Symbolab Algebra Cheat Sheet

Number Rules

- $a \cdot 0 = 0$
- $1 \cdot a = a$

Expand Rules

- $-(a \pm b) = -a \mp b$
- $a \cdot (b + c) \cdot (d + e) = abd + abe + acd + ace$
- $-(-a) = a$
- $a \cdot (b + c) = ab + ac$
- $(a + b) \cdot (c + d) = ac + ad + bc + bd$

Fraction Rules

- $\frac{0}{a} = 0, \quad a \neq 0$
- $\frac{a}{a} = 1$
- $\left(\frac{a}{b}\right)^{-c} = \left(\left(\frac{a}{b}\right)^{-1}\right)^{c} = \left(\frac{b}{a}\right)^{c}$
- $a^{-b} = \frac{1}{a^b}$
- $\frac{-a}{b} = -\frac{a}{b}$
- $\frac{a}{\left(\frac{b}{c}\right)} = \frac{a \cdot c}{b}$
- $\frac{1}{\left(\frac{b}{c}\right)} = \frac{c}{b}$
- $\frac{a}{1} = a$
- $\left(\frac{a}{b}\right)^{-1} = \frac{1}{\left(\frac{a}{b}\right)} = \frac{b}{a}$
- $a^{-1} = \frac{1}{a}$
- $\frac{-a}{-b} = \frac{a}{b}$
- $\frac{a}{-b} = -\frac{a}{b}$
- $\frac{\left(\frac{b}{c}\right)}{a} = \frac{b}{c \cdot a}$

Absolute Rules

- $|-a| = a, \quad 0 \leq a$
- $|-a| = |a|$
- $|a| = a, \quad 0 \leq a$
- $|a \cdot x| = a \cdot |x|, \quad 0 \leq a$

Exponent Rules

- $1^a = 1$
- $a^0 = 1, \quad a \neq 0$
- $(ab)^n = a^n b^n$
- $\frac{a^m}{a^n} = \frac{1}{a^{n-m}}, \quad m < n$
- $(a^b)^c = a^{b \cdot c}$
- $\left(\frac{a}{b}\right)^c = \frac{a^c}{b^c}$
- $a^c \cdot b^c = (a \cdot b)^c$
- $\sqrt[n]{a \cdot b} = \sqrt[n]{a} \cdot \sqrt[n]{b}$
- $a^1 = a$
- $0^a = 0, \quad a \neq 0$
- $\frac{a^m}{a^n} = a^{m-n}, \quad n < m$
- $a^{b+c} = a^b \cdot a^c$
- $a^{b \cdot c} = (a^b)^c$
- $a^{\frac{m}{n}} = \left(\sqrt[n]{a}\right)^m$

Factor Rules

- $x^2 - y^2 = (x - y) \cdot (x + y)$
- $x^3 + y^3 = (x + y) \cdot (x^2 - xy + y^2)$
- $x^n - y^n = (x - y) \cdot (x^{n-1} + x^{n-2}y + \cdots + xy^{n-2} + y^{n-1})$
- $x^n + y^n = (x + y) \cdot (x^{n-1} - x^{n-2}y + \cdots - xy^{n-2} + y^{n-1})$, n is odd
- $a \cdot x^{2 \cdot n} - b = \left(\sqrt{a} \cdot x^n + \sqrt{b}\right)\left(\sqrt{a} \cdot x^n - \sqrt{b}\right)$
- $a \cdot x^4 - b = \left(\sqrt{a} \cdot x^2 + \sqrt{b}\right)\left(\sqrt{a} \cdot x^2 - \sqrt{b}\right)$
- $a \cdot x^{2 \cdot n} - b \cdot y^{2 \cdot m} = \left(\sqrt{a} \cdot x^n + \sqrt{b} \cdot y^m\right)\left(\sqrt{a} \cdot x^n - \sqrt{b} \cdot y^m\right)$
- $a \cdot x^4 - b \cdot y^4 = \left(\sqrt{a} \cdot x^2 + \sqrt{b} \cdot y^2\right)\left(\sqrt{a} \cdot x^2 - \sqrt{b} \cdot y^2\right)$

Factorial Rules

- $0! = 1$
- $n! = 1 \cdot 2 \cdots (n - 1) \cdot n$
- $\frac{n!}{(n+m)!} = \frac{1}{(n+1) \cdot (n+2) \cdots (n+m)}$
- $\frac{n!}{(n-m)!} = n \cdot (n - 1) \cdots (n - m + 1)$, $m < n$

Log Rules

- $\log(0)$ =Undefined
- $\log_a(a) = 1$
- $\log_{a^b}(x) = \frac{1}{b} \cdot \log_a(x)$
- $\log_{\frac{1}{a}}(x) = -\log_a(x)$
- $\log_x\left(\left(\frac{1}{x}\right)^n\right) = -n$
- $\log_a(b) = \frac{\ln(b)}{\ln(a)}$
- $\log(1) = 0$
- $\log_a(x^b) = b \cdot \log_a(x)$
- $\log_a\left(\frac{1}{x}\right) = -\log_a(x)$
- $\log_{x^n}(x) = \frac{1}{n}$
- $\log_x(x^n) = n$
- $a^{\log_a(b)} = b$

Undefined

- 0^0 =Undefined
- $\log_a(b)$ =Undefined, $a \leq 0$
- $\log_1(a)$ =Undefined
- $\frac{x}{0}$ =Undefined
- $\log_a(b)$ =Undefined, $b \leq 0$

Complex Number Rules

- $i^2 = -1$
- $\sqrt{-1} = i$
- $\sqrt{-a} = \sqrt{-1} \cdot \sqrt{a}$