



## Functions الدوال

### Definition التعريف

A function is a relationship between inputs & outputs, where each input is related to exactly one output.

Inputs are denoted by  $x$ .

Outputs are denoted by  $y$ .

Function is always denoted by  $f$

Input  $x \Rightarrow$  Function  $f \Rightarrow$  outputs  $y$

According to the clouded flowchart,  $y$  always depends on the quantity  $x$  in such a way that every value of  $x$  corresponds to one & only one value of  $y$ , then we say that " $y$  is a function of  $x$ ", written,

$$y = f(x)$$

$x$  --- Independent variable . متغير غير معتمد

$y$  --- Dependent variable . متغير معتمد

- The set of all possible input values is called the Domain of the function.
- The set of all output values " $y = f(x)$ " is called the Range of the function.





## Types of Functions: أنواع الدوال

### 1- Algebraic Functions: الدوال الجبرية

Algebraic Functions is a Function that involves only algebraic operations, such as "addition, subtraction, multiplication, division, and taking roots"

#### Types:

##### a- linear Functions: الدوال الخطية

A function of the form;

$$f(x) = mx + b$$

$m$  -- slope

$b$  -- constant

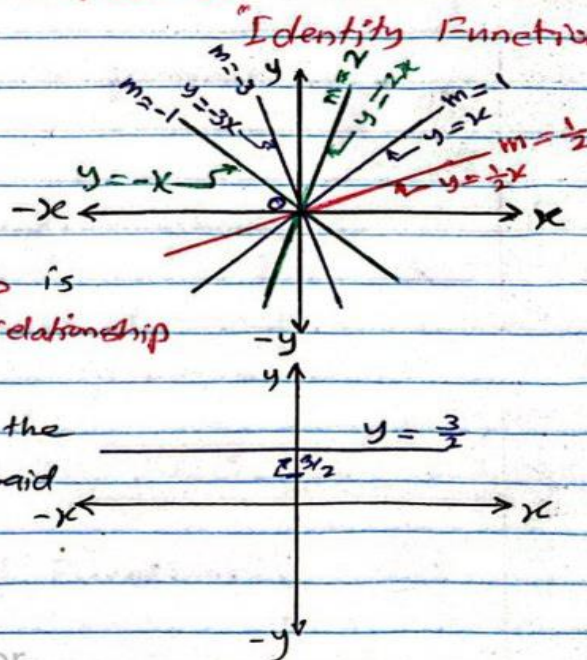
\* IF  $b = 0 \Rightarrow f(x) = mx \Rightarrow$  gives lines pass through the origin

\* IF  $m = 1$  and  $b = 0 \Rightarrow f(x) = x \Rightarrow$  called the "Identity Function"

\* IF  $m = 0 \Rightarrow f(x) = b$

\* A linear function with positive slope with  $b = 0$  is called a proportionality relationship

\* IF  $y$  is proportional to the reciprocal  $\frac{1}{x}$ , then it is said that  $y$  is inversely proportional to  $x$







## b- Polynomial Functions دوال متعددة الحدود

A Function  $P$  is a polynomial if

$$P(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0$$

$n$  --- nonnegative <sup>عدد صحيح</sup> integer, (degree of the polynomial)  
 $a_0, a_1, a_2, \dots, a_n$  --- real constants (coefficients of the Polynomial).

Note

All polynomials have domain  $(-\infty, \infty)$

Ex

①  $P(x) = ax^2 + bx + c$  is polynomial of degree 2 and called "quadratic function" دالة تربيعية

②  $P(x) = ax^3 + bx^2 + cx + d$  is polynomial of degree 3 and called "cubic function" دالة مكعبة

## c- Rational Functions دوال كسرية

A rational function is a quotient or ratio

$$f(x) = \frac{p(x)}{q(x)}$$

$p$  &  $q$  --- Polynomial Functions.

The domain of a rational function is the set of all real  $x$  for which  $q(x) \neq 0$

Ex

$$y = \frac{2x^2 - 1}{7x + 4} ; y = \frac{5x^2 + 8x - 3}{3x^2 + 2} ; y = \frac{11x + 2}{2x^3 - 1}$$

These are all rational functions.





### Summary - ملخص

From the all previous info, any function constructed from **polynomials** using algebraic operators ( $+$ ,  $-$ ,  $\times$ ,  $\div$ ,  $\sqrt{\quad}$ ) lies within the class of **algebraic functions**. All rational functions are algebraic, but also included are more complicated functions (such as those satisfying an equation like  $y^3 - 9xy + x^3 = 0$ ).

### 2- Transcendental Functions - دوال متسامية

These are functions that are not algebraic. They include (a- Trigonometric fun, b- Inverse Trigonometric, c- Exponential, d- Logarithmic, e- Hyperbolic trigonometric fun, d- Inverse of hyperbolic).

A particular example of a transcendental function is a **Catenary**. Its graph has the shape of a cable, like a telephone line or electric cable, strung from one support to another & hanging freely under its own weight.

In our next topics, we will study the Transcendental functions in some details.