

**Lesson Objectives**

By the end of this lesson, you should be able to:

- Write an expression for the of functions.
- Find the of the composition of functions.
- the composition of functions.

**Words to Know**

Fill in this table as you work through the lesson. You may also use the glossary to help you.

composition of functions	the act of <input type="text"/>	one <input type="text"/>
	after another	

Instruction | Composition of Functions

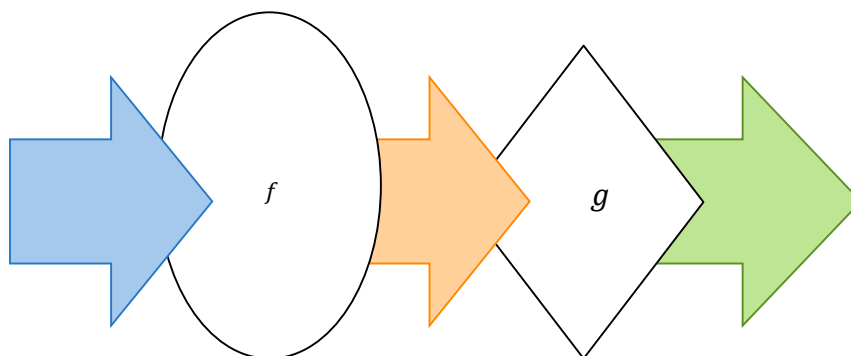
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Lesson Question

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Composite Functions



A **composition of functions** is applying one after another.

This new function is called a **function**.

It is written as either $g(f(x))$ or $(g \circ f)(x)$.

Since is the innermost function, that's where you start.

It's important to realize that composition of functions does not mean

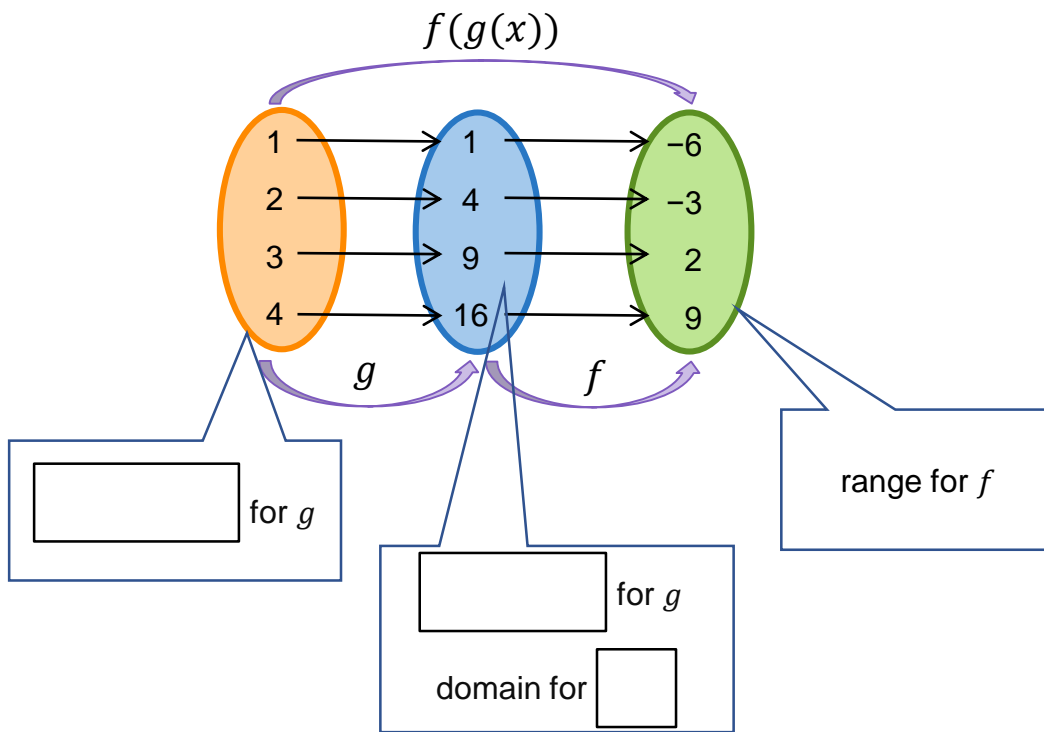
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Mapping Diagram



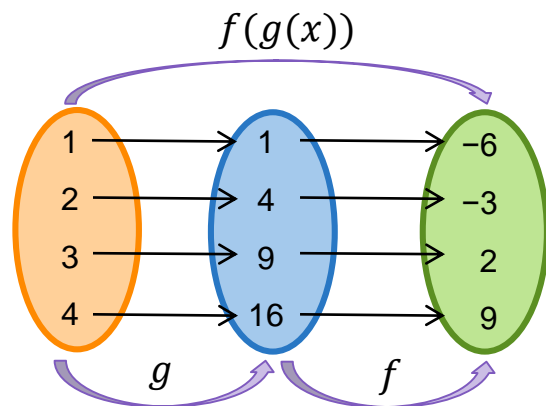
Example: Find $f(g(3))$.

