

Please write clearly in block capitals.

Centre number

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Candidate number

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Surname StemUp Model Solution

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

H

Higher Tier

Paper 1 Non-Calculator

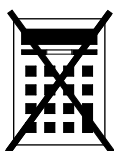
Time allowed: 1 hour 30 minutes

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.

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	

Advice

In all calculations, show clearly how you work out your answer.



J U N 2 1 8 3 0 0 1 H 0 1

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

- 1 Simplify $(a^5)^3$
Circle your answer.

[1 mark]

$8a$

$15a$

a^8

a^{15}

- 2 $x \neq 0.4$
Circle the possible value of x .

[1 mark]

$\frac{4}{10}$

$\frac{20}{50}$

$\frac{26}{70}$

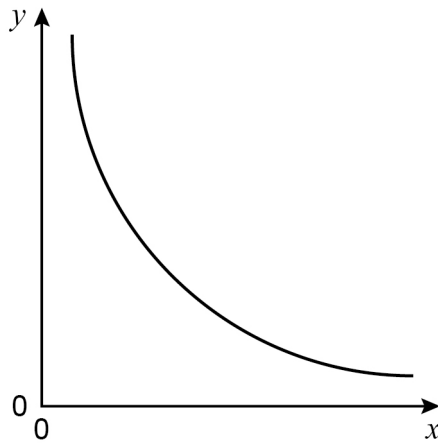
$\frac{120}{300}$

- 3 Circle the solid that has 7 vertices.

[1 mark]

hexagonal
prismhexagon-based
pyramidpentagonal
prismpentagon-based
pyramid

- 4 Here is a sketch of a graph.



Circle the equation of the graph.

k is a constant.

[1 mark]

$$y = kx$$

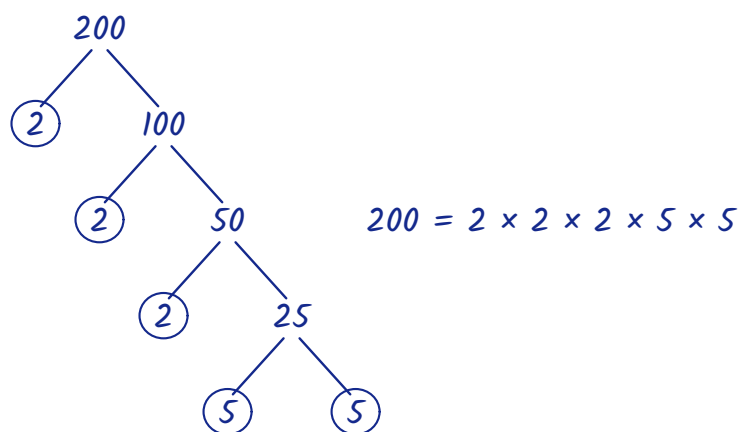
$$y = k + x$$

$$y = k - x$$

$$y = \frac{k}{x}$$

- 5 Write 200 as a product of prime factors.
Give your answer in index form.

[3 marks]



Answer $2^3 \times 5^2$

Turn over ►



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]

$$\text{Lily: } 2 \times 12 + 4 = 28 \text{ months}$$

$$\text{Hugo: } 12 + 8 = 20 \text{ months}$$

$$\frac{28}{20} = \frac{14}{10} = \frac{7}{5}$$

Answer $\frac{7}{5}$

7

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

[3 marks]

$$\sqrt{97} \approx \sqrt{100} = 10, \quad 2.014^3 \approx 2^3 = 8$$

$$0.49 \approx 0.5$$

$$\frac{10 + 8}{0.5} = \frac{18}{0.5} = 18 \times 2 = 36$$

Answer 36



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

[3 marks]

