

21/1/2025

## 16. Permutation &amp; combination

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- Permutation (Arrangement  $\rightarrow$ )

$$n_{P_r} = \frac{n!}{(n-r)!}$$

Imp	$n_{P_0} = 1$
	$n_{P_1} = n$
	$n_{P_n} = n!$

- Combination (group  $\rightarrow$ )

$$n_{C_r} = \frac{n!}{(n-r)! \times r!}$$

Imp	$n_{C_0} = 1$
	$n_{C_1} = n$
	$n_{C_n} = 1$

permutation :-

$$n! \Rightarrow n \times (n-1) \times (n-2) \times \dots \times 3 \times 2 \times 1$$

$$5! \Rightarrow 5 \times 4 \times 3 \times 2 \times 1$$

$$5! = 5 \times 4!$$

$$n_{P_r} = \frac{n!}{(n-r)!}$$

$$7_{P_4} \Rightarrow \frac{7!}{3!} = \frac{7 \times 6 \times 5 \times 4 \times 3!}{3!} = \frac{7 \times 6 \times 5 \times 4}{1} = 840$$

tricks  
Pasun

$$5_{P_2} = 5 \times 4$$

3 nos.  
multiply  
 $\rightarrow 11_{P_3} = 11 \times 10 \times 9$

$$15_{P_5} = 15 \times 14 \times 13 \times 12 \times 11$$

~~(X)~~  $\rightarrow$  Remember:  $0! = 1$      $3! = 6$      $6! = 720$

$1! = 1$	$4! = 24$	$7! = 5040$
$2! = 2$	$5! = 120$	$8! = 403200$

Combination :-

group, team, Committee Selection

$$nC_r = \frac{n!}{(n-r)!r!}$$

Imp Property

$$nC_r = rC_{(n-r)}$$

$$12C_9 = \frac{12!}{3! \times 9!}$$

$$12C_9 = \frac{12!}{(12-9)!} = \frac{12!}{3!}$$

$$12C_3 = \frac{12!}{9! \times 3!}$$

Imp  $15 \text{ अंकों } 4 \text{ numbers}$   
multiply  $\rightarrow 15C_4 = \frac{15 \times 14 \times 13 \times 12}{4 \times 3 \times 2 \times 1}$

4 अंकों 1 परिणाम

$$11C_3 = \frac{11 \times 10 \times 9}{3 \times 2 \times 1}$$

Imp

and  $\rightarrow \times$ or  $\rightarrow \oplus$ 

- 1) From a group of 7 men and 6 women, five persons are to be selected to form a committee so that at least 3 men are there on the committee. In how many ways can it be done?



S

$$7m \quad 6w = 7C_3 \times 6C_2 + 7C_4 \times 6C_1 + 7C_5 \times 6C_0$$

or 3 &amp; 2

or 4 &amp; 1

or 5 &amp; 0

$$= \frac{7 \times 6 \times 5}{3 \times 2 \times 1} + \frac{6 \times 5}{2 \times 1} + \frac{7 \times 6 \times 5 \times 4}{4 \times 3 \times 2 \times 1} + 1 + \frac{7 \times 6 \times 5 \times 4 \times 3}{5 \times 4 \times 3 \times 2 \times 1}$$

 $\times 61$ 

$$= 35 \times 15 + 35 \times 6 + 21 \times 1$$

$$= 525 + 210 + 21$$

 $\boxed{756}$

2) In how many different ways can the letters of the word 'LEADING' be arranged in such a way that the vowels always come together?



### LEADING

$$5P_5 = 5!$$

$$(EAI) \quad L, D, N, G$$

1.    2    3    4    5

$$\Rightarrow 5! \times 3! \Rightarrow 120 \times 6 = 720$$

3) In how many different ways can the letters of the word 'CORPORATION' be arranged so that the vowels always come together?



$$(OOOAI) \quad C, R, P, R, T, N$$

1    2    3    4    5    6    7

12 letters  
repeat 3 times  
पुनरावृत्ति वाली अक्षर  
पुनरावृत्ति वाली अक्षर  
Factorial से divide  
 $\frac{12!}{3!}$

$$\frac{7!}{2!} \times \frac{5!}{3!} \Rightarrow \frac{5040}{2} \times \frac{120}{6} = 50400$$

4) Out of 7 consonants and 4 vowels, how many words of 3 consonants and 2 vowels can be formed?



