

# What is Calculus?

# History

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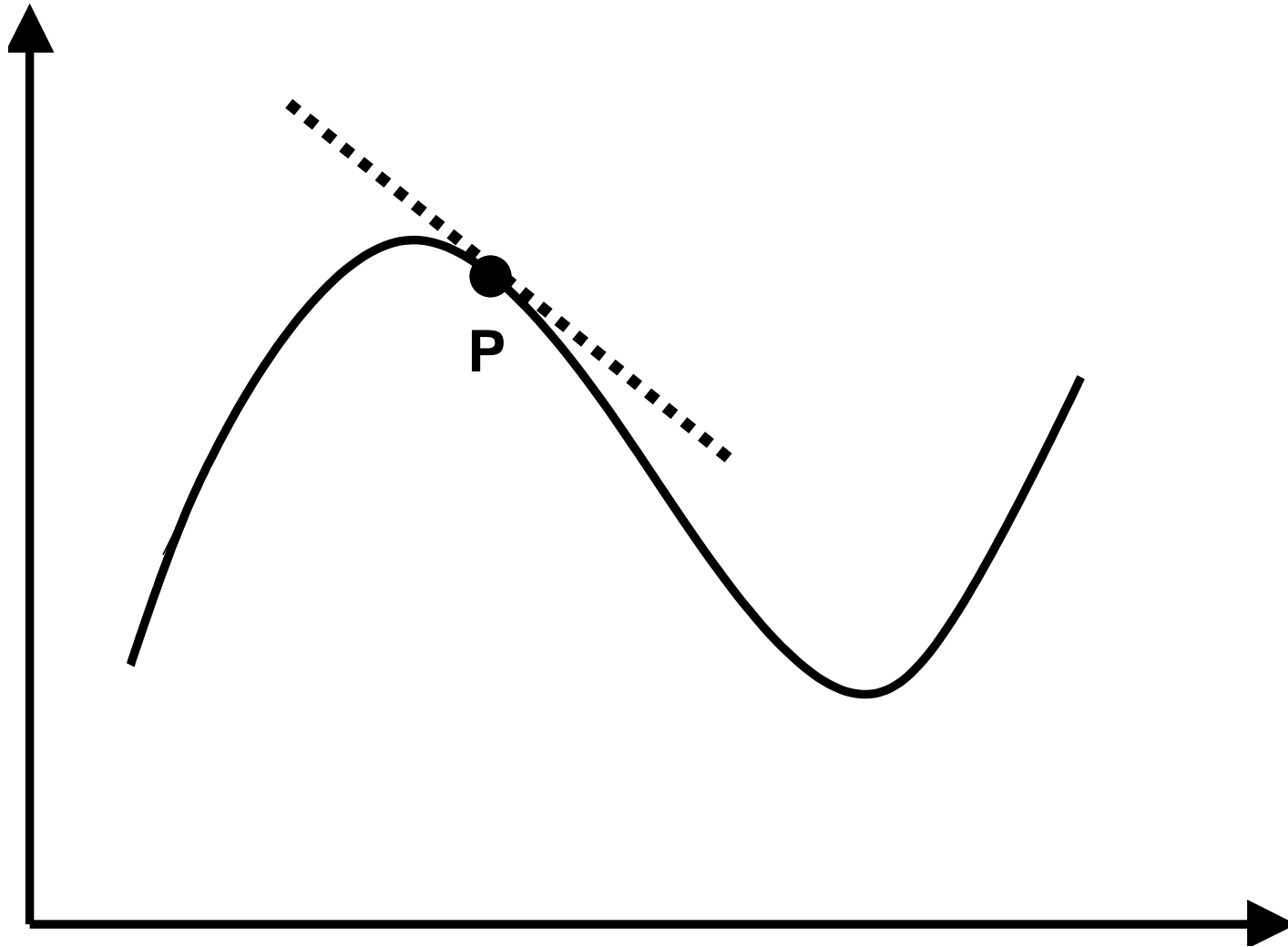
Calculus is a branch of mathematics which was developed in the 17<sup>th</sup> century by Isaac Newton and Gottfried Leibniz while studying the following geometric problems:

- Tangent Problem: Find a tangent line at a given point on a curve.
- Area Problem: Find the area of the region under a curve.

