MATHEMATICS · GRADES 10-12

Finding the axis of symmetry

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is the line down the middle of a symmetric curve. The centre line of a bridge arch or a thrown ball's path splits the curve into two mirror halves, and the highest point sits right on that line. Finding the line tells you where the peak is before you work out its height. It is the shortcut to the most important point on any symmetric curve.



Rule

Axis of symmetry: for a parabola $y = ax^2 + bx + c$, the axis of symmetry is the vertical line $x = -\frac{b}{(2a)}$.

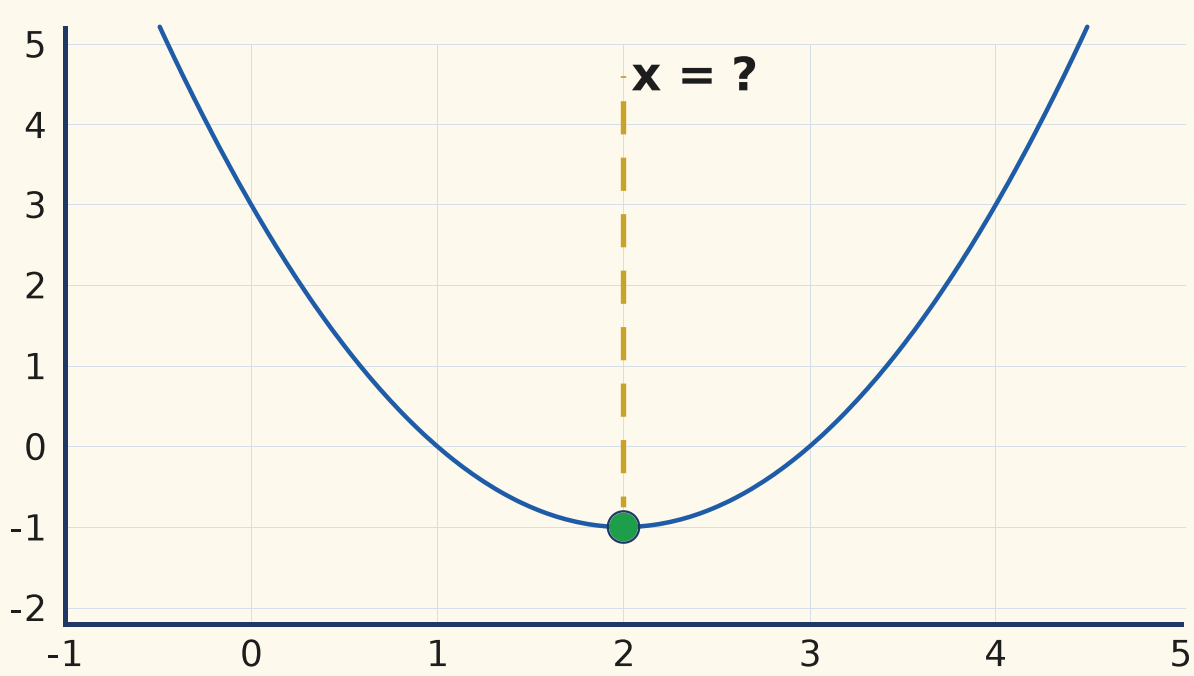
It runs through the vertex and splits the curve into two mirror halves.