Circle the arrow showing that $g(3) = 9$.

$$f(g(3)) = f(\quad)$$

Circle the arrow showing that $f(9) = 2$.

$$f(g(3)) = \quad$$



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Writing a Rule for Composite Functions

$$f(x) = x - 7$$

$$g(x) = x^2$$

Write a rule for $(f \circ g)(x)$.

$$(f \circ g)(x) = f(g(x))$$

$$= f(\boxed{})$$

$$= \boxed{} - 7$$

Write a rule for $(g \circ f)(x)$.

$$(g \circ f)(x) = g(f(x))$$

$$= g(\boxed{})$$

$$= (x - 7)^2$$

$$= \boxed{}$$

Composition is not $\boxed{}$, meaning that you can't switch the order and get the same answer.

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Methods of Evaluating Composite Functions

METHOD 1: EVALUATE INDIVIDUALLY

$$f(x) = 6x + 7$$

$$g(x) = \frac{x}{2}$$

What is $(f \circ g)(-2)$? $(f \circ g)(-2) = f(g(-2))$

$$\text{Find } g(-2): g(-2) = \frac{-2}{2} = \boxed{}$$

$$\text{Now, find } f(\boxed{}): f(-1) = 6(-1) + 7 = \boxed{}$$

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METHOD 2: FIND THE COMPOSITE RULE

$$f(x) = 6x + 7$$

$$g(x) = \frac{x}{2}$$

What is $(f \circ g)(-2)$?

$$(f \circ g)(x) = f(g(x))$$

$$= f\left(\frac{x}{2}\right)$$

$$= 6\left(\boxed{}\right) + 7$$

$$= \boxed{} + 7$$

$$(f \circ g)(-2) = 3\left(\boxed{}\right) + 7$$

$$= \boxed{}$$

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Restrictions on Domain

Find any domain restrictions on $f(g(x))$.

$$f(x) = \frac{1}{x}$$

$$g(x) = x - 4$$

The domain of g is all real numbers.

The range of g is .

The domain of f is $x \neq \boxed{}$, because division by 0 is not allowed.

To find the domain of $f(g(x))$, find the composition function.

$$f(g(x)) = f(x - 4) = \frac{1}{\boxed{}}$$

So, the domain of $f(g(x))$ is .

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Restrictions on Domain**METHOD 1: USE INDIVIDUAL FUNCTIONS**Find any domain restrictions on $f(g(x))$.

$$f(x) = \sqrt{x - 3} \qquad g(x) = x + 5$$

There will be restrictions on the domain for f , because you can't have anumber under a square root. Find the domain of f .

$$x - 3 \geq \text{$$

$$x \geq \text{$$

Use the domain of f to find the domain of g .

$$x + 5 \geq \text{$$

$$x \geq \text{$$

So, the domain of $f(g(x))$ is $x \geq -2$.

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METHOD 2: FIND THE COMPOSITE RULEFind any domain restrictions on $f(g(x))$.

$$f(x) = \sqrt{x - 3}$$

$$g(x) = x + 5$$

To find the domain of $f(g(x))$, find the rule.

$$f(g(x)) = f(x + 5)$$

$$= \sqrt{(\boxed{}) - 3}$$

$$= \sqrt{x + \boxed{}}$$

We have to have a positive number underneath the square root sign.

$$x + 2 \geq 0$$

So, the domain of $f(g(x))$ is $\boxed{}$

Summary | Composition of Functions



Lesson Question

How can you write a new function that uses the output of one function as the input of another?



Answer

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Review: Key Concepts

Applying one function followed by

another is a

of functions.

Notation:

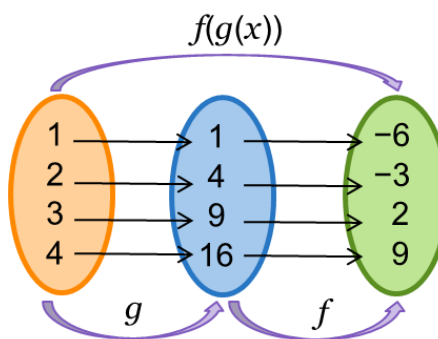
$$f(g(x))$$

Order is important: $f(g(x))$ is not

necessarily equal to $g(f(x))$.

of g becomes domain of f .

restrictions must be considered!



Summary | Composition of Functions

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Review: Common Problem Types

Write a rule for a composite function.

- Substitute the function into the function and simplify.

Evaluate composite functions.

1. Evaluate the inner function, then use the output to evaluate the outer function.
2. the value of x into the composite function.

Determine the domain of a composite function.

1. Write the composite function and determine the domain, or
2. Determine the values of x for which the of the inner function makes the outer function undefined.



Summary

Composition of Functions

Use this space to write any questions or thoughts about this lesson.