

CAT 2026 · QUANT · MODERN MATH

ThinkCAT

Practice Book



CAT Modern Math Formula Sheet

4 topics · 39 formulas · 15 common mistakes · 5 real CAT PYQs one tap away

15

Modern Math questions in CAT 2021-25

5%

of all 330 QA questions

12

were P&C counting; none were probability

7

were TITA: no negative marks

HOW OFTEN CAT ASKED EACH TOPIC · 2021-25

[Tap a topic to open its page](#)

#	Topic	2021	2022	2023	2024	2025	Total	TITA	Page
1	● Permutations	1	2	1	3	·	7		4 p.3
2	● Combinations	2	1	·	1	1	5		3 p.4
3	● Set Theory	·	1	·	1	1	3		0 p.2
-	● Probability	·	·	·	·	·	0		0 p.5
All Modern Math		3	4	1	5	2	15	7	

Also inside: [Counting or Probability? \(p.6\)](#), a one-page guide to picking the right method ↗

Counts: every official CAT QA question from 2021-2025 (15 slots, 330 questions), tagged to one main topic by ThinkCAT. Deep links open the exact question on [thinkcat.in](#).

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TOPIC 44 · MODERN MATH 1 OF 5

OCCASIONAL

Set Theory

3

CAT questions from this topic, 2021-25

#3 of 4 in Modern Math · 0 TITA

0	1	0	1	1
2021	2022	2023	2024	2025

CORE FORMULAS

- $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
- $n(A \cup B \cup C) = \Sigma A - \Sigma(\text{pairs}) + n(A \cap B \cap C)$
- Exactly one = $\Sigma A - 2\Sigma(\text{pairs}) + 3 \times (\text{all three})$
- Exactly two = $\Sigma(\text{pairs}) - 3 \times (\text{all three})$
- At least two = $\Sigma(\text{pairs}) - 2 \times (\text{all three})$
- $n(A') = n(U) - n(A)$; $n(A - B) = n(A) - n(A \cap B)$
- A set with n elements has 2^n subsets
- $n(A \cap B)$ is at most $\min(n(A), n(B))$ and at least $n(A) + n(B) - n(U)$
- Three sets in U : $(\text{all three}) \geq \Sigma A - 2n(U)$

60-SECOND SHORTCUT

Bounds on an overlap

100 people, 60 like tea and 70 like coffee: both is at least $60 + 70 - 100 = 30$ and at most **60**.

DON'T MAKE THESE MISTAKES

- ✗ $n(A \cup B) = n(A) + n(B)$
- ✓ Subtract the overlap once: **$- n(A \cap B)$**
- ✗ $\Sigma(\text{pairs}) = \text{people in exactly two sets}$
- ✓ The triple overlap sits in it 3 times: **exactly two = $\Sigma \text{pairs} - 3 \times \text{all}$**
- ✗ Everyone belongs to some set
- ✓ Check for **none**: $n(U) - n(A \cup B \cup C)$

SOLVE THE REAL ONES

PYQs and practice on thinkcat.in

CAT 2024 Slot 3

Q9 · Moderate · MCQ

Set Theory set

65+ practice questions

Solve every CAT Venn Diagram PYQ, free



TOPIC 45 · MODERN MATH 2 OF 5

MOST ASKED

Permutations

7

CAT questions from this topic, 2021-25

#1 of 4 in Modern Math · 4 TITA



CORE FORMULAS

- Independent choices multiply ('and'); separate cases add ('or')
- $P(n, r) = \frac{n!}{(n-r)!}$: arrangements of r out of n distinct things
- n things with p alike and q alike: $\frac{n!}{(p! q!)}$ arrangements
- Circular: $(n-1)!$; necklace or garland (flipping allowed): $(n-1)!/2$
- With repetition allowed: n^r
- Must sit together: glue them into one block, then multiply by the block's own arrangements
- Never together = total - together
- Numbers from digits: fill the first place first (no 0 there), then the restricted places
- Sum of all numbers from n distinct digits, each used once: $(n-1)! \times (\text{sum of digits}) \times 11\dots 1$ (n ones)
- Derangements (nothing in its own place): $D_3 = 2, D_4 = 9, D_5 = 44$

60-SECOND SHORTCUT

Divide out the repeats

Arrangements of LEVEL: $\frac{5!}{(2! \times 2!)} = 30$ (two Ls and two Es).

