MATHEMATICS · GRADES 10-12

Reflections

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you describe a mirror image, like how a graph flips when a profit becomes a loss, or how a reflection in a lake flips a scene upside down. A mirror swaps left and right, so a word held up to a mirror reads backwards. A lake flips a mountain upside down, and a graph of a loss is the mirror of a graph of a profit. A reflection changes which way something faces, but it never changes its size or shape.



Rule

A minus sign outside the function reflects the graph across the x-axis.

A minus sign inside, on x, reflects the graph across the y-axis.

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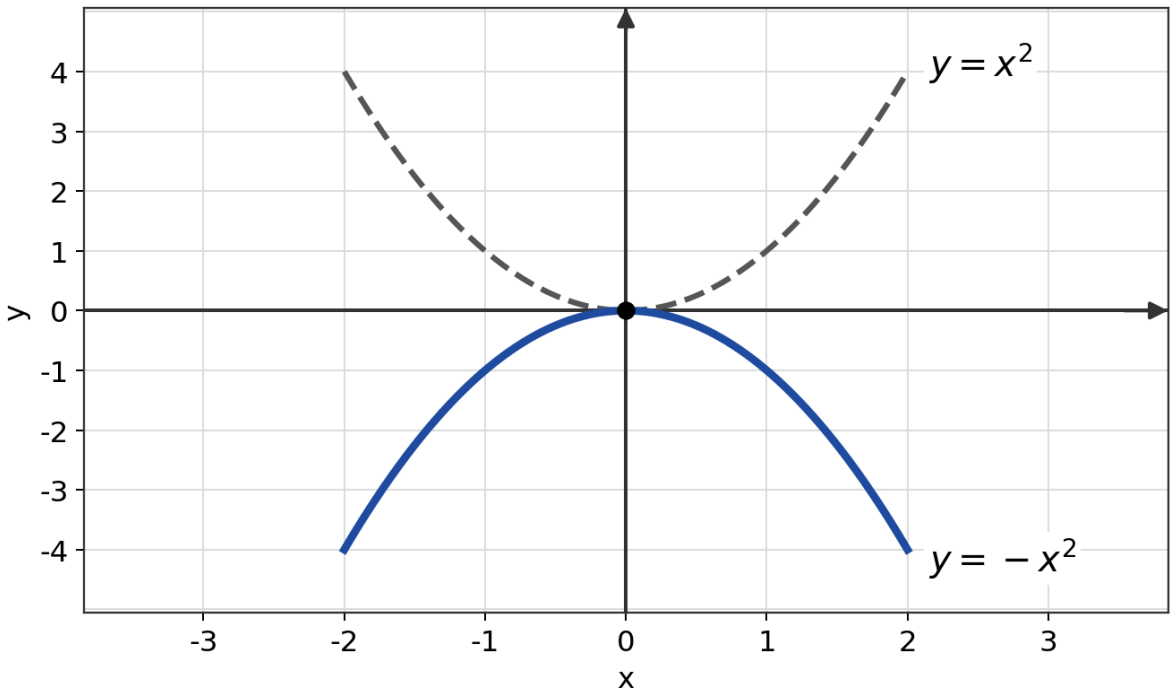
Worked examples

EXAMPLE 1

Q Describe the reflection in $y = -x^2$ compared to $y = x^2$



SOLUTION

The minus sign is outside the square, in front of the whole function.

Negate the whole function and its graph flips across the x-axis.

So the parabola flips from opening upward to opening downward.

