Functions 6a - Inverse Functions - From Graphs & Tables

Standards: F-BF.4 - Find Inverse Functions (4a & 4c)

GLO: #3 Complex Thinker

Math Practice: #2 Reason abstractly & quantitatively

Learning Targets:

How do you find inverse values from a graph and table?

To evaluate a function means to identify a **range**/output value (e.g. f(x)) corresponding to a **domain**/input value (e.g. x).

(erase to show)

An **Inverse Function** reverses or "undoes" the input→output process resulting in an output→input process

For inverse type questions, you are given a range/output value and asked to find the corresponding domain/input value that yields the given output.

1. Timmy's Taxi charges an initial fee and then a certain amount of money per mile or fraction thereof. The table shows the cost **C** of using Timmy's Taxi as a function of the number of miles driven ***m***.

m (miles)	C(m) (cost)
1	4.66
2	5.87
3	7.08
4	8.29
5	9.50
6	10.71
7	11.92
8	13.13
9	14.34
10	15.55
11	16.76
12	17.97

a. How much will it cost for a 7 mile ride? $11.92

b. How many miles can you travel for $15.55? 10 miles

c. How many miles can you travel for $9.50? 5 miles

d. How much will it cost for a 12 mile ride? $17.97

e. How many miles can you travel for $5.87? 2 miles

Question 1a asks you to evaluate function C at m = 7. The algebraic notation representing this problem should be very familiar to you: C(7). The value of C(7) is the answer to the question: "How much would it cost for a 7 mile ride?"

In goes the number of miles 7 $\longrightarrow$ $\boxed{C(m)}$ $\longrightarrow$ out comes the corresponding cost

Question 1b is an **inverse-type** question. One way you could ask this question with function notation would be as a fill in the blank: C(□) = 15.55.

? $\longrightarrow$ $\boxed{C(m)}$ $\longrightarrow$ $15.55

In mathematics we use a **special notation for inverse-type questions**. You need to be familiar with this notation and be able to explain its meaning.

input $\longrightarrow$ $\boxed{C^{-1}(m)}$ $\longrightarrow$ out comes the corresponding mile

(Say "C inverse of m")

Question in words: How many miles can you travel for $15.55?

$15.55 $\longrightarrow$ $\boxed{C^{-1}(m)}$ $\longrightarrow$?

Question using <u>inverse notation</u>: $C^{-1}(15.55) = ?$

With this inverse notation, the "inputs" and "outputs" of function C are switched. We now input the cost and want to know the number of miles that would result in that cost.

Caution: The notation used for inverse functions uses a superscript of "-1" that looks like an exponent. It is not! The negative one, therefore, does not mean "reciprocal".

That is, $f^{-1}(x)$ is <u>not</u> the same as $\dfrac{1}{f(x)}$, which is actually written as $\left(f(x)\right)^{-1}$.

2. Functions f, g, and h are given below with tables. Use these tables to evaluate the following.

(1st column)

input

$f(3) =$ -2

output

$g^{-1}(0) =$ -5

output

$f^{-1}(-1) =$ 8

input

$h(15) =$ -6

output

$f^{-1}(5) =$ 4

x	$f(x)$
-1	-4
3	-2
4	5
8	-1
11	3

x	$g(x)$
-5	0
-3	1
0	3
2	6
5	2

x	$h(x)$
3	1
7	9
9	2
15	-6
16	15

2. Functions f, g, and h are given below with tables. Use these tables to evaluate the following.

(2nd column) output

$g^{-1}(2) = $ 5

input

$g(2) = $ 6

output

$f^{-1}(3) = $ 11

output

$h^{-1}(15) = $ 16

input

$h(9) = $ 2

x	$f(x)$
-1	-4
3	-2
4	5
8	-1
11	3

x	$g(x)$
-5	0
-3	1
0	3
2	6
5	2

x	$h(x)$
3	1
7	9
9	2
15	-6
16	15

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2. Functions f, g, and h are given below with tables. Use these tables to evaluate the following.

(3rd column)

output

$g^{-1}(3) =$ 0

input

$g(0) =$ 3

input

$f(8) =$ -1

output

$h^{-1}(9) =$ 7

input

$f(-1) =$ -4

x	$f(x)$
-1	-4
3	-2
4	5
8	-1
11	3

x	$g(x)$
-5	0
-3	1
0	3
2	6
5	2

x	$h(x)$
3	1
7	9
9	2
15	-6
16	15

3. The Kealohas are filling their swimming pool with a garden hose. The height h of the water in the pool measured in centimeters is a function of time t. Here t is measured in minutes, where $t = 0$ represents the moment when the garden hose was turned on.

