks]



Do not write outside the box

Subtracting the number of people who visited the house and the museum, the house only and the garden only leaves the number who visited the museum only. Multiplying the number of visitors to the house only by the price of visiting the house only gives the amount paid to visit the house only. Adding together the amounts paid to visit the house and the museum, the house only and the museum only gives the total amount paid. The garden is ignored as it is free

Answer £ _____

7 Jeff and Kaz share £270 in the ratio Jeff : Kaz = 2.6 : 1

How much **more** than Kaz does Jeff get?

[3 marks]

Work how many parts there are in total in the ratio. This many parts represents the £270. Work out what 1 part is worth. Work out how many parts Jeff gets more than Kaz. Multiplying this many parts by the worth of 1 part gives how much more than Kaz Jeff gets

Answer £ _____

8

Do not write outside the box

8 The heel of a shoe exerts a pressure of 198 pounds per square inch.

Convert this pressure into kilograms per square centimetre.

Use

1 pound = 0.45 kilograms

1 square inch = 6.25 square centimetres

[3 marks]

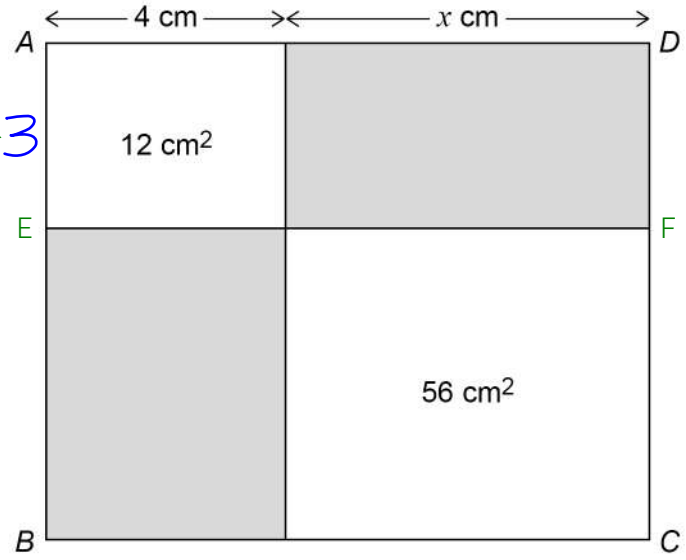
198 x 0.45 converts the pounds into kilograms. Per means to divide and there are 6.25 square centimetres in 1 square inch

Answer _____ kg/cm^2

Do not write outside the box

9 Rectangle *ABCD* is split into four smaller rectangles.

Two of the smaller rectangles are shaded.



Not drawn accurately

Length AE must be 3cm as 3 x 4 = 12 → 3

$4 : x = 1 : 2$

For rectangle *ABCD*, work out the ratio shaded area : unshaded area

Give your answer in its simplest form.

[4 marks]

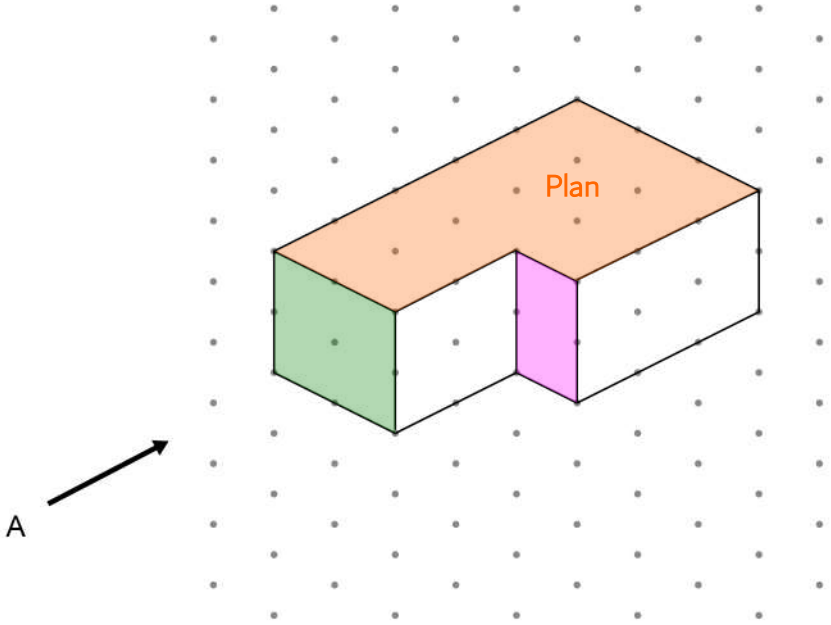
Area of rectangle = length x width. Work out length x using the ratio. 4 is represented by 1 part and x is represented by 2 parts. Work out length FG in a similar way to length AE. The shaded areas can then be worked out. Ratios simplify in a similar way to fractions so putting the total shaded area over the total unshaded area in the calculator can help to find the ratio in its simplest form

