Combinatorics

① India and Pakistan play a 3-match series. How many results are possible? Note that we consider (Ind, Ind, Pak) different from (Ind, Pak, Ind) etc.

Click on an option to submit your answer

A	6
B	9
C	8
D	4

② India, South Africa, Australia & England are playing a series of 10 matches. How many outcomes of these matches are possible?

$$4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 \times 4 = 4^{10}$$

$$\frac{I|P}{\downarrow} \quad \frac{I|P}{\downarrow} \quad \frac{I|P}{\downarrow}$$
$$(2) \times (2) \times (2) = 8$$

Product Rule: If a task 'T' can be divided into 'n' subtasks t1, t2, ..., tn and n(t1) is the number of ways to do t1, n(t2) is number of ways to do t2, ... , n(tn) is number of ways to do tn and, to perform 'T' it is necessary to perform all t1, t2, ..., tn then the number of ways to perform T is:
n(T) = n(t1) * n(t2) * .... * n(tn)

In a bowl-out, for a specific ball you have to choose a bowler and a wicket keeper. Suppose you have 5 bowlers and 3 wicket keepers. How many ways can you select for a ball?

Click on an option to submit your answer

A	8
B	125
C	243
D	15
E	2

$$\frac{b}{\downarrow} \quad \frac{w}{\downarrow}$$
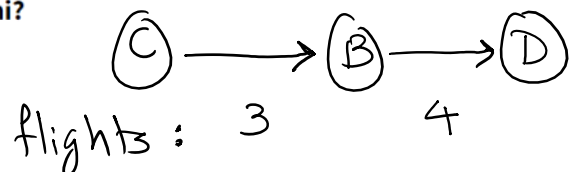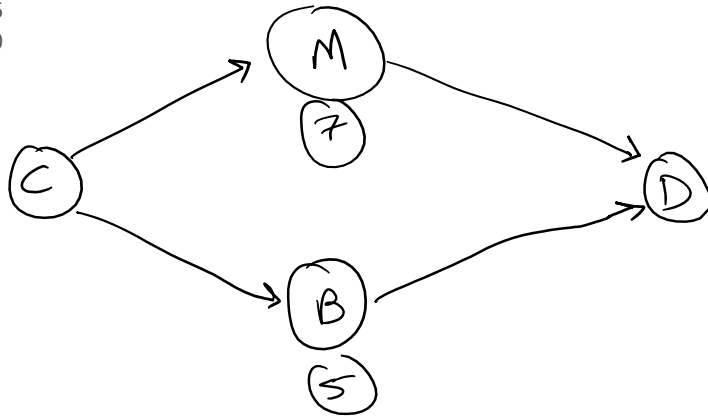$$(5) \times (3) = 15$$

Chennai to Delhi I:

There are 3 ways to move from Chennai to Bangalore.
There are 4 ways to move from Bangalore to Delhi.
What are the total ways of moving from Chennai to Delhi?

Click on an option to submit your answer

A	7
B	12
C	81
D	64

$$(C) \longrightarrow (B) \longrightarrow (D)$$

flights :   3   4

To go from (C) to (D) we need to select both flights from (C) to (B) & (B) to (D)

∴ Product Rule. ans = 3 × 4 = 12

Chennai to Delhi II:

To reach Delhi from Chennai one can go either via Bangalore or via Mumbai. There are 5 flights that go via Bangalore and 7 flights via Mumbai. Total how many combinations of flights a person can have to go to Delhi from Chennai?

A. 35
B. 12
C. 25
D. 10

Chennai to Delhi III:

There are 3 ways to move from Chennai to Bangalore, and 4 ways to move from Bangalore to Delhi.
There are 2 ways to move from Chennai to Hyderabad, and 3 ways to move from Hyderabad to Delhi.
In how many ways can we move from Chennai to Delhi?