$$7C_3 \quad 4V$$

$$3 \quad & \quad 2$$

$$7C_3 \times 4C_2 = \frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times \frac{2 \times 1}{2 \times 1}$$

$$35 \times 2 = 70 \leftarrow \text{selection}$$

$$= 70 \times 5! = 70 \times 120$$

$$= 8400 \leftarrow$$

Q) In how many ways can the letters of the word 'LEADER' be arranged?

$$\Rightarrow \text{LEADER} \quad \text{E - Repeat 2 times}$$

$\frac{6!}{2!} = \frac{720}{2} = \boxed{360}$

6) In a group of 6 boys and 4 girls, four children are to be selected. In how many different ways can they be selected such that at least one boy should be there?

$$\Rightarrow \begin{array}{ccc} 6B & 4G \\ 4 \rightarrow & & \\ \text{or } 1 & \& 3 \\ & 2 & \& 3 \\ \text{or } 3 & \& 1 \\ \text{or } 4 & \& 0 \end{array} \quad \boxed{\begin{aligned} & [{}^6C_1 \times {}^4C_3 + {}^6C_2 \times {}^4C_2 + {}^6C_3 \times {}^4C_1 + {}^6C_4 \times {}^4C_0] \\ & \text{Find these value get ans.} \end{aligned}}$$

$$\begin{aligned}
 (\text{At least 1 Boy}) &= \text{Total} - \text{None(boy)} \quad \leftarrow \text{only for at least } 1 \\
 &= {}^5C_4 - {}^4C_4 \\
 \Rightarrow \frac{{}^5C_3 \times {}^2C_2}{4 \times 3 \times 2 \times 1} - 1 &\quad \boxed{h_{Cn=1}} \\
 &= 210 - 4 \\
 &\quad \boxed{209}
 \end{aligned}$$

7) How many 3-digit numbers can be formed from the digits 2, 3, 5, 6, 7, and 9, which are divisible by 5 and none of the digits is repeated?

$\Rightarrow$  No repetition  $\rightarrow \frac{5 \times 4 \times 1}{ways} = 20$  ✓  
 last digit is 5 then divisible by 5

$$\text{Repn} \Rightarrow \frac{5 \times 5 \times 1}{5!} = \underline{\underline{25}}$$

8) In how many ways a committee consisting of 5 men and 6 women can be formed from 8 men and 10 women?

$\Rightarrow$

Combination

8 m      10 w

↓            ↓  
5            &     6

$$\begin{aligned}
 &= \frac{8}{\cancel{2}} \times \frac{7}{\cancel{2}} \times \frac{6}{\cancel{2}} \times \frac{5}{\cancel{2}} \times \frac{4}{\cancel{2}} \times \frac{10}{\cancel{5}} \times \frac{9}{\cancel{3}} \times \frac{8}{\cancel{2}} \times \frac{7}{\cancel{1}} \times \frac{6}{\cancel{1}} \times \frac{5}{\cancel{1}} \times \frac{4}{\cancel{1}} \times \frac{3}{\cancel{1}} \times \frac{2}{\cancel{1}} \times \frac{1}{\cancel{1}} \\
 &= \cancel{10 \times 9 \times 8 \times 7 \times 6 \times 5} \times \frac{56 \times 210}{5 \times 4 \times 3 \times 2 \times 1} \\
 &= \cancel{10 \times 9 \times 8 \times 7 \times 6 \times 5} \times \frac{56 \times 210}{5 \times 4 \times 3 \times 2 \times 1} \\
 &= 56 \times 210 \\
 &= \boxed{11760}
 \end{aligned}$$

9) A box contains 2 white balls, 3 black balls, and 4 red balls. In how many ways can 3 balls be drawn from the box, if at least one black ball is to be included in the draw?

$\Rightarrow$

2 W, 3 B, 4 R

atleast 1 =

3 →

(Atleast 1) = Total - None (black)

$$\rightarrow 9C_3 - 6C_3$$

$$\frac{9 \times 8 \times 7}{3 \times 2 \times 1} - \frac{6 \times 5 \times 4}{3 \times 2 \times 1}$$

$$= 84 - 20 = \boxed{64}$$

Q) In how many different ways can the letters of the word 'DETAIL' be arranged in such a way that the vowels occupy only the odd positions?

