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

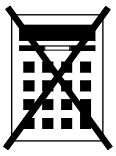
Higher Tier Paper 1 Non-Calculator

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.
- 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 the exam.

Anything written in green in a rectangle doesn't have to be written in the exam.

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.

Do not write outside the box

1 Simplify $\left(a^5\right)^3$

Circle your answer.

[1 mark]

$8a$ $15a$ a^8 a^{15}

$(a^x)^y = a^{xy}$. So the 5 and 3 are multiplied to give the power of 15

2 $x \neq 0.4$

Circle the possible value of x.

[1 mark]

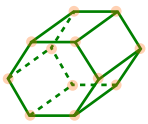
$\frac{4}{10}$ $\frac{20}{50}$ $\frac{26}{70}$ $\frac{120}{300}$

4/10 = 0.4 and this simplifies to 2/5. 20/50 simplifies to 2/5 so equals to 0.4. 26/70 simplifies to 13/35 which is not 2/5 so cannot equal to 0.4. 120/300 simplifies to 2/5 so equals to 0.4

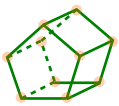
3 Circle the solid that has 7 vertices.

[1 mark]

hexagonal prism | hexagon-based pyramid | pentagonal prism | pentagon-based pyramid


12 vertices

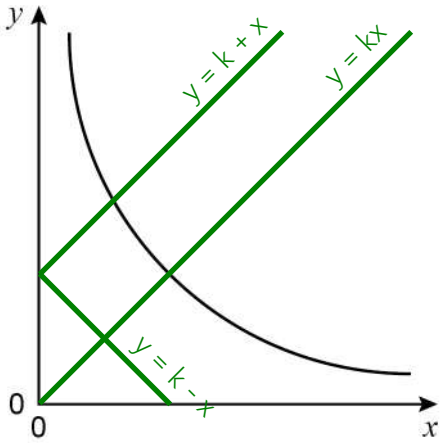

7 vertices


10 vertices


6 vertices

Do not write outside the box

4 Here is a sketch of a graph.



All of the graphs are drawn assuming that k is 1

Circle the equation of the graph.

k is a constant.

[1 mark]

$y = kx$ $\quad y = k + x$ $\quad y = k - x$ $\quad y = \frac{k}{x}$

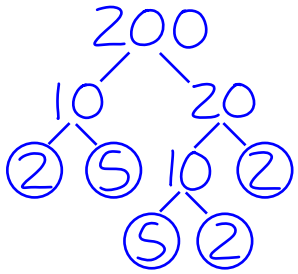
y increases as x increases for both of these so it can't be these two

y decreases as x increases for this one but it would be a straight line so it can't be this one

5 Write 200 as a product of prime factors.

Give your answer in index form.

[3 marks]



Doing a factor tree for 200 and circling the primes

Answer $2^3 \times 5^2$

Multiplying all the circled primes gives this

7

Do not write outside the box

6 Lily's age is 2 years and 4 months.

Hugo's age is 1 year and 8 months.

Write Lily's age in months as a fraction of Hugo's age in months.

Give your fraction in its simplest form.

[2 marks]

2×12 ← There are 12 months in a year. Multiplying the 2 years by 12 converts it into 24 months

$24 + 4 = 28$ ← Adding the 4 months to the 24 months works out that Lily's age is 28 months

$12 + 8$ ← There are 12 months in a year. Adding the 8 months to 12 months works out that Hugo's age is 20 months

$\frac{28}{20}$ ← Expressing Lily's age in months as a fraction of Hugo's age in months

Answer $\frac{7}{5}$

↑ Dividing both the numerator and denominator by 4 simplifies the fraction. It cannot go any simpler as 7 and 5 cannot be divided by the same amount to get smaller whole numbers

7 Use approximations to estimate the answer to $\dfrac{\sqrt{97} + 2.014^3}{0.49}$

[3 marks]

$\frac{\sqrt{100} + 2^3}{0.5}$ ← Each number is rounded to 1 significant figure

$\frac{18}{0.5}$ ← $\sqrt{100} = 10$ and $2^3 = 8$ then $10 + 8 = 18$

$5 \overline{)1\,'8\,^3 0}$ → 036 ← Multiplying both the numerator and denominator by 10 eliminates the decimal and makes the division easier

Answer 36

Do not write outside the box

8 (a) Solve $5x + 6 > 3x + 15$

[3 marks]

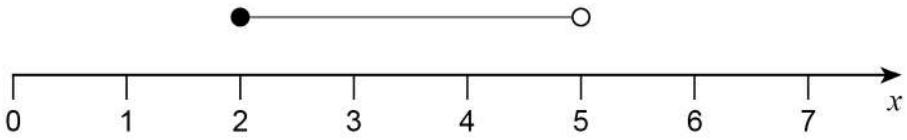
$2x+6>15$ ← Subtracting 3x from both sides to get all the x on the same side

$2x>9$ ← Subtracting 6 from both sides to get the x term on its own

Answer $x>\frac{9}{2}$

Dividing both sides by 2 to get x on its own

8 (b) Write down the inequality represented by the number line.