# Tangent Problem

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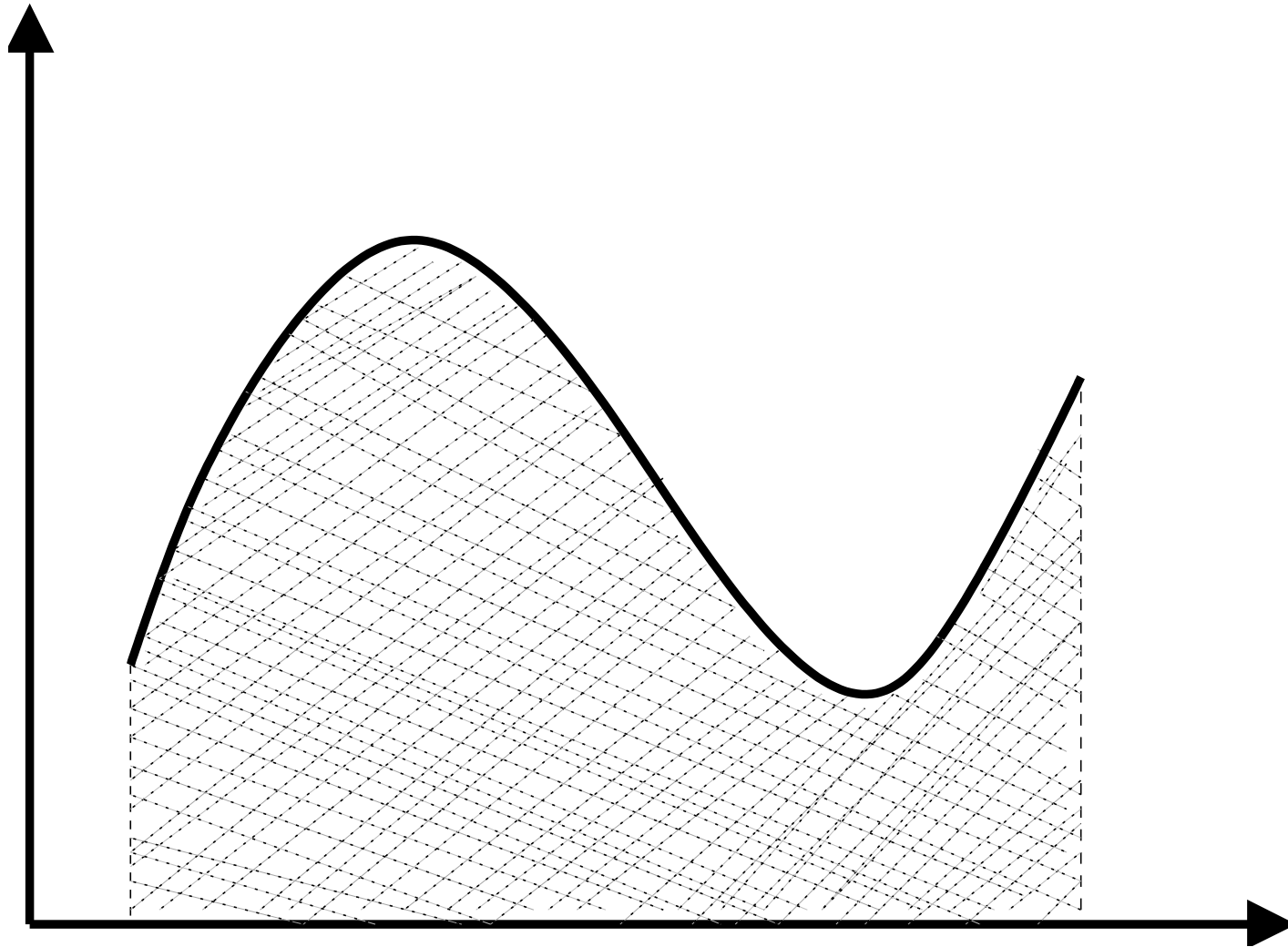
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The slope of the tangent line gives the rate of change of the function at the point **P**.

# Area Problem

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# Main Topics in Calculus

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Differential  
Calculus

Integral  
Calculus

Fundamental Theorem  
of Calculus

# Differential Calculus

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- Finding the instantaneous rate of change of one quantity with respect to another.
- Finding the slopes of tangent lines.
- Analyzing the graphs of functions.
- Solving maximization/minimization problems.

# Applications

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- Find the velocity and acceleration of an object at a particular time from its position function.
- Find the rate of growth of a population at a particular time.
- Find the periods of time in which the number of new cases of a disease is increasing.
- Find the optimal price per unit that a company should charge to maximize its profit.

# Integral Calculus

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- Finding the area below the graph of a function.
- Finding the average value of a function.

# Applications

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- Find the velocity of an object at a particular moment if its acceleration is known.
- Predict the future population level if the rate of change of the population is known.
- Find the total number of cases of a disease if the rate of infection is known.
- Find the average concentration of an environmental pollutant during a particular period of time.

# Fields that use calculus

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- Physical and Biological Sciences
- Social Sciences
- Business
- Engineering
- Computer Science
- Mathematics

# Plan for Math 1142

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- Functions:
  - ★ Review of functions and graphs.
  - ★ Limits of functions.
- Differential Calculus:
  - ★ Definition of the derivative as a limit.
  - ★ Techniques for computing derivatives.
  - ★ Many applications, including:
    - ★ Related rates.
    - ★ Analysis of graphs of functions.
    - ★ Optimization problems.
    - ★ Derivatives of exponential and logarithmic functions.

# Plan for Math 1142 (continued)

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- Integral Calculus:
  - ★ Antiderivatives.
  - ★ Definition of the integral as a limit.
  - ★ Fundamental Theorem of Calculus.
  - ★ Techniques for computing integrals.
  - ★ Many applications, including:
    - ★ Average values of functions.
    - ★ Introductory differential equations and modeling.
    - ★ Probability.
- Multivariable Calculus:
  - ★ Functions of several variables.
  - ★ Partial derivatives.
  - ★ Optimization problems.