



- 1 The curve **C** has equation $y = (x - 3)^2 + 5$

Write down the coordinates of the turning point of **C**.

(1 mark)

A squared real number cannot be negative. $(x - 3)^2$ is smallest when $x - 3 = 0$, so $x = 3$

At $x = 3$, $y = 0 + 5 = 5$. The curve therefore has its minimum (turning point) at $(3, 5)$

$(3, 5)$

- 2 The curve $y = x^2 - 6x + 8$ crosses the x -axis at $x = 2$ and at $x = 4$.

a. Write down the solutions of $x^2 - 6x + 8 = 0$

b. Write down the x -coordinate of the turning point of the curve.



(2 marks)

a) The solutions of $x^2 - 6x + 8 = 0$ are the x -values where the curve crosses the x -axis: $x = 2$ and $x = 4$

b) By symmetry, the turning point is halfway between the roots: $x = \frac{2 + 4}{2} = 3$

3

A quadratic graph has the equation $y = (x - 2)(x - 6)$.

- Write down the coordinates of the points where the graph crosses the x -axis.
- Work out the coordinates of the point where the graph crosses the y -axis.
- Sketch the graph, showing these points.

(4 marks)

a) $y = 0$

$$(x - 2)(x - 6) = 0$$

$$(2, 0) \text{ and } (6, 0)$$

b) $x = 0$

$$y = (-2)(-6) = 12$$

$$(0, 12)$$

c) U-shaped (positive x^2)

through $(2, 0)$, $(6, 0)$ and $(0, 12)$

4

A quadratic graph has equation $y = (x + 3)(x - 7)$.

- Write down the roots of the equation.
- Write down the equation of the line of symmetry of the graph.
- Work out the coordinates of the turning point.

(3 marks)

a)

$$x = -3, x = 7$$

b) Halfway between the roots

$$\frac{-3 + 7}{2} = 2$$

$$x = 2$$

c) Put $x = 2$ into the equation

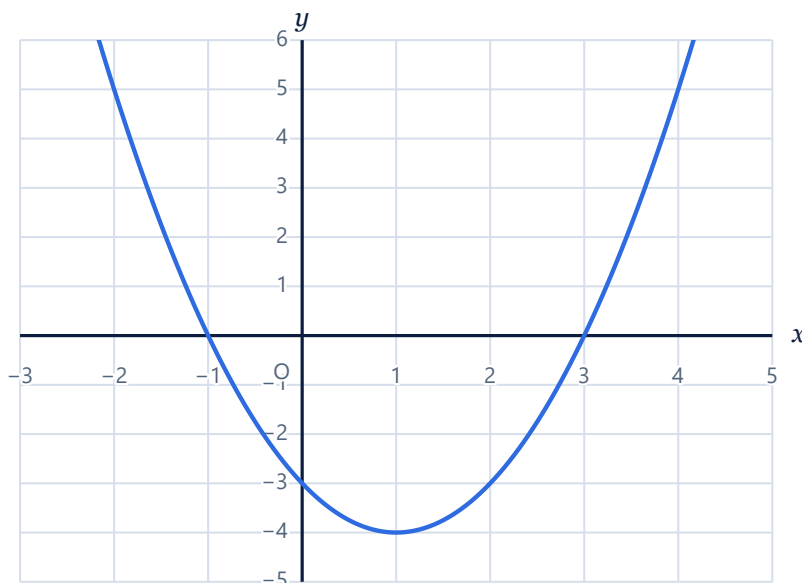
$$y = (2 + 3)(2 - 7) = 5 \times (-5)$$

$$(2, -25)$$

5

The diagram shows the graph of $y = x^2 - 2x - 3$

- Write down the coordinates of the point where the graph crosses the y -axis.
- Write down the solutions of $x^2 - 2x - 3 = 0$
- Write down the coordinates of the turning point of the graph.



(3 marks)

- The graph crosses the y -axis where $x = 0$: $y = -3$, so $(0, -3)$
- The graph crosses the x -axis at $x = -1$ and $x = 3$
- The lowest point of the curve is at $(1, -4)$

6

The graph of $y = x^2$ is translated 3 units to the right and 2 units down to give a new graph.

- Write down the equation of the new graph in the form $y = (x - a)^2 + b$.
- Write down the coordinates of the turning point of the new graph.
- Work out where the new graph crosses the y -axis.

