

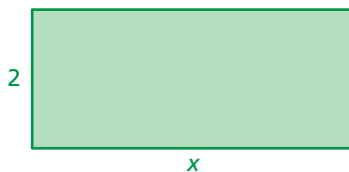
# 6.1 Relations and Functions

**Essential Question** How can you use a mapping diagram to show the relationship between two data sets?

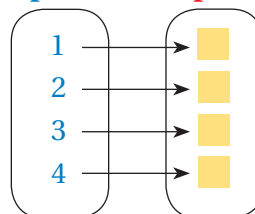
## 1 ACTIVITY: Constructing Mapping Diagrams

Work with a partner. Copy and complete the mapping diagram.

a. Area  $A$



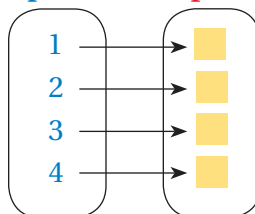
Input,  $x$       Output,  $A$



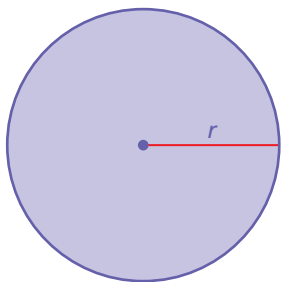
b. Perimeter  $P$



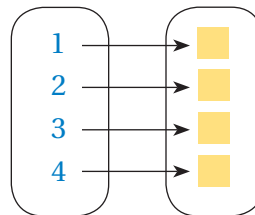
Input,  $x$       Output,  $P$



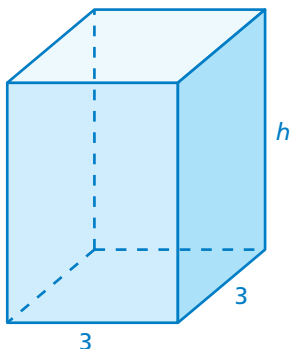
c. Circumference  $C$



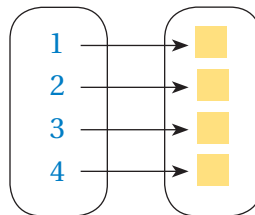
Input,  $r$       Output,  $C$



d. Volume  $V$



Input,  $h$       Output,  $V$



### Functions

In this lesson, you will

- define relations and functions.
- determine whether relations are functions.
- describe patterns in mapping diagrams.

## 2 ACTIVITY: Describing Situations

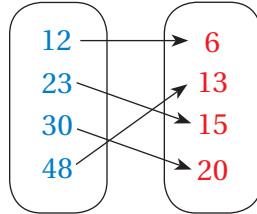
### Math Practice

#### View as Components

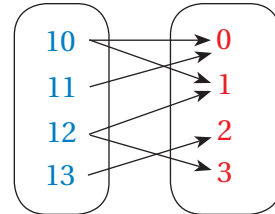
What are the input values? Do any of the input values point to more than one output value? How does this help you describe a possible situation?

Work with a partner. How many outputs are assigned to each input? Describe a possible situation for each mapping diagram.

a. **Input,  $x$**     **Output,  $y$**



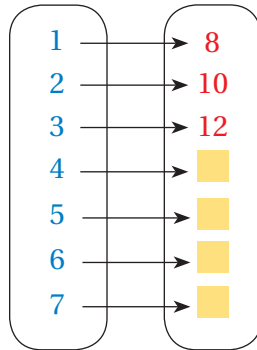
b. **Input,  $x$**     **Output,  $y$**



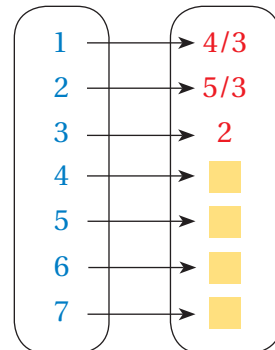
## 3 ACTIVITY: Interpreting Mapping Diagrams

Work with a partner. Describe the pattern in the mapping diagram. Copy and complete the diagram.

