

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

Tuesday 1 November 2022

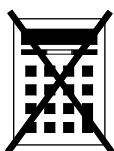
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- mathematical instruments
- the Formulae Sheet (enclosed).



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	
TOTAL	



N 0 V 2 2 8 3 0 0 1 H 0 1

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

Do not write
outside the
box

1 Work out $-4 \times -\frac{7}{9}$

Circle your answer.

[1 mark]

$$-\frac{28}{36}$$

$$-\frac{28}{9}$$

$$\frac{28}{36}$$

$$\frac{28}{9}$$

2 Circle the value of $(\sqrt{6})^4$

[1 mark]

$$12$$

$$36$$

$$10$$

$$\sqrt{24}$$

3 $0.203 = \frac{1}{5} + x$

Circle the value of x .

[1 mark]

$$\frac{1}{300}$$

$$\frac{1}{3000}$$

$$\frac{3}{100}$$

$$\frac{3}{1000}$$



4 Circle the correct statement.

[1 mark]

$$3x \equiv x + 2x$$

$$3x \equiv 2$$

$$3x + x \equiv 2 - x$$

$$3x + x - 2 \equiv 0$$

5 Divide 62 in the ratio 3 : 7

[3 marks]

$$3 + 7 = 10 \text{ parts}$$

$$1 \text{ part} = 62 \div 10 = 6.2$$

$$3 \text{ parts} = 6.2 \times 3 = 18.6$$

$$7 \text{ parts} = 6.2 \times 7 = 43.4$$

$$\text{Check: } 18.6 + 43.4 = 62$$

Answer 18.6 and 43.4

Turn over for the next question

Turn over ►



6

Here is some information about the time spent on social media by 40 women and 40 men last week.

Time spent, t (hours)	Number of women	Number of men
$2 < t \leq 5$	12	10
$5 < t \leq 8$	11	17
$8 < t \leq 11$	14	9
$11 < t \leq 14$	2	4
$14 < t \leq 17$	1	0

Tick **one** box for each statement.

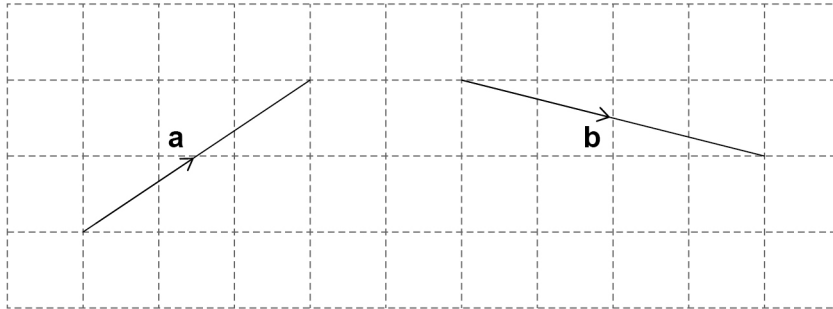
[3 marks]

	Definitely true	Might be true	Cannot be true
Three of the women spent more than 11 hours on social media.	☒	☐	☐
The range for the men is 15 hours.	☐	☐	☒
The women have a higher median than the men.	☐	☒	☐



7 The diagram shows the vectors **a** and **b**.

As a column vector $\mathbf{a} = \begin{pmatrix} 3 \\ 2 \end{pmatrix}$



7 (a) What is **b** as a column vector?

[2 marks]

Answer $\begin{pmatrix} 4 \\ -1 \end{pmatrix}$

7 (b) Work out $4\mathbf{a}$ as a column vector.

[1 mark]

Answer $\begin{pmatrix} 12 \\ 8 \end{pmatrix}$

7 (c) $\mathbf{a} + \mathbf{c} = \begin{pmatrix} 3 \\ 0 \end{pmatrix}$

Work out **c** as a column vector.

Circle your answer.

[1 mark]

$$\begin{pmatrix} 2 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 0 \\ 2 \end{pmatrix}$$

$$\begin{pmatrix} -2 \\ 0 \end{pmatrix}$$

$$\begin{pmatrix} 0 \\ -2 \end{pmatrix}$$



8

Work out $\left(\frac{7}{10} - \frac{4}{15}\right) \div \frac{2}{3}$

Give your answer as a fraction.