⇒ Arrang. permutation

D E T A I L  
1 2 3 4 5 6

V → (EAI) → 3 ← odd positions

$3P_3 \times 3P_3$  ← remaining positions

$$3! \times 3! = 6 \times 6 = [36] \checkmark$$

II) In how many ways can a group of 5 men and 2 women be made out of a total of 7 men and 3 women?

⇒

7 M      3 W  
↑            ↑  
5      &      2

$$= {}^7C_5 \times {}^3C_2 =$$

$$= \frac{7 \times 6 \times 5 \times 4 \times 3}{5 \times 4 \times 3 \times 2 \times 1} \times \frac{3 \times 2}{2 \times 1}$$

$$= 21 \times 3 = [63] \checkmark$$

Q) How many 4-letter words with or without meaning can be formed out of the letters of the word, 'LOGARITHMS'. if repetition of letters is not allowed?

⇒

10 choose  
g choice 1 2 3 4 5 6 7 8 9

L O G A R I H M S

$$\begin{matrix} 10 & \times & 9 & \times & 8 & \times & 7 \\ \swarrow & & \nearrow & & \nearrow & & \leftarrow 7 \text{ choice} \\ 8 \text{ choice} & & & & & & \end{matrix} = [5040] \checkmark$$

$$1^{\circ} P_4 = 10 \times 9 \times 8 \times 7$$

$$= [5040] \checkmark$$

(B) In how many different ways can the letters of the word 'MATHEMATICS' be arranged so that the vowels always come together?



MATHEMATICS  
1 2 3 4 5 6 7 8 9 10 11

AAEI, M, T, H, M, T, C, S  
1 2 3 4 5 6 7 8

$$\frac{8!}{2! \times 2!} \times \frac{4!}{2!} = \frac{8!}{A \text{ repeat}} \times 7! \times 4!$$

$$= 5040 \times 24$$

$$= \boxed{120960}$$

(4) In how many different ways can the letters of the word 'OPTICAL' be arranged so that the vowels always come together?



OPTICAL  
1 2 3 4 5 6 7

OIA, P, T, C, L  
1 2 3 4 5

$$5! \times 3! = 120 \times 6$$

$$= \boxed{720}$$

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- 1) In how many different ways can the letters of the word "TABLE" be arranged?

⇒

T A B L E  
1 2 3 4 5

$$S_{P_5} = 5! \Rightarrow [120] \checkmark$$

- 2) In how many different ways can the letters of the word "MATHEMATICS" be arranged?

⇒

M A T H E M A T I C S  
1 2 3 4 5 6 7 8 9 10 11

$$\frac{11!}{2! \times 2! \times 2!} = \boxed{\frac{11!}{8}} \checkmark$$

m repeat A repeat T repeat

- 3) In how many ways can 6 letters be posted in 5 letter boxes available in the locality?

⇒

Box → □ □ □ □ □

$$\text{choices} \rightarrow 5 \times 5 \times 5 \times 5 \times 5 \times 5 = [5^6] \checkmark$$

- 4) How many 3-digit numbers are there, with distinct digits, with each digit odd?

⇒

[1, 3, 5, 7, 9]

$$\text{No Repetition } \underline{5 \times 4 \times 3} \Rightarrow [60] \checkmark$$

$$\text{With Repetition } \underline{5 \times 5 \times 5} \Rightarrow 125$$

5) In how many ways can the letters of the word 'UNIVERSAL' be arranged when E, R, S are always together?

⇒

UNIVERSAL  
1 2 3 4 5 6 7 8 9

(ERS), U, N, I, V, A, L  
1 2 3 4 5 6 7

$$7! \times 3! = 5040 \times 6$$

$$= 30240 \checkmark$$

\* 6) In how many ways can the letters of the word 'ALGEBRA' be arranged when both A do not come together?

⇒

ALGEBRA  
1 2 3 4 5 6 7

(AA) L, G, E, B, R  
1 2 3 4 5 6

$$\text{Total} = \frac{7!}{2!} = \frac{5040}{2} \rightarrow 2520 \checkmark$$

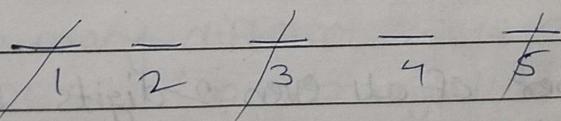
A repeat  $\Rightarrow$  A together  $= \frac{6! \times 2!}{2!} = 720$

$$(\text{Total} - \text{A together}) = 2520 - 720 = 1800 \checkmark \text{ Ans}$$

7) In how many ways can the letters of the word 'NUTAN' be arranged when consonants occupy odd places and vowels come on even places?

