* Permutation

- It is a technique that determines the number of possible arrangments in set when the order of arrangments matters.
- Permutation is set of arrangment of its members into sequence. And if the members already orderd then reordering them.

$$\boxed{{}^{n}P_{r} = \frac{n!}{(n-r)!}}$$

n = total no. of elements in set

r = no. of selected elemnts arranged in order

* Relation of permutation and combination

$$\boxed{\text{Theorem : } {}^{n}P_{r} = {}^{n}C_{r} \cdot r!}$$

$$
\begin{aligned}
{}^{n}C_{r} \cdot r! &= \frac{n!}{r!(n-r)!} \cdot r! \\
&= \frac{n!}{(n-r)!} \\
&= {}^{n}P_{r}
\end{aligned}
$$

→ It means that for each combination of ${}^{n}C_{r}$ we have $r!$ permutations because r objects in every combination can be rearranged in $r!$ ways.

* Combination

- It is a techique that determines the number of possible arrangments in the collection of items where order of selection doesn't matters.
- Combination is selection of items from a set that has distinct members, such that order of selection doesnt matter.

$$\boxed{{}^{n}C_{r} = \frac{n!}{r!\,(n-r)!}}$$

n = total no. of elements in set

r = no. of selected elements.

* $\boxed{\text{Theorem : } {}^{n}C_{r} + {}^{n}C_{r-1} = {}^{n+1}C_{r}}$

$$
\begin{aligned}
{}^{n}C_{r} + {}^{n}C_{r-1} &= \frac{n!}{r!(n-r)!} + \frac{n!}{(r-1)!(n-r+1)!} \\
&= \frac{n!}{r(r-1)!\,(n-r)!} + \frac{n!}{(r-1)!(n-r+1)!\,(n-r)!} \\
&= \frac{n!}{(r-1)!\,(n-r)!}\left[\frac{1}{r} + \frac{1}{(n-r+1)}\right] \\
&= \frac{(n+1)!}{r!\,(n+1-r)!} \\
&= {}^{n+1}C_{r}
\end{aligned}
$$

* Permutation vs Combination

→ **Permutation :**

- the different ways of arranging a set of objects into a sequential order.
- order matters.
- denotes arrangment of objects
- multiple permutations can be derived from single combination.
- simply these are orderd elements.

→ **Combination :**

- one of the several way of choosing object from large set of objects, without considering the order.
- order doesn't matters.
- denotes selection of objects.
- single combination can be derived from single permutation.
- simply defined as unorderd sets.

→ If order matters use permutation, else combination.

→ Ex, Let elements be X, Y, Z . (for two)

- Possible permutations are,
  XY, YX, YZ, ZY, XZ, ZX
- Possible combinations are,
  XY, YZ, ZX.