MATHEMATICS · GRADES 10-12

Graphing parabolas

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you picture the path of a thrown ball or a fountain of water, so you can see its highest point (see Vertex form) and where it lands. A parabola is the curve of anything thrown or launched, rising, turning, and falling back down in a smooth arc. You use it to work out how far a ball will travel, how high a fountain will spray, or where a satellite dish must point to catch a signal.

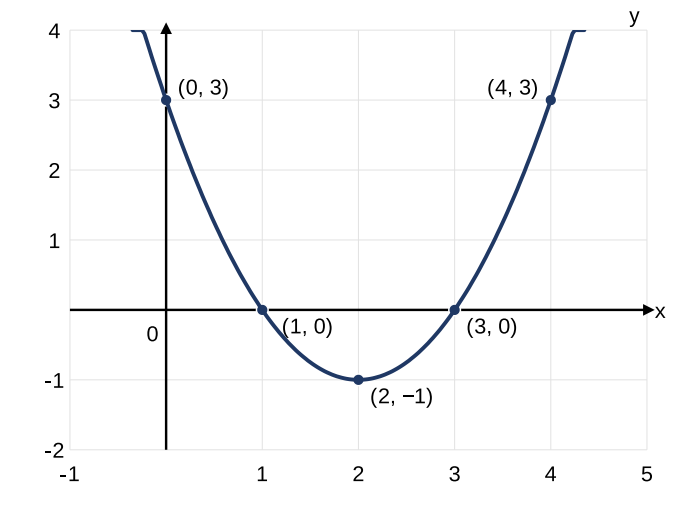


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Worked examples

EXAMPLE 1

Q Graph $y = x^2 - 4x + 3$



SOLUTION

Find the vertex: $x = -(-4) \div (2 \times 1) = 2$, $y = 2^2 - 4 \times 2 + 3 = -1$, so the vertex is $(2, -1)$.

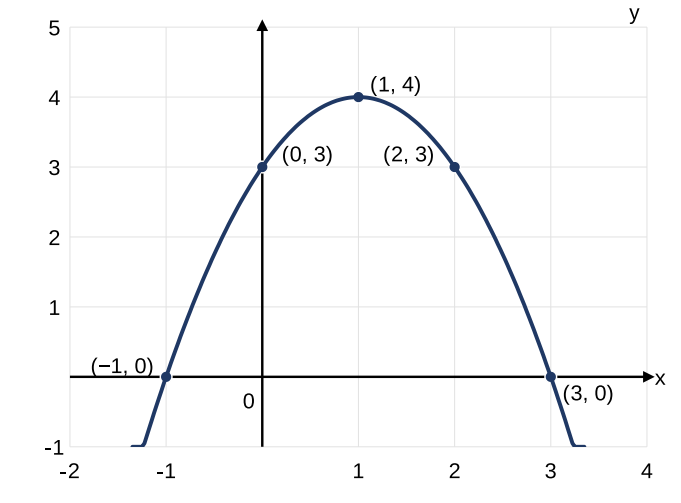
Find the intercepts: y-intercept $(0, 3)$; x-intercepts $(1, 0)$ and $(3, 0)$.

Plot the points $(0, 3)$, $(1, 0)$, $(2, -1)$, $(3, 0)$, $(4, 3)$ and join them with a smooth upward curve.

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EXAMPLE 2

Q Graph $y = -x^2 + 2x + 3$



SOLUTION

Find the vertex: $x = -2 \div (2 \times -1) = 1$, $y = -1^2 + 2 \times 1 + 3 = 4$, so the vertex is (1, 4).

Find the intercepts: y-intercept (0, 3); x-intercepts (3, 0) and (-1, 0).

Plot the points (-1, 0), (0, 3), (1, 4), (2, 3), (3, 0) and join them with a smooth downward curve.

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Practice questions

1 Graph $y = x^2$ and state the vertex.

- **A** (0, 0)
- **B** (0, 1)
- **C** (1, 0)
- **D** (0, -1)

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2 Graph $y = x^2 - 1$ and give the lowest point.

- **A** (0, 1)
- **B** (0, -1)
- **C** (-1, 0)
- **D** (1, 0)

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3 Graph $y = (x - 2)^2$ and state the vertex.

- **A** (0, 2)
- **B** (2, 0)
- **C** (-2, 0)
- **D** (0, 0)

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4 For $y = -x^2$, which way does the parabola open, and where is the vertex?

