

Analyzing Quadratic Functions in Vertex Form

30 minutes, 3 stages

When you analyze a quadratic function, you move beyond plotting points to understanding its structure. The vertex form $y=a(x-h)^2+k$ reveals the key features of a parabola directly: where it turns, which way it opens, and how it stretches. You will identify these characteristics and use them to sketch accurate graphs ([Outcome](#)).

Stage 1: Extract features from vertex form (10 min)

For each function, write down the vertex, the direction of opening, and the axis of symmetry. Do not graph yet; just read the information from the equation.

1. $y=2(x-3)^2+5$

- Vertex:
- Opens: upward or downward?
- Axis of symmetry:

2. $y=-(x+1)^2-4$

- Vertex:
- Opens: upward or downward?
- Axis of symmetry:

3. $y=0.5(x-0)^2+2$

- Vertex:
- Opens: upward or downward?
- Axis of symmetry:

Stage 2: Find intercepts (12 min)

For the function $y=2(x-3)^2+5$ from Stage 1, find the y-intercept and the x-intercepts.

y-intercept: Substitute $x=0$ into the equation and solve for y.

$$y=2(0-3)^2+5$$

$$y=2(9)+5$$

$$y=23$$

The y-intercept is 23.

x-intercepts: Substitute $y=0$ and solve for x.

$$0=2(x-3)^2+5$$

$$-5=2(x-3)^2$$

$$-2.5=(x-3)^2$$

Since $(x-3)^2$ cannot equal a negative number, there are no x-intercepts.

Now do the same for $y=-(x+1)^2-4$.

- y-intercept: (Substitute $x=0$.)
- x-intercepts: (Substitute $y=0$. Solve for x.)

Stage 3: Sketch and verify (8 min)

For $y = (x+1)^2 - 4$, sketch the parabola on a coordinate grid.

Mark and label:

- The vertex
- The axis of symmetry (as a dashed line)
- The y-intercept
- The direction of opening

Use your answers from Stages 1 and 2 to guide your sketch.

Self-check

1. For the function $y = a(x - p)^2 + q$, what do the values p and q tell you about the location of the vertex?
2. How do you determine whether a parabola opens upward or downward by looking at the equation in vertex form?
3. If a parabola has its vertex above the x-axis and opens downward, can it have x-intercepts? Explain.