

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname

Forename(s)

Candidate signature

GCSE MATHEMATICS

H

Higher Tier

Paper 1 Non-Calculator

Thursday 24 May 2018

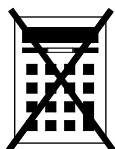
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- mathematical instruments



You must **not** use a calculator.

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	
26–27	
TOTAL	

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

Answer **all** questions in the spaces provided

- 1 Work out $\sqrt[3]{64 \times 1000}$ $= \sqrt[3]{64} \times \sqrt[3]{1000}$
Circle your answer. [1 mark]

40

80

400

4000

The numbers can be cube rooted separately. The cube root of 64 is 4 as $4^3 = 64$ and the cube root of 1000 is 10 as $10^3 = 1000$. $4 \times 10 = 40$

- 2 The vector $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ translates A to B. ← The vector means 2 to the left and 3 up

Circle the vector that translates B to A.

[1 mark]

 $\begin{pmatrix} -2 \\ 3 \end{pmatrix}$ $\begin{pmatrix} -3 \\ 2 \end{pmatrix}$ $\begin{pmatrix} 3 \\ -2 \end{pmatrix}$ $\begin{pmatrix} 2 \\ -3 \end{pmatrix}$

The exact opposite is 2 to the right and 3 down

- 3 Circle the expression that is equivalent to $3a - a \times 4a + 2a$ [1 mark]

 $8a^2 + 2a$ $12a^2$ $5a - 4a^2$ $3a - 6a^2$

The order of operations, BIDMAS, should be followed so multiplication is done first. $-a \times 4a = -4a^2$. Then the addition and subtraction can be done in any order so the like terms can be collected



- 4 Circle the number that is closest in value to $\frac{9.8}{0.0195}$ [1 mark]

5

50

500

5000

Rounding each number to 1 significant figure works out an estimation of the value. To eliminate the decimal on the denominator the numerator and denominator on the fraction can be multiplied by a power of 10

- 5 Solve $5(x + 3) < 60$ [2 marks]

Follow BIDMAS backwards and do the opposite operations to both sides to eliminate everything apart from x on the left

Answer _____

Turn over for the next question



6

The height of Zak is 1.86 metres.

The height of Fred is 1.6 metres.

Write the height of Zak as a fraction of the height of Fred.

Give your answer in its simplest form.

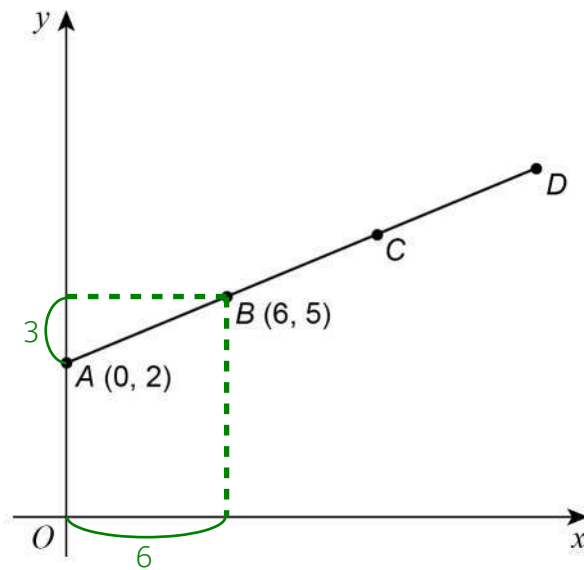
[3 marks]

Putting the height of Zak over the height of Fred expresses the fraction. Multiply the numerator and denominator by the same amount to eliminate the decimals and make it simpler. Then keep dividing the numerator and denominator by the same amount to get smaller whole numbers until it cannot be done any more

Answer _____



- 7 $A(0, 2)$ and $B(6, 5)$ are points on the straight line $ABCD$.



Not drawn
accurately

$$AB = BC = CD$$

Therefore all of the points are equally spaced out

Work out the coordinates of D .

[3 marks]

As all the points are equally spaced out and are on a straight line, the change in x and y between each point must be the same

Answer (_____ , _____)

Turn over for the next question

Turn over ►



- 8 A coin is thrown 50 times.
It lands on heads 31 times.

