## 1.6: Represent Functions as Rules and Tables

Goals: *Understand what a function is and identify relationships as functions
*Identify the domain and range of a function
*Write a rule for a function

## **Function**

## Consists of input and output values. Each input can produce exactly one output value.

Domain: The set of all possible input values.

Range: The set of all possible output values.

Ex: The input-output table shows the cost of various amounts of regular unleaded gas from the same pump. Identify the domain and range of the function.

| Input (gallons) | 10 | 12 | 13 | 17 |
| :--- | :---: | :---: | :---: | :---: |
| Output <br> (dollars) | 19.99 | 23.99 | 25.99 | 33.98 |

Domain: $\qquad$ 10, 12, 13, 17 $\qquad$ Range: $\qquad$ 19.99, 23.99, 25.99, 33.98 $\qquad$

Ex: Identify the domain and range of the given function:

| Input | 0 | 1 | 2 | 4 |
| :--- | :--- | :--- | :--- | :--- |
| Output | 5 | 2 | 2 | 1 |

Domain: $\qquad$ $0,1,2,4$ $\qquad$ Range: $\qquad$ 1, 2, 5 $\qquad$
*can list in order and don't have to repeat
**Why is it a function even though 2 appears twice in the output?
The input 1, has only one output value. Its 2 .
The input 2 , has only one output value. Its 2.

Decide if the following relationships represent a function. Explain why or why not. If yes, identify the domain and range.
Ex:
Ex:


| Input | Output |
| :---: | :---: |
| 0 | 0 |
| 1 | 2 |
| 4 | 8 |
| 6 | 12 |

Yes, each input has 1 output

No, 0 has 2 outputs
Ex:

| Input | 3 | 6 | 9 | 12 |
| :--- | :---: | :---: | :---: | :---: |
| Output | 1 | 2 | 2 | 1 |

Yes, each input has one output
Ex:

| Input | 2 | 2 | 4 | 7 |
| :--- | :--- | :--- | :--- | :--- |
| Output | 0 | 1 | 2 | 3 |

No, 2 has two outputs: 0 and 1

Independent Variable: input variable, domain, the output depends on it. Usually $x$

Dependent Variable: output variable, range, depends on the input. Usually y

## Ways to Represent Functions

## Verbal Rule

The output is 3 more than the input.

Equation
$y=3+x$

Table

| Input $(x)$ | 0 | 1 | 2 | 3 |
| :--- | :--- | :--- | :--- | :--- |
| Output $(y)$ | 3 | 4 | 5 | 6 |

$$
y=3+x
$$

Ex: The domain of the function $y=2 x$ is $0,2,5,7,8$. Make a table for the function, then identify the range.

| Input | 0 | 2 | 5 | 7 | 8 |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Output | 0 | 4 | 10 | 14 | 16 |

Range: $\qquad$ $0,4,10,14,16$ $\qquad$

Ex: Make a table for the function $y=x-5$ with a domain of $10,12,15,18,29$. Then identify the range.

| Input | 10 | 12 | 15 | 18 | 29 |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Output | 5 | 7 | 10 | 13 | 24 |

Range: $\qquad$ $5,7,10,13,24$ $\qquad$

## Writing a Rule for a Function:

Basic Premise: If you have $x$, how do you get $y$ ?
**REMEMBER THAT ALL FUNCTIONS START WITH: $y=\quad * *$

Ex:

| Input | 0 | 1 | 4 | 6 | 10 |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Output | 2 | 3 | 6 | 8 | 12 |

$$
y=x+2
$$

Ex:

| Input | 1 | 2 | 4 | 7 | 9 |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Output | 0 | 1 | 3 | 6 | 8 |

$$
y=x-1
$$

Ex:

| Input | 1 | 3 | 5 | 7 | 9 |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Output | 1 | 5 | 9 | 13 | 17 |

$\Delta$ Greek letter Delta- in math it means "Change in" So $\Delta T$ would mean change in temperature

1. Start with $y=$
2. Find $\Delta y$ and $\Delta x$. (How much do $x$ and $y$ change by each time? If the table is not consistent, just use one segment)
3. Make a fraction. $\frac{\Delta y}{\Delta x}$ and simplify if possible. This number will be the coefficient of $x$ in the function. (It multiplies $x$ )
4. Adjust as necessary by adding or subtracting.
5. Check that your function works for all input and output values.

## Write a rule for the following functions. (If you cannot see the relationship between $x$ and $y$ easily, use the rules provided)

## Ex:

| Input | 0 | 3 | 6 | 9 | 12 |
| :--- | :---: | :---: | :---: | :---: | :---: |
| Output | 5 | 14 | 23 | 32 | 41 |

$\Delta y=9, \Delta x=3$
$\frac{9}{3}=3$
$y=3 x$ Plug in 0 , get 0 out. Need 5 so add 5 .
$y=3 x+5$

## Ex:

| Input | 4 | 6 | 10 | 16 | 26 |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Output | 4 | 5 | 7 | 10 | 15 |

$$
\begin{aligned}
& \Delta y=1, \Delta x=2 \\
& \frac{1}{2}
\end{aligned}
$$

$$
y=\frac{1}{2} x \text { If you plug in } 4 \text { you get } 2
$$ out. Need 4 so add 2.

$$
y=\frac{1}{2} x+2
$$

Ex: You are buying concert tickets that cost $\$ 15$ each. You can buy up to six tickets.
a) Write a rule for the amount you spend (in dollars) as a function of the number of tickets you buy.

$$
y=15 x
$$

b) Identify the independent and dependent variables.

The number of tickets $(x)$ is independent The total cost $(y)$ is dependent.
c) Identify the domain and range.

Domain (All of the possible numbers of tickets you can buy): 0, 1, 2, 3, 4, 5, 6
Range (All of the total costs depending on the number of tickets): $0,15,30,45,60,75,90$

Ex: At a community center, art lessons are offered at night. The fee is $\$ 12$ per lesson. You plan to attend up to 5 lessons.
a) Write a rule for the amount you spend (in dollars) as a function of the number of lessons you attend. $y=12 x$
b) Identify the independent and dependent variables.
$x$ - the number of lessons attended - independent
$y$ - the total cost - dependent
c) Identify the domain and range.

Domain: 0, 1, 2, 3, 4, 5
Range: $\quad 0,12,24,36,48,60$