$$5x + 6 > 3x + 15$$

$$5x - 3x > 15 - 6$$

$$2x > 9$$

$$x > 4.5$$

Answer $x > 4.5$

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



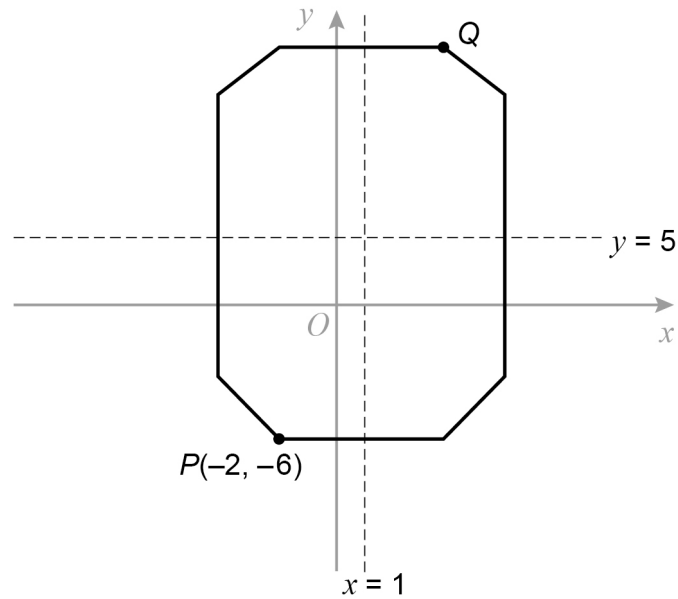
[2 marks]

Answer $2 \leq x < 5$



9

The diagram shows an octagon.

Not drawn
accurately $x = 1$ and $y = 5$ are lines of symmetry.

Work out the coordinates of point Q.

[2 marks]

$$\text{Reflect } P \text{ in } x = 1: 1 - (-2) = 3, \quad x = 1 + 3 = 4$$

$$\text{Vertex vertically below } Q \text{ is } (4, -6)$$

$$\text{Reflect in } y = 5: 5 - (-6) = 11, \quad y = 5 + 11 = 16$$

$$Q = (4, 16)$$

Answer (4 , 16)

- 10 (a)** Work out $2000 \times 70\,000$
Give your answer in standard form.

[2 marks]

$$2000 \times 70\,000 = 2 \times 10^3 \times 7 \times 10^4$$

$$= 14 \times 10^7$$

$$= 140\,000\,000$$

$$= 1.4 \times 10^8$$

Answer 1.4×10^8

- 10 (b)** Work out $\frac{1.8 \times 10^2}{3 \times 10^{-1}}$
Give your answer as an ordinary number.

[2 marks]

$$1.8 \div 3 = 0.6$$

$$10^2 \div 10^{-1} = 10^{2 - (-1)} = 10^3$$

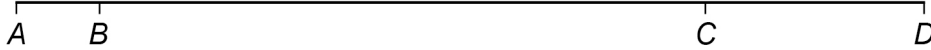
$$0.6 \times 10^3 = 0.6 \times 1000 = 600$$

Answer 600

Turn over ►

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

Not drawn
accurately



$$\text{distance } CD = 3 \times \text{distance } AB$$

$$\text{distance } BC = 25 \text{ miles}$$

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]

$$30 \text{ minutes} = 0.5 \text{ hours}$$

$$AC = 62 \times 0.5 = 31 \text{ miles}$$

$$AB = 31 - 25 = 6 \text{ miles}$$

$$CD = 3 \times 6 = 18 \text{ miles}$$

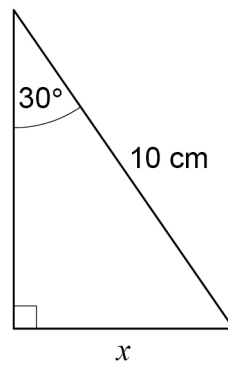
$$AD = 31 + 18 = 49 \text{ miles}$$

Answer 49 miles



12

Here is a right-angled triangle.

Not drawn
accuratelyUse trigonometry to work out the value of x .**[3 marks]**

$$\sin 30^\circ = \frac{\text{opp}}{\text{hyp}} = \frac{x}{10}$$

$$x = 10 \times \sin 30^\circ$$

$$\sin 30^\circ = 0.5$$

$$x = 10 \times 0.5 = 5$$

Answer 5 cm

Turn over for the next question

Turn over ►



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

[2 marks]

$$0.8333...$$

$$6 \overline{) 5.500000}$$

$$5 \div 6 = 0.8333...$$

Answer 0.8 $\dot{3}$

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

Circle your answer.

