



Please write clearly in block capitals.

Centre number

Candidate number

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS



Higher Tier Paper 3 Calculator

Wednesday 14 June 2023

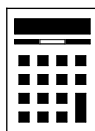
Morning

Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:

- a calculator
- mathematical instruments
- the Formulae Sheet (enclosed).



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	
TOTAL	

Advice

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



JUN2383003H01

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

Do not write
outside the
box

1 The line with equation $y = 2x + 7$ intersects the y -axis at A.

Complete the coordinates of A.

[1 mark]

Answer (0 , 7)
①

2 Write down a fraction equivalent to 1.875

[1 mark]

Answer $\frac{15}{8}$ ①

3 Solve $5x + 11 = 3x + 19$

[2 marks]

$$5x - 3x = 19 - 11$$

$$2x = 8$$
 ①

$$x = \frac{8}{2} = 4$$
 ①

$$x = \underline{4}$$



Do not write
outside the
box

- 4 A map has a scale of 1 : 5000

How many **metres** are represented by a length of 4.5 cm on the map?

[2 marks]

$$4.5 \times 5000 = 22\,500 \text{ cm}$$

①

$$(22\,500 \div 100) \text{ m}$$

$$= 225 \text{ m}$$

①

Answer 225 m

- 5 The number of hedgehogs in England is expected to **reduce** by 4% each year.
Assume there are now 1 000 000 hedgehogs in England.

Work out the expected number of hedgehogs in England after **five** years.

You **must** show your working.

[3 marks]

$$1 - 0.04 = 0.96 \text{ ①}$$

$$1\,000\,000 \times 0.96^5 = 815\,372.70$$

①

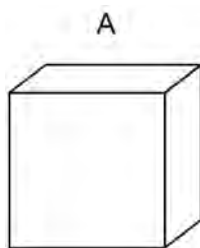
$$\approx 815\,373$$

Answer 815 373 ①

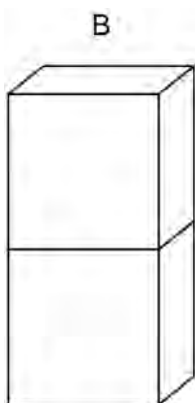


Do not write outside the box

6 Here is cuboid A.



Cuboid B is made from **two** of cuboid A.



volume of A : volume of B = 1 : 2

Matthew says,

“surface area of A : surface area of B must be 1 : 2 because B is made of 2 of A.”

Is Matthew correct?

Tick **one** box.

Yes

No

Cannot tell

Give a reason for your answer.

[2 marks]

2 faces are hidden . ①



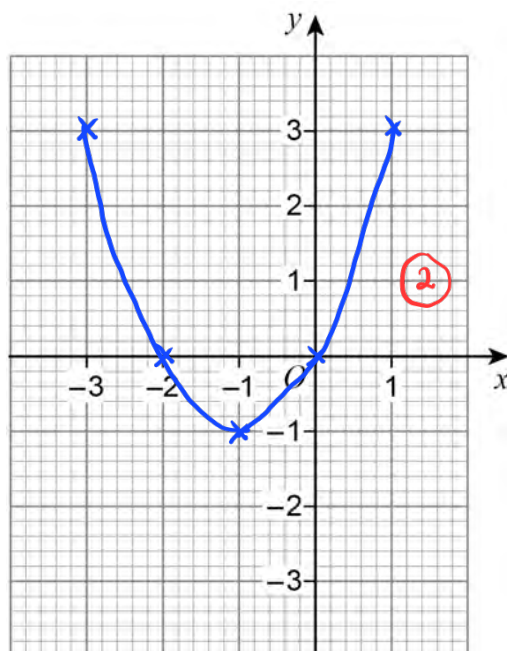
7 (a) Complete the table of values for $y = x^2 + 2x$

[2 marks]

x	-3	-2	-1	0	1
y	3	0	-1	0	3

7 (b) Draw the graph of $y = x^2 + 2x$ for values of x from -3 to 1

[2 marks]



Turn over for the next question

Turn over ►



- 8 Jing has £2450
She saves some and gives the rest to her four brothers.
money saved : money given to brothers = 2 : 5
She gives each of her **four** brothers the **same** amount.
Does each brother receive more than £430 ?
You **must** show your working. [4 marks]

$$\text{Total ratio : } 2 + 5 = 7$$

$$\text{money she gives : } \frac{5}{7} \times 2450 = 1750 \quad (1)$$

$$\text{Each brother receive : } \frac{1750}{4} = 437.50 \quad (1)$$

Yes. Each receive £437.50.

