Evaluate Expressions

Goal: Evaluate algebraic expressions and use exponents.

VOCABULARY

Variable is a letter (x, y, a, b...) that represents a number.

Algebraic expression is a collection of numbers, variables, operations (+, -, x, ÷) and symbols of inclusion ( ), [ ], ⟨⟩.

Evaluating an expression means to find the value of the expression.

<table>
<thead>
<tr>
<th>Power</th>
<th>FACTORS: Numbers or variables</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base</td>
<td>MULTIPLIED TOGETHER</td>
</tr>
<tr>
<td>Exponent</td>
<td>FACTORS ARE SEPARATED BY MULT. SIGNS</td>
</tr>
</tbody>
</table>

ALGEBRAIC EXPRESSIONS

Algebraic Expression Meaning Operation
----------------- ------------------------
\( t \times 7 \) 7 times \( t \) MULTIPLY
\( \frac{x}{20} \) FRACTIONS MEAN Division
\( y - 8 \) SUBTRACTION
\( 12 + a \) ADDITION
Example 1: Evaluate algebraic expressions

Evaluate the expression when \( n = 4 \).

a. \( 11 \times n = 11 \times 4 \)  
   Substitute \( n = 4 \) for \( n \).
   \[ 11n = 11 \times 4 = 44 \]

To evaluate an expression, substitute a number for the variable, perform the operation(s), and simplify.

Given Expression: \( 11n \)

Do not use \( \times \) for multiplication.

Checkpoint: Evaluate the expression when \( y = 8 \).

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( 7y )</td>
<td>2. ( y \div 2 )</td>
</tr>
<tr>
<td>( 7(8) )</td>
<td>( 8 \div 2 )</td>
</tr>
<tr>
<td>56</td>
<td>4</td>
</tr>
</tbody>
</table>

Example 2: Read and write powers

Write the power in words and as a product.

<table>
<thead>
<tr>
<th>Power</th>
<th>Words</th>
<th>Product of factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ( 12^1 )</td>
<td>twelve to the first power</td>
<td>12</td>
</tr>
<tr>
<td>b. ( 2^3 )</td>
<td>two to the third power or two cubed</td>
<td>2 \cdot 2 \cdot 2</td>
</tr>
<tr>
<td>c. ( (\frac{1}{4})^2 )</td>
<td>one fourth to the second power, or one fourth squared</td>
<td>( \frac{1}{4} \cdot \frac{1}{4} )</td>
</tr>
<tr>
<td>d. ( a^4 )</td>
<td>( a ) to the 4th power</td>
<td>( a \cdot a \cdot a \cdot a )</td>
</tr>
</tbody>
</table>

Lesson 1.1 • Algebra 1 Notetaking Guide
**Checkpoint** Write the power in words and as a product.

<table>
<thead>
<tr>
<th>Expression</th>
<th>Words</th>
<th>Product (expanded)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$2^5$</td>
<td>2 to the 5\textsuperscript{th}</td>
<td>1,024</td>
</tr>
<tr>
<td>$\left(\frac{1}{3}\right)^2$</td>
<td>$\frac{1}{3}$ squared</td>
<td>$\frac{1}{9}$</td>
</tr>
<tr>
<td>$(10)^3$</td>
<td>10 cubed</td>
<td>1,000</td>
</tr>
</tbody>
</table>

**Example 3.** Evaluate powers

Evaluate the expression.

a. $y^3$ when $y = 3$

**Solution**

a. $y^3 = (3)^3$

$$= 3 \cdot 3 \cdot 3 = 27$$

**Checkpoint** Evaluate the expression.

8. $t^2$ when $t = 3$

$$= (3)^2 = 9$$

9. $m^5$ when $m = \frac{1}{2}$

$$= \left(\frac{1}{2}\right)^5$$

$$= \frac{1}{32}$$

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Apply Order of Operations

Goal: Use the order of operations to evaluate expressions.

Your Notes

**WARNING** Be careful using PEMDAS

**ORDER OF OPERATIONS**

To evaluate an expression involving more than one operation, use the following steps.

Step 1: Evaluate expressions inside **Grouping Symbols**

Step 2: Evaluate **Powers**

Step 3: **Multiply** and divide from left to right.

Step 4: Add and **Subtract** from left to right.

Example 1 - Evaluate Expressions

Evaluate the expression $30 \div 2^2 - 5$.

