AP Calculus AB Course Study Guide
Applications of Integration

From Simple Studies, https://simplestudies.edublogs.org & @simplestudies4 on Instagram

Average Value

- To find the average value, integrate the function by **using the fundamental theorem of calculus**
- After that, **divide the answer by the length of the interval**

$$\frac{1}{b-a}\int_a^b f(x)\,dx$$

Picture Credits: magoosh

Example: f(x)=3x; [1,3]

$$\frac{1}{3-1}\int_1^3 3x\,dx$$

$$3(3)^2 - 3 = 6$$

Total Displacement

- **The difference between the starting position and ending position**
- Interval [a,b]
- **Can be negative**
- Formula:

$$\int_a^b v(t)dt = s(b) -$$

Example: What is the object's displacement on the closed interval [0,2]

- $s(t)=2t^3-12t+6$
- $s(b)-s(a) \rightarrow s(2)-s(0)=[2(2)^3-12(2)+6]-[2(0)^3-12(0)+6]$
- $-2-6=-8$

Total Distance

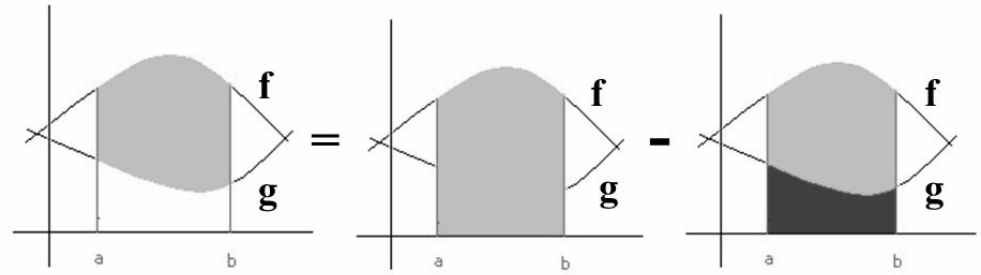
- **Total distance traveled by a particle is the sum of the amounts it displaces between the start, all of the stop(s), and the end.**
- **Distance can't be negative**
- Formula:

$$\int_a^b |v(t)|dt$$

Example with steps: $s(t)=-t^2+4t-3$

Find where v(t)=0	$v(t)=-2t+4 \rightarrow t=2$
Rewrite the integral and then break up limits where v(t)=0	$\int |v(t)| \quad |v(\quad \int \quad |v($
Integrate.	$\|[s(2)-s(0)]\|+\|[s(5)-s(2)]\| =$ $\|[1-(-3)]\| + \|[-8-1]\|=$ $\|[4]\| + \|[-9]\| = 13$

Area of a Region Between Two Curves



Area of region between f and g = **Area of region under f(x)** - **Area of region under g(x)**

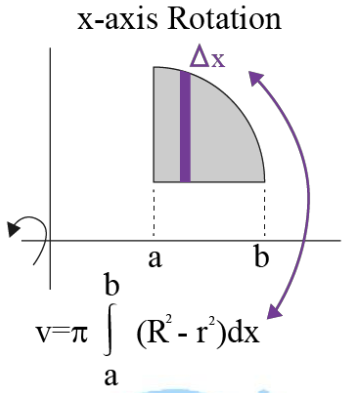
$$\int_a^b [f(x) - g(x)]dx = \int_a^b f(x)dx - \int_a^b g(x)dx$$

Picture Credits: helenjohns

The Disk Method

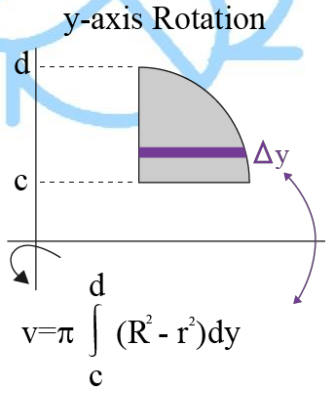
If a region in the plane **revolves about a line, the resulting solid is a solid of revolution**, and the line is called the **axis of revolution.** The simplest solid is a right circular cylinder or disk, which is formed by revolving a rectangle about an axis adjacent to one side of the rectangle.

- ***Rotate Around x-axis***
    - The **horizontal axis of revolution**



Picture Credits: calcworkshop

- ***Rotate Around y-axis***
    - The **vertical axis of revolution**



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The Washer Method

- **Horizontal Line of Rotation**

$$v = \pi \int_a^b \left[(furthest\ equation) - (line\ of\ rotation) \right]^2 - \left[(closest\ equation) - (line\ of\ rotation) \right]^2 dx$$

- **Vertical Line of Rotation**

$$v = \pi \int_c^d \left[(furthest\ equation) - (line\ of\ rotation) \right]^2 - \left[(closest\ equation) - (line\ of\ rotation) \right]^2 dy$$

The Washer Method Calculating Volume Using Integration

Step One: Draw a picture of your graph→ ***shade appropriate region***

Step Two: ***Identify whether you are rotating*** about a vertical or horizontal line

- Vertical
  - Get everything in terms of y
- Horizontal
  - Get everything in terms of x

Step Three: ***Set up your integral***

$$v = \pi \int_a^b \left[(furthest\ equation) - (line\ of\ rotation) \right]^2 - \left[(closest\ equation) - (line\ of\ rotation) \right]^2 dy\ or\ dx$$

Step Four: ***Simplify***

Step Five: ***Integrate Definite Integral***