AP Calculus AB Formulas:

Derivatives:

Point-Slope Form:

$$y - y_1 = m(x - x_1)$$

Limit Definition of Derivative:

$$\frac{d}{dx}f(x) = \lim_{h \to 0} \frac{f(x+h) - f(x)}{h}$$

$$\frac{d}{dx}f(x) = \lim_{x \to c} \frac{f(x) - f(c)}{x - c}$$

Power Rule:

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

Constant Rule:

$$\frac{d}{dx}c = 0$$

Product Rule:

$$\frac{d}{dx}\left(f(x) \cdot g(x)\right) = f'(x)g(x) + f(x)g'(x)$$

Quotient Rule:

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

General Power Rule (u-substitution):

$$\frac{d}{dx}u^n = nu^{n-1}u'$$

Chain Rule:

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

Implicit Differentiation: Factor out y'.

Increasing Function:

$$f'(x) \geq 0$$

Decreasing Function:

$$f'(x) \leq 0$$

Concave Up:

$$f''(x) \geq 0$$

Concave Down:

$$f''(x) \leq 0$$

Mean Value Theorem (MVT) and Integrals:

Mean Value Theorem (MVT):

$$f'(c) = \frac{f(b) - f(a)}{b - a}$$

Reverse Power Rule:

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

Reverse Constant Rule:

$$\int k \, dx = kx + C$$

Reverse Chain Rule:

$$\int u^n u' \, dx = \frac{u^{n+1}}{n+1} + C, \quad n \neq -1$$

Area Under the Curve:

$\int_a^b f(x) \, dx = F(b) - F(a)$, Where $F(x)$ is the antiderivative of $f(x)$

Fundamental Theorem of Calculus:

$$\int_a^b f'(x) \, dx = f(b) - f(a)$$

Start + Accumulation:

$$f(b) = f(a) + \int_a^b f'(x) \, dx$$

Mean Value Theorem (MVT) for Integrals:

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

Derivative of an Integral:

$$\frac{d}{dx} \int (2x - 3) \, dx = 2x - 3$$

Second Fundamental Theorem:

$$\frac{d}{dx} \int_a^x f(t) \, dt = f(x)$$

Exponential and Logarithmic Functions:

Derivative of Exponential Function:

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

Derivative of General Exponential Function:

$$\frac{d}{dx}a^x = a^x \ln a$$

Derivative of Natural Log:

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

Derivative of Logarithm (Base a):

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

Integral of Exponential Function:

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

Integral of General Exponential Function:

$$\int a^x \, dx = \frac{a^x}{\ln a} + C$$

Integral of Natural Log:

$$\int \ln x \, dx = x \ln x - x + C$$

Integral of Exponential Function (Reverse Chain Rule):

$$\int e^u u' \, dx = e^u + C$$

Integral of General Exponential Function (Reverse Chain Rule):

$$\int a^u u' \, dx = \frac{a^u}{\ln a} + C$$

Integral of Natural Log (Reverse Chain Rule):

$$\int \ln u \, du = u \ln u - u + C$$

Trigonometric Functions:

Derivative of Sine Function:

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

Derivative of Cosine Function:

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

Derivative of Tangent Function:

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

Derivative of Cosecant Function:

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

Derivative of Secant Function:

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

Derivative of Cotangent Function:

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

Integral of Sine Function:

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

Integral of Cosine Function:

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

Integral of Tangent Function:

$$\int \tan x \, dx = -\ln|\cos x| + C$$

Integral of Cosecant Function:

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

Integral of Secant Function:

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

Integral of Cotangent Function:

$$\int \cot x \, dx = \ln|\sin x| + C$$