**EVALUATE:**

$\frac{30 \div 4}{-5} = \frac{6}{-5} = \frac{15}{-5} = 10$
**Checkpoint** Evaluate the expression.

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1. $10 + 3^2 = $</td>
<td>2. $16 - 2^3 + 4 = $</td>
</tr>
<tr>
<td>$10 + 9 = $</td>
<td>$16 - 8 + 4 = $</td>
</tr>
<tr>
<td>$19$</td>
<td>$12$</td>
</tr>
<tr>
<td>3. $28 ÷ 2^2 + 1 = $</td>
<td>4. $4 \cdot 5^2 + 4$</td>
</tr>
<tr>
<td>$28 ÷ 4 + 1 = $</td>
<td>$4 \cdot 25 + 4$</td>
</tr>
<tr>
<td>$7 + 1 = $</td>
<td>$100 + 4 = $</td>
</tr>
<tr>
<td>$8$</td>
<td>$104$</td>
</tr>
</tbody>
</table>

**Example 2** Evaluate expressions with grouping symbols

Evaluate the expression.

a. $6(9 + 3) = 6(12) = 72$

b. $50 - (3^2 + 1) = 50 - (9 + 1) = 50 - 10 = 40$

c. $3[5 + (5^2 + 5)] = 3[5 + (25 + 5)] = 3[5 + 30] = 3(35) = 105$


**Checkpoint** Evaluate the expression.

5. \(6(3 + 9^2)\)
   \[
   \begin{align*}
   6(3+9) &= 6(12) = 72 \\
   \text{(Work down)}
   \end{align*}
   \]

6. \(2[(10 - 4) \div 3]\)
   \[
   \begin{align*}
   2(6 \div 3) &= 2(2) = 4
   \end{align*}
   \]

**Example 3:** Evaluate an algebraic expression

Evaluate the expression \(\frac{12k}{3(k^2 + 4)}\) when \(k = 2\).

**Solution**

\[
\frac{12k}{3(k^2 + 4)} = \frac{12(2)}{3[2^2 + 4]}
\]

**STEP I** Substitute 2 for \(k\).

**STEP II** Evaluate expression

\[
\frac{12(2)}{3[4 + 4]} = \frac{24}{24} = 1
\]

A fraction bar can act as a grouping symbol. Evaluate the numerator and denominator before dividing.

**Checkpoint** Evaluate the expression when \(x = 3\).

7. \(x^3 - 5\)
   \[
   \begin{align*}
   (3)^3 - 5 &= 27 - 5 = 22
   \end{align*}
   \]

8. \(\frac{6x + 2}{x + 7}\)
   \[
   \begin{align*}
   \frac{6(3) + 2}{3 + 7} &= \frac{20}{10} = 2
   \end{align*}
   \]
Write Expressions

Goal  •  Translate verbal phrases into expressions.

VOCABULARY

Verbal model (used in this textbook) uses words to describe the problem. This should be a mental step.

Rate is a fraction that compares two quantities measured in different units.

Unit rate is a rate per 1 given unit in the denominator.

Example: Rate = \( \frac{400 \text{ miles}}{8 \text{ hours}} \)

Ex: Simplify above rate: \( 50 \text{ miles/hour} \)

TRANSLATING VERBAL PHRASES

<table>
<thead>
<tr>
<th>Operation</th>
<th>Verbal Phrase</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition</td>
<td>The sum of 3 and a number ( n )</td>
<td>( 3 + n )</td>
</tr>
<tr>
<td></td>
<td>A number ( x ) plus 10</td>
<td>( x + 10 )</td>
</tr>
<tr>
<td>Subtraction</td>
<td>The difference of 7 and a number ( a )</td>
<td>( 7 - a )</td>
</tr>
<tr>
<td></td>
<td>Twelve less than a number ( x )</td>
<td>( x - 12 )</td>
</tr>
<tr>
<td>Multiplication</td>
<td>Five times a number ( y )</td>
<td>( 5y )</td>
</tr>
<tr>
<td></td>
<td>The product of 2 and a number ( n )</td>
<td>( 2n )</td>
</tr>
<tr>
<td>Division</td>
<td>The quotient of a number ( a ) and 6</td>
<td>( \frac{a}{6} )</td>
</tr>
<tr>
<td></td>
<td>Eight divided into a number ( y )</td>
<td>( \frac{y}{8} )</td>
</tr>
</tbody>
</table>

Quantity means ( )’s

Is means equal

Of means multiply

Order is important when writing subtraction and division expressions.
Example 1 Translate verbal phrases into expressions

Translate the verbal phrase into an expression.

