1) Linear Arrangement: ‘n’ things can be arranged in a linear manner in n!. Linear arrangement refers to arrangement of people in a row or when people are seated on a bench etc.

2) Arrangement in a Circle: Let us consider a circle having n seats. All the seats in a circle are identical. So, the first person is seated in a circle in 1 way. Remaining n – 1 persons are seated in $(n-1)!$ ways. Total ways = $1 \times (n-1)! = (n-1)!$

Q1) In how many ways can 20 people be seated around a circle?

Solution: $1 \times 19! = 19!$ ways

3) Arrangement around a Square: Let us consider a square having n seats i.e. $\frac{n}{4}$ seats per side. First person can be seated in $\frac{n}{4}$ ways. Remaining n – 1 persons are seated in $(n-1)!$ ways. Total ways = $\frac{n}{4} \times (n-1)!$

Q2) In how many ways can 20 people be seated around a square?

Solution: First person can be seated in 5 ways (5 seats per side). Remaining 19 persons are seated in 19! ways. Total ways = 5 × 19!

4) Arrangement around an Equilateral Triangle: Let us consider an Equilateral Triangle having n seats i.e. $\frac{n}{3}$ seats per side. First person can be seated in $\frac{n}{3}$ ways. Remaining n – 1 persons are seated in $(n-1)!$ ways. Total ways = $\frac{n}{3} \times (n-1)!$

Q3) In how many ways can 6 people be seated around an Equilateral Triangle?

Solution: First person can be seated in 2 ways (2 seats per side). Remaining 5 persons are seated in 5! ways. Total ways = 2 × 5! ways

5) Arrangement around a Rectangle: Let us consider a Rectangle having n seats such that there are ‘m’ seats each on two opposite sides and ‘k’ seats each on the other two sides such that $m + k = \frac{n}{2}$. First person can be seated in $m + k$ ways. Remaining n – 1 persons are seated in $(n-1)!$ ways. Total ways = $(m + k) \times (n-1)!$

Q4) In how many ways can 20 people be seated around a Rectangle such that the Rectangle has 7 seats each on two of the opposite sides and 3 seats each on the other two sides?

Solution: First person can be seated in $7 + 3 = 10$ ways. Remaining 19 persons are seated in 19! ways. Total ways = 10 × 19! ways

NOTE: Formulas specified above can be used only when there are ‘n’ people and ‘n’ seats.

Q5) In how many ways can 7 people be seated around a square having 4 seats on each side?

Solution: First person can be seated in 4 ways (4 seats per side). Now, remaining 6 persons will occupy 6 places out of the remaining 15 places in $C(15,6)$ ways. 6 persons are now arranged in 6! ways. So, total ways = $4 \times C(15,6) \times 6!$ ways

Q6) In how many ways can 7 people be seated around a rectangle having 7 seats each on two of the opposite sides and 1 seat each on the other two sides?

Solution: First person can be seated in $7 + 1 = 8$ ways. Now, remaining 6 persons will occupy 6 places out of the remaining 15 places in $C(15,6)$ ways. 6 persons are now arranged in 6! ways. So, total ways = $8 \times C(15,6) \times 6!$ ways

Q7) In how many ways can 6 people be seated around an Equilateral Triangle having 4 seats on each side?

Solution: First person can be seated in 4 ways (4 seats per side). Now, remaining 5 persons will occupy 5 places out of the remaining 11 places in $C(11,5)$ ways. 5 persons are now arranged in 5! ways. So, total ways = $4 \times C(11,5) \times 5!$ ways.

Q8) In how many ways can 11 people be seated around an Isosceles Triangle having 4 seats each on the equal side and 3 seats on the other side?

Solution: First person can be seated in $4 + 3 = 7$ ways. Now, remaining 10 persons be arranged in 10! ways. So, total ways = $7 \times 10!$ ways

Q9) In how many ways can 8 people be seated around an Isosceles Triangle having 5 seats each on the equal side and 4 seats on the other side?

Solution: First person can be seated in $5 + 4 = 9$ ways. Now, remaining 7 persons will occupy 7 places out of the remaining 13 places in $C(13,7)$ ways. 7 persons are now arranged in 7! ways. So, total ways = $9 \times C(13,7) \times 7!$ ways