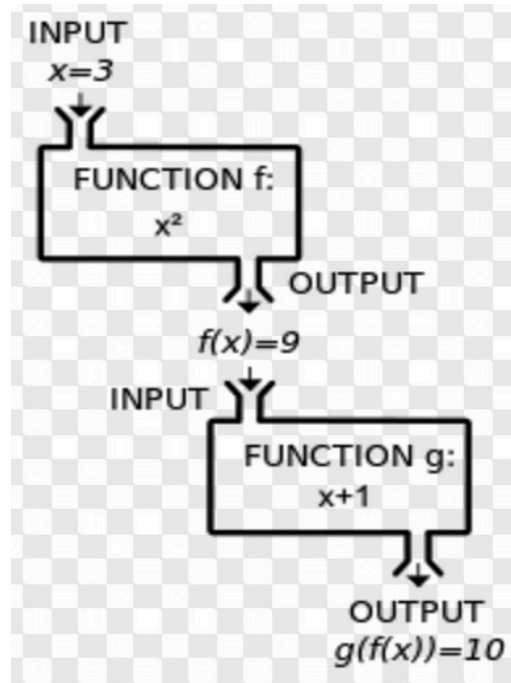


CP Algebra 2



Unit 5 Function Operations (Book sections 7.6 and 7.7)

NAME _____ PERIOD _____ Teacher _____

Learning Targets

Function Operations	1. I can perform operations with functions. 2. I can evaluate composite functions
Function Composition	3. I can write function rules for composite functions
Inverse Functions	4. I can graph and identify domain and range of a function and its inverse. 5. I can write function rules for inverses of functions and verify using composite functions

Function Operations

Date: _____

After this lesson and practice, I will be able to...

- perform operations with functions. (LT1)
 - evaluate composite functions. (LT2)
-

Having studied how to perform operations with one function, you will next learn how to perform operations with several functions.

Function Operation Notation

Addition: $(f + g) = f(x) + g(x)$

Multiplication: $(f \cdot g) = f(x) \cdot g(x)$

Subtraction: $(f - g) = f(x) - g(x)$

Division $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}, g(x) \neq 0$

The domain of the results of each of the above function operation are the _____-values that are in the domains of both _____ and _____ (except for _____, where you must exclude any _____-values that cause _____. (Remember you cannot divide by zero)

Function Operations (LT 1)

Example 1: Given $f(x) = 3x + 8$ and $g(x) = 2x - 12$, find $h(x)$ and $k(x)$ and their domains:

a) $h(x) = (f + g)(x)$ and

b) $k(x) = 2f(x) - g(x)$

Example 2: Given $f(x) = x^2 - 1$ and $g(x) = x + 5$, find $h(x)$ and $k(x)$ and their domains:

a) $h(x) = (f \cdot g)(x)$

b) $k(x) = \frac{f(x)}{g(x)}$

Your Turn 1: Given $f(x) = 3x - 1$, $g(x) = 2x^2 - 3$, and $h(x) = 7x$, find each of the following functions and their domains.

- a. $f(x) + g(x)$ b. $(f - h)(x)$ c. $g(x) \cdot h(x)$ d. $\left(\frac{g}{f}\right)(x)$

Composite Functions (LT 2)

Let's explore another function operation using a familiar topic – money!

Example 3: A store offers a 20% discount on all items and you also have a \$3 coupon. Suppose you want to buy an item that originally costs \$30. If both discounts can be applied to your purchase, which discount should you apply first? Does it matter?

- a) 20% then \$3 b) \$3 then 20%

This example demonstrates the idea of _____ functions.

Definition 1: **Composition of Functions** is created when the output of one function becomes the input of another function.

The composition of function f with function g is written as _____ or _____ and is read as “ f of g of x ”

The composition of function g with function f is written as _____ or _____ and is read as “ g of f of x ”

When evaluating a composite function, evaluate the _____ function first.

Example 4: Let $f(x) = 2x^2 - 5$ and $g(x) = -3x + 1$. Find

- a. $(f \circ g)(2)$ b. $g(f(-3))$ This is read “ g of f of -3 ”

FINAL CHECK: (Cont)

Learning Target 2: I can evaluate composite functions.

2. Let $f(x) = 2x^2 + 5x - 1$ and $g(x) = 4x + 2$. Find and simplify each function below. *Show all work.*
- a. $f(g(-3))$ b. $g(f(-5))$

3. Let $f(x) = \frac{1}{5}x - 3$ and $g(x) = -5x + 8$. Find and simplify each function below. *Show all work.*
- a. $f(g(2))$ b. $g(g(-3))$

Practice Assignment

- I can use perform operations with function. (LT1)
- I can evaluate composite functions. (LT2)
 - Worksheet 7.6 on the next page (for both LT 1 and LT 2)

..(Answers Practice 7.6)

Practice 7-6

1a. $f(x) = 1.8x$ 1b. $g(x) = 0.75x$ 1c. $g(f(150)) = \$202.50$

1d. No; it doesn't matter whether you first multiply by 0.75 or by 1.8. 2. $2x^2 + 4x + 2$; all real numbers

3. $-2x^2 + 4x - 4$; all real numbers

4. $8x^3 - 2x^2 + 12x - 3$; all real numbers

5. $\frac{4x-1}{2x^2+3}$; all real numbers 6. $2x^2 - 4x + 4$; all real

numbers 7. $\frac{2x^2+3}{4x-1}$; all real numbers except $\frac{1}{4}$ 8. -4

9. -2 10. 7 11. $\frac{-3a+2}{5}$ 12. $-4x + 7$

13. $2x^2 - 3x - 7$ 14. $\frac{17}{5}$ 15. $\frac{16}{5}$ 16. $-8x + 6$ 17. $-\frac{4}{5}$

18. $\frac{-3x+2}{5}$ 19. $\frac{7}{5}$ 20. $3x^2 - 13$

21. $3x^3 + 2x^2 - 15x - 10$ 22. $-2x^2 + 3x + 12$

23a. $f(x) = 0.75x$ 23b. $g(x) = x - 5$

23c. $g(f(50)) = \$32.50$ 23d. Yes; multiplying by 0.75 and then subtracting by 5 is different than subtracting by 5 and then multiplying by 0.75.

Practice 7-6

Function Operations

1. A boutique prices merchandise by adding 80% to its cost. It later decreases by 25% the price of items that don't sell quickly.
 - a. Write a function $f(x)$ to represent the price after the 80% markup.
 - b. Write a function $g(x)$ to represent the price after the 25% markdown.
 - c. Use a composition function to find the price of an item after both price adjustments that originally costs the boutique \$150.
 - d. Does the order in which the adjustments are applied make a difference? Explain.

Let $f(x) = 4x - 1$ and $g(x) = 2x^2 + 3$. Perform each function operation and then find the domain.

