MATHEMATICS · GRADES 10-12

Constant multiple rule

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you find how fast a scaled-up quantity is changing. If each item costs the same amount, the total cost changes at that amount times the rate the number of items changes, and the constant multiple rule is what lets you keep the number in front while you differentiate. It is a small rule, but it shows up in almost every differentiation problem.



Rule

Constant multiple rule: the derivative of a constant times a function is the constant times the derivative of the function.

Keep the number in front and differentiate the function as usual. In symbols, the derivative of $c \times f(x)$ is $c \times f'(x)$.

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Worked examples

EXAMPLE 1

Q Differentiate $5x^2$.

SOLUTION

Leave the 5 where it is and differentiate x^2 to $2x$.

$5 \times 2x = 10x$

So the answer is $10x$.

EXAMPLE 2

Q Differentiate $3x^3$.

SOLUTION

Differentiate x^3 to $3x^2$.

$3 \times 3x^2 = 9x^2$

So the answer is $9x^2$.

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Practice questions

1 Differentiate $4x^2$.

- **A** $4x$
- **B** $8x$
- **C** $8x^2$
- **D** $2x$

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2 Differentiate $2x$.

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

A $10x + 3$

B $10x$

C $5x + 3$

D $10x^2 + 3$

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4 What does the constant multiple rule say?

A $d/dx\ (c\ f(x)) = c\ f'(x)$

B $d/dx\ (c\ f(x)) = f'(x)$

C $d/dx\ (f(x) + g(x)) = f'(x) + g'(x)$

D $d/dx\ (c\ f(x)) = c\ f(x)$

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5 What happens to the derivative if you double the constant in front?

- A The derivative doubles
- B The derivative stays the same
- C The derivative halves
- D The derivative becomes zero

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6 Differentiate $-3x^2$.

- A $-3x$
- B $-6x^2$
- C $-6x$
- D $6x$

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7 Differentiate $4x^3$, then find the value of the derivative when $x = 2$.

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8 Differentiate $0.5x^2$.

A 0.5x

B x

C 2x

D 0.25x

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9 Which function has derivative $12x^2$?

- **A** $4x^3$
- **B** $3x^3$
- **C** $12x^3$
- **D** $6x^2$

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10 Differentiate x^2.

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

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ANSWER KEY

1. 8x

2. 2

3. 10x + 3

4. d/dx (c f(x)) = c f'(x)

5. The derivative doubles

6. -6x

7. 48

8. x

9. $4x^3$

10. 2x

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