(3 marks)

a) Right 3: x becomes $(x - 3)$. Down 2: subtract 2

$$y = (x - 3)^2 - 2$$

b) $(0, 0)$ moves right 3, down 2

$$(3, -2)$$

c) $x = 0$

$$y = (0 - 3)^2 - 2 = 9 - 2$$

$$(0, 7)$$

7

$$y = x^2 - 8x + 7$$

- Write $x^2 - 8x + 7$ in the form $(x + a)^2 + b$.
- Write down the coordinates of the turning point and the equation of the line of symmetry of the graph.
- Work out the coordinates of the points where the graph crosses the x-axis.

(4 marks)

a) Half of -8 is -4

$$x^2 - 8x + 7 = (x - 4)^2 - 16 + 7$$

$$(x - 4)^2 - 9$$

b) Minimum when $(x - 4)^2 = 0$

$$(4, -9), \text{ line of symmetry } x = 4$$

c) $y = 0$

$$(x - 1)(x - 7) = 0$$

$$(1, 0) \text{ and } (7, 0)$$

8

By completing the square, find the coordinates of the minimum point of the curve

$$y = x^2 + 10x - 2$$

(3 marks)

Complete the square

$$x^2 + 10x - 2 = (x + 5)^2 - 25 - 2 = (x + 5)^2 - 27$$

Check by expanding

$$x^2 + 10x + 25 - 27 = x^2 + 10x - 2$$

The minimum is when $x = -5$, so the minimum point is $(-5, -27)$

$$(-5, -27)$$

9

$$y = -x^2 + 6x - 5$$

- Write y in the form $y = -(x - p)^2 + q$.
- Write down the coordinates of the turning point and say whether it is a maximum or a minimum.
- Sketch the graph, showing where it crosses the axes.

(4 marks)

a) Take out -1 first

$$\begin{aligned} y &= -(x^2 - 6x + 5) \\ &= -((x - 3)^2 - 9 + 5) \end{aligned}$$

$$y = -(x - 3)^2 + 4$$

b) x^2 term is negative, so n-shaped

maximum at (3, 4)

c) Roots 1 and 5, y-intercept -5

n-shaped curve through (1, 0), (5, 0), (0, -5)

10

- Complete the table of values for $y = 6 - x^2$

x	-3	-2	-1	0	1	2	3
y	-3		5		5		-3

- Write down the coordinates of the maximum point of the graph of $y = 6 - x^2$
- Use the table to write down the two consecutive whole numbers that the positive solution of $6 - x^2 = 0$ lies between.

(4 marks)

a) When $x = -2$: $y = 6 - 4 = 2$; when $x = 0$: $y = 6$; when $x = 2$: $y = 6 - 4 = 2$

b) The largest value of y is 6, at $x = 0$, so the maximum point is (0, 6)

c) Between $x = 2$ and $x = 3$ the y -values change from 2 to -3, so $y = 0$ somewhere between them

11 The graph of $y = x^2 + bx + c$ passes through the points (0, 8) and (6, 8).

- Write down the equation of the line of symmetry of the graph.
- Find the values of b and c .
- Work out the coordinates of the turning point.

(5 marks)

a) Same height, so halfway between

$$\frac{0 + 6}{2} = 3$$

$$x = 3$$

b) Use (0, 8)

$$c = 8$$

Use (6, 8)

$$\begin{array}{rcl} 36 + 6b + 8 & = & 8 \\ 6b + 44 & = & 8 \\ -44 & & \\ \div 6 & & \end{array} \quad \begin{array}{rcl} 6b & = & -36 \\ b & = & -6 \end{array} \quad \begin{array}{l} -44 \\ \div 6 \end{array}$$

c) $x = 3$

$$y = 9 - 18 + 8 = -1$$

$$(3, -1)$$

12 a. Complete the table of values for $y = x^2 + 2x - 8$

x	-4	-3	-2	-1	0	1	2
y	0	-5		-9		-5	

b. Use the table to write down the solutions of $x^2 + 2x - 8 = 0$

c. Write down the equation of the line of symmetry of the graph of $y = x^2 + 2x - 8$

