

Please write clearly in block capitals.

Centre number

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Candidate number

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I declare this is my own work.

# GCSE MATHEMATICS

# H

Higher Tier Paper 2 Calculator

Wednesday 7 June 2023

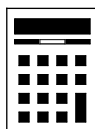
Morning

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.

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	
<b>TOTAL</b>	

## Advice

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



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

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

Do not write  
outside the  
box

**1** Write  $30 : 12$  in the form  $n : 1$

**[1 mark]**

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Answer \_\_\_\_\_ : 1

**2** Four consecutive triangular numbers are 6 10 15 21

Write down the next triangular number.

**[1 mark]**

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Answer \_\_\_\_\_



- 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]

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Answer £ \_\_\_\_\_

Turn over for the next question



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]

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Answer \_\_\_\_\_ : \_\_\_\_\_



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]

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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)

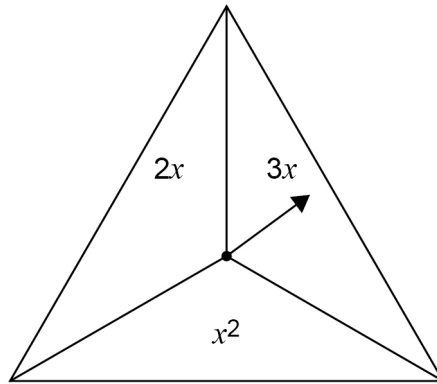
It could be any of the above



7

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	

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- 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]

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Answer \_\_\_\_\_

- 7 (c) The game is played 711 times.

Estimate the number of games that are won.

[2 marks]

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Answer \_\_\_\_\_

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

Work out the values of  $a$  and  $b$ .

[2 marks]

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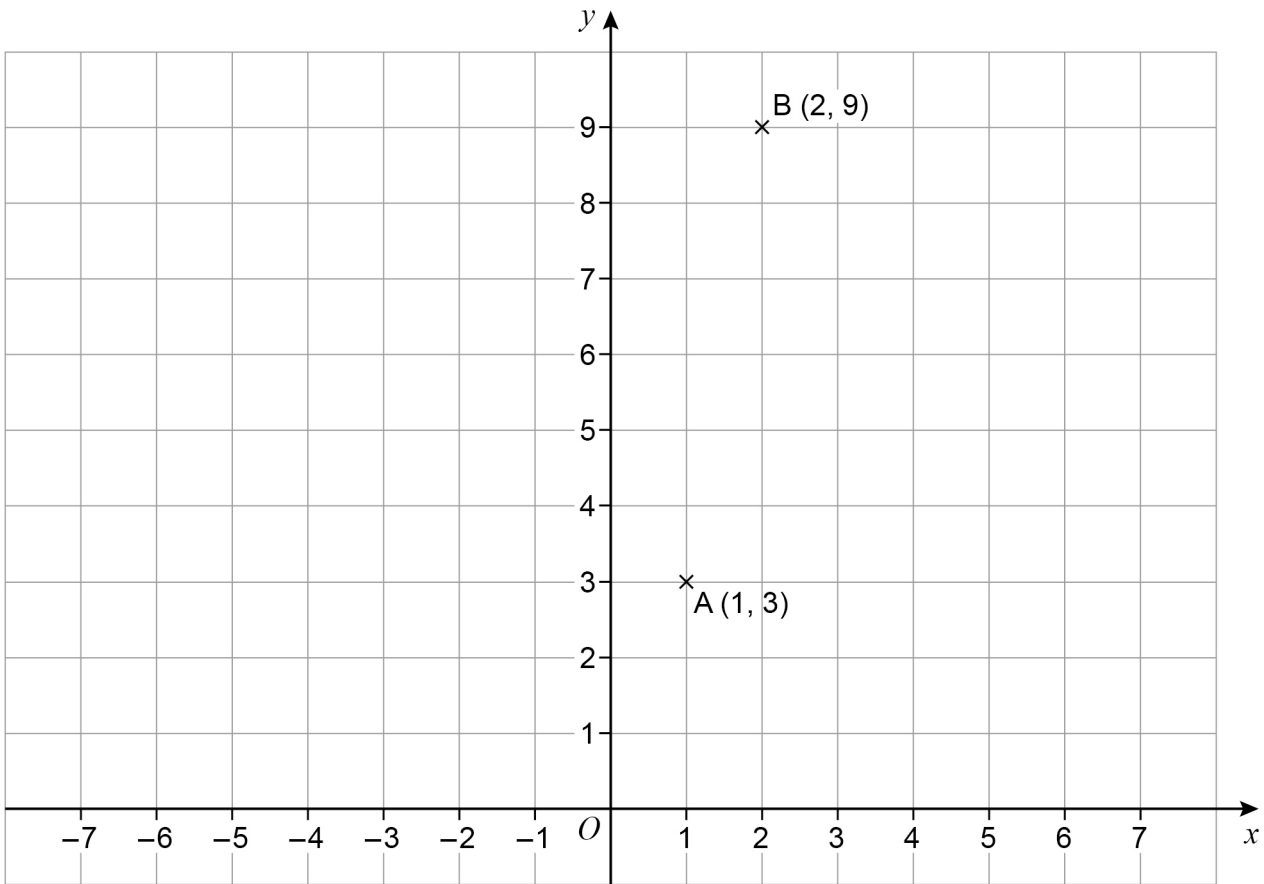
$a =$  \_\_\_\_\_  $b =$  \_\_\_\_\_

