AQA

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

GCSE MATHEMATICS

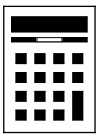
H

Higher Tier Paper 2 Calculator

Wednesday 7 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.

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	

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

Do not write outside the box

1 Write 30 : 12 in the form n : 1

[1 mark]

Answer _____ : 1

2 Four consecutive triangular numbers are 6 10 15 21

Write down the next triangular number.

[1 mark]

Answer _____

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

Do not write outside the box

1 Write 28 : 8 in the form n : 1

[1 mark]

Answer _____ : 1

2 Four consecutive terms from the Fibonacci sequence are 3 5 8 13

Write down the next term.

[1 mark]

Answer _____

Do not write outside the box

3 Write down the reciprocal of $\frac{4}{7}$

[1 mark]

Answer _____

4 The price of a toy increases by 12.5% to £19.53

Work out the **original** price of the toy.

[2 marks]

_____

_____

_____

_____

Answer £ _____

Turn over for the next question

5

Do not write outside the box

3 Write down the reciprocal of $\frac{5}{8}$

[1 mark]

Answer _____

4 The price of a necklace increases by 37.5% to £38.17

Work out the **original** price of the necklace.

[2 marks]

_____

_____

_____

_____

Answer £ _____

Turn over for the next question

5

Do not write outside the box

5 Jess saves 2p, 5p and 10p coins.

She has

- 45 10p coins
- 8 times as many 2p coins as **10p coins**
- £17.70 in total.

Work out total **value** of 2p coins : total **value** of 5p coins

Give your answer in its simplest form.

[4 marks]

Answer _____ : _____

Do not write outside the box

5 Emily saves 2p, 5p and 10p coins.

She has

- 35 10p coins
- 9 times as many 2p coins as **10p coins**
- £14.30 in total.

Work out total **value** of 2p coins : total **value** of 5p coins

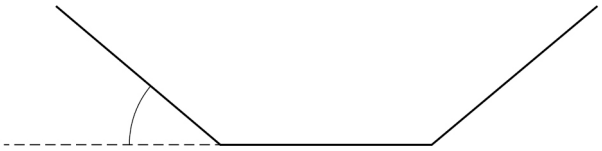
Give your answer in its simplest form.

[4 marks]

Answer _____ : _____

Do not write outside the box

6 (a) Part of a regular polygon is shown.



Not drawn accurately

Assume that the polygon is an octagon.

Work out the size of an **exterior** angle.

[2 marks]

Answer _____ °

6 (b) In fact, the polygon has **more** sides than an octagon.

What does this mean about the size of an exterior angle?

Tick **one** box.

[1 mark]

☐ It is more than the answer to part (a)

☐ It is the same as the answer to part (a)

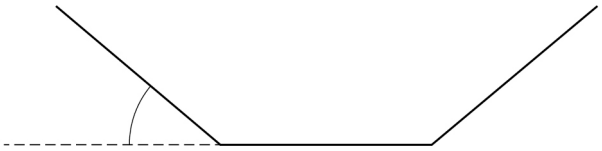
☐ It is less than the answer to part (a)

☐ It could be any of the above

7

Do not write outside the box

6 (a) Part of a regular polygon is shown.



Not drawn accurately

Assume that the polygon is a hexagon.

Work out the size of an **exterior** angle.

[2 marks]

Answer _____ °

6 (b) In fact, the polygon has **more** sides than an octagon.

What does this mean about the size of an exterior angle?

Tick **one** box.

[1 mark]

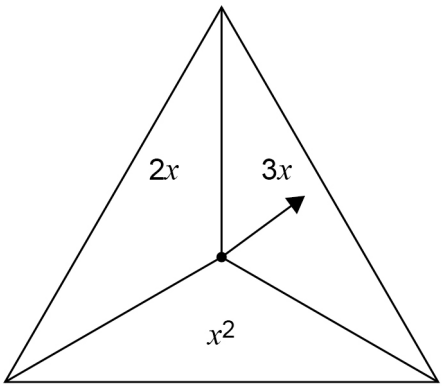
- ☐ It is more than the answer to part (a)
- ☐ It is the same as the answer to part (a)
- ☐ It is less than the answer to part (a)
- ☐ It could be any of the above

7

Do not write outside the box

7 In a game,

- an ordinary fair six-sided dice is rolled
- the fair spinner shown is spun.



The score is the dice number **substituted** into the spinner expression.

7 (a) Complete the table to show all of the possible scores.

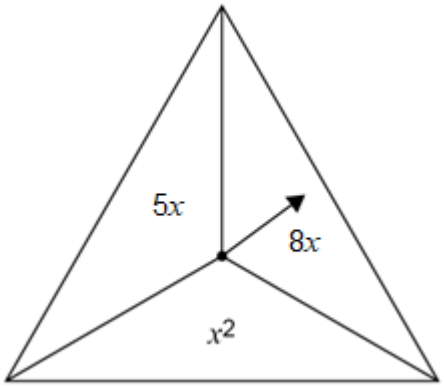
[2 marks]

	1	**2**	**3**	**4**	**5**	**6**
$2x$				8		
$3x$		6				
x^2					25	

Do not write outside the box

7 In a game,

- an ordinary fair six-sided dice is rolled
- the fair spinner shown is spun.



