LF LearnFrenzy

QUANTITATIVE APTITUDE · FREE STUDY MATERIAL

Permutations and Combinations

Formulas & Shortcut Tricks

Every important formula, shortcut and exam trick for Permutations and Combinations in one place – with solved examples, common mistakes and a one-page revision sheet.

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USEFUL FOR

- Bank PO & Clerk (IBPS, SBI, RBI)
- SSC CGL / CHSL
- Railways (RRB NTPC)
- Campus placements (TCS, Infosys, Wipro, Accenture)
- UPSC CSAT & state PSC exams

Practise **Permutations and Combinations** free on LearnFrenzy – questions with instant explanations →

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1 Topic introduction

What it is, why it matters and how it is asked

Permutations count arrangements, where order matters; combinations count selections, where order does not. Choosing 3 people for a team is a combination; giving them the posts of captain, vice-captain and manager is a permutation.

Exams test letters of words, numbers formed from digits, people seated in a row or round a table, committees with conditions, handshakes and diagonals, points and triangles, routes on a grid and distributing objects among people.

Why it matters in exams

- Bank PO and placement papers ask 1–3 counting questions.
- Probability questions depend on counting.
- The answers are exact – one clear method gives full marks.

Where it is used

- Passwords, PINs and number plates.
- Seating plans, schedules and team selection.
- Routes, networks and tournament fixtures.

Common question patterns

Letters of a word
With repeats; vowels together or apart.

Numbers from digits
Even, divisible by 5, greater than a value.

Circular seating
Round tables and necklaces.

Committees
At least, at most, one person must or must not be in.

Geometry counts
Handshakes, diagonals, lines and triangles.

Grids
Shortest routes; rectangles and squares.

Distribution
Identical objects into groups.

Rank and derangements
Dictionary rank; letters in wrong envelopes.

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2 Important formulas

Cards marked MOST USED are the ones to revise first

Counting principles

Multiplication and addition rules

MOST USED

AND (one task after another) → multiply. OR (one task or the other) → add

Read the question for “and” and “or”.

EXAMPLE 3 shirts and 4 trousers → 3 × 4 = **12** outfits.

Factorial

$n! = n \times (n-1) \times \ldots \times 2 \times 1;\ 0! = 1$

n different things can be arranged in a row in n! ways.

EXAMPLE 5 books on a shelf → 5! = **120** ways.

Permutations (order matters)

Arranging r out of n

MOST USED

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

Filling r places in order from n different things.

EXAMPLE 8 runners, gold–silver–bronze → ${}^{8}P_{3} = 8 \times 7 \times 6 =$ **336**.

Repeated letters

MOST USED

$n!/(p!\,q!\,r!\,\ldots)$ for p alike, q alike, r alike …

Divide out the swaps of identical letters.

EXAMPLE LETTER (E ×2, T ×2) → $6!/(2!\,2!) =$ **180**.

Circular arrangements

MOST USED

n people round a table: $(n-1)!$. Necklace or garland: $(n-1)!/2$

Fix one person; a necklace can also be flipped over.

EXAMPLE 6 people round a table → 5! = **120**; 6 beads in a necklace → 60.

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Repetition allowed

r places, each from n choices → n^r

Each place is filled independently.

EXAMPLE 3-digit codes from 5 digits, repeats allowed → $5^3 = 125$.

Combinations (order does not matter)

Choosing r out of n

MOST USED

$^nC_r = n!/[r!\,(n-r)!]$; $^nC_r = {}^nC_{n-r}$

Choosing r is the same as leaving out n − r.

EXAMPLE 3 people from 10 → $^{10}C_3 = 120$.

Points, lines and polygons

Handshakes / lines: $^nC_2$. Diagonals: $n(n-3)/2$. Triangles: $^nC_3 - {}^mC_3$ (m collinear)

Collinear points cannot form a triangle.

EXAMPLE 10 points, 4 in a line → $120 - 4 = 116$ triangles.

Distributing identical objects

n identical into r groups: $^{n+r-1}C_{r-1}$; each group at least one: $^{n-1}C_{r-1}$

Stars and bars – place r − 1 dividers among the objects.

EXAMPLE 10 identical sweets to 4 children, each gets one or more → $^9C_3 = 84$.

Any number of selections

From n different things: 2^n subsets; at least one: $2^n - 1$

Each item is either taken or left.

EXAMPLE 5 different fruits, at least one → $2^5 - 1 = 31$.

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3 Shortcut tricks & smart techniques

Each trick says when to use it – that matters as much as the trick

Block method (always together)

MOST USED

USE WHEN Some items must stay together.

1. Tie them into one block and arrange the blocks.
2. Multiply by the arrangements inside the block.

EXAMPLE MOTHER with O, E together → 5! × 2! = **240**.

