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PGT (MATHS)

# EXPONENTIAL AND LOGARITHMIC FUNCTIONS

## 1. EXPONENTIAL FUNCTION

(i) Exponential series:

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$$

(ii) Exponential Number:

$$e = 1 + \frac{1}{1!} + \frac{1}{2!} + \frac{1}{3!} + \cdots$$

(iii) Value of exponential Number:

$$e = 2.7 \text{ (Approx.)}$$

(iv) Exponential Function:

$f(x) = a^x$, where $a > 1$

Domain $=$ R and Range $=$ $R^+$

Examples:

$f(x) = 2^x, f(x) = 3^x, f(x) = 10^x, f(x) = a^x$ *etc.*

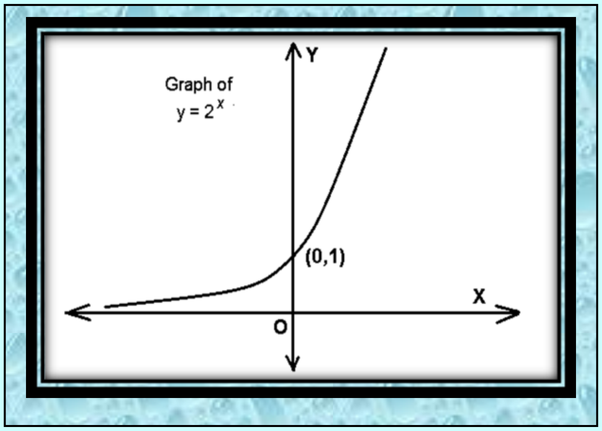
(iv) Graph of exponential Function:

Consider an exponential function

$$y = f(x) = 2^x$$

Let us consider some points on the graph of this function an

| x | -3 | -2 | -1 | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|---|---|---|
| y | $\frac{1}{8}$ | $\frac{1}{4}$ | $\frac{1}{2}$ | 1 | 2 | 4 | 8 | 16 | 32 |




Characteristics of the graph

*(a) Domain of the exponential function is **R**, the set of all real numbers.*
*(b) Range of the exponential function is the set of all positive real numbers.*
*(c) The point (0, 1) is always on the graph of the exponential function.*
*(d) Exponential function is ever increasing; i.e., as we move from left to right, the graph rises above.*
*(e) For very large negative values of x, the exponential function is very close to 0.*

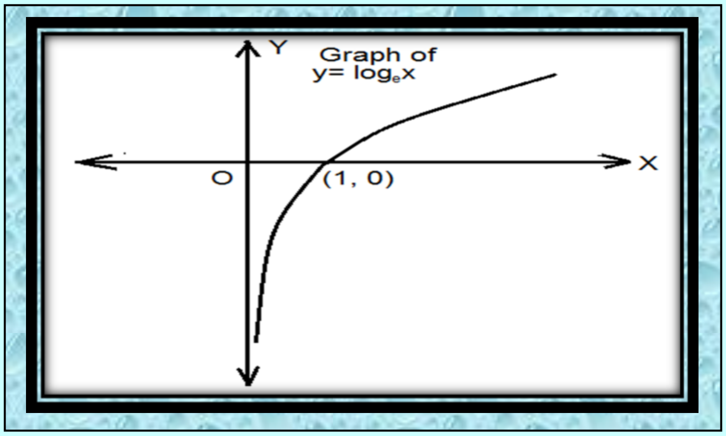
## 2. LOGARITHMIC FUNCTION

### 1. Logarithmic Function:

$f(x) = \log_e x$

Domain $= (0, \infty) = \mathrm{R}^+$ and Range $= \mathrm{R}$

**Graph of the Logarithmic Function**:




Characteristics of the graph:

(a) *We cannot make a meaningful definition of logarithm of non-positive numbers and hence the domain of log function is **R₊**.*
(b) *The range of log function is the set of all real numbers.*
(c) *The point (1, 0) is always on the graph of the log function.*
(d) *The log function is ever increasing, i.e., as we move from left to right the graph rises above.*
(e) *For x very near to zero, the value of log x can be made lesser than any given real number. In other words in the fourth quadrant the graph approaches y-axis (but never meets it).*

**LOGARITHMIC FUNCTION IS THE INVERSE OF EXPONENTIAL FUNCTION**