a. **Input,  $t$**     **Output,  $M$**

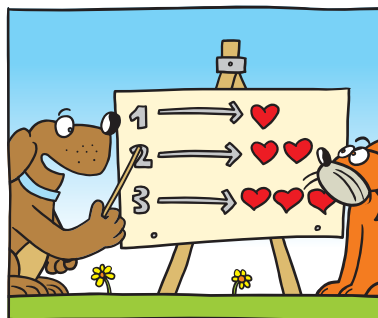


b. **Input,  $x$**     **Output,  $A$**

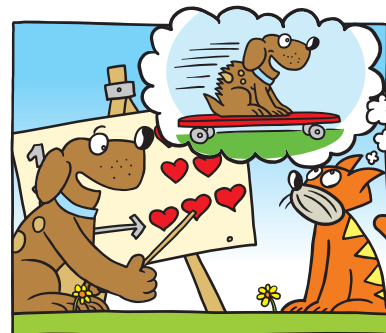


## What Is Your Answer?

4. **IN YOUR OWN WORDS** How can you use a mapping diagram to show the relationship between two data sets?



"I made a mapping diagram."



"It shows how I feel about my skateboard with each passing day."

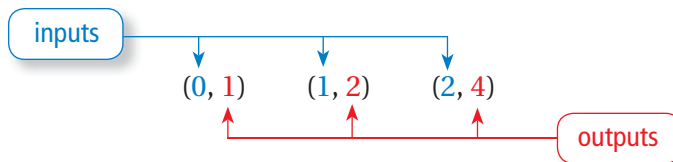
### Practice

Use what you learned about mapping diagrams to complete Exercises 3–5 on page 246.

### Key Vocabulary

input, p. 244  
output, p. 244  
relation, p. 244  
mapping diagram, p. 244  
function, p. 245

Ordered pairs can be used to show **inputs** and **outputs**.



## Key Idea

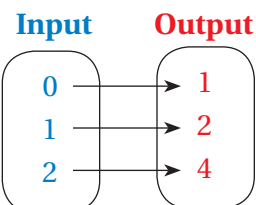
### Relations and Mapping Diagrams

A **relation** pairs inputs with outputs. A relation can be represented by ordered pairs or a **mapping diagram**.

#### Ordered Pairs

$(0, 1)$   
 $(1, 2)$   
 $(2, 4)$

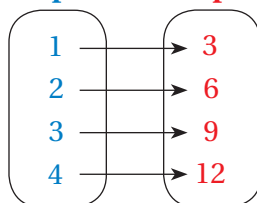
#### Mapping Diagram



## EXAMPLE 1 Listing Ordered Pairs of a Relation

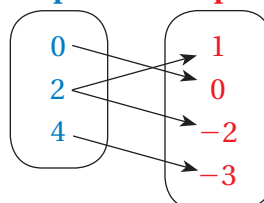
List the ordered pairs shown in the mapping diagram.

a. **Input**      **Output**



∴ The ordered pairs are  $(1, 3)$ ,  $(2, 6)$ ,  $(3, 9)$ , and  $(4, 12)$ .

b. **Input**      **Output**

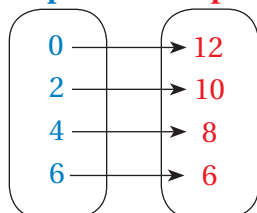


∴ The ordered pairs are  $(0, 0)$ ,  $(2, 1)$ ,  $(2, -2)$ , and  $(4, -3)$ .

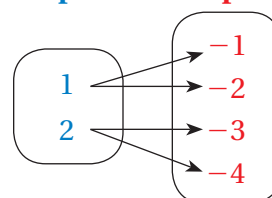
## On Your Own

List the ordered pairs shown in the mapping diagram.

1. **Input**      **Output**



2. **Input**      **Output**



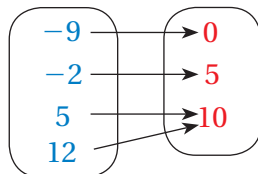
Now You're Ready  
Exercises 6–8

A relation that pairs each input with *exactly one* output is a **function**.

## EXAMPLE 2 Determining Whether Relations Are Functions

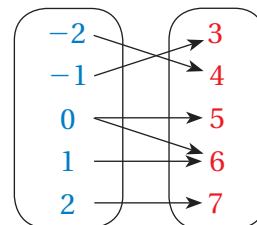
Determine whether each relation is a function.

a. **Input**      **Output**



∴ Each input has exactly one output. So, the relation is a function.