⇒

NUTAN  
consonant (NTN)      vowels (TUA)  
odd                          even



$$\frac{3! \times 2!}{2!} = \frac{3!}{1!} = 6$$

Odd consonant    Even vowel  
repeat              vowel

8) There are seven candidates for 3 posts. In how many ways can the posts be filled?

$\Rightarrow$  (7)

$$\underline{7} \times \underline{6} \times \underline{5} \Rightarrow (210) \swarrow$$

9) How many 3-digits numbers can be formed using 0, 2, 3, 5, 7 when repetition is allowed?

$\Rightarrow 0, 2, 3, 5, 7$

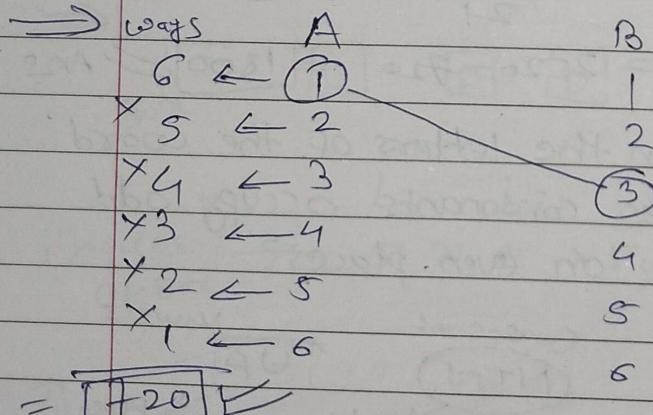
Repetition  $\Rightarrow \underline{5} \times \underline{5} \times \underline{5} \Rightarrow (125) \swarrow$

0 not allowed

in first

position because if 0 in 1st position then number is 2 digits

10) There are 6 items in column A and 6 items in column B. A student is asked to match each item in column A with an item in column B. How many possible (correct or incorrect) answers are there to this question?



$$6! = 720 \swarrow$$

11) Find the number of all even 2-digits numbers, not having 0 at the unit's place?

$\Rightarrow$

$$\boxed{1-9} \quad \boxed{2, 4, 6, 8}$$

$$9 \times 4 = (36) \swarrow$$

12) How many 3-digit numbers are there with no digit repeated?

$$\Rightarrow \boxed{10-9}$$

~~no repetition~~  $\rightarrow 9 \times 9 \times 8 = \textcircled{648} \checkmark$

○ not for these position

13) How many 2-digit numbers are there with distinct digits?

$$\Rightarrow \boxed{10-9}$$

no repetition

$$\rightarrow 9 \times 9 = \textcircled{81} \checkmark$$

○ not for these position

14) How many 4-digit numbers are there with distinct digits?

$$\Rightarrow \boxed{10-9}$$

~~distinct  
no repetition~~  $\rightarrow 9 \times 9 \times 8 \times 7 = \textcircled{4536} \checkmark$

○ not for these Position

15) In how many different ways can the letters of the word 'DETAIL' be arranged in such a way that the vowels occupy only the odd positions?

$$\Rightarrow \text{D E T A I L} \quad (\text{EAT})$$

~~1 2 3 4 5 6~~

$$3! \times 3! = 6 \times 6 = \textcircled{36} \checkmark$$

~~moderate~~

16)

How many 3-digit even numbers can be formed using 0, 2, 3, 5, 7 when repetition is not allowed?

$\Rightarrow 0, 2, 3, 5, 7$

$$\cancel{2} \times \cancel{2} \times \cancel{5} \Rightarrow \cancel{12}$$

~~(1)~~

$$4 \times 3 \times \frac{1}{(0)} = 12$$

+

~~(4215)~~

$$\cancel{3} \times \cancel{3} \times \frac{1}{(2)} = \cancel{9} \quad (12+9) = \cancel{21}$$

~~(12+9)~~

17) There are 6 multiple choice questions in an examination. How many sequences of answers are possible, if the first three questions have 4 choice each and the next three have 5 each?

