.CG Maths.
Worked Solutions
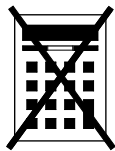
AQA

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 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.

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

Circle your answer.

[1 mark]

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

$(a^x)^y = a^{xy}$

2 $x \neq 0.4$

Circle the possible value of x.

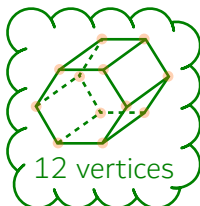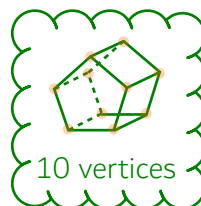**[1 mark]**

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

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

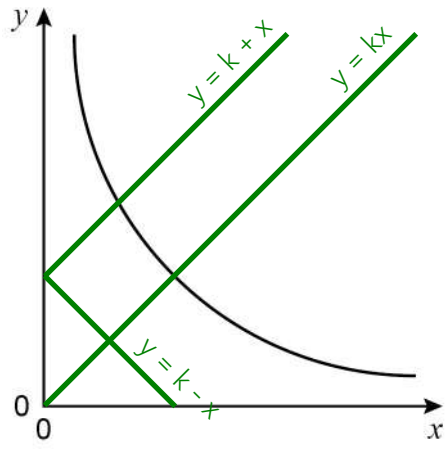**3** Circle the solid that has 7 vertices.

[1 mark]

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

12 vertices   7 vertices   10 vertices   6 vertices

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4 Here is a sketch of a graph.

All of the graphs are plotted assuming that k is 1

$y = k + x$

$y = kx$

$y = k - x$

Circle the equation of the graph.

k is a constant.

[1 mark]

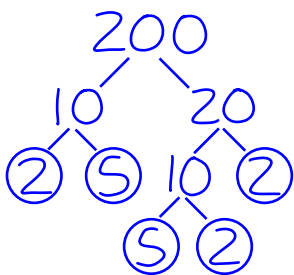$y = kx$ $y = k + x$ $y = k - x$ $y = \dfrac{k}{x}$

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]

200
10   20
2 5 10 2
5 2

Doing a factor tree for 200 and circling the primes

Multiplying all the circled primes gives this

Answer _____ $2^3 \times 5^2$ _____

7

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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]

$$\frac{2 \times 12 + 4}{12 + 8}$$

Converting both Lily's and Hugo's age into months by multiplying the years by 12 and adding the months. There are 12 months in a year. Writing Lily's ages over Hugo's age

$$\frac{28}{20}$$

Answer $\dfrac{7}{5}$

28/20 is simplified by dividing both the numerator and denominator by 4

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. 2^3 = 8. 10 + 8 = 18

$$\begin{array}{r} 0\ 3\ 6 \\ 5\overline{)1\ '8\ ^30} \end{array}$$

Multiplying both the numerator and denominator by 10 to divide by a whole number

Answer 36

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

[3 marks]

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

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

Dividing both sides by 2 to get x on its own

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

Answer _____

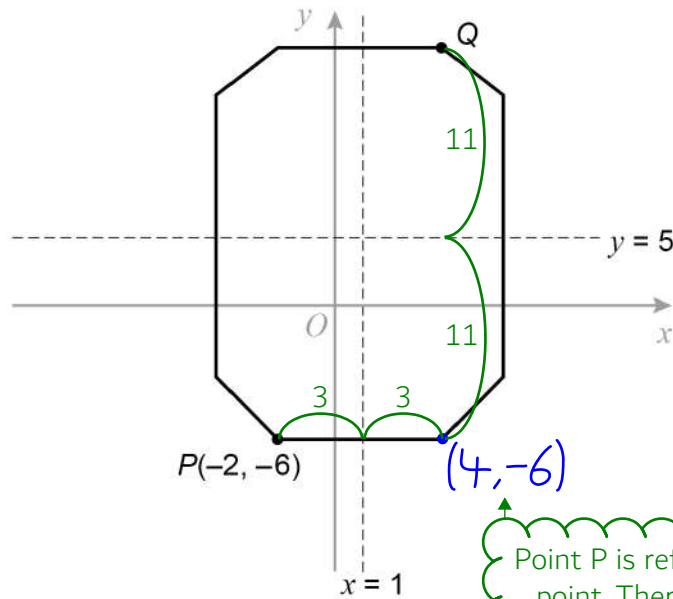**8 (b)** Write down the inequality represented by the number line.

