Differentiation:General Formulas

$$\frac{d}{dx}(c) = 0 \qquad \frac{d}{dx}[cf(x)] = cf'(x)$$
$$\frac{d}{dx}[f(x)+g(x)] = f'(x)+g'(x) \qquad \frac{d}{dx}[f(x)-g(x)] = f'(x)-g'(x)$$
$$\frac{d}{dx}[f(x)g(x)] = f(x)g'(x)+g(x)f'(x) \qquad \frac{d}{dx}\left[\frac{f(x)}{g(x)}\right] = \frac{g(x)f'(x)-f(x)g'(x)}{[g(x)]^2}$$
$$\frac{d}{dx}f(g(x)) = f'(g(x))g'(x) \qquad \frac{d}{dx}(x^n) = nx^{n-1}$$

Differentiation: Exponential and Logarithmic Functions

$$\frac{d}{dx}(e^x) = e^x \qquad \frac{d}{dx}(a^x) = a^x \ln a$$
$$\frac{d}{dx}\ln|x| = \frac{1}{x} \qquad \frac{d}{dx}(\log_a x) = \frac{1}{x\ln a}$$

Differentiation: Trigonometric Functions

$$\frac{d}{dx}(\sin x) = \cos x \qquad \frac{d}{dx}(\cos x) = -\sin x \qquad \frac{d}{dx}(\tan x) = \sec^2 x$$
$$\frac{d}{dx}(\csc x) = -\csc x\cot x \qquad \frac{d}{dx}(\sec x) = \sec x\tan x \qquad \frac{d}{dx}(\cot x) = -\csc^2 x$$

Differentiation: Inverse Trigonometric Functions

$$\frac{d}{dx}(\sin^{-1}x) = \frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx}(\cos^{-1}x) = -\frac{1}{\sqrt{1-x^2}} \qquad \frac{d}{dx}(\tan^{-1}x) = \frac{1}{1+x^2}$$
$$\frac{d}{dx}(\csc^{-1}x) = -\frac{1}{x\sqrt{x^2-1}} \qquad \frac{d}{dx}(\sec^{-1}x) = \frac{1}{x\sqrt{x^2-1}} \qquad \frac{d}{dx}(\cot^{-1}x) = -\frac{1}{1+x^2}$$

Integration Formulas

$$\int udv = uv - \int vdu \qquad \int \sec^2 u\,du = \tan u + C \qquad \int \csc u\,du = \ln|\csc u - \cot u| + C$$
$$\int u^n du = \frac{u^{n+1}}{n+1} + C, \quad n \neq 1 \qquad \int \csc^2 u\,du = -\cot u + C \qquad \int \frac{1}{\sqrt{a^2-u^2}}du = \sin^{-1}\frac{u}{a} + C$$
$$\int \frac{1}{u}du = \ln|u| + C \qquad \int \sec u\tan u\,du = \sec u + C \qquad \int \frac{1}{a^2+u^2}du = \frac{1}{a}\tan^{-1}\frac{u}{a} + C$$
$$\int e^u du = e^u + C \qquad \int \csc u\,\cot u = -\csc u + C \qquad \int \frac{1}{u\sqrt{u^2-a^2}}du = \frac{1}{a}\sec^{-1}\frac{u}{a} + C$$
$$\int a^u du = \frac{a^u}{\ln a} + C \qquad \int \tan u\,du = \ln|\sec u| + C \qquad \int \frac{1}{a^2-u^2}du = \frac{1}{2a}\ln\left|\frac{u+a}{u-a}\right| + C$$
$$\int \sin u\,du = -\cos u + C \qquad \int \cot u\,du = \ln|\sin u| + C \qquad \int \frac{1}{u^2-a^2}du = \frac{1}{2a}\ln\left|\frac{u-a}{u+a}\right| + C$$
$$\int \cos u\,du = \sin u + C \qquad \int \sec u\,du = \ln|\sec u + \tan u| + C$$

Integration by Parts (order for choosing u)

Logarithmic **I**nverse Trig. **A**lgebraic **T**rigonometric **E**xponential

Trigonometric Identities

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

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

$\tan(x+y) = \frac{\tan x + \tan y}{1 - \tan x \tan y}$

$\tan(x-y) = \frac{\tan x - \tan y}{1 + \tan x \tan y}$

$\sin(x+y) = \sin x \cos y + \cos x \sin y$

$\sin(x-y) = \sin x \cos y - \cos x \sin y$

$\cos(x+y) = \cos x \cos y - \sin x \sin y$

$\cos(x-y) = \cos x \cos y + \sin x \sin y$

$\sin 2x = 2 \sin x \cos x$

$\cos 2x = \cos^2 x - \sin^2 x$

$= 2\cos^2 x - 1$

$= 1 - 2\sin^2 x$

Miscellaneous

Quad. form.: $x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$

Eq. of circle: $(x-h)^2 + (y-k)^2 = r^2$

$\log_a x = y \Leftrightarrow a^y = x$

$x^2 - y^2 = (x+y)(x-y)$

$x^3 + y^3 = (x+y)(x^2 - xy + y^2)$

$x^3 - y^3 = (x-y)(x^2 + xy + y^2)$

Vol. of sphere: $V = \frac{4}{3}\pi r^3$

Vol. of cylinder: $V = \pi r^2 h$

$(x+y)^2 = x^2 + 2xy + y^2$

$(x-y)^2 = x^2 - 2xy + y^2$

$(x+y)^3 = x^3 + 3x^2y + 3xy^2 + y^3$

$(x-y)^3 = x^3 - 3x^2y + 3xy^2 - y^3$

Unit Circle