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Worked examples

EXAMPLE 1

Q Find the axis of symmetry of $y = x^2 - 4x + 3$



SOLUTION

Use $x = -\frac{b}{(2a)}$

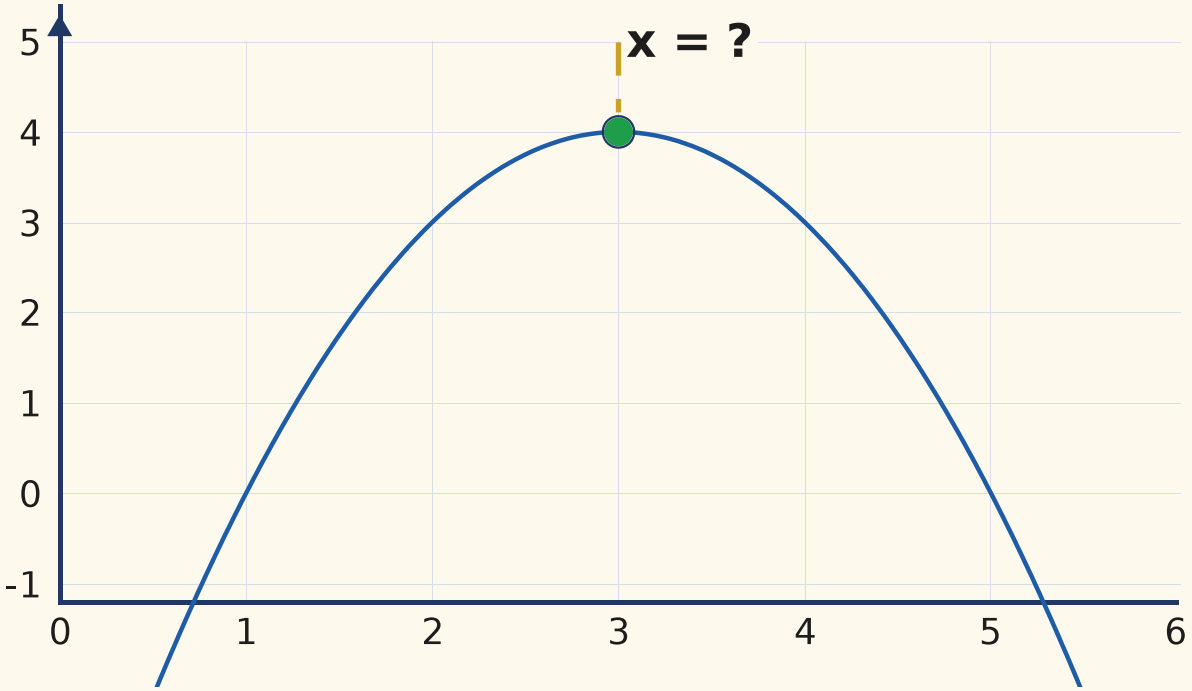
Substitute b = -4 and a = 1: $x = \frac{-(-4)}{2} = \frac{4}{2} = 2$

So the axis of symmetry is x = 2

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EXAMPLE 2

Q Find the axis of symmetry of $y = -x^2 + 6x - 5$



SOLUTION

Use $x = -\frac{b}{(2a)}$

Substitute $b = 6$ and $a = -1$: $x = \frac{-6}{-2} = 3$

So the axis of symmetry is $x = 3$

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Practice questions

1 What is the axis of symmetry of $y = x^2 + 2x - 3$?

- **A** x = -1
- **B** x = 1
- **C** x = 2
- **D** x = -2

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2 What is the axis of symmetry of $y = x^2 - 6x + 5$?

- **A** x = 6
- **B** x = -3
- **C** x = 3
- **D** x = 0

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3 What is the axis of symmetry of $y = -x^2 + 4x + 1$?

- **A** $x = -2$
- **B** $x = 2$
- **C** $x = 4$
- **D** $x = 0$

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4 What is the axis of symmetry of $y = x^2 + 8x + 12$?

- **A** $x = 4$
- **B** $x = 8$
- **C** $x = 0$
- **D** $x = -4$

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5 What is the axis of symmetry of $y = 2x^2 - 8x + 3$?

- **A** $x = 8$
- **B** $x = 2$
- **C** $x = -2$
- **D** $x = 4$

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6 A parabola's vertex sits at $x = 3$. What is its axis of symmetry?

- **A** $x = 3$
- **B** $x = -3$
- **C** $x = 1$
- **D** $x = 0$

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7 A parabola's axis of symmetry is $x = -2$. Its equation is $y = x^2 + bx + 1$. What is b?

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8 A parabola is $y = x^2 - 6x + 5$. Its axis of symmetry is $x = 3$. Why?

A. Because $x = -\frac{b}{(2a)} = \frac{-(-6)}{2} = 3$

B. Because $x = \frac{b}{(2a)} = \frac{-6}{2} = -3$

C. Because $x = -\frac{b}{a} = \frac{6}{1} = 6$

D. Because the constant term is 5, so the axis is $x = 5$

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9 A parabola passes through (1, 5) and (5, 5). What is its axis of symmetry?

- **A** $x = 1$
- **B** $x = 5$
- **C** $x = 3$
- **D** $x = 2$

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10 Three of these parabolas share an axis of symmetry and one does not. Which one does not share the axis of symmetry?

- **A** $y = x^2 + 2x$
- **B** $y = x^2 - 2x$
- **C** $y = -x^2 - 2x$
- **D** $y = x^2 + 2x + 5$

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ANSWER KEY

1. $x = -1$

2. $x = 3$

3. $x = 2$

4. $x = -4$

5. $x = 2$

6. $x = 3$

7. 4

8. Because $x = -\frac{b}{(2a)} = \frac{-(-6)}{2} = 3$

9. $x = 3$

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

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