[2 marks]

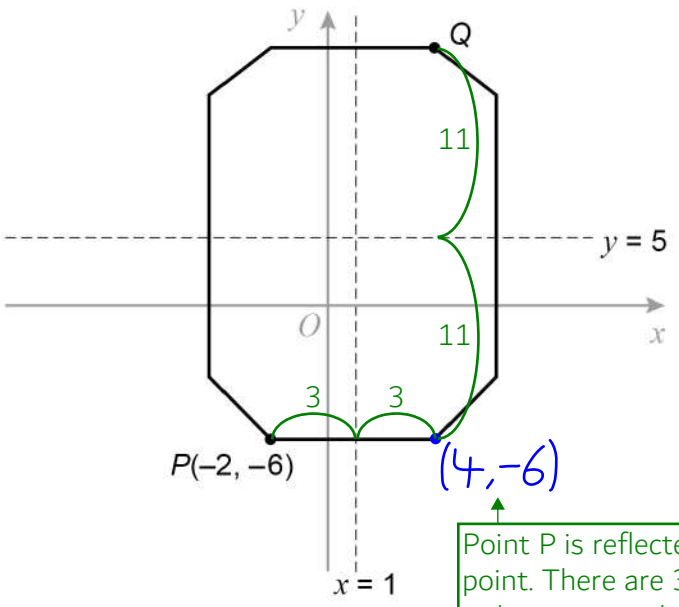
Answer $2 \leq x < 5$

The line runs between 2 and 5. As the dot is shaded above 2, x can also equal to 2

10

Do not write outside the box

9 The diagram shows an octagon.



Not drawn accurately

$x = 1$ and $y = 5$ are lines of symmetry.

Point P is reflected on the line x = 1 to get this point. There are 3 jumps to the line in the x-direction, as the difference between 1 and -2 is 3, so another 3 jumps are done on the other side. 1 + 3 = 4. The y-coordinate stays the same

Work out the coordinates of point Q.

[2 marks]

Answer (4 , 16)

(4, -6) is reflected on the line y = 5 to get point Q. There are 11 jumps to the line in the y-direction, as the difference between 5 and -6 is 11, so another 11 jumps are done on the other side. 5 + 11 = 16. The x-coordinate stays the same

Do not write outside the box

10 (a) Work out $2000 \times 70\,000$

Give your answer in standard form.

[2 marks]

140000000

2 x 7 = 14. Multiply by 10 7 times, so add 7 0s, as 2000 is 2 multiplied by 10 3 times and 70000 is 7 multiplied by 10 4 times

Answer 1.4×10^8

140000000 is divided by 10 8 times to get 1.4 so multiplying by 10^8 to keep it equal

10 (b) Work out $\dfrac{1.8 \times 10^2}{3 \times 10^{-1}}$

Give your answer as an ordinary number.

[2 marks]

0.6×10^3

18/3 = 6 so 1.8/3 = 0.6.
$10^2/10^{-1} = 10^3$ as $a^x/a^y = a^{x-y}$

Answer 600

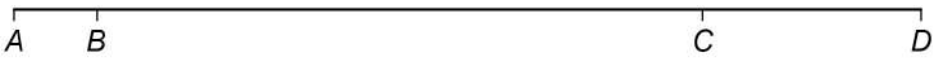
0.6 multiplied by 10 3 times

6

Do not write outside the box

11 *A*, *B*, *C* and *D* are junctions on a motorway.

Not drawn accurately



distance *CD* = 3 × distance *AB*

distance *BC* = 25 miles

Salma drives from *A* to *C*.

She drives for 30 minutes at an average speed of 62 miles per hour.

Work out the distance *AD*.

