MATHEMATICS · GRADES 10-12

Increasing and decreasing intervals

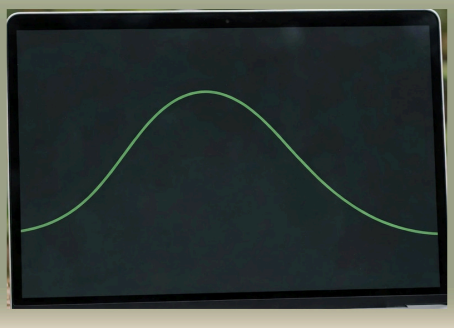
Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you read a graph to see where values climb and where they drop, like a temperature curve rising through the morning and falling after sunset. A graph tells a story of rising and falling, and naming those stretches is how you describe what happened and when. You use it to read a temperature curve, a stock chart, or a fitness tracker, and to explain in words when something was going up and when it was coming back down.



Rule

A function is increasing where its graph rises as you move from left to right, and decreasing where it falls.

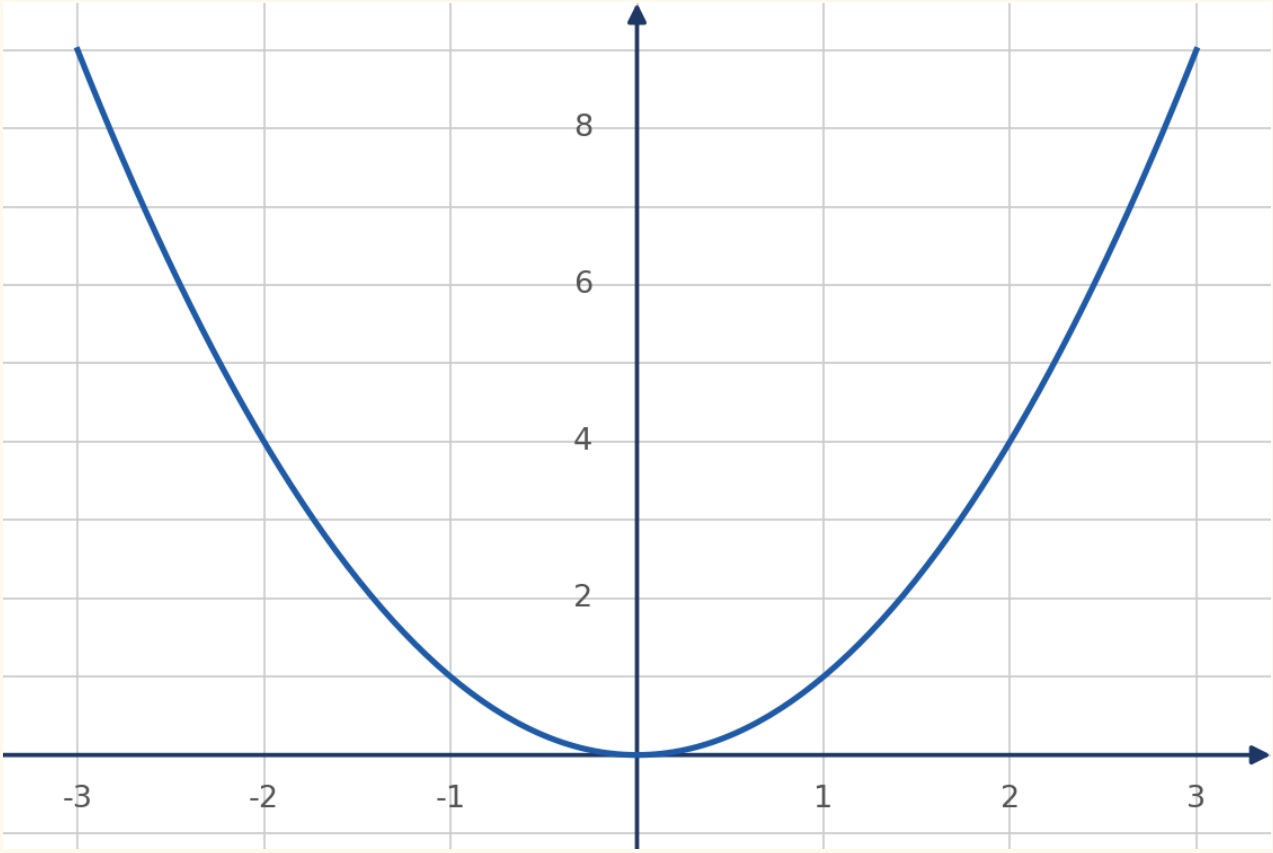
Read the graph from left to right and name the stretches where it goes up and the stretches where it goes down.