Answer _____ : _____

7

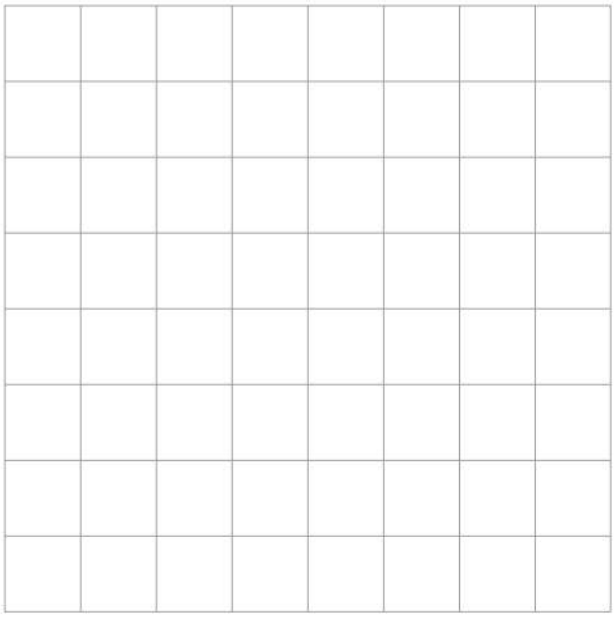
Do not write outside the box

10 A solid shape is drawn on isometric paper.



10 (a) On the centimetre grid, draw the elevation of the shape from A.

[1 mark]

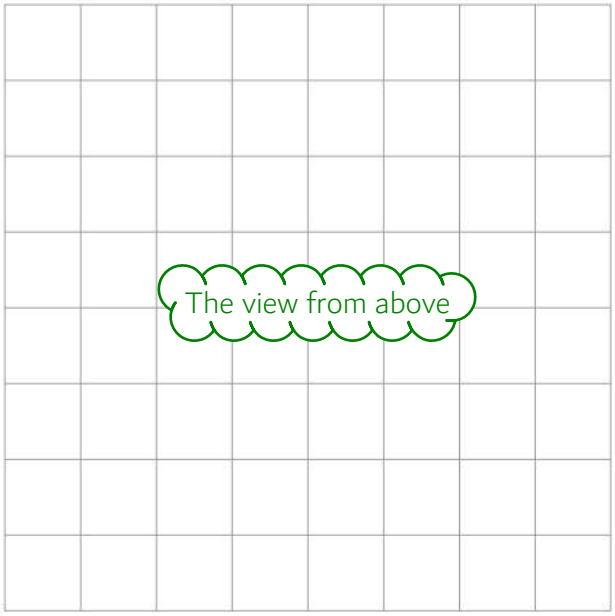


The faces shaded in green and pink will be seen in the elevation

Do not write outside the box

10 (b) On the centimetre grid, draw a plan of the shape.

[1 mark]



11 Erik thinks of a prime number between 20 and 30

His number is x% of 125

Work out **one** possible value of x.

[3 marks]

Prime numbers only have two factors, themselves and 1. In other words, they cannot be divided by any number apart from themselves and 1. Write the prime he could have thought of as a fraction of 125 then convert it into a percentage

Answer _____

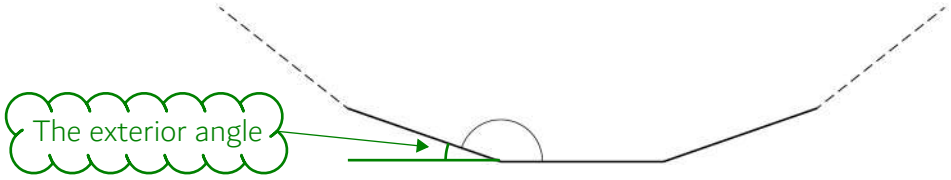
5

Turn over ►

Do not write outside the box

12 Part of a regular polygon with 15 sides is shown.

Not drawn accurately



Work out the size of an **interior** angle.