The score is the number on the dice **substituted** into the spinner expression.

7 (a) Complete the table to show all of the possible scores.

[2 marks]

	1	**2**	**3**	**4**	**5**	**6**
5x						30
8x		16				
x^2				16		

Do not write outside the box

7 (b) A player wins the game if their score is 10 or more.

Work out the probability that they win the game.

[1 mark]

Answer _____

7 (c) The game is played 711 times.

Estimate the number of games that are won.

[2 marks]

Answer _____

8 $(a - 3)x^2 + 2b \equiv 5x^2 + 12$

Work out the values of a and b.

[2 marks]

$a =$ _____ $b =$ _____

7

Do not write outside the box

7 (b) A player wins the game if their score is 30 or more.

Work out the probability that they win the game.

[1 mark]

Answer _____

7 (c) The game is played 756 times.

Estimate the number of games that are won.

[2 marks]

Answer _____

8 $(a-5)x^2 + 4b \equiv 3x^2 + 20$

Work out the values of a and b.

[2 marks]

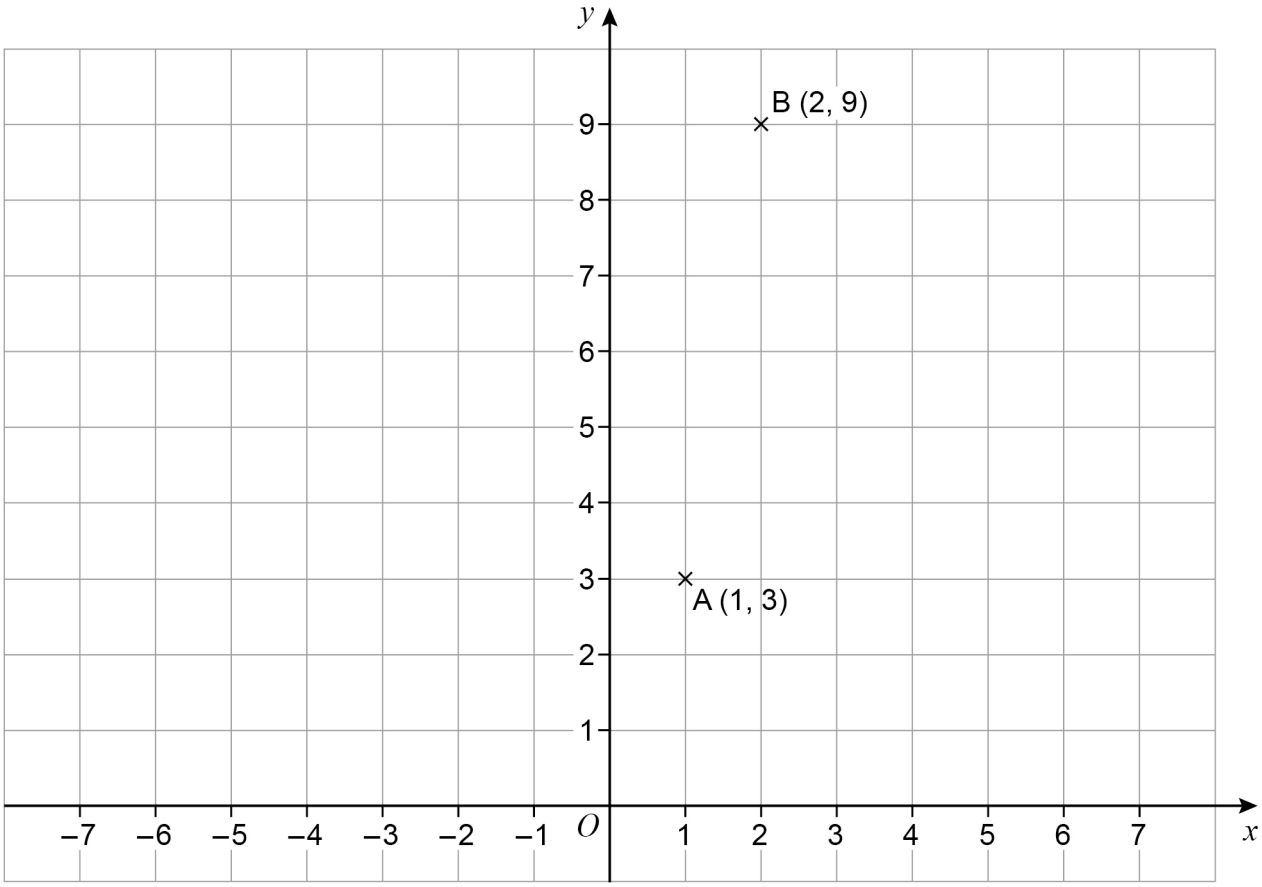
$a =$ _____ $b =$ _____

Turn over for the next question

7

Do not write outside the box

9 A (1, 3) and B (2, 9) are points on a centimetre grid.



ABCD is a parallelogram.

AD and BC are **horizontal** and each has length 5 cm

The diagonals of ABCD cross at E.

