UGC-NET Paper I Unit V: Mathematical Reasoning and Aptitude – Notes

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1. Types of Reasoning

Type	Direction	Nature of conclusion	Example
Deductive	General → particular	Certain, if premises are true and form is valid	All men are mortal; Ram is a man; so Ram is mortal
Inductive	Particular → general	Probable, not certain	Every crow seen so far is black; so all crows are black
Abductive	Observation → best explanation	Plausible hypothesis	The road is wet; it probably rained
Analogical	Similarity → similar conclusion	Probable	A is like B in many ways; B has X; so A probably has X
Mathematical	Logical steps from axioms and definitions	Certain within the system	Proofs, number patterns

2. Number Series

Find the rule that links the terms. Check these patterns in order:

1. **Differences:** constant (arithmetic), or differences that themselves form a pattern (2nd-level difference).
2. **Ratios:** constant multiplier (geometric), e.g. 3, 9, 27, 81.
3. **Squares and cubes:** 1, 4, 9, 16…; 1, 8, 27, 64…; or $n^2 \pm 1$, $n^3 \pm 1$.
4. **Primes:** 2, 3, 5, 7, 11, 13, 17, 19, 23, 29…
5. **Mixed operations:** $\times 2 + 1$, $\times 3 - 1$, etc.
6. **Alternating series:** two series interleaved (look at odd and even positions separately).
7. **n(n + 1) type:** 2, 6, 12, 20, 30, 42…

Useful values

n	1	2	3	4	5	6	7	8	9	10
n^2	1	4	9	16	25	36	49	64	81	100
n^3	1	8	27	64	125	216	343	512	729	1000

Squares of 11 to 20: 121, 144, 169, 196, 225, 256, 289, 324, 361, 400.

3. Letter Series

Convert letters to their positions: A = 1, B = 2 … Z = 26. Reverse positions: A = 26 … Z = 1 (position + reverse position = 27).

Memory aid 'EJOTY': E = 5, J = 10, O = 15, T = 20, Y = 25.

A	B	C	D	E	F	G	H	I	J	K	L	M
1	2	3	4	5	6	7	8	9	10	11	12	13

N	O	P	Q	R	S	T	U	V	W	X	Y	Z
14	15	16	17	18	19	20	21	22	23	24	25	26

Common patterns: equal skips (B, E, H, K: +3), increasing skips (A, C, F, J, O: +2, +3, +4, +5), opposite pairs (AZ, BY, CX, DW), and letter-number combinations.

4. Coding-Decoding

Type	How it works	Example
Letter shifting	Each letter moves forward or backward by a fixed number	CAT → DBU (+1)
Reverse order	Letters written backwards	MONDAY → YADNOM
Letter-to-number	Letters replaced by positions or a key	FACE → 6, 1, 3, 5
Substitution	One word is called another	If 'sky' is called 'sea', what is blue?
Matching codes	Compare words sharing letters to find each letter's code	ROSE = 6821, CHAIR = 73456
Opposite letter	Each letter replaced by its mirror (A↔Z, B↔Y)	GOD → TLW

5. Relationships (Blood Relations)

Tips: draw a family tree; use + for male, − for female; horizontal lines for the same generation and vertical lines for parent-child.

Relation	Meaning
Mother's or father's brother	Uncle
Mother's or father's sister	Aunt
Uncle's or aunt's child	Cousin
Brother's or sister's son / daughter	Nephew / Niece
Son's wife	Daughter-in-law
Wife's or husband's brother	Brother-in-law
Father's or mother's father	Grandfather
Only son of my grandfather	My father

Typical phrasing: 'Pointing to a man, X said, "He is the son of my mother's only brother."' The man is X's cousin.

6. Fractions

- To compare fractions, convert to decimals or cross-multiply: a/b > c/d if ad > bc.
- 'Of' means multiply: 3/4 of 2/3 of 120 = 60.

Fraction	1/2	1/3	1/4	1/5	1/6	1/8	1/10	1/12
Percent	50%	33.33%	25%	20%	16.67%	12.5%	10%	8.33%

7. Percentage

- x% of y = (x × y)/100. Also, x% of y = y% of x.
- Percentage change = (Change / Original) × 100.
- If A is r% more than B, then B is less than A by [r / (100 + r)] × 100%.
- If price rises by r%, consumption must fall by [r / (100 + r)] × 100% to keep expenditure unchanged.
- **Successive change** of a% and b%: net change = a + b + (ab/100). For +20% then −20%: 20 − 20 − 4 = −4%.

8. Ratio and Proportion

- Divide amount S in ratio a : b → shares S·a/(a+b) and S·b/(a+b).
- If a : b = p : q and b : c = r : s, then a : b : c = pr : qr : qs.
- **Proportion:** a : b :: c : d means ad = bc.
- **Fourth proportional** to a, b, c = bc/a. **Third proportional** to a, b = b^2/a. **Mean proportional** between a and b = √(ab).

9. Profit, Loss and Discount

Formula	Expression
Profit	SP − CP
Profit %	(Profit / CP) × 100
Loss %	(Loss / CP) × 100
SP (profit p%)	CP × (100 + p)/100
Discount	Marked Price − SP; Discount % is on Marked Price
Successive discounts a% and b%	Single equivalent = a + b − (ab/100)

If SP of x items = CP of y items, profit % = [(y − x)/x] × 100.

10. Interest and Discounting

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

$$A = P\left(1 + \frac{R}{100}\right)^{T}, \qquad CI = A - P$$

- Difference between CI and SI for 2 years = $P(R/100)^2$.
- Money doubles under SI when R × T = 100 (e.g. 12.5% for 8 years).
- **Rule of 72:** under compound interest, money doubles in about 72/R years.
- **Present value (discounting):** PV = A / (1 + R/100)^T. True discount = Amount − Present value.

11. Averages

- Average = Sum of observations / Number of observations.
- Average of first n natural numbers = (n + 1)/2.
- If a new person joins and the average changes, new person's value = new total − old total.
- Weighted average = $\Sigma(w \times x) / \Sigma w$.

12. Time and Distance

- Speed = Distance / Time.
- km/h to m/s: multiply by 5/18. m/s to km/h: multiply by 18/5.
- **Average speed** for equal distances at speeds x and y = 2xy/(x + y).
- **Relative speed:** same direction = difference of speeds; opposite direction = sum of speeds.
- A train crossing a pole travels its own length; crossing a platform travels (train length + platform length).

13. Time and Work

- If A finishes a job in a days, A's one-day work = 1/a.
- A and B together: time = ab/(a + b).

14. Exam Tips

- Use options: substitute them back to check.
- Convert percentages to fractions for speed (e.g. 12.5% = 1/8).
- Write units clearly in time-distance questions.
- In series questions, test differences first, then ratios.