<table>
<thead>
<tr>
<th>Verbal Phrase</th>
<th>Expression</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 6 less than the quantity</td>
<td>$8x - 6$</td>
</tr>
<tr>
<td>b. 2 times the sum of 5</td>
<td>$2(5 + a)$</td>
</tr>
<tr>
<td>c. The difference of 17 and the cube of a number n</td>
<td>$17 - n^3$</td>
</tr>
</tbody>
</table>

Checkpoint Translate the verbal phrase into an expression.

1. The product of 5 and the quantity 12 plus a number $n$

2. The quotient of 10 and the quantity a number $x$ minus 3

Example 2 Use a verbal model to write an expression

Food Drive You and three friends are collecting canned food for a food drive. You each collect the same number of cans. Write an expression for the total number of cans collected.

Solution

Step 1 Mentally think of a verbal model: Amount $\times$ Number of cans $\div$ People

Step 2 Translate the verbal model into an algebraic expression.

An expression that represents the total number of cans is $4C$. 

Key Information

4 people collect the same # of cans

Define Variable $C =$ # of Cans

Do not forget units
Your Notes

**Checkpoint** Complete the following exercise.

3. In Example 2, suppose that the total number of cans collected are distributed equally to 2 food banks. Write an expression that represents the number of cans each food bank receives.

\[
\frac{\text{Total number of cans}}{2} = \frac{4C}{2} \\
\text{2 Food Banks}
\]

**Example 3** Find a unit rate

Three gallons of milk cost $9.15. Find the unit rate.

**Solution**

\[
\frac{\text{3.05}}{\text{1 gallon}}
\]

The unit rate is $3.05 per gallon or $3.05/gal.

**Checkpoint** Find the unit rate.

4. \( \frac{420 \text{ miles}}{3 \text{ hours}} = \text{140 miles/hour} \)

5. \( \frac{12 \text{ ft}^2}{3 \text{ ft}^2} = \frac{4}{1} \text{ ft}^2 \)

6. \( \frac{20 \text{ cups}}{8 \text{ people}} = 2.5 \text{ cups/person} \)

Homework
Write Equations and Inequalities

Goal. • Translate verbal sentences into equations or inequalities.

VOCABULARY

Open sentence are equations and inequalities

Equation
Two expressions connected with an equal sign

Inequality
Two expressions connected with $\geq$, $\leq$, $\neq$

Solution of an equation is the number(s) that make the equation true

Solution of an inequality is the set of all numbers that make the inequality true

EXPRESSING OPEN SENTENCES

Symbol Meaning
\(a = b\) \(a\) is equal to \(b\)
\(a < b\) \(a\) is less than \(b\)
\(a \leq b\) \(a\) is less than or equal to \(b\)
\(a > b\) \(a\) is greater than \(b\)
\(a \geq b\) \(a\) is greater than or equal to \(b\)

\(a \neq b\) \(a\) is not equal to \(b\)

Example

1. \(x < 5\)  “5 is not a solution”
2. \(x \leq 5\)  “5 is a solution”
Example 1: Write equations and inequalities

Write an equation or an inequality.

Verbal Sentence

a. The sum of three times a number \( a \) and 4 is 25.

b. The quotient of a number \( x \) and 4 is fewer than 10.

c. A number \( n \) is greater than 6 and less than 12.

Equation or Inequality

\[ 3a + 4 = 25 \]

\[ \frac{x}{4} < 10 \]

\[ 6 < n < 12 \text{ or } 2 \]

\[ n > 6 \text{ AND } n < 12 \]

Example 2: Check possible solutions

Check whether 2 is a solution of the equation or inequality.

<table>
<thead>
<tr>
<th>Equation or Inequality</th>
<th>Substitute</th>
<th>Conclusion</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. ( 7x - 8 = 9 )</td>
<td>( 7(2) - 8 \neq 9 )</td>
<td>( 6 \neq 9 \text{ Evaluates each side. ( 2 ) is NOT a solution.} )</td>
</tr>
<tr>
<td>b. ( 4 + 5y &lt; 18 )</td>
<td>( 4 + 5(2) &lt; 18 )</td>
<td>( 14 &lt; 18 \text{ Evaluates each side. ( 2 ) is a solution.} )</td>
</tr>
</tbody>
</table>

Checkpoint: Check whether the given number is a solution of the equation or inequality.