DON'T MAKE THESE MISTAKES

- ✗ 6 people around a table: $6!$ ways
- ✓ Fix one seat: **$5! = 120$**
- ✗ 4-digit numbers, no repeated digit: $10 \times 9 \times 8 \times 7$
- ✓ No 0 up front: $9 \times 9 \times 8 \times 7 = 4,536$
- ✗ Arrangements of BOOK = $4!$
- ✓ Divide by $2!$ for the Os: **12**

SOLVE THE REAL ONES

Official CAT questions on thinkcat.in

CAT 2024 Slot 3

Q18 · Moderate · TITA

CAT 2024 Slot 2

Q18 · Hard · TITA

Solve every CAT P&C PYQ, free ↗



TOPIC 46 · MODERN MATH 3 OF 5

MOST ASKED

Combinations

5

CAT questions from this topic, 2021–25

#2 of 4 in Modern Math · 3 TITA

2	1	0	1	1
2021	2022	2023	2024	2025

CORE FORMULAS

- $C(n, r) = \frac{n!}{r!(n-r)!}$, and $C(n, r) = C(n, n-r)$
- $C(n, 0) + C(n, 1) + \dots + C(n, n) = 2^n$; at least one of n items: $2^n - 1$ ways
- $C(n, r) + C(n, r-1) = C(n+1, r)$
- n identical items to k people: $C(n+k-1, k-1)$; each gets at least one: $C(n-1, k-1)$
- n distinct items to k people: k^n
- Lines through n points (no 3 collinear): $C(n, 2)$; diagonals of an n -gon: $C(n, 2) - n$
- Triangles from n points with m collinear: $C(n, 3) - C(m, 3)$
- Must include k given items: choose the rest from the other $n-k$
- Split $2n$ people into n pairs: $(2n)!/(2^n \times n!)$
- Rectangles on a grid of m horizontal and n vertical lines: $C(m, 2) \times C(n, 2)$

60-SECOND SHORTCUT

Fix the must-haves first

Choose 3 of 10 people with two particular people always in: only one seat is open, so $C(8, 1) = 8$ ways.

DON'T MAKE THESE MISTAKES

- ✗ 10 identical sweets, 3 kids, each ≥ 1 : $C(12, 2)$
- ✓ $C(12, 2) = 66$ allows zeros; each ≥ 1 : $C(9, 2) = 36$
- ✗ A committee depends on the order you pick it
- ✓ Selection ignores order: use **C**, not **P**
- ✗ At least one of n items: n ways
- ✓ $2^n - 1$ non-empty selections

SOLVE THE REAL ONES

Official CAT questions on thinkcat.in

CAT 2025 Slot 1

Q8 · Moderate · MCQ

CAT 2024 Slot 1

Q12 · Moderate · MCQ

[Practise 90+ P&C questions with solutions](#)


TOPIC 47 · MODERN MATH 4 OF 5

NOT ASKED 2021-25

Probability

CAT questions from this topic, 2021-25

0

No probability question in CAT 2021-25. It stays on the syllabus and rests on the P&C counting CAT asks every year.

2021	2022	2023	2024	2025
0	0	0	0	0

CORE FORMULAS

- $P(E) = \text{favourable} \div \text{total equally likely outcomes}; 0 \leq P(E) \leq 1$
- $P(\text{not } E) = 1 - P(E); P(\text{at least one}) = 1 - P(\text{none})$
- $P(A \cup B) = P(A) + P(B) - P(A \cap B)$
- Independent events: $P(A \cap B) = P(A) \times P(B)$
- Mutually exclusive: $P(A \cap B) = 0$, so $P(A \cup B) = P(A) + P(B)$
- Conditional: $P(A | B) = P(A \cap B) \div P(B)$
- Bayes: $P(A | B) = P(B | A) \times P(A) \div P(B)$
- Exactly k successes in n tries: $C(n, k) \times p^k \times (1 - p)^{n-k}$
- Odds in favour $a : b \Rightarrow P = a / (a + b)$
- Two dice: 36 outcomes; a sum of 7 is the most likely (6 ways)

60-SECOND SHORTCUT

Go through the complement

At least one six in 3 throws: $1 - (5/6)^3$
 $= 1 - 125/216 = \mathbf{91/216}$.