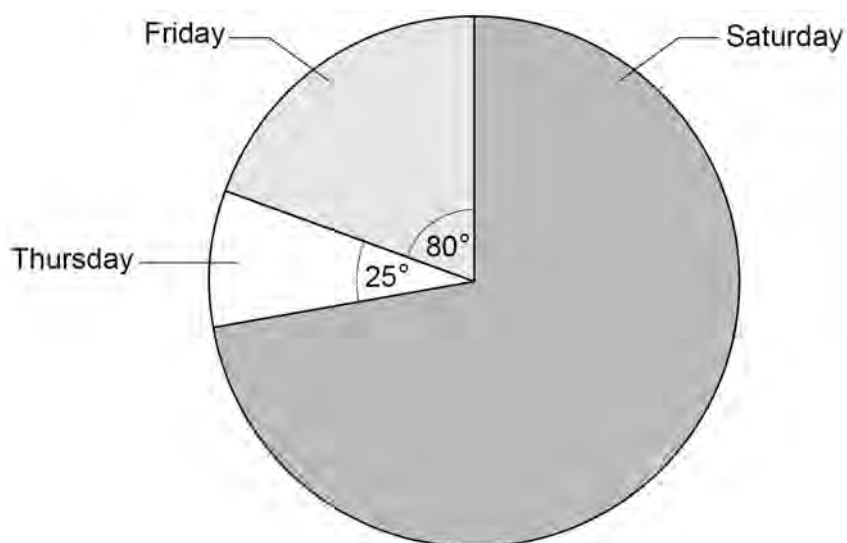
(1)



9

The pie chart shows information about people at a fair during three days.

Do not write
outside the
box



Not drawn
accurately

There were 132 **more** people on Friday than on Thursday.

Work out the number of people on Saturday.

[3 marks]

$$80 - 25 = 55 \quad (1)$$

$$\frac{132}{55} = 2.4 \text{ people per 1 degree}$$

$$\text{Saturday} = 360 - 80 - 25 = 255 \text{ degree} \quad (1)$$

$$\text{No. of people on Saturday} = 255 \times 2.4 = 612 \quad (1)$$

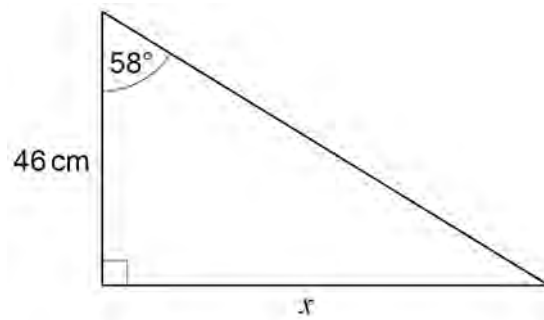
Answer 612

Turn over for the next question

Turn over ►



10

Use trigonometry to work out the value of x .Do not write
outside the
boxNot drawn
accurately

$$\textcircled{1} \quad \tan 58^\circ = \frac{x}{46}$$

[3 marks]

$$x = 46 \tan 58^\circ \textcircled{1}$$

$$= 73.6 \textcircled{1}$$

$$x = 73.6 \text{ cm}$$



11 Millie is estimating the value of $\frac{1}{(\sqrt[3]{8.34})^2 \times 10.21}$

She rounds each decimal number to 1 significant figure.

11 (a) Work out Millie's estimate.

You **must** show your working.

$$\frac{1}{(\sqrt[3]{8})^2 \times 10} = \frac{1}{2^2 \times 10} = \frac{1}{40}$$

[2 marks]

Answer $\frac{1}{40}$

11 (b) Millie says,

“My estimate must be more than the exact value.”

Without working out the exact value, give a reason how she can know this.

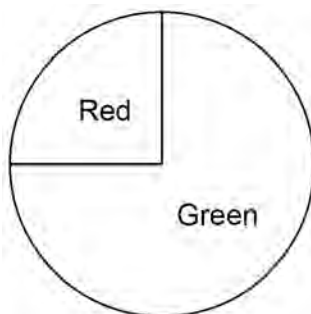
[1 mark]

Both numbers are rounded down.