<table>
<thead>
<tr>
<th>Problem</th>
<th>Solution</th>
<th>Check</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( 6r + 1 = 25 )</td>
<td>( r = 4 )</td>
<td>( 6(4) + 1 = 25 ) is a solution</td>
</tr>
<tr>
<td>2. ( x^2 - 5 &gt; 10 )</td>
<td>( x = 5 )</td>
<td>( (5)^2 - 5 &gt; 10 ) is a solution</td>
</tr>
<tr>
<td>3. ( 7a &lt; 21 )</td>
<td>( a = 6 )</td>
<td>( 7(6) &lt; 21 ) is a solution</td>
</tr>
</tbody>
</table>

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Example 3: Use mental math to solve an equation

Solve the equation using mental math.

1. \( n + 6 = 11 \)
   - Think: What number plus 6 equals 11?
   - Solution: \( n = 5 \)

2. \( \frac{b}{11} = 3 \)
   - Solution: \( b = 33 \)

Check:

3. \( \frac{5 + 6}{11} = 1 \)
   - Correct: \( 11 = 11 \)

Checkpoint: Solve the equation using mental math.

4. \( x + 9 = 14 \)  
   - Solution: \( x = 5 \)
   - Check: \( 5 + 9 = 14 \)

5. \( 5t - 4 = 11 \)  
   - Solution: \( t = 3 \)
   - Check: \( 5(3) - 4 = 11 \)

6. \( \frac{y}{4} = 15 \)  
   - Solution: \( y = 60 \)
   - Check: \( \frac{60}{4} = 15 \)

How to Do Homework:
- Write Problem
- Circle Solution
- Check
Use a Problem Solving Plan

Goal: Use a problem solving plan to solve problems.

Your Notes

A PROBLEM SOLVING PLAN

Use the following four-step plan to solve a problem.

Step 1: Read and Understand
Read the problem carefully. Identify what you want to know and what you want to find out.

Step 2: Make a Plan
Decide on an approach to solving the problem.

Step 3: Solve the Problem
Carry out your plan. Try a new approach if the first one isn't successful.

Step 4: Look Back and Check
Check that your answer is reasonable.

Example 1: Read a problem and make a plan

You have $7 to buy orange juice and bagels at the store. A container of juice costs $1.25 and a bagel costs $0.75. If you buy two containers of juice, how many bagels can you buy?

Solution:

\[ \begin{align*}
\text{KI:} & \quad \text{$7 to spend} \\
& \quad \text{\$1.25 - juice} \\
& \quad \text{\$0.75 - bagel} \\
& \quad 2 \text{ containers of juice} \\
\text{Variable:} & \quad \text{B = \# bagels} \\
& \quad \text{remember Units} \\
\text{Equation:} & \quad \text{Units} \\
& \quad \text{See example 2}
\end{align*} \]
Solve the problem in Example 1 by carrying out the plan. Then check your answer.

Step 1: Mentally think about a verbal model to help write an equation.

<table>
<thead>
<tr>
<th>Price of juice of bagel (in dollars)</th>
<th>Number of containers</th>
<th>Price of bagel (in dollars)</th>
<th>Number of bagels</th>
<th>Cost (in dollars)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.25</td>
<td>2</td>
<td>0.75</td>
<td>b</td>
<td>7</td>
</tr>
</tbody>
</table>

The equation is: \[2.50 + 0.75b = 7\]

Steps: Solve

\[
\begin{align*}
2.50 + 0.75b &= 7 \\
-2.50 &= -2.50 \\
0.75b &= 4.50 \\
0.75b &= 4.50 \\
b &= 6
\end{align*}
\]

Step 6: Does answer make sense

Mentally

Juice: \$1.25(2) + 0.75(6) = \$7

\$2.50 + \$4.50 = \$7

Makes sense

Step 7: Answer in a sentence

You can buy 6 bagels.
VOCABULARY:

Formulas are equations that relate 2 or more quantities.

Below are 4 sample formulas.

