Quadratic Functions

Introduction to Parabolas

Year 11 Mathematical Methods

🎯 Learning Intentions

By the end of today you will be able to:

1. **Identify** key features of a quadratic function
2. **Sketch** a parabola with all features labelled
3. **Explain** how changing a, b, and c affects the graph

🌉 Bridge — 10 minutes

> *“What do you already know about parabolas?*
> *Where have you seen them in real life?”*

✏️ **2 min**	🗣️ **2 min**	📢 **4 min**
Think	Pair	Share

Parabolas in Real Life

You see them everywhere:

- Throwing a ball
- Bridge arches
- Satellite dishes
- Water fountains
- Roller coasters

The mathematics:

All follow the shape of:

$$f(x) = ax^2 + bx + c$$

Today we learn to work with this.

🔍 Discover — Key Features

Feature	How to find it
y-intercept	Let $x = 0$, gives $y = c$
x-intercepts	Solve $ax^2 + bx + c = 0$
Axis of symmetry	$x = -\dfrac{b}{2a}$
Vertex	Substitute axis of symmetry into $f(x)$
Concavity	$a > 0$: opens up $\cup$ $a < 0$: opens down $\cap$

🔍 I Do — Example 1

Sketch $f(x) = x^2 - 4x + 3$

Step 1: y-intercept
$f(0) = 3 \rightarrow (0, 3)$

Step 2: x-intercepts
$(x - 1)(x - 3) = 0 \rightarrow x = 1$ or $x = 3$

Step 3: Axis of symmetry
$x = \dfrac{-(-4)}{2 \times 1} = 2$

draw on board

Step 4: Vertex

$f(2) = 4 - 8 + 3 = -1 \to (2, -1)$

Step 5: $a = 1 > 0 \longrightarrow$ concave up $\cup$

🔍 We Do — Example 2

$$f(x) = -x^2 + 2x + 8$$

Work through each step in your books alongside me:

1. What is the y-intercept?
2. Find the x-intercepts
3. Find the axis of symmetry
4. Find the vertex
5. Concave up or down — why?

✏️ **Achieve — Guided Practice**

Work with a partner on Questions 1–3 (10 minutes)

Watch out for:

- ⚠️ Sign errors in $x = -\dfrac{b}{2a}$ — don't forget the negative
- ⚠️ Check the sign of a for concavity **before** sketching
- ⚠️ Label **all** features on your sketch

✏️ Achieve — Independent Practice

> **Work individually on Questions 4–6** (15 minutes)

Finished early? Try Extension Questions 7–8

> **Useful check:** if $x = 1$ is an x-intercept, then $f(1)$ should equal 0

🪞 Reflect — Exit Ticket

Answer on your slip before you leave:

1. State the axis of symmetry of $f(x) = 2x^2 - 8x + 1$

$$x = -\frac{b}{2a} = \,?$$

2. One thing I understood well today was…

3. One thing I am still unsure about is…

Next Lesson

The Quadratic Formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

What happens when we can't factorise?