- | | | |
|------------------------|------------------|------------------------|
| 2. $f(x) + g(x)$ | 3. $f(x) - g(x)$ | 4. $f(x) \cdot g(x)$ |
| 5. $\frac{f(x)}{g(x)}$ | 6. $g(x) - f(x)$ | 7. $\frac{g(x)}{f(x)}$ |

Let $f(x) = -3x + 2$, $g(x) = \frac{x}{5}$, $h(x) = -2x^2 + 9$, and $j(x) = 5 - x$. Find each value or expression.

- | | | |
|-----------------------|-----------------------|-----------------------|
| 8. $(f \circ j)(3)$ | 9. $(j \circ h)(-1)$ | 10. $(h \circ g)(-5)$ |
| 11. $(g \circ f)(a)$ | 12. $f(x) + j(x)$ | 13. $f(x) - h(x)$ |
| 14. $(g \circ f)(-5)$ | 15. $(f \circ g)(-2)$ | 16. $3f(x) + 5g(x)$ |
| 17. $g(f(2))$ | 18. $g(f(x))$ | 19. $f(g(1))$ |

Let $g(x) = x^2 - 5$ and $h(x) = 3x + 2$. Perform each function operation.

- | | | |
|----------------------|-----------------------|---------------------|
| 20. $(h \circ g)(x)$ | 21. $g(x) \cdot h(x)$ | 22. $-2g(x) + h(x)$ |
|----------------------|-----------------------|---------------------|

23. A department store has marked down its merchandise by 25%. It later decreases by \$5 the price of items that have not sold.
 - a. Write a function $f(x)$ to represent the price after the 25% markdown.
 - b. Write a function $g(x)$ to represent the price after the \$5 markdown.
 - c. Use a composition function to find the price of a \$50 item after both price adjustments.
 - d. Does the order in which the adjustments are applied make a difference? Explain.

More Practice #1

1) Adding and Subtracting Functions. Let $f(x) = -2x + 6$ and $g(x) = 5x - 7$.

a) Find $f + g$ and its domain

b) Find $f - g$ and its domain

2) Let $f(x) = 5x^2 - 4x$ and $g(x) = 5x + 1$.

a) Find $f + g$ and its domain

b) Find $f - g$ and its domain

3) Multiplying and Dividing Functions. Let $f(x) = x^2 + 1$ and $g(x) = x^4 - 1$.

a) Find $(f \cdot g)$ and its domain

b) Find $\left(\frac{f}{g}\right)(x)$ and its domain

c) Find $f(g(2))$

d) $g(f(-2))$

4) Let $f(x) = 6x^2 + 7x - 5$ and $g(x) = 2x - 1$.

a) Find $(f \cdot g)$ and its domain

b) Find $\left(\frac{f}{g}\right)(x)$ and its domain

c) Find $f(g(2))$

d) $g(f(-2))$

6) A store is offering a 10% discount on all items. In addition, employees get a 25% discount.

a) Write a composite function to model taking the 10% discount first.

b) Write a composite function to model taking the 25% discount first.

c) If you were an employee, which would you prefer?

More Practice: #2

1) Given $f(x) = x + 2$ and $g(x) = 8x - x^2$, find the following:

a) $h(x) = f(x) + g(x)$

b) $h(x) = 3f(x) - g(x)$

c) $h(x) = f(x) \cdot g(x)$

d) $h(x) = \frac{1}{2}g(x) + f(x)$

e) $h(x) = g(x) \div f(x)$

f) $(f \circ g)(3)$

g) $g(f(5))$

2) Given $f(x) = x^2 + 2$ and $g(x) = 3x - 5$

a) $f(6) + 3g(2) =$

b) $2g(6) =$

c) $f(-4) =$

d) $5g\left(\frac{1}{3}\right) =$

e) $g(f(-2)) =$

f) $(f \circ g)(-1)$

g) $g(f(\frac{1}{2})) =$

More Practice #3: Practice with Composite Functions using the same $f(x) = x^2 - 4x + 1$ and $g(x) = 12x + 3$. Remember, work from the inside - out!

- 1) $(f \circ g)(3)$ 2) $f(g(-1)) =$ 3) $f\left(g\left(\frac{1}{6}\right)\right) =$
- 4) $4(f(2)) =$ 5) $g(-1) - 2f(-3) =$ 6) $g(f(\frac{1}{2})) =$

More Practice #4:

Function Notation

1. Please find the indicated value of $f(x)$:

- a. $f(x) = -x^2 - 3x + 2$, $3f(-2)$ b. $f(x) = \frac{1}{2}x^2 - 4$, $f(1)$

Operations with Functions

2. Given: $f(x) = x^2 + 4$ & $g(x) = 2x - 1$, evaluate:

- a. $f(x) + g(x) =$ b. $g(x) - 2f(x) =$ c. $f(g(5)) =$

- a. _____ b. _____ c. _____

- d. $f(x) * g(x) =$ e. $(f \circ g)(3) =$ f. $g(f(4)) =$

- d. _____ e. _____ f. _____

Function Composition

Date: _____

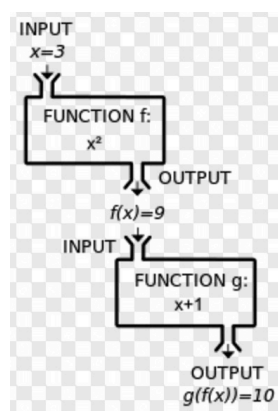
After this lesson and practice, I will be able to...

- write function rules for composite functions (LT 3).

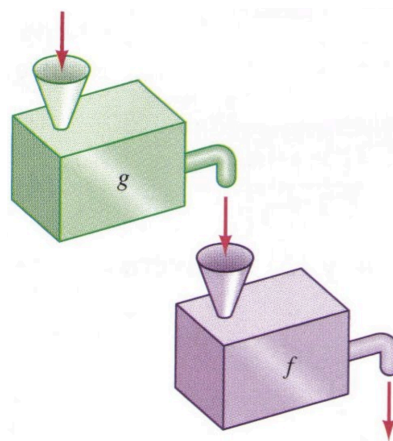
Warm Up: Let $f(x) = 3x^2 - 4$ and $g(x) = 2x + 1$. Find

- a. $(f \circ g)(3)$
- b. $g(f(-2))$

In the previous lesson, we found specific values of compositions of two functions. In this lesson, we will find a general formula for function compositions. In evaluating function compositions, we substituted the value of x into the input function, then used the output from that function as the input on the next function.


$$g(f(x)) \text{ or } (g \circ f)(x)$$

With function composition, the rule of the input function is used as the input into the next function.

