Exponential Functions Guided Notes

Exponential Function

An exponential function is a function of the form:

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

Where,

a = constant called the base

x = variable

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!**
> $a^{\infty} = \infty$
> $a^{-\infty} = 0$

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

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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

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**

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**

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

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

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