

THE DEFINITIVE CAT FORMULA BOOK

Quantitative Aptitude Cheat Sheet for 99+ Percentile

- ✓ Comprehensive formulas covering all core CAT modules
- ✓ Arithmetic, Algebra, Geometry, Mensuration & Number Systems
- ✓ Structurally organized for rapid revision and high retention
- ✓ Engineered specifically for CAT 2026 aspirants

Essential Algebraic Identities

Incorporate these core factoring and expansion identities to simplify complex algebraic expressions efficiently:

- $(a - b)^2 = a^2 + b^2 - 2ab$
- $(a + b)^2 = a^2 + b^2 + 2ab$
- $(a + b)(a - b) = a^2 - b^2$
- $(a + b + c)^2 = a^2 + b^2 + c^2 + 2(ab + bc + ca)$
- $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
- $a^3 + b^3 = (a + b)(a^2 - ab + b^2)$
- $a^3 + b^3 + c^3 - 3abc = (a + b + c)(a^2 + b^2 + c^2 - ab - bc - ac)$
- **Special Condition:** When $a + b + c = 0$, then $a^3 + b^3 + c^3 = 3abc$

Binomial Theorem Expansion

$$(a + b)^n = a^n + {}^n C_1 a^{n-1} b + {}^n C_2 a^{n-2} b^2 + \dots + {}^n C_{n-1} a b^{n-1} + b^n$$

2. Arithmetic Core Foundations

Arithmetic traditionally carries significant weight in the CAT exam. Mastery of ratios, computational shortcuts, and rate problems is vital.

LCM and HCF

- **Fundamental Product Rule:** $LCM \times HCF = \text{Product of the two numbers}$
- **Co-prime Numbers:** For any co-prime pairs, the $LCM = \text{Product of the numbers}$ (since their $HCF = 1$).

Profit, Loss, and Discount

| Metric / Target Variable | Formula / Expression |
|---------------------------------|---|
| Profit (or Gain) | $SP - CP$ |
| Profit Percentage (Profit %) | $(Profit / CP) \times 100$ |
| Selling Price (SP) given Gain % | $SP = [(100 + Gain\%) / 100] \times CP$ |
| Cost Price (CP) given Gain % | $CP = [100 / (100 + Gain\%)] \times SP$ |
| Loss | $CP - SP$ |
| Loss Percentage (Loss %) | $(Loss / CP) \times 100$ |
| Selling Price (SP) given Loss % | $SP = [(100 - Loss\%) / 100] \times CP$ |
| Cost Price (CP) given Loss % | $CP = [100 / (100 - Loss\%)] \times SP$ |

Speed, Time, Distance & Work Dynamics

Speed, Time, and Distance Equations

Moving bodies follow linear relationships where one variable can be explicitly solved via the others:

$$\text{Distance} = \text{Speed} \times \text{Time} \quad | \quad \text{Time} = \text{Distance} / \text{Speed} \quad | \quad \text{Speed} = \text{Distance} / \text{Time}$$

Time and Work Rates

- If X can complete a piece of work in n days, then X 's structural 1-day work output rate is exactly $1/n$.
- Conversely, if X 's daily execution metric is evaluated as $1/n$, the total calendar duration needed to fully close the asset work loop is n days.

Percentages & Averages

- **Percentage Definition:** To calculate what percentage of variable x corresponds to scalar y : **Percentage** = $(y / x) \times 100$
- **Value Scaling:**
 - To increase a baseline amount N by a factor of S %: **New Value** = $N \times (1 + S / 100)$
 - To decrease a baseline amount N by a factor of S %: **New Value** = $N \times (1 - S / 100)$
- **Statistical Average:** **Average** = *Sum of all individual observations / Total count of observations*

Mixtures and Alligations

The Rule of Alligation

When mixing two ingredients of varying unit costs (Cheaper $C.P._c$ and Dearer $C.P._d$) to achieve an intermediate Mean Price (M):

$$\text{Quantity of Cheaper} / \text{Quantity of Dearer} = (C.P. \text{ of Dearer} - \text{Mean Price}) / (\text{Mean Price} - C.P. \text{ of Cheaper})$$

3. Commercial Math & Advanced Algebra

Simple and Compound Interest Frameworks

Let P represent Principal, R represent rate of interest per annum, and n represent the compounding periods or years.

Interest Compounded Annually

$$\text{Amount (A)} = P \times (1 + R / 100)^n$$

Interest Compounded Half-Yearly

$$\text{Amount (A)} = P \times [1 + (R / 2) / 100]^{2n}$$

Interest Compounded Quarterly

$$\text{Amount (A)} = P \times [1 + (R / 4) / 100]^{4n}$$

Compounding with Fractional Temporal Limits

When computing accrued metrics for non-integer time spans (e.g., 3 years and a fractional compound interval):

$$\text{Amount (A)} = P \times (1 + R / 100)^3 \times [1 + (R \times \text{fraction}) / 100]$$

Varying Multi-Year Interest Matrices

If interest metrics scale over consecutive timelines at distinct changing rates ($R_1\%$, $R_2\%$, $R_3\%$):

$$\text{Amount (A)} = P \times (1 + R_1 / 100) \times (1 + R_2 / 100) \times (1 + R_3 / 100)$$