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

Example 1: Given $f(x) = 3x + 1$ and $g(x) = 2x + 3$, find

- a. $f(g(x))$ b. $(g \circ f)(x)$ c. $(f \circ f)(x)$

Example 2: Given $f(x) = x^2 + 1$ and $g(x) = x + 3$, find

- a. $f(g(x))$ b. $(g \circ f)(x)$ c. $(g \circ g)(x)$

Example 3: Given $f(x) = x^2 + 2x + 3$ and $g(x) = x - 2$, find

a. $f(g(x))$

b. $(g \circ f)(x)$

c. $g(g(x))$

Example 4: A store offers a 15% discount on all items and you also have a \$10 coupon. Both discounts can be applied to your purchase. Write a function rule, $f(x)$ for using the coupon and a function rule, $g(x)$ for using the 15% discount. Write a function composition rule for using the \$10 coupon first and then taking the 15% discount and another rule for using the 15% discount first and then taking the \$10 coupon. Which will give the lowest purchase cost?

Coupon then %

% then coupon

Your Turn:

Example 5: Suppose you are taking a trip across the world (from the U.S. to Prague, to Cape Town) exchanging your money as you travel to each destination. The currency exchange function from x US dollars (USD) to Czech Koruna is $K(x) = 20.6x$. The exchange rate from x koruna to South Africa rand to is $R(x) = .60x$.

a. Write a function to exchange x USD directly to rand.

b. If you have \$210 USD, use your function from part (a) to determine how many rand you would have if you exchanged all your money to rand.

FINAL CHECK: Find the following composite functions:

	$f(g(x))$	$(g \circ f)(x)$	$f(f(x))$
a) $f(x) = 4x^2 + 2$ $g(x) = x-3$	$= f(g(x))$ $= f(x-3)$ $= 4(x-3)^2 + 2$		
b) $f(x) = 4x$ $g(x) = 2-x$			
c) $f(x) = x^2 - 2x$ $g(x) = 5x + 1$			
d) $f(x) = -x^2 - 2$ $g(x) = x + 4$			

2. Suppose you are taking a trip across the world (from the U.S. to Israel, to Morocco), exchanging your money as you travel to each destination. The currency exchange function from x US dollars to Israeli shekel is $S(x) = 3.5x$. The currency exchange function from x Israeli shekels to Moroccan dirham is $D(x) = 2.63x$.

a. Write a function to exchange x USD directly to dirhams.

b. If you have \$210 USD, use your function from part (a) to determine how many dirhams you would have if you exchanged all your money to dirhams.

Practice Assignment

- Write function rules for composite functions (LT 3).
 - Worksheet (next pages)

Function Composition Worksheet LT#3

Perform the indicated operation.

1) $g(x) = x - 2$
 $f(x) = x^3 - 2$
Find $(g \circ f)(x)$

2) $g(a) = 4a - 2$
 $f(a) = a^2 + 5 - 2a$
Find $(g \circ f)(a)$

3) $g(n) = n^2 - 2 + n$
 $h(n) = 4n - 5$
Find $(g \circ h)(n)$

4) $h(a) = a^3 - 5$
 $g(a) = 2a - 4$
Find $(h \circ g)(a)$

5) $f(n) = 3n + 3$
 $g(n) = n^3 - n$
Find $(f \circ g)(n)$

6) $h(a) = 4a + 4$
 $g(a) = a^2 + 2$
Find $(g \circ h)(a)$

7) $f(t) = 2t - 2$
 $g(t) = t^2 + 4t$
 Find $(g \circ f)(t)$

8) $g(x) = -x - 4$
 $h(x) = x - 1$
 Find $(g \circ h)(x)$

9) $g(x) = 2x + 2$
 $f(x) = x^2 + 3$
 Find $(g \circ f)(x)$

10) $h(n) = n - 5$
 $g(n) = n^3 - 3n^2 - 2n$
 Find $(h \circ g)(n)$

11) $g(n) = -3n^2 + 5n$
 $f(n) = 2n - 1$
 Find $(g \circ f)(n)$

12) $g(x) = -x + 3$
 $f(x) = x^2 + 2x$
 Find $(g \circ f)(x)$

More Practice #1:

1. A department store has marked down its merchandise by 25%. It later decreases by \$5 the price of items that have not sold.
 - a. Write a function $f(x)$ to represent the price after the 25% markdown.
 - b. Write a function $g(x)$ to represent the price after the \$5 markdown.
 - c. Use a composition function to find the price of a \$50 item after both price adjustments.
 - d. Does the order in which the adjustments are applied make a difference? Explain.

2. A boutique prices merchandise by adding 80% to its cost. It later decreases by 25% the price of items that don't sell quickly.
 - a. Write a function $f(x)$ to represent the price after the 80% markup.
 - b. Write a function $g(x)$ to represent the price after the 25% markdown.
 - c. Use a composition function to find the price of an item after both price adjustments that originally costs the boutique \$150.
 - d. Does the order in which the adjustments are applied make a difference? Explain.

3 Given: $f(x) = x^2 + 4$ & $g(x) = 2x - 1$, evaluate:

e. $f(x) \div g(x) =$

f. $f(g(x)) =$

e. _____

f. _____

g. $g(f(x)) =$

h. $f(g(-3)) =$

g. _____

h. _____

4. Given: $g(x) = 2x - 5$ & $j(x) = -9x - 3$, evaluate:

a. $g(x) + j(x) =$

b. $j(x) - 2g(x) =$

a. _____

b. _____

c. $g(x) * j(x) =$

d. $g(x) \div j(x) =$

c. _____

d. _____

e. $g(j(x)) =$

f. $j(g(x)) =$

e. _____

f. _____

Please find the indicated value of $f(x)$:

5. $f(x) = -2x^2 + x - 1$, $f(-2)$

Let $g(x) = x^2 - 5$ and $h(x) = 3x + 2$. Perform each function operation.

6. $(h \circ g)(x)$

7. $g(x) \cdot h(x)$

8. $-2g(x) + h(x)$

9. Let $f(x) = -3x + 2$, $g(x) = \frac{x}{5}$, $h(x) = -2x^2 + 9$. Find each value or expression.

a. $g(f(2))$

b. $g(f(x))$

c. $f(g(1))$

Inverse Relations and Functions

After this lesson and practice, I will be able to ...

- Graph and identify the domain and range of a function and its inverse. (LT 4)

Warm Up: Let $f(x) = 4x + 2$ and $g(x) = \frac{x-2}{4}$, find $(f \circ g)(x)$

Definition 1: **Inverse Relations** – If f and g are _____ relations, then the domain of f is the _____ of g and the range of f is the _____ of g .

In other words, If (x, y) is an ordered pair in f the _____ is an ordered pair in its inverse, g .

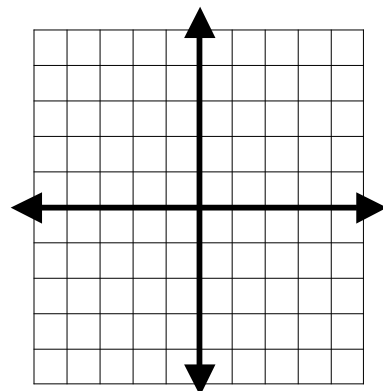
Example 1: The coordinates of a relation are $\{(-2, 4)(5, 0)(3, -11)\}$, find the coordinates of its inverse.

