
Permutation:An arrangement that can be formed by taking some or all, of a finite set of thing is called permutation Linear Permutation: A permutation is said to be a Linear permutation if the objects are arranged in a row or Line

1). Number of permutations of "n" different things, taken "r" at a time is ${}^{n}p_{r}$

2). Number of permutations of different things, taken all "n" at a time n!

3). Number of permutations of "n" things, taken all at a time when "p" are alike, "q" are alike of other kind is $\frac{n!}{p!q!}$ (where p + q = n)

4a). Total number of permutations of "n" different things, taken not more than "r" at a time is $n+n^2+n^3+.....+n^r$, if repetition is allowed

${}^{n}p_1+{}^{n}p_2+.....+{}^{n}p_r$, if repetition is not allowed

4b). The number of permutations of "n" distinct items taken "r" at a time when each thing may be
repeated any number of times is n^r.

5). Number of permutations of "n" different things, taken "r" at a time

a) When a particular thing is never included as ${}^{(n-1)}p_r={}^{(n-1)}c_r r!$

b) "m"-specified things are not to be included, as n!-(n-m+1)! m! = (total – inclusion)

c) When a particular things is to be always included is ${}^{(n-1)}C_r r!={}^{n=1}p_{r-1}.r.$

d). "m"-specified things always come together is, as (n-m+1)! m!

6)a. Number of ways in which m different things of one kind and n different things of second kind are arranged in a row, such that all the things of second kind come together, is $(m+1)!.n!$

b). Number of ways in which m different things of one kind and (m-1) different things of second kind are arranged in a row, such that no two things of same kind come together, is $(m-1)!.m!$

c). Number of ways in which m different things of one kind and m different things of second kind are arranged in a row, such that things are arranged alternatively, is $2.m!.m!$

Examples:

1). m different green balls and n different red balls are to arranged in a line such that balls of the
samecolour, occurs are always together is m! n! 2!

2). m different green balls and n different red balls to be arranged in a line such that all red balls are together (m+1) ! n!

3). m different green balls and n different red balls are to be arranged in a line such that no two red balls are together $(m \geq n-1)$ is $(m+n)_{c_n}\ m!n!$

4). m different green balls and m different red balls are to be arranged in a line such that colour of the balls is alternating $2(m!)^2$

5). m – identical green balls and n identical red ball are to be arranged in a line such that no two red balls are together $(m \geq n-1) is^{(m+1)}C_n$

6). m identical green balls and n different red balls are to be arranged in a line such that no two red balls are together $(m \geq n-1) is^{(m+1)}C_n n!$.

7). "m" men and n women are to be seated in a row so that no two women sit together, (if m>n) then number of ways this can be done is m! ${}^{(m+1)}c_n.n!$

8). Number of ways in which "m" boys and "m" girls sit alternately, in a row, is $2(m!)^2$.

9). Number of ways in which "m" boys and "n" girls sit in a row so that all the girls sit together is $n!(m+1)!(m>n)$

Selection from different items:

a) Number of ways of selecting one or more items from a group of "n" distinct items is $2^n - 1$

b) Number of ways of answering one or more of "n" question is $2^n - 1$

c) Number of ways of answering one or more of "n" questions, if each question has an alternative is $3^n - 1$

d) Number of ways of answering, all of "n" different questions, when each question has an alternate is 2^n

Circular permutation:

a). Number of circular permutations of "n" distinct objects, taken r items at a time is ${}^n c_r.(r-1)!$

b). Circular permutation of "n" distinct objects, taken all at a time, is (n-1)!

c). If direction is not considered (i.e. Anti clock and clock wise arrangements are considered same), then, the required permutations are $\frac{1}{2}(n-1)!$

d). Number of circular permutations of "n" distinct objects, so that objects do not get the same neighborhood is $\frac{1}{2!}(n-1)!$

e). Number of ways in which m distinct things of first kind and n distinct things of second kind (m > n) are arranged in a circular table such that no two things of second kind come together is $(m-1)!.^{m}c_{n}.n!$

f). Number of ways in which m distinct things of first kind and n distinct things of second kind (m > n) are arranged in a circular table such that all the things of second kind come together is $m!.n!$