7

Turn over ►



- 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]**

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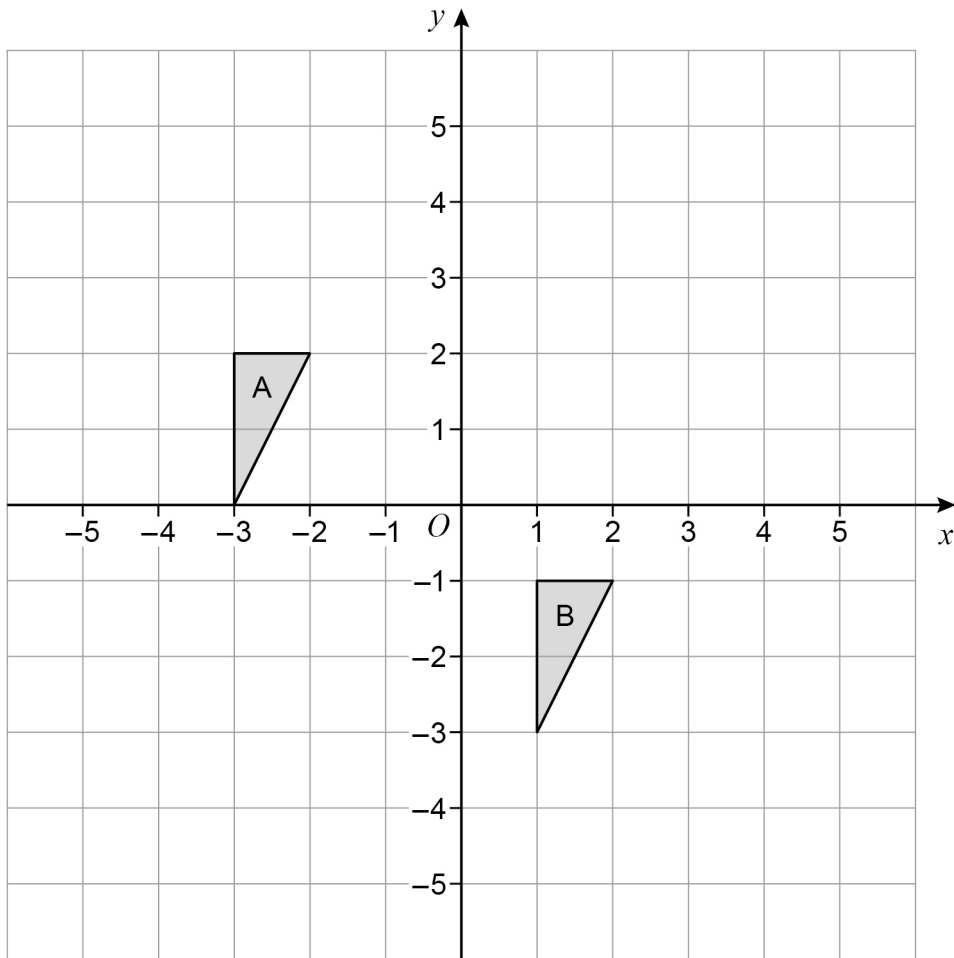
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Answer ( \_\_\_\_\_ , \_\_\_\_\_ ) and ( \_\_\_\_\_ , \_\_\_\_\_ )