[3 marks]

$$\left(\frac{7}{10} - \frac{4}{15}\right) = \frac{21}{30} - \frac{8}{30} = \frac{13}{30}$$

$$\frac{13}{30} \div \frac{2}{3} = \frac{13}{30} \times \frac{3}{2} = \frac{39}{60}$$

$$\frac{39}{60} = \frac{13}{20} \quad (\div 3)$$

Answer $\frac{13}{20}$

9

Work out all the **integer** values of x for which $12 \leq 4x < 25$

[2 marks]

$$12 \leq 4x < 25$$

$$\div 4: \quad 3 \leq x < 6.25$$

Integers: 3, 4, 5, 6

Answer 3, 4, 5, 6



10

Here is some information about 120 people who visit a shop.

$\frac{3}{4}$ of the people buy neither a coat nor a dress.

19 people buy a coat.

14 people buy a dress.

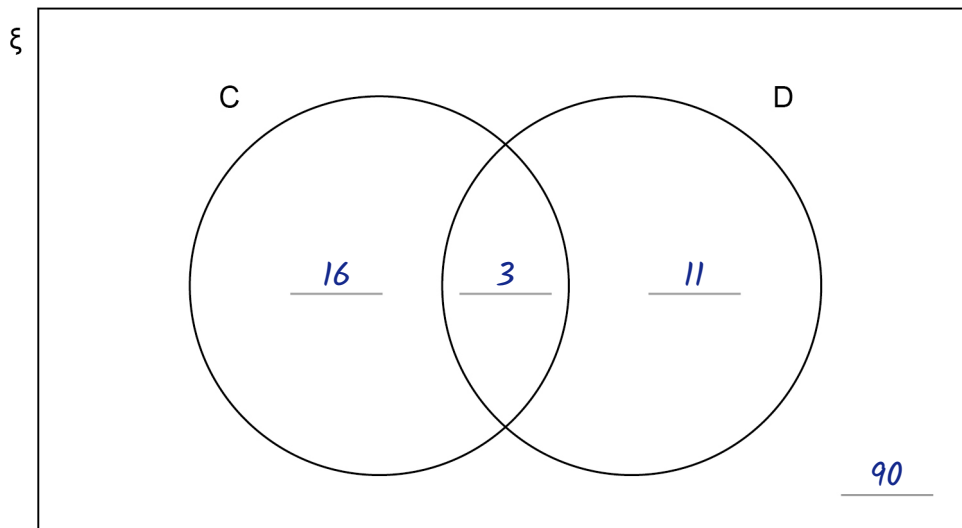
Complete this Venn diagram to represent the information.

[3 marks]

ξ = 120 people who visit the shop

C = people who buy a coat

D = people who buy a dress



$$\frac{3}{4} \times 120 = 90 \text{ buy neither}$$

$$120 - 90 = 30 \text{ buy a coat or a dress (or both)}$$

$$19 + 14 = 33, \quad 33 - 30 = 3 \text{ buy both}$$

$$\text{Coat only} = 19 - 3 = 16, \quad \text{Dress only} = 14 - 3 = 11$$



- 11 Write $(3^6 \times 3^5) : 3^7$ in the form $n : 1$ where n is an integer.

[3 marks]

$$3^6 \times 3^5 = 3^{6+5} = 3^{11}$$

$$3^{11} : 3^7$$

$$\text{divide both by } 3^7: 3^{11-7} : 1 = 3^4 : 1$$

$$3^4 = 3 \times 3 \times 3 \times 3 = 9 \times 9 = 81$$

$$81 : 1$$

Answer 81 : 1

- 12 a is 10% more than b .

Circle the ratio $a : b$

[1 mark]

10 : 11

10 : 1

11 : 10

1 : 10

- 13 Work out $0.4\dot{7} + 0.312$

Circle your answer.