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Worked examples

EXAMPLE 1

Q On what intervals is $y = x^2$ increasing and decreasing?



SOLUTION

Look at the graph: to the left of the vertex, the graph goes down as x increases.

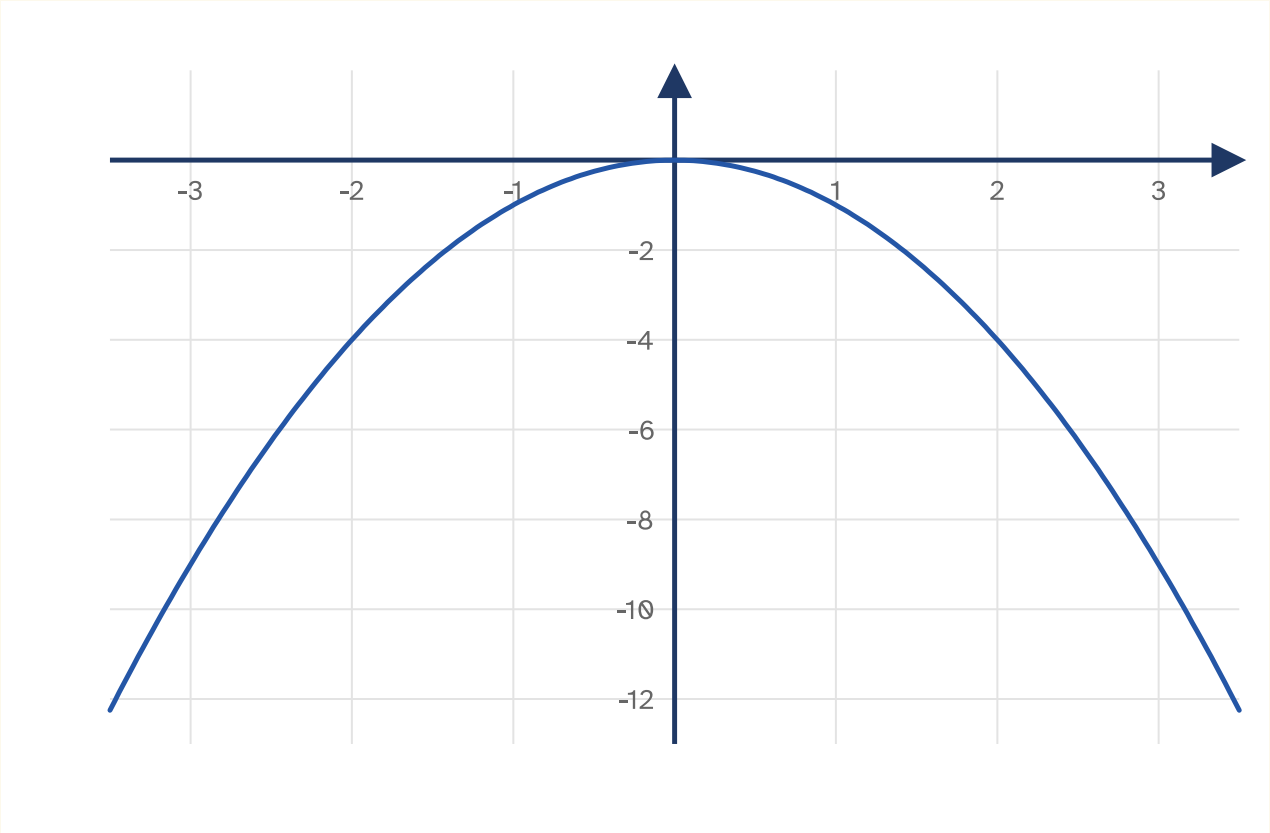
To the right of the vertex, the graph goes up as x increases.