12 Here is a **biased** spinner.

Do not write
outside the
box



12 (a) Ali, Ben and Cary want to know the probability of spinning red on the biased spinner. They each spin it and count how many times it lands on red and divide by the total number of spins.

Ali says

I spun red the most times

Ben says

I spun the spinner the most times

Cary says

My relative frequency of red is 0.25

Who had the best estimate for the probability of spinning red?

Give a reason for your answer.

[1 mark]

Ben since he spun the most times.



Do not write
outside the
box

12 (b) Dev spins the spinner 80 times.

He says,

“My relative frequency of red is 0.185”

Give a reason why his relative frequency must be wrong.

[1 mark]

$80 \times 0.185 = 14.8$. The answer is not a whole number.

(1)

12 (c) Elena spins the spinner 125 times.

The relative frequency of red is 0.32

Work out how many times the spinner landed on **green**.

[2 marks]

$1 - 0.32 = 0.68$ (1)

$125 \times 0.68 = 85$ (1)

Answer 85

Turn over for the next question

4

Turn over ►



13

Charlie is driving 293 miles home.

He

- leaves at 9.00 am
- travels the first 176 miles at an average speed of 48 mph
- drives the rest of the way at an average speed of 65 mph

Will he be home by 2.30 pm?

You **must** show your working.

[4 marks]

$$\text{first : } \frac{176}{48} = 3 \frac{2}{3} \text{ hours} = 3 \text{ hours } 40 \text{ minutes} \quad (1)$$

$$\text{the rest : } \frac{293-176}{65} = \frac{117}{65} = 1.8 \text{ hours} \\ = 1 \text{ hour } 48 \text{ minutes} \quad (1)$$

$$9 \text{ am} + 3 \text{ hour } 40 \text{ mins} + 1 \text{ hour } 48 \text{ mins} \\ = 2.28 \text{ pm} \quad (1)$$

(1)

Yes. He arrives at 2.28 pm



14

Kiran paid Income Tax and National Insurance on her annual salary.

Do not write
outside the
box**Income Tax**

0% of the first £12 570 of her annual salary
20% of the rest of her annual salary

National Insurance

0% of the first £9 880 of her annual salary
13.25% of the rest of her annual salary

Kiran paid £5186 Income Tax.

How much National Insurance did she pay?

[4 marks]