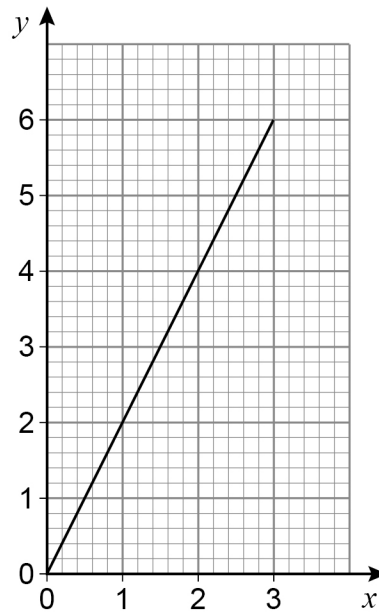
[1 mark]

0.782

0.789

0.789 $\dot{7}$ 0.7 $\dot{8}$ 9

- 14** Craig wants to draw a graph, for values of x from -3 to 3 , where the x -coordinate and y -coordinate are always in the ratio $2 : 1$. Here is his graph.



Make two criticisms of Craig's graph.

[2 marks]

Criticism 1 The graph does not go from $x = -3$ to 3 , it only starts at $x = 0$ (no negative x values are drawn).

Criticism 2 Wrong ratio: at $x = 3$, $y = 6$, so $x : y = 1 : 2$ not $2 : 1$. It should be $y = \frac{1}{2}x$, through $(3, 1.5)$.



15

Show that $(3x + 4)(2x - 5) - 11x(x - 2) + 5(x^2 - 3x - 1)$ simplifies to an integer.

[4 marks]

$$(3x + 4)(2x - 5) = 6x^2 - 15x + 8x - 20 = 6x^2 - 7x - 20$$

$$-11x(x - 2) = -11x^2 + 22x$$

$$5(x^2 - 3x - 1) = 5x^2 - 15x - 5$$

$$\text{Total} = 6x^2 - 7x - 20 - 11x^2 + 22x + 5x^2 - 15x - 5$$

$$x^2 \text{ terms: } 6x^2 - 11x^2 + 5x^2 = 0$$

$$x \text{ terms: } -7x + 22x - 15x = 0$$

$$\text{numbers: } -20 - 5 = -25$$

$$= -25$$

-25 is an integer, as required



16

A graph has the equation $y = x^2 + px + r$ where p and r are constants.

The graph passes through the points $(0, 4)$, $(1, 3)$ and $(8, w)$

Work out the value of w .

[4 marks]

$$(0, 4): 4 = 0^2 + p \times 0 + r, \text{ so } r = 4$$

$$(1, 3): 3 = 1^2 + p \times 1 + 4$$

$$3 = 5 + p, \text{ so } p = -2$$

$$y = x^2 - 2x + 4$$

$$(8, w): w = 8^2 + (-2) \times 8 + 4$$

$$w = 64 - 16 + 4 = 52$$

$$w = \underline{\hspace{2cm} 52 \hspace{2cm}}$$

Turn over for the next question

Turn over ►



- 17** The table shows information about the heights of 60 athletes.

Height, h (cm)	Frequency
$150 < h \leq 160$	4
$160 < h \leq 170$	12
$170 < h \leq 180$	35
$180 < h \leq 190$	7
$190 < h \leq 200$	2

- 17 (a)** Complete the cumulative frequency table.

[1 mark]

Height, h (cm)	Cumulative frequency
$h \leq 150$	0
$h \leq 160$	4
$h \leq 170$	16
$h \leq 180$	51
$h \leq 190$	58
$h \leq 200$	60

- 17 (b)** Circle the class interval that contains the lower quartile.

[1 mark]