DON'T MAKE THESE MISTAKES

- ✗ Mutually exclusive = independent
- ✓ Exclusive events with $P > 0$ are **never** independent
- ✗ At least one head in 3 tosses = $3 \times \frac{1}{2}$
- ✓ $1 - (\frac{1}{2})^3 = \mathbf{7/8}$
- ✗ Every sum of two dice is equally likely
- ✓ Sum 2: $1/36$; sum 7: $\mathbf{6/36}$

PRACTISE IT NOW

Worked solutions on thinkcat.in

Probability set

90+ practice questions

Modern Math PYQs

CAT 2017-25 papers

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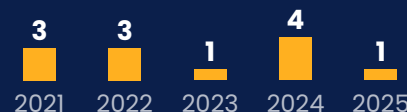
TOPIC 48 · MODERN MATH 5 OF 5 **MOST ASKED**

Counting or Probability?

12

CAT P&C questions, 2021–25

all P&C counting, 0 probability · 7 TITA


CORE FORMULAS

- 'How many ways' → counting. 'What is the chance' → favourable ÷ total, both counted the same way
- Order matters (ranks, seats, digits, codes)? Permutation. Only who is in (teams, committees)? Combination
- Identical items? Divide by the repeats' factorials, or use $C(n + k - 1, k - 1)$ to distribute
- Repetition allowed? Multiply the options for each place: n^r
- Round table or ring? $(n - 1)!$, and ÷ 2 if flipping gives the same arrangement
- 'At least one' or 'not all'? Count the complement and subtract
- Two-step tasks (pick a team, then seat it): C first, then P, and multiply
- Overlapping conditions ('A or B')? Inclusion-exclusion: $A + B - \text{both}$
- With replacement: multiply each draw's probability. Without: count with C, or multiply shrinking fractions

60-SECOND SHORTCUT
Name the task in one word

Before computing, say it: **arrange** (P), **choose** (C), **distribute** ($C(n + k - 1, k - 1)$) or **chance** (favourable ÷ total). Most P&C errors come from the wrong word.

DON'T MAKE THESE MISTAKES

- ✗ Choose 2 of 5 people for a team: $P(5, 2) = 20$
- ✓ A team has no order: **$C(5, 2) = 10$**
- ✗ $P(2 \text{ heads in } 2 \text{ tosses}) = 1/3$ (0, 1 or 2 heads)
- ✓ Those outcomes are not equally likely: **$1/4$**
- ✗ With replacement, count with $C(n, r)$
- ✓ Draws are independent: **multiply** the probabilities

PRACTISE IT NOW

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P&C PYQs

CAT 2017–25 papers

Modern Math set

360+ practice questions

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SCREENSHOT THIS PAGE

12× = asked 12 times in CAT 2021-25

The Modern Math Formula Wall

44 Set Theory

3×

p.2

- $n(A \cup B) = n(A) + n(B) - n(A \cap B)$
- 3 sets: $\Sigma A - \Sigma \text{pairs} + \text{all three}$
- Exactly two = $\Sigma \text{pairs} - 3 \times \text{all three}$
- Overlap $\geq n(A) + n(B) - n(U)$

46 Combinations

5×

p.4

- $C(n, r) = C(n, n - r)$
- Identical items to k people:
 $C(n + k - 1, k - 1)$
- At least one each: $C(n - 1, k - 1)$
- At least one item: $2^n - 1$

45 Permutations

7×

p.3

- $P(n, r) = n! / (n - r)!$
- Repeats: $n! / (p! q!)$
- Circular: $(n - 1)!$
- Sum of numbers: $(n - 1)! \times \Sigma \text{digits} \times 11...1$

47 Probability

0×

p.5

- At least one = $1 - P(\text{none})$
- Independent: multiply
- $P(A | B) = P(A \cap B) / P(B)$
- Binomial: $C(n, k) p^k (1 - p)^{n-k}$

48 Counting or Probability?

12×

p.6

- Arrange $\rightarrow P$ · Choose $\rightarrow C$
- Identical items $\rightarrow$ divide repeats or
 $C(n + k - 1, k - 1)$
- At least one $\rightarrow$ complement
- Chance = favourable $\div$ total

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