[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

Turn over ▶

10

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9 The diagram shows an octagon.

Not drawn accurately

P(−2, −6)

(4, −6)

x = 1

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]

(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

Answer (_____4_____ , _____16_____)

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Do not write outside the box

10 (a) Work out   2000 × 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

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

Answer 1.4×10^8

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 ←

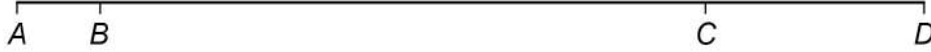18/3 = 6 so 1.8/3 = 0.6. $10^2/10^{-1} = 10^3$ as $a^x/a^y = a^{x-y}$

0.6 multiplied by 10 3 times

Answer   600

6

Turn over ▶

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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]

$s\frac{d}{t}$ ← 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 the distance from A to C. 30 minutes is half an hour
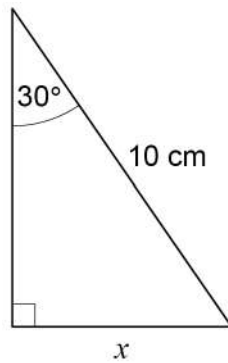
$31 - 25$ ← AC - BC = AB

6×3 ← AB x 3 = CD

$31 + 18$ ← AC + CD = AD

Answer _____49_____ miles

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12 Here is a right-angled triangle.

Not drawn accurately

30°

10 cm

x

Use trigonometry to work out the value of x.

[3 marks]

$S^{O}_{H} C^{A}_{H} T^{O}_{A}$ ← Right angled trigonometry can be used so writing SOH CAH TOA as formula triangles. Ticking H as we have the hypotenuse and O as we are finding the opposite

$Sin30 \times 10$ ← There are two ticks on the SOH formula triangle so this one can be used. Opposite = (sin of the angle) x hypotenuse

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

Answer _____ 5 _____ cm

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

Turn over for the next question

7

Turn over ▶

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

[2 marks]

$$6\overline{)5.^50^20}$$ gives $0.8\dot{3}$

Dividing 5 by 6. There is a remainder of 2 which is repeated therefore the 3 recurs

Answer $\qquad 0.8\dot{3}$

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

Circle your answer.

[1 mark]

$\boxed{\dfrac{7}{x}}$ $\qquad$ $\dfrac{7}{2x}$ $\qquad$ $\dfrac{12}{x}$ $\qquad$ $\dfrac{12}{x^2}$

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

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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

$a = \pm 5$ ← Square rooting 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

Turn over ▶

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1 1

16 The cumulative frequency graph represents the masses of 40 necklaces.
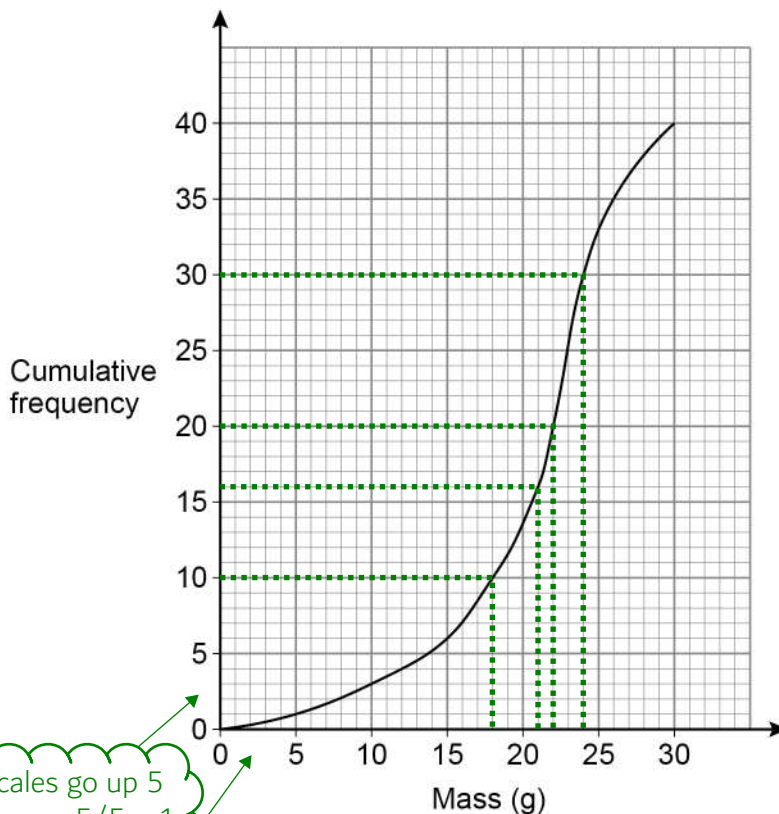
Both scales go up 5 over 5 boxes. 5/5 = 1 so each box is worth 1

