


Don Bosco Technical Institute


AP Physics C Prep

Day 1, Part 2: What is Calculus?




Learning Objectives

- By the end of this lesson, you should understand...
 - the requirements, materials, goals, and procedures for this course.
 - the inputs and outputs of derivatives, indefinite integrals, and definite integrals.
 - how to take a limit using algebraic manipulations and substitution.
 - how to take a derivative by graphing and drawing tangent lines
- Learning Objectives are usually listed as the first slide of part 1




3 Basic Operations of Calculus

- Derivative
 - A derivative is an operation which converts a function into the rate at which that function changes.
 - Any time you hear the word "rate" it means a derivative.
 - Input: a function
 - Output: the rate of change
 - Example
 - Velocity is the rate of change in position
 - The derivative of position is velocity
 - Velocity is the derivative of position

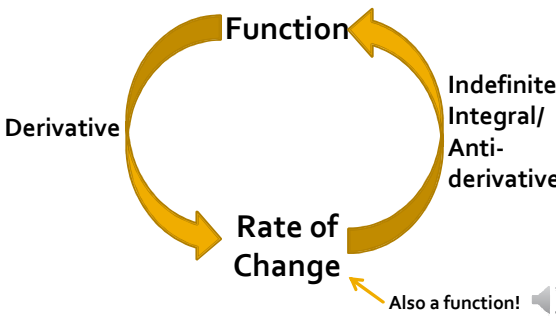


3 Basic Operations of Calculus

- Indefinite Integral/Anti-derivative
 - An indefinite integral is an operation which converts the rate of change back into the original function.
 - Inverse operation of a derivative; the indefinite integral and the derivative operations cancel each other out.



3 Basic Operations of Calculus




Derivative

Function

Indefinite Integral/Anti-derivative

Rate of Change


Also a function!



3 Basic Operations of Calculus

- Definite Integral
 - Area under a curve and between boundaries (a and b)
 - Areas can be negative
 - Areas below the x-axis are negative
 - Definite integrals have a direction to them
 - Definite integrals taken from left to right are positive
 - Definite integrals taken from right to left are negative

	Left to Right	Right to Left
Above horizontal axis	+	-
Below horizontal axis	-	+



3 Basic Operations of Calculus

Direction of integration →

Direction of integration ←

- Integrating from left to right
 - Area above the curve is positive
 - Area below the curve is negative
 - Both areas are about the same
 - Definite integral is nearly 0
- Integrating from right to left
 - Area below the curve is positive
 - Area above the curve is negative
 - Both areas are about the same
 - Definite integral is nearly 0

3 Basic Operations of Calculus

Function and boundaries

↓

Definite Integral

↓

Area under the function

A number, not a function

Practice 1

The cost of an item (C) is a function of the quantity of items made (q). The marginal cost (M) is defined as the rate of change in cost (C) as the quantity of items is increased. Which statement is true about $M(q)$ and $C(q)$.

- $M(q)$ is the derivative of $C(q)$
- $C(q)$ is the derivative of $M(q)$
- $M(q)$ is the indefinite integral of $C(q)$
- $C(q)$ is the definite integral of $M(q)$

Practice 2

In Materials Science, a common experiment is a tensile test. In this test a sample of material is pulled apart until it breaks. Based on data collected during this experiment the stress (σ) and strain (ϵ) are calculated, and stress is plotted as a function of strain.

The area under this curve is called toughness (materials with low toughness are brittle). Which of the following statements are true?

- σ is the derivative of ϵ
- toughness is the definite integral of σ
- toughness is positive for this graph

- I only
- III only
- I and III only
- II and III only
- I, II, and III

Practice 3

Many systems undergo a cycle in which the system is charged and then discharged. When it discharges, not all of the energy comes back in the same form as when it was charged. Hysteresis is defined as the area between the charging curve and the discharging curve. Restate the definition of hysteresis using calculus operations.

Hysteresis

Area under the charging curve (+)

Area under the discharging curve (-)

Hysteresis = Definite integral of the charging curve + Definite integral of the discharging curve

Up Next...

Video:

Khan Academy:
 Newton, Leibniz, and Usain Bolt
<http://youtu.be/EKvHQc3QEow>

This video will start automatically if you are using the AP Physics C Prep - Day 1 playlist