 $\Rightarrow$ 

$$\begin{array}{c} 4 \text{ choice} \quad 5 \text{ choice} \\ \boxed{\phantom{0}} \quad \boxed{\phantom{00}} \\ \hline 4 \times 4 \times 4 \times 5 \times 5 \times 5 \end{array}$$

$$64 \times 125 = \underline{\underline{8000}}$$

18) From a group of 7 men and 6 women, five persons are to be selected to form a Committee so that at least 3 men are there in the Committee. In how many ways can it be done?

 $\Rightarrow$ 

7M 6W  
 $\rightarrow 3 \text{ & } 2$

or  
 $4 \text{ & } 1$

or  
 $5 \text{ & } 0$

$$7C_3 \times 6C_2 + 7C_4 \times 6C_1 + 7C_5 \times 6C_0$$

$$= \frac{7 \times 6 \times 5}{3 \times 2 \times 1} \times \frac{2 \times 1}{2 \times 1} + \frac{7 \times 6 \times 5 \times 4}{4 \times 3 \times 2 \times 1} \times \frac{6}{1} + \frac{7 \times 6 \times 5 \times 4 \times 3}{5 \times 4 \times 3 \times 2 \times 1} \times 1$$

$$= 35 \times 15 + 35 \times 6 + 21 \times 1$$

$$= 525 + 210 + 21$$

$$= \underline{\underline{756}}$$

19) In how many different ways can the letters of the word 'LEADING' be arranged in such a way that the vowels always come together?



LEADING  
1 2 3 4 5 6 7

(EAD) L, D, N, G  
1 2 3 4 5

$$5! \times 3! = 120 \times 6$$

= 720

20) How many different four letter words can be formed (the words need not be meaningful) using the letters of the word "MEDITERRANEAN" such that the first letter is E and the last letter is R?



M E D I T E R R A N E A N

<sup>different</sup>  
letter

M D I T (EE) R (AA) (NN)

$$\frac{1}{\cancel{E}} \times \frac{8}{\cancel{E}} \times \frac{7}{\cancel{A}} \frac{1}{\cancel{R}} \Rightarrow \boxed{\cancel{120}} / \boxed{56}$$

Same choice

$$\frac{1}{\cancel{A}} \times \frac{3}{\cancel{E}} \times \frac{1}{\cancel{R}} \times \frac{1}{\cancel{N}} \Rightarrow 3$$

(A) A  
(E) E  
(R) R  
(N) N

~~120 + 3~~

~~= 123~~

56 + 3

~~- (59) ←~~

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- Q1 There are 6 men and 8 women in a club in which a committee of 5 people has to be made. What will be the number of ways to select 5 people if:

- i) 2 men and 3 women are selected

$$\begin{matrix} 6m & 8w \\ \downarrow & \downarrow \\ 2 & 3 \end{matrix}$$

$$6C_2 \times 8C_3$$

$$\frac{3}{6} \times \frac{2}{5} \times \frac{1}{4} \times \frac{0}{3} \times \frac{2}{2}$$

$$15 \times 56 = 840 \checkmark$$

- ii) Only men are selected

$$\begin{matrix} 6m \\ \downarrow \\ 5 \end{matrix} \quad 6C_5 = \frac{6 \times 5 \times 4 \times 3 \times 2}{5 \times 4 \times 3 \times 2 \times 1}$$

$$= 6 \checkmark$$

- iii) At least one woman is selected

$$\begin{matrix} 6m & 8w \\ \text{or } 4 & \& 1 \\ \text{or } 3 & \& 2 \\ \text{or } 2 & \& 3 \\ \text{or } 1 & \& 4 \\ \text{or } 0 & \& 5 \end{matrix}$$

At least 1 = Total - none

$$= 14C_5 - 6C_5$$

$$= \frac{7 \times 6 \times 5 \times 4 \times 3}{5 \times 4 \times 3 \times 2 \times 1} - 6$$

$$= 182 \times 11 - 6$$

$$= 2002 - 6$$

$$= 1996 \checkmark$$

Q) Almost one man is selected:-

$$5 \rightarrow \begin{matrix} 6m & 8w \\ 1 & 4 \\ 0 & 5 \end{matrix}$$

$$= 6C_1 \times 8C_4 + 6C_0 \times 8C_5$$

$$= 6 \times \frac{8 \times 7 \times 6 \times 5}{4 \times 3 \times 2 \times 1} + 1 \times \frac{8 \times 7 \times 6 \times 5 \times 4}{8 \times 7 \times 6 \times 5 \times 4}$$

$$= 6 \times 70 + 1 \times 56$$

$$= \underline{\underline{476}}$$