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 gives the number which were greater than 21 grams

Answer 24

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

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16 (b) The lowest mass was 3 grams.

The highest mass was 28 grams.

Draw a box plot to represent the data.

[3 marks]

Mass (g)
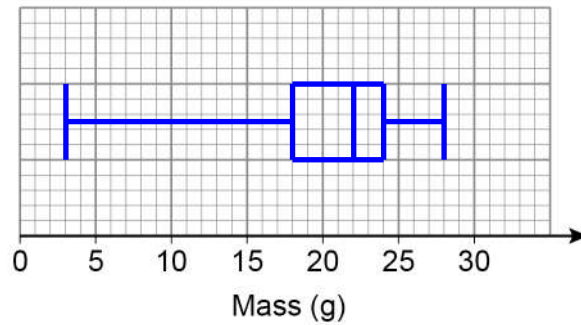
17 Circle the vector that translates the point (−2, 7) to the point (3, −1)

[1 mark]

$$\begin{pmatrix} 5 \\ -6 \end{pmatrix} \qquad \begin{pmatrix} 5 \\ -8 \end{pmatrix} \qquad \begin{pmatrix} -5 \\ 8 \end{pmatrix} \qquad \begin{pmatrix} -5 \\ 6 \end{pmatrix}$$
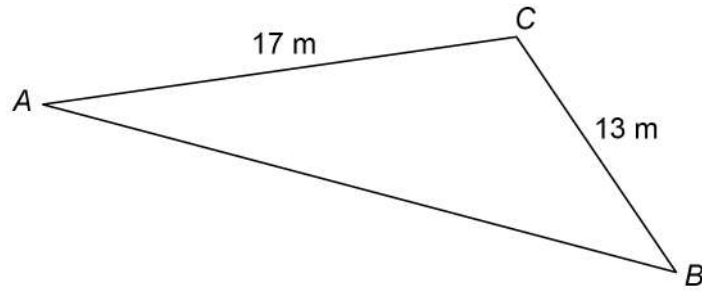
-2 increases by 5 to 3. 7 decreases by 8 to -1

Turn over for the next question

6

Turn over ▶

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18 (a) Here is a triangle.

Not drawn accurately

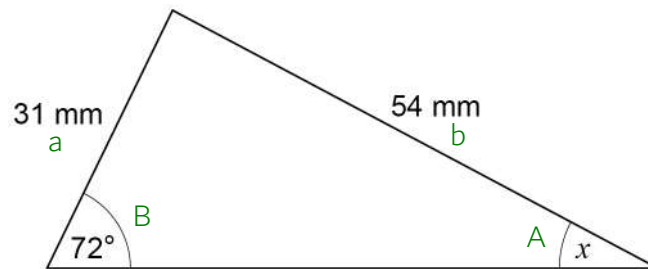Give a reason why the length of side *AB* **cannot** be 35 m

[1 mark]

35 > 17 + 13

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

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18 (b) Here is a different triangle.

