Your friend is playing a board game. He is on the space shown in the diagram at the right. He rolled a 3 to get to that space. Where could he have started? Explain your reasoning.
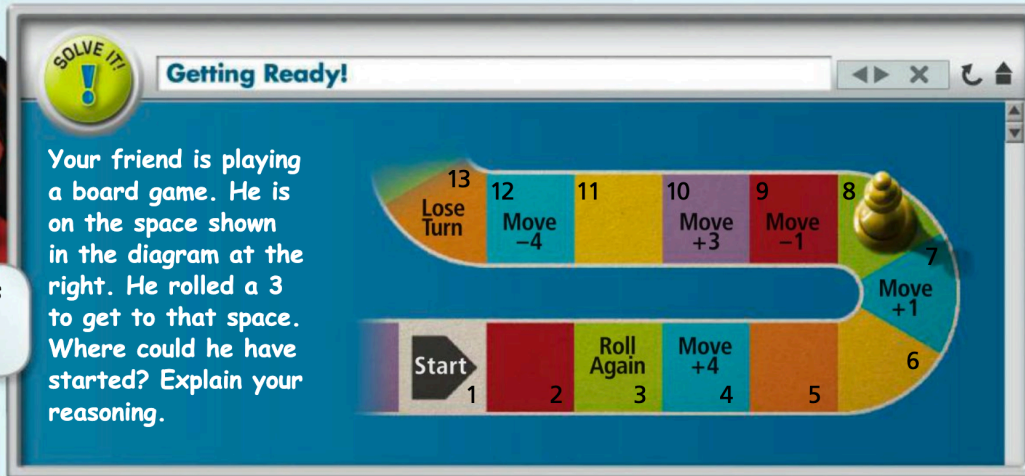
Where you land is related to where you start.

A ***relation*** is a pairing of numbers in one set, call the ***domain***, with numbers in another set, called the ***range***. A relation is often represented as a set of ordered pairs *(x,y)*. In this case, the domain is the set of *x*-values and the range is the set of *y*-values.

A function is a special type of relation in which each value in the domain is paired with exactly one value in the range.

PROBLEM 1: IDENTIFYING FUNCTIONS USING MAPPING DIAGRAMS
Identify the domain and range of each relation. Represent the relation with a mapping diagram. Is the relation a function?

a) {(-2, 0.5), (0, 2.5), (4, 6.5), (5, 2.5)}

b) {(6,5), (4,3), (6,4), (5, 8)}

c) {(4.2, 1.5), (5, 2.2), (7, 4.8), (4.2, 0)}

d) {(-1, 1), (-2, 2), (4, -4), (7, -7)}

Another way to decide if a relation is a function is to analyze the graph of the relation using the **_vertical line test_**. If any vertical line passes through more than one point of the graph, then for some domain value there is more than one range value. So the relation is not a function.

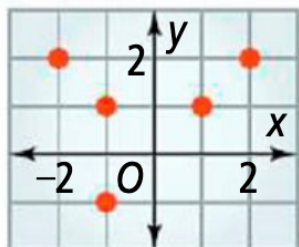**PROBLEM 2: IDENTIFYING FUNCTIONS USING THE VERTICAL LINE TEST**
Is the relation a function?

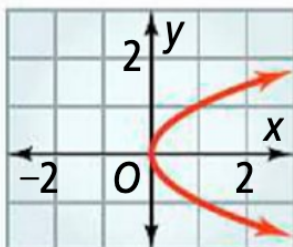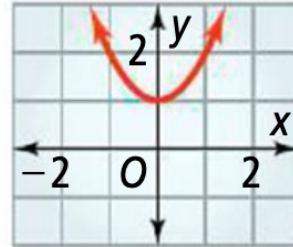a) {(-4, 2), (-3, 1), (0, -2), (-4, -1), (1, 2)}

b) $y = -x^2 + 3$
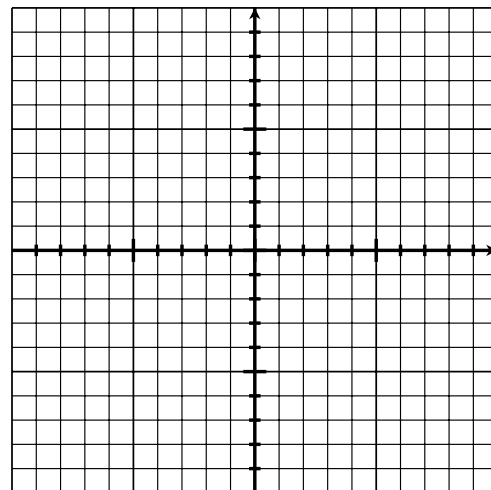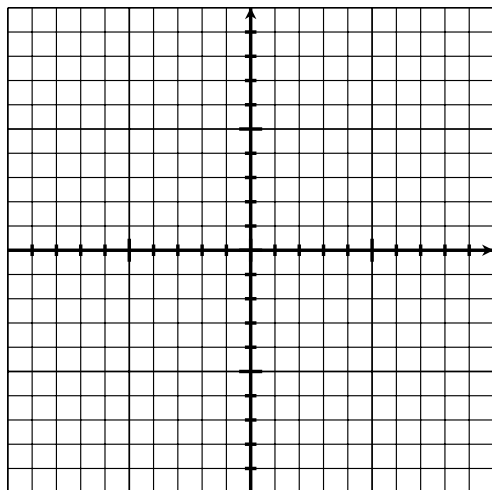
c)

d)

e)

You have seen functions represent as equations involving *x* and *y*, such as $y = -3x + 1$. Below is the same equation written using **_function notation_**.

