Mr. Hollen

Algebra 2

Packets #17-21

#17

Name ______________________________ Date ______________

Functions

A **relation** pairs inputs with outputs. When a relation is given as ordered pairs, the x-coordinates are inputs and the y-coordinates are outputs. A relation that pairs each input with *exactly one* output is a **function**.

Example 1 Determine whether each relation is a function. Explain.

a. $(-1, 3), (0, 3), (1, 3), (2, 1), (3, 1)$

Every input has exactly one output.

▶ So, the relation is a function.

b. $(5, 1), (9, 8), (7, 5), (5, 4), (6, 3)$

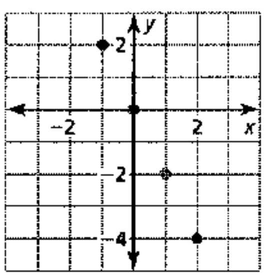
The input 5 has two outputs, 1 and 4.

▶ So, the relation is *not* a function.

The **domain** of a function is the set of all possible input values. The **range** of a function is the set of all possible output values.

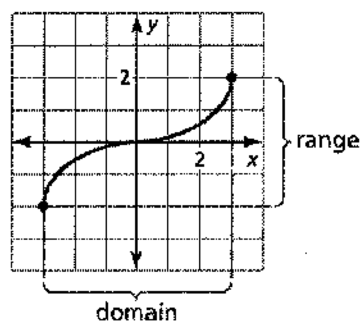
Example 2 Find the domain and range of the function represented by the graph.

a.



▶ The domain is $-1, 0, 1$, and 2.
The range is $-4, -2, 0$, and 2.

b.



▶ The domain is $-3 \le x \le 3$.
The range is $-2 \le y \le 2$.

Practice

Check your answers at BigIdeasMath.com.

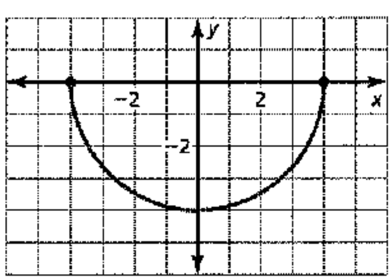
Determine whether the relation is a function. Explain.

1. $(2, -5), (3, -1), (4, 2), (5, -5), (6, 7)$

2. $(8, 5), (6, 0), (4, -7), (2, -4), (4, 7)$

Find the domain and range of the function represented by the graph.

3.



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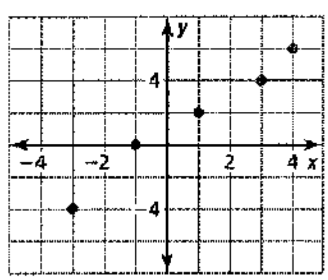

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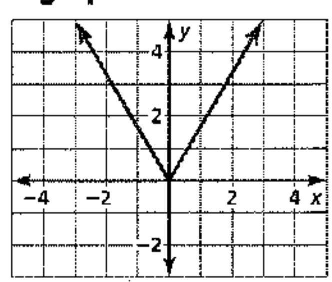

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#18

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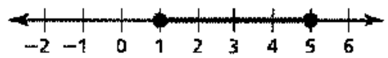
Graphing Linear Functions

A **linear function** is a function whose graph is a nonvertical line. A linear function can be represented by a linear equation in two variables, $y = mx + b$, where m is the slope and b is the y-intercept. A **solution of a linear equation in two variables** is an ordered pair (x, y) that makes the equation true. The graph of a linear equation in two variables is the set of points (x, y) in a coordinate plane that represents all solutions of the equation. The points may be distinct or connected.

Discrete Domain	Continuous Domain
A **discrete domain** is a set of input values that consists of only certain numbers in an interval.	A **continuous domain** is a set of input values that consists of all numbers in an interval.
Example: Integers from 1 to 5	**Example:** All numbers from 1 to 5
	

Example 1 The linear function $y = 29.8x$ represents the number y of kilometers Earth travels in orbit around the Sun in x seconds. (a) Find the domain of the function. Is the domain discrete or continuous? Explain. (b) Graph the function using its domain.

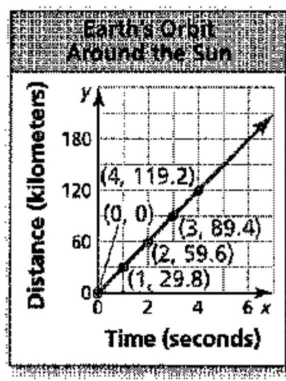
a. Earth can travel in orbit for part of a second. The number x of seconds Earth travels in orbit can be any value greater than or equal to 0.