[4 marks]

$s\ ^{d}t$ ← This is a speed, distance, time problem so writing out the formula triangle

$62 \times \frac{1}{2}$ ← Distance = speed x time so this works out that the distance from A to C is 31 miles. 30 minutes is half an hour

$31 - 25$ ← AC - BC = AB. So the distance from A to B is 6 miles

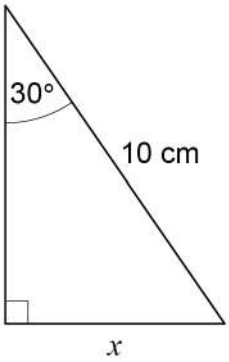
6×3 ← AB x 3 = CD. So the distance from C to D is 18 miles

$31 + 18$ ← AC + CD = AD

Answer 49 miles

Do not write outside the box

12 Here is a right-angled triangle.



Not drawn accurately

Use trigonometry to work out the value of x.

[3 marks]

SOH CAH TOA

Right angled trigonometry can be used. Ticking H as we have the hypotenuse and O as we are finding the opposite

Sin30×10

There are two ticks on the SOH formula triangle so this one can be used. Opposite = (sin of the angle) x hypotenuse

$\frac{1}{2} \times 10$

Sin30 = 1/2. Working it out by listing the angles we need to remember which are 0, 30, 45, 60, 90. Listing 0, 1, 2, 3, 4 under these, square rooting them then putting them over 2. $\sqrt{1}/2 = 1/2$

Answer 5 cm

Turn over for the next question

7

Do not write outside the box

13 Convert $\frac{5}{6}$ to a recurring decimal.

[2 marks]

$0.8\dot{3}$
$6\overline{)5.^{5}0^{2}0}$

Dividing the numerator by the denominator. There is a remainder of 2 which repeats so the 3 recurs

Answer $0.8\dot{3}$

14 Simplify $\frac{3}{x} + \frac{4}{x}$

Circle your answer.

[1 mark]

$\frac{7}{x}$ $\quad \frac{7}{2x}$ $\quad \frac{12}{x}$ $\quad \frac{12}{x^2}$

The denominators are the same so the numerators can be added. The denominator stays the same

Do not write outside the box

15 $(x + a)(x + 3a) \equiv x^2 + bx + 75$

Work out the **two** possible values of b.

[3 marks]

$x^2+3ax+ax+3a^2$ ← Expanding the brackets

$3a^2=75$ ← Equating the coefficients. The constant (the term not involving x) on the left must equal the constant on the right

$a^2=25$ ← Dividing both sides by 3

$a=\pm5$ ← Doing the positive and negative square root of both sides

$4a=b$ ← Equating the coefficients of the x terms. There is 4ax on the left, as 3ax + ax = 4ax, and bx on the right

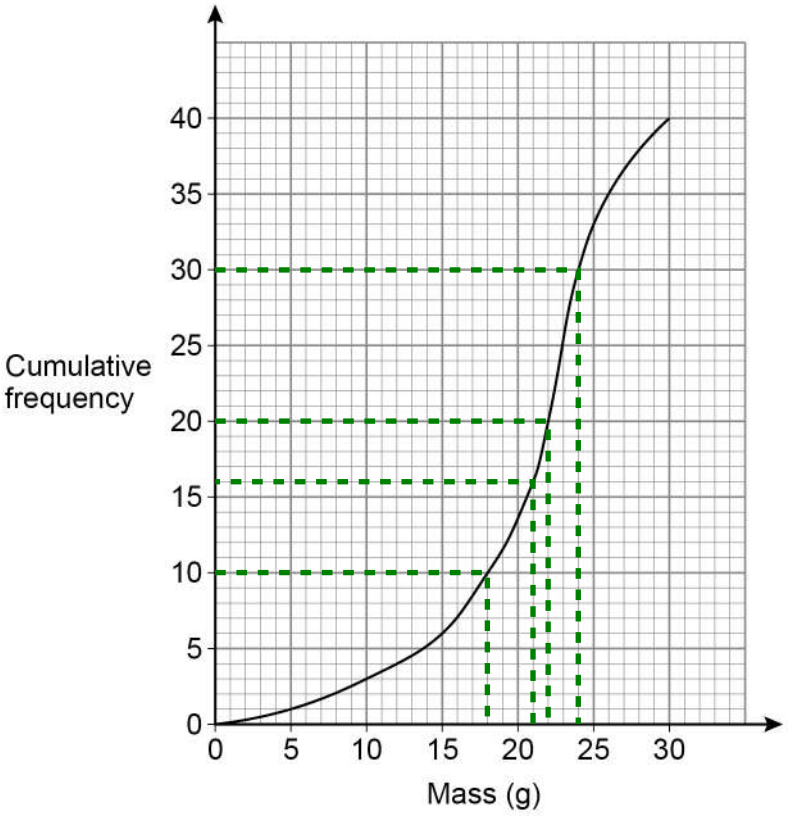
Answer 20 and -20

b is equal to 4 x 5 or 4 x -5

6

Do not write outside the box

16 The cumulative frequency graph represents the masses of 40 necklaces.



16 (a) A jeweller buys every necklace with mass **greater than** 21 grams.

