6. Permutation & Combination

Basic Difference

(A) Permutation	(B) Combination
- Arrangement - Order Matters	- Selection, Group - Order doesn't matter
Types of Questions asked :- Arrangement of things, Standing in a row, sitting on a chair, word formation, Digit formation, Round table arrangement, etc.	Types of questions asked :- Selecting, Collecting, Grouping, Committee making, Geometrical Problems, etc
E.g :- In how many ways 1st & 2nd price be given out of 7 persons participating in quiz?	E.g :- In how many ways, we can select 2 persons from a group of 7 persons.

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(A) Permutations

(i) Fundamental Principal of Counting :-

OR → Add
And → Multiply

Addition	Multiplication
- If 2 things are performed independently in 'm' and 'n' ways respectively, then - Total = (m+n) ways	- If an event can occur in 'm' different ways, following which another one can occur in 'n' & 'p' different ways, then - Total = (m x n x p) ways

(ii) Factorial Notations :-

- The product of first 'n' natural no's is n! or $\lfloor n$.
- Remember :-

$n! = n(n-1)!$

0!	1
1!	1
2!	2
3!	6
4!	24
5!	120

6!	720
7!	5040
8!	40320
9!	362880
10!	3628800

(iii) Permutations :-

- n = no. of objects
- r = no. of places

Permutations of 'n' different objects taken 'r' at a time, when :-

(a) Repetition is allowed (All objects are repeated) :-

$\therefore {}^nP_r = n^r$

(b) Repetition not allowed :-

$\therefore {}^nP_r = \frac{n!}{(n-r)!}$ - (Here, $r \leq n$)

iv) Permutation with repetition (Not all, but some obj's are repeated / alike)

- If there are 'n' objects, not all distinct but in which 'm' objects are of one type and 'p' objects are of second type.

∴ No of Permutations = $\frac{n!}{m! \times p!}$

For E.g:- GREEN

Total letters = 5

E is repeated 2 times,

∴ $\frac{5!}{2!}$

(v) Circular Permutations:-

- No. of permutations of 'n' distnct objects to be arranged in a circular table =

∴ (n-1)! ways.

- If Anti-Clockwise / Clockwise order are not distinct, then

∴ No. of permutations = $\frac{(n-1)!}{2}$ ways

(B) Combination

- Selecting 'r' things from 'n' distinct objects at a time, then

$\therefore$ No. of ways $= \frac{n!}{r!(n-r)!}$

- **Properties** of Combination :-

(i)	(ii)
${}^nC_x = {}^nC_y$ $\therefore x = y$ **or** $x + y = n$	${}^nC_r + {}^nC_{r-1} = {}^{(n+1)}C_r$

- **To find diff betw largest values** :-

(i) If 'n' is even :-

Max value of ${}^nC_r$ occurs at $r = \frac{n}{2}$

(ii) If 'n' is odd :-

Max value of ${}^nC_r$ occurs at $r = \frac{(n-1)}{2}$ or $\frac{(n+1)}{2}$

Imp formula for Combinations :- (Word Problems)

① Point of intersection of 'n' lines (Non-parallel / Non-concurrent)

$= {}^nC_2$ [Also Applicable for finding no. of straight line, if two points are collinear]

② No. of Straight lines, if 'm' are collinear out of 'n' points

$= {}^nC_2 - {}^mC_2 + 1$

③ Total no. of diagonals in a polygon out of 'n' points

$= {}^nC_2 - n$

No. of Triangles formed from 'n' points,

$= {}^{n}C_3$

(5) No. of Triangles formed from 'n' points, in which 'm' are collinear, ~~then~~

$= {}^{n}C_3 - {}^{m}C_3$