## Some Algebra

$a^b a^c = a^{b+c}, \quad \frac{a^b}{a^c} = a^{b-c}$

$(a^b)^c = a^{bc}, \quad \frac{a^n}{b^n} = \left(\frac{a}{b}\right)^n$

$\sqrt{a} = a^{1/2}; \quad \ln(a^b) = b \ln a$

$\ln(ab) = \ln a + \ln b, \quad \ln \frac{a}{b} = \ln a - \ln b$

## Basic Derivatives

$\frac{d}{dx}\, x^n = nx^{n-1}$

$\frac{d}{dx} \ln x = \frac{1}{x}$

$\frac{d}{dx}\, e^x = e^x$

$\frac{d}{dx} \sin x = \cos x$

$\frac{d}{dx} \cos x = -\sin x$

$\frac{d}{dx} \tan x = \sec^2 x$

$\frac{d}{dx} \cot x = -\csc^2 x$

$\frac{d}{dx} \sec x = \sec x\, \tan x$

$\frac{d}{dx} \csc x = -\csc x\, \cot x$

$\frac{d}{dx} \tan^{-1} x = \frac{1}{1+x^2}$

## Rules for Derivatives

Chain Rule, special forms:

$\frac{d}{dx}(g(x))^n = ng(x)^{n-1} g'(x)$

$\frac{d}{dx}\, e^{g(x)} = g'(x)\, e^{g(x)}$

$\frac{d}{dx} \ln g(x) = \frac{g'(x)}{g(x)}$

Chain Rule: $\frac{d}{dx} f(g(x)) = f'(g(x))\, g'(x)$

Product Rule: $\frac{d}{dx}(fg) = f'g + fg'$

Quotient Rule: $\frac{d}{dx}\left(\frac{f}{g}\right) = \frac{f'g - fg'}{g^2}$

## Basic Integrals

$\int x^n\, dx = \frac{x^{n+1}}{n+1} + C$, if $n \neq -1$

$\int \frac{1}{x}\, dx = \ln|x| + C$

$\int e^x\, dx = e^x + C$

$\int \cos x\, dx = \sin x + C$

$\int \sin x\, dx = -\cos x + C$

$\int \frac{1}{1+x^2}\, dx = \arctan x + C$

$\int \frac{1}{\sqrt{1-x^2}}\, dx = \arcsin x + C$

$\int \sec^2 x\, dx = \tan x + C$

$\int \sec x\, \tan x\, dx = \sec x + C$

## Linear substitution

If $F(x)$ is an antiderivative of $f(x)$, then
$\int f(kx+b)\, dx = \frac{1}{k} F(kx+b) + C$

As in, $\int \cos(3x)\, dx = \frac{1}{3} \sin(3x) + C$

$\int \sqrt{5x+2}\, dx = \frac{1}{5} \frac{(5x+2)^{3/2}}{3/2} + C = \ldots$

## Life Savers

Complete the square: $x^2 + 2bx = (x+b)^2 - b^2$

Sometimes the formula $(a \pm b)^2 = a^2 \pm 2ab + b^2$
must be read backwards: $a^2 \pm 2ab + b^2 = (a \pm b)^2$

To get rid of roots: $(a+b)(a-b) = a^2 - b^2$

These help with trig integrals:

$$\begin{cases} \sin^2 x &= \frac{1}{2}[1 - \cos 2x] \\ \cos^2 x &= \frac{1}{2}[1 + \cos 2x] \\ \sin x \cos x &= \frac{1}{2} \sin 2x \end{cases}$$

And two more: $\begin{cases} \sin^2 x + \cos^2 x &= 1 \\ \tan^2 x + 1 &= \sec^2 x \end{cases}$