Mini-Exploration: Inverse Function Graphically

1. Suppose the function $f(x)$ consists of the ordered pairs in the table below. Use a solid line to graph $f(x)$. Use a dashed line to graph its inverse on the same graph. Fold your graph paper so the graphs of $f(x)$ and its inverse lay directly on top of one another. Using the fold determine the line about which the inverse functions are symmetric.

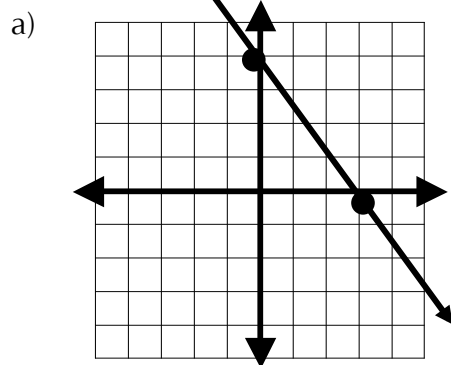
x	-3	-2	-1	0	1	2	3
y	-5	-3	-1	1	3	5	7

2. Explain how the x- and y- values of $f(x)$ above relate to the x- and y- values of its inverse.



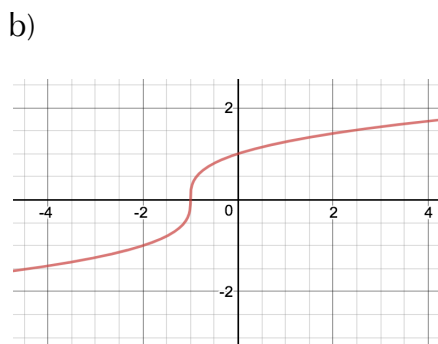
From the exploration, we see that (graphically speaking) inverse relations are _____ of each other across the line _____.

Example 2: Sketch the inverse of the function graphed and the line of reflection. What is the domain and range of the original function and it's inverse



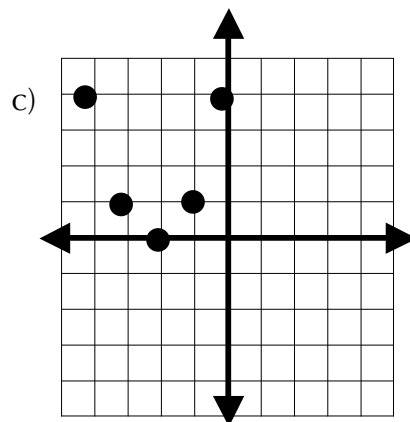
D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____



D_f : _____ $D_{f^{-1}}$: _____

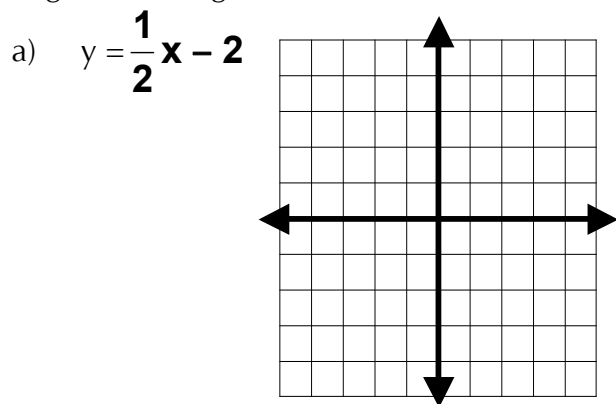
R_f : _____ $R_{f^{-1}}$: _____



D_f : _____ $D_{f^{-1}}$: _____

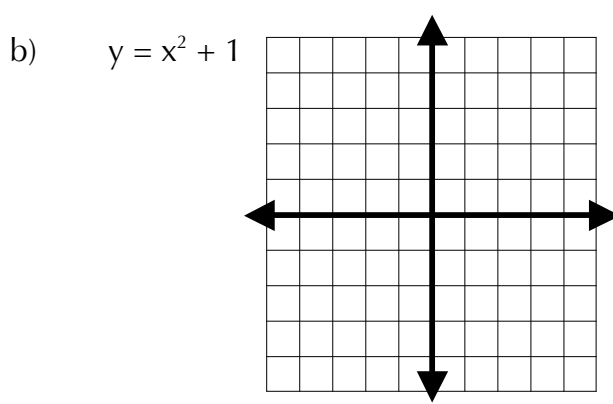
R_f : _____ $R_{f^{-1}}$: _____

Example 3: Sketch the function, it's inverse and the line of reflection. Determine the domain and range of the original function and it's inverse.



D_f : _____ $D_{f^{-1}}$: _____

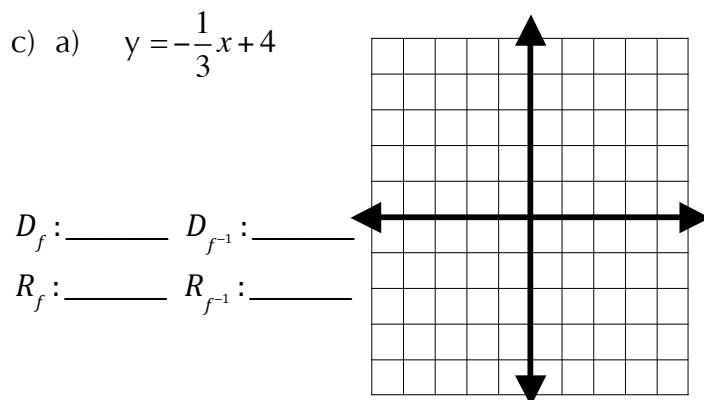
R_f : _____ $R_{f^{-1}}$: _____



D_f : _____ $D_{f^{-1}}$: _____

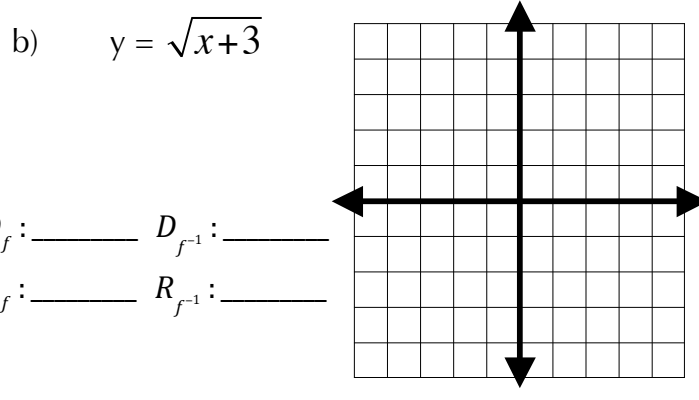
R_f : _____ $R_{f^{-1}}$: _____

Your turn:



D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____



D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____

Inverse Function Algebraically

After this lesson and practice, I will be able to ...

