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I. Differentiation
Differentiation is a concept in mathematics that involves finding the rate at which a quantity changes. It is commonly used in calculus to calculate derivatives and determine the slope of a graph at a given point. Understanding differentiation is essential for solving problems involving rates of change and optimization.
    A. Definition and Basic Rules
Differentiation is a mathematical concept used to find the slope or rate of change of a function at a particular point. It measures how a function changes as its input variable changes. The basic rules of differentiation include the power rule, product rule, chain rule, and quotient rule, which help find the derivatives of various functions.
        1. The Chain Rule
The chain rule is a fundamental rule in calculus related to differentiation. It allows for the computation of the derivative of a composition of functions. By applying the chain rule, we can simplify complex functions and find their rates of change.
        2. Product Rule
The product rule is a fundamental rule in differentiation that allows us to find the derivative of a product of two functions. It states that the derivative of the product of two functions is equal to the first function times the derivative of the second function plus the second function times the derivative of the first function. This rule is essential in calculus and is used to find the derivatives of many functions.
    B. Differentiation Techniques
Differentiation techniques refer to methods used to find the derivative of a function. These techniques can include the power rule, product rule, chain rule, and quotient rule. They allow us to analyze the rate of change, slope, and concavity of a function at different points.
        1. Implicit Differentiation
Implicit differentiation is a technique used in calculus to differentiate equations that cannot be easily solved for a specific variable. It involves differentiating both sides of the equation with respect to the variable of interest, treating any other variable as a function of that variable. This allows us to find the derivative of implicit functions.
        2. Logarithmic Differentiation
Logarithmic differentiation is a technique used in calculus to differentiate functions that are difficult to differentiate using standard differentiation rules. It involves taking the natural logarithm of both sides of an equation before differentiating, which can simplify the process. This technique is particularly useful when dealing with functions that involve products, quotients, or powers.
    C. Applications of Differentiation
Differentiation is a concept used in calculus to determine the rate at which a function is changing. It has numerous applications in various fields such as physics, economics, and biology. Some examples include finding optimal solutions, determining rates of change, and analyzing the behavior of a function.
        1. Related Rates
Related rates is a branch of calculus that deals with finding the rate at which one quantity changes in relation to the rate of change of another related quantity. It involves the use of differentiation to establish relationships between the rates of change of different variables. This concept is particularly useful in fields such as physics, engineering, and economics where multiple variables are involved.
        2. Optimization

Optimization related to differentiation involves finding the maximum or minimum values of a function using concepts from calculus. It enables us to determine the optimal values for certain variables in order to optimize a system or process. By utilizing differentiation techniques, we can identify critical points and make informed decisions for improved efficiency.