

# EXPONENTIAL FUNCTIONS

## Students will be able to:

Understand exponential functions, their properties and graphs

## Key Vocabulary:

- Exponential Function
- Graphing Exponential Functions

# EXPONENTIAL FUNCTIONS

## Exponential Function

An exponential function is a function of the form:

$$f(x) = a^x$$

Where,

$a$  = constant called the base

$x$  = variable

# EXPONENTIAL FUNCTIONS

## Domain and Range

An exponential function  $f(x)$  is normally defined for all the values of  $x$  i.e. domain =  $(-\infty, +\infty)$  and the range is either  $(0, +\infty)$  or  $(-\infty, 0)$  depending on the sign with the base.

## Asymptote and Intercept

Asymptote of the exponent function is a horizontal line that touches the exponential function. Intercept is the value of the exponential function where its graph meets the y-axis.

**Important!**

$$a^{\infty} = \infty$$

$$a^{-\infty} = 0$$

## EXPONENTIAL FUNCTIONS

**Problem 1: Graph the function  $f(x) = 2^{-x}$  and mention its domain, range, asymptote and intercept.**

## EXPONENTIAL FUNCTIONS

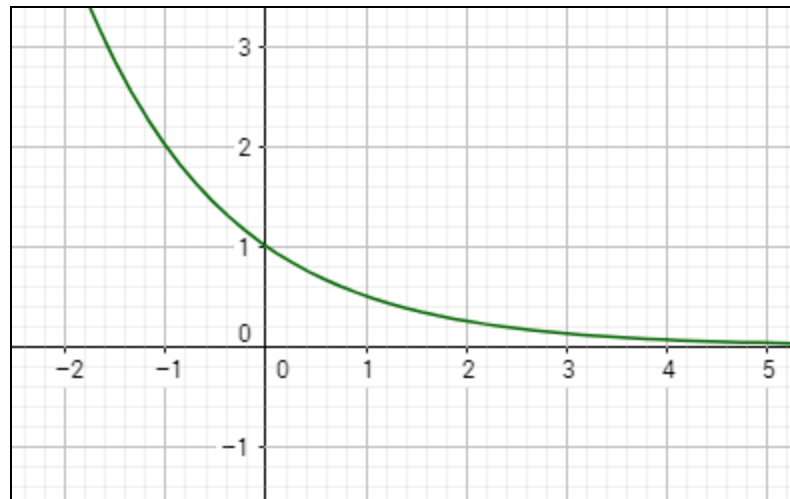
**Problem 1: Graph the function  $f(x) = 2^{-x}$  and mention its domain, range, asymptote and intercept.**

**Domain:**  $(-\infty, \infty)$

**Range:**  $(0, \infty)$

**Asymptote:**  $y = 0$

**Intercept:**  $f(0) = 2^{-0} = 1 \rightarrow (0, 1)$



# EXPONENTIAL FUNCTIONS

## Special Exponential Function

A special case of exponential functions is when the base is a constant  $e \approx 2.7183$ :

$$f(x) = e^x$$

Where,

$e \approx 2.7183$

$x$  = variable

# EXPONENTIAL FUNCTIONS

## Graphing Exponential Functions

To graph exponential functions having shifts or positive or negative signs with base or the variable, we have the following cases:

1.  $f(x) = a^{x+k}$

- Graph of  $a^x$  shifts left if  $k$  is positive
- Graph of  $a^x$  shifts right if  $k$  is negative

# EXPONENTIAL FUNCTIONS

## Graphing Exponential Functions

2.  $f(x) = a^x + h$

- Graph of  $a^x$  shifts up if  $h$  is positive
- Graph of  $a^x$  shifts down if  $h$  is negative

3.  $f(x) = a^{cx}$

- Graph of  $a^x$  compresses horizontally by a factor  $c$



# EXPONENTIAL FUNCTIONS

## Graphing Exponential Functions

4.  $f(x) = a^{-x}$

- Graph of  $a^x$  reflects around y-axis

5.  $f(x) = -a^x$

- Graph of  $a^x$  reflects around x-axis

6.  $f(x) = ba^x$

- Graph of  $a^x$  expands by a factor  $b$

## EXPONENTIAL FUNCTIONS

**Problem 2: Graph the functions  $f(x) = e^x$  and  $g(x) = e^{-x+1}$ .**

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The function  $g(x)$  can be graphed using  $f(x)$ .

$e^{-x+1}$  means the graph of  $e^x$  is reflected around x-axis and then shifted left by 1 unit.