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

Notice that *f(x)* replaces *y*. It is read "*f* of x." The letter *f* is the name of the function, not a variable. Function notation is used to emphasize that the function value *f(x)* depends on the independent variable *x*. Other letters besides *f* can also be used, such as *g* and *h*.

PROBLEM 3: EVALUATING A FUNCTION

a) The function $w(x) = 250x$ represents the number of words *w(x)* you can read in *x* minutes. How many words can you read in 8 min?

b) Light travels about 186,000 mi/s. The function $d(t) = 186,000t$ gives the distance $d(t)$, in miles, that light travels in t seconds. How far does light travel in 30 s?

c) You are buying orange juice for $4.50 per container and have a gift card worth $7. The function $f(x) = 4.50x - 7$ represents your total cost $f(x)$ if you buy x containers of orange juice and use the gift card. How much do you pay to buy 4 containers of orange juice?

Use the functions $f(x) = 2x$ and $g(x) = x^2 + 1$ to find the value of each expression.

d) f(3) + g(4)   e) g(3) + f(4)   f) f(5) – 2[g(1)]   h) f(g(3))

PROBLEM 4: FINDING THE RANGE OF A FUNCTION
Find the range of the function for the given domain.

a) $f(x) = -1.5x + 4; \{1, 2, 3, 4\}$ b) $g(x) = 8x - 3; \left\{-\frac{1}{2}, \frac{1}{8}, \frac{1}{4}, \frac{3}{4}\right\}$

c). $h(x) = 2x - 7; \{-2, -1, 0, 1, 2\}$ d) $f(x) = x^2; \{-2, -1, 0, 1, 2\}$

PROBLEM 5: IDENTIFYING A REASONABLE DOMAIN AND RANGE

a) You have 3 qt of paint to paint the trim in your house. A quart of paint covers 100 ft^2. The function $A(q) = 100q$ represents the area $A(q)$, in square feet, that q quarts of paint cover. What domain and range are reasonable for the function?

b) If you have 7 qt of paint, what domain and range are reasonable for the area of paint cover?

c) A car can travel 32 mi for each gallon of gasoline. The function $d(x) = 32x$ represents the distance $d(x)$, in miles, that the car can travel with x gallons of gasoline. The car's fuel tank holds 17 gallons of gasoline. What is a reasonable domain and range?

d) There are 98 International Units (IUs) of vitamin D in 1 cup of milk. The function $V(c) = 98c$ represents the amount $V(c)$ of vitamin D, in IUs, you get from c cups of milk. You have a 16-cup jug of milk.

4-6 Homework

Identify the domain and range of each relation. Use a mapping diagram to determine whether the relation is a function.
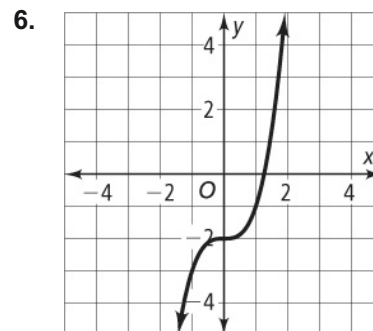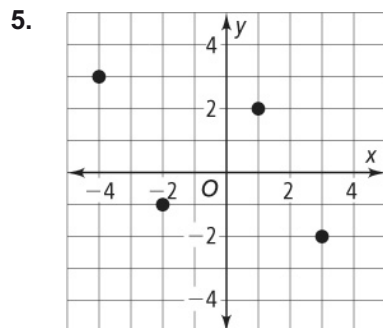
1. $\{(3, 6), (5, 7), (7, 7)\ (8, 9)\}$

2. $\{(0, 0.4), (1, 0.8), (2, 1.2), (3, 1.6)\}$

3. $\{(5, -4), (3, -5), (4, -3), (6, 4)\}$

4. $\{(0.3, 0.6), (0.4, 0.8), (0.3, 0.7), (0.5, 0.5)\}$

Use the vertical line test to determine whether the relation is a function.

5.

6.

7. The function $w(x) = 60x$ represents the number of words $w(x)$ you can type in x minutes. How many words can you type in 9 minutes?

8. Sound travels about 343 meters per second. The function $d(t) = 343t$ gives the distance $d(t)$ in meters that sound travels in t seconds. How far does sound travel in 8 seconds?

Find the range of each function for the given domain.

9. $f(x) = -3x + 2;\ \{-2, -1, 0, 1, 2\}$

10. $f(x) = x^3;\ \{-1, -0.5, 0, 0.5, 1\}$

11. $f(x) = 4x + 1;\ \{-4, -2, 0, 2, 4\}$

$f(x) = x^2 + 2;\ \{0, \dfrac{1}{4}, \dfrac{1}{2}, \dfrac{3}{4}, 1\}$

Find a reasonable domain and range for each function. Then graph the function.

13. A high school is having a pancake breakfast fundraiser. They have 3 packages of pancake mix that each feed 90 people. The function $N(p) = 90p$ represents the number of people $N(p)$ that p packages of pancake mix feed.

14. A charter boat travels at a maximum rate of 25 miles per hour. The function $d(x) = 25x$ represents the distance $d(x)$, in miles, that the boat can travel in x hours. The charter boat travels a maximum distance of 75 miles from the shore.

15. Reasoning If $f(x) = x^2 - 3$ and $f(a) = 46$, what is the value of a? Explain.

16. Open-Ended What is a value of x that makes the relation $\{(2, 4), (3, 6), (x, 8)\}$ a function?