Present Worth Valuation

The contemporary present value of an explicit amount x due exactly n years in the future under active compounding:

$$\text{Present Worth (PW)} = x / (1 + R / 100)^n$$

Logarithmic Operational Properties

Logarithmic equations can be evaluated and converted across bases using these operational identities:

- **Product rule:** $\log_a(xy) = \log_a x + \log_a y$
- **Quotient rule:** $\log_a(x/y) = \log_a x - \log_a y$
- **Identity base matching:** $\log_x x = 1$
- **Zero log rule:** $\log_a 1 = 0$
- **Power rule scaling:** $\log_a(x^n) = n \times \log_a x$
- **Reciprocal base property:** $\log_a x = 1 / \log_x a$
- **Base change theorem:** $\log_a x = (\log_b x) / (\log_b a) = \log x / \log a$

4. Geometry, Coordinate Systems & Mensuration

2D and 3D Mensuration Metrics

| Geometric Object | Core Metric Formula |
|------------------|---|
| Triangle | Area = $\frac{1}{2} \times b \times h$ Heron's Formula: $\sqrt{[s(s - a)(s - b)(s - c)]}$, where semi-perimeter $s = (a + b + c) / 2$ |
| Square | Area = a^2 Perimeter = $4a$ |
| Rectangle | Area = $l \times b$ Perimeter = $2(l + b)$ |
| Cube | Volume (V) = a^3 Lateral Surface Area = $4a^2$ Total Surface Area = $6a^2$ Space Diagonal (d) = $\sqrt{3} a$ |
| Cuboid | Volume = $l \times b \times h$ Total Surface Area = $2(lb + bh + hl)$ Internal Space Diagonal = $\sqrt{l^2 + b^2 + h^2}$ |
| Circle & Sectors | Area = πr^2 or $\pi d^2 / 4$ Circumference = $2\pi r$ or πd Area of a Sector = $(\theta / 360) \times \pi r^2$ |

Trigonometric Ratios and Identities

For a right-angled triangle with reference angle θ :

- **Sine** (θ) = *Opposite / Hypotenuse* | **Co-Secant** (θ) = *Hypotenuse / Opposite*
- **Cosine** (θ) = *Adjacent / Hypotenuse* | **Secant** (θ) = *Hypotenuse / Adjacent*
- **Tangent** (θ) = *Opposite / Adjacent* | **Co-Tangent** (θ) = *Adjacent / Opposite*

Reciprocal Identity Links

$$\operatorname{cosec} \theta = 1 / \sin \theta$$

$$\sec \theta = 1 / \cos \theta$$

$$\cot \theta = 1 / \tan \theta$$

Coordinate Geometry Principles

Distance Equation between two spatial points $A(x_1, y_1)$ and $B(x_2, y_2)$

$$AB^2 = (x_2 - x_1)^2 + (y_2 - y_1)^2 \Rightarrow AB = \sqrt{[(x_2 - x_1)^2 + (y_2 - y_1)^2]}$$

Midpoint of a Connecting Line Segment

The coordinate position exactly bisecting points (x_1, y_1) and (x_2, y_2) :

$$\text{Midpoint} = [(x_1 + x_2) / 2 , (y_1 + y_2) / 2]$$

Linear Equation Form (Point-Slope Form)

The structural equation of a straight line passing through a specific anchor point (x_1, y_1) with a defined gradient/slope m :

$$y - y_1 = m(x - x_1)$$

5. Modern Mathematics & Data Architecture

Set Theory and Structural Set Relations

De Morgan's Laws

$$(A \cap B)' = A' \cup B' \quad \text{and} \quad (A \cup B)' = A' \cap B'$$

A relation R mapped onto a functional set system $A \times A$ is categorized based on these structural properties:

- **Reflexive Relation:** Valid if and only if aRa holds true $\forall a \in A$.
- **Symmetric Relation:** Valid if whenever aRb is true, then bRa is also true $\forall a, b \in A$.
- **Transitive Relation:** Valid if whenever aRb and bRc are true, then aRc must be true $\forall a, b, c \in A$.

Equivalence Relation: If any given operational relation R simultaneously fulfills all three criteria (Reflexive, Symmetric, and Transitive) inside target set A , it is formally defined as an **Equivalence Relation**.

Permutations, Combinations & Probability Models

Permutation Formula (Order-Sensitive Selection)

Choosing and arranging r items from a structural pool of n discrete elements without tracking replacement systems where placement order is critical:

$${}^n P_r = n! / (n - r)!$$

Combination Formula (Order-Agnostic Selection)

Selecting a subset of r elements from a general collection of n items where operational position or sequence order does not matter:

$${}^n C_r = n! / [r!(n - r)!]$$

Probability Calculus

- **Sample Space (S):** The complete set containing all possible outcomes from an experimental trial.
- **Event Subset (E):** Any defined structural subset compiled within the parent sample space boundaries ($E \subseteq S$).

Probability of Occurrence Metric

The explicit probability that a target event E materializes during an active trial inside sample architecture S :

$$P(E) = n(E) / n(S)$$

Where $n(E)$ is the number of favorable outcomes and $n(S)$ is the total number of elements in the sample space.