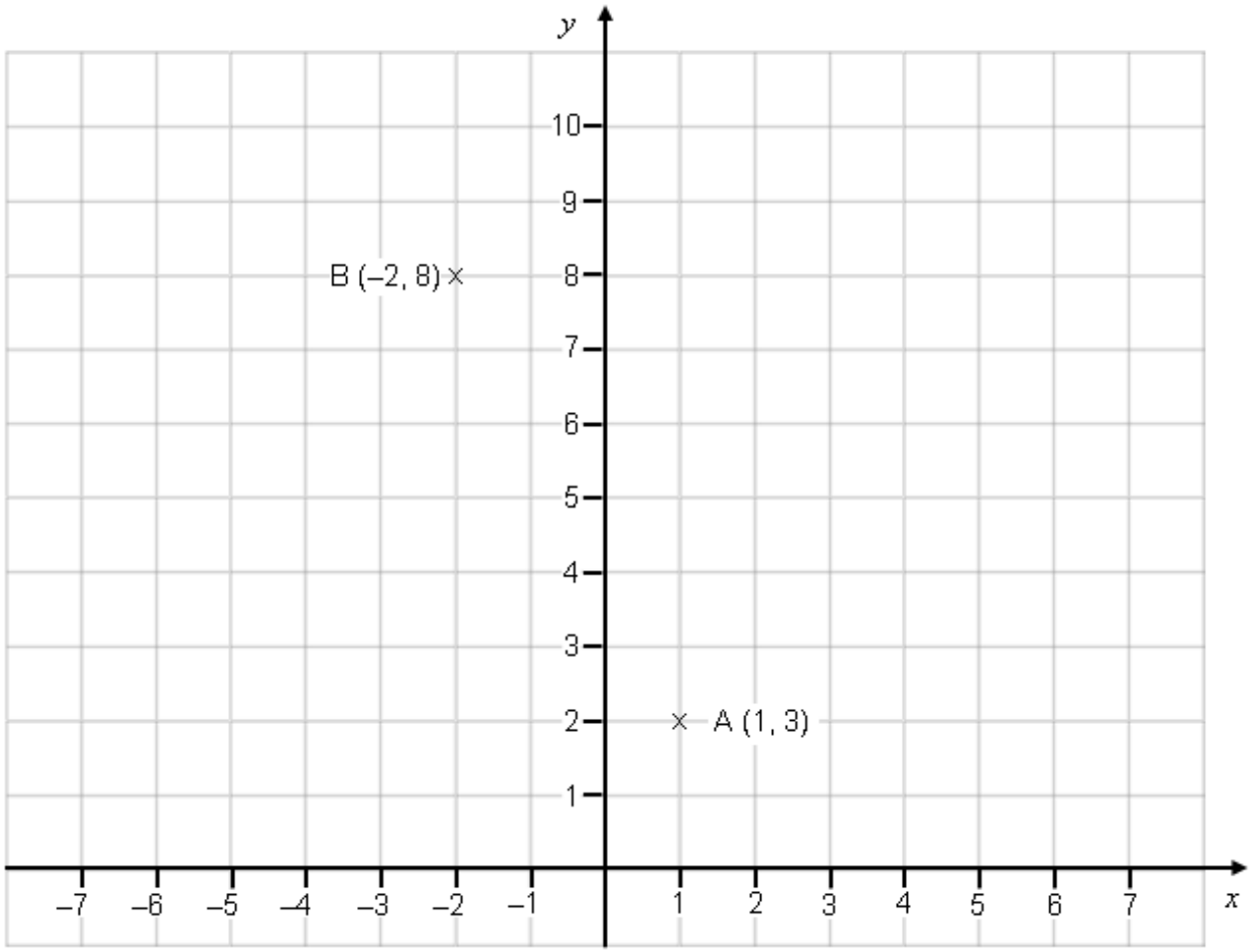
Work out the **two** possible pairs of coordinates of E.

[4 marks]

Answer (_____ , _____) and (_____ , _____)

Do not write outside the box

9 A (1, 2) and B (–2, 8) are points on a centimetre grid.



ABCD is a parallelogram.

AD and BC are **horizontal** and each has length 5 cm

The diagonals of ABCD cross at E.

Work out the **two** possible pairs of coordinates of E.

