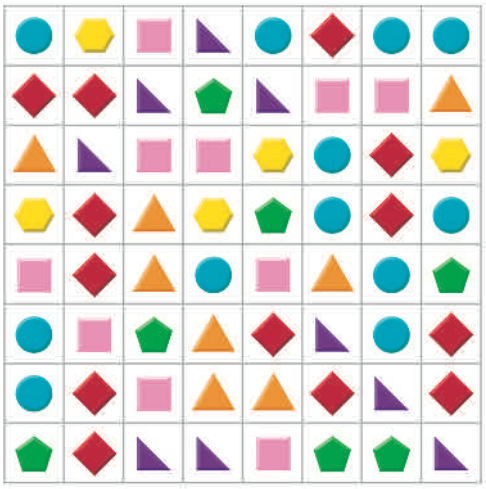
4-1 Introduction to Relations

Objective To define relation, domain, and range • To represent relations with rules, tables, mapping diagrams, or graphs • To identify the domain and range of a relation

Ira is playing a computer game in which he has to swap adjacent pieces of the same colored shape to make groups of 3 or more. If he makes a group of 3, he earns 6 points. A group of 4 earns 8 points, a group of 5 earns 10 points, and a group of 6 earns 12 points. How can the relationship between the number of shapes in the group and the number of points earned be represented?



You can use a set of ordered pairs of numbers to show the relationship between the number of shapes in the group and the corresponding number of points earned.

$$\{(3, 6), (4, 8), (5, 10), (6, 12)\}$$

In an ordered pair, it is important to note which element is the first of the pair and which is the second. The ordered pair $(3, 6)$ is not the same as the ordered pair $(6, 3)$.

► A relationship that is represented by a set of ordered pairs is called a relation. The domain of a relation is the set of all *first* elements of the ordered pairs. The range of a relation is the set of all *second* elements of the ordered pairs.

For Ira's game relation, the domain is $\{3, 4, 5, 6\}$, and the range is $\{6, 8, 10, 12\}$.

► The set of ordered pairs in a relation may be represented by a rule, a table, a mapping diagram, or a graph.

Express Ira's game relation as a *rule*, as a *table*, as a *mapping diagram*, and as a *graph*.

Rule

If (x, y) represents an ordered pair in Ira's game relation, then a rule for that relation is:

$$y = 2x$$

The x-value is the input value.

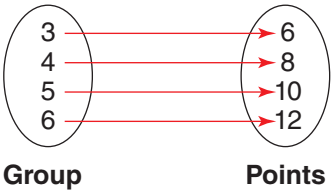
The y-value is the output value.

Table

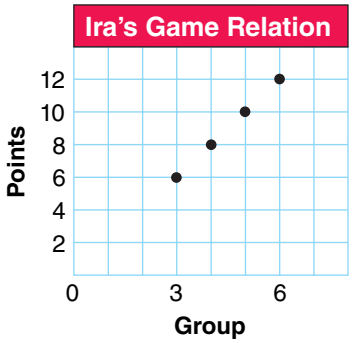
Ira's Game Relation	
Group (x)	Points (y)
3	6 ← $6 = 2(3)$
4	8 ← $8 = 2(4)$
5	10 ← $10 = 2(5)$
6	12 ← $12 = 2(6)$

Mapping Diagram

Ira's Game Relation



Graph



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Examples

Write the domain and range of each relation.

1

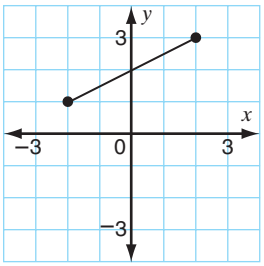
x	y
−2	−7
0	−1
1	2
2	5
5	14

Ordered Pairs: $(-2, -7)$, $(0, -1)$, $(1, 2)$ $(2, 5)$, $(5, 14)$

Domain (D) = $\{-2, 0, 1, 2, 5\}$

Range (R) = $\{-7, -1, 2, 5, 14\}$

2

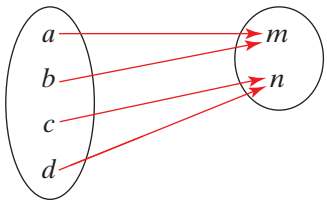


There are infinitely many ordered pairs in this relation.

Domain (D) = $\{x | -2 \le x \le 2\}$

Range (R) = $\{y | 1 \le y \le 3\}$

3



Ordered Pairs: (a, m), (b, m), (c, n), (d, n)

Domain (D) = $\{a, b, c, d\}$

Range (R) = $\{m, n\}$

▶ You can determine the ordered pairs in a relation specified by a rule.

A relation, T, is represented by the rule $y = -4x - 1$.

a. Does the ordered pair $(1, -3)$ belong to the relation represented by the rule? Explain.

$y = -4x - 1$

$-3 \stackrel{?}{=} -4(1) - 1$ ← Substitute 1 for x and -3 for y.

$-3 = -5$ False

No, the ordered pair $(1, -3)$ is not in T.

b. If $(2, k)$ belongs to the relation, find k.

$y = -4x - 1$

$k = -4(2) - 1$ ← Substitute 2 for x and k for y.

$k = -9$

For the relation, an input value of 2 results in an output value of -9.

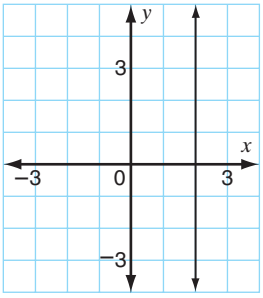
Try These

Write the domain and range of each relation.

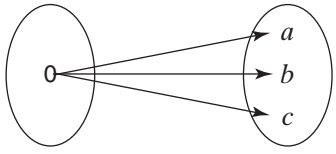
1.

x	y
−6	−2.5
−4	−1.5
−2	−0.5
0	0.5
2	1.5

2.



3.



4. Does the ordered pair $(-7, 7)$ belong to the relation $y = -|x|$? Explain.

5. Find the value of h if the ordered pair $(h, 0)$ belongs to the relation $y = -3x + 4$.

6. Discuss and Write Describe a verbal situation using a relation. Create a rule and a mapping diagram to represent the situation you wrote about.

Go to PRACTICE BOOK Lesson 4-1 for exercise sets.

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