So it is decreasing when x is less than 0 and increasing when x is greater than 0.

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EXAMPLE 2

Q On what intervals is $y = -x^2$ increasing and decreasing?



SOLUTION

The graph opens downward, so it goes up first and then down.

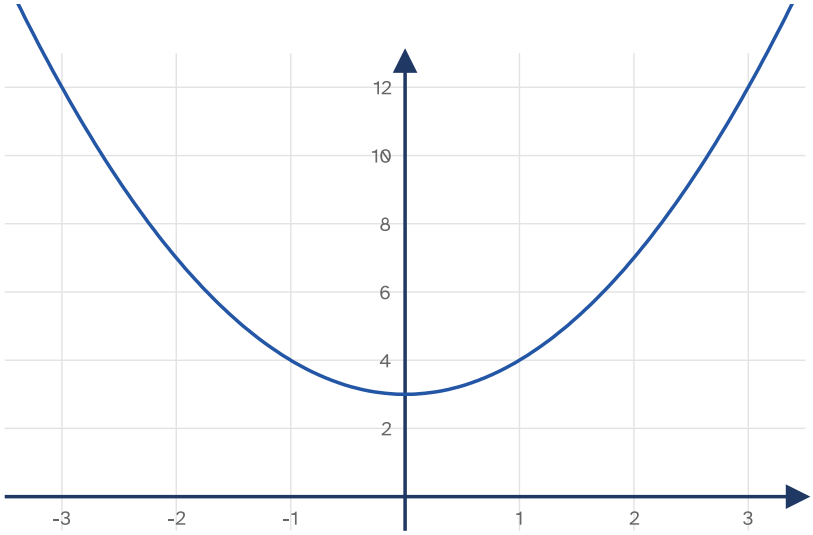
It rises until the vertex at $x = 0$ and falls after it.

So it is increasing when x is less than 0 and decreasing when x is greater than 0.

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Practice questions

1 For $y = x^2 + 3$, as x grows, when does it fall and when does it rise?



A Decreasing when x is less than 0, increasing when x is greater than 0

B Increasing when x is less than 0, decreasing when x is greater than 0

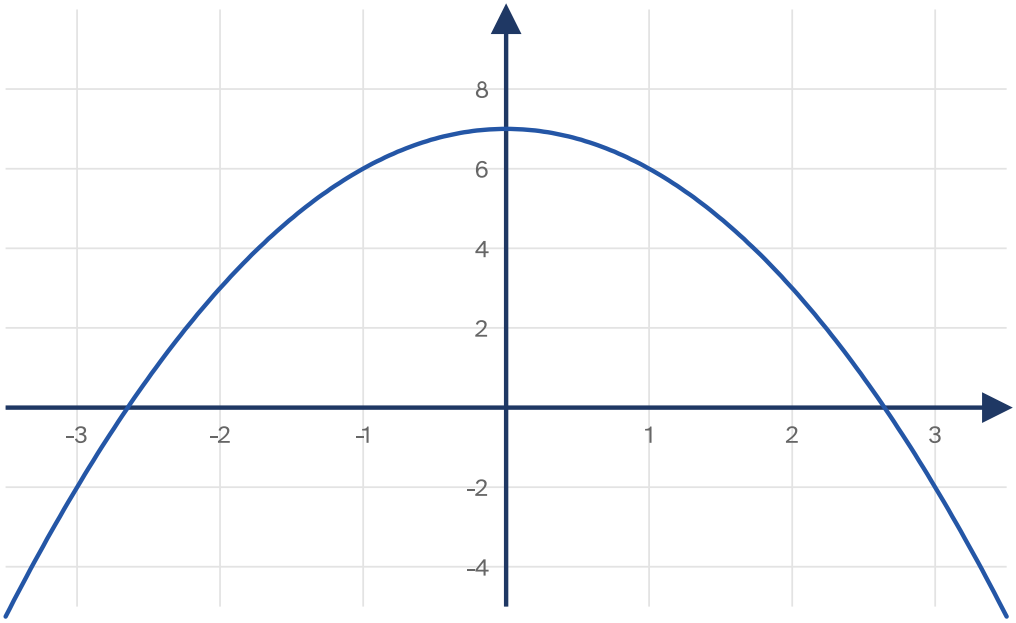
C Increasing when x is greater than 0, decreasing when x is less than 0

D Increasing for all real numbers

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2 For $y = -x^2 + 7$, state the interval where it increases and the interval where it decreases.