$150 < h \leq 160$

$160 < h \leq 170$

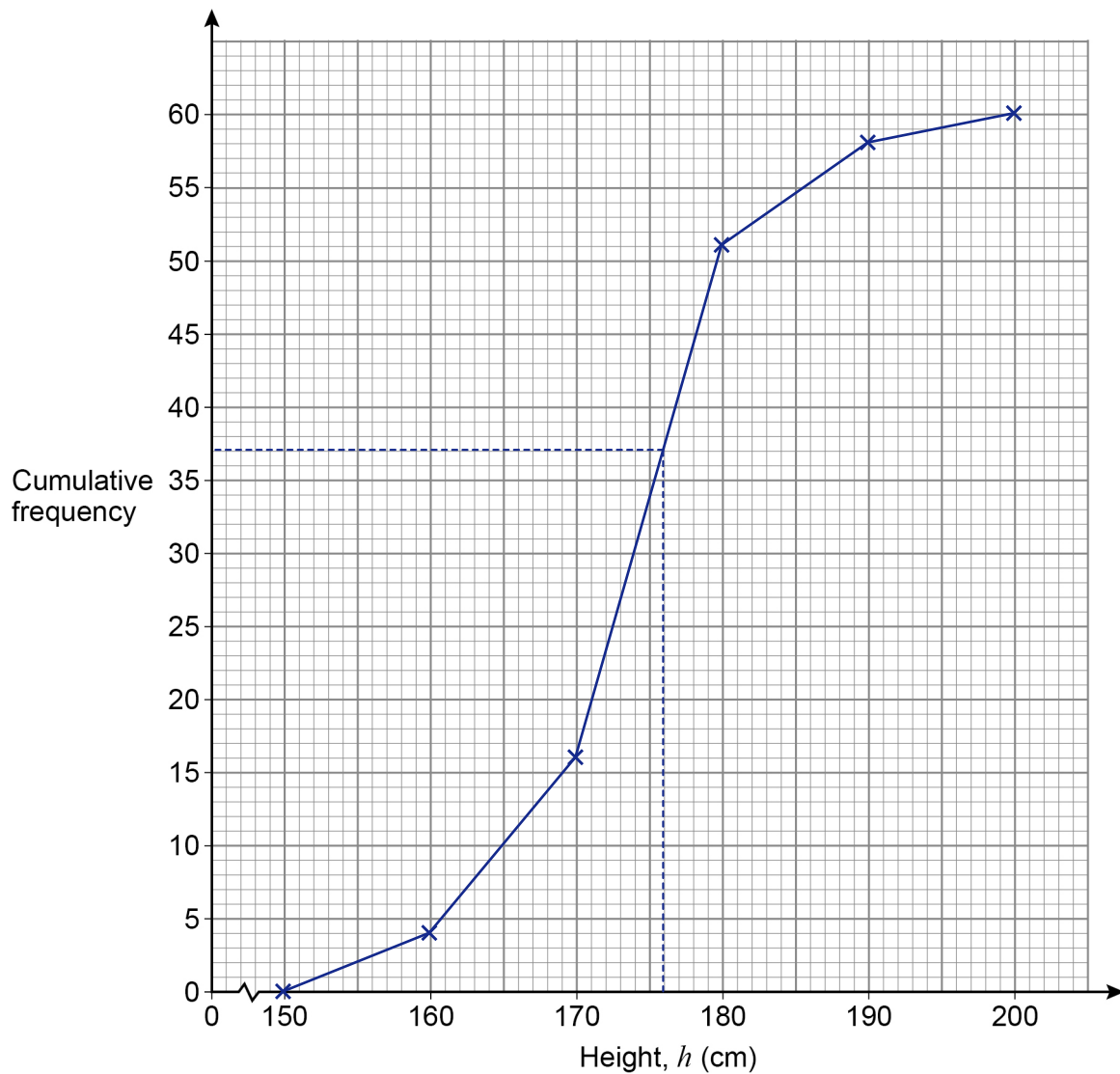
$170 < h \leq 180$

$180 < h \leq 190$



17 (c) Draw a cumulative frequency diagram to represent the data.

[2 marks]



17 (d) Estimate the number of the athletes whose height is **more** than 176 cm

[2 marks]

Reading at 176 cm: cumulative frequency = 37

More than 176 cm: $60 - 37 = 23$

Answer 23



18

A road has three sections, D, E and F.

The lengths of D, E and F are in the ratios

$$D : E = 3 : 5 \quad E : F = 7 : 4$$

What fraction of the length of the road is section D?