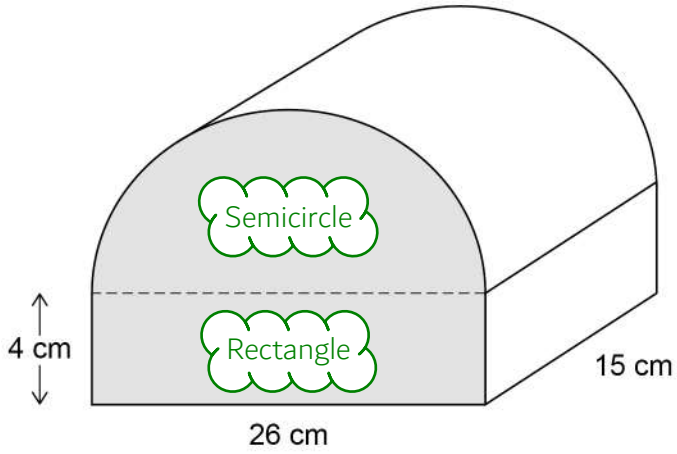
[2 marks]

All of the exterior angles on a polygon add up to 360°. As it has 15 sides it must have 15 exterior angles. Work out the exterior angle. The exterior angle and the interior angle lie around a point on a straight line and angles around a point on a straight line add up to 180°

Answer _____ degrees

Do not write outside the box

13 A box is the shape of half a cylinder on top of a cuboid.



Work out the volume of the box.

[4 marks]

Volume of prism = cross sectional area x length. The box is similar to a prism. Adding the area of the rectangle and the semicircle gives the cross sectional area. The length is 15cm.
Area of rectangle = length x width.
Area of circle = πr^2, where r is the radius

Answer _____ cm^3

6

Do not write outside the box

14 Phil sells ties.

He increases the original price of each tie by 10% to £13.20

A month later he announces a sale.

Phil says,

"The ties will be back to their original price, because each change was by 10%"

Is he correct?

Tick a box.

☐ Yes ☑ No

Show working to support your answer.

[3 marks]

Ignore the £13.20. Let x be the original price. To increase by 10%: 100 + 10 works out the percentage it increases to then putting it over 100 converts it into a fraction which when multiplied by will increase by 10%. To decrease by 10% do a similar method. The result should be something less than x and therefore the ties will not be back to their original price

Do not write outside the box

15 A biased spinner can land on A, B or C.

The table shows the probabilities, in terms of k, of A, B and C.

	A	B	C
Probability	$0.5k$	$7k - 0.15$	$2.5k$

Work out the probability of B.

[3 marks]

It is certain to be either A, B or C therefore the probabilities of them all added together must equal 1. Using this fact an equation in terms of k can be made which can be simplified, rearranged and solved. Then substitute in the value of k into the expression for the probability of B to find its probability

Answer _____

Turn over for the next question

6

Do not write outside the box

16 *P* is the point (2, 14)

Q is the point (6, 8)

R is the point (2, 5)

Use gradients to show that angle *PQR* is **not** a right angle.

[3 marks]

Perpendicular gradients multiply to -1. Show that the gradient of PQ multiplied by the gradient of QR does not equal to -1. Gradient = (change in y)/(change in x). Change in y is found by subtracting the first y coordinate from the second y coordinate. Change in x is found by subtracting the first x coordinate from the second x coordinate

Do not write outside the box

17 $m^2 > 9$

Circle the possible value of m.

[1 mark]

~~$-2\frac{7}{8}$~~ 2.8 3 $-\frac{7}{2}$

$(-2^7/_8)^2 = 8.2...$ which is not greater than 9

18 Simplify $w^1 \times w^0$

Circle your answer.

[1 mark]

1 0 w w^2

$a^x \times a^y = a^{x+y}$

19 The equation of a circle is $x^2 + y^2 = 11$

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

Circle your answer.