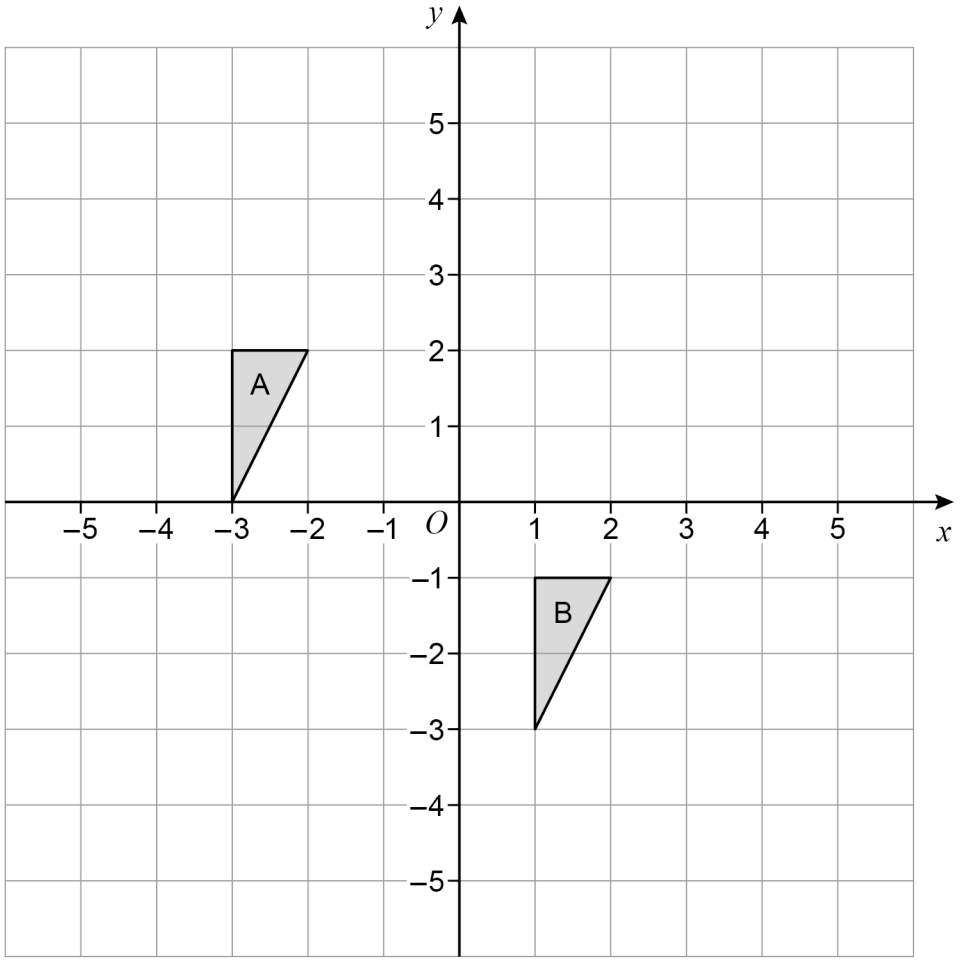
[4 marks]

Answer (_____ , _____) and (_____ , _____)

Do not write outside the box

10 Write down the translation vector that maps shape A onto shape B.

[2 marks]



Answer _____

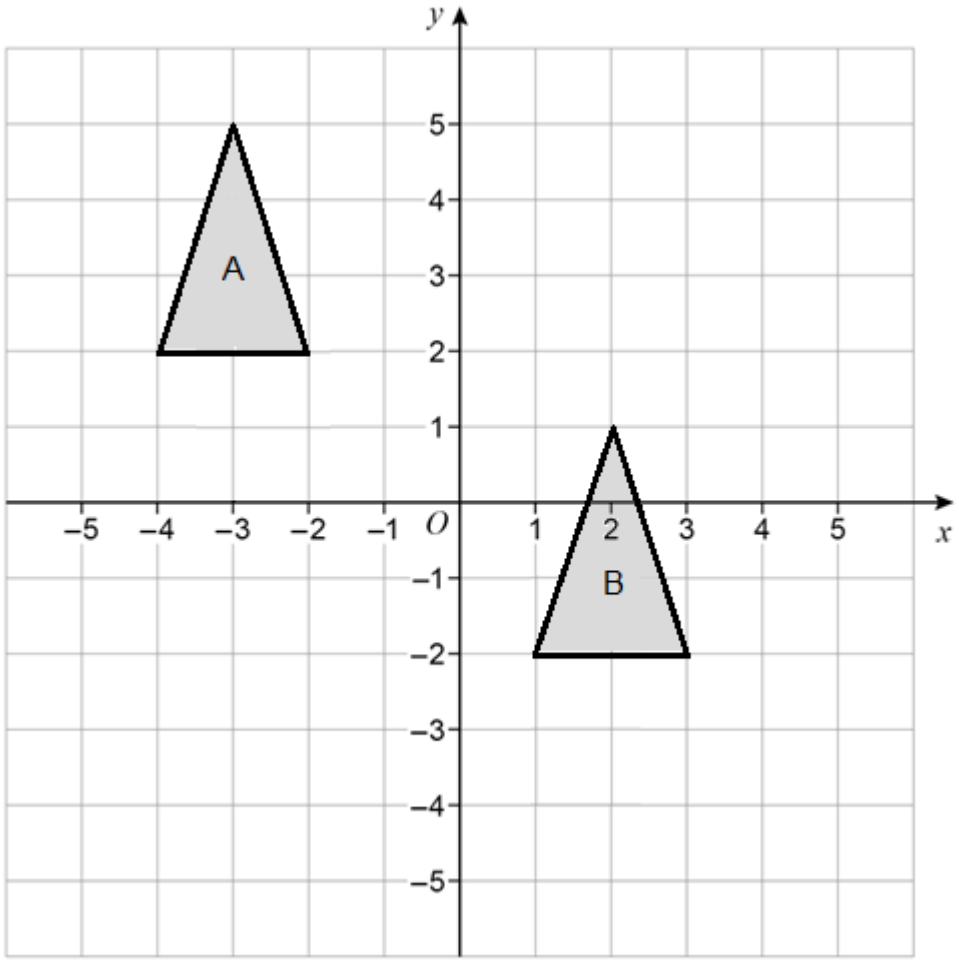
6

Turn over ►

Do not write outside the box

10 Write down the translation vector that maps shape A onto shape B.

[2 marks]