[1 mark]

$$\frac{7}{x}$$

$$\frac{7}{2x}$$

$$\frac{12}{x}$$

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



15

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

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

[3 marks]

$$(x + a)(x + 3a) = x^2 + 3ax + ax + 3a^2$$

$$= x^2 + 4ax + 3a^2$$

$$\text{Constant terms: } 3a^2 = 75$$

$$a^2 = 25, \text{ so } a = 5 \text{ or } a = -5$$

$$\text{x terms: } b = 4a$$

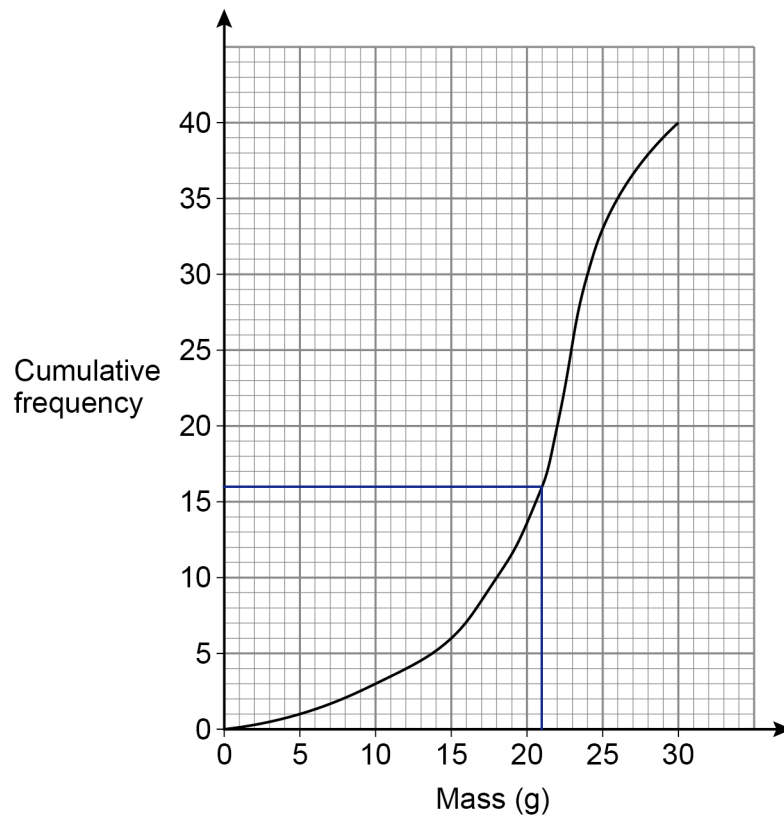
$$a = 5: b = 4 \times 5 = 20$$

$$a = -5: b = 4 \times (-5) = -20$$

Answer 20 and -20



- 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]

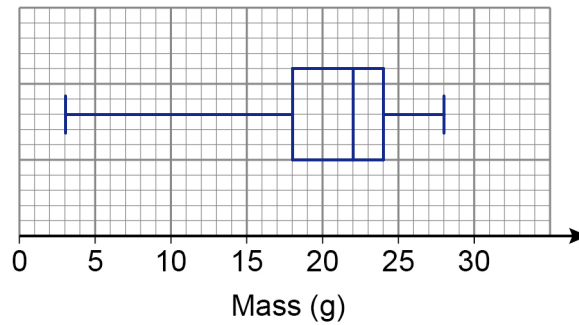
At 21 g the cumulative frequency is 16

Greater than 21 g: $40 - 16 = 24$

Answer 24



- 16 (b)** The lowest mass was 3 grams.
The highest mass was 28 grams.
Draw a box plot to represent the data.

