Math 426.2SY
Calculus II

University of New Hampshire

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Outline

Introduction

Finding the volume using the Method of Disks/Washers

- Look at a slice of the 2D region **perpendicular** to the axis of revolution.
- Find the volume of this slice after rotation. (Call it ΔV_k)
- Approximate the total volume by $V \approx \sum_{k=1}^{n} \Delta V_k$
- Replace the $\sum$ by $\int$
- Find the limits of integration by looking at the region.
- Evaluate the definite integral.

Today

- The first step in this procedure (taking slices perpendicular to the axis of rotation) is not always efficient.
- Sometimes its easier to take slice that are **Parallel** to the axis of rotation.
- The rest of the procedure remains unchanged.
- This new method is called the the **Method of Cylindrical Shells**.

The Shell Method

Example

The region enclosed by the x-axis and the parabola $y = f(x) = 3x - x^2$ is revolved about the vertical line $x = -1$ to generate a solid. Find the volume of the solid.

The Shell Method

- Using the Method of Washers requires us to solve $y = f(x) = 3x - x^2$ for x, which leads to complicated formulas.

The Shell Method

- Instead, let's look at slices of the 2D region **parallel** to the axis of revolution.

The Shell Method

Example

The region bounded by the curve $y = \sqrt{x}$ the x-axis, and the line $x = 4$ is revolved about the y-axis to generate a solid. Find the volume of the solid.

The Shell Method

Example

The region bounded by the curve $x = 3 - y^2$ and the lines $y = \sqrt{3}, x = 3$ is revolved about the x-axis to generate a solid. Find the volume of the solid.

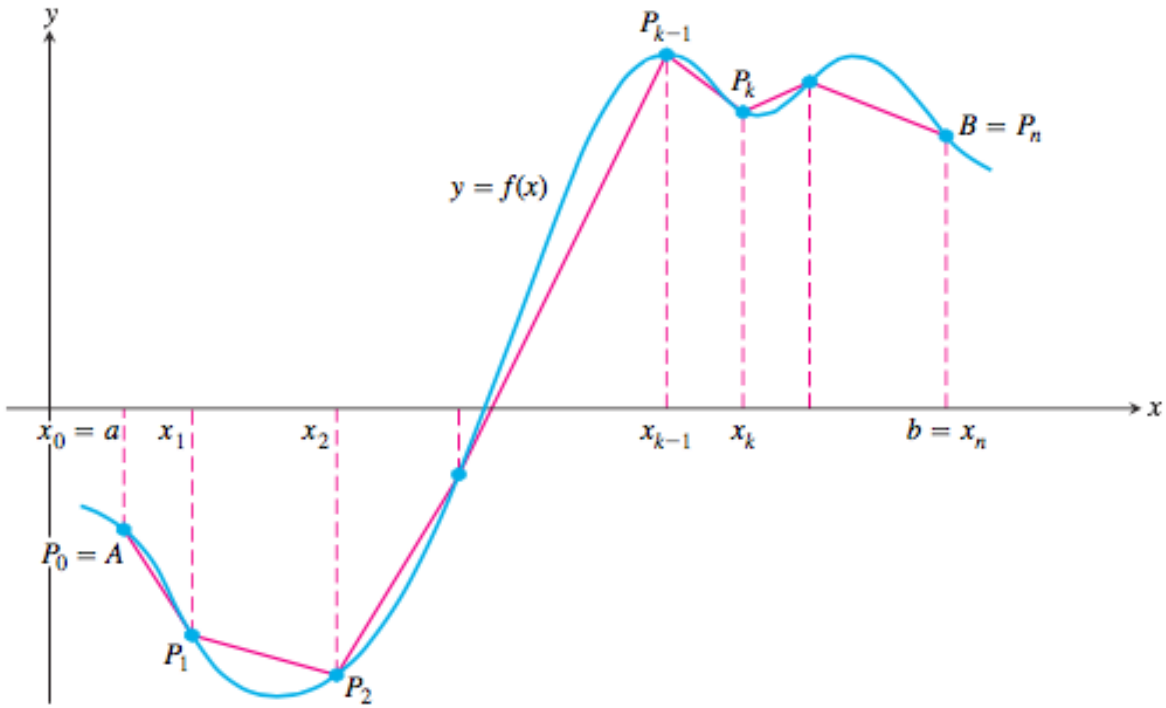
The Washer Method

Example

The region bounded by the curve $x = 3 - y^2$ and the lines $y = \sqrt{3}, x = 3$ is revolved about the x-axis to generate a solid. Find the volume of the solid.

6.3 - Arc Lenght

- We know what is meant by the lenght of a straight line segment.
- Using Calculus, we can find a precise denfition for the lenght of a general curve.



Arc Lenght

Example

Find the lenght of $y = \ln x - x^2/8$ from $x = 1$ to $x = 2$.

Arc Lenght

Example

Find the lenght of $y = \int_{-2}^{x} \sqrt{3t^4 - 1}\, dt$ from $x = -2$ to $x = -1$.