Al-Mustaqbal University
College of Science
Forensic Evidence Department
Second Stage

جامعة المستقبل
AL MUSTAQBAL UNIVERSITY

كلية العلـوم
قســم الادلة الجنائية

Lecture (7)

EXPONENTIAL FUNCTIONS

Complex Analysis : المادة

المرحلة : الثانية

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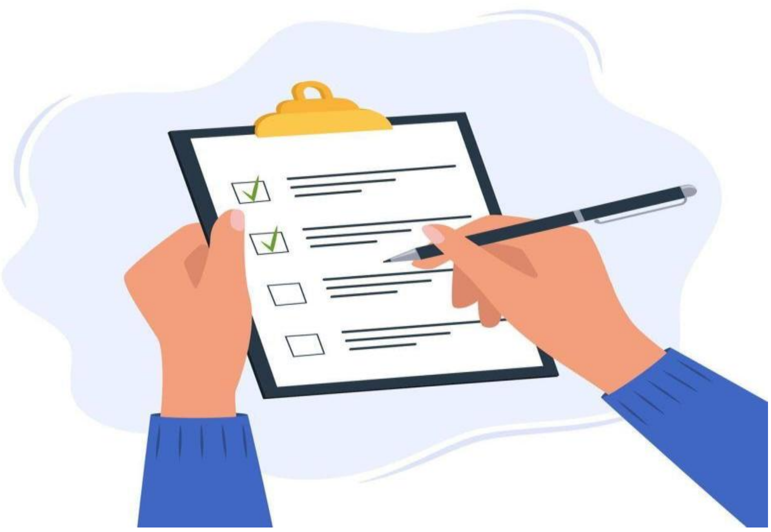

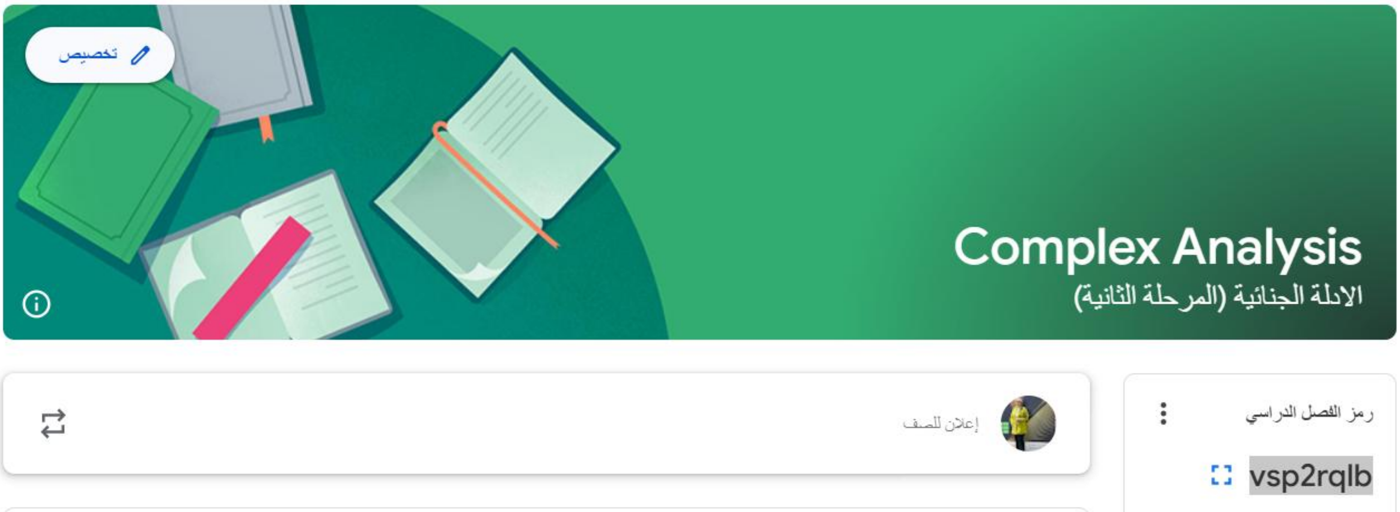

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I. Introduction

For any exponential number $a > 0$ and $a \neq 1$ there is a function called an exponential function that is defined as :