[3 marks]

Median: 20th value = 22 g LQ: 10th value = 18 g
UQ: 30th value = 24 g lowest 3 g, highest 28 g

- 17** Circle the vector that translates the point $(-2, 7)$ to the point $(3, -1)$

[1 mark]

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

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

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

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

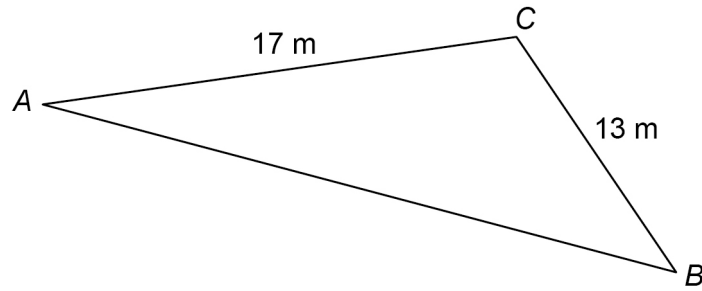
Turn over for the next question

Turn over ►



18 (a) Here is a triangle.

Not drawn
accurately



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

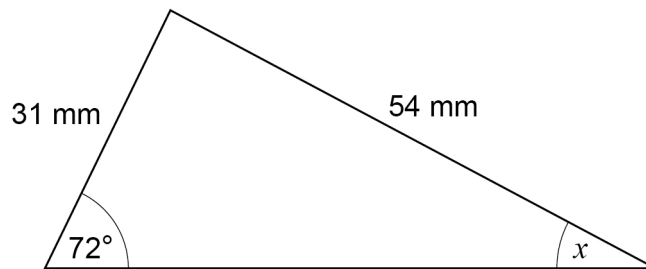
[1 mark]

$AC + BC = 17 + 13 = 30$ m, and 35 m is more than 30 m.

*Any two sides of a triangle must add up to more than
the third side, so AB must be less than 30 m.*



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]

She has used x as a length and 31 as an angle.

x is the angle opposite the 31 mm side, so it should be

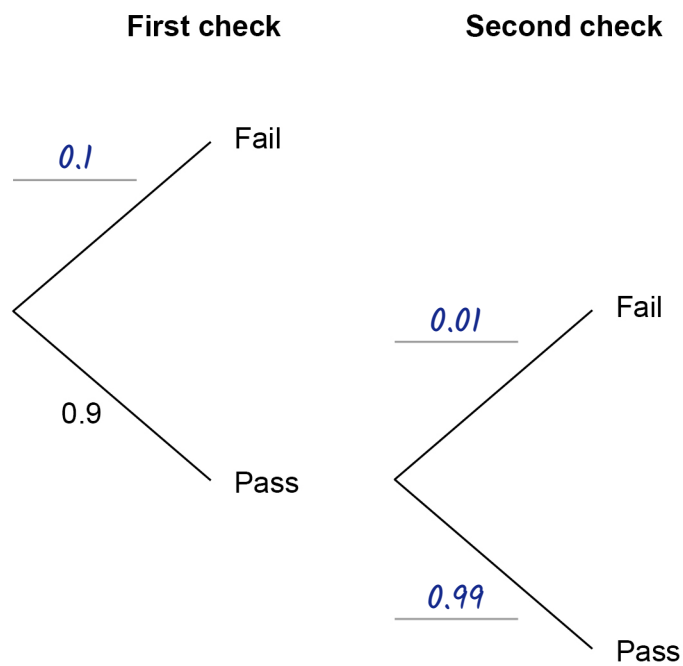
$$\frac{\sin x}{31} = \frac{\sin 72}{54}$$



- 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]



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

Work out the probability that the item is scrapped.

[3 marks]

$$P(\text{scrapped}) = P(\text{fail 1st}) + P(\text{pass 1st and fail 2nd})$$

$$= 0.1 + 0.9 \times 0.01$$

$$= 0.1 + 0.009$$

$$= 0.109$$

Answer 0.109

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

Circle your answer.