(4 marks)

a) When $x = -2$: $y = 4 - 4 - 8 = -8$; when $x = 0$: $y = -8$; when $x = 2$: $y = 4 + 4 - 8 = 0$

b) $y = 0$ in the table at $x = -4$ and $x = 2$, so these are the solutions

c) The line of symmetry is halfway between the roots

$$x = \frac{-4 + 2}{2} = -1$$

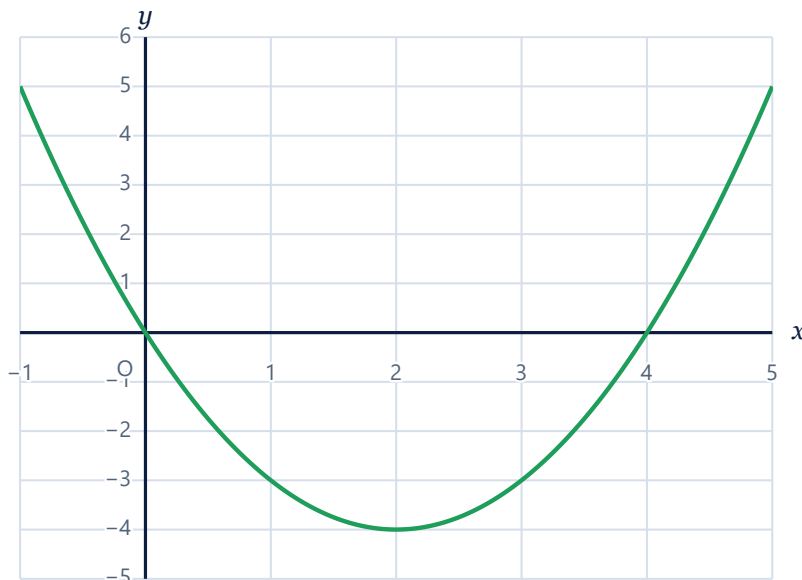
13

a. Complete the table of values for $y = x^2 - 4x$

x	-1	0	1	2	3	4	5
y	5	0			-3		5

b. On the grid, draw the graph of $y = x^2 - 4x$ for values of x from -1 to 5

c. Write down the coordinates of the turning point of the graph.



(5 marks)

a) When $x = 1$: $y = 1 - 4 = -3$; when $x = 2$: $y = 4 - 8 = -4$; when $x = 4$: $y = 16 - 16 = 0$

b) Plot the seven points and join with a smooth curve

c) The minimum point of the curve is (2, -4)

14

a. Complete the table of values for $y = x^2 - 8x + 11$

x	0	1	2	3	4	5	6	7	8
y	11	4		-4		-4		4	11

b. Write down the coordinates of the turning point of the graph of $y = x^2 - 8x + 11$

c. Write down the equation of the line of symmetry of the graph.

(5 marks)

a) When $x = 2$: $y = 4 - 16 + 11 = -1$; when $x = 4$: $y = 16 - 32 + 11 = -5$; when $x = 6$: $y = 36 - 48 + 11 = -1$

b) The smallest y -value is -5, at $x = 4$, so the turning point is (4, -5)

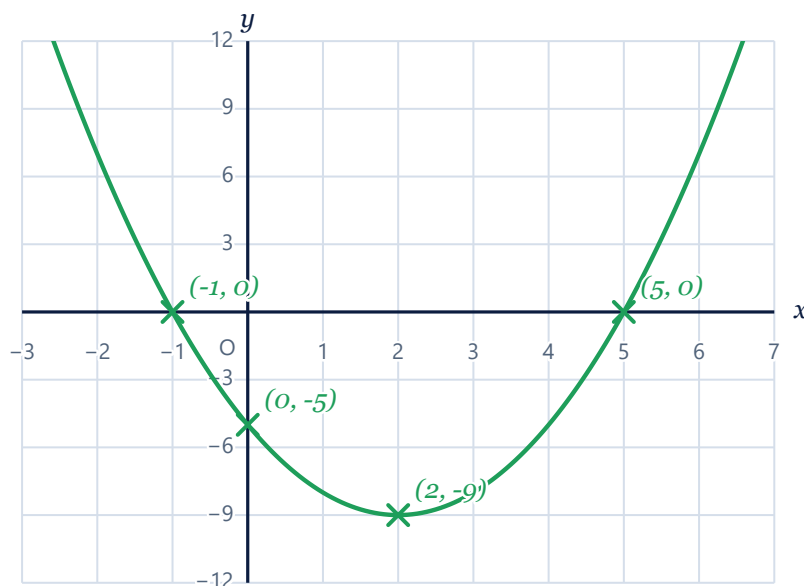
c) The line of symmetry passes through the turning point
 $x = 4$

15

The curve **C** has equation $y = x^2 - 4x - 5$

a. Write $x^2 - 4x - 5$ in the form $(x - a)^2 + b$

b. Sketch **C**, showing clearly the coordinates of the turning point and the coordinates of the points where **C** crosses the axes.