Division of distinct items into groups:

1a). Number of ways in which (m+n) distinct items can be divided into two groups (indistinguishable) containing m and n things is $\frac{(m+n)!}{m!n!}$

1b). Number of ways in which (m+n) distinct items can be divided into two groups (distinguishable) containing m and n things is $\frac{(m+n)!}{m!n!}2!$

1c). Number of ways in which (m+n) distinct items can be divided into two groups (distinguishable) containing m and n things respectively, is $\frac{(m+n)!}{m!n!}$

2a). (m+n+p) distinct items are to be divided among 3 persons (distinguishable), so that three

Persons get m, n, p items respectively is, $\frac{(m+n+p)!}{m!n!p!}$

2b). (m+n+p) distinct items are to be divided among 3 persons (distinguishable), so that persons get m, n, p items 3! $\frac{(m+n+p)!}{m!n!p!}$

2c). (m+n+p) distinct items are to be divided among three groups (indistinguishable) so that each group gets m, n, p items respectively is $\frac{(m+n+p)!}{m!n!p!}$

3a). (mn) distinct items are to be divided, equally among "n" groups (indistinguishable) is $\frac{(mn)!}{(n!)^{m}m!}$

3b). (mn) distinct items are to be divided, equally among "m" persons (distinguishable) is $\frac{(mn)!}{(n!)^{m}}$

example:

a) 5 distinct items are to divided among 3 groups(indistinguishable) having 1, 1 3 items is, $\frac{5!}{3!.(2)}=\frac{120}{6(2)}=10.$

b) 12 distinct items are to divided among 3 groups(indistinguishable) having equal items is, $\frac{12!}{4!.4!.4!(3!)}$

c) 12 distinct items are to divided among 3 groups(indistinguishable) having 5,5,and 2 tems is, $\frac{12!}{5!.5!.2!(2!)}$

d) 12 distinct items are to divided among 3 groups (distinguishable) having5,5,and 2 tems is, $\frac{12!}{5!.5!.2!}.3$

Arrangement in groups:

1). The number of ways in which “n” different things can be arranged in r different boxes is

$r(r+1)(r+2).......(r+n-1)=\frac{(n+r-1)!}{(r-1)!}$ if blank boxes are allowed

2). If blank boxes are not allowed $n!.^{(n-1)}c_{r-1}$ (i.e. every box has atleast one item)

Divisors:

1. a). Number of ways of selecting “r” items from “n” identical items is 1

b). Number of ways of selecting one or more, items from “n” identical items is “n” (number of ways of selecting, any number of items (zero or more items), is n+1

c). Number of ways of selecting one or more item, from the set, containing “p” are alike of one kind “q” are alike of second kind, “r” are alike of third kind, is (p+1)(q+1)(r+1)-1

d).Total number of ways of selecting one or more items from the set, containing “p” are alike of one kind “q” are alike of second kind, “r” are alike of third kind and “n” different items is

(p+1)(q+1)(r+1) 2^n-1

2. If $N=a_1^{\sim_1}.a_2^{\sim_2}.a_3^{\sim_3}.....a_k^{\sim_k}$ where $a_{1,}a_{2,}a_3.....a_k$ prime numbers, then.

a).Total number of divisors of N is product of all the terms $(\sim_1+1),(\sim_2+1),.....,(\sim_k+1)$

b).Total number of proper divisors of N is (excluding 1 and N)=

$(\sim_1+1)(\sim_2+1)...(\sim_k+1)-2$

c).Sum of all divisors of N is. = $\left(\frac{a_1^{\sim_1+1}-1}{a_1-1}\right)\left(\frac{a_2^{\sim_2+1}-1}{a_2-1}\right).......\left(\frac{a_k^{\sim_k+1}}{a_k-1}\right)$

d). Number of ways, N can be expressed as a product of two factors is

$\frac{(\sim_1+1)(\sim_2+1).......(\sim_k+1)}{2}$,if N is not a perfect square.