[1 mark]

cm²/g

cm³/g

g/cm²

g/cm³

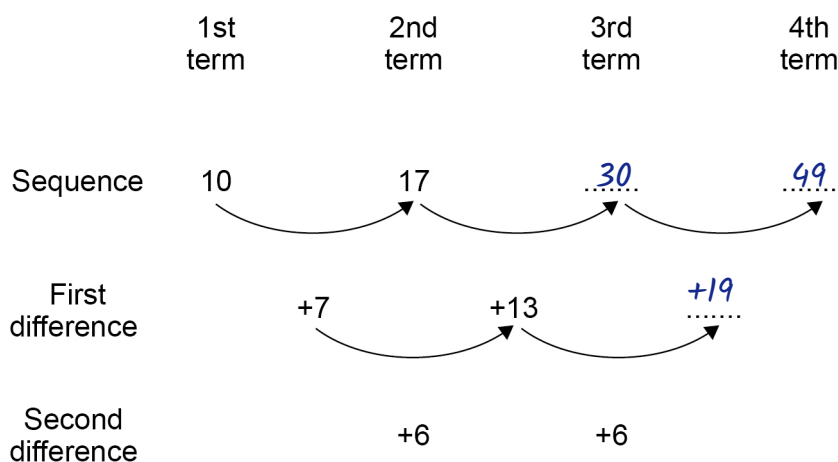
Turn over for the next question



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 n th term of the sequence.

[4 marks]

Second difference = 6, so $6 \div 2 = 3$: $3n^2$

n	1	2	3
sequence	10	17	30
$3n^2$	3	12	27
sequence - $3n^2$	7	5	3

Linear part 7, 5, 3 goes down by 2: $-2n + c$

$-2 \times 1 + c = 7$, so $c = 9$

n th term = $3n^2 - 2n + 9$

Check $n = 2$: $12 - 4 + 9 = 17$

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



22

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

Give your answer as a mixed number.

[3 marks]

$$\left(\frac{5}{7}\right)^{-2} = \left(\frac{7}{5}\right)^2 = \frac{7^2}{5^2} = \frac{49}{25} = 1\frac{24}{25}$$

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

23

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

[3 marks]

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

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

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

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

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

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]

$$f(4) = 7: \quad 4c + d = 7$$

$$f(10) = 22: \quad 10c + d = 22$$

$$\text{Subtract: } 6c = 15$$

$$c = 15 \div 6 = 2.5$$

$$4 \times 2.5 + d = 7$$

$$10 + d = 7$$

$$d = -3$$

$$c = \underline{\quad 2.5 \quad} \quad d = \underline{\quad -3 \quad}$$



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

Circle the expression for $hg(x)$

[1 mark]

$$\frac{2x^2 - x}{2}$$

$$\frac{2x - 1}{2}$$

$$x^2 - x$$

$$x - 1$$

25

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

[3 marks]

$$\sqrt{150} = \sqrt{25 \times 6} = 5\sqrt{6}$$

$$\sqrt{2} \times \sqrt{3} = \sqrt{6}$$

$$\frac{\sqrt{150} - \sqrt{6}}{\sqrt{2} \times \sqrt{3}} = \frac{5\sqrt{6} - \sqrt{6}}{\sqrt{6}} = \frac{4\sqrt{6}}{\sqrt{6}} = 4$$

4 is an integer

Turn over for the next question

Turn over ►



26

$$d = 2f$$

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

Work out the ratio $e : f$

[3 marks]

$$d = 2f, \text{ so } \frac{e-f}{2f-e} = \frac{1}{4}$$

$$4(e-f) = 2f-e$$

$$4e - 4f = 2f - e$$

$$5e = 6f$$

$$\frac{e}{f} = \frac{6}{5}$$

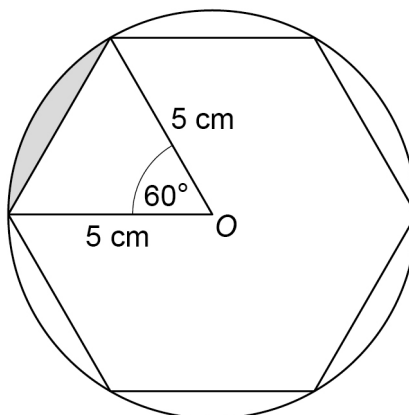
Answer 6 : 5



27

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

Not drawn
accurately



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]

