**Function Machines**

Here is a function machine: It takes one number as an **input** and produces another number as the **output**. A **function** is a rule that tells the machine what output to produce for any input.



**Example 1**: The doubling function. The rule here is that the output is twice the input.



Here are some examples of how this function works.

|  |  |
| --- | --- |
|  | When the input is 7 the output is 14.We can say, “Doubling 7 gives you 14.”We can write “doubling(7) = 14” (doubling OF 7 equals 14)When the input is –4 the output is –8.We can say, “Doubling –4 gives you –8.”We can write “doubling(–4) = –8” (doubling OF –4 equals –8) |

Questions on Example 1:

1. If the input of the doubling function is 5, what is the output? \_\_\_\_\_\_\_\_
2. Doubling (6) = \_\_\_\_\_\_?
3. Doubling (–9) = \_\_\_\_\_\_?
4. When the input of the doubling function is a positive number, what kind of number (positive or negative) is the output? \_\_\_\_\_\_\_\_\_\_
5. When the input of the doubling function is a negative number, what kind of number (positive or negative) is the output? \_\_\_\_\_\_\_\_\_\_
6. Another way of describing the doubling function is that the output is \_\_\_\_\_ times the input.
7. What is the domain of the doubling function? What is the range?
8. Make a table of values for the doubling function. Chose your own values for the last three inputs.

|  |  |
| --- | --- |
| **Input** | **Output** |
| –9 |  |
| –4 |  |
| 0 |  |
| 3 |  |
| 6 |  |
| 7 |  |
|  |  |
|  |  |
|  |  |

**Example 2:** The square function. The rule here is that the output is found by multiplying the input by itself.

Here are some examples of how this function works.

|  |  |
| --- | --- |
|  | When the input is 3 the output is 9.We can write “square(3) = 9” (The square OF 3 equals 9)When the input is –4 the output is –16.We can write “square(–4) = 16” (The square OF –4 equals 16) |

Questions on Example 2:

1. If the input of the square function is 5, what is the output? \_\_\_\_\_\_\_\_
2. Square (6) = \_\_\_\_\_\_?
3. Square (–9) = \_\_\_\_\_\_?
4. When the input of the square function is a positive number, what kind of number (positive or negative) is the output? \_\_\_\_\_\_\_\_\_\_
5. When the input of the square function is a negative number, what kind of number (positive or negative) is the output? \_\_\_\_\_\_\_\_\_\_
6. If the input of the square function is zero, what is the output?\_\_\_\_\_\_\_
7. If *x* is the input of the square function, what is the output? \_\_\_\_\_\_
8. What is the domain of the square function? What is the range?
9. Make a table of values for the square function. Chose your own values for the last three inputs.

|  |  |
| --- | --- |
| **Input** | **Output** |
| –9 |  |
| –4 |  |
| 0 |  |
| 3 |  |
| 6 |  |
|  |  |
|  |  |
|  |  |

**Function Notation:**

We have observed that functions may be given names, such as “doubling” or “square.” Sometimes we just use a letter of the alphabet for the function name. Since the word “function” begins with the letter “*f*” we most often use *f*. Sometimes we use *g* or *h* since they come after *f* in the alphabet.

Since the input and output of the function may take on many values they are **variables.** The input is sometimes called the **independent variable** and the output the **dependent variable**. (Here’s how to remember this: the output **depends** upon the input.)

The letter ***x*** is often use for the input (independent) variable. The letter ***y*** is used for the output (dependent) variable. Thus, functions in general may be represented by this machine.

**Example 3**

Functions may be defined by algebraic rules. Suppose *f(x)*, *g(x)*, and *h(x)* are defined as follows:

$$f\left(x\right)=x+10 g\left(x\right)=3x h\left(x\right)=4x-5$$

Questions on Example 3:

1. For the function *f*, when the input is 6, the output is \_\_\_\_\_.
2. For the function *g*, when the input is –5, the output is \_\_\_\_\_\_.
3. For the function *h*, when the input is 2, the output is \_\_\_\_\_\_.
4. Find *f*( –3).
5. Find *g*(7).
6. Find *h*(7).
7. Fill in the tables below:

|  |  |
| --- | --- |
| ***x*** | ***f*(*x*)** |
| –3 |  |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

|  |  |
| --- | --- |
| ***x*** | ***g*(*x*)** |
| –3 |  |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

|  |  |
| --- | --- |
| ***x*** | ***h*(*x*)** |
| –3 |  |
| –2 |  |
| –1 |  |
| 0 |  |
| 1 |  |
| 2 |  |
| 3 |  |

1. Describe any patterns you see in the table above.
2. Does *f*(*x*) mean “*f* times *x*”? Explain.