

Arithmetic Word Problems: Master Cheat Sheet

Essential Formulas, Frameworks, and Shortcuts for Competitive Exams

1. The 4-Step Problem-Solving Framework

- Deconstruct:** Read the problem twice. Identify *Given* values and what needs to be *Found*.
- Translate:** Convert verbal statements into algebraic equations or ratios.
- Execute:** Apply the appropriate formula carefully.
- Verify:** Check if the answer is logical and units match.

2. Percentages & Ratios

Percentage Change:

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

Successive Percentage Change (a and b):

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

Proportions (Rule of Three): $A : B = c : d$, then $Ad = Bc$.

3. Speed, Time & Distance

Core Relationship:

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

Average Speed (Equal Distances):

$$\text{Avg Speed} = \frac{2xy}{x + y}$$

where x and y are outbound and return speeds. **Relative Speed:** * Same Direction: $S_1 - S_2$ * Opposite Direction: $S_1 + S_2$ **Trains:**

$$\text{Time} = \frac{\text{Length of Train} + \text{Length of Platform}}{\text{Relative Speed}}$$

4. Time & Work

person A finishes work in x days, 1-day work is $\frac{1}{x}$. **Combined Work:**

$$\text{If } A = x \text{ days, } B = y \text{ days} \implies \text{Together} = \frac{xy}{x + y}$$

Efficiency Principle:

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

A is twice as efficient as B , A takes half the time. **M1D1H1 / W1 = M2D2H2 / W2:**

$$\frac{M_1 D_1 T_1}{W_1} = \frac{M_2 D_2 T_2}{W_2}$$

5. Profit, Loss & Discount

Core Metrics:

$$\text{Profit} = SP - CP \quad | \quad \text{Loss} = CP - SP$$

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

Marked Price & Discount:

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

$$\text{Selling Price} = MP \times \left(1 - \frac{\text{Disc}\%}{100} \right)$$

Dishonest Dealer:

$$\text{Gain}\% = \left[\frac{\text{Error}}{\text{True Value} - \text{Error}} \right] \times 100\%$$

6. Simple & Compound Interest

Simple Interest (SI):

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

Compound Interest (CI):

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

$$CI = A - P$$

Difference between CI and SI (2 Years):

$$\text{Diff} = \frac{PR^2}{100^2}$$

7. Mixtures & Alligation

mix two quantities at prices C_1 and C_2 to form a mean price M ($C_1 < M < C_2$):

$$\frac{\text{Quantity of Cheaper}}{\text{Quantity of Dearer}} = \frac{C_2 - M}{M - C_1}$$

$$\begin{array}{c} C_1 \searrow \\ M \\ C_2 \nearrow \end{array} \quad C_2 - M : M - C_1$$