Arithmetic Master Cheat Sheet

Essential Formulas, Rules, and Quick-Calculation Techniques

1. Number Systems

- **Natural Numbers ($\mathbb{N}$)**: $\{1, 2, 3, \dots\}$
- **Whole Numbers**: $\{0, 1, 2, 3, \dots\}$
- **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 fractions (e.g., $\pi, e, \sqrt{2}$).

2. Divisibility Rules

2
Sum of digits is divisible by 3. **4**

Last digit is 0 or 5. **9**

Diff. of alternate digit sums is 0 or multiple of 11.

3. HCF and LCM

- For any 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**:

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

4. Fractions and 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**:

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

5. Percentages

- **Percentage to Fraction**:

$$x\% = \frac{x}{100}$$

- **Percentage Change**:

$$\%\ \text{Change} = \frac{\text{Final} - \text{Initial}}{\text{Initial}} \times 100$$

- **Successive Percentage Change** (for $a\%$ and $b\%$):

$$\text{Net Change} = \left(a + b + \frac{ab}{100}\right)\%$$

6. Ratio and Proportion

- If $a : b = c : d$, then $ad = bc$ (Cross Product).
- **Componendo and Dividendo**:

$$\text{If } \frac{a}{b} = \frac{c}{d}, \text{ then } \frac{a+b}{a-b} = \frac{c+d}{c-d}$$

- **Direct Proportion**: $y = kx \implies \frac{y_1}{x_1} = \frac{y_2}{x_2}$
- **Inverse Proportion**: $xy = k \implies x_1 y_1 = x_2 y_2$

7. Profit, Loss, and Discount

- **Profit (P)**: SP − CP
- **Loss (L)**: CP − SP
- **Profit Percentage**:

$$\text{P}\% = \left(\frac{\text{SP} - \text{CP}}{\text{CP}}\right) \times 100$$

- **Loss Percentage**:

$$\text{L}\% = \left(\frac{\text{CP} - \text{SP}}{\text{CP}}\right) \times 100$$

- **Discount Formula**:

Discount = Marked Price (MP) − Selling Price (SP)

8. Simple and Compound Interest

- **Simple Interest (SI)**:

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

where P = Principal, R = Rate, T = Time.

- **Compound Interest (CI)**:

$$A = P\left(1 + \frac{R}{100}\right)^n$$

$$\text{CI} = A - P$$

where n = Number of compounding periods.

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9. Speed, Time, and Distance

- **Fundamental Relations**:

$$\text{Distance} = \text{Speed} \times \text{Time}$$

- **Average Speed**:

$$\text{Avg Speed} = \frac{\text{Total Distance}}{\text{Total Time}}$$

- **Unit Conversion**:

$$1 \text{ km/hr} = \frac{5}{18} \text{ m/s}$$

- **Relative Speed**:
  - Same direction: $S_1 - S_2$
  - Opposite direction: $S_1 + S_2$

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