- **A** Opens downward, vertex (0, 0)
- **B** Opens upward, vertex (0, 0)
- **C** Opens downward, vertex (0, -1)
- **D** Opens upward, vertex (0, 1)

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5 What is the y-intercept of $y = x^2 + 3$?

A (0, 3)

B (3, 0)

C (0, 0)

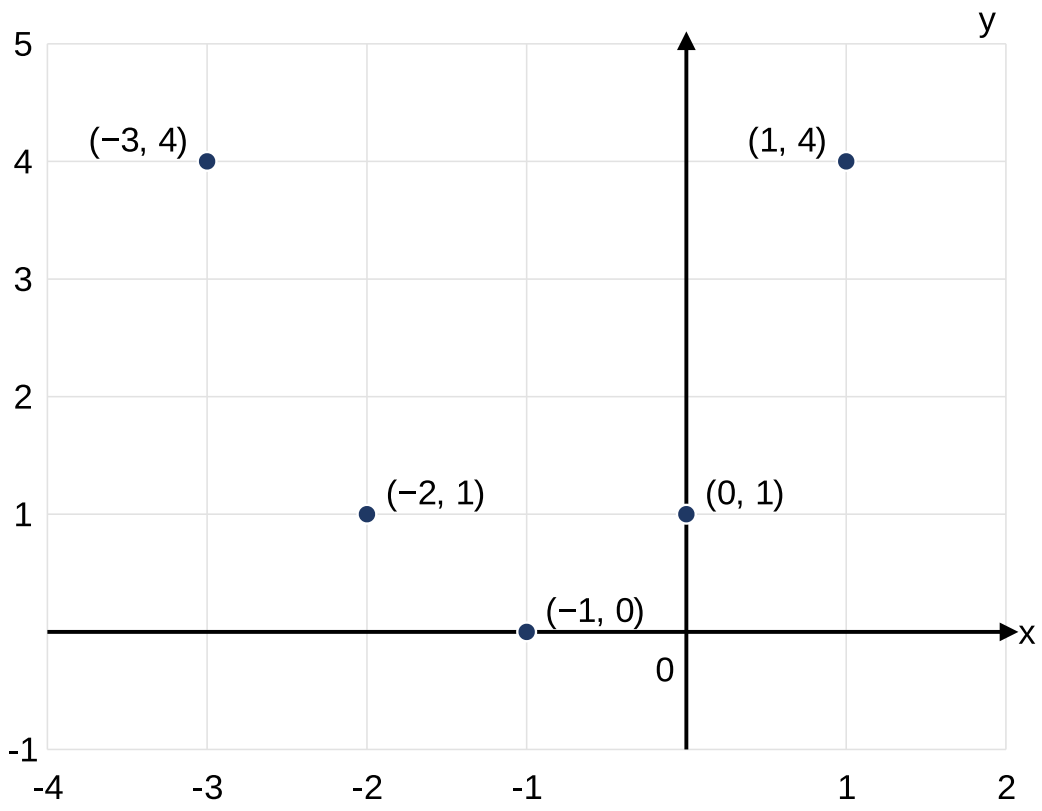
D (0, -3)

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6 The graph shows points on $y = (x + 1)^2$. Plot them, draw the curve, and state the vertex.



A (1, 0)

B (-1, 0)

C (0, -1)

D (0, 1)

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7 Graph $y = x^2 - 4x + 4$ and state the vertex.

- **A** (-2, 0)
- **B** (0, 2)
- **C** (0, 0)
- **D** (2, 0)

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8 Graph $y = -x^2 + 4$ and give the highest point.

- **A** (0, -4)
- **B** (4, 0)
- **C** (0, 4)
- **D** (0, 0)

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9 **Graph $y = 2x^2$. How does its shape compare with $y = x^2$, and where is the vertex?**

- **A** Wider (flatter), vertex (0, 0)
- **B** Narrower (steeper), vertex (0, 0)
- **C** Narrower (steeper), vertex (0, 2)
- **D** Wider (flatter), vertex (2, 0)

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10 **What is the axis of symmetry of $y = x^2 + 2x + 1$?**

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

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ANSWER KEY

1. (0, 0)

2. (0, -1)

3. (2, 0)

4. Opens downward, vertex (0, 0)

5. (0, 3)

6. (-1, 0)

7. (2, 0)

8. (0, 4)

9. Narrower (steeper), vertex (0, 0)

10. x = -1

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