- 8 (a) Write down the relative frequency it lands on heads.

[1 mark]

Answer _____

Express the fraction of the throws which were heads

- 8 (b) Raj says,
"The coin is biased towards heads."

Use the data to give a reason why he might be correct.

[1 mark]

Biased towards heads means that it
was more likely to be heads than tails



9 The range of a set of numbers is $15\frac{1}{4}$

The smallest number is $-2\frac{7}{8}$

Work out the largest number.

[3 marks]

Convert both mixed fractions into improper fractions by multiplying the whole numbers by the denominators then adding the results to the numerators. The range is the distance between the largest and smallest so adding the range to the smallest number works out the largest number. To add or subtract fractions the denominators need to be the same

Answer _____

10 y is inversely proportional to x .

Complete the table.

[2 marks]

x	12	6	
y		4	8

Doubling x halves y . Halving x doubles y .
Doubling y halves x . Halving y doubles x

Turn over for the next question



- 11 A large rectangle is made by joining three identical small rectangles as shown.



Not drawn
accurately

The perimeter of one small rectangle is 15 cm

Work out the perimeter of the large rectangle.

[4 marks]

Let x be the shorter edge of each small rectangle. The longer edge on each small rectangle can be expressed as a multiple of x . Express the perimeter of a small rectangle in terms of x and set this equal to the perimeter. This creates an equation which can be solved to work out x . Then work out how many lots of x are on the perimeter of the large rectangle and work out what the value of this is

Answer _____ cm



- 12 Put these numbers in order from smallest to largest.

$$8 \times 10^{-4} \quad 4 \times 10^{-2} \quad 6 \times 10^{-4} \quad 0.07$$

[2 marks]

$\times 10^{-n}$ means to divide by 10 n times. Converting the standard form into ordinary form allows the numbers to be easily compared

Smallest _____

Largest _____

- 13 Circle the volume that is the same as 15 cm^3

[1 mark]

$$15\,000 \text{ mm}^3 \quad 1.5 \text{ mm}^3 \quad 0.0015 \text{ mm}^3 \quad 150 \text{ mm}^3$$

There are 10mm in 1cm so multiplying by 10 converts the centimetres to millimetres. But as the unit is cubed the 15 should be multiplied by 10^3

Turn over for the next question

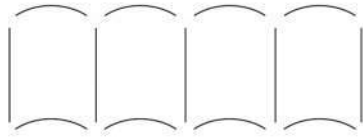
Turn over ►



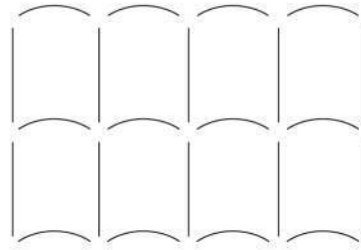
14 Patterns are made using straight lines and arcs.

14 (a)

Pattern A (one row)



Pattern B (two rows)



More rows are added to **Pattern B** so that

$$\text{number of straight lines} : \text{number of arcs} = 10 : 9$$

How many rows are added?

[2 marks]

5 more straight lines and 4 more arcs are added to get the next pattern in the sequence. Express the ratio of the number of straight lines : number of arcs in each pattern until the ratio simplifies to 10 : 9. To simplify a ratio divide both sides by the same amount to get smaller whole numbers. Count how many rows are added

Answer _____



14 (b) A different pattern is made using 20 straight lines and 16 arcs.

The straight lines and arcs are made from metal.

20 straight lines cost £12

cost of one straight line : cost of one arc = 2 : 3

Work out the **total** cost of the metal in the pattern.

[3 marks]

Dividing the £12 by the 20 works out the cost of one straight line. 2 parts of the ratio represent the cost of one straight line. Dividing the cost of one straight line by 2 works out what 1 part of the ratio is worth. Multiplying this by 3 works out what the 3 parts which represent the cost of one arc are worth. Multiplying the cost of one arc by the 16 works out the cost of the 16 arcs. Adding the cost of the straight lines to the cost of the arcs works out the total cost of the pattern

Answer £ _____

Turn over for the next question



15

A biased dice is thrown.