10 Write down the translation vector that maps shape A onto shape B. [2 marks]



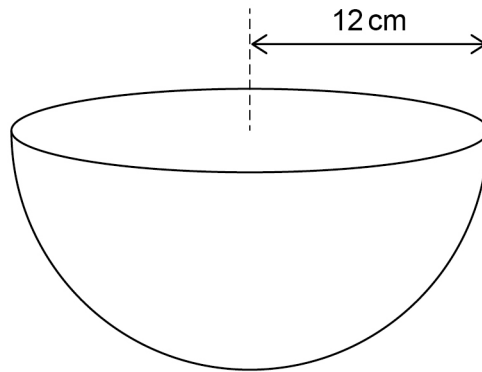
Answer \_\_\_\_\_



11

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

A bowl is a hemisphere with radius 12 cm



Water is poured into the bowl  
at a rate of  $325 \text{ cm}^3$  per second  
for 8 seconds.

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

You **must** show your working.

[4 marks]

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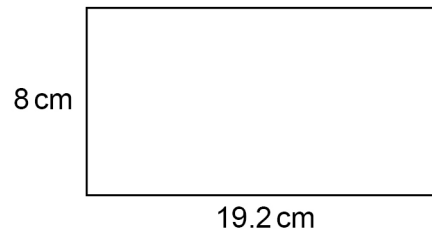
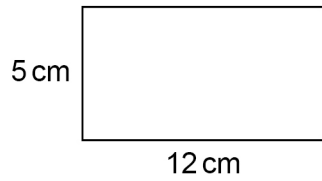
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- 12** Show that these two rectangles are similar.

**[2 marks]**

Not drawn  
accurately




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- 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]**

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**Turn over for the next question**

**Turn over ►**



- 14** A company has 123 employees.  
Information about their hourly rates of pay is shown in the table.

Hourly rate, $\text{£}p$	Number of employees
$10 \leq p < 14$	66
$14 \leq p < 20$	32
$20 \leq p < 40$	15
$40 \leq p < 100$	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  $\text{£}17$ ”

**Statement B**

“The average hourly rate of pay is more than  $\text{£}20$ ”

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

**[3 marks]**

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

[1 mark]

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

[3 marks]

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

[1 mark]

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

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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]

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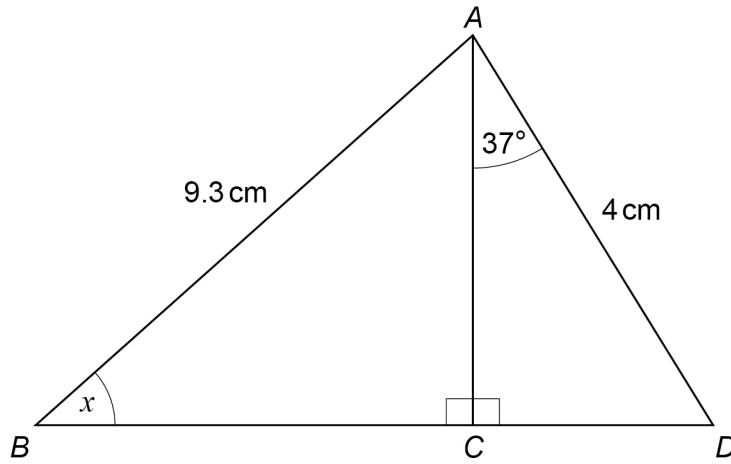
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17

Not drawn  
accuratelyWork out the size of angle  $x$ .**[4 marks]**


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 $x =$  \_\_\_\_\_  $^{\circ}$ 

9
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Turn over ►



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

[3 marks]

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Answer \_\_\_\_\_





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

3      20      47      84

Work out an expression for the  $n$ th term of the sequence.

