10.4 Start Thinking

Write a function rule with the x-values as inputs and y-values as outputs. Create a table of values and a graph for the rule.

Follow the steps to create a new function rule:

1. Replace $f(x)$ with y.

2. Switch x and y in the equation.

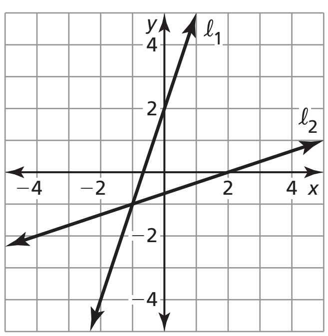
3. Solve for y.

Graph the new function rule on the same coordinate plane. What do you notice? Create a table of values for this function using the y-values in the original table as x-values in the new table. Compare the tables. What do you notice?

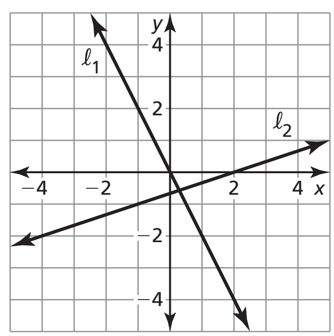
10.4 Warm Up

Determine whether ℓ_2 is a reflection in the line $y = x$ of ℓ_1.

1.



2.



10.4 Cumulative Review Warm Up

Factor the polynomial.

1. $x^2 - 9$

2. $y^2 - 1$

3. $9x^2 - 4$

4. $x^2 - 10x + 25$

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10.4 Practice A

In Exercises 1 and 2, find the inverse of the relation.

1.

Input	−4	−2	0	0	2	4
Output	1	2	3	4	5	6

2.

Input	0	1	4	6	9	10
Output	−3	0	3	6	9	12

In Exercises 3–5, solve $y = f(x)$ for x. Then find the input when the output is 2.

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

4. $f(x) = 3x - 2$

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

In Exercises 6–8, find the inverse of the function. Then graph the function and its inverse.

6. $f(x) = 5x - 3$

7. $f(x) = -3x + 1$

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

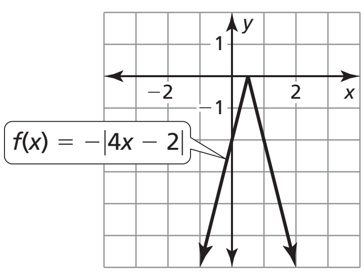
In Exercises 9 and 10, find the inverse of the function. Then graph the function and its inverse.

9. $f(x) = \frac{1}{4}x^2, x \geq 0$

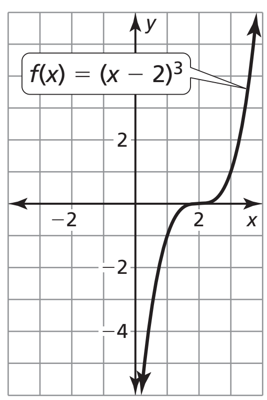
10. $f(x) = -x^2 + 3, x \leq 0$

In Exercises 11 and 12, use the Horizontal Line Test to determine whether the inverse of *f* is a function.

11.



12.



13. The temperature −273.15°C is defined as being absolute zero. It is the basis for the Kelvin (K) temperature scale. The formula $C = K - 273.15$ converts a Kelvin temperature to a Celsius temperature.

a. Determine whether the inverse of the formula $C = K - 273.15$ is a function.

b. Using the formula $C = K - 273.15$, solve for K. Is this new formula the inverse of the formula $C = K - 273.15$? Explain.

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10.4 Practice B

In Exercises 1 and 2, find the inverse of the relation.

1.

Input	−10	−5	0	5	10	15
Output	1	2	1	2	1	2

2.

Input	0	2	4	6	8	10
Output	7	2	−3	−8	−13	−18

In Exercises 3–5, solve $y = f(x)$ for x. Then find the input when the output is 2.

3. $f(x) = 4x + 5$

4. $f(x) = \frac{3}{4}x - 1$

5. $f(x) = 4x^2$

In Exercises 6–8, find the inverse of the function. Then graph the function and its inverse.

6. $f(x) = 3x - 4$

7. $f(x) = \frac{1}{2}x + 4$

8. $f(x) = -\frac{3}{4}x - \frac{1}{4}$

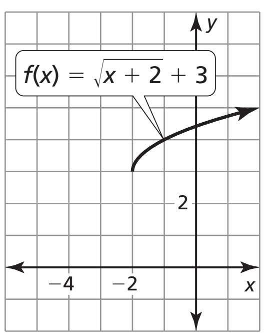
In Exercises 9 and 10, find the inverse of the function. Then graph the function and its inverse.