[3 marks]

$$D : E = 3 : 5 = 21 : 35 \quad (\times 7)$$

$$E : F = 7 : 4 = 35 : 20 \quad (\times 5)$$

$$D : E : F = 21 : 35 : 20$$

$$\text{Total parts} = 21 + 35 + 20 = 76$$

$$D = \frac{21}{76} \text{ of the road}$$

Answer $\frac{21}{76}$



- 19 (a) Work out the value of $\left(\frac{5}{4}\right)^{-2}$

[2 marks]

$$\left(\frac{5}{4}\right)^{-2} = \left(\frac{4}{5}\right)^2 = \frac{4^2}{5^2} = \frac{16}{25}$$

Answer $\frac{16}{25}$

- 19 (b) Work out the value of $\left(\frac{9}{100}\right)^{\frac{3}{2}}$

[2 marks]

$$\left(\frac{9}{100}\right)^{1/2} = \frac{\sqrt{9}}{\sqrt{100}} = \frac{3}{10}$$

$$\left(\frac{3}{10}\right)^3 = \frac{3^3}{10^3} = \frac{27}{1000}$$

Answer $\frac{27}{1000}$

Turn over for the next question

Turn over ►



20

The only solution to $x^2 + bx + c = 0$ is $x = -15$

Work out the values of b and c .

[3 marks]

Only one solution, so $x = -15$ is a repeated root

$$(x + 15)^2 = 0$$

$$(x + 15)(x + 15) = x^2 + 15x + 15x + 225$$

$$= x^2 + 30x + 225$$

$$b = 30 \quad c = 225$$

21

Convert $0.\dot{6}1$ to a fraction.

[3 marks]

$$x = 0.6111...$$

$$10x = 6.1111...$$

$$100x = 61.1111...$$

$$100x - 10x = 61.1111... - 6.1111...$$

$$90x = 55$$

$$x = \frac{55}{90} = \frac{11}{18}$$

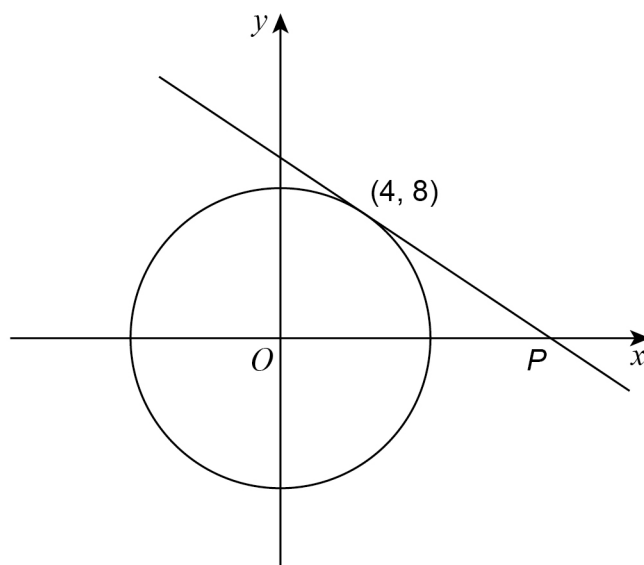
Answer $\frac{11}{18}$



22

(4, 8) is a point on a circle, centre O .

The tangent at (4, 8) intersects the x -axis at P .



Not drawn
accurately

Work out the x -coordinate of P .

[5 marks]

$$\text{Gradient of radius} = \frac{8 - 0}{4 - 0} = \frac{8}{4} = 2$$

$$\text{Tangent} \perp \text{radius, so gradient of tangent} = \frac{-1}{2}$$

$$y = \frac{-1}{2}x + c, \quad (4, 8): 8 = \frac{-1}{2} \times 4 + c$$

$$8 = -2 + c, \quad \text{so } c = 10$$

$$\text{At } P, y = 0: 0 = \frac{-1}{2}x + 10$$

$$\frac{1}{2}x = 10, \quad x = 20$$

Answer 20



23

$$4 \times \sin 30^\circ \times \tan 30^\circ \times \cos 30^\circ = \sin y$$

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

You **must** show your working.