Answer _____

Turn over for the next question

6

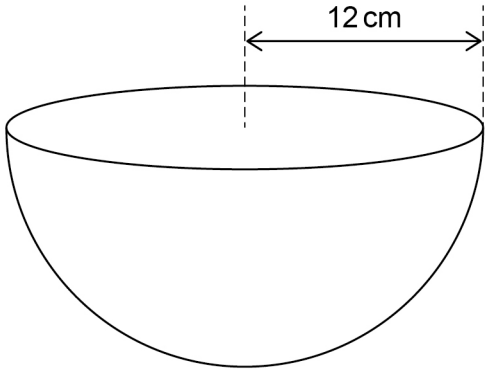
Turn over ►

Do not write outside the box

11

Volume of a sphere $= \frac{4}{3}\pi r^3$

A bowl is a hemisphere with radius 12 cm



Water is poured into the bowl

at a rate of 325 cm^3 per second

for 8 seconds.

Does the water fill **more than** 70% of the bowl?

You **must** show your working.

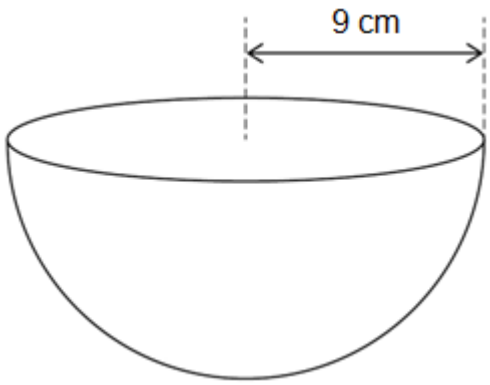
[4 marks]

Do not write outside the box

11

Volume of a sphere $= \frac{4}{3}\pi r^3$

A hollow bowl is in the shape of a hemisphere with radius 9 cm



Water is poured into the bowl

at a rate of 185 cm^3 per second

for 7 seconds.

Does the water fill **more than** 80% of the bowl?

You **must** show your working.

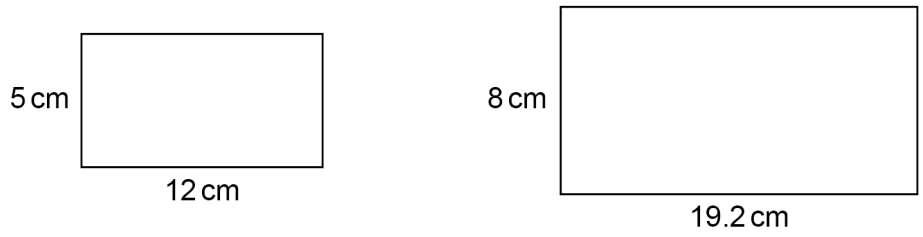
[4 marks]

Do not write outside the box

12 Show that these two rectangles are similar.

[2 marks]

Not drawn accurately



13 A factory packs x boxes of teabags per hour.

Each box contains 80 teabags.

Show that the factory packs $\frac{4x}{3}$ teabags per minute.

[2 marks]

Turn over for the next question

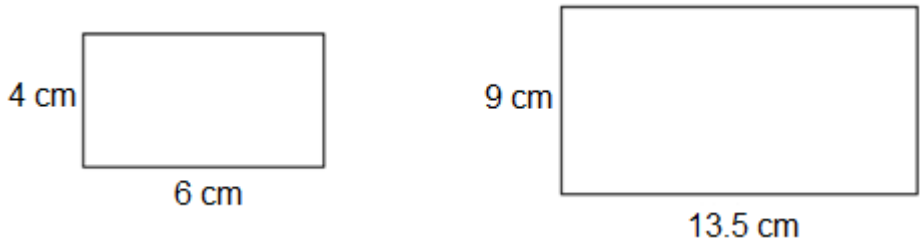
8

Do not write outside the box

12 Show that these two rectangles are similar.

[2 marks]

Not drawn accurately



13 A factory packs x boxes of plasters per hour.

Each box contains 100 plasters.

Show that the factory packs $\frac{5x}{3}$ plasters per minute.

[2 marks]

Turn over for the next question

8

Do not write outside the box

14 A company has 123 employees.

Information about their hourly rates of pay is shown in the table.

Hourly rate, £p	**Number of employees**
$10 \leqslant p < 14$	66
$14 \leqslant p < 20$	32
$20 \leqslant p < 40$	15
$40 \leqslant p < 100$	10
	Total = 123

The owner of the company uses the data to make two statements.

Statement A

"Over 30% of employees have an hourly rate that is more than £17"

Statement B

"The average hourly rate of pay is more than £20"

14 (a) Show working that supports **Statement A**.

[3 marks]

Do not write outside the box

14 A company has 113 employees.

Information about their hourly rates of pay is shown in the table.

Hourly rate, £p	**Number of employees**
$8 \leqslant p < 12$	56
$12 \leqslant p < 20$	28
$20 \leqslant p < 40$	17
$40 \leqslant p < 60$	12
	Total = 113

The owner of the company uses the data to make two statements.

Statement A

"Over 35% of employees have an hourly rate that is more than £16"

Statement B

"The average hourly rate of pay is more than £18"

14 (a) Show working that supports **Statement A**.

[3 marks]

Do not write outside the box

14 (b) Why might **Statement A not** be true?

[1 mark]

14 (c) Work out an estimate of the mean to support **Statement B**.

