

## 5.2 Relations and Functions

### NEW VOCABULARY

a **relation** is a set of ordered pairs.

the **domain** of a relation is the set of first coordinates of the ordered pairs.

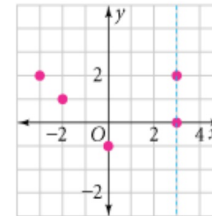
the **range** is the set of second coordinates of the ordered pairs.

a **function** is a relation that assigns exactly one value in the range to each value in the domain

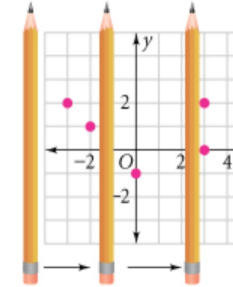
### 2 EXAMPLE Using the Vertical-Line Test

Determine whether the relation  $\{(3, 0), (-2, 1), (0, -1), (-3, 2), (3, 2)\}$  is a function.

**Step 1** Graph the ordered pairs on a coordinate plane.



**Step 2** Pass a pencil across the graph as shown. Keep your pencil straight to represent a vertical line.



A line would pass through both  $(3, 0)$  and  $(3, 2)$ , so the relation is not a function.

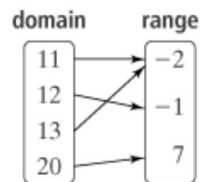
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### 3 EXAMPLE Using a Mapping Diagram

Determine whether each relation is a function.

a.  $\{(11, -2), (12, -1), (13, -2), (20, 7)\}$



There is no value in the domain that corresponds to more than one value of the range.

The relation is a function.

b.  $\{(-2, -1), (-1, 0), (6, 3), (-2, 1)\}$



The domain value corresponds to two range values,  $-1$  and  $1$ .

The relation is not a function.

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Find the domain and range of the relation represented by the table.

Domain	Range
4	3
-2	1
-1	3
4	-2
-1	1

$$d: \{-2, -1, 4\}$$

$$r: \{-2, 1, 3\}$$

Each term in the domain is listed in ascending order, and only listed once. The same rules apply to the range.



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Words and Notations  
Used With a Function

Domain	Range
input	output
$x$	$f(x)$
$x$	$y$

Evaluate each function rule for  $x = 2.1$

$$y = 2x + 1$$

$$y = 2(2.1) + 1$$

$$y = 4.2 + 1$$

$$y = 5.2$$

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

$$f(2.1) = 2.1^2 - 4$$

$$f(2.1) = 4.41 - 4$$

$$f(2.1) = 0.41$$

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

$$g(2.1) = -2.1 + 2$$

$$g(2.1) = -0.1$$

Find the range of each function for the domain  $\{-2, 0, 2\}$

$f(x) = x - 6$	$y = -4x$	$g(t) = t^2 + 1$
$f(-2) = -2 - 6$	$y = -4(-2)$	$g(-2) = (-2)^2 + 1$
$f(-2) = -8$	$y = 8$	$g(-2) = 5$
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$f(0) = 0 - 6$	$y = -4(0)$	$g(0) = 0^2 + 1$
$f(0) = -6$	$y = 0$	$g(0) = 1$
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$f(2) = 2 - 6$	$y = -4(2)$	$g(2) = 2^2 + 1$
$f(2) = -4$	$y = -8$	$g(2) = 5$
$\{-8, -6, -4\}$	$\{8, 0, -8\}$	$\{5, 1, 5\}$

Remember, domain and range must be written in order and can't have repeats!