[4 marks]

$$\sin 30^\circ = \frac{1}{2}, \quad \tan 30^\circ = \frac{1}{\sqrt{3}}, \quad \cos 30^\circ = \frac{\sqrt{3}}{2}$$

$$4 \times \frac{1}{2} \times \frac{1}{\sqrt{3}} \times \frac{\sqrt{3}}{2} = \frac{4 \times 1 \times 1 \times \sqrt{3}}{2 \times \sqrt{3} \times 2} = \frac{4\sqrt{3}}{4\sqrt{3}}$$

$$= 1$$

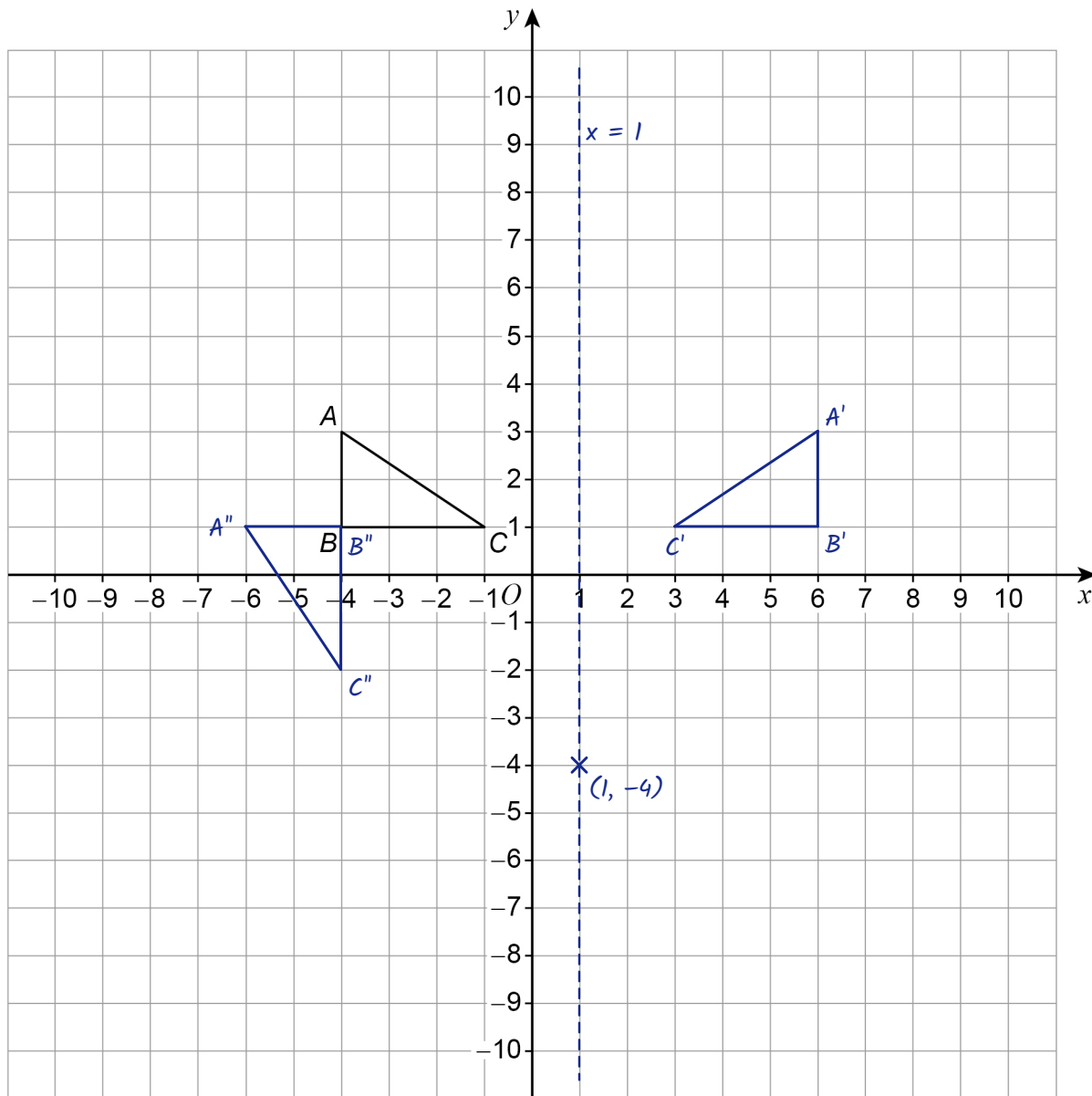
$$\sin y = 1$$

$$y = 90^\circ$$

Answer 90 degrees



24

Triangle ABC is drawn on a grid.