Describe, in words, the meaning of the following. The first one has been done as an example.
Note: your answers should read as complete sentences.

a) $h(60) =$ The height of the water in centimeters 60 minutes after the hose is turned on.

b) $h^{-1}(100) =$ The time in minutes after the hose is turned on that the water is 100cm high.

c) $h(100) =$ The height of the water in cm, 100 minutes after hose is turned on.

d) $h^{-1}(60) =$ The time in minutes after the hose is turned on that the water is 60cm high.

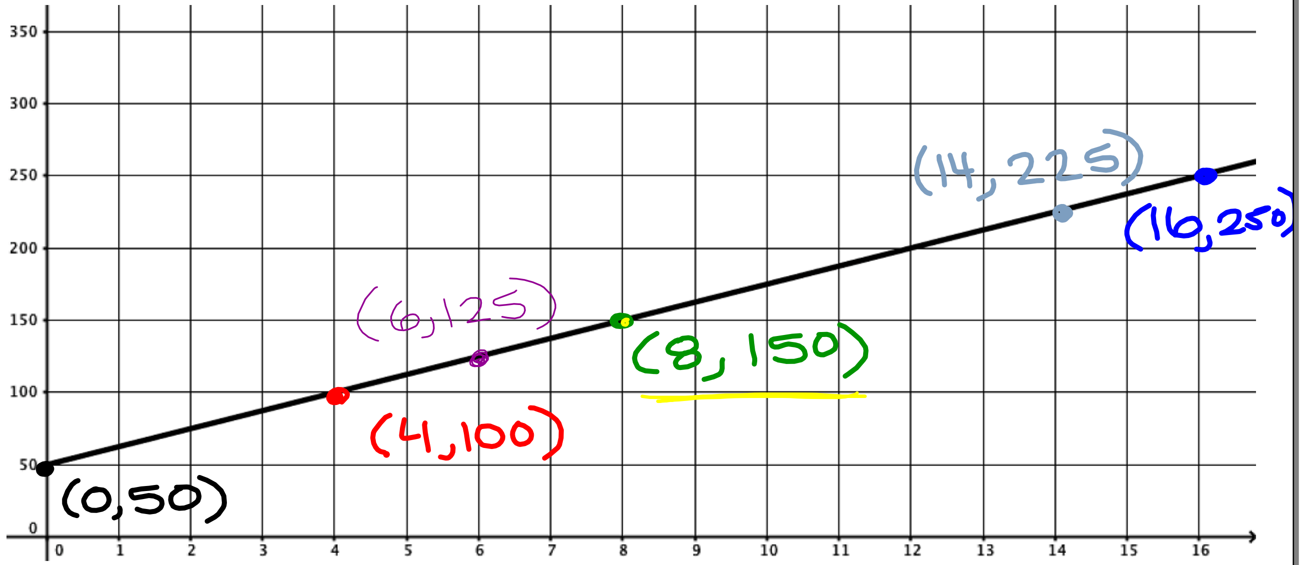
e) $h(45) =$ The height of the water in cm, 45 minutes after the hose is turned on.

f) Use what you previously learned about composite functions to explain why $h^{-1}\left(h(20)\right) = 20$

$h(20) \rightarrow$ The hight of water in cm 20 minutes after hose is turned on.

$h^{-1}(h(20)) \rightarrow$ The time in minutes that the height of the water was after 20 minutes of the hose being on.

4. The graph of a linear function, g(x), is shown below. The scale used on the x-axis is 1 unit and the scale used on the y-axis is 50 units.



Use the graph of g(x) to complete the chart below.
Each row should have all 3 columns completed.

	Question	Re-write the question using function notation	Answer the question
A.	What is the value of $g(x)$ when $x = 8$?	$g(8)$	150
B.	For what value of x is $g(x) = 250$?	$g^{-1}(250)$	16
C.	What is the value of g(x) when x=0?	$g(0)$	50
D.	What is the value of g(x) where x=4?	$g(4)$	100
E.	For what value of x is g(x) = 125?	$g^{-1}(125)$	6
F.	For what value of x is g(x)=150?	$g^{-1}(150)$	8
G.	What is the value of g(x) when x=14?	$g(14)$	225