Click on an option to submit your answer

A	12
B	6
C	72
D	18
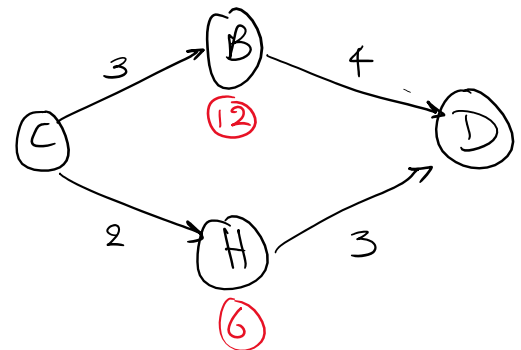
ans = 12 + 6 = 18

Hotel Menu:

Menu has following items:

```
Burgers: 3
Pizza: 3
Drinks: 3
Sandwiches: 5
Fruits: 7
```

You can buy one of the following combos:

- 1 Burger & 1 Sandwich → *3 × 5 = 15*
- 1 Fruit & 1 drink → *7 × 3 = 21*
- 1 Pizza → *3 × 1 = 3*

39

How many ways can we have combos?

Click on an option to submit your answer

A	21

A	21
B	945
C	39
D	30

Permutations & Combinations

① **Rule-1** : If order is important, use permutation and if order is not important, use combination.

Example-1: We want to select 3 students for a fully paid Dubai Trip. (Out of 4 students) - Order is not imp.

A, B, C, P

Case-1: selected students are: P, C, A

Case-2: "   "   " : A, P, C

Example-2: We have organized a hackethon and 3 winners will get the following prizes:

1st Prize: iPhone 16 pro max

2nd Prize: Samsung galaxy S24

3rd prize: Oppo

Case-1: Winners are: P, C, A ⎫
                          ⎬ order is imp.
Case-2: "   " : A, P, C ⎭

Example-1: possible ways: ④   **Example-2**: Possible ways: ㉔

... ... CAD BAC ACB   ABC, ACB, BAC, BCA, CAB, CBA

Example-1 : possible ways : ④

ABC → CBA, BAC, ACB

BCP

ACP

ABP

Example-2 : possible ways : ?

ABC, ACB, BAC, BCA, CAB, CBA

BCP, BPC, PBC, PCB, CPB, CBP

ACP, APC, PAC, PCA, CAP, CPA

ABP, APB, PAB, PBA, BAP, BPA

Formula of product rule :

Permutation without repeatition

3 students to be arranged at 3-places :

A|B|C   B|C   B
 ↓   ↓   ↓
 3 × 2 × 1 = 3!

ABC, ACB, BAC, BCA, CAB, CBA

∴ no. of ways to arrange n-items in n-boxes = $n!$

5 students & 3 places (boxes)   — $^5P_3$

$$\underset{\circled{5} \times \circled{4} \times \circled{3}}{\overline{\quad}\;\overline{\quad}\;\overline{\quad}} = \frac{5 \times 4 \times 3 \times 2 \times 1}{2 \times 1} = \frac{5!}{2!}$$

7 students & 4 places :   — $^7P_4$

$$\underset{\circled{7}\;\circled{6}\;\circled{5}\;\circled{4}}{\overline{\quad}\;\overline{\quad}\;\overline{\quad}\;\overline{\quad}} = \frac{7!}{3!} = \frac{7!}{(7-4)!}$$

∴ Generalized formula for Permutation :

$$\boxed{\; ^nP_r = \,^nP^r = \,^r_nP = \frac{n!}{(n-r)!} \;}$$

$(n-r)!$

What if the order is not important?

3 students to be select for a foriegn trip from 4 students

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

$$\Rightarrow \ _4C_3 = \frac{4!}{3!\,(4-3)!} = \frac{4!}{3!\cdot 1!} = \frac{4 \times 3!}{3!} = 4$$

on the other hand,

$$_4P_3 = \frac{4!}{(4-3)!} = \frac{4!}{1!} = 4! = 4 \times 3 \times 2 \times 1 = 24$$

Repeatition is not allowed either in Permutation or in Combination.

What is the number of ways of ARRANGING three characters A, B, C?

Click on an option to submit your answer

A	3
B	4
C	6
D	8
E	9

Is repentition allowed?

Ans - No

Is order important?

