

1. Exponents and Logarithms

$$a^m \cdot a^n = a^{m+n}$$

$$\frac{a^m}{a^n} = a^{m-n}$$

$$(a^m)^n = a^{mn}$$

$$\log_b(xy) = \log_b x + \log_b y$$

$$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$$

$$\log_b(x^k) = k \log_b x$$

$$\log_b x = \frac{\log_a x}{\log_a b}$$

2. Quadratic Equations

For $ax^2 + bx + c = 0$:

Quadratic Formula:

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

Discriminant (Δ): $\Delta > 0$: Two real roots

$\Delta = 0$: One repeated root $\Delta < 0$: Two complex roots

Vieta's Formulas: Sum of roots: $r_1 + r_2 = -\frac{b}{a}$

Product of roots: $r_1 r_2 = \frac{c}{a}$

3. Polynomials and Binomial Theorem

Special Products:

$$(a+b)^2 = a^2 + 2ab + b^2$$

$$(a-b)^2 = a^2 - 2ab + b^2$$

$$a^2 - b^2 = (a-b)(a+b)$$

$$a^3 + b^3 = (a+b)(a^2 - ab + b^2)$$

$$a^3 - b^3 = (a-b)(a^2 + ab + b^2)$$

Binomial Theorem:

$$(x+y)^n = \sum_{k=0}^n \binom{n}{k} x^{n-k} y^k$$

where $\binom{n}{k} = \frac{n!}{k!(n-k)!}$.

4. Sequences and Series

Arithmetic Progression (AP): n -th term: $a_n = a_1 + (n-1)d$

Sum of n terms: $S_n = \frac{n}{2}[2a_1 + (n-1)d]$

Geometric Progression (GP): n -th term:

$a_n = a_1 r^{n-1}$ Sum of n terms: $S_n = \frac{a_1(1-r^n)}{1-r}$ ($r \neq 1$)

Infinite Sum ($|r| < 1$): $S_\infty = \frac{a_1}{1-r}$

5. Complex Numbers

Let $z = a + bi$, where $i^2 = -1$. **Magnitude:**

$|z| = \sqrt{a^2 + b^2}$ **Conjugate:** $\bar{z} = a - bi$ **Euler's Formula:**

$e^{i\theta} = \cos \theta + i \sin \theta$ **De Moivre's Theorem:**

$$(r(\cos \theta + i \sin \theta))^n = r^n(\cos(n\theta) + i \sin(n\theta))$$

6. Matrices and Determinants

For a 2×2 matrix $A = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$:

Determinant: $\det(A) = ad - bc$ **Inverse:**

$$A^{-1} = \frac{1}{ad - bc} \begin{pmatrix} d & -b \\ -c & a \end{pmatrix}$$