$\frac{(\sim_1+1)(\sim_2+1).......(\sim_k+1)+1}{2}$, if N is a perfect square.

e). Product of the divisors of N is = $\left(a_1^{\sim_1}.a_2^{\sim_2}.....a_k^{\sim_k}\right)^{\frac{total\ divisors}{2}}$

3). Perfect square numbers have odd number of divisors and perfect square of prime numbers have exactly 3 factors.

4). $N = a_1^{\sim_1} a_2^{\sim_2} .....a_k^{\sim_k}$:The number of ways in which a composite number N, can be expressed as a product of two co prime factors is 2^{k-1}(k=number of different prime factors of N).

5). LCM of two numbers x and y, is $p_1^{\ a} p_2^{\ b} p_3^{\ c}$ where $p_1, p_2 \,\&\, p_3$ are prime numbers, then number of ways of choosing these two numbers (x, y) is (2a+1)(2b+1)(2c+1)

example:

If $N = 2^p 3^q 5^r$ .then

i) total divisors. (p+1)(q+1)(r+1)

ii) odd divisors 1(q+1)(r+1)

iii) Even divisors, p(q+1)(r+1)

iv) Factors of the form 4n+2 is (q+1)(r+1)

v) Factors which are divisible by 10 is (p).(q+1).r

(At least one “2” and at least one “5” & any number of ”3”)

vi) Factors of the form $(4n+1)$

Use $(4m+1)(4n+1) = 4l+1$ (or) (4m-1)(4n-1)=4l+1 (or)

(4m-1)(4n-1)(4l+1)=(4k+1) (or) (4m-1)(4n+1)(4l-1)=(4k+1)

(4m+1)(4n-1)(4l-1)=(4k+1) (or) (4m+1)(4n+1)(4l+1)=(4k+1)

vii) $N = 2^3 3^3 5^3$ no/. of factors of N, which have exactly 4 divisors (including 1 & the number itself) is $2^3 or 3^3 or 5^3 (or) 2x3 (or) 3x5 .is\, 6$

Distribution of identical objects/ Integral solutions:

1. Coefficient $x^n in (1-x)^{-r}\ is ^{(n+r-1)}c_{r-1}$

2a). Total number of non-negative integral solutions of the equation $x_1 + x_2 + x_3 + ... + x_r = n$ is $^{(n+r-1)}c_{r-1}$

total number of positive integral solutions is $^{n-1}c_{r-1}$

2b). Total number of ways of dividing “n” identical objects among r persons, such that each one of

whom can receive 0,1,2....., $n(\le n)$ is $^{(n+r-1)}c_{r-1}$

If each one of whom, can receive at least one item is $^{(n-1)}c_{r-1}$

2c). Total number of non-negative integral solutions.of $x_1 + x_2 + x_3 \le n\ is\, x_1 + x_2 + x_3 + k = n \Rightarrow ^{(n+4-1)} c_{4-1}$

$(k \ge 0)(x_1, x_2, x_3 \ge 0)$

3). No. of positive integral solutions of $N = x_1 x_2 x_3 \left(N = a^p b^q c^r\right)$ where a,b,c are prime numbers is

$\left(a^{\sim_1} b^{\ 2} c^{¥_1}\right)\left(a^{\sim_2} b^{\ 2} c^{¥_2}\right)\left(a^{\sim_3} b^{\ 3} c^{¥_3}\right) = a^p b^q c^r$ is the product of number of solutions of