$$20\% \text{ of the rest of salary} = \text{£}5186$$

$$\text{rest of salary} = \frac{5186}{20\%} = 25\,930 \quad (1)$$

$$\text{Total salary} = 25\,930 + 12\,570 = 38\,500 \quad (1)$$

$$\text{National Insurance} : 38\,500 - 9\,880 = 28\,620$$

$$\frac{13.25}{100} \times 28\,620 = 3\,792.15 \quad (1) \quad (1)$$

Answer £ 3792.15

8

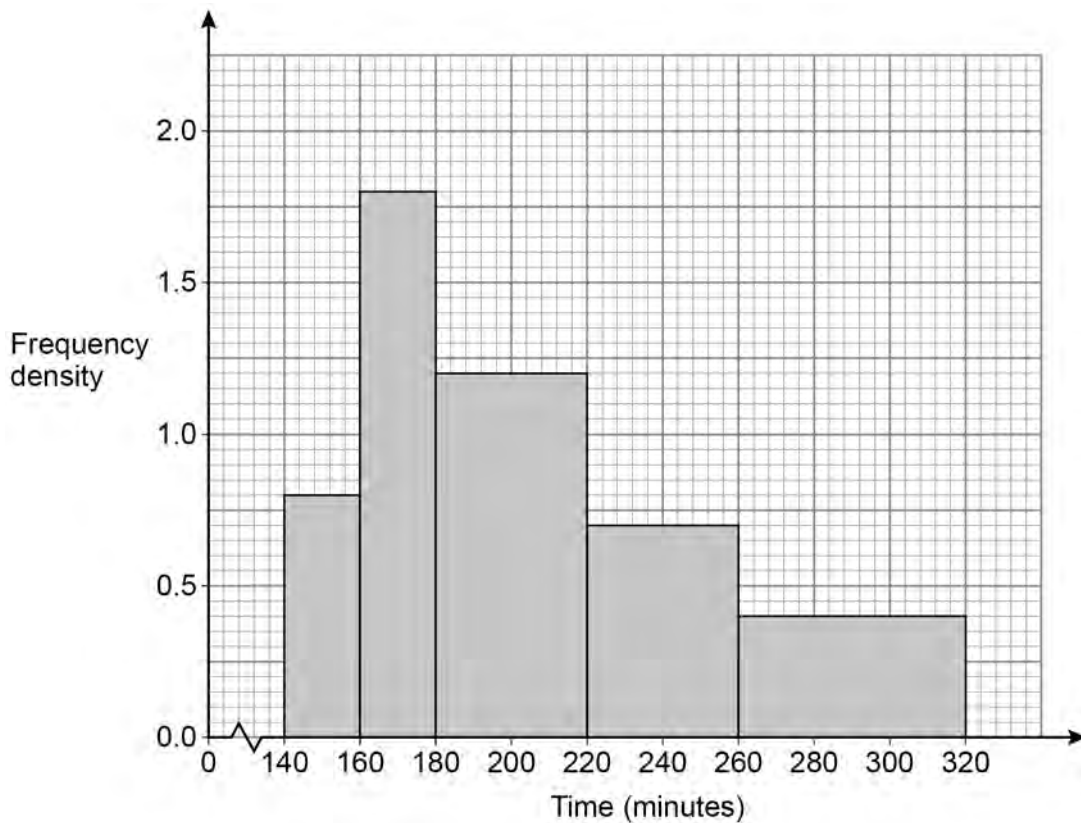
Turn over ►



Do not write outside the box

15 180 runners **started** a marathon.
Some of the runners did not complete it.

15 (a) The histogram represents the times of the runners who did complete the marathon.



How many runners did **not** complete the marathon?

[3 marks]

$$(20 \times 0.8) + (20 \times 1.8) + (40 \times 1.2) + (40 \times 0.7) + (60 \times 0.4)$$

$$= 16 + 36 + 48 + 28 + 24$$

$$= 152$$

$$180 - 152 = 28$$

Answer 28



15 (b) The table shows information about the runners who did **not** complete the marathon.

Do not write outside the box

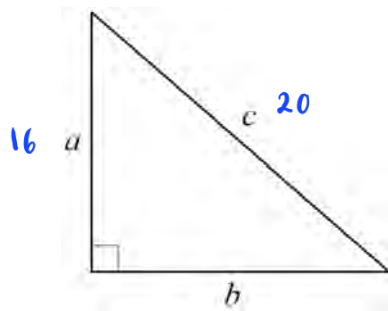
	Distance run (miles)
Least distance	5
Greatest distance	23
Lower quartile	11
Median	18
Interquartile range	9

Draw a box plot to represent the information.

[3 marks]



16

Not drawn
accuratelyDo not write
outside the
box

In this right-angled triangle,

$$a = 16 \text{ cm}$$

$$a : c = 4 : 5$$

Work out the area of the triangle.

[4 marks]

$$c = \frac{5}{4} \times 16 = 20 \quad (1)$$

$$b = \sqrt{20^2 - 16^2}$$

$$= \sqrt{144} \quad (1)$$

$$= 12 \quad (1)$$

$$\text{Area} = \frac{1}{2} \times 16 \times 12$$

$$= 96 \quad (1)$$

Answer 96 cm²

Do not write
outside the
box

17 Solve $\frac{x+8}{2} + \frac{9-x}{5} = 4$

[4 marks]

$$5(x+8) + 2(9-x) = 4(2)(5)$$

$$5x + 40 + 18 - 2x = 40$$

$$5x - 2x = 40 - 58$$

$$3x = -18$$

$$x = -\frac{18}{3} = -6$$

$$x = \underline{\quad -6 \quad}$$

Turn over for the next question

Turn over ►



18 $f(x) = x^2 + 6x$
 $g(x) = 2x + 4$

18 (a) Show that $fg(x) = 4x^2 + 28x + 40$

[3 marks]

$$\begin{aligned} fg(x) &= (2x+4)^2 + 6(2x+4) \quad (1) \\ &= 4x^2 + 16x + 16 + 12x + 24 \quad (1) \\ &= 4x^2 + 28x + 40 \quad (\text{shown}) \\ &\quad (1) \end{aligned}$$