I can write function rules for inverses of functions and verify using composite functions (LT5)

Since the x- and y-values of inverse relations are _____, to find an equation for the inverse of a relation you simply _____ the x and y in the original relation and solve for _____.

Example 1: Find the inverse for each of the following functions.

a. $y = 3x + 4$

b. $y = -5x - 2$

c. $f(x) = x^2 + 7$

Your Turn: Find the inverse for each of the following functions.

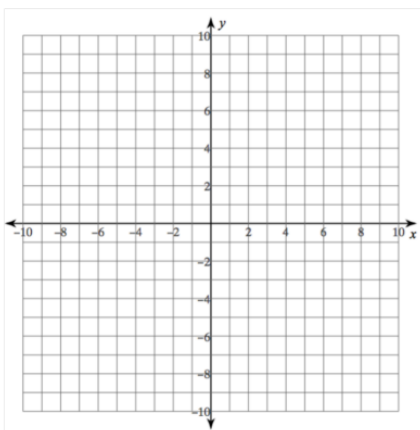
a. $y = 5x - 9$

b. $y = \frac{x+11}{7}$

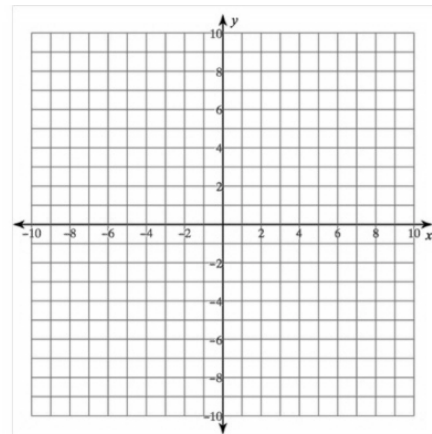
c. $f(x) = (x - 4)^2$

Example 2: Find the inverse algebraically then graph the function, its inverse, and the line of reflection.

a. $y = -\frac{1}{3}x + 2$



b. $y = x^2 + 5$



Which of the above inverse is also a function _____? Remember, for a relation to be a function, each input must correspond to exactly _____ output: or each value in the domain must correspond to exactly _____ value in the range.

*Note, you can quickly determine if a function's inverse is also a function by using the _____ Line Test.

Notation: Given a function $f(x)$, its inverse relation is denoted _____. This is read as " f inverse of x ."

An interesting result occurs when you compose a function with its inverse. Revisit the Warm Up!

Property: If _____ and _____ are inverses of each other then:

Example 3: Let $f(x) = 2x - 5$. Find $f^{-1}(x)$ and then verify that f and f^{-1} are inverses of each other.

Your Turn 2: Let $f(x) = \frac{1}{3}x + 2$. Find $f^{-1}(x)$ and then verify that f and f^{-1} are inverses of each other.

Example 4: Let $f(x) = -4x + 1$. Find $f^{-1}(x)$ then find the other values

$f^{-1}(x)$ a. $f(f^{-1}(5))$ b. $f(f^{-1}(360))$ c. $f^{-1}(f(-97\pi))$

FINAL CHECK: LT 4 and 5

1. Write an equation for the inverse of each of the given functions. Then state whether the inverse is a function. *Show your work.*

a. $y = -3x + 9$

b. $f(x) = 2x^2 - 1$

Inverse: _____

Inverse: _____

Inverse a function? _____

Inverse a function? _____

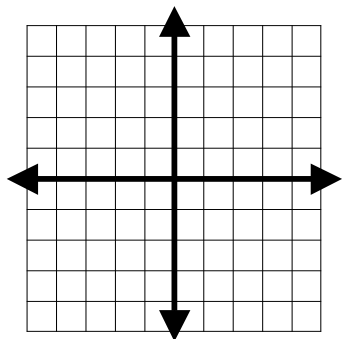
2. Verify, using function composition, that $f(x) = \frac{1}{5}x + 6$ and $g(x) = 5x - 30$ are inverses of each other. Show all steps.

$f(g(x)) =$

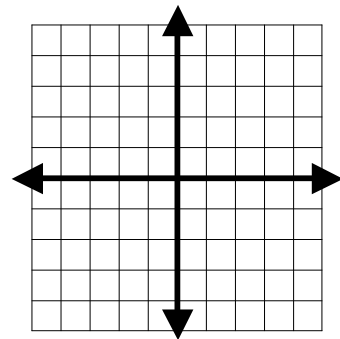
$g(f(x))$

4. Sketch the function, it's inverse and the line of reflection:

a) $y = \frac{3}{4}x - 4$



b) $y = -(x-2)^2$

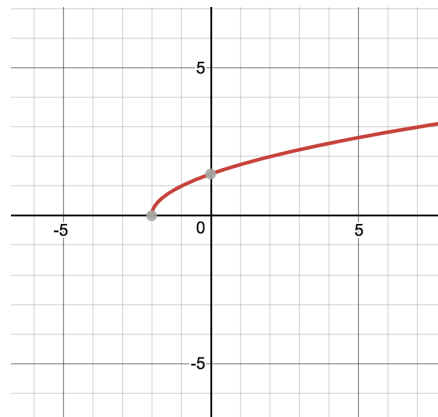


3. Let $f(x) = -4x + 5$. Find $f(f^{-1}(10)) =$ _____

4. The graph of $f(x)$ is shown. Graph the inverse as a solid line and the line of reflection as a dashed line.

Domain of f : _____ Domain of f^{-1} : _____

Range of f : _____ Range of f^{-1} : _____



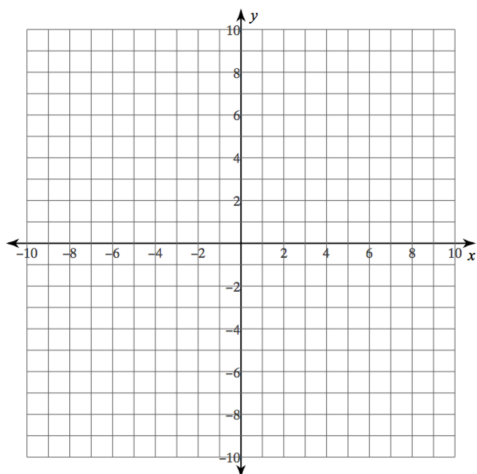
Practice Assignment

- Graph and identify the domain and range of a function and its inverse. (LT 4)
 - LT 4 Homework Worksheet
- Write function rules for inverses of functions. (LT 5)
 - Worksheet 7-7 odds

Learning Target 4 Homework

Graph each function, its inverse, and determine the domain and range of f and f^{-1} .