[1 mark]

$\sqrt{11}$ $2\sqrt{11}$ $\sqrt{22}$ 22

The general equation of a circle with its centre at (0 , 0) is $x^2 + y^2 = r^2$, where r is the radius. The diameter is double the radius

Turn over for the next question

6

Do not write outside the box

20 $\frac{a}{b} = 3c$

$\frac{b}{c} = 2$

Work out the value of a when $c = 8$

[3 marks]

Rearrange to make a the subject in the first equation to get a formula for a in terms of b and c. We are given the value of c but not b so we need to rearrange the second equation to make b the subject to get a formula for b in terms of c. Then substitute b for an expression in terms of c into the original rearranged equation and substitute c for 8 to find a

Answer _____

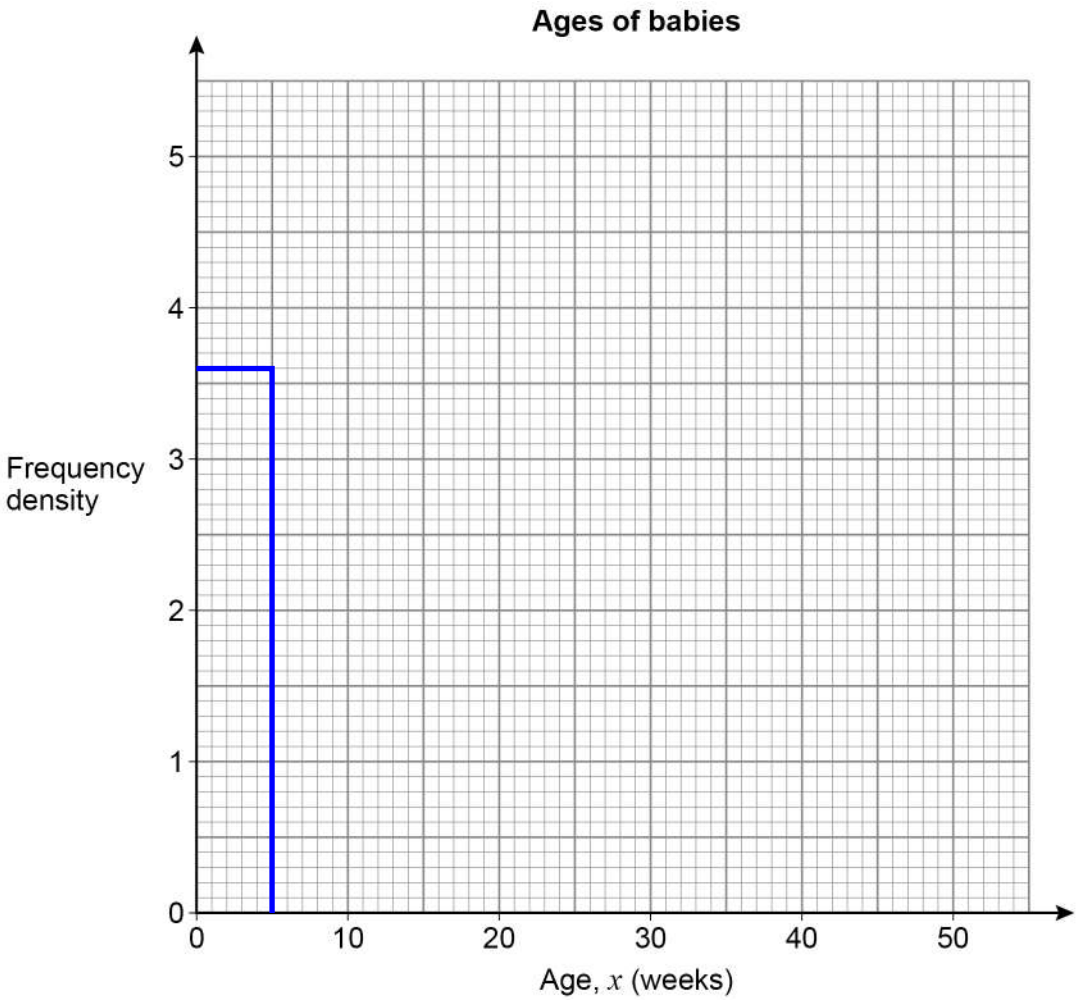
Do not write outside the box

21 Here is some information about the ages of babies at a clinic.

Age, x (weeks)	Frequency		
$0 \leqslant x < 5$	18		
$5 \leqslant x < 10$	23		
$10 \leqslant x < 20$	17		
$20 \leqslant x < 50$	21		

Draw a histogram to represent the information.