Not drawn
accurately

31 mm
a

54 mm
b

B

72°

A

x

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?
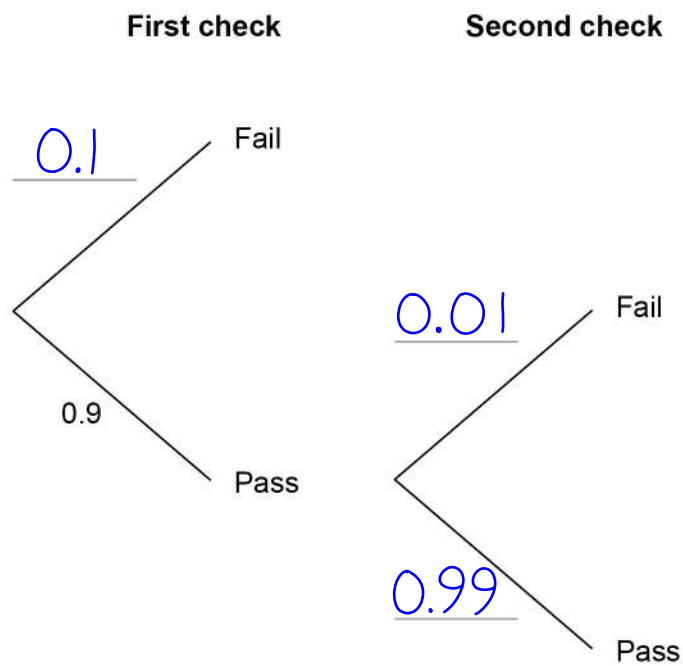
[1 mark]

Should be 31/sinx

The sine rule: a/sinA = b/sinB

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1 5

2

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]

First check   Second check

0.1   Fail

0.9   Pass

0.01   Fail

0.99   Pass

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

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

Work out the probability that the item is scrapped.

[3 marks]

$0.1 + 0.9 \times 0.01$ ← Fail OR pass AND fail. OR means to add, AND means to multiply

0.01 = 1/100 so 0.9 x 1/100 = 0.9/100 = 0.009

Answer 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
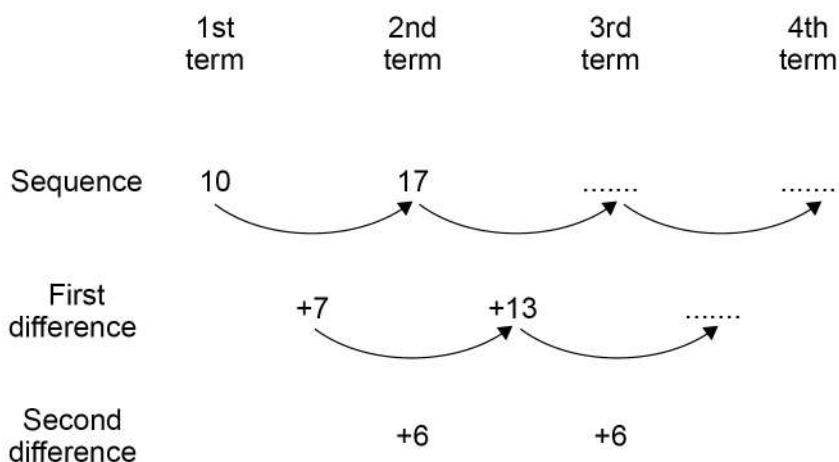
Density = mass/volume

Turn over for the next question

6

Turn over ▶

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

Here is some information about the sequence.

	1st term	2nd term	3rd term	4th term
Sequence	10	17	....	....
First difference		+7	+13	....
Second difference			+6	+6

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 $3n^2$. $3(1)^2 = 3$. $3(2)^2 = 12$

7 , 5

Working 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

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

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

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

Give your answer as a mixed number.

[3 marks]

$\dfrac{49}{25}$

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

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

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

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

[3 marks]

$\dfrac{1}{y} = \sqrt{x+1}$

Doing the reciprocal of both sides. The over 1 on the right is ignored as dividing by 1 has no effect

$\dfrac{1}{y^2} = x + 1$

Squaring both sides to eliminate the square root

Subtracting 1 from both sides

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

10

Turn over ▶

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 x for 4 in f(x) and setting equal to 7

$10C + d = 22$ ← Substituting x for 10 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

$c = \dfrac{15}{6}$ $d = -3$

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

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

Circle the expression for $hg(x)$

[1 mark]

$\dfrac{2x^2 - x}{2}$ $\qquad$ $\boxed{\dfrac{2x-1}{2}}$ $\qquad$ $x^2 - x$ $\qquad$ $x - 1$

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]

$\sqrt{2} \times \sqrt{3} = \sqrt{6}$ $\longleftarrow$ √a x √b =√ab

$6\overline{)1\,^{1}5\,^{3}0}$ = 0 2 5 $\longleftarrow$ √a/√b = √a/b so dividing 150 by 6

