MATHEMATICS · GRADES 10-12

Vertex form

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you read the highest or lowest point of a parabola at a glance, like the peak of a thrown ball or the cheapest price on a cost curve, without plotting lots of points. In vertex form, the turning point is written straight into the equation, so you can read it off without drawing the graph. That point is the peak of a throw, the lowest cost, or the best value, depending on the problem. Knowing how to read it means the most important point on the curve is visible at once.



Rule

Vertex form: a parabola in vertex form is $y = a(x - h)^2 + k$, and its vertex is (h, k).

The number inside the brackets gives the x of the vertex with the opposite sign, and the number outside gives the y.

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Worked examples

EXAMPLE 1

Q Find the vertex of $y = (x - 3)^2 + 2$

SOLUTION

Vertex form is $y = a(x - h)^2 + k$, where the vertex is (h, k).

Match the form: $h = 3$ and $k = 2$.

So the vertex is $(3, 2)$.

EXAMPLE 2

Q Find the vertex of $y = -(x + 1)^2 + 4$

SOLUTION

Match the form: $h = -1$ and $k = 4$.

Note the negative sign inside: $x + 1$ means $h = -1$, not 1.

So the vertex is $(-1, 4)$.

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Practice questions

1 A ball follows $y = (x - 2)^2 + 5$. Find the vertex.

- A (1, 5)
- B (2, 5)
- C (2, -5)
- D (-2, 5)

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2 A rocket follows $y = (x + 4)^2 - 3$. Find the vertex.

- A (-4, -3)
- B (4, -3)
- C (-4, 3)
- D (4, 3)

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3 A dive follows $y = 2(x - 1)^2 + 7$. Find the vertex.

- **A** (1, -7)
- **B** (-1, 7)
- **C** (1, 7)
- **D** (-1, -7)

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4 A swing follows $y = -(x - 5)^2 + 1$. Find the vertex.

- **A** (-5, 1)
- **B** (5, -1)
- **C** (5, 1)
- **D** (-5, -1)

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5 A jump follows $y = (x + 2)^2 + 0$. Find the vertex.

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

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6 A kite follows $y = (x + 5)^2 - 1$. Find its highest or lowest point.

- **A** (-5, -1)
- **B** (5, -1)
- **C** (-5, 1)
- **D** (5, 1)

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7 A parabola has vertex $(-2, 5)$ and equation $y = (x - h)^2 + k$. Find h and k.

- **A** $h = -2, k = 5$
- **B** $h = 2, k = 5$
- **C** $h = -2, k = -5$
- **D** $h = 2, k = -5$

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8 Moe says the vertex of $y = (x + 3)^2 - 4$ is $(3, -4)$. Where does Moe go wrong?

- **A** He got the sign wrong; the vertex is $(-3, -4)$
- **B** He got the sign wrong; the vertex is $(3, 4)$
- **C** He got the number wrong; the vertex is $(-3, 4)$
- **D** Moe is right; the vertex is $(3, -4)$

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9 What is the vertex of $y = (x - 4)^2 + 2$?

- **A** (4, -2)
- **B** (-4, 2)
- **C** (2, 4)
- **D** (4, 2)

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10 Which one of these parabolas has a vertex with a negative y-value?

- **A** $y = (x - 2)^2 + 5$
- **B** $y = (x + 2)^2 + 5$
- **C** $y = (x - 2)^2 - 5$
- **D** $y = (x + 2)^2 + 1$

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ANSWER KEY

1. (2, 5)

2. (-4, -3)

3. (1, 7)

4. (5, 1)

5. (-2, 0)

6. (-5, -1)

7. h = -2, k = 5

8. He got the sign wrong; the vertex is (-3, -4)

9. (4, 2)

10. $y = (x - 2)^2 - 5$

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