[3 marks]

14 (d) Why is the mean **not** the best average to represent the data?

[1 mark]

8

Do not write outside the box

14 (b) Why might **Statement A not** be true?

[1 mark]

14 (c) Work out an estimate of the mean to support **Statement B**.

[3 marks]

14 (d) Why is the mean **not** the best average to represent the data?

[1 mark]

Turn over for the next question

8

Do not write outside the box

15 Expand $(x^2 - 9xy)(2x + 5y)$

[2 marks]

Answer _____

16 Line A

has equation $y = ax - 1$

passes through the point (7, 13)

Line B has equation $5y - 3x = 4$

Show that line A has a greater gradient than line B.

[3 marks]

Do not write outside the box

15 Expand $(a^2 - 7ab)(3a + 2b)$

[2 marks]

Answer _____

16 Line A

has equation $y = ax - 5$

passes through the point (9, 22)

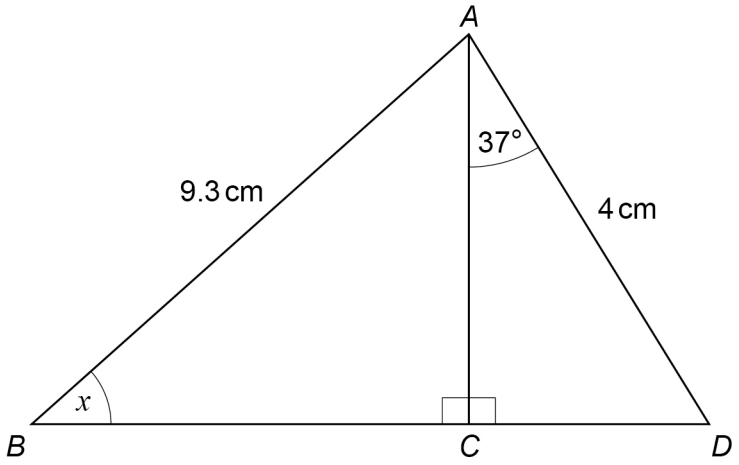
Line B has equation $2y - 5x = 7$

Show that line A has a greater gradient than line B.

[3 marks]

Do not write outside the box

17



Not drawn accurately

Work out the size of angle x.

[4 marks]

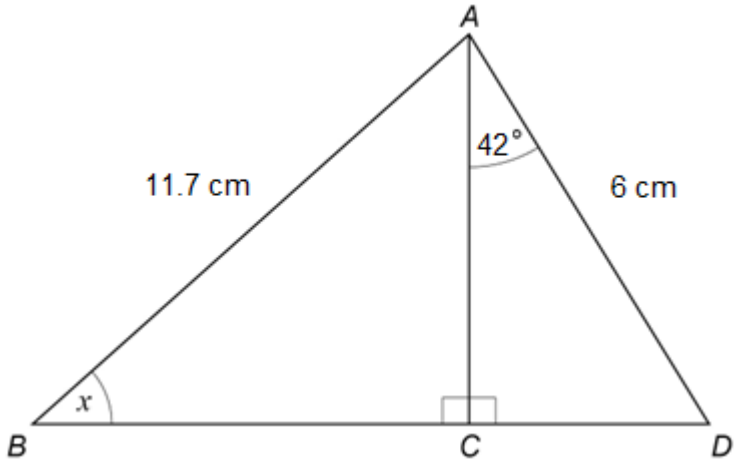
$x =$ _____ °

9

Turn over ►

Do not write outside the box

17



Not drawn accurately

Work out the size of angle x.

[4 marks]

$x =$ _____ °

9

Turn over ►

Do not write outside the box

18 Rearrange $y = \frac{x+8}{x}$ to make x the subject.

[3 marks]

Answer _____

Do not write outside the box

18 Rearrange $z = \frac{xy + 4}{x}$ to make x the subject.

[3 marks]

Answer _____

Do not write outside the box

19 Here are the first four terms of a quadratic sequence.

3 20 47 84

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

[4 marks]

Answer _____

7

Do not write outside the box

19 Here are the first four terms of a quadratic sequence.

6 24 52 90

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

[4 marks]

Answer _____

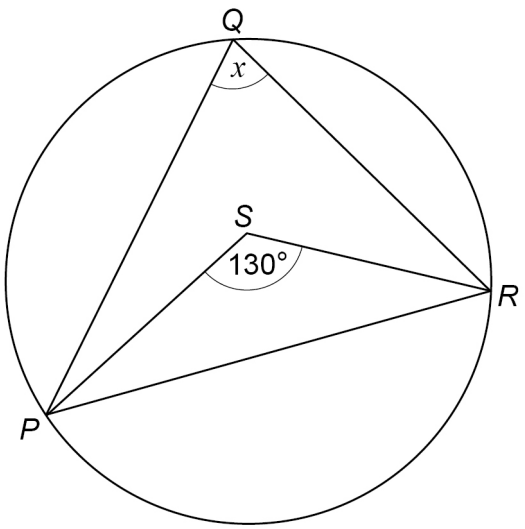
7

Do not write outside the box

20 (a) *P*, *Q* and *R* are points on a circle.

S is a point inside triangle *PQR*.

Not drawn accurately



Assume that *S* is the centre of the circle.

Work out the size of angle x.