(5 marks)

$$a) x^2 - 4x - 5 = (x - 2)^2 - 4 - 5 = (x - 2)^2 - 9$$

a) Check by expanding

$$x^2 - 4x + 4 - 9 = x^2 - 4x - 5$$

b) The turning point is $(2, -9)$

b) For the x -intercepts, factorise

$$x^2 - 4x - 5 = (x - 5)(x + 1), \text{ so the curve crosses at } (5, 0) \text{ and } (-1, 0)$$

b) When $x = 0$, $y = -5$, so the y -intercept is $(0, -5)$

b) Draw a U-shaped parabola through these points with its minimum at $(2, -9)$

16

a. Complete the table of values for $y = 2x^2 - 3$

x	-2	-1	0	1	2
y	5			-1	

b. Write down the coordinates of the turning point of the graph of $y = 2x^2 - 3$ c. Use the table to write down the two consecutive whole numbers that the positive solution of $2x^2 - 3 = 0$ lies between.

(5 marks)

a) When $x = -1$: $y = 2 - 3 = -1$; when $x = 0$: $y = -3$; when $x = 2$: $y = 8 - 3 = 5$

b) The minimum value of y is -3 , at $x = 0$, so the turning point is $(0, -3)$

c) Between $x = 1$ and $x = 2$ the y -values change from -1 to 5 , so $y = 0$ somewhere between them

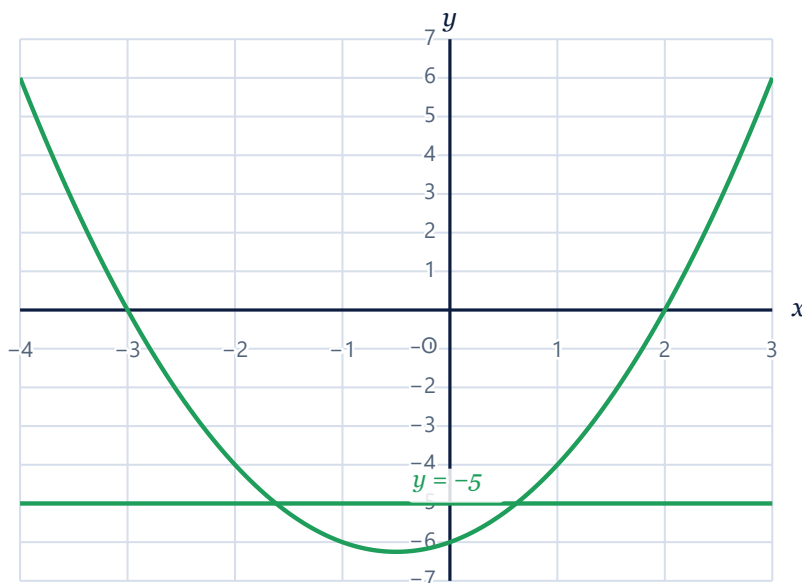
a. Complete the table of values for $y = x^2 + x - 6$

x	-4	-3	-2	-1	0	1	2	3
y	6	0		-6		-4		6

b. On the grid, draw the graph of $y = x^2 + x - 6$ for values of x from -4 to 3

c. Write down the solutions of $x^2 + x - 6 = 0$

d. Use your graph to estimate the solutions of $x^2 + x - 6 = -5$



(6 marks)

a) When $x = -2$: $y = 4 - 2 - 6 = -4$; when $x = 0$: $y = -6$; when $x = 2$: $y = 4 + 2 - 6 = 0$

b) Plot the eight points and join with a smooth curve

c) The curve crosses the x -axis at $x = -3$ and $x = 2$

d) Draw the line $y = -5$ and read where it meets the curve: approximately $x = -1.6$ and $x = 0.6$ (exact values are $\frac{-1 \pm \sqrt{5}}{2}$)

For the final equation, draw the horizontal line $y = -5$ and read the x -coordinates where it meets the curve. Keep the negative sign: the line is five units below the x -axis