A Decreasing when x is less than 0, increasing when x is greater than 0

B Increasing when x is less than 0, decreasing when x is greater than 0

C Decreasing when x is greater than 0, increasing when x is less than 0

D Decreasing for all real numbers

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3 For $y = (x - 2)^2$, where does it go down, and where does it go up?

- **A** Decreasing when x is less than 2, increasing when x is greater than 2
- **B** Increasing when x is less than 2, decreasing when x is greater than 2
- **C** Decreasing when x is greater than 2, increasing when x is less than 2
- **D** Increasing for all real numbers

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4 For $y = -(x + 1)^2$, on which side of $x = -1$ is it increasing, and on which side is it decreasing?

A. Increasing when x is less than -1, decreasing when x is greater than -1

B. Decreasing when x is less than -1, increasing when x is greater than -1

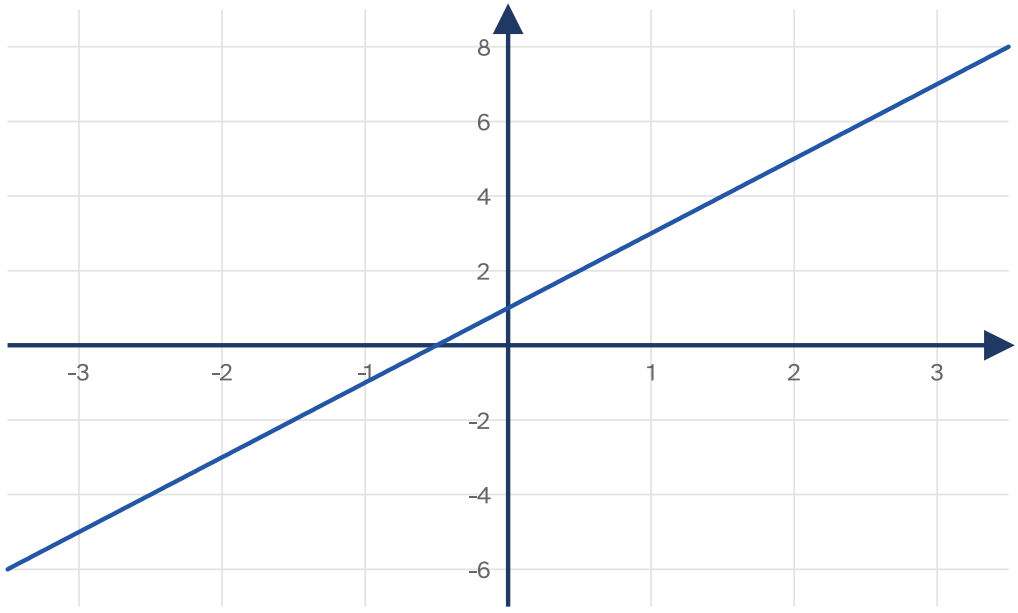
C. Increasing when x is greater than -1, decreasing when x is less than -1

D. Decreasing for all real numbers

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5 For $y = 2x + 1$, is it increasing or decreasing, and on what interval?