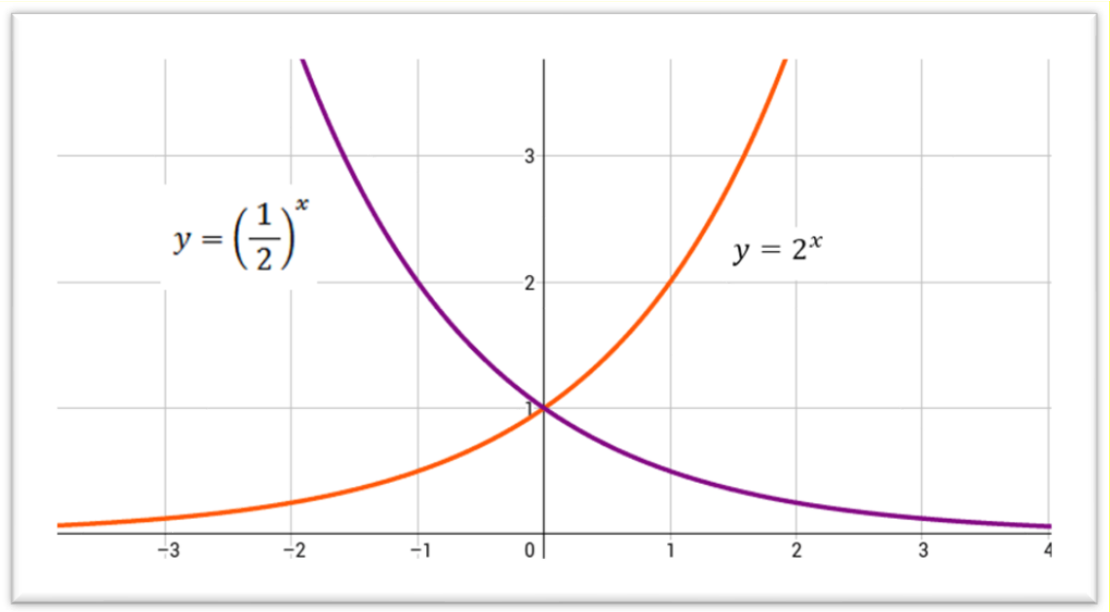
$$f(x) = a^x$$

If a = 1 then:

$$f(x) = 1^x = 1$$

So this just gives us the constant function f(x) = 1.

Here is the graph of $y = 2^x$ *and* $f(x) = (\frac{1}{2})^x$



Now, let's talk about some of the properties of exponential functions.

1. The graph of $f(x) = a^x$ will always contain the point$(0,1)$. Or put another way, $a^0 = 1$ for any a.
2. For every possible a, $a^x > 0$. Note that this implies that $a^x \neq 0$.

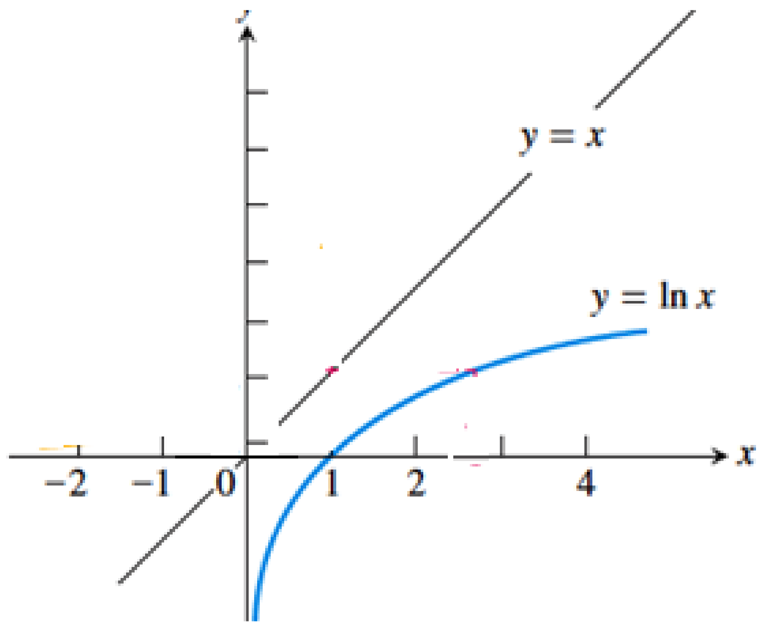
3. If $0 < a < 1$ then the graph of a^x will decrease as we move from left to right.
4. If $a > 1$ then the graph of a^x will increase as we move from left to right.
5. If $a^x = b^x$ then $a = b$.