$(\sim_1 + \sim_2 + \sim_3 = p)(\ _1 + \ _2 + \ _3 = q)(¥_1 + ¥_2 + ¥_3 = r)\ \sim_1, \sim_2, \sim_3,\ _1,\ _2,\ _3, ¥_1, ¥_2, ¥_3 \ge 0$

4a). If there are n_1 objects of one kind, n_2 objects of second kind, ... n_k objects of k^{th} kind then the

number of ways of selecting r objects out of these, is (if there is no restriction) coefficient x^r in $\left(1+x+x^2+....+x^{n_1}\right)\left(1+x+x^2+....+x^{n_2}\right)....\left(1+x+x^2+....+x^{n_1}\right)$ or

Coefficient $x^r\ in\left(1+x+x^2+.......\right)^k$

4b). Coefficient $x^r\ in\left(x+x^2+.......\right)^k$, if that "r" selection includes at least one from each kind.

Number of ways of arranging these "r" elements out of n elements, is the coefficient $x^r\ in\ r!\left(\frac{x}{1!}+\frac{x^2}{2!}+\frac{x^3}{3!}+....\right)^k$ orcoefficient $x^r\ in\ r!\left(e^x-1\right)^r$.

Example:

1. Number of non-negative integral solutions of $x_1+x_2+x_3+4x_4=20$ is coefficient x^{20} in $\left(1+x+x^2+....\right)^3\left(1+x^4+x^8+...\right) or\ x_1+x_2+x_3=20-4k, 0\le k\le 5 \Rightarrow \sum_{k=0}^{5}\left(22-4k\right)_{c_2}$

2. Number of integral solutions of $x_1+x_2+x_3+x_4=6,$ is coefficient x^6 in $\left(x+x^2+x^3+x^4+x^5+x^6\right)^4$

Where $1\le x_{1,}x_{2,}x_{3,}x_{4,}\le 6$

Derangement:

1. Let $a_1, a_2, a_3....a_r$ be "r" distinct objects such that their positions are fixed in a row as 1,2,3....,r.

We rearrange $a_1, a_2, ..., a_r$ In such a way that no one object occupies its original place is

$$D_n=n!\left\{1-\frac{1}{1!}+\frac{1}{2!}-\frac{1}{3!}+\frac{1}{4!}-.....+\left(-1\right)^n\frac{1}{n!}\right\}$$

2). F: $\left\{a_1, a_2....., a_n\right\}\to\left\{a_1, a_2.., ...a_n\right\}$ is a bijective function such that $F\left(a_1\right)\ne a_i, i=1,2,....n$ is

$$Dn=n!\left\{1-\frac{1}{1!}+\frac{1}{2!}+\frac{1}{3!}+\frac{1}{4!}-....+\left(-1\right)^n\frac{1}{n!}\right\}$$

3). If $r\left(0\le r\le n\right)$ objects occupy the places assigned to them and the remaining particular

(n-r) objects do not occupy its original places is $Dn=n!\left\{1-\frac{1}{1!}+\frac{1}{2!}-.....+\left(-1\right)^{n-r}\frac{1}{\left(n-r\right)!}\right\}$

General Lines, Circles and triangles:

1. If there are "n" non-collinear points in a plane then number of line segments formed

by joining these points is ${}^nc_2$

2. If there are "n" points out of which m-are collinear, then number of lines formed by joining

these points is ${}^nc_2-{}^mc_2+1$

3. If there are "n" points, in a plane (no three points are collinear) then number of triangles,

formed with these points, is ${}^nc_3$

4. If there are "n" points, out of which m are collinear then number of triangles formed is ${}^{n}c_3 - {}^{m}c_3$

or ${}^{m}c_1.{}^{(n-m)}c_2 + {}^{m}c_2.{}^{(n-m)}c_1 + {}^{m}c_0.{}^{(n-m)}c_3$

5. The maximum number of point of intersecting of n lines, in which no three lines are concurrent

is ${}^{n}c_2$.

