MATHEMATICS · GRADES 10-12

Sum and difference rules

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you find the rate of change of something made of parts, like a total cost that adds a fixed fee and a per item charge, by handling each part on its own. A total made of several pieces changes at a rate that is the sum of how each piece changes. So you can work out the rate for each piece separately, then add the results together, instead of wrestling with the whole thing at once. That is how you read a bill that mixes a flat fee with a charge per item, or any total built from separate parts.



Rule

Sum and difference rules: $(f + g)' = f' + g'$, and $(f - g)' = f' - g'$.

Differentiate each term on its own, then put the results together with the same signs.

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Worked examples

EXAMPLE 1

Q Differentiate $x^3 + 2x$.

SOLUTION

Differentiate x^3: $3x^2$

Differentiate $2x$: 2

Add: $3x^2 + 2$

EXAMPLE 2

Q Differentiate $x^2 - 5x + 3$.

SOLUTION

Differentiate each term: $2x$, -5, 0

Combine with the same signs: $2x - 5 + 0 = 2x - 5$

So the answer is $2x - 5$.

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Practice questions

1 Differentiate $x^2 + 3x$.

- **A** $2x + 3$
- **B** $2x - 3$
- **C** $x + 3$
- **D** $2x$

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2 Differentiate $x^3 - x$.

- **A** $3x^2 + 1$
- **B** $3x - 1$
- **C** $3x^2 - 1$
- **D** $3x^2$

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3 Differentiate $2x + 7$.

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4 Differentiate $x^4 - 2x^2$.

A $4x^3 + 4x$

B $4x^3 - 4x$

C $4x^3 - 2x$

D $x^4 - 2x^2$

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5 In your own words, what does the sum rule say?

- **A** The derivative of a sum is the product of the derivatives
- **B** The derivative of a sum is the sum of the derivatives
- **C** The derivative of a sum is the derivative of the first term only
- **D** The derivative of a sum is the sum of the functions

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6 Differentiate $5x^2 + 5$

- **A** $10x + 5$
- **B** $5x$
- **C** $10x$
- **D** 10

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7 Differentiate $x^3 + x^2 - x$.

A $3x^2 + 2x - 1$

B $3x^2 + 2x + 1$

C $3x^2 + x - 1$

D $3x^2 + 2x$

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8 Differentiate $4x^2$ twice. What is the second derivative?

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9 Which function has derivative $1 + 2x + 3x^2$?

- **A** $x + x^2 + x^3$
- **B** $x^2 + 2x^3$
- **C** $3x + 2x^2 + x^3$
- **D** $x + x^2$

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10 What is the derivative of $8x^2 - 4x$ at $x = 1$?

- **A** 12
- **B** 16
- **C** 4
- **D** 20

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ANSWER KEY

1. $2x + 3$

2. $3x^2 - 1$

3. 2

4. $4x^3 - 4x$

5. The derivative of a sum is the sum of the derivatives

6. $10x$

7. $3x^2 + 2x - 1$

8. 8

9. $x + x^2 + x^3$

10. 12

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