$$\text{Sector} = \frac{60}{360} \times \pi \times 5^2 = \frac{25\pi}{6}$$

$$\text{Triangle} = \frac{1}{2} \times 5 \times 5 \times \sin 60^\circ = \frac{25}{2} \times \frac{\sqrt{3}}{2} = \frac{25\sqrt{3}}{4}$$

$$\text{Shaded} = \frac{25\pi}{6} - \frac{25\sqrt{3}}{4} = \frac{50\pi}{12} - \frac{75\sqrt{3}}{12}$$

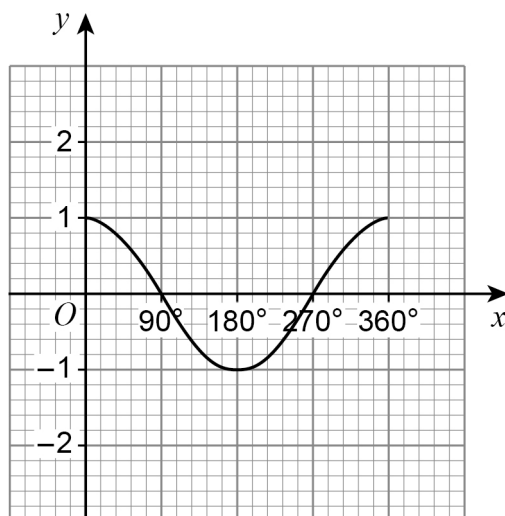
$$= \frac{50\pi - 75\sqrt{3}}{12}$$

Answer $\frac{50\pi - 75\sqrt{3}}{12}$ cm²

Turn over ►



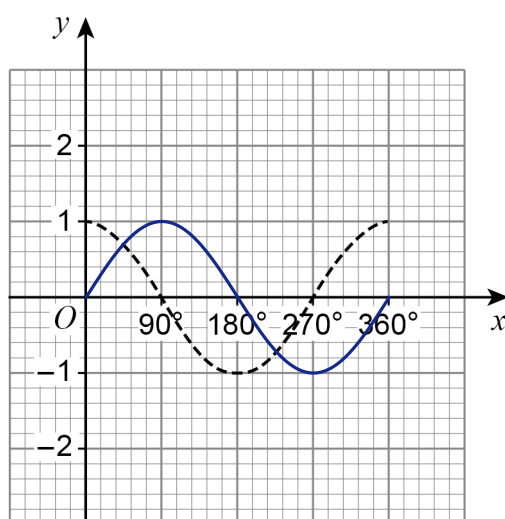
28 Here is the graph of $y = \cos x$ for $0^\circ \leq x \leq 360^\circ$



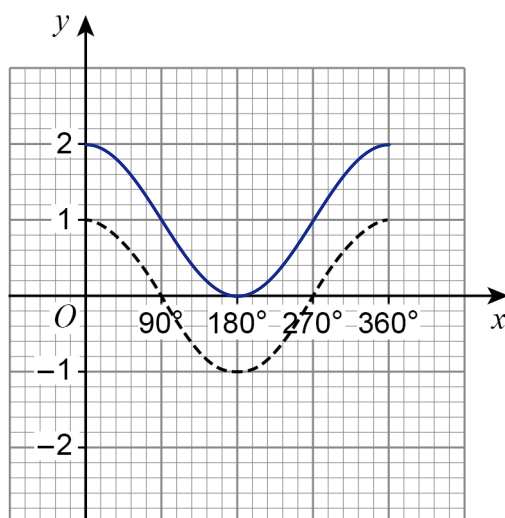
In parts (a) and (b) the graph of $y = \cos x$ is shown as a dashed line.