6. Maximum number of point of intersection of n circles is ${}^{n}c_2.2!$

7. Maximum number of points of intersection of n circles and m straight lines intersect, is

${}^{n}p_2 + {}^{m}c_2 + m.(2n)$ (a line cuts a circle at 2 points)

8. There are "n" straight lines, drawn in a plane, no two of which are parallel and no three pass

through the same point, and the points of intersection of these lines are joined. Then the number of

fresh lines, hence made is $\frac{n(n-1)(n-2)(n-3)}{8} = {}^{N}c_2 - n.{}^{(n-1)}c_2$.(where $N = {}^{n}c_2$)

9. m points on one straight line, are joined to n points on the other line, then the number of points

of intersection of these line segments is ${}^{m}c_2.{}^{n}c_2$.

10. Any R Points are taken on each of 3 coplanar parallel lines then maximum number of triangles

with vertices at theses points is $R^2(4R-3)$

11. n straight lines are drawn in a plane such that no two lines are parallel and no 3 lines are

concurrent. Then number of parts into which these lines divide the plane is, $1+\frac{n(n+1)}{2}$

12. There are "m" points on one straight line AB and "n" points another straight line AC, none of

them being A, then the number of triangles formed with these points as vertices is ${}^{m}c_2{}^{n}c_1 + {}^{m}c_1{}^{n}c_2$

If A is also included then the number of triangles formed with these points as vertices is

${}^{(m+1)}c_2{}^{n}c_1 + {}^{m}c_1{}^{n}c_2$

Chess board:

1. Number of rectangles on a chess board = $9c_2.9c_2 = 1296$

2. Number of squares on a chess board = $204 = (1^2 + 2^2 + ... + 8^2)$

Number of rectangles which are not square is =1296-204=1092

Number of squares of 3 units is 6^2

Number of squares of 2 units is 7^2

Number of squares of 1 unit is 8^2 and so on.

3. Number of non-congruent rectangles (including squares) that can be formed on a normal chess
board are ${}^{8}c_2+8=36$ (only rectangles =28). (1x1, 1x2, 1x3,.....2x3, 2x4,....,7x8)

Squares, rectangles and parallelogram:

1. Total number of rectangles of all size (r x s, r and s = 1,2,3,...,n) in a square of size n x n is
$\sum_{r=1}^{n} r^3=\frac{n^2(n+1)^2}{4}$ or ${}^{(n+1)}c_2.{}^{(n+1)}c_2$

2. Total number of squares of any size (r x r) (r = 1,2,3,...,n) in a square of size n x n is
$\sum_{r=1}^{n} n^2=\frac{n(n+1)(2n+1)}{6}$ (or) $1^2+2^2+3^2+.....+n^2$.

3. Total number of rectangles of all size (r x s) (r,s = 1,2,3,...,n) in a square of size n x n is m x n (m
is greater than or equal to n) is = ${}^{(m+1)}c_2.{}^{(n+1)}c_2$.

4. Total number of squares any size (r x r) (r = 1,2,3,...,n) in a rectangle of size $m\,x\,n$
$\sum_{r=1}^{n}(m-r+1).(n-r+1)\ (m\geq n)$

5. Number of parallelograms when a parallelogram is cut by, a two sets of "m" lines, parallel to its
sides is ${}^{(m+2)}c_2.{}^{(m+2)}c_2$

6. l, m, n points on three parallel lines l_1,l_2,l_3 lie on a plane, then maximum number of triangles,
be formed with vertices at these points are ${}^{(l+m+n)}c_3-{}^{l}c_3-{}^{m}c_3-{}^{n}c_3$

7. If "m" parallel lines in a plane are intersecting "n" parallel lines. Then number of
parallelograms, formed is ${}^{m}c_2.{}^{n}c_2(or)\frac{mn(m-1)}{4}$

Polygon:

1. Number of diagonals, drawn in a polygon of n sides is ${}^{n}c_2-n=\frac{n(n-3)}{2}$ (total number of lines
formed-number of sides)

