

Arithmetic Master Cheat Sheet

Essential Formulas, Properties, and Shortcuts

1. Number Systems

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:** Non-repeating, non-terminating decimals (e.g., π , $\sqrt{2}$).

Divisibility Rules

- **2:** Last digit is even.
- **3:** Sum of digits is divisible by 3.
- **4:** Last two digits form a number divisible by 4.
- **5:** Last digit is 0 or 5.
- **9:** Sum of digits is divisible by 9.
- **11:** Alternating sum of digits is divisible by 11.

2. LCM and HCF (GCD)

For any two positive integers a and b :

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

Fractions LCM/HCF:

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

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

3. Percentages

Percentage Formula:

$$\% \text{ value} = \frac{\text{Part}}{\text{Whole}} \times 100$$

Percentage Change:

$$\% \text{ Change} = \frac{\text{New Value} - \text{Old Value}}{\text{Old Value}} \times 100$$

Successive Percentage Change: If a quantity changes by $a\%$ and then by $b\%$, the net percentage change is:

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

4. Ratio and Proportion

If $\frac{a}{b} = \frac{c}{d}$, then:

- **Invertendo:** $\frac{b}{a} = \frac{d}{c}$
- **Alternendo:** $\frac{a}{c} = \frac{b}{d}$
- **Componendo:** $\frac{a+b}{b} = \frac{c+d}{d}$
- **Dividendo:** $\frac{a-b}{b} = \frac{c-d}{d}$
- **Comp. & Div.:** $\frac{a+b}{a-b} = \frac{c+d}{c-d}$

5. Average

$$\text{Average} = \frac{\text{Sum of Observations}}{\text{Number of Observations}}$$

Speed Averages:

- If a person covers a distance at x km/h and returns at y km/h, Average Speed is:

$$v_{\text{avg}} = \frac{2xy}{x+y}$$

6. Profit, Loss, and Discount

Profit = Selling Price (SP) – Cost Price (CP) Loss = Cost Price (CP) – Selling Price (SP)

Marked Price (MP) & Discount:

$$\text{Discount} = \text{MP} - \text{SP}$$

$$\text{SP} = \text{MP} \times \left(1 - \frac{\text{Discount}\%}{100}\right)$$

7. Simple and Compound Interest

Simple Interest (SI):

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

where P = Principal, R = Rate/annum, T = Time in years.

Compound Interest (CI):

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

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

where n is the number of compounding periods.

Difference between CI and SI for 2 years:

$$\text{CI} - \text{SI} = \frac{PR^2}{100^2}$$

8. Time, Speed, and Distance

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

Unit Conversion:

$$1 \text{ m/s} = \frac{18}{5} \text{ km/h}, \quad 1 \text{ km/h} = \frac{5}{18} \text{ m/s}$$

Relative Speed:

- Moving in same direction at speeds u and v : $u - v$
- Moving in opposite direction: $u + v$

9. Time and Work

If A can complete a work in x days, A's 1-day work = $\frac{1}{x}$.

Efficiency & Time: Efficiency $\propto \frac{1}{\text{Time}}$

Combined Work: If A and B take x and y days respectively, together they take:

$$\text{Time} = \frac{xy}{x + y} \text{ days}$$