ABC is transformed to $A'B'C'$ by a reflection in the line $x = 1$

$A'B'C'$ is transformed to $A''B''C''$ by a rotation 90° anticlockwise about $(1, -4)$

Which **one** point on ABC is invariant under the combined transformation?

You **must** show the result of each transformation on the grid.

[4 marks]

Answer $B (-4, 1)$

Turn over ►



25 (a) Solve $x^2 - 5x - 6 < 0$

[2 marks]

$$x^2 - 5x - 6 = (x + 1)(x - 6)$$

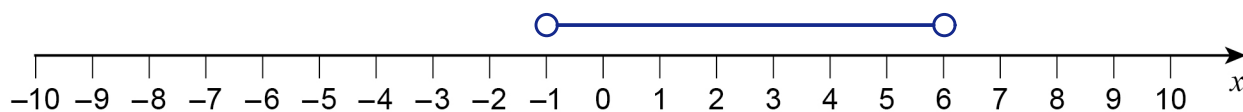
$$(x + 1)(x - 6) = 0 \text{ gives } x = -1 \text{ or } x = 6$$

U-shaped graph is below 0 between the roots

Answer $-1 < x < 6$

25 (b) Show the solution to $x^2 - 5x - 6 < 0$ on the number line.

[1 mark]

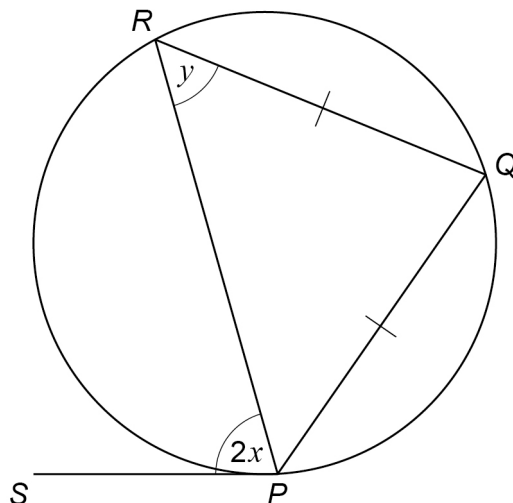


26

P , Q and R are points on a circle.

SP is a tangent to the circle.

$RQ = PQ$



Not drawn
accurately

Prove that $y = 90^\circ - x$

[4 marks]

Angle $RPQ = y$ (base angles of an isosceles triangle are equal, as $RQ = PQ$)

Angle $RQP = 2x$ (alternate segment theorem)

Angles in a triangle sum to 180° :

$$y + y + 2x = 180^\circ$$

$$2y = 180^\circ - 2x$$

$$y = 90^\circ - x$$



27

Work out $\sqrt{2\frac{13}{16}} - \frac{2}{\sqrt{5}}$ Give your answer in the form $\frac{a\sqrt{5}}{b}$ where a and b are integers.**[4 marks]**

$$2\frac{13}{16} = \frac{2 \times 16 + 13}{16} = \frac{45}{16}$$

$$\sqrt{\frac{45}{16}} = \frac{\sqrt{45}}{\sqrt{16}} = \frac{\sqrt{9 \times 5}}{4} = \frac{3\sqrt{5}}{4}$$

$$\frac{2}{\sqrt{5}} = \frac{2}{\sqrt{5}} \times \frac{\sqrt{5}}{\sqrt{5}} = \frac{2\sqrt{5}}{5}$$

$$\frac{3\sqrt{5}}{4} - \frac{2\sqrt{5}}{5} = \frac{15\sqrt{5}}{20} - \frac{8\sqrt{5}}{20} = \frac{7\sqrt{5}}{20}$$

Answer $\frac{7\sqrt{5}}{20}$ **END OF QUESTIONS**

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2 8



2 2 B G 8 3 0 0 / 1 H