2. Vertices of n sided polygon are joined to form, triangle

a). Number of triangles, so formed is ${}^{n}c_3$

b). Number of triangles formed, in such a way that exactly two sides, of the triangle are common
that of the polygon is "n".

c). Number of triangles formed, in such a way that exactly one side, of the triangle, is common that of the polygon is n. ${}^{(n-4)}c_1$

d). Number of triangles formed, in such a way that no side is common that of the polygon is

$${}^{n}c_3 - n - n.{}^{(n-4)}c_1 = \frac{n(n-4)(n-5)}{6}$$

3). Vertices of n-sided regular polygon, joined to form a triangle then

a). Number of right angled triangles, is zero, if n is odd.

b). Number of right angled triangles (if n is even), is $n.\left(\frac{n}{2}-1\right)$

c). Number of obtuse angled triangle, is = $2k.{}^{(k-1)}c_2$, if n=2k,

= ${}^{K}c_2.(2k+1)$, if n=2k+1,

d). Number of acute angled triangles, is =

Total number of triangles –(number of obtuse angled triangles)-(number of right angled triangles)

e) Number of isosceles triangles is $=\frac{n(n-2)}{2}$ when n is even but not a multiple of 3

Number of isosceles triangles is $=\frac{n(n-1)}{2}$ when n is odd but not a multiple of 3

Number of isosceles triangles is = $\left(\frac{n(n-2)}{2}-2k\right)$ when n = 3k and even

Number of isosceles triangles is = $\left(\frac{n(n-1)}{2}-2k\right)$ when n = 3k andodd

4). Vertices of n-sided regular polygon, joined to form a quadrilateral. Then

a). Number of rectangles formed, is 0, if n is odd and

b). Number of rectangles formed, is $\frac{n\left(\frac{n}{2}-1\right)}{2}$, if n even.

5). Vertices of n-sided polygon are joined to form a quadrilateral. Then

a). Number of quadrilaterals, having exactly one side common that of the polygon is

" $n.\left({}^{n-4}c_2-(n-5)\right)=\frac{n(n-5)(n-6)}{2}$ "

a). Number of quadrilaterals having exactly two sidescommon that of the polygon

is $n.{}^{(n-5)}c_1+\frac{n.{}^{(n-5)}c_1}{2}$ = $\frac{3n(n-5)}{2}$ $\Big[n.{}^{(n-5)}c_1 =$ two consecutive sides that are common to the polygon

& $\frac{n.{}^{(n-5)}c_1}{2} =$ two opposite sides that are common to the polygon]

c). Number of quadrilaterals, having exactly 3 sides common that of the polygon is "n" d). Number of quadrilaterals, having no side common that of the polygon is "total quadrilateral – exactly one side common – exactly two side common – exactly three side common "

6). Vertices of n-sided polygon are joined to form quadrilaterals. Then Number of points of
intersection of diagonals, drawn to the polygon, which lie inside the polygon is ${}^{n}c_4.1!$

7. There are n points on the circumference of a circle then

a) The number of triangles, formed by joining these points, is ${}^{n}c_3$

b) The number of line segments formed by joining these points, is ${}^{n}c_2$

c) The number of quadrilaterals formed by joining these points is, ${}^{n}c_4$

Number of functions:

