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 describe where a quantity is rising and where it is falling, like the price of a stock going up in the morning and down in the afternoon. Knowing the stretches where something rises and where it falls is how you turn a wiggly graph into a clear story. You use it to talk about prices, temperatures, and sales over a day, and to spot the turning points where a rise becomes a fall or a fall becomes a rise.



Rule

A function is increasing where its derivative is positive, and decreasing where its derivative is negative.

Find the derivative, work out where it is above zero and where it is below zero, and those are the increasing and decreasing intervals.

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Worked examples

EXAMPLE 1

Q Where is $f(x) = x^2$ increasing?

SOLUTION

Derivative: $2x$

$2x$ is positive when x is greater than 0.

So f increases for x greater than 0, and decreases for x less than 0.

EXAMPLE 2

Q Where is $f(x) = -x^2$ increasing?

SOLUTION

Derivative: $-2x$

$-2x$ is positive when x is less than 0.

So f increases for x less than 0, and decreases for x greater than 0.

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Practice questions

1

Where is $f(x) = x^3$ increasing?

A Increasing for all real numbers

B Decreasing for all real numbers

C Increasing when x is greater than 0

D Decreasing when x is less than 0

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2

Where is $f(x) = 2x + 1$ increasing?

A Increasing when x is greater than 0

B Increasing for all real numbers

C Decreasing for all real numbers

D Increasing when x is less than 0

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3 Where is f(x) = -x increasing?

A Increasing for all real numbers

B Decreasing for all real numbers

C Increasing when x is less than 0

D Decreasing when x is greater than 0

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4 Where is f(x) = -x² increasing?

A Increasing when x is less than 0

B Increasing when x is greater than 0

C Increasing for all real numbers

D Decreasing for all real numbers

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5 Where is $f(x) = -x^2$ decreasing?

A Decreasing when x is less than 0

B Decreasing when x is greater than 0

C Decreasing for all real numbers

D Increasing for all real numbers

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6 Where is $f(x) = x^2$ decreasing?

A Decreasing when x is greater than 0

B Decreasing when x is less than 0

C Decreasing for all real numbers

D Increasing when x is less than 0

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7 Where is $f(x) = x^2 + 1$ increasing?

A Increasing when x is less than 0

B Increasing for all real numbers

C Increasing when x is greater than 0

D Decreasing when x is greater than 0

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8 Where is $f(x) = 5 - x$ decreasing?

A Increasing for all real numbers

B Decreasing when x is less than 0

C Decreasing for all real numbers

D Increasing when x is greater than 0

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9 Where is $f(x) = -(x - 2)^2$ increasing?

A Increasing when x is less than 2

B Increasing when x is greater than 2

C Increasing for all real numbers

D Decreasing when x is less than 2

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10 Where is $f(x) = x^3$ decreasing?

A Decreasing when x is less than 0

B Decreasing for all real numbers

C Nowhere, it increases everywhere

D Decreasing when x is greater than 0

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ANSWER KEY

1. Increasing for all real numbers

2. Increasing for all real numbers

3. Decreasing for all real numbers

4. Increasing when x is less than 0

5. Decreasing when x is greater than 0

6. Decreasing when x is less than 0

7. Increasing when x is greater than 0

8. Decreasing for all real numbers

9. Increasing when x is less than 2

10. Nowhere, it increases everywhere

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