$\sqrt{25} - 1$ $\longleftarrow$ √150/√6 =√25 . √6/√6 = 1

4 $\longleftarrow$ √25 = 5. 5 - 1 = 4, which is an integer

Turn over for the next question

Turn over ▶

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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 d for 2f so there is an equation in terms of only e and f

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

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

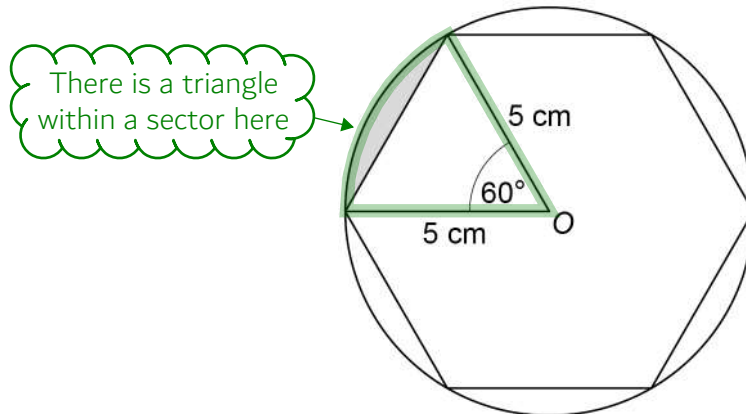e could equal to 6 and f could equal to 5 for the equation to work

Answer _____ 6 _____ : _____ 5 _____

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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

5 cm

60°

5 cm O

Work out the shaded area.

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

[4 marks]

$$\frac{60}{360} \times \pi \times 5^2 - \frac{1}{2} \times 5 \times 5 \times \sin 60$$

Subtracting the area of the triangle from the area of the sector leaves the shaded area

Area of the sector. πr^2, where r is the radius works out the area of the whole circle. There are 60° out of the 360° in the circle so doing 60/360 of this

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

$$\frac{25\pi}{6} - \frac{25}{2} \times \frac{\sqrt{3}}{2}$$

60/360 = 6/36 = 1/6. 5^2 = 25. Sin60 = $\sqrt{3}$/2. Working this 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

For the denominator of the second term: 2 x 2 = 4. A common multiple of 6 and 4 is 12 so converting both fractions into this by multiplying both the numerators and denominators by the same amount to get 12
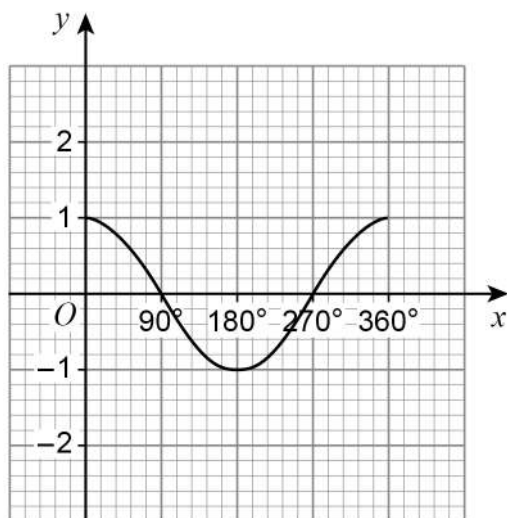
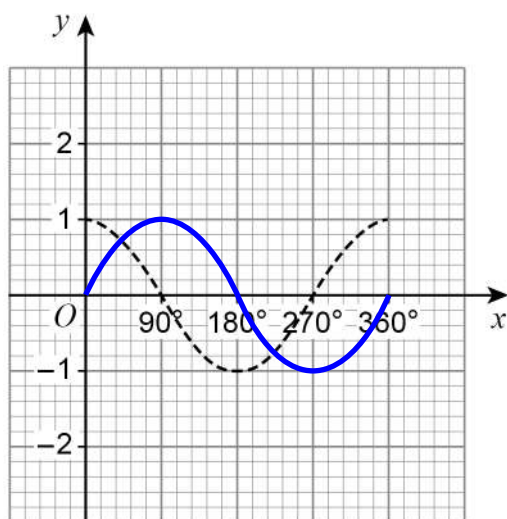Answer $\dfrac{50\pi - 75\sqrt{3}}{12}$ cm^2

