

Arithmetic Cheat Sheet

Essential Formulas, Rules, and Quick Reference

1. Number Systems Properties 3. Exponents Radicals

- **Natural Numbers ($\mathbb{N}$):** $\{1, 2, 3, \dots\}$
- **Whole Numbers ($\mathbb{W}$):** $\{0, 1, 2, 3, \dots\}$
- **Integers ($\mathbb{Z}$):** $\{\dots, -2, -1, 0, 1, 2, \dots\}$
- **Rational Numbers ($\mathbb{Q}$):** $\frac{p}{q}$ where $q \neq 0$.
- **Irrational Numbers:** Cannot be expressed as simple fractions (e.g., $\pi, \sqrt{2}$).
- **Real Numbers ($\mathbb{R}$):** Union of rational and irrational numbers.

Properties of Operations

- **Commutative:** $a + b = b + a, \quad ab = ba$
- **Associative:** $(a + b) + c = a + (b + c)$
- **Distributive:** $a(b + c) = ab + ac$

2. Fractions Decimals

- **Addition/Subtraction:**

$$\frac{a}{b} \pm \frac{c}{d} = \frac{ad \pm bc}{bd}$$

- **Multiplication:**

$$\frac{a}{b} \times \frac{c}{d} = \frac{ac}{bd}$$

- **Division:**

$$\frac{a}{b} \div \frac{c}{d} = \frac{a}{b} \times \frac{d}{c} = \frac{ad}{bc}$$

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

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

$$(a^m)^n = a^{m \cdot n}$$

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

$$a^{-n} = \frac{1}{a^n}$$

$$a^{1/n} = \sqrt[n]{a}$$

$$\sqrt[n]{ab} = \sqrt[n]{a} \cdot \sqrt[n]{b}$$

4. Percentages

- **Percentage Formula:**

$$\text{Percentage} = \left(\frac{\text{Part}}{\text{Whole}} \right) \times 100$$

- **Percentage Increase/Decrease:**

$$\% \text{ Change} = \left(\frac{\text{New} - \text{Old}}{\text{Old}} \right) \times 100$$

- **Simple Interest (SI):**

$$SI = \frac{P \times R \times T}{100}$$

- **Compound Interest (CI):**

$$A = P \left(1 + \frac{R}{100} \right)^t, \quad CI = A - P$$

5. Ratio, Proportion Variation

- **Ratio:** Comparison of two quantities $a : b = \frac{a}{b}$.
- **Proportion:** Equality of two ratios, $\frac{a}{b} = \frac{c}{d} \implies ad = bc$.
- **Direct Variation:** $y = kx$
- **Inverse Variation:** $y = \frac{k}{x}$

6. HCF and LCM

- **Highest Common Factor (HCF / GCD):** Greatest divisor that divides each of the numbers.
- **Lowest Common Multiple (LCM):** Smallest positive integer that is divisible by both.
- **Key Property for Two Numbers a and b :**

$$\text{HCF}(a, b) \times \text{LCM}(a, b) = a \times b$$

- **HCF of Fractions:**

$$\text{HCF} \left(\frac{a}{b}, \frac{c}{d} \right) = \frac{\text{HCF}(a, c)}{\text{LCM}(b, d)}$$

- **LCM of Fractions:**

$$\text{LCM} \left(\frac{a}{b}, \frac{c}{d} \right) = \frac{\text{LCM}(a, c)}{\text{HCF}(b, d)}$$

7. Averages (Mean)

- **Arithmetic Mean:**

$$\text{Average} = \frac{\sum x_n}{n} = \frac{\text{Sum of Observations}}{\text{Total Number of Observations}}$$

- **Weighted Average:**

$$\bar{x} = \frac{w_1 x_1 + w_2 x_2 + \dots + w_n x_n}{w_1 + w_2 + \dots + w_n}$$