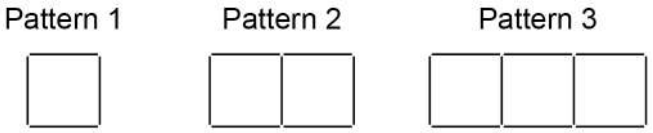
[4 marks]



Frequency is the area of each box on the histogram so frequency = frequency density x class width.
Frequency density = frequency/(class width). Class width is the upper bound subtract the lower bound for each interval

7

22 A sequence of patterns is made using horizontal sticks and vertical sticks.



The table shows the number of horizontal sticks and vertical sticks in each pattern.

Pattern	Number of horizontal sticks	Number of vertical sticks
1	2	2
2	4	3
3	6	4

What fraction of the total number of sticks in Pattern n are horizontal?

Give your answer in terms of n.

[3 marks]

Expressing the nth term for the horizontal sticks as a fraction of the nth term for the total number of sticks gives the desired fraction. The nth term of these sequences is bn + c as they are linear sequences, they increase by the same amount between each term. b is the amount it changes between each term of the sequence and c is the 0th term, the term before the first term

Answer _____

Do not write outside the box

23 The equation of a curve is $y = 16^x$

23 (a) Circle the point that lies on the curve.

[1 mark]

x coordinate y coordinate

(2, 32) (32, 2) (2, 256) (256, 2)

The y coordinate must be equal to 16 to the power of the x coordinate

23 (b) A different point on the curve has y-coordinate $\frac{1}{16}$

Work out the x-coordinate.

[1 mark]

1/16 is the reciprocal of 16

Answer _____

24 $a^b = 3$ where a is an integer and b is a proper fraction.

Work out **one** possible pair of values of a and b.

[1 mark]

$a =$ _____ $b =$ $\frac{1}{2}$

6

Do not write outside the box

25 Expand and simplify fully $(x-3)(x+2)(x+5)$

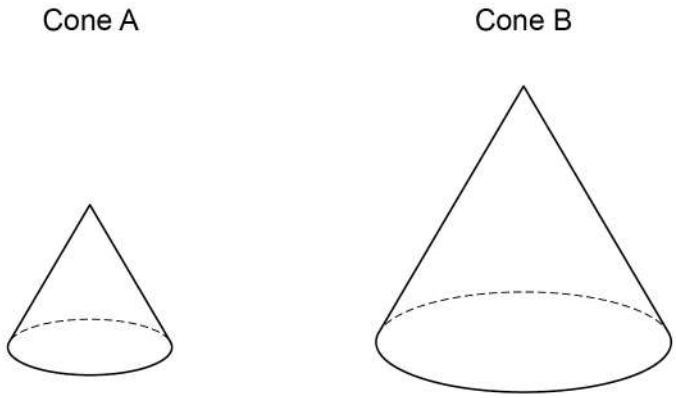
[3 marks]

Expand the first two brackets. Simplify by collecting like terms then write it multiplied by the third bracket. Expand these two brackets. Simplify by collecting like terms

Answer _____

Do not write outside the box

26 Here are two similar cones.



The surface area of cone A is 2 m^2

The surface area of cone B is 4.5 m^2

Work out the ratio radius of cone A : radius of cone B

Give your answer in the form 1 : n

[3 marks]

The ratio of the areas is 2 : 4.5. Square rooting both sides gives the ratio of the lengths. As the radius is a length this is the ratio we are looking for. Simplify the ratio into the form 1 : n by dividing both sides by the same amount. Anything divided by itself is 1