Here are the probabilities of each score.

Score	1	2	3	4	5	6
Probability	0.25	0.05	0.15	0.05	0.3	0.2

The dice is thrown 200 times.

Work out the expected number of times the score will be odd.

[3 marks]

OR means to add the probabilities. Work out the probability of getting an odd number. Multiplying this by the 200 works out the expected number of times it will be odd

Answer _____



16 The value of y is 20% more than the value of x .

Circle the ratio $x : y$

[1 mark]

5 : 6

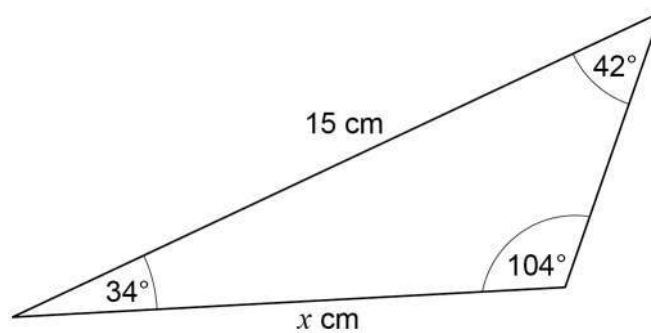
6 : 5

4 : 5

5 : 4

In this ratio x could be 5 and y could be 6. Is 6 20% more than 5?

17 Here is a triangle.



Not drawn
accurately

Circle the correct equation.

[1 mark]

$$\frac{\sin x}{42} = \frac{\sin 15^\circ}{104}$$

$$\frac{x}{\sin 42^\circ} = \frac{15}{\sin 104^\circ}$$

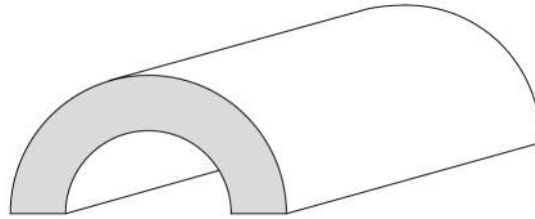
$$\frac{\sin x}{34} = \frac{\sin 15^\circ}{104}$$

$$\frac{x}{\sin 42^\circ} = \frac{15}{\sin 34^\circ}$$

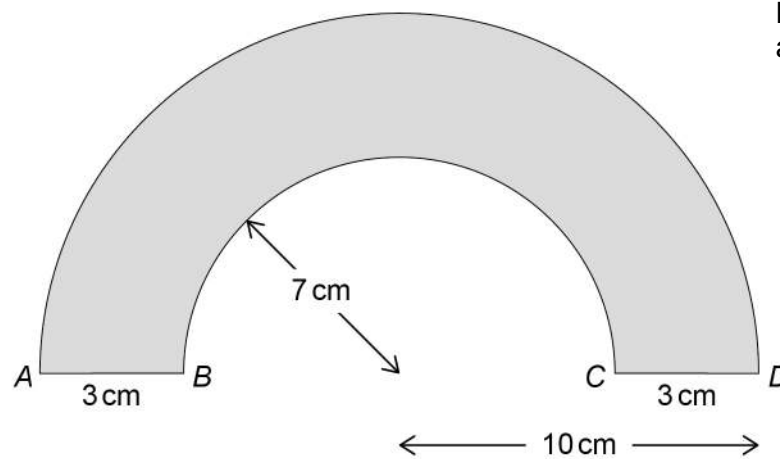
The sine rule is $a/\sin A = b/\sin B$



- 18 Here is a tunnel for a toy train.



The diagram below shows the cross section of the tunnel.



AD is a semicircular arc of radius 10 cm

BC is a semicircular arc of radius 7 cm

The length of the tunnel is 30 cm

Work out the total area of all **six** faces of the tunnel.