▶ So, the domain is $x \geq 0$, and it is continuous.

b. Make an input-output table to find ordered pairs.

x	0	1	2	3	4
$y = 29.8x$	0	29.8	59.6	89.4	119.2

Plot the ordered pairs. Draw a line through the points starting at (0, 0). Use an arrow to indicate that the line continues without end.



Practice

Check your answers at BigIdeasMath.com.

Copy and complete the table.

1.

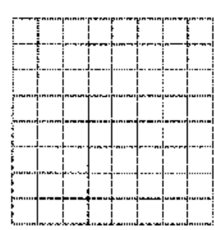
x	−2	−1	0	1	2
$y = x + 2$					

2.

x	−2	−1	0	1	2
$y = x - 7$					

3. BOATING A speed boat tour costs $60 per ticket. There are 5 tickets left. The total cost y of the tickets is a function of the number t of tickets you buy.

a. Find the domain of the function. Is the domain discrete or continuous? Explain.



b. Graph the function using its domain.

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Function Notation

A linear function can be written in the form $y = mx + b$. By naming a linear function f, you can also write the function using **function notation**.

$$f(x) = mx + b \qquad \text{Function notation}$$

The notation $f(x)$ is another name for y. If f is a function, and x is in its domain, then $f(x)$ represents the output of f corresponding to the input x. You can use letters other than f to name a function, such as g or h.

Example 1 Evaluate the function for the given value of *x*.

a. $f(x) = 2x + 5;\ x = 7$

$f(7) = 2(7) + 5$ — Substitute 7 for x.

$= 14 + 5$ — Multiply.

$= 19$ — Add.

▶ When $x = 7$, $f(x) = 19$.

b. $g(x) = 4x - x^2;\ x = -3$

$g(-3) = 4(-3) - (-3)^2$ — Substitute −3 for x.

$= -12 - 9$ — Multiply.

$= -21$ — Subtract.

▶ When $x = -3$, $g(x) = -21$.

Example 2 Determine whether the ordered pair is a solution of the equation.

a. $h(x) = 8 + x;\ (-6, 2)$

$2 \stackrel{?}{=} 8 + (-6)$ — Substitute −6 for x and 2 for $h(x)$.

$2 = 2$ ✓ — Add.

▶ So, $(-6, 2)$ is a solution.

b. $p(x) = |3x - 1|;\ (-2, -7)$

$-7 \stackrel{?}{=} |3(-2) - 1|$ — Substitute −2 for x and −7 for $p(x)$.

$-7 \stackrel{?}{=} |-7|$ — Evaluate.

$-7 \neq 7$ ✗ — Evaluate.

▶ So, $(-2, -7)$ is *not* a solution.

Practice

Check your answers at BigIdeasMath.com.

Evaluate the function for the given value of *x*.

1. $f(x) = x + 9;\ x = 8$
2. $g(x) = 6 - 5x;\ x = -1$
3. $h(x) = 4x + 3;\ x = 10$
4. $n(x) = -x - 4;\ x = -2$
5. $p(x) = -\frac{3}{4}x^2;\ x = 6$
6. $q(x) = x^2 - 11x;\ x = 4$
7. $k(x) = x^2 + 7x - 1;\ x = -3$
8. $h(x) = |3x - 8|;\ x = 1$
9. $f(x) = |x| + 2;\ x = -15$

Determine whether the ordered pair is a solution of the equation.

10. $f(x) = 3x + 5;\ (-1, 2)$
11. $h(x) = 7x - 2;\ (-3, -19)$
12. $g(x) = -x^2 + x + 5;\ (-5, 25)$
13. $n(x) = x^2 - 6x - 1;\ (4, -7)$
14. $h(x) = |x| - 14;\ (-4, 10)$
15. $p(x) = |-9x - 2|;\ (0, 2)$

16. **TICKETS** The function $C(x) = 49.5x + 19.5$ represents the cost (in dollars) of buying x concert tickets. How much does it cost to buy four tickets? How many tickets can you buy with \$465?

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Zeros of Quadratic Functions

A **zero of a function** f is an x-value for which $f(x) = 0$. If a real number k is a zero of the function $f(x) = ax^2 + bx + c$, then k is an x-intercept of the graph of the function.

