This cheat sheet compiles the essential formulas, shortcut methods, and concepts for the GATE General Aptitude section, covering Quantitative, Analytical, and Spatial Aptitude.

I. Quantitative Aptitude Formula Sheet

1. Number Systems

- **Sum of Natural Numbers:** $\sum n = \frac{n(n+1)}{2}$
- **Sum of Squares:** $\sum n^2 = \frac{n(n+1)(2n+1)}{6}$
- **Sum of Cubes:** $\sum n^3 = [\frac{n(n+1)}{2}]^2$
- **Divisibility Rules:**
  - **3 & 9:** Sum of digits is divisible by 3 or 9.
  - **11:** | (Sum of odd place digits) − (Sum of even place digits) |= 0 or divisible by 11.
  - **4:** Last two digits divisible by 4.
- **HCF & LCM:** HCF × LCM = Product of two numbers

2. Percentages, Profit & Loss

- **Profit %:** $\frac{\text{Profit}}{CP} \times 100$
- **Loss %:** $\frac{\text{Loss}}{CP} \times 100$
- **Discount %:** $\frac{\text{MP}-\text{SP}}{\text{MP}} \times 100$
- **Successive Discounts ($a\%, b\%$):** Effective Discount $= a + b - \frac{ab}{100}$
- **True Discount:** $\frac{\text{Banker's Discount} \times 100}{100+(R \times T)}$

3. Simple & Compound Interest (SI & CI)

- **Simple Interest:** $SI = \frac{P \times R \times T}{100}$
- **Compound Interest (Amount):** $A = P\,(1 + \frac{R}{100})^n$
- **Difference between CI and SI:**
  - **For 2 Years:** $D = P\,(\frac{R}{100})^2$
  - **For 3 Years:** $D = P\,(\frac{R}{100})^2\,(\frac{R}{100} + 3)$

4. Time, Speed & Distance

- **Average Speed:** $\frac{2xy}{x+y}$ (when distances are equal, speeds are x and y).
- **Relative Speed:**
  - Same Direction: $S_1 - S_2$
  - Opposite Direction: $S_1 + S_2$
- **Boats & Streams:**
  - Downstream Speed (D): $u + v$ (Boat + Stream)
  - Upstream Speed (U): $u - v$ (Boat - Stream)
  - Boat Speed in Still Water: $\frac{D+U}{2}$
  - Stream Speed: $\frac{D-U}{2}$

5. Time & Work

- **Unit Work Method:** If A does work in x days, 1 day work $= \frac{1}{x}$.
- **M-D-H Formula:** $\frac{M_1 D_1 H_1}{W_1} = \frac{M_2 D_2 H_2}{W_2}$
  - (M=Men, D=Days, H=Hours, W=Work/Wages)

6. Permutation, Combination & Probability

- **Permutation (Order matters):** ${}^nP_r = \frac{n!}{(n-r)!}$
- **Combination (Order doesn't matter):** ${}^nC_r = \frac{n!}{r!(n-r)!}$
- **Probability:** $P(E) = \frac{\text{Favorable Outcomes}}{\text{Total Outcomes}}$
- **Mutually Exclusive Events:** $P(A \cup B) = P(A) + P(B)$
- **Independent Events:** $P(A \cap B) = P(A) \times P(B)$

7. Mensuration (Geometry)

- **Triangle Area:** $\sqrt{s(s-a)(s-b)(s-c)}$ (Heron's Formula)
- **Equilateral Triangle Area:** $\frac{\sqrt{3}}{4}a^2$
- **Cylinder Volume:** $\pi r^2 h$ | **Surface Area:** $2\pi r(r+h)$
- **Cone Volume:** $\frac{1}{3}\pi r^2 h$ | **CSA:** $\pi r l$ (where $l = \sqrt{h^2 + r^2}$)
- **Sphere Volume:** $\frac{4}{3}\pi r^3$ | **Surface Area:** $4\pi r^2$

II. Analytical & Spatial Aptitude Cheat Sheet

1. Clocks

- **Angle Formula:** $\theta = |\frac{11}{2}M - 30H|$
  - (M = Minutes, H = Hours)
- **Coincidence (0°):** Happens **22 times** in 24 hours.
- **Right Angle (90°):** Happens **44 times** in 24 hours.
- **Straight Line (180°):** Happens **22 times** in 24 hours.
- **Faulty Clock:** If a clock gains/loses x minutes in 24 hours, actual time = $\frac{\text{Indicated Time} \times 24 \times 60}{24 \times 60 \pm x}$

2. Calendars

- **Odd Days:** Days remaining after dividing total days by 7.
- **Ordinary Year:** 1 Odd Day (365 days)
- **Leap Year:** 2 Odd Days (366 days)
  - *Rule:* Divisible by 4 (e.g., 2024). For centuries, must be divisible by 400 (e.g., 2000 is leap, 1900 is not).
- **Century Odd Days:**
  - 100 years = 5 odd days
  - 200 years = 3 odd days
  - 300 years = 1 odd day
  - 400 years = 0 odd days

3. Spatial Aptitude (Visualization)

- **Dice Rules:**
  - If two positions of a dice show one common number, rotate clockwise from the common number to find opposite pairs.
- **Paper Folding:** Use the "Elimination Method". Visualize the fold line as a mirror axis.
- **Rotations:**
  - Positive (+) Rotation = Counter-Clockwise (Standard math convention).

- Negative (-) Rotation = Clockwise.

III. Shortcut Methods for GATE

Topic	Shortcut / Trick	Example Application
Time & Work	**LCM Method:** Instead of fractions, assume Total Work = LCM of days taken by individuals.	A takes 10 days, B takes 15. Total work = LCM(10,15) = 30 units. A=3u/day, B=2u/day. Together = 30/5 = 6 days.
Compound Interest	**Rule of 72:** To find approx years to double money at R%.	Time $ \approx 72/R$. If R=6%, money doubles in $72/6 = 12$ years.
Algebra	**Value Substitution:** For complex algebraic expressions asking for equivalence.	Put $x = 0, 1, \text{or } -1$ (avoid denominator=0) to check options quickly.
Averages	**Deviation Method:** Assumed Mean.	Avg of 42, 45, 48. Assume 45. Dev: -3, 0, +3. Net dev = 0. Avg = 45.
Last Digit	**Cyclicity:** Powers of 2, 3, 7, 8 repeat last digit every 4th power.	$2^{33} \rightarrow 33/4$ rem 1 $\rightarrow 2^1$ ends in 2.
Geometry	**Scale Factor:** If side is scaled by k, Area scales by k^2, Vol by k^3.	Cube side doubled ($k = 2$). Volume becomes $2^3 = 8$ times original.

IV. GATE-Specific Strategy

1. **Use the Virtual Calculator:** Practice with it beforehand. It is slower than a physical calculator; use it only when manual calculation is hard (e.g., 1.05^{12}).
2. **Units Check:** GATE traps often involve units (e.g., Speed in km/hr but Time in seconds). Always write units in your rough work.
3. **Drawing Diagrams:** For spatial aptitude and geometry, **never** solve in your head. Draw the 2D view of 3D objects on your scribble pad.