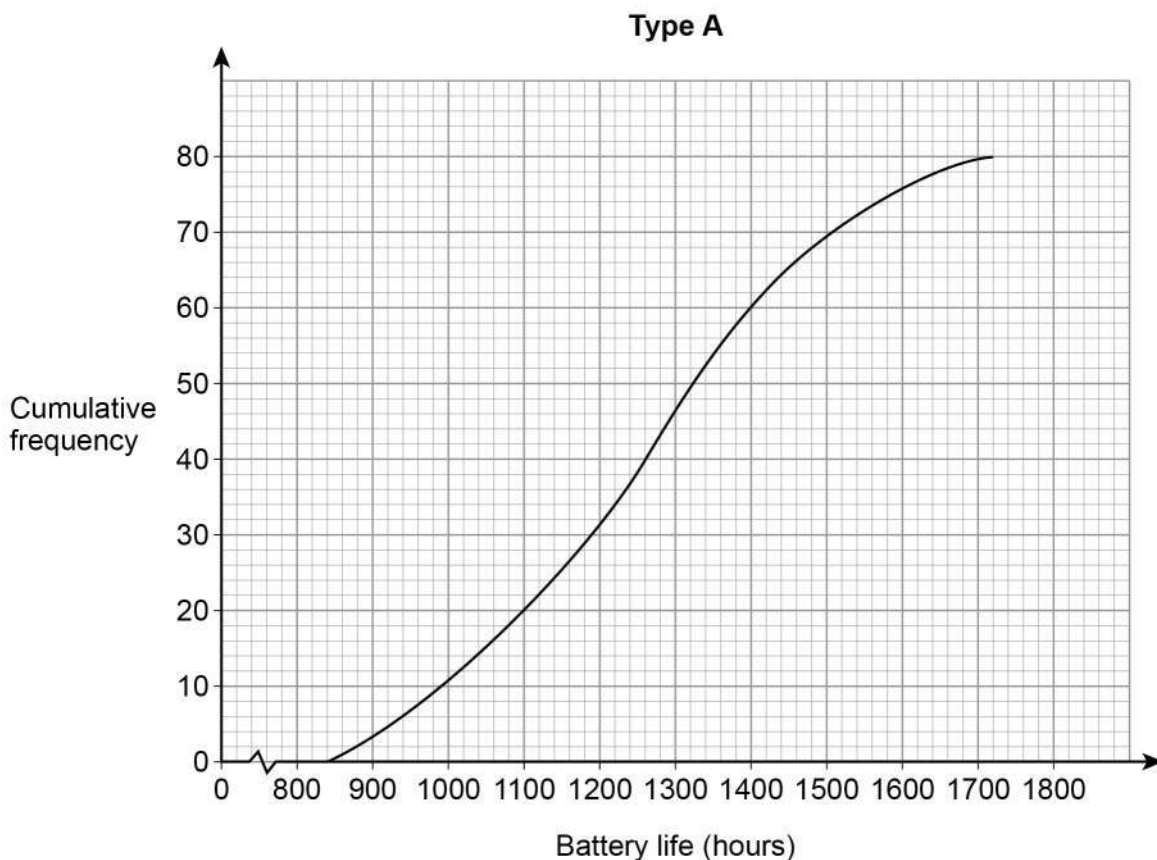
Give your answer in terms of π .

[5 marks]

Area of circle = $\pi \times \text{radius}^2$. Area of rectangle = length \times width.
The top and under-side curved faces of the tunnel are basically curved rectangles. Circumference = $\pi \times \text{diameter}$



- 19 Type A batteries and type B batteries were tested.
The cumulative frequency diagram shows information about the battery life of type A.



- 19 (a) Estimate the interquartile range for type A.

[2 marks]

Answer _____ hours

There were 80 type A batteries. The lower quartile is $\frac{1}{4}$ of the way through these. Drawing a line from this on the cumulative frequency to the line then down works out an estimate of the lower quartile. The upper quartile is $\frac{3}{4}$ of the way through the 80. Drawing a line from this on the cumulative frequency to the line then down works out an estimate of the upper quartile. Interquartile range = upper quartile - lower quartile



