

1. Exponents and Logarithms

Geometric Sequence:

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

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

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

$$(ab)^n = a^n b^n$$

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

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

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

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 distinct real roots * $\Delta = 0$: One repeated real root * $\Delta < 0$: Two complex conjugate roots

3. Polynomials and Factoring

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

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

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

Binomial Theorem:

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

4. Sequences and Series

Arithmetic Sequence:

$$a_n = a_1 + (n - 1)d$$

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

5. Inequalities and Absolute Value

$$* |x| < c \iff -c < x < c \quad * |x| > c \iff x > c \text{ or } x < -c$$

Triangle Inequality:

$$|x + y| \leq |x| + |y|$$

6. 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: $e^{i\theta} = \cos \theta + i \sin \theta$