

Comprehensive Algebraic Formulas & Identities

Complete Mathematical Reference Guide (Excluding Logarithms)

1 Basic Algebraic Identities

Identity Name	Algebraic Expression
Square of Sum	$(a + b)^2 = a^2 + 2ab + b^2$
Square of Difference	$(a - b)^2 = a^2 - 2ab + b^2$
Difference of Two Squares	$a^2 - b^2 = (a - b)(a + b)$
Sum of Two Squares	$a^2 + b^2 = (a + b)^2 - 2ab$ or $a^2 + b^2 = (a - b)^2 + 2ab$
Product of Binomials	$(x + a)(x + b) = x^2 + (a + b)x + ab$
Square of Trinomial	$(a + b + c)^2 = a^2 + b^2 + c^2 + 2ab + 2bc + 2ca$

2 Cubic Identities

Identity Name	Algebraic Expression
Cube of Sum	$(a + b)^3 = a^3 + 3a^2b + 3ab^2 + b^3$ $(a + b)^3 = a^3 + b^3 + 3ab(a + b)$
Cube of Difference	$(a - b)^3 = a^3 - 3a^2b + 3ab^2 - b^3$ $(a - b)^3 = a^3 - b^3 - 3ab(a - b)$
Sum of Cubes	$a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
Difference of Cubes	$a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
Sum of Three Cubes	$a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ca)$ Special Condition: If $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$.

3 Quadratic Equations

Standard Form: $ax^2 + bx + c = 0$ (where $a \neq 0$)

Concept	Formula / Rule
Quadratic Formula	$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$
Discriminant (Δ)	$\Delta = b^2 - 4ac$
Nature of Roots	• If $\Delta > 0 \Rightarrow$ Roots are Real & Unequal • If $\Delta = 0 \Rightarrow$ Roots are Real & Equal • If $\Delta < 0 \Rightarrow$ Roots are Non-Real / Complex
Root Relations (α, β)	• Sum of roots: $\alpha + \beta = -b/a$ • Product of roots: $\alpha \times \beta = c/a$
Equation Construction	$x^2 - (\alpha + \beta)x + \alpha\beta = 0$

4 Exponents & Radicals Rules

Rule Name	Mathematical Formula
Product Rule	$a^m \cdot a^n = a^{m+n}$
Quotient Rule	$a^m / a^n = a^{m-n}$
Power Rule	$(a^m)^n = a^{m \cdot n}$
Power of a Product	$(ab)^n = a^n \cdot b^n$
Power of a Quotient	$(a/b)^n = a^n / b^n$
Zero Exponent	$a^0 = 1$ (for $a \neq 0$)
Negative Exponent	$a^{-n} = 1 / a^n$
Fractional Exponent	$a^{m/n} = \sqrt[n]{a^m} = (\sqrt[n]{a})^m$

5 Arithmetic Progression (A.P.)

Concept	Formula
nth Term (t_n)	$t_n = a + (n - 1)d$ (where a = first term, d = common difference)
Sum of n Terms (S_n)	1) $S_n = (n / 2) \times [2a + (n - 1)d]$ 2) $S_n = (n / 2) \times [t_1 + t_n]$ (when first & last terms are known)
Consecutive Terms	• 3 terms: $a - d, a, a + d$ • 4 terms: $a - 3d, a - d, a + d, a + 3d$ Diff = $2d$ • 5 terms: $a - 2d, a - d, a, a + d, a + 2d$