Equality

Reflexive Property:
$(a = b) \iff (b = a)$
Transitive Property:
$(a = b) \wedge (b = c) \implies (a = c)$

Addition

Commutative Property:
$a + b = b + a$
Associative Property:
$(a + b) + c = a + (b + c)$
Additive Identity Property:
$a + 0 = a$
Inverse Property:
$a + (-a) = 0$

Multiplication

Commutative Property:
$a \cdot b = b \cdot a$
Associative Property:
$(a \cdot b) \cdot = a \cdot (b \cdot c)$
Multiplicative Identity Property:
$a \cdot 1 = a$
Inverse Property:
$a \cdot \frac{1}{a} = 1; a \neq 0$
Distributive Property:
$a \cdot (b + c) = a \cdot b + a \cdot c$
Zero Product Property:
$a \cdot 0 = 0$

Exponents

Exponential Identity Property:
$a^1 = a$
Zero Power Property:
$a^0 = 1; a \neq 0$
Power of One Property:
$1^a = a$
Power of Zero Property:
$0^a = 0; a \neq 0$
Product of Powers Property:
$x^a \cdot x^b = x^{a+b}$
Quotient of Powers Property:
$\frac{x^a}{x^b} = x^{a-b}; x \neq 0$
Power of a Power Property:
$(x^a)^b = x^{a \cdot b}$
Power of a Product Property:
$(x \cdot y)^a = x^a \cdot y^a$
Power of a Quotient Property:
$\left(\frac{x}{y}\right)^a = \frac{x^a}{y^a}; y \neq 0$
Negative Power Property:
$x^{-a} = \frac{1}{x^a}; x \neq 0$
Fractional Power Property:
$x^{\frac{a}{b}} = \sqrt[b]{x^a}; b \neq 0$

Roots

Product of Roots Property:
$\sqrt[a]{x} \cdot \sqrt[a]{y} = \sqrt[a]{x \cdot y}; a \neq 0 \wedge x, y \in \mathbb{R}^+$
Quotient of Roots:
$\frac{\sqrt[a]{x}}{\sqrt[a]{y}} = \sqrt[a]{ar\frac{x}{y}}; a, y \neq 0$
Radical Identity Property:
$\sqrt[a]{x^a} = x; a \neq 0$

Logarithms

Logarithmic Identity Properties:
$\log_x 1 = 0$
$\log_x x = 1$
Product Property:
$log_a(x \cdot y) = \log_a x + \log_a y$
Quotient Property:
$\log_a \frac{x}{y} = \log_a x - \log_a y$
Power Property:
$\log_a x^y = y \cdot \log_a x$

Base Change Property:
$\log_a x = \dfrac{\log_n x}{\log_n a}$

Summation

Constant Factorization:
$\displaystyle\sum_{k=1}^{n} c \cdot a_k = c \cdot \sum_{k=1}^{n} a_k$
Sum or Difference of Sequences:
$\displaystyle\sum_{k=1}^{n} (a_k \pm b_k) = \sum_{k=1}^{n} a_k \pm \sum_{k=1}^{n} b_k$
Summation of a Constant:
$\displaystyle\sum_{k=1}^{n} c = n \cdot c$
Index Shift:
$\displaystyle\sum_{k=1}^{n} a_k = \sum_{k=1+p}^{n+p} a_{k-p}$

Products

Associative Property:
$\prod_{k=1}^{n} (a_k \cdot b_k) = (\prod_{k=1}^{n} a_k) \cdot (\prod_{k=1}^{n} b_k)$
Commutative Property:
$(\prod_{k=1}^{n} a_k)^x = \prod_{k=1}^{n} a_k^x$

