# Summary of Differentiation Rules

The following is a list of differentiation formulae and statements that you should know from Calculus 1 (or equivalent course).

**Product Rule:**

$$(f(x)g(x))' = f(x)g'(x) + f'(x)g(x)$$

**Quotient Rule:**

$$\left(\frac{f(x)}{g(x)}\right)' = \frac{g(x)f'(x) - g'(x)f(x)}{(g(x))^2}$$

**Chain Rule:**

$$(f(g(x))' = f'(g(x))g'(x)$$

**Derivative of Trigonometric Function:**

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

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

**Derivative of Exponential and Logarithm Functions:**

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

# Summary of Integration Rules

The following is a list of integral formulae and statements that you should know Calculus 1 (or equivalent course).

$$\int x^n\,dx = \frac{x^{n+1}}{n+1} + C; \quad n \neq -1 \qquad \int (ax+b)^n\,dx = \frac{(ax+b)^{n+1}}{a(n+1)} + C; \quad n \neq -1$$

$$\int x^{-1}\,dx = \int \frac{1}{x}\,dx = \ln|x| + C \qquad \int \frac{1}{ax+b}\,dx = \frac{1}{a}\ln|ax+b| + C$$

$$\int e^x\,dx = e^x + C \qquad \int e^{ax+b}\,dx = \frac{1}{a}e^{ax+b} + C$$

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

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

$$\int \csc x \cot x\,dx = -\csc x + C \qquad \int \csc^2 x\,dx = -\cot x + C$$

$$\int \sec x\,dx = \ln|\sec x + \tan x| + C \qquad \int \csc x\,dx = -\ln|\csc x + \cot x| + C$$

**Fundamental Theorem of Calculus**

Let $F$ an antiderivative of $f$ i.e. $F'(x) = f(x)$. Then we have:

(1) $\displaystyle\int_a^b f(x)\,dx = F(b) - F(a) = [F(x)]_a^b$

(2) Total change in $F$ when $x$ changes from $a$ to $b = F(b) - F(a) = \displaystyle\int_a^b F'(x)\,dx$