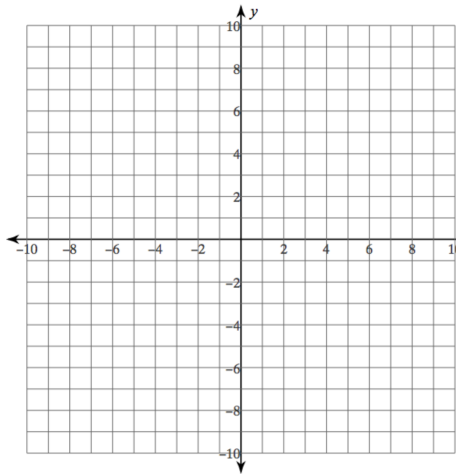
1. $f(x) = 2x + 1$



D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____

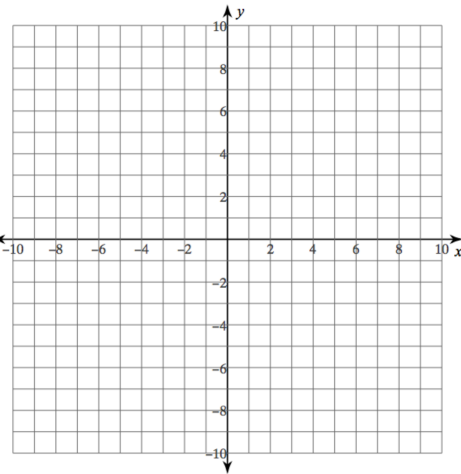
2. $f(x) = \sqrt{x} + 2$



D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____

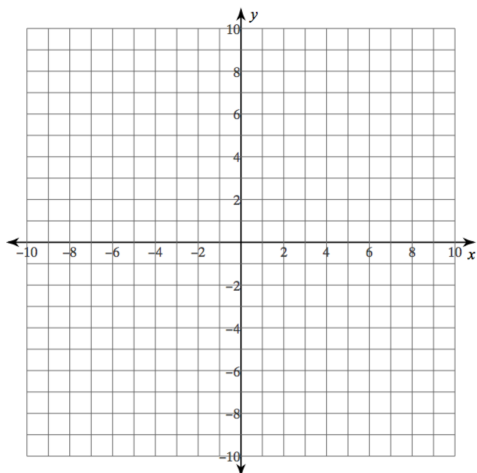
3. $f(x) = x^2 + 2$



D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____

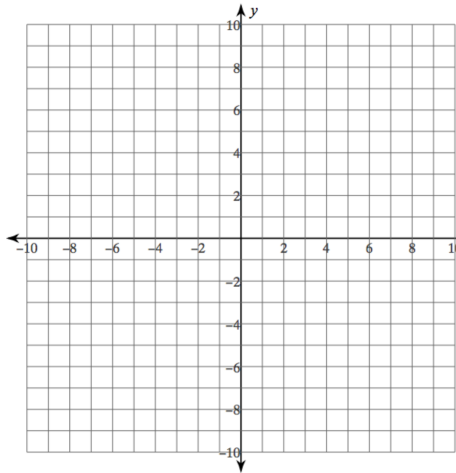
4. $f(x) = 0.5x - 2$



D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____

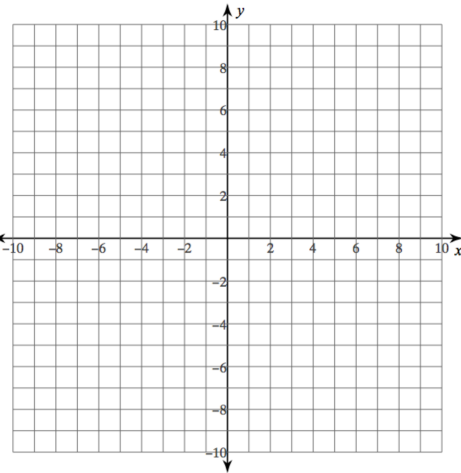
5. $f(x) = \sqrt{x - 4}$



D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____

6. $f(x) = -x^2 - 3$



D_f : _____ $D_{f^{-1}}$: _____

R_f : _____ $R_{f^{-1}}$: _____

Practice 7-7.....Inverse Relations and Functions

Graph each relation and its inverse.

1. $y = \frac{x+3}{3}$

2. $y = \frac{1}{2}x + 5$

3. $y = 2x + 5$

4. $y = 4x^2$

5. $y = \frac{1}{2}x^2$

6. $y = \frac{2}{3}x^2$

Find the inverse of each function. Is the inverse a function?

7. $y = x^2 + 2$

8. $y = x + 2$

9. $y = 3(x + 1)$

10. $y = -x^2 - 3$

11. $y = 2x - 1$

12. $y = 1 - 3x^2$

13. $y = 5x^2$

14. $y = (x + 3)^2$

15. $y = 6x^2 - 4$

16. $y = 3x^2 - 2$

17. $y = (x + 4)^2 - 4$

18. $y = -x^2 + 4$

For each function f , find f^{-1} and the domain and range of f and f^{-1} . Determine whether f^{-1} is a function.

19. $f(x) = \frac{1}{6}x$

20. $f(x) = -\frac{1}{5}x + 2$

21. $f(x) = x^2 - 2$

22. $f(x) = x^2 + 4$

23. $f(x) = \sqrt{x-1}$

24. $f(x) = \sqrt{3x}$

Find the inverse of each relation. Graph the given relation and its inverse.

25.

x	-2	-1	0	1
y	-3	-2	-1	0

26.

x	0	1	2	3
y	-3	-1	0	-2

Let $f(x) = 2x + 5$. Find each value.

27. $(f^{-1} \circ f)(-1)$

28. $(f \circ f^{-1})(3)$

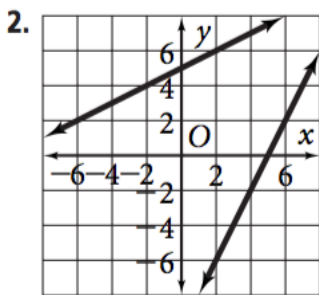
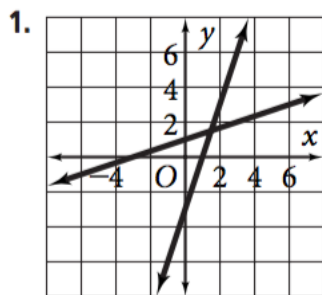
29. $(f \circ f^{-1})\left(-\frac{1}{2}\right)$

30. The equation $f(x) = 198,900x + 635,600$ can be used to model the number of utility trucks under 6000 pounds that are sold each year in the U.S. with $x = 0$ representing the year 1992. Find the inverse of the function. Use the inverse to estimate in which year the number of utility trucks under 6000 pounds sold in the U.S. will be 4,000,000.

Source: www.infoplease.com

(answers next page)

Practice 7-7



19. $f^{-1}(x) = 6x$; The domain and range of f and f^{-1} is the set of all real numbers; f^{-1} is a function.