Gap method (never together)

MOST USED

USE WHEN No two of some items may be side by side.

1. Arrange the other items first.
2. Place the restricted items in the gaps between them.

EXAMPLE 4 boys, 3 girls, no two girls together → $4! \times {}^{5}P_{3} = 24 \times 60 = \mathbf{1{,}440}$.

Grids

USE WHEN Shortest routes; rectangles on a grid or chessboard.

1. Routes: m steps right, n steps up → $(m + n)!/(m!\ n!)$.
2. Rectangles on an m × n grid: ${}^{m+1}C_{2} \times {}^{n+1}C_{2}$; chessboard 36 × 36 = 1,296.

EXAMPLE 4 right and 3 up → $7!/(4!\ 3!) = \mathbf{35}$ routes.

Derangements (all in wrong places)

USE WHEN Letters in envelopes, hats returned so that nobody gets their own.

n	1	2	3	4	5	6
D_n	0	1	2	9	44	265

EXAMPLE 4 letters, 4 envelopes, all wrong → **9** ways.

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4 Solved examples

The full method on the left, the exam shortcut on the right

1 REPEATED LETTERS

In how many ways can the letters of the word BANANA be arranged?

STEP BY STEP

1. 6 letters: A ×3, N ×2, B ×1.
2. Ways = 6!/(3! × 2!) = 720/12 = 60.

SHORTCUT

${}^{6}C_{3}$ for A's × ${}^{3}C_{2}$ for N's = 20 × 3.

Why it works: Trap: 720 – not dividing for repeated letters.

Answer: 60

2 VOWELS TOGETHER

In how many ways can the letters of EQUATION be arranged so that all the vowels come together?

STEP BY STEP

1. Vowels E, U, A, I, O → one block.
2. Block + Q, T, N = 4 units → 4! = 24.
3. Inside the block: 5! = 120.
4. Ways = 24 × 120 = 2,880.

SHORTCUT

4! × 5!.

Why it works: Trap: 24 – forgetting the arrangements inside the block.

Answer: 2,880

3 NEVER TOGETHER

In how many ways can the letters of PENCIL be arranged so that E and I are never together?

STEP BY STEP

1. All arrangements = 6! = 720.
2. E and I together = 5! × 2! = 240.
3. Never together = 720 – 240 = 480.

SHORTCUT

Total – together.

Why it works: With two letters, subtracting is quicker than gaps.

Answer: 480

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4 NUMBERS

How many 4-digit even numbers can be formed from the digits 0, 1, 2, 3, 4, 5 if no digit is repeated?

STEP BY STEP

1. Ending in 0: remaining 3 places from 5 digits → ${}^5P_3 = 60$.
2. Ending in 2 or 4: first digit 4 choices (not 0, not the last), middle ${}^4P_2 = 12$ → $2 \times 4 \times 12 = 96$.
3. Total = 60 + 96 = 156.

SHORTCUT

Split by the last digit: 0 or not 0.

Why it works: Trap: letting 0 lead the number.

Answer: 156

5 COMMITTEE

A committee of 4 is chosen from 5 men and 4 women. In how many ways can it have at least 2 women?

STEP BY STEP

1. 2 women, 2 men: ${}^4C_2 \times {}^5C_2 = 60$.
2. 3 women, 1 man: ${}^4C_3 \times {}^5C_1 = 20$.
3. 4 women: ${}^4C_4 = 1$.
4. Total = 81.

SHORTCUT

Total ${}^9C_4 = 126$ minus (0 or 1 woman: 5 + 40) = 81.

Why it works: "At least" → add the cases, or subtract the rest.

Answer: 81

6 CIRCULAR

In how many ways can 5 men and 5 women sit round a table so that men and women sit alternately?

STEP BY STEP

1. Seat the men round the table: $(5 - 1)! = 24$.
2. This fixes 5 gaps; seat the women: $5! = 120$.
3. Ways = $24 \times 120 = 2{,}880$.

SHORTCUT

$4! \times 5!$.

Why it works: Once the men are seated, the seats for women are distinct.

Answer: 2,880

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7 HANDSHAKES

At a meeting every person shook hands once with every other person. There were 66 handshakes. How many people attended?

STEP BY STEP

1. $n(n-1)/2 = 66$.
2. $n(n-1) = 132 = 12 \times 11$.
3. $n = 12$.

SHORTCUT

Find two consecutive numbers whose product is 132.

Why it works: Each handshake is a pair – ${}^{n}C_{2}$.

Answer: 12

8 DISTRIBUTION

In how many ways can 12 identical balls be put into 3 different boxes if a box may be empty?

STEP BY STEP

1. Stars and bars: 12 balls and 2 dividers.
2. Ways = ${}^{14}C_{2} = 91$.

SHORTCUT

${}^{n+r-1}C_{r-1} = {}^{14}C_{2}$.