[1 mark]

$x =$ _____ °

20 (b) In fact, the centre of the circle is on *PS* but **not** at *S*.

What does this mean about the size of angle x ?

Tick **one** box.

[1 mark]

☐ It is the same as the answer to part (a)

☐ It is greater than the answer to part (a)

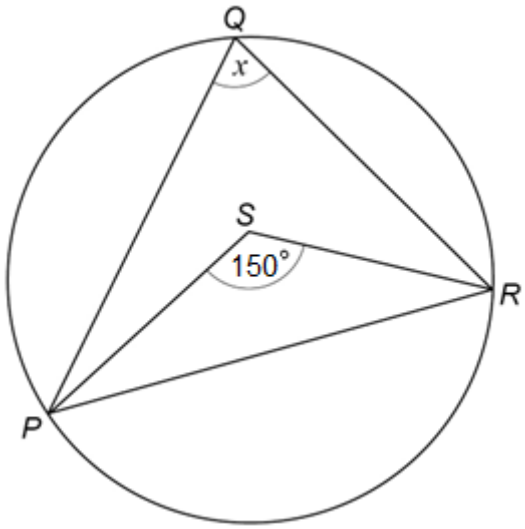
☐ It is smaller than the answer to part (a)

☐ It is impossible to tell

Do not write outside the box

20 (a) *P*, *Q* and *R* are points on a circle.

S is a point inside triangle *PQR*.



Not drawn accurately

Assume that *S* is the centre of the circle.

Work out the size of angle x.

[1 mark]

$x =$ _____ °

20 (b) In fact, *S* is not the centre of the circle.

What does this mean about the size of angle x ?

Tick **one** box.

[1 mark]

☐ It is the same as the answer to part (a)

☐ It is greater than the answer to part (a)

☐ It is smaller than the answer to part (a)

☐ It could be bigger or smaller than the answer to part (a)

Do not write outside the box

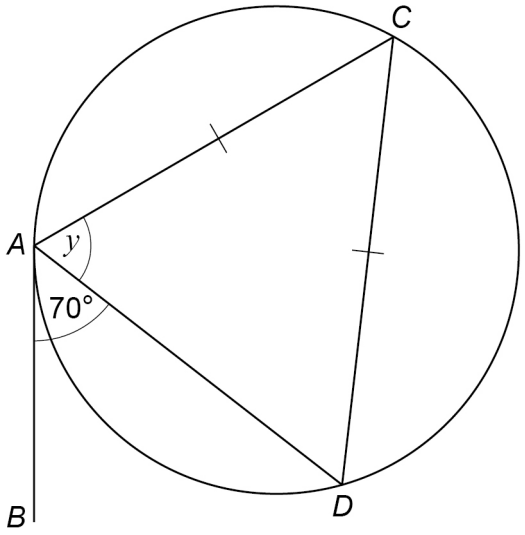
20 (c) For a different circle,

AB is a tangent at *A*

C and *D* are on the circumference of the circle

$AC = CD$

Not drawn accurately



Here is Simon's method to work out the size of angle y.

Angle $ADC = 70°$ (alternate segment theorem)
Therefore $y = 70°$ (angles in an isosceles triangle)

Is he correct?

Give a reason for your answer.

[1 mark]

3

Do not write outside the box

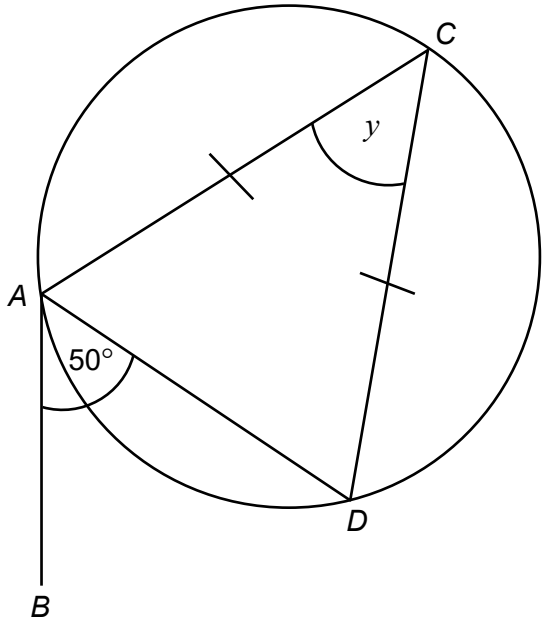
20 (c) For a different circle,

AB is a tangent at *A*

C and *D* are on the circumference of the circle

$AC = CD$

Not drawn accurately



Here is Ollie's method to work out the size of angle y.

Angle $ADC = 50°$ (alternate angles are equal)

Angle $CAD = 50°$ (angles in an isosceles triangle)

Therefore $y = 80°$ (angles in a triangle)

Is he correct?

Give a reason for your answer.

[1 mark]

3

Turn over ►

Do not write outside the box

21 Magana decides to put £500 into an account that pays compound interest.

She wants to have **at least** £560 in the account after 3 years.

Work out to 1 decimal place the **minimum** annual interest rate she needs.

[3 marks]

Answer _____ %

Do not write outside the box

21 Asmae decides to put £2500 into an account that pays compound interest.

She wants to have **at least** £3200 in the account after 5 years.

