

My Notes

Learning Targets:

- Write the composition of two functions.
- Evaluate the composition of two functions.

SUGGESTED LEARNING STRATEGIES: Note Taking, Create Representations, Think-Pair-Share, Group Presentation, Debriefing

A *composition of functions* forms a new function by substituting the output of the inner function into the outer function. The function $y = f(g(x))$ is a composition of f and g where g is the inner function and f is the outer function.

1. The tables show information about Jim's mowing service. Use the tables to evaluate each expression. Then tell what the expression represents.

Area of Property a (acres)	Time to Mow $t(a)$ (hours)
1	4
2	8
3	12
4	16

Time to Mow t (hours)	Cost to Mow $c(t)$ (\$)
4	110
8	190
12	270
16	350

- a. $t(4)$
- b. $c(4)$
- c. $c(t(1))$
- d. $c(t(4))$

2. **Reason quantitatively.** Use the tables of values below to evaluate each expression.

x	$f(x)$
1	3
2	2
3	1
4	4

x	$g(x)$
1	4
2	3
3	2
4	1

- a. $f(3)$
- b. $g(3)$
- c. $g(f(3))$
- d. $f(g(3))$

MATH TIP

The order matters when you compose two functions. $y = g(f(x))$ and $y = f(g(x))$ are two different functions.

Lesson 5-3

More Function Composition

ACTIVITY 5

continued

3. Using f and g from Item 2, complete each table of values to represent the composite functions $(f \circ g)(x)$ and $(g \circ f)(x)$.

a.

x	$(f \circ g)(x) = f(g(x))$
1	
2	
3	
4	

b.

x	$(g \circ f)(x) = g(f(x))$
1	
2	
3	
4	

Check Your Understanding

4. What does the notation $(g \circ h)(t)$ represent? What is another way you can write $(g \circ h)(t)$?
5. **Reason abstractly.** Explain how $(f \circ g)(x)$ is different from $(f \cdot g)(x)$.
6. Given that $p(t) = t^2 + 4$ and $q(t) = t + 3$, write the equation for $(p \circ q)(t)$. Explain how you determined your answer.

For Items 7–11, use these three functions:

- $f(x) = x^2$
- $g(x) = 2x - 1$
- $h(x) = 4x - 3$

7. Evaluate each expression.

a. $g(f(2))$ b. $f(g(2))$

8. Write each composite function in terms of x .

a. $y = g(f(x))$ b. $y = f(g(x))$

9. Verify that you composed g and f correctly by evaluating $g(f(2))$ and $f(g(2))$ using the functions you wrote in Item 8. Compare your answers with those from Item 7.

My Notes

WRITING MATH

The notation $(f \circ g)(x)$ represents a composition of two functions.

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

Read the notation as “ f of g of x .”

CONNECT TO AP

In AP Calculus, you will identify the “inner” function and the “outer” function that form a composite function.

For example, the function $h(x) = f(g(x)) = (2x + 3)^2$ could be the composition of the inner function $g(x) = 2x + 3$ and the outer function $f(x) = x^2$.

My Notes

MATH TIP

As shown in Item 11, the inner and outer functions that form a composite function can be the same function.

10. a. Evaluate $h(g(3))$.

b. Write the composition $(h \circ g)(x)$ in terms of x .

11. a. Evaluate $g(g(2))$.

b. Write the composition $(g \circ g)(x)$ in terms of x .

Check Your Understanding

12. Explain how you found the rule for the composition $(g \circ g)(x)$ in Item 11b.

13. Given that $p(n) = 4n$ and $q(n) = n + 2$, for what value of n is $(p \circ q)(n) = 8$? Explain how you determined your answer.

LESSON 5-3 PRACTICE

For Items 14 and 15, use the following functions:

- $f(x) = 5x + 1$
- $g(x) = 3x - 4$

14. Evaluate $f(2)$, $g(2)$, $(f \circ g)(2)$, and $(g \circ f)(2)$.

15. Write the composite functions $h(x) = g(f(x))$ and $k(x) = f(g(x))$.

The jeans at a store are on sale for 20% off, and the sales tax rate is 8%. Use this information for Items 16–18.

16. Write a function $s(p)$ that gives the sale price of a pair of jeans regularly priced at p dollars.

17. Write a function $t(p)$ that gives the total cost including tax for a pair of jeans priced at p dollars.

18. **Construct viable arguments.** A customer wants to buy a pair of jeans regularly priced at \$25. Does it matter whether the sales clerk applies the sale discount first or adds on the sales tax first to find the total cost? Use compositions of the functions s and t to support your answer.