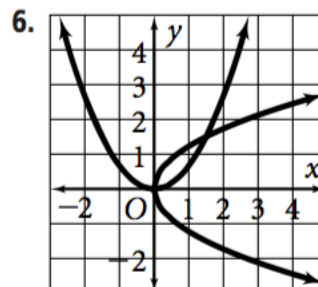
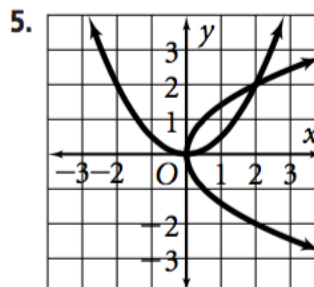
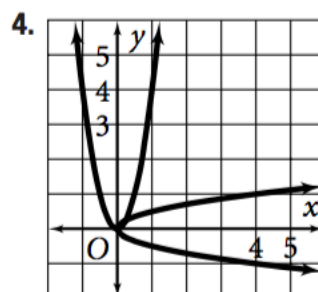
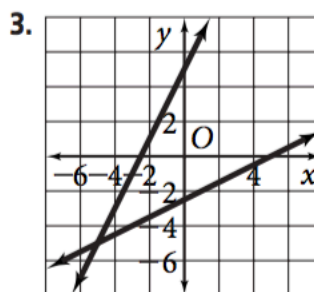
20. $f^{-1}(x) = -5x + 10$; The domain and range of f and f^{-1} is the set of all real numbers; f^{-1} is a function.

21. $f^{-1}(x) = \pm\sqrt{x+2}$; Domain of f = all real numbers = range of f^{-1} ; Range of f = the set of real numbers greater than or equal to -2 = domain of f^{-1} ; f^{-1} is not a function.

22. $f^{-1}(x) = \pm\sqrt{x-4}$; Domain of f = all real numbers = range of f^{-1} ; Range of f = all real numbers greater than or equal to 4 = domain of f^{-1} ; f^{-1} is not a function.

23. $f^{-1}(x) = x^2 + 1$; Domain of f = all real numbers greater than or equal to 1 = range of f^{-1} ; Range of f = all real numbers greater than or equal to 0 = domain of f^{-1} ; f^{-1} is a function.

24. $f^{-1}(x) = \frac{1}{3}x^2$; The domain and range of f and f^{-1} is the set of all real numbers greater than or equal to 0 ; f^{-1} is a function.



7. $y = \pm\sqrt{x-2}$; no 8. $y = x-2$; yes

9. $y = \frac{1}{3}x - 1$; yes 10. $y = \pm\sqrt{-x-3}$; no

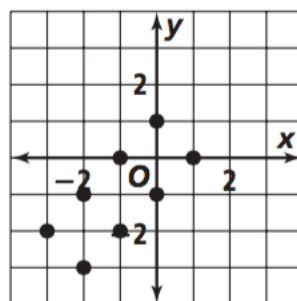
11. $y = \frac{1}{2}x + \frac{1}{2}$; yes 12. $y = \pm\sqrt{\frac{1-x}{3}}$; no

13. $y = \pm\sqrt{\frac{x}{5}}$; no 14. $y = \pm\sqrt{x-3}$; no

15. $y = \pm\sqrt{\frac{x+4}{6}}$; no 16. $y = \pm\sqrt{\frac{x+2}{3}}$; no

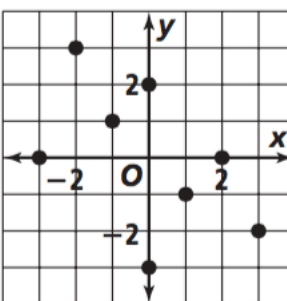
25.

x	-3	-2	-1	0
y	-2	-1	0	1



26.

x	-3	-1	0	-2
y	0	1	2	3



27. -1 28. 3 29. $-\frac{1}{2}$ 30. $f^{-1}(x) = \frac{x - 635,600}{198,900}$; in 2009

More Practice #1:

The **inverse** of a relation is the set of ordered pairs obtained by _____ the coordinates of each ordered pair!

Original

Inverse

1) $\{(1,3), (2,4), (3,6)\}$

2) $\{(-9,-7), (3,5), (0,2), (-10,8)\}$

To write the EQUATION OF THE INVERSE OF A FUNCTION:

- 1) Interchange the x and y variables.
- 2) Solve for y.



Write the inverse for each of these functions:

3) $y = 3x - 4$

4) $y = 2x + 1$

5) $y = x^2 + 3$

$\downarrow \quad \downarrow$
 $(\quad) = 3(\quad) - 4$

If two functions are inverses of each other then: $f(g(x)) = \underline{\hspace{1cm}}$ & $g(f(x)) = \underline{\hspace{1cm}}$!!!!

6) Determine whether or not the functions are inverses of each other:

a) $f(x) = 2x + 4$

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

Ans. _____

b) $f(x) = \frac{1}{3}x + 2$

$g(x) = 3x - 2$

Ans. _____

1. Let $f(x) = x^2 - 2$ and let $g(x) = 3x$. Find the following:

$$f(g(2)) =$$

$$g(f(1)) =$$

2. Let $f(x) = x^2 + 5$ and let $g(x) = x + 1$. Find and simplify $f(g(x))$ and $g(f(x))$.

$f(g(x))$	$g(f(x))$
$f(g(x)) =$ _____	$g(f(x)) =$ _____

3. Let $f(x) = 2x - 1$ and let $g(x) = x + 4$. Find and simplify a new function, $h(x)$, according to the indicated operation or composition.

a. $f(x) + g(x)$

$$h(x) =$$

b. $f(x) - g(x)$

$$h(x) =$$

c. $f(x) \cdot g(x)$

$$h(x) =$$

d. $f(x) \div g(x)$

$$h(x) =$$

e. $f(g(x))$

$$h(x) =$$

f. $g(f(x))$

$$h(x) =$$

One of the above $h(x)$ functions has a domain restriction on what x could be. Place a comma after the $h(x)$ function above, followed by the restriction on x .

4. Write the inverse of the relation: $\{(-2,1), (3,0), (4,-2), (6,1)\}$

5. Write an equation for the inverse of the relation and solve for y.

original: $y = 2x - 4$

inverse: $y =$ _____

6. What is the equation for the line of reflection between a relation and its inverse?

7. a. Graph the inverse of $f(x) = \sqrt{x+2} + 1$. Include the line of reflection as a dashed line.

b. Is the inverse a function? _____

c. domain of $f(x)$: _____

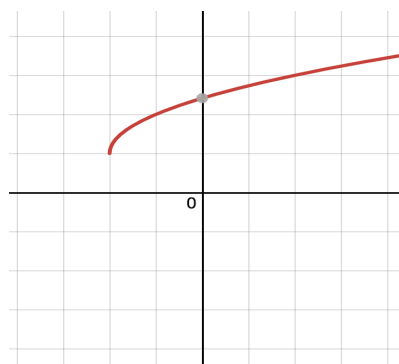
range of $f(x)$: _____

domain of $f^{-1}(x)$: _____

range of $f^{-1}(x)$: _____

>

>



8. a. If two functions are inverses of each other, then $f(g(x)) =$ _____ and $g(f(x)) =$ _____ .

b. Verify, with composition of functions, that $f(x) = -4x + 12$ and $g(x) = \frac{-1}{4}x + 3$ are inverses of each other. Please show all steps!