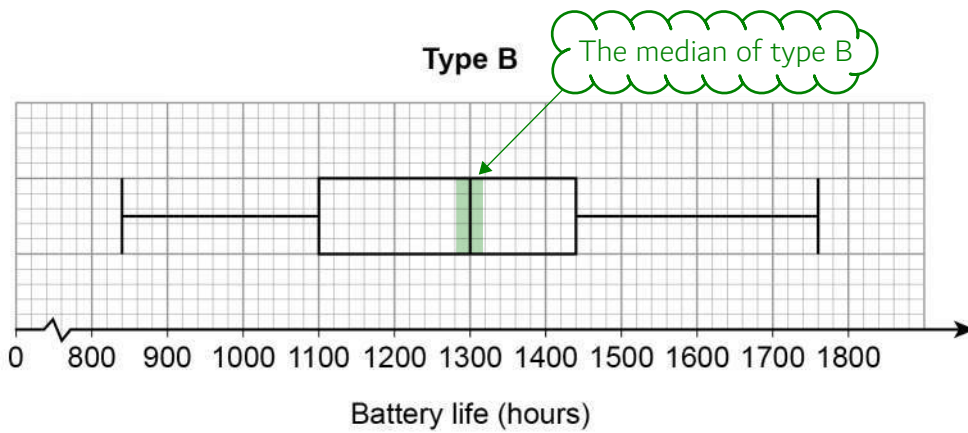
19 (b) Estimate the number of type A batteries that had a battery life of more than 1600 hours.

[1 mark]

Drawing a line up from 1600 to the line and across works out an estimate of how many had a battery life of 1600 hours or less. The rest of the 80 batteries must have had more than 1600

Answer _____

19 (c) The box plot shows information about the battery life of type B.



On average, which type had the greater battery life?

Tick a box.

type A

type B

Using data from **both** diagrams, state how you chose your answer.

[2 marks]

The median for type A is halfway through the 80 batteries. Drawing a line across from this on the cumulative frequency to the line then down works out an estimate of the median of type A



20

A linear sequence starts

$$a + 2b \quad a + 6b \quad a + 10b \quad \dots\dots \quad \dots\dots$$

The 2nd term has value 8

The 5th term has value 44

Work out the values of a and b .**[4 marks]**

$$a + 6b = 8 \quad \leftarrow \text{The 2nd term has value 8}$$

The sequence increases by $4b$ between each term. Work out the 5th term in terms of a and b and set this equal to 44. There will now be two equations which can be solved simultaneously to work out a and b . Both the numbers of a should be the same in both equations so either subtracting or adding the equations together will eliminate the a terms. This will leave an equation in terms of b which can be rearranged and solved. Then substitute the value of b back into one of the equations to rearrange and solve for a .

$$a = \underline{\hspace{10em}}$$

$$b = \underline{\hspace{10em}}$$



20

A linear sequence starts

$$a + 2b \quad a + 6b \quad a + 10b \quad \dots\dots \quad \dots\dots$$

The 2nd term has value 8

The 5th term has value 44

Work out the values of a and b .**[4 marks]**

$$a + 6b = 8$$

The 2nd term has value 8

$$a + 18b = 44$$

The sequence increases by $4b$ between each term. $10b + 4b + 4b = 18b$ so the 5th term is $a + 18b$, which has a value of 44

$$12b = 36$$

Solving the equations simultaneously. Subtracting the first equation from the second equation eliminates the a terms. $18b - 6b = 12b$. $44 - 8 = 36$

$$a = 8 - 6 \times 3$$

Subtracting $6b$ from both sides in the first equation makes a the subject and gives $a = 8 - 6b$. As $b = 3$, 3 can be substituted for b