Ans - Yes

We should use - Permutation

$$_3P_3 = \frac{3!}{(3-3)!} = \frac{3!}{0!} = \frac{3!}{1} = 6$$

$$\underset{\downarrow}{\text{—}} \ \underset{\downarrow}{\text{—}} \ \underset{\downarrow}{\text{—}}$$
$$\textcircled{3} \times \textcircled{2} \times \textcircled{1} = 6$$

How many 3-letter words (meaningful or meaningless) can be formed using alphabets A, B & C?

In a word, alphabets can repeat!

— ~ —

In a word, alphabets can repeat!

$$\overset{\downarrow}{\underset{\text{(3)}}{\rule{1.5em}{0.4pt}}} \times \overset{\downarrow}{\underset{\text{(3)}}{\rule{1.5em}{0.4pt}}} \times \overset{\downarrow}{\underset{\text{(3)}}{\rule{1.5em}{0.4pt}}} = 27$$

What is the number of ways of ARRANGING four characters A, B, C, D

Click on an option to submit your answer

A	4
B	12
C	16
D	24

Given 5 different characters, in how many ways can we arrange them in 2 places?

Click on an option to submit your answer

$$\overset{\downarrow}{\underset{\text{(5)}}{\rule{1.5em}{0.4pt}}} \quad \overset{\downarrow}{\underset{\text{(4)}}{\rule{1.5em}{0.4pt}}} \quad \leftarrow \text{order is imp.}$$

A	5
B	10
C	20
D	120

$$a\,b = b\,a \ ?$$

$$n C_r = \frac{n!}{r!\,(n-r)!} \quad \overset{\leftarrow \text{order}}{\text{doesn't matter}}$$

$$n P_r = \frac{n!}{(n-r)!} \quad \overset{\leftarrow \text{order}}{\text{matters}}$$

$$_5P_2 = \frac{5!}{3!} = \frac{5 \times 4 \times 3!}{3!} = 20$$

$$_5C_2 = \frac{5!}{2!\,3!} = \frac{5 \times 4 \times 3!}{4 \times 3!} = 10$$

A Maruti Showroom has 3 colours in their "Baleno" model and 3 colours in the "Swift" model. In how many ways can they place it such that Baleno and Swift are kept in alternate slots?

Click on an option to submit your answer

$$\underset{\downarrow}{B} \ \underset{\downarrow}{S} \ \underset{\downarrow}{B} \ \underset{\downarrow}{S} \ \underset{\downarrow}{B} \ \underset{\downarrow}{S}$$

$$3 \times 3 \times 2 \times 2 \times 1 \times 1 = 36$$

A	6
B	36
C	72
D	216
E	720

$$\underset{\downarrow}{S} \ \underset{\downarrow}{B} \ \underset{\downarrow}{S} \ \underset{\downarrow}{B} \ \underset{\downarrow}{S} \ \underset{\downarrow}{B} \quad +$$

$$3 \times 3 \dots \dots = 36$$

$$\overline{} \quad \overline{} \quad \overline{} \quad \overline{} \quad \overline{} \quad \overline{}$$
$$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$$
$$3 \times 3 \times 2 \times 2 \times 1 \times 1 = \frac{36}{72}$$

Quiz-11. In how many ways can we choose two coders from 5 students to represent our college in a national hackathon?

    a. 35
    b. 12
    c. 25
    d. 10

  5 C 2 = 5!/(2! *3!) = 5 * 4 * 3̶!̶ / (2! * 3̶!̶) = 10

Quiz-12: Get me the number of options to select batting order of first 4 batsmen from team of 11 players.

    a. 135
    b. 1200
    c. 2350
    d. 7920

Quiz-13: In how many ways can we pick three balls from a bag of balls containing black, red & yellow balls?

$$\overline{} \quad \overline{} \quad \overline{}$$
$$\downarrow \quad \downarrow \quad \downarrow$$
$$3 \times 3 \times 3 = 27$$

Quiz-14: How many 4 letter words can be formed using alphabets A, B, C & D? Note: the words might not have any meaning in English.