

M – Functions, Lesson 4, Operations with Functions (r. 2018)

FUNCTIONS

Operations with Functions

Common Core Standard	Next Generation Standard
F-BF.1 Write a function that describes a relationship between two quantities.	AI-F.BF.1 Write a function that describes a relationship between two quantities.

LEARNING OBJECTIVES

Students will be able to:

- 1) Compose new functions from existing functions using substitution and mathematical operations.

Overview of Lesson

Teacher Centered Introduction	Student Centered Activities
Overview of Lesson <ul style="list-style-type: none">- activate students' prior knowledge- vocabulary- learning objective(s)- big ideas: direct instruction- modeling	guided practice ←Teacher: anticipates, monitors, selects, sequences, and connects student work <ul style="list-style-type: none">- developing essential skills- Regents exam questions- formative assessment assignment (exit slip, explain the math, or journal entry)

VOCABULARY

LEARNING OBJECTIVES

Students will be able to:

- 1) Use the output of one function as the input for another function.
 - 2) Substitute expressions from one function into another.
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BIG IDEAS

Polynomial expressions can be substituted into equations and functions.

Example:

Given that: $f(x) = g(x) - 2h(x)$ and $g(x) = 3x + 4$, then $f(x) = (3x + 4) - 2(5x - 6)$

$$h(x) = 5x - 6$$

Functions can be multiplied or divided if each and every term in both expressions is multiplied or divided by the same value.

$$2(y = 3x + 4)$$

Example: $2(y) = 2(3x) + 2(4)$

$$2y = 6x + 8$$

DEVELOPING ESSENTIAL SKILLS

- If f and g are two functions defined by $f(x) = 3x + 5$ and $g(x) = x^2 + 1$, then $g(f(x))$ is
 - $x^2 + 3x + 6$
 - $9x^2 + 30x + 26$
 - $3x^2 + 8$
 - $9x^2 + 26$
- If $f(x) = -2x + 7$ and $g(x) = x^2 - 2$, then $f(g(3))$ is equal to
 - -7
 - -3
 - -1
 - 7
- The accompanying tables define functions f and g .

x	1	2	3	4	5
$f(x)$	3	4	5	6	7

x	3	4	5	6	7
$g(x)$	4	6	8	10	12

What is $g(f(3))$?

- 6
 - 2
 - 8
 - 4
- If $f(x) = x^2 + 4$ and $g(x) = \sqrt{1 - x}$, what is the value of $f(g(-3))$?
 - $2i\sqrt{3}$
 - 2
 - 8
 - 13
 - If $f(x) = x^2 + 4$ and $g(x) = 2x + 3$, find $f(g(-2))$.

ANSWERS

1. ANS: B

$$f(x) = 3x + 5$$

$$\begin{aligned}g(3x+5) &= (3x+5)^2 + 1 \\ &= 9x^2 + 30x + 26\end{aligned}$$

2. ANS: A

$$\begin{aligned}g(3) &= 3^2 - 2 \\ &= 7\end{aligned}$$

$$\begin{aligned}f(7) &= -2(7) + 7 \\ &= -7\end{aligned}$$

3. ANS: C

$$f(3) = 5, g(5) = 8$$

4. ANS: C

$$g(-3) = \sqrt{1-x} = \sqrt{1-(-3)} = 2$$

$$f(2) = 2^2 + 4 = 8$$

5. ANS:

$$5. \quad g(-2) = 2(-2) + 3 = -1. \quad f(-1) = (-1)^2 + 4 = 5.$$

REGENTS EXAM QUESTION (through June 2018)

A.APR.A.1: Operations with Functions

- 434) A company produces x units of a product per month, where $C(x)$ represents the total cost and $R(x)$ represents the total revenue for the month. The functions are modeled by $C(x) = 300x + 250$ and $R(x) = -0.5x^2 + 800x - 100$. The profit is the difference between revenue and cost where $P(x) = R(x) - C(x)$. What is the total profit, $P(x)$, for the month?
- 1) $P(x) = -0.5x^2 + 500x - 150$ 3) $P(x) = -0.5x^2 - 500x + 350$
2) $P(x) = -0.5x^2 + 500x - 350$ 4) $P(x) = -0.5x^2 + 500x + 350$

SOLUTION

- 434) ANS: 2
Strategy: Substitute $R(x)$ and $C(x)$ into $P(x) = R(x) - C(x)$.

Given: $P(x) = R(x) - C(x)$

$$R(x) = -0.5x^2 + 800x - 100$$

$$C(x) = 300x + 250$$

Therefore: $P(x) = (-0.5x^2 + 800x - 100) - (300x + 250)$

$$P(x) = -0.5x^2 + 800x - 100 - 300x - 250$$

$$P(x) = -0.5x^2 + 500x - 350$$

PTS: 2 NAT: A.APR.A.1 TOP: Addition and Subtraction of Polynomials
KEY: subtraction