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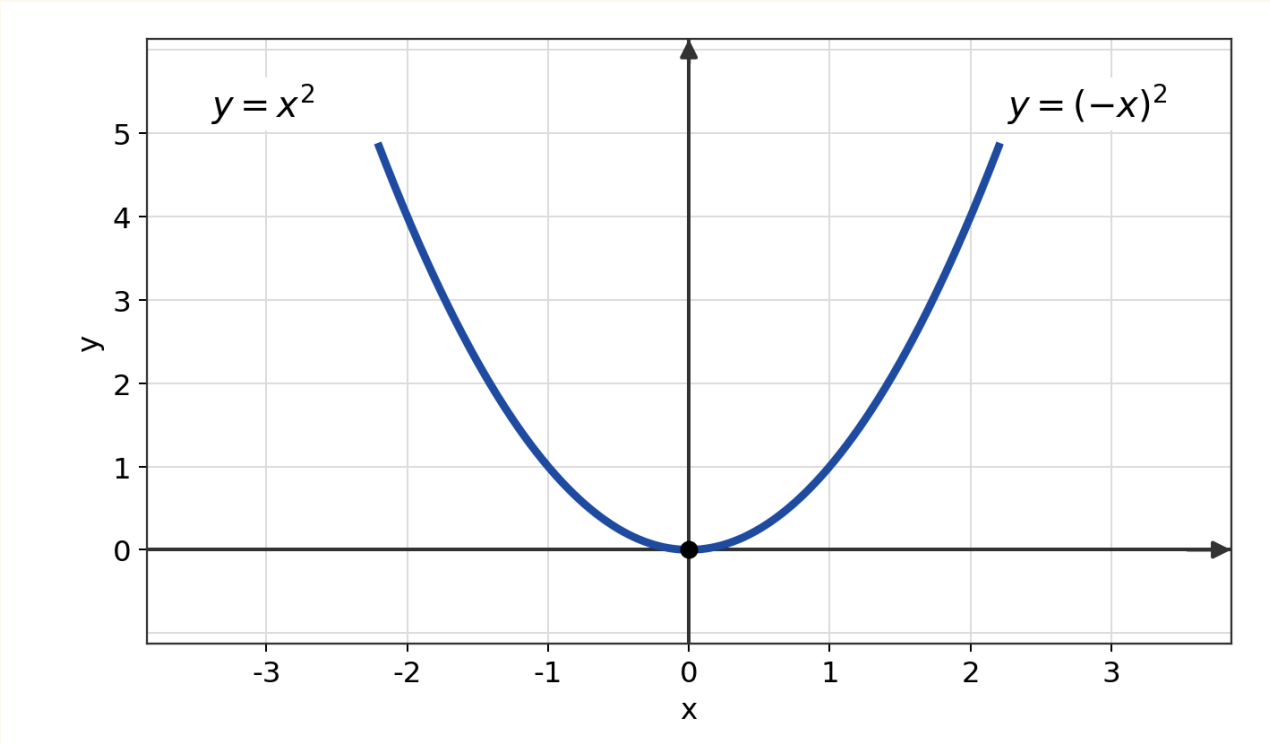
EXAMPLE 2

Q Describe the reflection in $y = (-x)^2$ compared to $y = x^2$



SOLUTION

The minus sign is inside, on x.

Negate the x inside and the graph flips across the y-axis.

For x^2 the graph is symmetric, so it looks unchanged, but the rule is still a y-axis reflection.

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Practice questions

1 Describe $y = -x^4$ compared to $y = x^4$: reflect across which axis?

- A x-axis
- B y-axis

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2 Describe $y = (-x)^3$ compared to $y = x^3$: reflect across which axis?

- A y-axis
- B x-axis

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3 The graph of $y = x^2$ is reflected across the x-axis. Which equation describes the reflected graph?

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

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4 For $y = -f(x)$, the graph of f is reflected across which axis?

- **A** x-axis
- **B** y-axis

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5 For y = f(-x), the graph of f is reflected across which axis?

A y-axis

B x-axis

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6 For y = -f(-x), the graph of f is reflected across which axis or axes?

A Both the x-axis and the y-axis

B The x-axis only

C The y-axis only

D Neither axis

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7 **The graph of $y = (-x)^2$ looks the same as the graph of $y = x^2$. Why?**

- **A** Because x^2 is symmetric about the y-axis, so the reflection leaves it unchanged
- **B** Because the minus sign cancels out
- **C** Because the graph has no reflection
- **D** Because $(-x)^2 = -x^2$

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8 If a point (2, 5) is reflected across the x-axis, what is the new point?

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

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9 If a point (2, 5) is reflected across the y-axis, what is the new point?

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

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10 **Which of these is the y-axis reflection of $y = x^2 + 2x$?**

A $y = x^2 - 2x$

B $y = -x^2 - 2x$

C $y = x^2 + 2x$

D $y = -x^2 + 2x$

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ANSWER KEY

1. x-axis

2. y-axis

3. $y = -x^2$

4. x-axis

5. y-axis

6. Both the x-axis and the y-axis

7. Because x^2 is symmetric about the y-axis, so the reflection leaves it unchanged

8. (2, -5)

9. (-2, 5)

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

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