Example 1 Find the zeros of each function.

a. $f(x) = 9x^2 - 1$

Set $f(x)$ equal to 0. Then use square roots to solve for x.

$$9x^2 - 36 = 0$$
$$9x^2 = 36$$
$$x^2 = 4$$
$$x = \pm\sqrt{4}$$
$$x = \pm 2$$

▶ The zeros of the function are $x = -2$ and $x = 2$.

b. $f(x) = x^2 - 2x - 8$

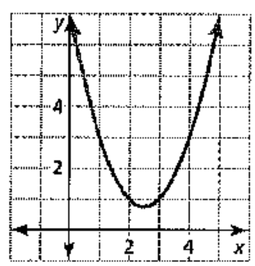
Set $f(x)$ equal to 0. Then use factoring to solve for x.

$$x^2 - 2x - 8 = 0$$
$$(x - 4)(x + 2) = 0$$
$$x - 4 = 0 \quad or \quad x + 2 = 0$$
$$x = 4 \quad or \quad x = -2$$

▶ The zeros of the function are $x = -2$ and $x = 4$.

Example 2 Find the zeros of $f(x) = x^2 - 5x + 7$.

Set $f(x)$ equal to 0. Then use the Quadratic Formula to solve for x.



$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$
$$= \frac{-(-5) \pm \sqrt{(-5)^2 - 4(1)(7)}}{2(1)}$$
$$= \frac{5 \pm \sqrt{-3}}{2}$$
$$= \frac{5 \pm i\sqrt{3}}{2}$$

▶ The zeros of the function are $x = \frac{5}{2} + \frac{\sqrt{3}}{2}i$ and $x = \frac{5}{2} - \frac{\sqrt{3}}{2}i$.

Notice that the graph of f does not intersect the x-axis.

Practice

Check your answers at BigIdeasMath.com.

Find the zero(s) of the function.

1. $f(x) = 8x^2 + 32$
2. $f(x) = -5x^2 + 40$
3. $f(x) = x^2 - 8x + 16$
4. $f(x) = 4x^2 + 12x + 9$
5. $f(x) = 4(x + 5)(x - 1)$
6. $f(x) = -\frac{1}{2}x(x + 3)$
7. $f(x) = 3x^2 + 12x + 15$
8. $f(x) = 2x^2 - x - 15$
9. $f(x) = -(x + 1)^2 + 18$
10. $f(x) = (x - 7)^2 + 9$

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#21

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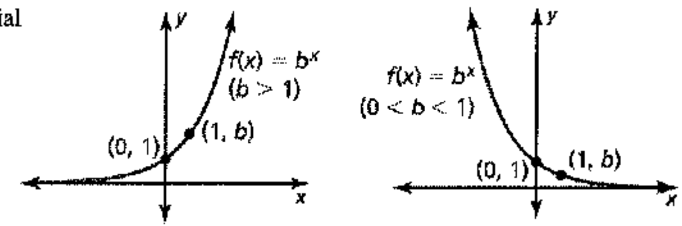
Exponential Functions

Graphing Exponential Functions

An **exponential function** is a nonlinear function of the form $y = ab^x$, where $a \neq 0$, $b \neq 1$, and $b > 0$.

- When $a > 0$ and $b > 1$, the function is an exponential growth function.
- When $a > 0$ and $0 < b < 1$, the function is an exponential decay function.

The graphs of the parent exponential functions $y = b^x$ are shown.

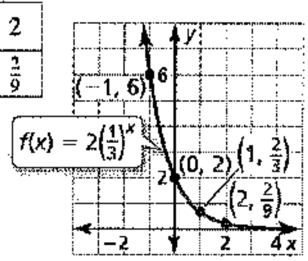


Example 1 Tell whether each function represents *exponential growth* or *exponential decay*. Then graph the function.

a. $f(x) = 2\left(\frac{1}{3}\right)^x$

Because $a = 2$ is positive and $b = \frac{1}{3}$ is greater than 0 and less than 1, the function is an exponential decay function. Use a table to graph the function.

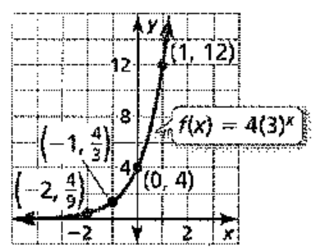
x	-1	0	1	2
y	6	2	$\frac{2}{3}$	$\frac{2}{9}$



b. $f(x) = 4(3)^x$

Because $a = 4$ is positive and $b = 3$ is greater than 1, the function is an exponential growth function. Use a table to graph the function.

x	-2	-1	0	1
y	$\frac{4}{9}$	$\frac{4}{3}$	4	12



Practice

Check your answers at BigIdeasMath.com.

Tell whether the function represents *exponential growth* or *exponential decay*.

[redacted]

1. $f(x) = \left(\frac{1}{4}\right)^x$

2. $f(x) = \left(\frac{4}{3}\right)^x$

3. $f(x) = 0.5(4)^x$

4. $f(x) = 3(0.75)^x$

5. $f(x) = 2(0.8)^x$

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

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