# Relations & Linear Functions

**Definition 1:** A relation is a set of ordered pairs where the first components of the ordered pairs are the input values and the second components are the output values.

**Definition 2:** A function is a relation that assigns to each input number EXACTLY ONE output number.

**Definition3:** The domain is the set of all input values to which the rule applies.  These are called the independent variables. These are the values that correspond to the first components of the ordered pairs it is associated with.

**Definition 4:** The range is the set of all output values.  These are called your dependent variables. These are the values that correspond to the second components of the ordered pairs it is associated with.

**Example 1:** Find the domain and range of the relation.  Determine whether the relation is a function: {(-2, 2), (5, 3), (-6, 4), (1, 10)}

Domain is the set of all input values.  In terms of ordered pairs, it is the first component of each one.  Therefore, the domain is {-2, 5, -6, 1}

Range is the set of all output values.  In terms of ordered pairs, it is the second component of each one.  Therefore, the range is {2, 3, 4, 10}

To determine if the given relation is a function, we have to check if every first element (or input) corresponds to exactly one second element (or output). For {(-2, 2), (5, 3), (-6, 4), (1, 10)}: -2 goes only to 2, 5 goes only to 3, -6 goes only to 4, 1 goes only to 10.
Therefore, the relation is a function.

How to determine if a given graph is a graph of a function? To do so, we use the vertical line test.

**Rule 1:** Vertical Line Test: If no vertical line can be drawn so that it intersects a graph more than once, then it is a graph of a function.



The relation is a function because each vertical line intersect the red graph at one and only one point.
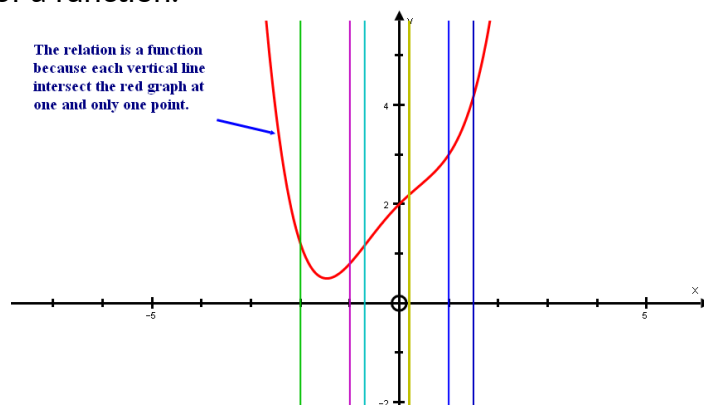
Think about it, if a vertical line intersects a graph in more than one place, then the *x*-value (input) would associate with more than one *y*-value (output), and you know what that means.  The relation is not a function.

**Definition 5:** A Linear equation is an equation with no exponents other than one and with no products of the variables (e.g., y=x+4, y= -4, and 3x-4y = $\frac{1}{2}$ are linear functions); in a rectangular coordinate system; the graph of a linear function is a line.

An alternative definition can be: A linear equation is an equation that can be written in the form Ax + By = C, where A, B, and C are any numbers, and A and B are not both zero. Ax + By = C, where A ≥ 0, is called the **standard form** if A, B, and C are integers whose greatest common factor is 1.