5.1 Represent Functions as Ordered Pairs and Rules

Goal • Represent functions as ordered pairs and rules.

Your Notes

VOCABULARY

Relation The pairing of the elements of one set with the elements of another set

Domain The collection of all input values

Range The collection of all output values

Function A rule that establishes a relationship between two quantities, called the input and the output. For each input, there is exactly one output

Independent variable The input variable

Dependent variable The output variable

Example 1 Identify the domain and range of a relation

The table shows temperatures over various increments of time.

a. Write the table as a set of ordered pairs.

b. Identify the domain and range of the relation.

Solution

a. The table can be written as \{(0, 24), (2, 27), (4, 30), (6, 33)\}.

b. The domain is 0, 2, 4, 6. The range is 24, 27, 30, 33.
Guided Practice Identify the domain and range of the relation.

1. \{(4, 10), (7, 20), (11, 35), (13, 45)\}

   The domain is 4, 7, 11, 13.
   The range is 10, 20, 35, 45.

Example 2 Multiple Choice Practice

Which relation is a function?

A \{\{(6, 0), (6, 3), (6, 6), (6, 9)\}\}
B \{\{(0, 4), (1, 2), (4, 1), (0, 8)\}\}
C \{\{(1, 8), (2, 7), (1, 6), (2, 5)\}\}
D \{\{(2, 4), (4, 2), (6, 4), (8, 2)\}\}

Solution

Choices A, B, and C are not functions because each relation contains a domain element that is paired with two different range elements. For instance, 0 is paired with both 4 and 8 in choice B.

The relation \{(2, 4), (4, 2), (6, 4), (8, 2)\} in choice D is a function because each domain element is paired with exactly one range element.

The correct answer is D.

Guided Practice Determine whether the relation is a function.

2. \{(5, 3), (5, 4), (10, 6), (15, 6)\}
   No, the relation is not a function.

3. \{\{(0, 3), (4, 5), (12, 9), (20, 13)\}\}
   Yes, the relation is a function.
Your Notes

FUNCTIONS

<table>
<thead>
<tr>
<th>Verbal Rule</th>
<th>Equation</th>
<th>Set of Ordered Pairs</th>
</tr>
</thead>
<tbody>
<tr>
<td>The output is 2 less than the input.</td>
<td>( y = x - 2 )</td>
<td>{(2, 0), (4, 2), (6, 4), (8, 6), (10, 8)}</td>
</tr>
</tbody>
</table>

Example 3  Use a function rule

The domain of the function \( y = 3x \) is 0, 1, 2, and 3. Make a table of ordered pairs that represents the function. Then identify the range of the function.

Solution

<table>
<thead>
<tr>
<th>( x )</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>( y = 3x )</td>
<td>3(0) = 0</td>
<td>3(1) = 3</td>
<td>3(2) = 6</td>
<td>3(3) = 9</td>
</tr>
</tbody>
</table>

The range of the function is 0, 3, 6, and 9.

Example 4  Write a function rule

Write a rule for the function.

<table>
<thead>
<tr>
<th>Input</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>6</td>
<td>10</td>
<td>14</td>
<td>18</td>
<td>22</td>
</tr>
</tbody>
</table>

Solution

Let \( x \) be the input and let \( y \) be the output. Notice that each output is twice the corresponding input. So, a rule for the function is \( y = 2x \).

Guided Practice  Write a rule for the function. Identify the domain and the range.

Function Rule: \( y = 1.5x \)

Domain: 1, 2, 3, 4          Range: 1.5, 3, 4.5, 6
Cooking You are making vegetable soup and each batch requires 2.5 cups of salt. You make at most 4 batches of soup.

- Write the amount of salt (in cups) you use as a function of number of batches of soup.
- Identify the independent and dependent variables.
- Identify the domain and the range of the function.
  (Assume that you are making only full batches of soup.)

Solution
Write a verbal model. Then write a function rule. Let $b$ represent the number of batches and $c$ represent the number of cups of salt.

\[
\text{Total amount of salt} = \text{Amount of salt per batch} \cdot \text{Number of batches}
\]

\[
C = 2.5 \cdot b
\]

So, the function rule is $C = 2.5b$. The total amount of salt depends on the number of batches made, so $b$ is the independent variable and $C$ is the dependent variable.

Because you can make at most 4 batches of soup, the domain of the function is $0, 1, 2, 3, 4$. Make a table to identify the range.

<table>
<thead>
<tr>
<th>Number of batches, $b$</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Amount of salt (cups), $C$</td>
<td>0</td>
<td>2.5</td>
<td>5</td>
<td>7.5</td>
<td>10</td>
</tr>
</tbody>
</table>

The range of the function is $0, 2.5, 5, 7.5, 10$.  

Your Notes

Example 5 Write a function rule for a real-world situation

Homework