Answer _____ : _____

6

Do not write outside the box

27 In the diagram

$\overrightarrow{DE} = \mathbf{a}$

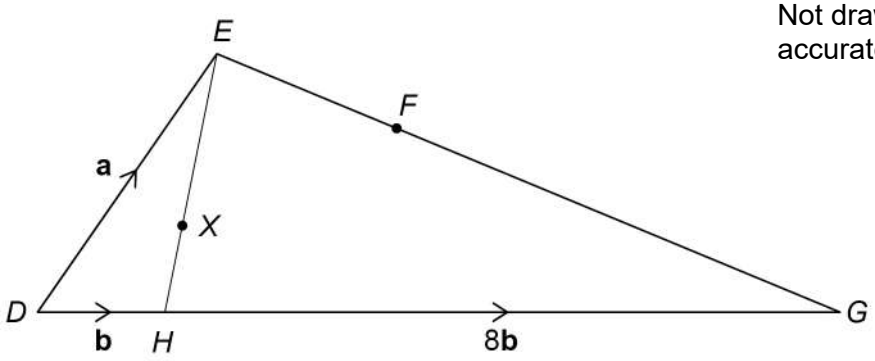
$\overrightarrow{DH} = \mathbf{b}$

$\overrightarrow{HG} = 8\mathbf{b}$

$EX : XH = 3 : 1$

$EF : FG = 1 : 3$

Not drawn accurately



27 (a) Show that $\overrightarrow{DX} = \frac{1}{4}\mathbf{a} + \frac{3}{4}\mathbf{b}$

[2 marks]

$\overrightarrow{DX} = \overrightarrow{DH} + \overrightarrow{HX}$. $\overrightarrow{DH} = b$. $\overrightarrow{HX} = 1/4\ \overrightarrow{HE}$ as 1 out of the 4 parts going from EH is XH in the ratio EX : XH. $\overrightarrow{HE} = \overrightarrow{HD} + \overrightarrow{DE}$. $\overrightarrow{HD} = -b$ as it is going the opposite direction to $\overrightarrow{DH}$. $\overrightarrow{DE} = a$

Do not write outside the box

27 (b) Is *DXF* a straight line?

Show working to support your answer.

[4 marks]

If $\overrightarrow{DF}$ can be expressed as something multiplied by $\overrightarrow{DX}$ it must be a straight line

Turn over for the next question

6

Do not write outside the box

28 $a = 4.72$ to 3 significant figures.

$b = 158$ to 3 significant figures.

Work out the upper bound of $\frac{a}{b}$

You **must** show your working.

[3 marks]

Consider whether the upper or lower bounds are needed for a and b.
To get the upper or lower bound, add or subtract half of the resolution.
For example in a, the third significant figure has a resolution of 0.01 as the 2 is in the hundredth place. So adding 0.01/2 gives the upper bound and subtracting 0.01/2 gives the lower bound

Answer _____

Do not write outside the box

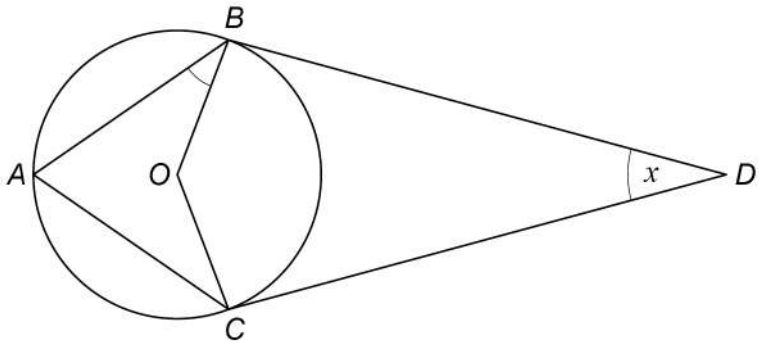
29 A, B and C are three points on the circumference of a circle, centre O.

BD and CD are tangents to the circle.

$ABDC$ is a kite.

Angle BDC is x

Not drawn accurately



Prove that angle ABO is $45° - \frac{x}{4}$

[4 marks]

The angle between a tangent and radius is a right angle. Angles in a quadrilateral add up to 360°. Angles at the circumference are half the angle at the centre. ABD = ACD as two of the angles in a kite are equal

7

Do not write outside the box

30 A sphere has radius r cm

An approximate value of r can be found using the iterative formula

$$r_{n+1} = \sqrt{\frac{239}{r_n}}$$

The starting value is $r_1 = 7$

30 (a) Work out the values of r_2 and r_3

[2 marks]

Enter 7 then press =. Enter $\sqrt{239/ANS}$ then press = to get r_2. Press = again to get r_3

$r_2 =$ _____

$r_3 =$ _____

30 (b) Continue the iteration to work out the radius to 1 decimal place.

[1 mark]

Keep pressing = until the 2nd decimal place stops changing

Answer _____ cm

END OF QUESTIONS

3