Domain and Range of inverses

9. Let $f(x) = 10 - 3x$. Find $f(x)^{-1}$ and the following

a) $f(x)^{-1} =$ _____

b) Domain of $f(x)$ _____ Range $f(x)$ _____

c) Domain of $f(x)^{-1}$ _____ Range $f(x)^{-1}$ _____

d) $f^{-1}(f(3)) =$ _____ e) $f(f^{-1}(3)) =$ _____ f) $(f \circ f^{-1})(5) =$ _____

More Practice #3

1. Given: $\{(1,5), (4,3), (1,9), (0,-1)\}$

a. What is the inverse of the relation?

a. _____

b. What is the Domain of the relation?

b. _____

c. What is the Range of the relation?

c. _____

2. Please find the inverses of the following functions:

a. $y = 2x + 3$

a. _____

b. $y = -x^2 + 5$

b. _____

3. $y = 5x^2$

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

5. $y = 6x^2 - 4$

6. $y = 3x^2 - 2$

7. $y = (x + 4)^2 - 4$

8. $y = -x^2 + 4$

For each function f , find f^{-1} and the domain and range of f and f^{-1} . Determine whether f^{-1} is a function.

9. $f(x) = -\frac{1}{5}x + 2$

11. $f(x) = x^2 - 2$

12. $f(x) = \sqrt{3x}$

Domain f : _____

Range of f : _____

Domain of f^{-1} _____

Range of f^{-1} _____

Function? _____

10) Find an equation for the inverse of the relation $y = 15x - 7$

11) Write the inverse of the relation $\{(1,2),(-3,5),(6,-7),(8,-2)\}$

$f(x) = 2-x$ and $g(x) = 3x$, find each:

12) $g(x) - f(x)$

13) $f(x) \cdot g(x)$

14) $f(x) \div g(x)$

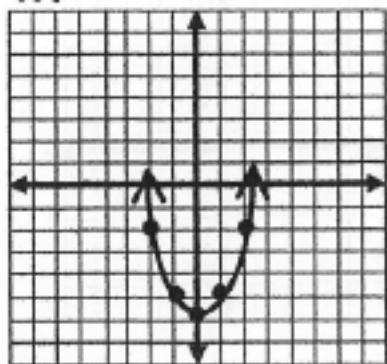
$f(x) = 2-x$ and $g(x) = 3x$, find each:

15) $4g(x)$

16) $f(x) + g(x)$

Graph the inverse of the function.

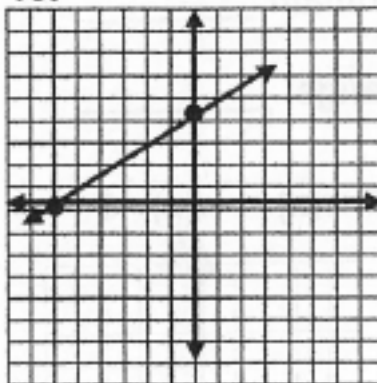
17.



19) $f(g(x))$

20) $g(f(x))$

18.



21) $(g \circ f)(2)$

22) $f(g(-7))$

23) $f(1) + g(3)$

24) $f(5) + g(0)$

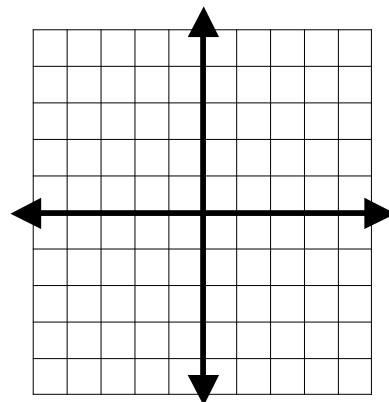
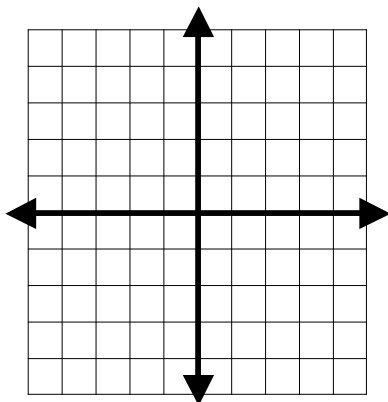
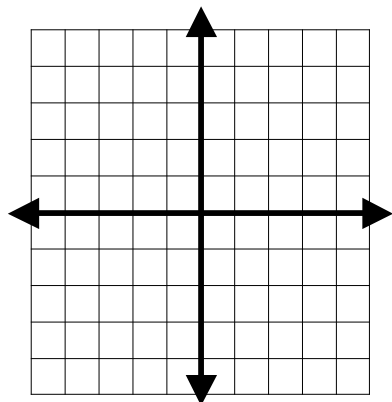
Find the inverse of the function. Then graph the original and the inverse on the same coordinate plane. Also sketch the line of reflection.

35) $f(x) = 4x + 3$

36) $f(x) = \frac{1}{2}x - 1$

37) $f(x) = x^2 + 2$

Inverse: _____



Find an equation for the inverse of the relation. Write in $y = mx + b$ form

38) $y = 2x$

39) $y = -x + 5$

40) $y = 2x + 1$

41) $y = 4x - 9$

42. Given $f(x) = 2x - 1$ and $g(x) = 5x - 12$, find the following:

a) $f(g(x))$

b) $f(x) - g(x)$

c) $3g(x) + f(x)$

Given $f(x) = x+4$ and $g(x) = 3x - 1$, find the following

43) $f(x) \div g(x)$

45) $g(f(x))$

47) $f(g(-5))$

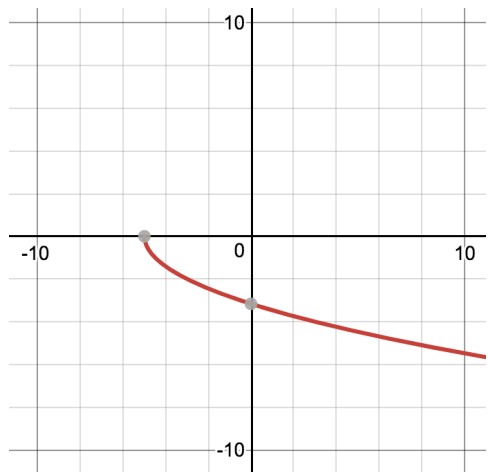
44) $2f(-3) + g(4)$

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

48) $(g \circ f)(3)$

49. Let $f(x) = -2x + 7$. Find $f(f^{-1}(10)) =$ _____

50. The graph of $f(x)$ is shown. Graph the inverse as a solid line and the line of reflection as a dashed line.



Domain of f : _____ Domain of f^{-1} : _____

Range of f : _____ Range of f^{-1} : _____