Functions: Representations

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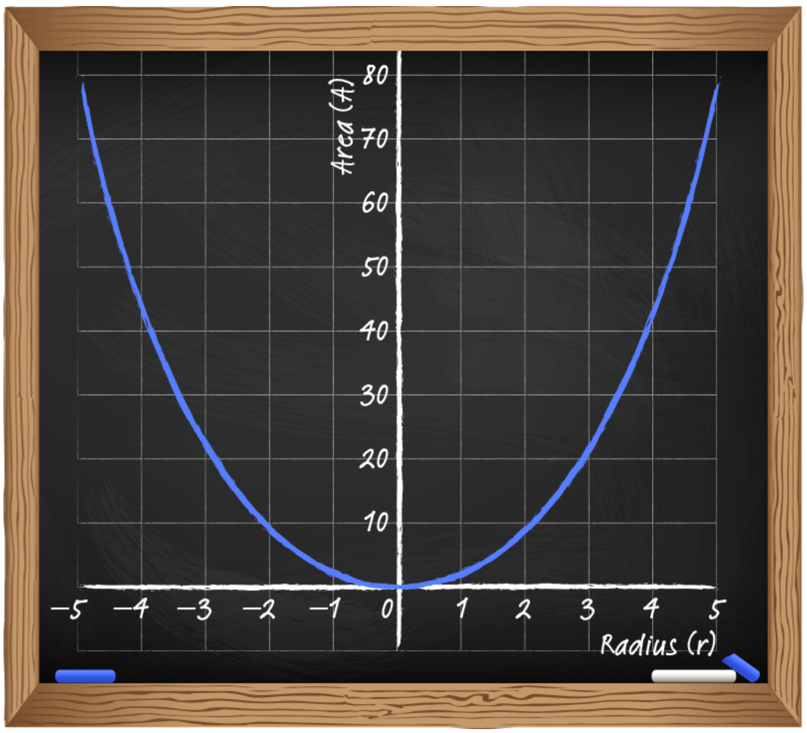
Definition of a Function

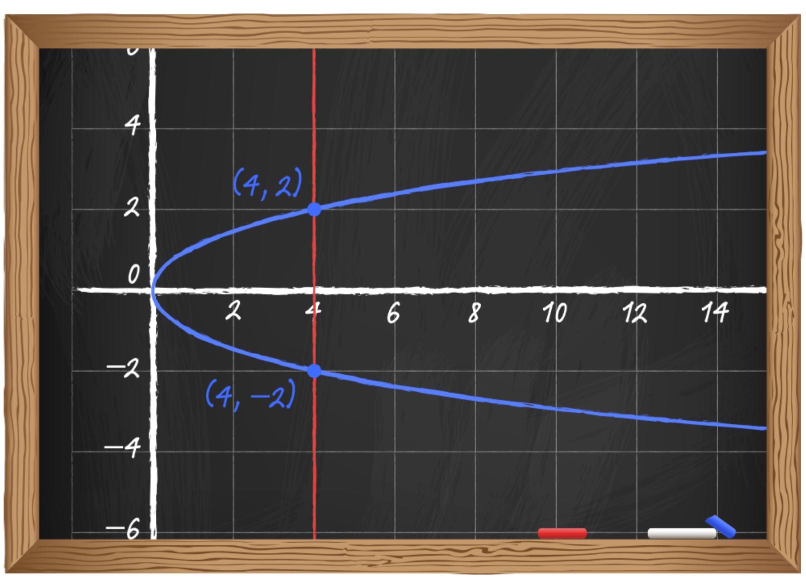
A **function** is a rule that specifies a unique output for any input.

This is a function:



In this graph, the input numbers are shown on the *x*-axis and the output numbers on the *y*-axis. If you select an input number on the *x*-axis, you can find the corresponding output number by going vertically up the graph and then horizontally over to the *y*-axis.

The following graph does not represent a function because there are two outputs (*y*-values) for each input (*x*-value).



Representing Functions

You can represent functions in several ways.

Algebraic Equation

Functions are commonly represented in the form of an algebraic equation. For example, the function that describes the relationship between Fahrenheit and Celsius temperatures is represented in the equation $F = \frac{9}{5}C + 32$, where F represents Fahrenheit temperature and C represents the corresponding Celsius temperature. If you *input* a value for C, you get an *output* value that tells you the corresponding Fahrenheit temperature. For example, the numerical input $C = 0$ gives the output $F = 32$, while the input $C = 100$ gives the output $F = 212$.