18 (b) Solve $fg(x) = -5$

[3 marks]

$$\begin{aligned} 4x^2 + 28x + 40 &= -5 \\ 4x^2 + 28x + 45 &= 0 \quad (1) \\ x &= \frac{-28 \pm \sqrt{28^2 - 4(4)(45)}}{2(4)} \quad (1) \\ &= \frac{-28 \pm \sqrt{64}}{8} \\ &= \frac{-28 \pm 8}{8} = \frac{-20}{8} \text{ or } \frac{-36}{8} \\ &= -2.5 \text{ or } -4.5 \\ \text{Answer } &\quad -2.5 \text{ and } -4.5 \quad (1) \end{aligned}$$



19

Two integers have a difference of 6

The integers are multiplied together.

9 is then added.

Prove algebraically that the result is always a square number.

[3 marks]

let 2 integers = n and $n+6$

$$n(n+6) = n^2 + 6n \quad (1)$$

$$= n^2 + 6n + 9 \quad (1)$$

$$= (n+3)(n+3)$$

$$= (n+3)^2 \quad (1)$$

Do not write
outside the
box

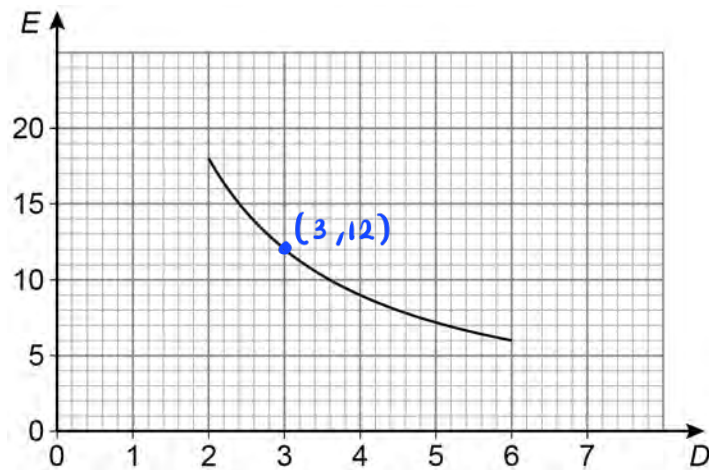
Turn over for the next question

Turn over ►



20 (a) Sunil thinks that E and D are linked by the equation $E = \frac{36}{D}$

The graph shows the values of D and E for $2 \leq D \leq 6$



Choose **one** point on the graph and state if Sunil's equation is correct for that point.

[1 mark]

For point (3,12) : $E = \frac{36}{3} = 12$ (1)

Yes. He is right



20 (b) G is directly proportional to the square root of H .

$$G : H = 3 : 2 \text{ when } H = 16$$

Work out $G : H$ when $H = 100$

[4 marks]

$$G = k H^{\frac{1}{2}} \quad (1)$$

$$\text{when } H = 16, G = \frac{16}{2} \times 3 = 24$$

$$24 = k (16)^{\frac{1}{2}}$$

$$k = \frac{24}{4} = 6 \quad (1)$$

$$G = 6H^{\frac{1}{2}}$$

$$\begin{aligned} \text{when } H = 100, G &= 6(100)^{\frac{1}{2}} \\ &= 6 \times 10 = 60 \quad (1) \end{aligned}$$

$$\begin{aligned} G : H &= 60 : 100 \quad \downarrow \div 20 \\ &= 3 : 5 \quad (1) \end{aligned}$$

Answer 3 : 5

Turn over for the next question



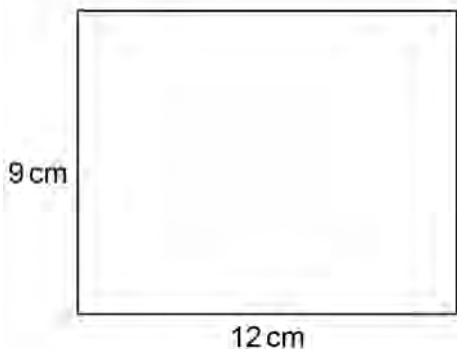
Do not write outside the box

21

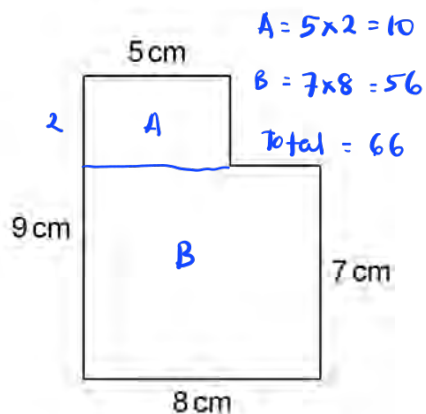
A solid shape is made from centimetre cubes.
The front elevation and side elevation of the shape are shown.