Use the graph to estimate how many she buys.

[2 marks]

40 − 16

Drawing a line up from 21 to the line then across estimates how many necklaces have a mass of 21 or less. Subtracting this many from the total number of necklaces estimates the number which were greater than 21 grams

Answer 24

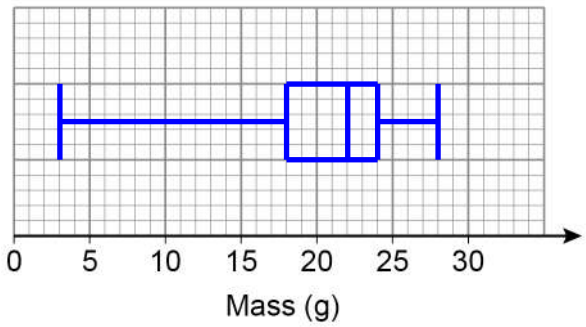
Do not write outside the box

16 (b) The lowest mass was 3 grams.

The highest mass was 28 grams.

Draw a box plot to represent the data.

[3 marks]



Line drawn across from 10 to the line then down to estimate the lower quartile, which is roughly 1/4 of the way through the 40. Line drawn across from 20 to the line then down to estimate the median, which is roughly 1/2 of the way through the 40. Line drawn across from 30 to the line then down to estimate the upper quartile, which is roughly 3/4 of the way through the 40

17 Circle the vector that translates the point (–2, 7) to the point (3, –1)

[1 mark]

$\begin{pmatrix} 5 \\ -6 \end{pmatrix}$ $\begin{pmatrix} 5 \\ -8 \end{pmatrix}$ $\begin{pmatrix} -5 \\ 8 \end{pmatrix}$ $\begin{pmatrix} -5 \\ 6 \end{pmatrix}$

-2 increases by 5 to 3 and 7 decreases by 8 to -1

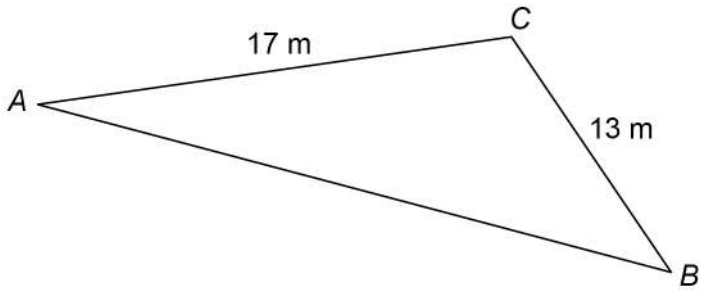
Turn over for the next question

6

Do not write outside the box

18 (a) Here is a triangle.

Not drawn accurately



Give a reason why the length of side *AB* **cannot** be 35 m

[1 mark]

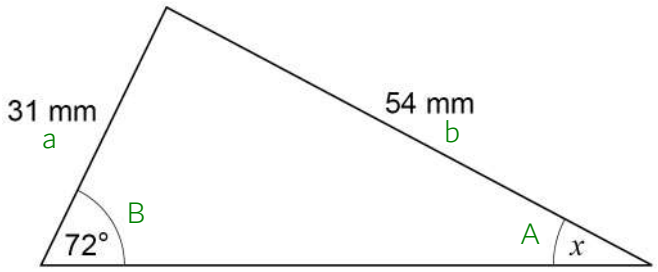
35m is greater than the other two sides combined so it couldn't possibly create a triangle

35>17+13

Do not write outside the box

18 (b) Here is a different triangle.

Not drawn accurately



Leah tries to use the sine rule to work out the size of angle x.

Here are the first two lines of her working.

$$\frac{x}{\sin 31} = \frac{54}{\sin 72}$$

$$x = \frac{54 \sin 31}{\sin 72}$$

What error has she made in this working?

[1 mark]

Should be 31/sinx ← The sine rule: a/sinA = b/sinB

2

Do not write outside the box

19 Items made at a factory have to pass two checks.

90% pass the first check.

