

Trig Integrals

$\int \sin x \, dx$	$= -\cos x + C$
$\int \cos x \, dx$	$= \sin x + C$
$\int \sec^2 x \, dx$	$= \tan x + C$
$\int \tan x \, dx$	$= \ln \sec x + C$
$\int \sec x \tan x \, dx$	$= \sec x + C$
$\int \csc^2 x \, dx$	$= -\cot x + C$
$\int \csc x \cot x \, dx$	$= -\csc x + C$
$\int \cot x \, dx$	$= \ln \sin x + C$

Trig Identities

$\int (1/x^2 + a^2) \, dx$	$= 1/a \tan^{-1}(x/a) + C$
$\int (1/\sqrt{a^2 - x^2}) \, dx$	$= \sin^{-1}(x/a) + C$

(While $a > 0$)

Area Between Curves

Area = $\int [\text{Height}] \, \text{Width}$

$A = \int (f(x) - g(x)) \, dx$

1. Graph Equations
2. Label
3. Determine how to slice
4. Set up dA
5. $dA = \text{height} \cdot dx$
6. Get range a & b from intersections
7. Plug in and find area

There is never (-) area.

Volume by Disk

$dV = A(x) \, dx$

$V = \int A(x) \, dx$

Volume = $\int \text{Radius}^2 \cdot \text{Thickness}$

$V = \int (\pi(r)^2) \, dx$

Volume by Washer

$dV = A(x) \, dx$

$V = \int A(x) \, dx$

Volume = $\int [(\pi r_{\text{out}}^2) - (\pi r_{\text{in}}^2)] \, dx$

Slice Perpendicular to Axis of Rotation

Volume by Shell

$dV = \text{Circumference} \cdot dA$

$dV = (2\pi r) \, dA$

$V = \int (2\pi r) (A) \, dx$

1. Write: $dV = 2\pi r \, dA$
2. Find $dA(\text{height} \, dx)$
3. Find Radius (x or y)
4. Plug in
5. Take integral

Slice Parallel to Axis of Rotation

Average Value of a Function

Average Value = $1/(b-a) \cdot \int f(x) \, dx$

Symmetry:

If $f(x)$ is EVEN, then $\int f(x) \, dx$ from $-a$ to $a = 2 \int f(x) \, dx$ from 0 to a

If $f(x)$ is ODD, then $\int f(x) \, dx$ from $-a$ to $a = 0$

Important Integrals

$\int c f(x) \, dx$	$= c \int f(x) \, dx$
$\int [f(x) + g(x)] \, dx$	$= \int f(x) \, dx + \int g(x) \, dx$
$\int 1/x \, dx$	$= \ln x + C$
$\int e^x \, dx$	$= e^x + C$
$\int b^x \, dx$	$= (b^x / \ln b) + C$

Methods of Integration

Method	When to Use	Example
U-Substitution	When a Polynomial is raised to a power > 1	$\int (3x + 5)^5$
Integration by Parts	When U-Sub will not work	$\int x e^x$
Trigonometric Integration	Only Trig raised to powers	$\int \sin^6 x \cos^3 x \, dx$
Trigonometric Substitution	$3/2$ powers or $\sqrt{a^2 - x^2}$ etc.	$dx / (x^2 \sqrt{25 - x^2})$

U-Substitution



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Integration by Parts

Logarithmic

Inverse trig

Algebraic

Trigonometric

Exponential

$$\int u \, dv = u \, v - \int v \, du$$

1. Write $u \, v - \int v \, du$

2. Use LIATE to find u ; the other term becomes dv

3. Setup $u = \quad dv = \quad du = \quad v = \quad$

4. Solve

Cyclical Functions will need to be split and substituted.

Trigonometric Integration

Identities

$$\sin^2 t + \cos^2 t = 1$$

$$\sin^2 t = \frac{1}{2} [1 - \cos(2t)]$$

$$\cos^2 t = \frac{1}{2} [1 + \cos(2t)]$$

Can use with U-Substitution

Don't change all of the trig to the same form.

Trigonometric Integration

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Trigonometric Substitution

Pythag. Identities

$$\sin^2 + \cos^2 = 1$$

$$1 + \tan^2 = \sec^2$$

$$1 + \cot^2 = \csc^2$$

1. Identify a and u

2. Sub in the trig

3. Manipulate to simplify

4. Get rid of trig with a triangle



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