Not drawn accurately

Front elevation



Side elevation



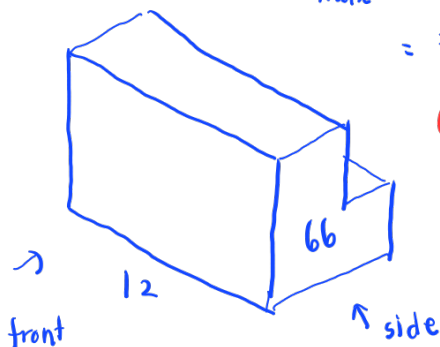
Work out

the **maximum** possible number of cubes in the shape
and
the **minimum** possible number of cubes in the shape.

[3 marks]

Maximum :

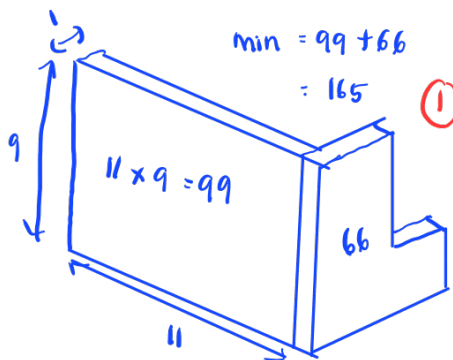
$$\text{Max} = 12 \times 66 = 792$$



Maximum 792

Minimum :

