# **Lesson Objectives**

1. The basics of function
2. Function notation
3. Understand the relationship between function notation and its graph
4. Determine whether a relation is a function
5. Evaluate a function from a formula or a graph
6. Determine the domain and range of a function

# **Functions – The Basics**

## Ways to **Represent** a function

1. **Symbolic** – a formula (equation)
2. **Numerical** – a table of values
3. **Graphical** – a visual display of points
4. **Verbal** – a description in words

## The variables of a function

* The set of all valid **inputs** for a function is called the **domain**, and the input variable is called the **independent** variable **– *x***.
* The set of all valid **outputs** for a function is called the **range**, and the output variable is called the **dependent** variable – ***y***.

# **Function Notation – the symbolic** representation

Function notation looks like this: and is read as “***y* equals *f* of *x***.”

The reverse is also true:

It does **NOT** mean multiplication! (It is NOT “*f* times *x* equals *y*.”)

Another way: ***f*(input) = output**

The **name** of the function is ***f***, but a function can be called *g*(*x*) or *h*(*x*), etc.

# Function Notation and its Graph: ***f*(Input) = Output**

When evaluating a graphically, first locate the **input** value on the ***x*-axis**,

then determine the corresponding **output** value on the ***y*-axis**.

* **EXAMPLE:** If *f*(-5) = 3, identify a point on the graph of *f*. (Type an ordered pair.)[1.3.23, Q4]
  + The number in **parentheses** is the ***x***, and the number **by itself** is the ***y***.
  + Together, they make the ordered pair, or the point, **(*x*, *y*)**.
  + So, if *f*(-5) = 3, that means a point on the graph of *f* is **(-5,3)**.
* **EXAMPLE:** If (5,27) lies on the graph of *f*, then *f*(\_\_**5**\_\_\_) = \_\_\_\_\_**27**\_\_\_\_\_. [1.3.25]
  + This is the reverse idea of the previous example.
  + Any point in the graph of a function can be written in function notation.
* **EXAMPLE:** A function g is defined as follows: *g*(-4) = -6, *g*(0) = -9, *g*(4) = -4, *g*(8) = -6

1. Write *g* as a set of ordered pairs.
2. Give the domain and range of *g*.

[1.3.47]

**[solution] (a)** *g* = { (-4,-6), (0,-9), (4,-4), (8,-6) }

**(b)** D = {-4, 0, 4, 8} and R = {-6, -9, -4}

# **Function** – special kind of relation (set of ordered pairs)

Each element in the domain corresponds to exactly one element in the range.

A function can only have one output for each input.

The ***x*-coordinates cannot repeat** in a function.

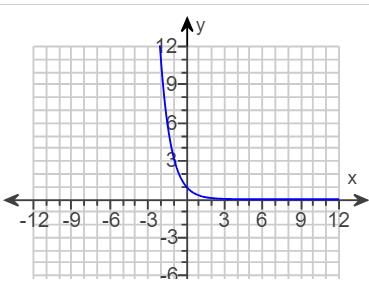
* **EXAMPLE:** Determine whether the relation *S* is a function. [1.3.107]

*S* = { (a,5), (b,5), (c,9), (d,5), (e,5) }.

* + Each *x*-coordinate is unique; none of the *x*-coordinates repeat.
  + **YES** – the relation **IS** a function (Doesn’t matter if *y*-coordinates repeat)

## **Vertical Line Test** – used to tell if a graph is a function

* Scan with a vertical line from left to right along the graph
* Must maintain EXACTLY **one** point of contact throughout the scan.
  + If it maintains **exactly one** point of contact, then YES, it’s a function
  + If it makes **two or more** points of contact anywhere, then NO, it’s not a function.
* **EXAMPLE:** Is the relation a function? [1.3-45]

 Although the left side looks like it’s going vertical, in reality, it’s not.