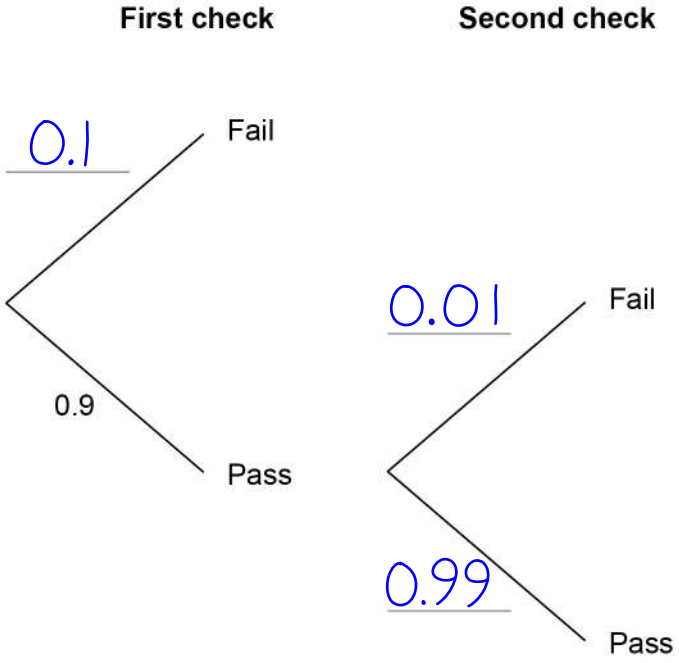
The items that fail are scrapped.

99% of the items that pass the first check pass the second check.

The items that fail are scrapped.

19 (a) Complete the tree diagram.

[2 marks]



It is certain to either pass or fail so each branch has to add up to 1.
99% as a decimal is 0.99 as 99/100 = 0.99

Do not write outside the box

19 (b) An item is chosen at random before the checks.

Work out the probability that the item is scrapped.

[3 marks]

0.1+0.9X0.01 ← Fail OR pass AND fail. OR means to add the probabilities, AND means to multiply the probabilities

Answer 0.109

9 x 1 = 9 so 0.9 x 0.01 = 0.009. Adding this to 0.1 gives 0.109

20 Which **one** of these is a unit of density?

Circle your answer.

[1 mark]

cm^2/g cm^3/g g/cm^2 g/cm^3

Density = mass/volume. g is a unit of mass and cm^3 is a unit of volume

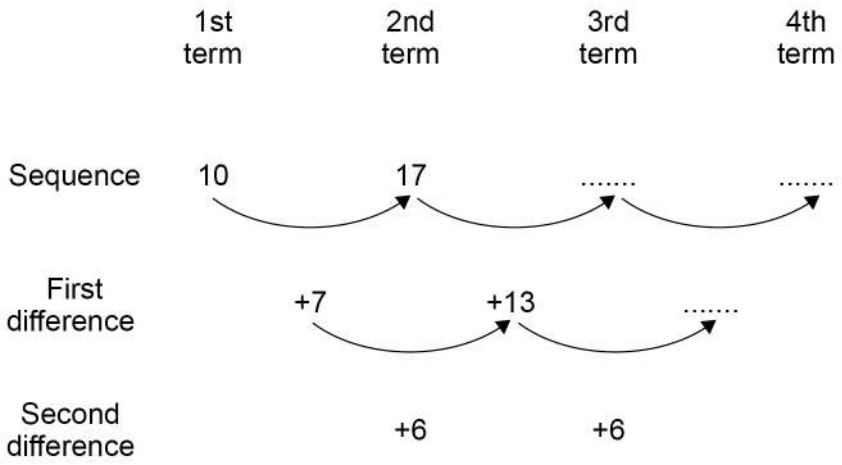
Turn over for the next question

6

Do not write outside the box

21 The first two terms of a quadratic sequence are 10 and 17

Here is some information about the sequence.



Work out an expression for the nth term of the sequence.

[4 marks]

3, 12 ← The sequence is a quadratic sequence in the form $an^2 + bn + c$. Halving the second difference gives a, which must be 3. Listing out the sequence of $3n^2$. $3(1)^2 = 3$ and $3(2)^2 = 12$

7, 5 ← Listing out the sequence which must be added to $3n^2$ to get the original sequence. 7 must be added to 3 to get 10 and 5 must be added to 12 to get 17

Answer $3n^2-2n+9$

The sequence of 7, 5 is a linear sequence in the form bn + c. It goes down by 2 between each term so b must be -2. The 0th term, the one before the 1st term, would be 9 so c must be 9. The sequence of -2n + 9 must be added to $3n^2$ to get the original sequence

Do not write outside the box

22 Work out the value of $\left(\frac{5}{7}\right)^{-2}$

Give your answer as a mixed number.