9. $f(x) = -2x^2 + 6, x \geq 0$

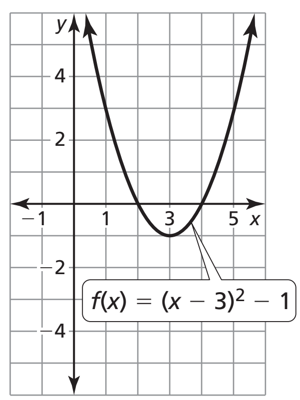
10. $f(x) = \frac{1}{4}x^2 - 1, x \leq 0$

In Exercises 11 and 12, use the Horizontal Line Test to determine whether the inverse of *f* is a function.

11.



12.



13. The formula $K = \frac{5}{9}(F - 32) + 273.15$ converts a Fahrenheit temperature to a Kelvin temperature. Solve the formula for F. Then find the Fahrenheit temperature for a Kelvin temperature of 310.15°K.

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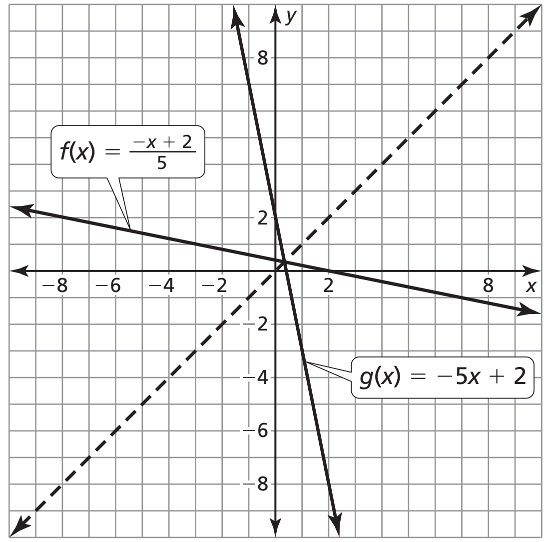
10.4 Enrichment and Extension

With inverse functions, the input and output are reversed. For instance, if $(-2, 5)$ is a point on the graph of a function, then $(5, -2)$ is a point on the graph of its inverse. That is, $f(-2) = 5$, and $f^{-1}(5) = -2$. If you substitute -2 into the first function, the output is 5. Similarly, when you substitute 5 into the inverse function, the output is -2. You end up back where you started. We use this same concept to prove that functions are inverses through composition. To prove inverse functions, you must compose two functions and show that the output reverts back to the original input value, x. This means that if $f(g(x)) = g(f(x)) = x$, where g composes with f to form an identity, the functions f and g are inverses.



Example: Prove $f(x) = \dfrac{-x+2}{5}$ and $g(x) = -5x + 2$ are inverses through composition.

$$f(g(x)) = \frac{-(-5x+2)+2}{5} = \frac{5x-2+2}{5} = \frac{5x}{5} = x$$

$$g(f(x)) = -5\left(\frac{-x+2}{5}\right) + 2 = x - 2 + 2 = x$$

So, the functions are inverses.

Prove or disprove that the functions are inverses through composition.

1. $f(x) = 3x + 1$

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

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

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

3. $f(x) = -\dfrac{1}{2}x + 3$

$g(x) = -2x + 6$

4. $f(x) = \dfrac{3}{2}x + 6$

$g(x) = \dfrac{2}{3}x - 4$

5. $f(x) = -x - 4$

$g(x) = x + 4$

6. $f(x) = -3x - 4$

$g(x) = \dfrac{x-4}{3}$

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10.4 Puzzle Time

What Has Eight Flippers, Two Beach Balls, And Rides A Bicycle Built For Two?

Write the letter of each answer in the box containing the exercise number.

Solve $y = f(x)$ for x. Then find the input when the output is 6.

1. $f(x) = x + 9$
2. $f(x) = 4x - 10$
3. $f(x) = \frac{3}{5}x - 12$
4. $f(x) = 6x^2$

Find the inverse of the function.

5. $f(x) = 7x - 2$
6. $f(x) = -8x + 1$
7. $f(x) = 3x - 4$
8. $f(x) = \frac{2}{3}x + 6$
9. $f(x) = 9x^2, x \geq 0$
10. $f(x) = \frac{1}{36}x^2, x \geq 0$
11. $f(x) = \sqrt{x + 8}$
12. $f(x) = \sqrt{5x - 10}$
13. A cargo plane is flying at a height of 600 feet when it drops some packages. The height h (in feet) of the packages can be modeled by $h = -16t^2 + 600$, where t is the time (in seconds) since the cargo plane dropped them. Determine after how many seconds the packages will be 200 feet above the ground by solving the equation for t.

Answers

E. $-1, 1$

O. 4

S. 5

E. -3

L. 30

S. $g(x) = \frac{\sqrt{x}}{3}$

W. $g(x) = \frac{1}{5}x^2 + 2$

S. $g(x) = x^2 - 8$

L. $g(x) = \frac{1}{7}x + \frac{2}{7}$

N. $g(x) = \frac{1}{3}x + \frac{4}{3}$

H. $g(x) = \frac{3}{2}x - 9$

A. $g(x) = -\frac{1}{8}x + \frac{1}{8}$

E. $g(x) = 6\sqrt{x}$

11	4	6	3	9		2	7		12	8	1	10	5	13