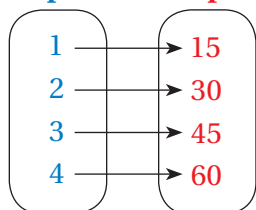
b. **Input**      **Output**



∴ The input 0 has two outputs, 5 and 6. So, the relation is *not* a function.

## EXAMPLE 3 Describing a Mapping Diagram

**Input**      **Output**



Consider the mapping diagram at the left.

a. **Determine whether the relation is a function.**

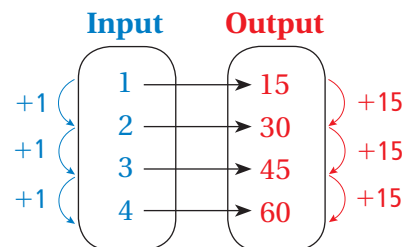
Each input has exactly one output.

∴ So, the relation is a function.

b. **Describe the pattern of inputs and outputs in the mapping diagram.**

Look at the relationship between the inputs and the outputs.

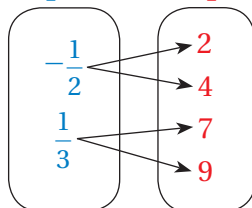
∴ As each input increases by 1, the output increases by 15.



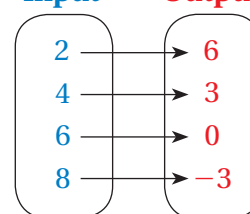
### On Your Own

Determine whether the relation is a function.

3. **Input**      **Output**



4. **Input**      **Output**



5. Describe the pattern of inputs and outputs in the mapping diagram in On Your Own 4.

**Now You're Ready**  
Exercises 9–11  
and 13–15

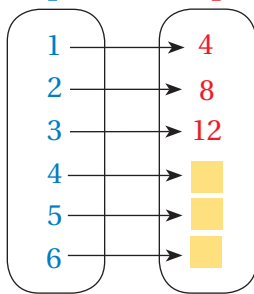
## Vocabulary and Concept Check

- VOCABULARY** In an ordered pair, which number represents the input? the output?
- PRECISION** Describe how relations and functions are different.

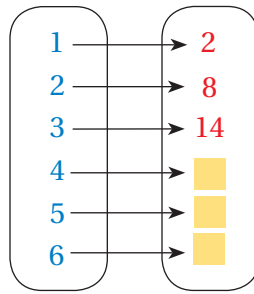
## Practice and Problem Solving

Describe the pattern in the mapping diagram. Copy and complete the diagram.

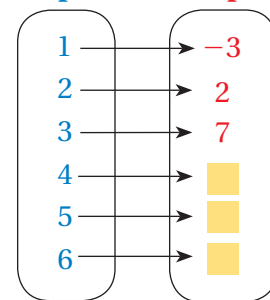
3. **Input**      **Output**



4. **Input**      **Output**

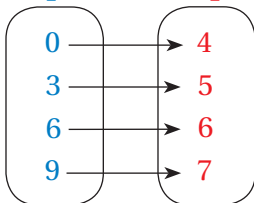


5. **Input**      **Output**

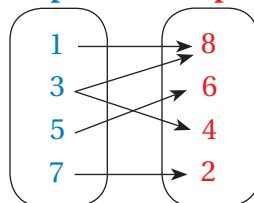


List the ordered pairs shown in the mapping diagram.

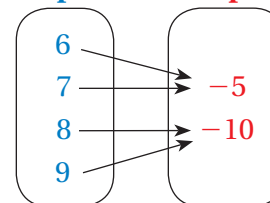
1 6. **Input**      **Output**



7. **Input**      **Output**

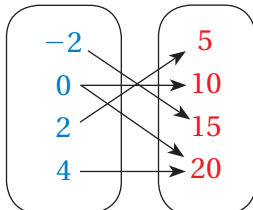


8. **Input**      **Output**

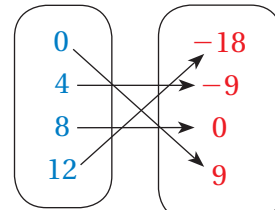


Determine whether the relation is a function.

