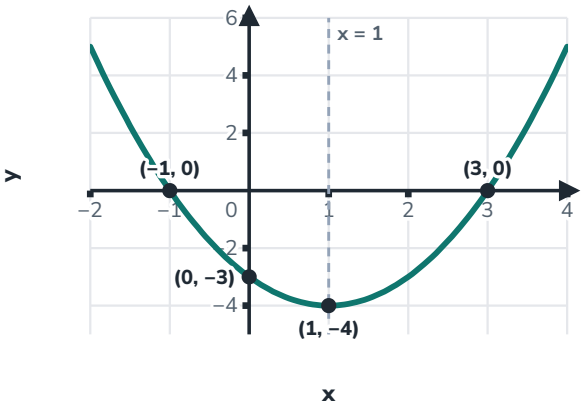
GCSE MATHS FOUNDATION & HIGHER (H = HIGHER ONLY)

Quadratic graphs

Learn with Fred
cheat sheet

The graph of $y = ax^2 + bx + c$ is a smooth, symmetrical curve called a **parabola**. Its **roots**, **y-intercept** and **turning point** tell you its story.

1 Key features of $y = x^2 - 2x - 3$



Feature	Here
roots (y = 0)	x = −1 and x = 3
y-intercept (x = 0)	(0, −3)
turning point	(1, −4), a minimum
line of symmetry	x = 1

The line of symmetry is **halfway between the roots**: (−1 + 3) ÷ 2 = 1.

2 Which way up?

a > 0: U shape opens upwards, turning point is a **minimum**

a < 0: ∩ shape opens downwards, turning point is a **maximum**

Number of roots: **two** (crosses the x-axis), **one** (just touches) or **none** (stays above or below).

3 Drawing it

1. Make a **table of values**.
2. Plot every point carefully.
3. Join with a **smooth curve**, never straight lines.

x	−2	−1	0	1	2	3	4
y	5	0	−3	−4	−3	0	5

4 Reading solutions

To solve $x^2 - 2x - 3 = 0$, read where the curve crosses the x-axis: $x = -1$ and $x = 3$.

To solve $x^2 - 2x - 3 = 2$, draw the line $y = 2$ and read the x-values where it meets the curve.

Check with algebra: $x^2 - 2x - 3 = (x + 1)(x - 3)$. This is 0 when $x = -1$ or $x = 3$. ✅

On the graph, the **y-intercept** is the constant term: $c = -3$.

5 Completing the square (Higher)

$$y = (x - p)^2 + q$$

Turning point: **(p, q)**.

Example

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

$= (x - 1)^2 - 4$ so the turning point is **(1, −4)**

Watch out

- ✕ Joining plotted points with **straight lines**. Draw a smooth curve, and round the bottom.
- ✕ Squaring a negative wrongly: $(-3)^2 = 9$, not −9.
- ✕ Mixing up **roots** (where y = 0) with the **y-intercept** (where x = 0).
- ✕ Giving a turning point as one number. It is a **coordinate pair**.

Exam tips

- Complete the **whole table** before you plot, then check the y-values are symmetrical.
- Give roots as **x = ...** values unless the question asks for coordinates.
- If a line like y = 2 is needed, **draw it** and show where you read the answers.

Try it: sketch $y = -x^2 + 4$. Which way up is it, and where does it cross the x-axis?

Check your answer with Fred: scan the code or go to **learnwithfred.co.uk/cs** to try Learn with Fred free.