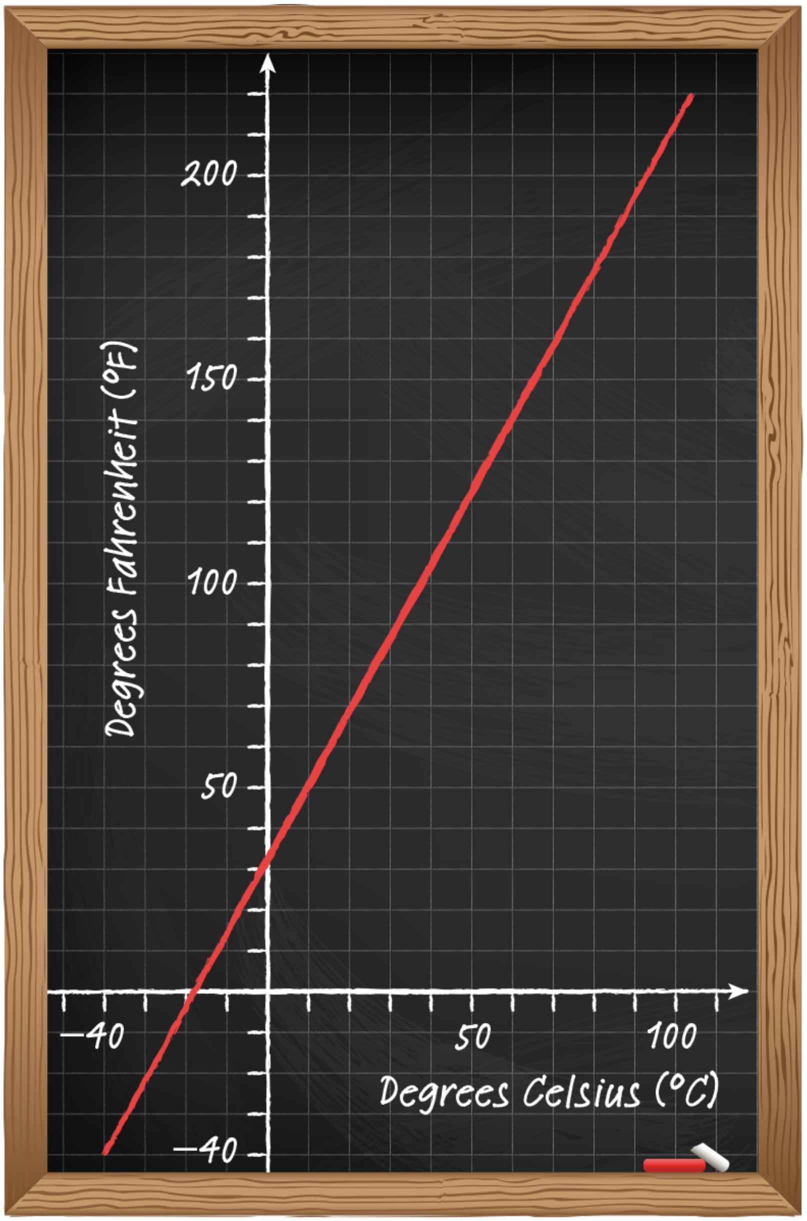
You say that the Fahrenheit temperature, F, is a function of the corresponding Celsius temperature, C.

Another example of a function is the relationship between a circle's circumference, C, and its diameter, d. The algebraic equation for this function is $C = \pi d$. You would say that the circumference C of a circle is a function of its diameter d.

Graph

The graph of a function visually shows the connection between each input and its corresponding output.

Here is a graph of the function $F = \frac{9}{5}C + 32$:



Table

You can use a table to represent some of the input-output pairs of a function.

Here is a table based on the function $F = \frac{9}{5}C + 32$:

C	−40	−30	−20	−10	0	10	20	30	40	50	60	100	C
F	−40	−22	−4	14	32	50	68	86	104	122	140	212	$\frac{9}{5}C + 32$

The first row shows different input values for *C*. The second row shows the corresponding output values for *F*.

Tables are helpful when looking for patterns. In this table, you can identify the following pattern: when *C* increases by 10, *F* increases by 18.

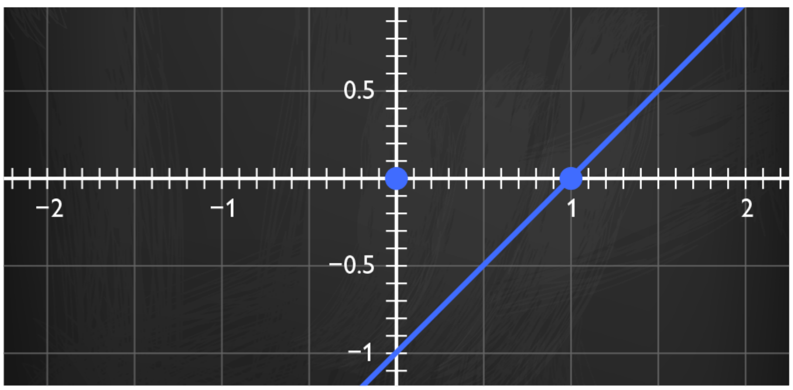
Comparing Functions With Different Representations

Consider the following three linear functions. One is represented with a table, one with a graph, and one with a formula using an algebraic representation. You can compare the three functions, first comparing their rates of growth and then comparing their initial values.

Function 1: Table

x	−3	−2	−1	0	1	2	3	4	x
$f(x)$	3	2	1	0	−1	−2	−3	−4	$0.5x-1$

Function 2: Graph



Function 3: Algebraic Representation

$$y = -0.5x + 3$$

Comparing the Rates of Growth

Function 1: The rate of growth is –1 because each increase of *x* in the table *decreases y* by 1.

Function 2: The rate of growth is 1 because 1 is the slope of the graph.

Function 3: The rate of growth is –0.5 because –0.5 is the coefficient of *x* in the algebraic expression –0.5*x* + 3.

Comparing the Initial Values

Function 1: The initial value is 0 because 0 is the *y*-value corresponding to *x* = 0 in the table.

Function 2: The initial value is –1 because –1 is the *y*-intercept in the graph.

Function 3: The initial value is 3 because 3 is the constant term in the algebraic expression –0.5*x* + 3.