Limits

Sum of Limits
$\displaystyle\lim_{x\to c} (f+g)(x) = \lim_{x\to c} f(x) + \lim_{x\to c} g(x)$
Difference of Limits:
$\displaystyle\lim_{x\to c} (f-g)(x) = \lim_{x\to c} f(x) - \lim_{x\to c} g(x)$
Product of Limits:
$\displaystyle\lim_{x\to c} (f\cdot g)(x) = \lim_{x\to c} f(x) \cdot \lim_{x\to c} g(x)$
Quotient of Limits:
$\displaystyle\lim_{x\to c} \frac{f(x)}{g(x)} = \frac{\lim_{x\to c} f(x)}{\lim_{x\to c} g(x)}; \lim_{x\to c} g(x) \neq 0$
Power of Limits:
$\displaystyle\lim_{x\to c} f(x)^{\frac{n}{d}} = (\lim_{x\to c} f(x))^{\frac{n}{d}}; \frac{n}{d} \in \mathbb{R}$

Composition of Limits:
$\displaystyle\lim_{x\to c} (f \circ g)(x) = f(\lim_{x\to c} g(x))$
Constant Multiple Rule:
$\displaystyle\lim_{x\to c} (k \cdot f(x)) = k \cdot \lim_{x\to c} f(x)$
Constant Rule:
$\displaystyle\lim_{x\to c} k = k$
Identity Rule:
$\displaystyle\lim_{x\to c} x = c$

Derivatives

Power Rule:
$\dfrac{d}{dx} x^n = n \cdot x^{n-1}$
Functional Power Rule:
$\dfrac{d}{dx}\left(f(x)^{g(x)} \cdot\right) = f(x)^{g(x)} \left(\dfrac{g(x) \cdot \frac{df}{dx}}{f(x)} + \dfrac{dg}{dx} \cdot \ln f(x)\right)$
Sum Rule:
$\dfrac{d}{dx}(f+g)(x) = \dfrac{df}{dx} + \dfrac{dg}{dx}$
Product Rule:
$\dfrac{d}{dx}(f\cdot g)(x) = f(x) \cdot \dfrac{dg}{dx} + g(x) \cdot \dfrac{df}{dx}$
General Leibniz Rule:
$\dfrac{d^n}{dx^n}(f \cdot g)(x) = \displaystyle\sum_{k=0}^{n} \binom{n}{k} \frac{d^{n-k} f}{dx^{n-k}} \cdot \frac{d^k g}{dx^k}$
Quotient Rule:
$\dfrac{d}{dx}\left(\dfrac{f(x)}{g(x)}\right) = \dfrac{g(x) \cdot \frac{df}{dx} - f(x)\frac{dg}{dx}}{g(x)^2}$
Chain Rule:
$\dfrac{d}{dx}(f \circ g)(x) = \dfrac{df}{dg} \cdot \dfrac{dg}{dx}$
Exponential Derivatives:
$\dfrac{d}{dx} n^x = n^x \ln(n); n > 0$
Logarithmic Derivatives:
$\dfrac{d}{dx} \log_b x = \dfrac{1}{x \ln b}$

Definite Integrals

Sum of Integrals:
$\displaystyle\int_a^c f(x)dx = \int_a^b f(x)dx + \int_b^c f(x)dx$

Identity Rule:
$$\int_a^a f(x)dx = 0$$
Inverse Rule:
$$\int_a^b f(x)dx = -\int_b^a f(x)dx$$

Indefinite Integrals

Inverse Power Rule:
$$\int x^n dx = \frac{x^{n+1}}{n+1} + C; n \neq -1$$
Sum Rule:
$$\int (f+g)(x)dx = \int f(x)dx + \int g(x)dx$$
Integration by Parts:
$$\int (f \cdot g)(x)dx = f(x)\cdot \int g(x)dx - \int g(x) \cdot \frac{df}{dx}dx$$
$$\int udv = u \cdot v - \int vdu$$
Integration by Substitution:
$$\int \frac{dg}{dx} \cdot (f \circ g)(x)dx = \int f(u)du; u = g(x)$$
Exponential Integrals:
$$\int n^x dx = \frac{n^x}{\ln(n)} + C$$
Logarithmic Integrals:
$$\int \log_b x dx = \frac{x}{\ln b}(\ln x - 1) + C$$