$$a = \underline{\hspace{2cm} -10 \hspace{2cm}}$$

$$b = \underline{\hspace{2cm} 3 \hspace{2cm}}$$

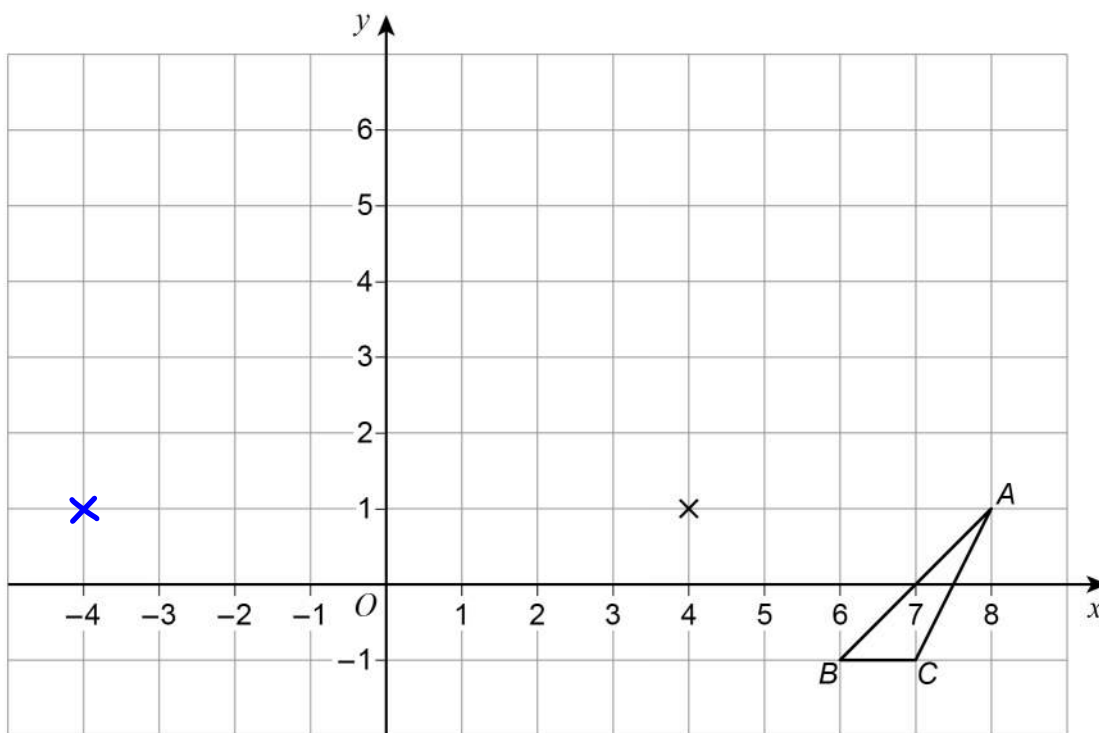
Dividing both sides of $12b = 36$ by 12 works out that $b = 3$. $a = 8 - 6 \times 3 = 8 - 18 = -10$



21 Enlarge triangle ABC by scale factor -2 , centre $(4, 1)$

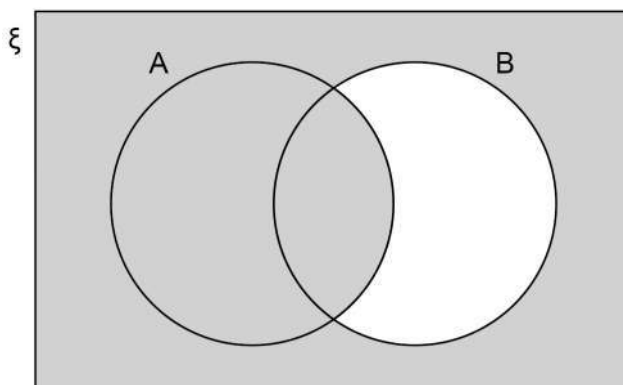
[2 marks]

$$\begin{pmatrix} 4 \\ 0 \end{pmatrix} \times -2 = \begin{pmatrix} -8 \\ 0 \end{pmatrix}$$



Expressing the vectors from the centre of enlargement to points A , B and C then multiplying each of them by -2 works out the new vectors from the centre of enlargement

22

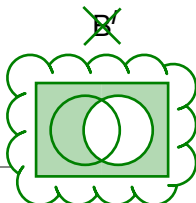


Which of these represents the shaded region?
Circle your answer.

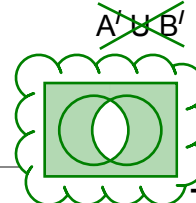
A or not B or both A and not B

[1 mark]

$A \cap B'$
Both A and not B



$A \cup B'$



7

Turn over ►



23

A shopkeeper compares the income from sales of a laptop in March and April.