Basic rules for exponents

1. The product rule $a^x . a^y = a^{x+y}$
2. The quotient rule $\frac{a^x}{a^y} = a^{x-y}$
3. The rule for power of a power $(a^x)^y = a^{x.y}$

II. Natural Exponential Function

The function $f(x) = e^x$ is often called exponential function or natural exponential Function which is an important function. The exponential function $f(x) = e^x$ is the inverse of the logarithm function $f(x) = \ln x$.



III. Graphs of Exponential Functions

We first graph exponential functions by plotting points. We will see that the graphs of such functions have an easily recognizable shape.

Example 1: Graphing Exponential Functions by Plotting Points Draw the graph of each function

1- $f(x) = 3^x$

2- $g(x) = (\frac{1}{3})^x$

Solution:

We calculate values of **f(x)** and **g(x)** and plot points to sketch the graphs in Figure 1.

x	$f(x) = 3^x$	$g(x) = (\frac{1}{3})^x$
−3	$\frac{1}{27}$	27
−2	$\frac{1}{9}$	9
−1	$\frac{1}{3}$	3
0	1	1
1	3	$\frac{1}{3}$
2	9	$\frac{1}{9}$
3	27	$\frac{1}{27}$

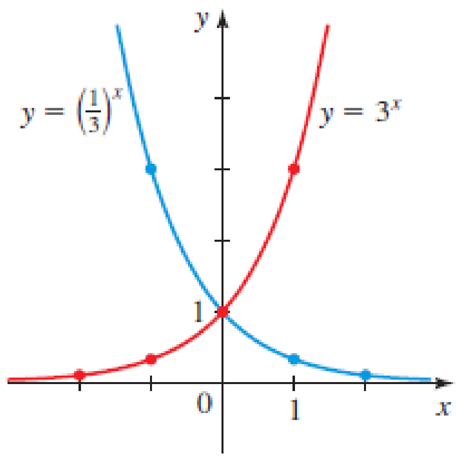


FIGURE 1

Notice that: $g(x) = (\frac{1}{3})^x = \frac{1}{3^x} = 3^{-x} = g(-x)$

so we could have obtained the graph of **g** from the graph of **f** by reflecting in the y-axis.

Homework: Graph both functions on one set of axes.

$f(x) = 2^x, \quad g(x) = 2^{-x}$

IV. Derivatives of Exponential Function

If u is a function x, then

$$\frac{d}{dx}(e^u) = e^u . \frac{du}{dx}$$

Example 2: Find y' of the functions at $x = 0$

1. $y = e^{3x-2}$

   $y' = e^{3x-2} \times 3 = 3e^{3x-2}$

   $y'(0) = 3e^{3(0)-2} = 3e^{-2} = 3 \times 0.135 = 0.405$

2. $y = 2xe^{1-5x}$

   $y' = 2xe^{1-5x} \times (-5) + 2e^{1-5x} = e^{1-5x}(-10x + 2)$

   $y'(0) = e^{1-5(0)}(-10(0) + 2) = 2e$

3. $y = e^{-3x} \sin 2x$

   $y' = 2e^{-3x} \cos 2x - 3e^{-3x} \sin 2x = e^{-3x}(2\cos 2x - 3 \sin 2x)$

   $y'(0) = e^0(2\cos 0 - 3 \sin 0) = 2$

Activity: Find derivative of the following equation:

1. $y = x^3 e^{-5x}$

TASK: Find derivative of the following equation:

1- $y = 2x^5 - 3e^{6x}$

2- $y = e^{(x^3 - 3x^2 + 1)}$


THANK
YOU

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