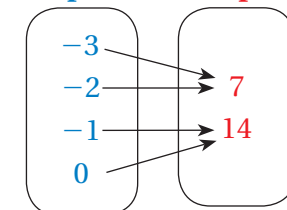
2 9. **Input**      **Output**



10. **Input**      **Output**



11. **Input**      **Output**



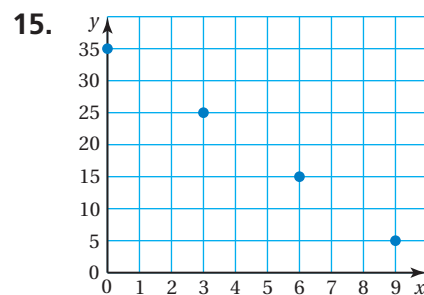
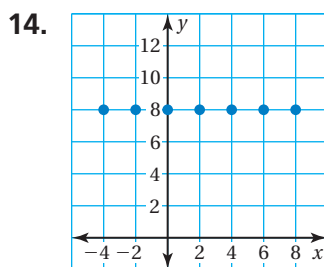
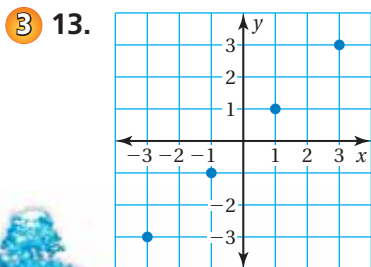
12. **ERROR ANALYSIS** Describe and correct the error in determining whether the relation is a function.

**X** **Input**      **Output**

|   |   |   |
|---|---|---|
| 4 | → | 5 |
| 4 | → | 6 |
| 4 | → | 7 |
| 4 | → | 8 |

Each output is paired with exactly one input. So, the relation is a function.

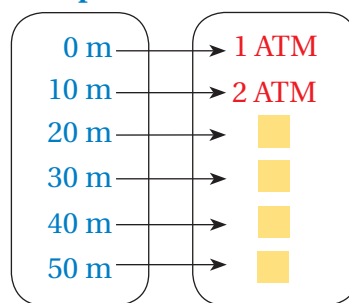
Draw a mapping diagram for the graph. Then describe the pattern of inputs and outputs.



16. **SCUBA DIVING** The normal pressure at sea level is one atmosphere of pressure (1 ATM). As you dive below sea level, the pressure increases by 1 ATM for each 10 meters of depth.

- Complete the mapping diagram.
- Is the relation a function? Explain.
- List the ordered pairs. Then plot the ordered pairs in a coordinate plane.
- Compare the mapping diagram and graph. Which do you prefer? Why?
- RESEARCH** What are common depths for people who are just learning to scuba dive? What are common depths for experienced scuba divers?

**Input, Depth**      **Output, Pressure**



17. **MOVIES** A store sells previously viewed movies. The table shows the cost of buying 1, 2, 3, or 4 movies.

- Use the table to draw a mapping diagram.
- Is the relation a function? Explain.
- Describe the pattern. How does the cost per movie change as you buy more movies?

| Movies | Cost |
|--------|------|
| 1      | \$10 |
| 2      | \$18 |
| 3      | \$24 |
| 4      | \$28 |

18. **Repeated Reasoning** The table shows the outputs for several inputs. Use two methods to find the output for an input of 200.

| Input, $x$  | 0  | 1  | 2  | 3  | 4  |
|-------------|----|----|----|----|----|
| Output, $y$ | 25 | 30 | 35 | 40 | 45 |



## Fair Game Review what you learned in previous grades & lessons

The coordinates of a point and its image are given. Is the reflection in the  $x$ -axis or  $y$ -axis? (Section 2.3)

19.  $(3, -3) \rightarrow (-3, -3)$       20.  $(-5, 1) \rightarrow (-5, -1)$       21.  $(-2, -4) \rightarrow (-2, 4)$

22. **MULTIPLE CHOICE** Which word best describes two figures that have the same size and the same shape? (Section 2.1)

- (A) congruent      (B) dilation      (C) parallel      (D) similar