Why it works: Identical balls → only the counts in each box matter.

Answer: 91

9 DICTIONARY RANK

The letters of SMILE are arranged in all ways and listed as in a dictionary. What is the rank of SMILE?

STEP BY STEP

1. Alphabetical order: E, I, L, M, S.
2. Words before S: $4 \times 4! = 96$.
3. S then E, I, L before M: $3 \times 3! = 18$.
4. SM then E before I: $1 \times 2! = 2$.
5. SMI then E before L: $1 \times 1! = 1$.
6. Rank = 96 + 18 + 2 + 1 + 1 = 118.

SHORTCUT

For each letter: smaller letters to its right × factorial of places left.

Why it works: Trap: forgetting the final +1 for SMILE itself.

Answer: 118

10 GRID ROUTE

On a street grid, a person must go 5 blocks east and 3 blocks north. How many shortest routes are there?

STEP BY STEP

1. Any shortest route is 8 moves: 5 E and 3 N.
2. Choose the places of the 3 N moves: ${}^{8}C_{3} = 56$.

SHORTCUT

$8!/(5!\,3!) = 56$.

Why it works: A route is an arrangement of E's and N's.

Answer: 56

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5 Important exam tips

Patterns, traps and habits that save marks

Frequently asked question patterns

- Letters of a word with conditions.
- Numbers formed from given digits.
- Circular seating and necklaces.
- Committees with “at least” conditions.
- Handshakes, diagonals and triangles.
- Grid routes and distribution.
- Dictionary rank and derangements.

Common mistakes to avoid

- Arranging (P) when the question only asks to choose (C).
- Not dividing for repeated letters.
- Forgetting arrangements inside a block.
- Counting a circle like a row.
- Letting 0 be the first digit.
- Double-counting in “at least” cases.

Points to remember

- $0! = 1$.
- ${}^{n}P_{r} = {}^{n}C_{r} \times r!$.
- Circle: $(n - 1)!$.
- Diagonals: $n(n - 3)/2$.
- Subsets: 2^{n}.

Speed and accuracy

- Ask: does order matter?
- Use “total – unwanted” for “at least one” and “never together”.
- Handle restricted places first (first digit, last digit).
- Learn factorials up to 8!.

Preparation strategy

- Decide P or C before writing any number.
- Practise on LearnFrenzy in order: Easy → Medium → Hard → Exam Pattern Mix → Data Sufficiency.
- Aim for 45–60 seconds per question.
- Then move to Probability – it uses the same counts.
- Read the Quick Revision Sheet (next page) the night before the exam.

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6 Quick revision sheet

Everything on one page for the night before the exam

Formulas

Arrange all n	$n!$	Arrange r of n	$n!/(n-r)!$
Choose r of n	$n!/[r!(n-r)!]$	Repeated letters	$n!/(p!\,q!\,\ldots)$
Round a table	$(n-1)!$	Necklace	$(n-1)!/2$
With repetition	n^r	Handshakes	$n(n-1)/2$
Diagonals	$n(n-3)/2$	Triangles (m collinear)	${}^{n}C_3 - {}^{m}C_3$
Identical into r groups	${}^{n+r-1}C_{r-1}$	Each group ≥ 1	${}^{n-1}C_{r-1}$
Subsets	2^n; at least one $2^n - 1$	Grid routes	$(m+n)!/(m!\,n!)$

Shortcut tricks

- Together → block × inside.
- Never together → gaps or total − together.
- Even numbers → split by last digit.
- At least → total − none.
- Rank → smaller letters × factorial.
- Derangements: 0, 1, 2, 9, 44.

Must-know numbers

Factorials	$3!$ 6 · $4!$ 24 · $5!$ 120 · $6!$ 720 · $7!$ 5,040 · $8!$ 40,320
Common nCr	${}^{5}C_2$ 10 · ${}^{6}C_2$ 15 · ${}^{6}C_3$ 20 · ${}^{7}C_3$ 35 · ${}^{8}C_3$ 56 · ${}^{10}C_3$ 120

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7 A message from LearnFrenzy

For everyone preparing for placements, competitive and government exams

Keep going – you are closer than you think

Success in examinations is not just about how many hours you study. It is about how effectively you understand concepts, practise questions, and improve yourself every day.

Every formula you learn, every problem you solve, and every mistake you correct brings you one step closer to your goal.

Whether you are preparing for campus placements, competitive examinations, or government jobs, remember that consistency, confidence, and smart preparation make a real difference.

Don’t just memorize formulas. Understand the concepts, practise smart techniques, and develop the confidence to solve problems independently.

Your hard work today can create the opportunities you dream of tomorrow.

— Team LearnFrenzy

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