Work out to 1 decimal place the **minimum** annual interest rate she needs.

[3 marks]

Answer _____ %

Do not write outside the box

22 An approximate value of a root of an equation, x, can be found using the iterative formula

$$x_{n+1} = \sqrt[3]{5(x_n)^2 - 2x_n - 3}$$

The starting value is $x_1 = 4$

22 (a) Work out the values of x_2 and x_3

[2 marks]

$x_2 =$ _____

$x_3 =$ _____

22 (b) By continuing the iteration, show that the value of x is more than 4.25

[1 mark]

6

Do not write outside the box

22 An approximate value of a root of an equation, x, can be found using the iterative formula

$$x_{n+1} = \sqrt[3]{7(x_n)^2 - 4x_n - 5}$$

The starting value is $x_1 = 5$

22 (a) Work out the values of x_2 and x_3

[2 marks]

$x_2 =$ _____

$x_3 =$ _____

22 (b) By continuing the iteration, show that the value of x is more than 5.85

[1 mark]

Turn over for the next question

6

Do not write outside the box

23 Here are three sets of cards.

Set A	1	1	3	5	5	5	6	8
Set B	1	2	4	6	8	8	9	
Set C	3	4	5	6				

In a game, a player has two options.

Option 1
Pick two cards from Set A

Option 2
Pick one card from Set B
and
pick one card from Set C

The cards are picked at random.

The player wins if the total of their two cards is exactly 10

Do not write outside the box

Which option gives a better chance of winning?

Option 1 ☐ Option 2 ☐

Show working to support your answer.

[4 marks]

Turn over for the next question

4

Do not write outside the box

23 Here are three sets of cards.

Set A	1	2	3	3	6	6	6	8	8	8
Set B	1	1	2	4	7	7	8	8	10	10
Set C	3	3	3	6	6	7	8	8	9	

In a game, a player has two options.

Option 1
Pick two cards from Set A

Option 2
Pick one card from Set B
and
pick one card from Set C

The cards are picked at random.

The player wins if the total of their two cards is exactly 12

Which option gives a better chance of winning?

Option 1 ☐ Option 2 ☐

Show working to support your answer.

[4 marks]

Do not write outside the box

24 $a = 65$ to the nearest integer

$b = 30$ to 1 significant figure

Work out the **upper bound** for $2a^2 - b^2$

You **must** show your working.

[3 marks]

Answer _____

Do not write outside the box

24 $a = 45$ to the nearest integer

$b = 70$ to 1 significant figure

Work out the **upper bound** for $6a^2 - b^2$

You **must** show your working.

[3 marks]

Answer _____

Turn over for the next question

4

Do not write outside the box

25 Show that $\frac{x-5}{x-2} + \frac{x+5}{x+2}$

simplifies to $\frac{ax^2-b}{x^2-4}$ where a and b are integers.

[3 marks]

Turn over for the next question

6

Do not write outside the box

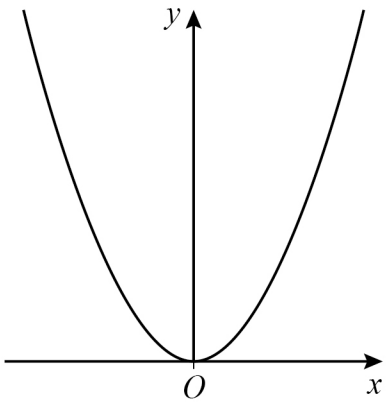
25 Show that $\frac{x-7}{x-4} + \frac{x+7}{x+4}$

simplifies to $\frac{ax^2-b}{x^2-16}$ where a and b are integers.

[3 marks]

Do not write outside the box

26 Here is a sketch of $y = x^2$



26 (a) The minimum point of $y = x^2$ is at (0, 0)

Write down the coordinates of the minimum point of $y = x^2 + 2$

[1 mark]

Answer (_____ , _____)

26 (b) The graph $y = x^2$ is reflected in the x axis.

Write down the equation of the graph after this transformation.

[1 mark]

Answer _____

26 (c) $y = x^2$ is now transformed to give $y = (x + 3)^2$

Describe fully this single transformation.

[2 marks]

_____

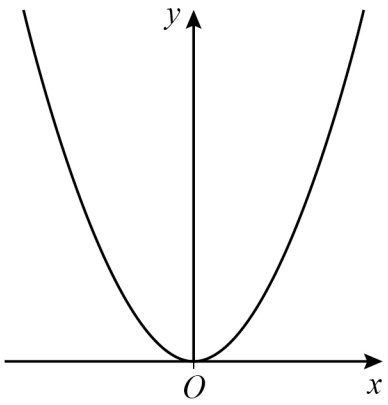
_____

END OF QUESTIONS

4

Do not write outside the box

26 Here is a sketch of $y = x^2$



26 (a) The minimum point of $y = x^2$ is at (0, 0)

Write down the coordinates of the minimum point of $y = x^2 - 3$

[1 mark]

Answer (_____ , _____)

26 (b) The graph $y = x^2$ is reflected in the line $y = 1$

Write down the equation of the graph after this transformation.

[1 mark]

Answer _____

26 (c) $y = x^2$ is now transformed to give $y = (x - 2)^2$

Describe fully this single transformation.

[2 marks]

_____

_____

END OF QUESTIONS

6