# Evaluate a Function from its Graph

* **EXAMPLE:** [\*Consortium 3.1.12]

|  |  |  |  |
| --- | --- | --- | --- |
| Use the graph of the function *f* shown to the right to answer parts **(a)** through **(d)**. | |  | |
| 1. Find *f*(– 14). | |
| The number in parentheses is always the ***x*-coordinate**. So, *f*(– 14) means find the ***y*-coordinate** that goes with *x* = – 14.  The graph contains the point (– 14,– 4), so | |
| Find *y* in (– 14, *y*) | *f*(– 14) = **– 4**. |
| 1. Find *f*(– 6). |  | **(d)** For what number(s) of *x* is *f*(*x*) = – 4 ? | |
| The graph contains the point (– 6,6), so | |  | |
| Find *y* in (– 6, *y*) | *f*(– 6) = **6**. | This problem is different – the number in parentheses, *x*, is not given. | |
| 1. Find *f*(12). | | ***f*(*x*)** is another name for ***y***, so *f*(*x*) = – 4 really means that ***y*-coordinate** is **– 4**. | |
| The graph contains the point (12,4), so | | The graph contains the point (– 14, – 4), so | |
| Find *y* in (12, *y*) | *f*(12) = **4**. | Find *x* in ( *x* , – 4) | So, *x* = **– 14** |

# Determine **Domain** and **Range** of a Function in a Graph

* **EXAMPLE:** Use the graph of the function *f* to estimate its domain and range.

Evaluate *f*(0). [1.3.73]

|  |  |  |  |
| --- | --- | --- | --- |
| Assume graph goes on forever, unless it has a big fat dot or open dot (endpoint). | |  | |
| **Domain:** all the ***x*-coordinates** shown in graph. | |
| **Domain is *x*, and it moves left – to – right.** | |
| (Answer) The domain is: |  |
|  | |
| **Range:** all the ***y*-coordinates** shown in graph. | |
| **Range is *y*, and it moves low – to – high.** | |
| (Answer) The range is: |  |
|  | |
| Use **bracket** for range because 11 is **included**. | | Evaluate *f*(0). | Find *y* in (0, *y*) |
|  | | That’s the point (0,11) | (Answer)  *f*(0) = **11** |

# Evaluate a Function from its Formula

* **E****XAMPLE:** Given that , find . [\*Akst Appendix.G-28]

means find when . Plug into the function formula.

Remember to always use **parentheses** to avoid messing up.

By the way – together, that makes the point on the graph:

There are two main ways you can do this on calculator:

|  |  |  |
| --- | --- | --- |
| 1. **Direct Substitution**   To get absolute value bars, press MATH, →, ENTER | 1. **“Go to the STO”**   You are going to store the number 3 for the variable *x*.  Press: **3** ; **STO>** ; **X,T,θ,n** ; **ENTER** | |
| (from TI-84 Plus)    (from TI-83 Plus) | Type in your function formula  as is, press **ENTER**.  Use variables – don’t plug in anything. | (from TI-84 Plus)    (from TI-83 Plus) |

(go on to the next page)

* **EXAMPLE:** Find when . [1.3-12]

means find when . Plug into the function formula.

Remember to always use **parentheses** to avoid messing up.

By the way – together, that makes the point on the graph:

There are two main ways you can do this on calculator:

|  |  |  |
| --- | --- | --- |
| 1. Direct Substitution | 1. **“Go to the STO”** | |
|  | Press **(–)**; **4** ; **STO>** ; **X,T,θ,n** ; **ENTER** |  |
| Type in your function formula  ***x*2 – 4*x* – 5** as is, press **ENTER**.  Use variables – don’t plug in anything. |

Sources used:

1. Pearson MyLab Math *College Algebra with Modeling and Visualization, 6th Edition*, Rockswold
2. Pearson MyLab Math *Consortium: MIA: Intro to Algebraic, Graphical, & Numerical Problem Solving, 6th Edition*.
3. Pearson MyLab Math *Developmental Mathematics through Applications, 1st Edition*, Akst.
4. Wabbitemu calculator emulator version 1.9.5.21 by Revolution Software, BootFree ©2006-2014 Ben Moody, Rom8x ©2005-2014 Andree Chea. Website <https://archive.codeplex.com/?p=wabbit>