7

Turn over ▶

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IB/M/Jun21/8300/1H

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 $0° \leqslant x \leqslant 360°$
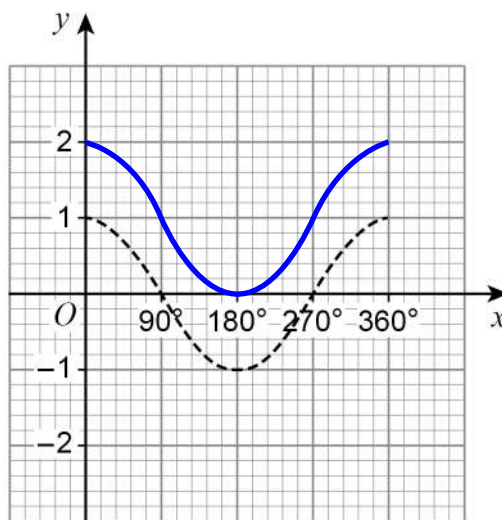
[1 mark]

The graph is translated 90 to the right

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

[1 mark]

The graph is translated 1 up

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

Here is her graph.
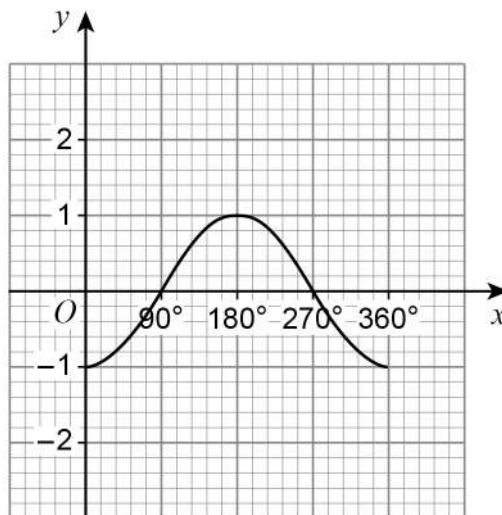
Give a reason why Rita's graph is incorrect.

[1 mark]

Should have been reflected in the y-axis

3

Turn over ▶

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IB/M/Jun21/8300/1H

29 Here is triangle *ABC* on a grid.
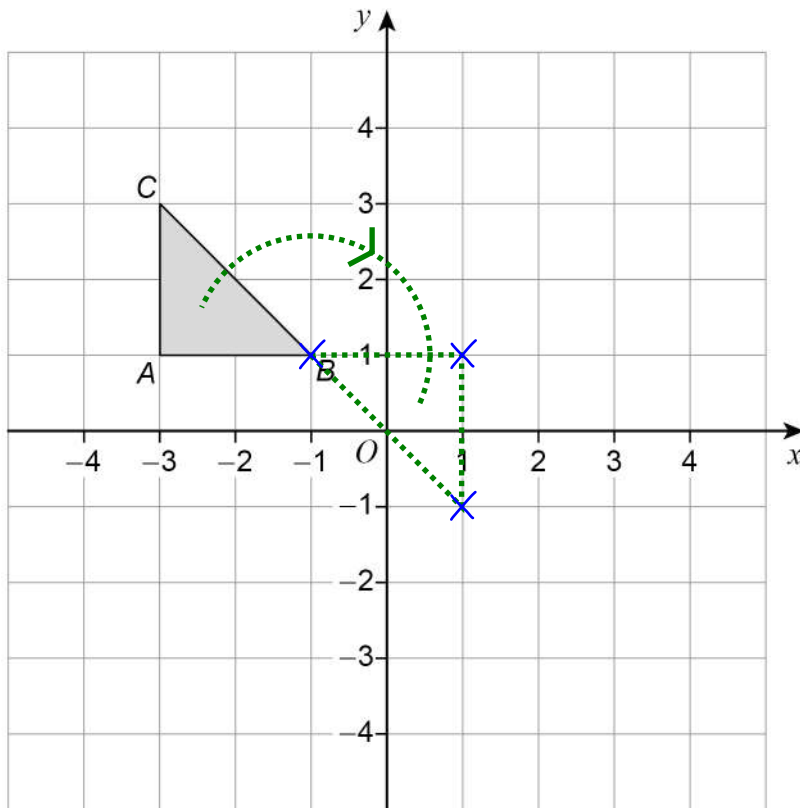
Describe a **single** transformation of the triangle so that

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

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