$f : A \to B$ and let $r = n(A), n = n(B)$

		Number of ways in which r different balls can be distributed among "n" persons,	
a)	Total number of functions	If any one can get any number of balls	$(n(B))^{n(A)}$ = n^r
b)	Total number of 1-1 functions	Each one gets,a maximum of one ball (or) Permutation of "n" different objects, Taken from "r" objects.	$\begin{cases} {}^{n}C_r.r! & if\ n(A) \geq n(B) \\ 0, & if\ n(B) < n(A) \end{cases}$
c)	Total number of many-one functions	At least one person gets more than one ball (or) Total functions – number of 1-1 functions	$\begin{cases} r^n - {}^{r}C_n.n! & if\ r \geq n \\ r^n, & if\ r < n \end{cases}$
d)	Total number of onto functions $f : A \to B,$ such that n(A) = n, n(B) = r	Each one gets at least one ball (that is no box is empty) (or) Coefficientof $x^{n(A)}\ in\ n(A)!.(e^x - 1)^{n(B)}$ (or) selection and arrangement of n items from "r" categories of identical items of unlimited numbers, selecting atleast one item from each category.	$\begin{cases} r^n - {}^{r}c_1.(r-1)^n + {}^{r}c_2.(r-2)^n \\ - {}^{r}c_3.(r-3)^n + ..., & if\ r < n. \end{cases}$ Or $\begin{cases} r! & if\ r = n \\ 0 & if\ r > n \end{cases}$
e)	Total number of into functions		Total functions - number of functions
f)	Total number of bijective(invertible) functions		$\begin{cases} r!\ if\ r = n \\ o\ if\ r \neq n \end{cases}$
g)	Number of constant functions	All the balls are received by any one person	n(B)
h)	Number of identityfunctions from $f : A \to A$ is		1

Miscellaneous:

1). The total number of n-digit numbers so that the sum of its digits is even (or) odd. is $\frac{9.10^{n-1}}{2}$

2a). The number of ways in which a n-digit number $(n \le 9)$ can be formed whose digits are in ascending order $= {}^{9}c_n$

2b). The number of ways in which a n-digit number $(n \le 9)$ can be formed whose digits are in' descending order (n < 9) in ${}^{10}C_n$

3). Sum of all the numbers that can be formed using the given digits, taken all at a time, is (sum of the digits). $(n-1)!\left(\frac{10^x-1}{10-1}\right)$.

4).Number of permutations of letters of a given word so that the relative position of consonants and vowels do not change is a! b!

(a=number of vowels, b= number of of consonants) (if no letter is repeated).

5).The number of ways in which "n" teachers can deliver their teachings, so that the teacher "A_1" teaches before A_3 and "A_3" before A_5, is $\frac{n!}{3!}$

5a) The number of ways in which "n" teachers can deliver their teachings, so that the teacher "A_1" teaches before A_3 and "A_2" before A_5, is $\frac{n!}{2!2!}$

5c) The number of ways in which "n" teachers can deliver their teachings, so that the teacher "A_1" teaches just before A_3 is $(n-1)!$

6).The number of ways of answering one or more of n questions when each question has "k" alternatives is $(k+1)^n - 1$

7). The set $S = \{1, 2, 3, ...3n\}$ is to be partitioned into three sets A, B, C of equal size, Thus AUBUC=S and $A \cap B = B \cap C = C \cap A = \varnothing$. Then number of ways to partition "S" is $\frac{(3n)!}{(n!)^3 3!}$

(Here A,B and C are distinct)

8. LCM of $\{a!,b!,c!\} = \max\{a!,b!,c!\}$ and HCF of $\{a!,b!,c!\} = m$ in $\{a!,b!,c!\}$

9. Exponent of a prime "p" in n! is $\left[\frac{n}{p}\right]+\left[\frac{n}{p^2}\right]+....+\left[\frac{n}{p^k}\right]$ $where\ p^k \le n$.

10. If n (A) = m, n (B) = n the no of onto functions from A to B is $n^m - {}^nC_1 (n-1)^m + {}^nC_2 (n-2)^m$ ....

$= (-1)^{n-1}\, {}^nC_{n-1}$

If n > m the above expression becomes zero

If n = m the above expression is equal to n!

The no. of ways of distributing m different things among n different boxes so that no box is empty is same as the above

formula.

11.If there are n things in a row then the no. of ways of selecting r things so that no two of them are consecutive is ${}^{n\,n-r+1}C_r$