MATHEMATICS · GRADES 10-12

Composition of functions

Difficulty level: Advanced

Mathematics: Grades 10-12

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Overview of the concept

This is how you describe a job done in stages as one single chain. Converting a price from US dollars to Canadian dollars and then adding tax is two steps, but composition treats it as one process with one input and one output. That is how most real calculations work, as a chain of steps where the output of one becomes the input of the next.



Rule

Composition: work the inside function first, then feed the result into the outside function.

(f o g)(x) means g first, then f, so you start with the function closest to x. The order matters, because (f o g)(x) is usually not the same as (g o f)(x).

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Worked examples

EXAMPLE 1

Q For $f(x) = 2x + 1$ and $g(x) = x^2$, find $(f \circ g)(2)$

SOLUTION

Work the inside function first: $g(2) = 2^2 = 4$

Feed that result into f: $f(4) = 2 \times 4 + 1 = 9$

So $(f \circ g)(2) = 9$

EXAMPLE 2

Q For $f(x) = 2x + 1$ and $g(x) = x^2$, find $(g \circ f)(2)$

SOLUTION

Work the inside function first: $f(2) = 2 \times 2 + 1 = 5$

Feed that result into g: $g(5) = 5^2 = 25$

So $(g \circ f)(2) = 25$

Practice questions

1 With $f(x) = 2x$ and $g(x) = x + 3$, find $(f \circ g)(2)$.

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2 With $f(x) = 2x$ and $g(x) = x + 3$, find $(g \circ f)(2)$.

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3 With $f(x) = x + 1$ and $g(x) = x^2$, find $(f \circ g)(3)$.

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4 With $f(x) = x + 1$ and $g(x) = x^2$, find $(g \circ f)(3)$.

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5 With $f(x) = 3x - 1$ and $g(x) = 2x$, find $(f \circ g)(x)$ as an expression.

- A $6x - 1$
- B $6x - 2$
- C $5x - 1$
- D $6x + 1$

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6 With $f(x) = 3x - 1$ and $g(x) = 2x$, find $(g \circ f)(x)$ as an expression.

- A $6x - 1$
- B $6x - 2$
- C $6x + 2$
- D $3x - 2$

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7 In (f o g)(3), which function do you work out first?

- **A** f
- **B** g
- **C** Both at the same time
- **D** Neither

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8 A shop first converts a price from US dollars to Canadian dollars (function f), then adds tax (function g). Which composition gives the final price?

- **A** (f o g)(x)
- **B** (g o f)(x)
- **C** f(x) + g(x)
- **D** f(x) × g(x)

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9 With $f(x) = x^2$ and $g(x) = x + 2$, find $(f \circ g)(1)$.

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10 With $f(x) = x^2$ and $g(x) = x + 2$, find $(g \circ f)(1)$.

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ANSWER KEY

1. 10

2. 7

3. 10

4. 16

5. 6x - 1

6. 6x - 2

7. g

8. (g o f)(x)

9. 9

10. 3

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