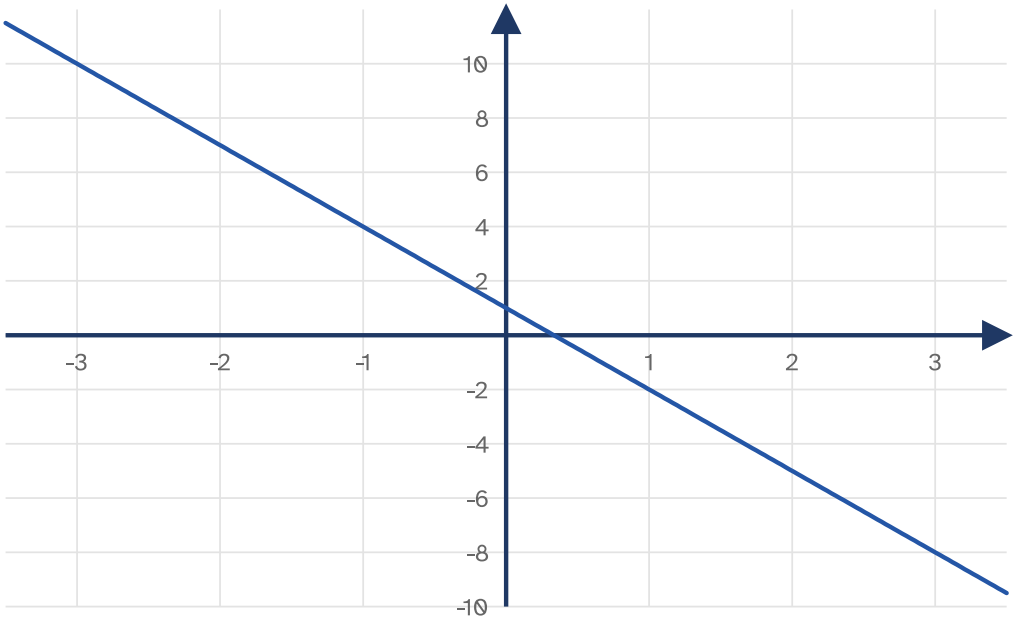
- **A** Increasing for all real numbers
- **B** Decreasing for all real numbers
- **C** Increasing when x is less than 0, decreasing when x is greater than 0
- **D** Decreasing when x is less than 0, increasing when x is greater than 0

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6

For y = -3x + 1, does y rise or fall as x grows, and on what interval?



A Increasing for all real numbers

B Decreasing for all real numbers

C Increasing when x is less than 0, decreasing when x is greater than 0

D Decreasing when x is less than 0, increasing when x is greater than 0

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7 **For $y = (x + 3)^2$, give the decreasing interval and the increasing interval.**

A. Decreasing when x is less than -3, increasing when x is greater than -3

B. Increasing when x is less than -3, decreasing when x is greater than -3

C. Decreasing when x is greater than -3, increasing when x is less than -3

D. Increasing for all real numbers

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8

For $y = -(x - 4)^2$, when is it climbing, and when is it falling?

A. Increasing when x is less than 4, decreasing when x is greater than 4

B. Decreasing when x is less than 4, increasing when x is greater than 4

C. Increasing when x is greater than 4, decreasing when x is less than 4

D. Decreasing for all real numbers

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9

The graph of a function rises until x = 1, then falls after x = 1. On what intervals is it increasing and decreasing?

A Increasing when x is less than 1, decreasing when x is greater than 1

B Decreasing when x is less than 1, increasing when x is greater than 1

C Increasing when x is greater than 1, decreasing when x is less than 1

D Decreasing for all real numbers

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10 For $y = x^3$, is it increasing or decreasing, and on what interval?

A Increasing for all real numbers

B Decreasing for all real numbers

C Increasing when x is less than 0, decreasing when x is greater than 0

D Decreasing when x is less than 0, increasing when x is greater than 0

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ANSWER KEY

1. Decreasing when x is less than 0, increasing when x is greater than 0

2. Increasing when x is less than 0, decreasing when x is greater than 0

3. Decreasing when x is less than 2, increasing when x is greater than 2

4. Increasing when x is less than -1, decreasing when x is greater than -1

5. Increasing for all real numbers

6. Decreasing for all real numbers

7. Decreasing when x is less than -3, increasing when x is greater than -3

8. Increasing when x is less than 4, decreasing when x is greater than 4

9. Increasing when x is less than 1, decreasing when x is greater than 1

10. Increasing for all real numbers

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