

EG02021 Mathematics**Class 5: Exponential and logarithmic Functions****4.1 Exponential Functions**

Exercise: Suppose that the number of bacteria in a sample grows exponentially at a rate of $r = 10\%$ every hour. If the initial population is 1000 bacteria, find the number of bacteria in the sample after 1 hr, after 2 hr and after 10 hr.

□ Theorem 1

Exercise 1: $\frac{d}{dx} 3e^x$

Exercise 2: $\frac{d}{dx}(x^2 \cdot e^x)$

Exercise 3: $\frac{d}{dx}\left(\frac{e^x}{x^3}\right)$

Exercise 4: $\frac{d}{dx} \sin e^x$

□ Theorem 2

Exercise 1: $\frac{d}{dx} e^{5x}$

Exercise 2: $\frac{d}{dx} e^{-x^2+4x-7}$

Exercise 3: $\frac{d}{dx} e^{\sqrt{x^2-3}}$

Exercise 4: Let $f(x) = (1 + \cos x)e^{\sin 2x}$. Find $f'(x)$.

4.2 Logarithmic Functions

Exercise 1: $\frac{d}{dx} \ln(\sec x + \tan x)$

4.3 Applications: Uninhibited Growth Model

Exercise 1: $\frac{dA}{dt} = 3A$

Exercise 2: Interest Compounded Continuously. Suppose that an amount P_0 is invested in a savings account where interest is compounded continuously at 7% per year. That is, the balance P grows at the rate given by

$$\frac{dP}{dt} = 0.07P$$

- Find the function that satisfies the equation. List it in terms of P_0 and 0.07.
- Suppose that \$100 is invested. What is the balance after 1yr?
- After what period of time will an investment of \$100 double itself?

□ **Theorem 9**

Exercise 2: Growth of E.Coli. A sample of E. Coli is growing exponentially. The generation time is 40 min. What is the exponential growth rate?

Exercise 3: World population: According to the U.S Bureau of the Census, the world population in 2004 was 6.393 billion people and the world population in 2010 is projected to be 6.973 billion people. Assume that the world population is growing exponentially.

$$\frac{dp}{dt} = kP$$

Where t is time in years after 2004, P is the world population in billions, and k is the exponential growth constant. We assume for simplicity that the population data is for the beginning of the year.

- Find the function that satisfies the initial- value problem.
- Estimate the world population in 2004.
- After what period of time will the world population double?