[3 marks]

$\frac{49}{25}$ ← The power of 2 means to square the fraction. This squares the numerator and denominator to give 25/49. The negative power means to do the reciprocal, which flips this

Answer $1\frac{24}{25}$

↑ 25 goes into 49 once with a remainder of 24. The 1 is the whole number and the 24 is left in the fraction

23 Rearrange $y = \frac{1}{\sqrt{x+1}}$ to make x the subject.

[3 marks]

$\frac{1}{y} = \sqrt{x+1}$ ← Doing the reciprocal of both sides. Over 1 on the right is ignored as dividing by 1 has no effect

$\frac{1}{y^2} = x + 1$ ← Squaring both sides to eliminate the square root

Answer $x = \frac{1}{y^2} - 1$

↑ Subtracting 1 from both sides

10

Do not write outside the box

24 (a) $f(x) = cx + d$

$f(4) = 7$

$f(10) = 22$

Work out the values of c and d.

[3 marks]

$4c + d = 7$ ← Substituting 4 for x in f(x) and setting equal to 7

$10c + d = 22$ ← Substituting 10 for x in f(x) and setting equal to 22

$6c = 15$ ← Solving the two equations simultaneously by subtracting the first equation from the second equation. This eliminates d

$d = 7 - 4\left(\frac{15}{6}\right)$ ← Rearranging the first equation to make d the subject and substituting in 15/6 for c

$c = \frac{15}{6}$ $\quad d = -3$

6c = 15 so dividing both sides by 6 works out c. It can be left as an unsimplified fraction as 15 cannot be divided by 6 to get a whole number

4(15/6) = 60/6 = 10. 7 - 10 = -3

Do not write outside the box

24 (b) $g(x) = 2x$ and $h(x) = \dfrac{x-1}{2}$

Circle the expression for $hg(x)$

[1 mark]

$\dfrac{2x^2 - x}{2}$ $\quad$ $\dfrac{2x-1}{2}$ $\quad$ $x^2 - x$ $\quad$ $x - 1$

g(x) is substituted for x in h(x)

25 Show that $\dfrac{\sqrt{150} - \sqrt{6}}{\sqrt{2} \times \sqrt{3}}$ simplifies to an integer.

[3 marks]

$\sqrt{2} \times \sqrt{3} = \sqrt{6}$ ← $\sqrt{a} \times \sqrt{b} = \sqrt{ab}$

$6\overline{)150}$ $\quad$ 025 ← $\sqrt{a}/\sqrt{b} = \sqrt{a}/\sqrt{b}$ so dividing 150 by 6

$\sqrt{25} - 1$ ← $\sqrt{150}/\sqrt{6} = \sqrt{25} \cdot \sqrt{6}/\sqrt{6} = 1$

4 ← $\sqrt{25} = 5$ then $5 - 1 = 4$, which is an integer

Turn over for the next question

7

Do not write outside the box

26 $d = 2f$

$$\frac{e-f}{d-e} = \frac{1}{4}$$

Work out the ratio $e : f$

[3 marks]

$\frac{e-f}{2f-e} = \frac{1}{4}$ ← Substituting 2f for d so there is an equation in terms of only e and f

$4e-4f = 2f-e$ ← Multiplying both sides by the denominators to eliminate them

$5e = 6f$ ← Collecting all the e terms on one side and the f terms on the other

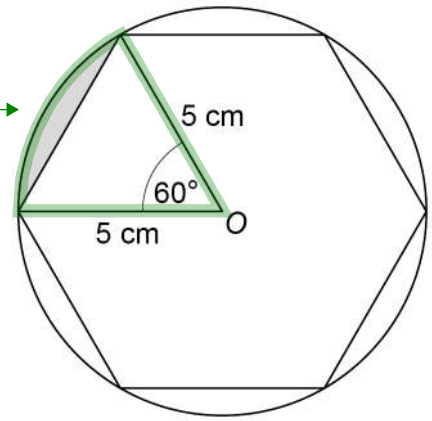
Answer 6 : 5

e could equal to 6 and f could equal to 5 for the equation to work as 5 x 6 = 6 x 5

Do not write outside the box

27 The vertices of a regular hexagon lie on a circle with centre O and radius 5 cm

Not drawn accurately



There is a triangle within a sector here

Work out the shaded area.