FORMULA REVIEW

Temperature

\[ C = \frac{5}{9}(F - 32), \text{ where } F = ^\circ \text{Fahrenheit}\]

and \[ C = ^\circ \text{Celsius} \]

Simple interest

\[ I = Prt, \text{ where } I = \text{interest}, P = \text{principal}, \]

\[ r = \text{interest rate} \text{ (as a decimal), and } t = \text{time} \]

Distance traveled

\[ d = rt, \text{ where } d = \text{distance}, r = \text{rate}, \]

\[ t = \text{time} \]

Profit

\[ P = I - E, \text{ where } P = \text{profit}, I = \text{income}, \text{ and } \]

\[ E = \text{expenses} \]

How TO DO WORD PROBLEMS:

\[ 1. \text{Write Key Info} \]

\[ 2. \text{Define Variable(s)} \]

*Remember units!*

\[ 3. \text{Write Equation(s)} \]

\[ 4. \text{Solve (show work clearly)} \]

\[ 5. \text{Check: Ask yourself "Does this answer make sense?"} \]

\[ 6. \text{Write answer in a sentence.} \]
Represent Functions as Rules and Tables

Goal: Represent functions as rules and as tables.

**VOCABULARY**
- **Relation:** A set of ordered pairs: \((x, y)\)
- **Function:** A special relation that has no repeating x-values, and given a graph it passes the vertical line test.
- **Domain:** The collection of all x-values.
- **Range:** The collection of all y-values.
- **Independent variable:** Is the x variable
- **Dependent variable:** Is the y variable

**Example 1:** Identify the domain and range of a function

The input-output table shows temperatures over various increments of time. Identify the domain and range of the function.

<table>
<thead>
<tr>
<th>Input (hours)</th>
<th>0</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output (°C)</td>
<td>24</td>
<td>27</td>
<td>30</td>
<td>33</td>
<td>33</td>
</tr>
</tbody>
</table>

**Solution**
- **Domain:** \(x = 0, 2, 4, 6, 8\)
- **Range:** \(y = 24, 27, 30, 33\)

Always put numbers low to high.

\(y = 2x + 1\)
**Checkpoint** Identify the domain and range of the function.

1. | Input | 4 | 7 | 11 | 13 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>10</td>
<td>20</td>
<td>35</td>
<td>45</td>
</tr>
</tbody>
</table>

   Domain $x = 4, 7, 11, 13$

   Range $y = 10, 20, 35, 45$

**Example 2** Identify a function

Tell whether the pairing is a function. Explain your reasoning.

**Solution**

a. Mapping diagrams are often used to represent functions. Take note of the pairings to make your decision.

```
Input | 4 | 8 | 2 |

Output | 1 | 2 | 3 |
```

Suggest create an $x-y$ table.

```
x
4 | 1
8 | 2
2 | 3
```

**Checkpoint** Tell whether the pairing is a function.

2. | Input | 5 | 5 | 10 | 15 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>3</td>
<td>4</td>
<td>6</td>
<td>8</td>
</tr>
</tbody>
</table>

**NOT A FUNCTION**

b/c there are repeating $x$ values (5's)

3. | Input | 0 | 4 | 12 | 20 |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Output</td>
<td>3</td>
<td>5</td>
<td>9</td>
<td>13</td>
</tr>
</tbody>
</table>

**FUNCTION** because there are no repeating $x$ values.

**(NOTE, THE $y$-VALUES CAN REPEAT)**
A function may be represented using a rule that relates one variable to another.

### FUNCTIONS

<table>
<thead>
<tr>
<th>Verbal Rule</th>
<th>Equation</th>
<th>Table</th>
</tr>
</thead>
<tbody>
<tr>
<td>The output is 2 less than the input.</td>
<td>$y = x - 2$</td>
<td>Input $x$</td>
</tr>
<tr>
<td>Output</td>
<td></td>
<td>Output</td>
</tr>
</tbody>
</table>

**Example 3**  
**Make a table for a function**

The domain of the function $y = 3x$ is 0, 1, 2, and 3. Make a table for the function, then identify the range of the function.

**Solution**

$$\text{Eq: } y = 3x$$

<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>0</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

The range of the function is $y = 0, 3, 6, 9$.

**Example 4**  
**Write a function rule**

Write a rule for the function.

<table>
<thead>
<tr>
<th>Input $x$</th>
<th>3</th>
<th>5</th>
<th>7</th>
<th>9</th>
<th>11</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output $y$</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 $y = 2x$.

☑ **Checkpoint** Write a rule for the function. Identify the domain and the range.

