Subject : Mathematics
Class : XI

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Functions

- **Ordered pair Pair** formed by two elements that are separated by a comma and written as (x, y).
- **Cartesian product** $A \times B$ of two sets A and B is given by $A \times B = \{(a,b) : a \in A, b \in B\}$

  In particular $R \times R = \{(x, y) : x, y \in R\}$ and $R \times R \times R = \{(x, y, z) : x, y, z \in R\}$

  If $(a,b) = (x, y)$, then $a = x$ and $b = y$.
- If $n(A) = p$ and $n(B) = q$, then $n(A \times B) =$ pq.
- $A \times \phi = \phi$
- In general, $A \times B \neq B \times A$.
- **Relation** A relation R from a set A to a set B is a subset of the cartesian product $A \times B$ obtained by describing a relationship between the first element x and the second element y of the ordered pairs in $A \times B$.
- **The image** of an element x under a relation R is given by y, where $(x, y) \in R$,
- **The domain** of R is the set of all first elements of the ordered pairs in a relation R.
- **The range** of the relation R is the set of all second elements of the ordered pairs in a relation R.
- **Function** A function f from a set A to a set B is a specific type of relation in which every element x of set A has one and only one image y in set B.

  We write $f : A \to B$, where $f(x) = y$.
- A is the domain and B is the codomain of f.
- The range of the function is the set of images.
  Algebra of functions For functions $f : X \to R$ and $g : X \to R$, we have

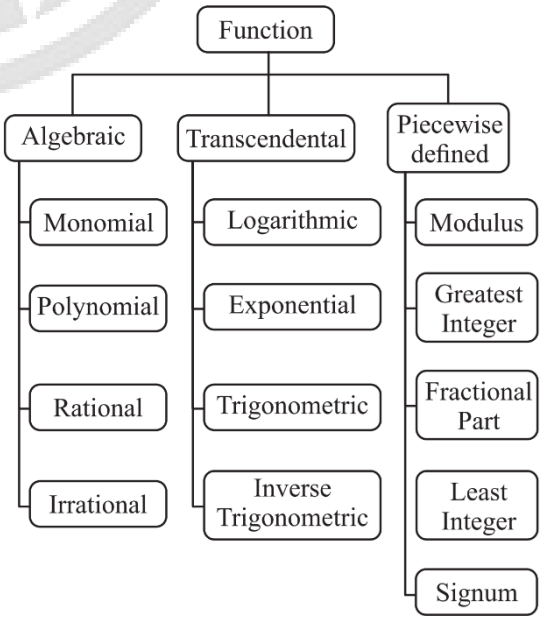
  $(f + g)(x) = f(x) + g(x), x \in X$

  $(f - g)(x) = f(x) - g(x), x \in X$

  $(f.g)(x) = f(x) \cdot g(x), x \in X)$

  $(kf)(x) = k(f(x)), x \in X$, where k is a real number.

  $\left(\frac{f}{g}\right)(x) = \frac{f(x)}{g(x)}, x \in X, g(x) \neq 0$



S.No.		Transformation	How to transform
1	(a)	$y=f(x)\to y=f(x+a)$	Shift the graph of $y=f(x)$ through ' a ' units towards left.
	(b)	$y=f(x)\to y=f(x-a)$	Shift the graph of $y=f(x)$ through ' a ' units towards right.
2	(c)	$y=f(x)\to y+a=f(x)$	Shift graph of $y=f(x)$ by ' a ' units downward.
	(d)	$y=f(x)\to y-a=f(x)$	Shift graph of $y=f(x)$ by ' a ' units upward.
3		$y=f(x)\to y=f(-x)$	Take the mirror image of $y=f(x)$ in the y-axis.
4		$y=f(x)\to y=-f(x)$	Take the mirror image of $y=f(x)$ in the x-axis.
5		$y=f(x)\to y=f(\lvert x\rvert)$	Remove the left portion of the graph after that take the mirror image of the right portion of the curve in the Y-axis. Also include the right portion of the graph of $y = f(x)$
6		$y=f(x)\to y=\lvert f(x)\rvert$	Take the mirror image of the lower portion of the curve (the curve below x-axis) in x-axis and reject the lower part (or flip lower part into upper).
7.		$y=f(x)\to \lvert y\rvert=f(x)$	Remove the lower portion of the curve then take the mirror image of upper portion of the curve in the x-axis. Also include the upper portion of the graph $y = f(x)$.
8.		$y=f(x)\to y=af(x)$	Stretch $(a>1)$ or squaeeze $(a<1)$ the graph of the given function vertically.
9.		$y=f(x)\to y=f(ax)$	Stretch $(a>1)$ or squaeeze $(a<1)$ the graph of the given function horizontally.