April

Price	$\frac{1}{5}$ more than March
Number sold	$\frac{1}{4}$ less than March

By what fraction does the income from these sales decrease in April?

[3 marks]

Multiplying the price by the number sold works out the income. Express the fraction of the price in March and the fraction of the number sold in March. Multiplying these fractions by multiplying the numerators and denominators works out what fraction of March the income reduces to. Work out how much less than 1 this is, where 1 represents the whole amount of income in March

Answer _____



24 (a) Work out the value of $2^{14} \div (2^9)^2$

Give your answer as a fraction in its simplest form.

[3 marks]

$(a^x)^y = a^{xy}$. $a^x \div a^y = a^{x-y}$. Negative power means to do the reciprocal, which means to do '1 divided by'

Answer _____

24 (b) Work out the value of $25^{\frac{3}{2}}$

[2 marks]

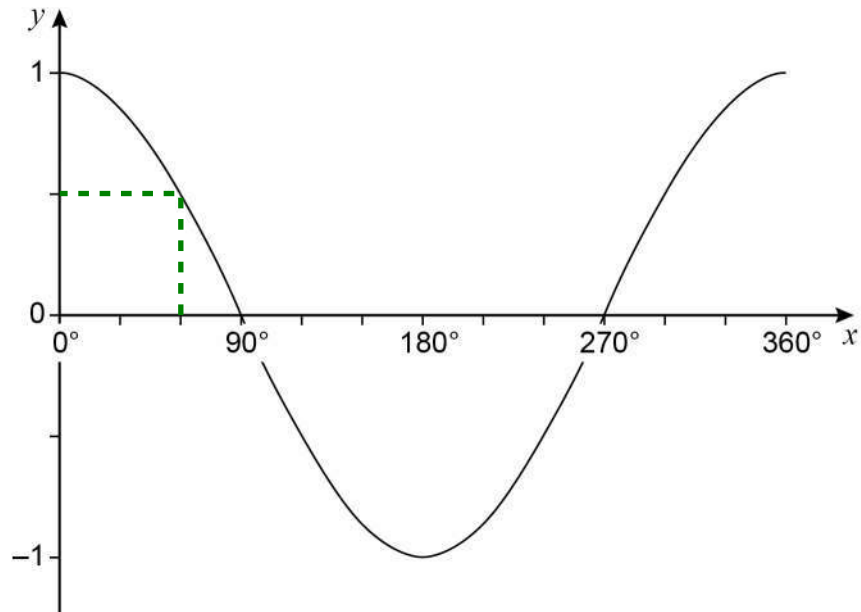
The over 2 as a power means to do the positive square root. The numerator of 3 as a power means to cube

Answer _____

Turn over for the next question



25 Here is a sketch of the graph of $y = \cos x$ for values of x from 0° to 360°



25 (a) $\cos x = \cos 60^\circ$

Work out the value of x when $90^\circ \leq x \leq 360^\circ$

[1 mark]

Answer _____ degrees

From the graph, $\cos 60 = 1/2$. Work out another angle of x , where $90^\circ \leq x \leq 360^\circ$, which gives $1/2$

25 (b) $\cos x = -\cos 60^\circ$

Work out the value of x when $180^\circ \leq x \leq 360^\circ$

[1 mark]

Answer _____ degrees

$\cos 60 = 1/2$ so $-\cos 60 = -1/2$. Work out another angle of x , where $180^\circ \leq x \leq 360^\circ$, which gives $-1/2$



26

 b is two thirds of c .

$$5a = 4c$$

Work out the ratio $a : b : c$ Give your answer in its simplest form where a , b and c are integers.**[3 marks]**

Work out a possible pair of values for a and c using the equation. Then work out what b would be given what c is. Express all of these numbers as a ratio then simplify. Eliminate any fractions if there are any and try to divide all of the sides by the same amount to get smaller whole numbers

Answer _____ : _____ : _____

Turn over for the next question**Turn over ►**

27 (a) Jo wants to work out the solutions of $x^2 + 3x - 5 = 0$

She says,

“The solutions **cannot** be worked out because $x^2 + 3x - 5$ does **not** factorise to $(x + a)(x + b)$ where a and b are integers.”