$$\text{min} = 99 + 66 = 165$$

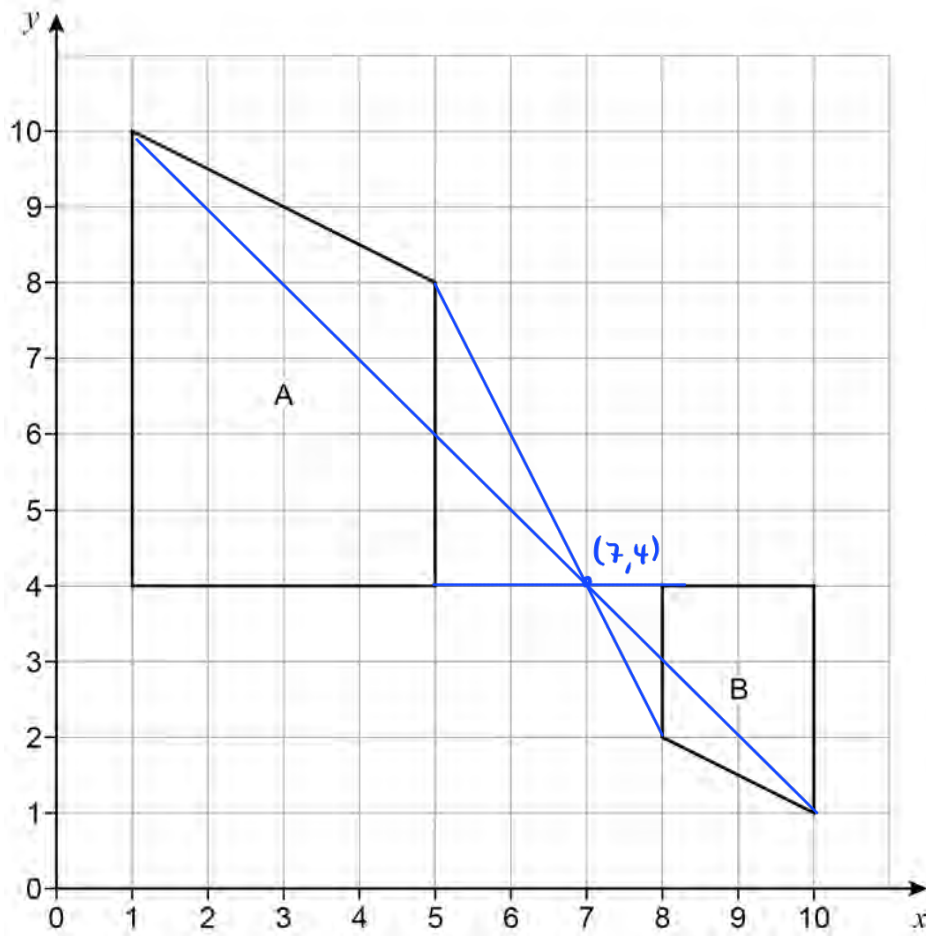


Minimum 165



Do not write outside the box

22 Shape A and shape B are shown on the grid.



Describe the **single** transformation that maps shape A to shape B.

[3 marks]

Enlargement of scale factor $(-\frac{1}{2})$ at centre $(7, 4)$

①

①

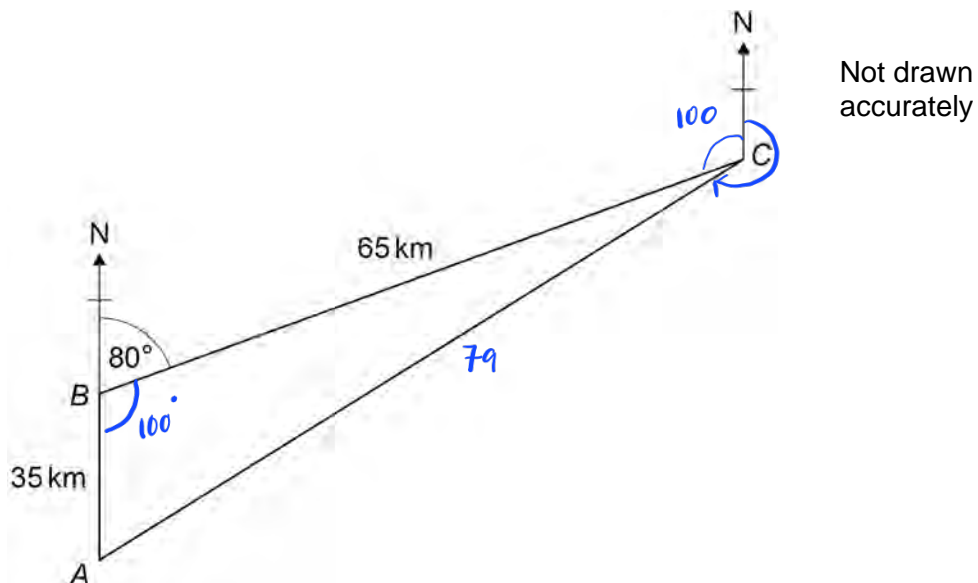
①

6

Turn over ►



23

Do not write
outside the
box

A boat sails 35 km North from A to B .
From B the boat sails to C and then back to A .

- 23 (a) Show that the distance the boat sails from C to A is 79 km to the nearest km
You **must** show your working.

[2 marks]

$$AC^2 = 65^2 + 35^2 - 2(65)(35) \cos 100^\circ \quad \textcircled{1}$$

$$= 4225 + 1225 - 4550 \cos 100^\circ$$

$$= 5450 + 790$$

$$= 6240$$

$$AC = \sqrt{6240}$$

$$= 78.9... \quad \textcircled{1}$$

$$\approx 79 \text{ (nearest km)}$$



23 (b) Work out the bearing of A from C.

[4 marks]

Do not write
outside the
box

$$\frac{\sin ACB}{35} = \frac{\sin 100}{79} \quad (1)$$

$$\sin ACB = \frac{35 \sin 100}{79}$$

$$\sin ACB = 0.436 \dots \quad (1)$$

$$ACB = \sin^{-1} 0.436 \dots$$

$$= 25.8 \dots \quad (1)$$

$$\text{Bearing of A from C} : 360^\circ - 100^\circ - 25.8^\circ$$

$$= 234.2^\circ \quad (1)$$

Answer 234.2 °

END OF QUESTIONS



There are no questions printed on this page

*Do not write
outside the
box*

**DO NOT WRITE ON THIS PAGE
ANSWER IN THE SPACES PROVIDED**