<table>
<thead>
<tr>
<th>Yarn (yd)</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Cost ($)</td>
<td>1.5</td>
<td>3</td>
<td>4.5</td>
<td>6</td>
</tr>
</tbody>
</table>

**Rule:** $y = 1.5x$  
$y = x + \frac{1}{2}x$
Represent Functions as Graphs

Goal  • Represent functions as graphs.

**GRAPHING A FUNCTION**

- You can use a graph to represent a **function**.
- In a given table, each corresponding pair of input and output values forms an **ordered pair** \((x, y)\).
- An ordered pair of numbers can be plotted as a **point**.
- The **x-coordinate** is the **input** \((x)\).
- The **y-coordinate** is the **output** \((y)\).
- The horizontal axis of the graph is labeled with the **x-axis**.
- The vertical axis is labeled with the **y-axis**.

---

**Example 1**  **Graph a function**

Graph the function \(y = x + 1\) with domain 1, 2, 3, 4, and 5.

**Solution**

Step 1  Make an **input-output** table.

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

Step 2  Plot a point for each ordered pair \((x, y)\). 

- **DO NOT DRAW THE LINE** (because you are given specific domain values). 
- **LABEL X AND Y.**
Example 2: Write a function rule for a graph

Write a function rule for the function represented by the graph. Identify the domain and the range of the function.

Solution

Step 1 Make a Table for the graph.

<table>
<thead>
<tr>
<th>x</th>
<th>2</th>
<th>4</th>
<th>6</th>
<th>8</th>
<th>10</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Step 2 Find a Relationship between the input and output values.

Mental work:
\[
\begin{align*}
\frac{1}{2}(4) &= 2 - 1 = 1
\
\frac{1}{2}(6) &= 3 - 1 = 2
\
\end{align*}
\]

Step 3 Write a Rule that describes the relationship.

\[
\begin{align*}
\sqrt{y} &= \frac{1}{2}x - 1 \\
\text{or} \quad y &= \frac{x}{2} - 1
\end{align*}
\]

A rule for the function is \( y = \frac{1}{2}x - 1 \). The domain of the function is \( x = 2, 4, 6, 8, 10 \).

The range is \( y = 0, 1, 2, 3 \).
1. Graph the function \( y = \frac{1}{3}x + 1 \) with domain 0, 3, 6, 9, and 12.

\[ y = \frac{1}{3}x + 1 \]

<table>
<thead>
<tr>
<th>x</th>
<th>0</th>
<th>3</th>
<th>6</th>
<th>9</th>
<th>12</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Since the domain is stacked, then do NOT draw a line segment.

2. Graph the function represented by the graph. Identify the domain and the range of the function.

<table>
<thead>
<tr>
<th>x</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>10</td>
<td>9</td>
<td>8</td>
<td>7</td>
<td>6</td>
<td>5</td>
</tr>
</tbody>
</table>

D: x = 1, 2, 3, 4
R: y = 10, 9, 8, 7, 6

Rule: \( y = 3x - 3 \)

<table>
<thead>
<tr>
<th>x</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>6</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>26</td>
<td>47</td>
<td>68</td>
<td>89</td>
<td>10</td>
</tr>
</tbody>
</table>

D: x = 2, 3, 4, 6, 8
R: y = 26, 47, 68, 89, 100

Rule: \( y = \frac{1}{2}x + 5 \)

3. Graph the function represented by the graph. Identify the domain and the range of the function.

<table>
<thead>
<tr>
<th>x</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>3</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

Rule: \( y = 3x - 3 \)

<table>
<thead>
<tr>
<th>x</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>y</td>
<td>6</td>
<td>9</td>
</tr>
</tbody>
</table>

Rule: \( y = \frac{1}{2}x + 5 \)

\( y = \frac{1}{2}(4) + 5 = 6 \)
\( y = \frac{1}{2}(4) + 5 = 7 \)

etc.
**Vertical Line Test**

**Visual Approach**

These are functions.

![Graphs showing functions](image1)

These are not functions.

![Graphs showing non-functions](image2)

**Four** of the following are functions. Which are they? **Circle the letter**

A. ![Graph](image3)  
B. ![Graph](image4)  
C. ![Graph](image5)  
D. ![Graph](image6)  
E. ![Graph](image7)  
F. ![Graph](image8)

What is a function?

**Function is a special relation with NO repeating**

**X-values**

What is the Vertical Line Test?

**Abbreviated VLINE TEST**

To determine if a graph is a function, use the **VLINE TEST**.

**: A vertical line can only touch the graph in 1 place to be a function.**