Give your answer in the form $\frac{a\pi - b\sqrt{c}}{12}$ where a, b and c are integers.

[4 marks]

$\frac{1}{2} \times 5 \times 5 \times \sin 60$ ← Area of the triangle. 1/2 x a x b x sinC, where a and b are two sides of the triangle and C is the angle between them

0 30 45 60 90
0 1 2 3 4 ← Listing the angles of 0, 30, 45, 60, 90 degrees then 0, 1, 2, 3, 4 under these. Square rooting the 3 and putting it over 2 works out that sin60 = $\sqrt{3}/2$

$\frac{25}{2} \times \frac{\sqrt{3}}{2} = \frac{25\sqrt{3}}{4}$ ← 5 x 5 = 25 then 1/2 x 25 = 25/2. Multiplying this by the value of sin60. To multiply fractions, multiply the numerators and multiply the denominators. This gives the area of the triangle

$\frac{60}{360} = \frac{6}{36} = \frac{1}{6}$ ← There are 60 degrees out of the 360 degrees in the circle. Expressing this as a fraction and simplifying it

$\frac{1}{6} \times \pi \times 5^2$ ← Area of circle = π x radius squared. The radius is 5 cm. The sector is 1/6 of the circle

$\frac{25\pi}{6} - \frac{25\sqrt{3}}{4}$ ← 5^2 = 25 then 1/6 x 25 = 25/6. Multiplying this by the π gives the area of the sector. Subtracting the area of the triangle from this gives the shaded area

$\frac{50\pi}{12} - \frac{75\sqrt{3}}{12}$ ← To subtract fractions the denominators need to be the same. 12 is a common multiple of 6 and 4 so multiplying both the numerator and denominator of the first fraction by 2 to get 12 as the denominator and multiplying both the numerator and denominator of the second fraction by 3 to get 12 as the denominator

Answer $\frac{50\pi - 75\sqrt{3}}{12}$ cm^2

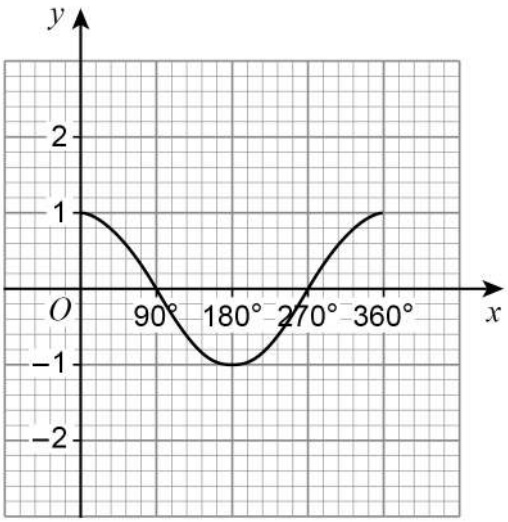
The numerators can be subtracted and the denominator stays the same

7

2 3

Do not write outside the box

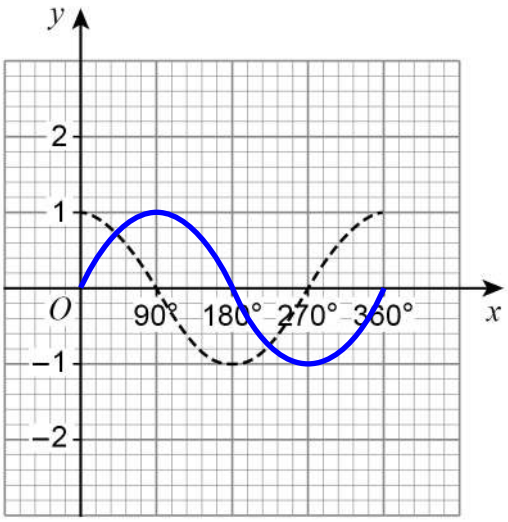
28 Here is the graph of $y = \cos x$ for $0° \leqslant x \leqslant 360°$



In parts (a) and (b) the graph of $y = \cos x$ is shown as a dashed line.