**[4 marks]**

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Answer \_\_\_\_\_

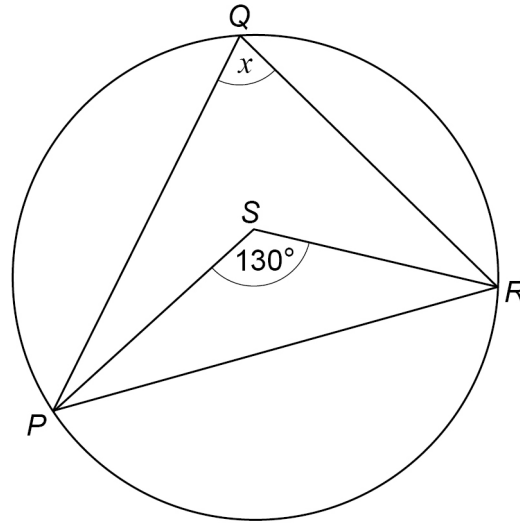
7

**Turn over ►**



- 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]

$x =$  \_\_\_\_\_  $^{\circ}$

- 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



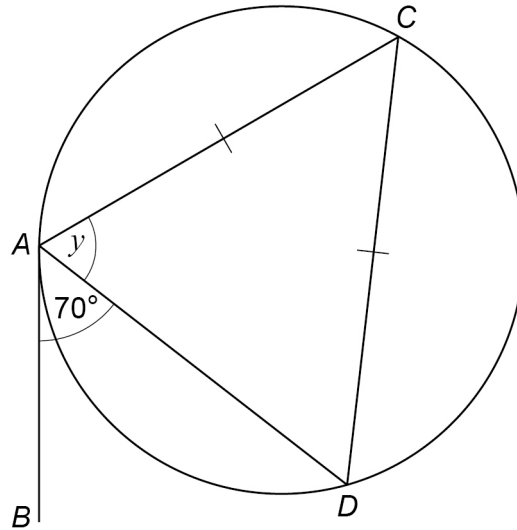
20 (c) For a different circle,

$AB$  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  $ADC = 70^\circ$  (alternate segment theorem)  
Therefore  $y = 70^\circ$  (angles in an isosceles triangle)

Is he correct?

Give a reason for your answer.

[1 mark]

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**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]**

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Answer \_\_\_\_\_ %



**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]**

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$$x_2 = \underline{\hspace{10em}}$$

$$x_3 = \underline{\hspace{10em}}$$

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

**[1 mark]**

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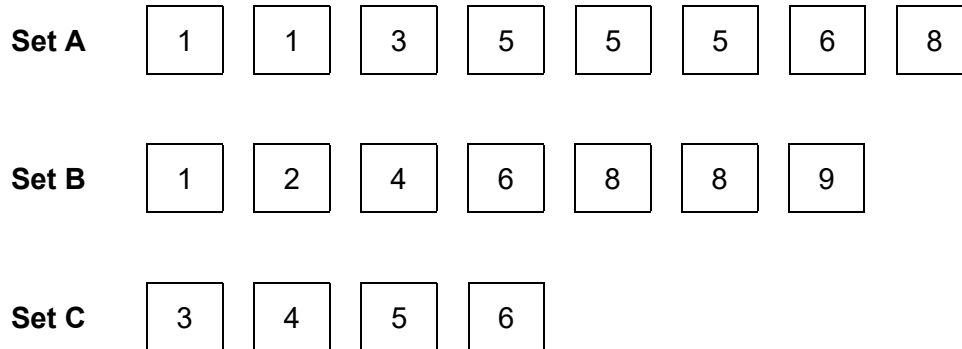


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23

Here are three sets of cards.



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



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Which option gives a better chance of winning?

Option 1

Option 2

Show working to support your answer.

**[4 marks]**

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**Turn over for the next question**

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**Turn over ►**



24

 $a = 65$  to the nearest integer $b = 30$  to 1 significant figureWork out the **upper bound** for  $2a^2 - b^2$ You **must** show your working.**[3 marks]**

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Answer \_\_\_\_\_





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]

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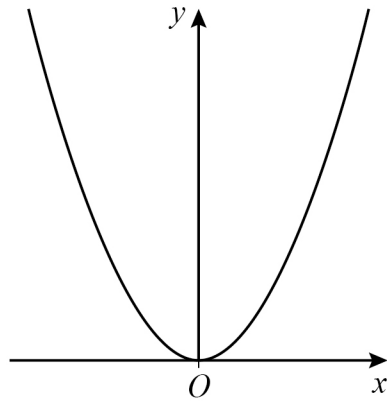
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Turn over for the next question

Turn over ►



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]

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END OF QUESTIONS



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Question number	<b>Additional page, if required.</b> <b>Write the question numbers in the left-hand margin.</b>









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3 2



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