Is Jo correct?

Tick a box.

Yes

No

Give a reason for your answer.

[1 mark]

Is factorising the only way to solve a quadratic?

27 (b) **Without** expanding any brackets,

show how to work out the **exact** solutions of $9(x + 3)^2 = 4$

Give the solutions.

[3 marks]

Follow BIDMAS backwards and do the opposite operations to both sides to eliminate everything apart from x on the left. Remember that when square rooting there is a positive and negative solution



28

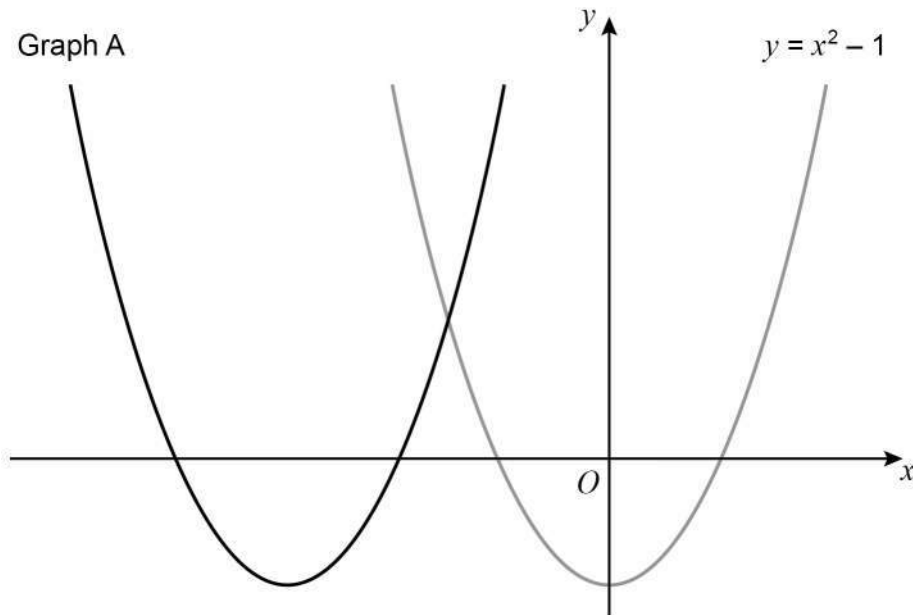
Simplify $\sqrt{80} + \sqrt{2\frac{2}{9}}$ Give your answer in the form $\frac{a\sqrt{b}}{c}$ where a and b are integers.**[3 marks]**

Express the mixed number as an improper fraction then square root the numerator and denominator. Simplify $\sqrt{80}$ and the numerator of the resulting fraction by using $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$ in reverse. a is a square number which can go into 80 and b is what a needs to be multiplied by to get 80. Add the simplified $\sqrt{80}$ and the simplified fraction by making the denominators the same

Answer _____

Turn over for the next question**Turn over ►**

29 Here are sketches of two graphs.



The graph of $y = x^2 - 1$ is translated 3 units to the left to give graph A.

29 (a) The equation of graph A can be written in the form $y = x^2 + bx + c$

Work out the values of b and c .

[3 marks]

$$(x+3)^2 - 1$$

Adding 3 to x translates the graph 3 units to the left

Expand the square bracket and simplify into the given form to work out b and c

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

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



29 (b) The graph of $y = x^2 - 1$ is reflected in the x -axis to give graph B.

Work out the equation of graph B.

[1 mark]

Changing the sign of all of the terms on the right reflects the graph in the x -axis

Answer _____

30 Show that the value of $\cos 30^\circ \times \tan 60^\circ + \sin 30^\circ$ is an integer.

[3 marks]

0 30 45 60 90

0 1 2 3 4

4 3 2 1 0

Work out the trig values needed by writing out the angles we need to remember and writing 0, 1, 2, 3, 4 under these for the sin values and 4, 3, 2, 1, 0 for the cos values. Square rooting them and putting them over 2 works out the trig values for the sin and cos. Dividing the sin value by the cos value works out the tan value

END OF QUESTIONS