28 (a) On the grid below, draw the graph of $y = \cos(x - 90°)$ for $0° \leqslant x \leqslant 360°$

[1 mark]

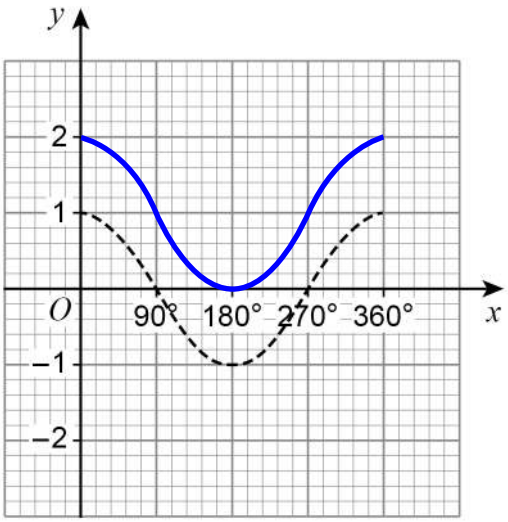


The graph is translated 90 to the right

Do not write outside the box

28 (b) On the grid below, draw the graph of $y = 1 + \cos x$ for $0° \leqslant x \leqslant 360°$

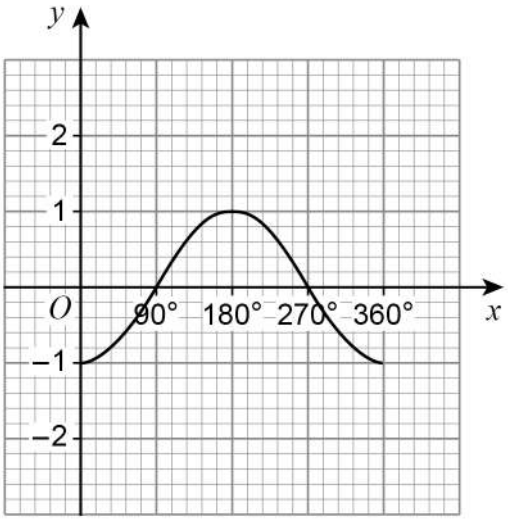
[1 mark]



The graph is translated 1 up

28 (c) Rita tries to draw the graph of $y = \cos(-x)$ for $0° \leqslant x \leqslant 360°$

Here is her graph.



Give a reason why Rita's graph is incorrect.

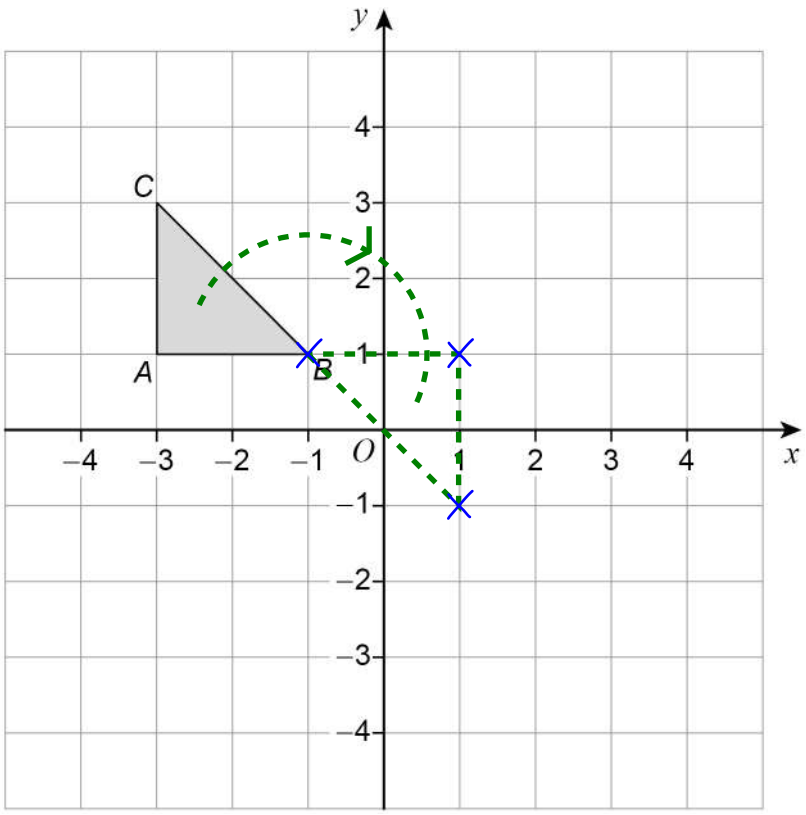
[1 mark]

Should have been reflected in the y-axis ← It has been reflected in the x-axis

3

Do not write outside the box

29 Here is triangle *ABC* on a grid.



Describe a **single** transformation of the triangle so that

point *B* is invariant

point *A* moves to (1, 1)

point *C* moves to (1, –1)

[3 marks]

Rotation by 180° about (-1 , 1)

END OF QUESTIONS

3