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

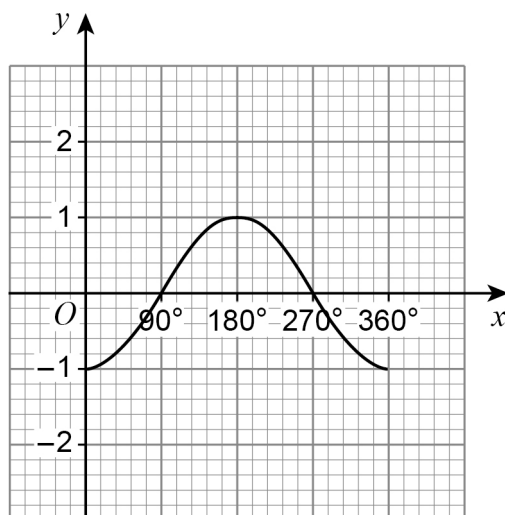
[1 mark]



- 28 (b) On the grid below, draw the graph of $y = 1 + \cos x$ for $0^\circ \leq x \leq 360^\circ$ [1 mark]



- 28 (c) Rita tries to draw the graph of $y = \cos(-x)$ for $0^\circ \leq x \leq 360^\circ$. Here is her graph.



Give a reason why Rita's graph is incorrect.

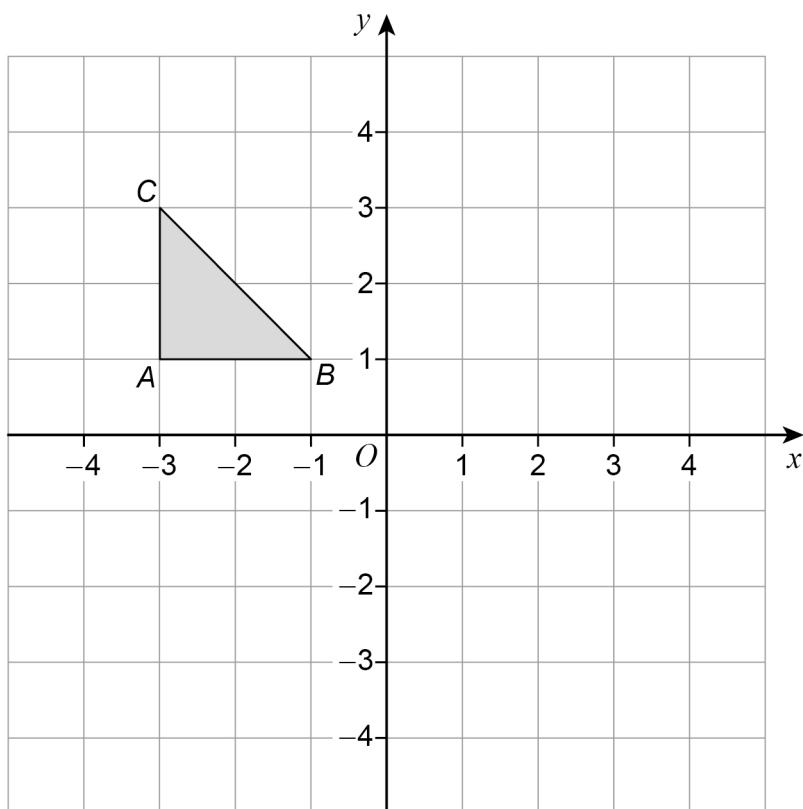
[1 mark]

$\cos(-x) = \cos x$, so it should be the same as $y = \cos x$, starting at $(0, 1)$.

Rita has drawn $y = -\cos x$ (reflected in the x -axis instead of the y -axis).



29

Here is triangle ABC on a grid.Describe a **single** transformation of the triangle so thatpoint B is invariantpoint A moves to $(1, 1)$ point C moves to $(1, -1)$ **[3 marks]***Rotation of 180° about the point $(-1, 1)$* *Check: $B(-1, 1)$ stays fixed, $A(-3, 1) \rightarrow (1, 1)$,* *$C(-3, 3) \rightarrow (1, -1)$* **END OF QUESTIONS**

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3 2



2 1 6 G 8 3 0 0 / 1 H