Maths Formula Sheet

Chapter by chapter, topic by topic. Written by the PadhoNa team for quick revision.

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CHAPTER 5

Permutations and Combinations

Counting basics

PERMUTATIONS AND COMBINATIONS

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

PROPERTIES

$$ {}^{n}C_{r} = {}^{n}C_{n-r}, \qquad {}^{n}C_{r} + {}^{n}C_{r-1} = {}^{n+1}C_{r}, \qquad r\,{}^{n}C_{r} = n\,{}^{n-1}C_{r-1} $$

WITH REPETITION

$$ \text{arrangements of } r \text{ from } n \text{ with repetition} = n^{r} $$

IDENTICAL OBJECTS

$$ \frac{n!}{p!\,q!\,r!\cdots} \text{ (p alike, q alike, …)} $$

Circular permutations

$$ (n-1)! \text{ ways;} \qquad \frac{(n-1)!}{2} \text{ if clockwise and anticlockwise are the same (necklace)} $$

Selections and distribution

TOTAL SELECTIONS

$$ {}^{n}C_{0} + {}^{n}C_{1} + \cdots + {}^{n}C_{n} = 2^{n}; \qquad \text{at least one: } 2^{n} - 1 $$

ALIKE OBJECTS

$$ (p+1)(q+1)(r+1) - 1 \text{ selections from p, q, r alike objects (at least one)} $$

N IDENTICAL INTO R GROUPS

$$ {}^{n+r-1}C_{r-1} \text{ (empty allowed)}, \qquad {}^{n-1}C_{r-1} \text{ (none empty)} $$

NON-NEGATIVE INTEGER SOLUTIONS

$$x_1 + x_2 + \cdots + x_r = n : \ {}^{n+r-1}C_{r-1}$$

DISTINCT INTO GROUPS

$$\frac{(m+n)!}{m!\,n!}\ (m \neq n); \qquad \frac{(2n)!}{2!\,(n!)^2}\ \text{(two equal groups)}$$

NUMBER OF DIVISORS

$$N = p_1^{a_1} p_2^{a_2} \cdots : \ \ (a_1+1)(a_2+1)\cdots \text{divisors}$$

Derangements

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

$D_1 = 0,\ D_2 = 1,\ D_3 = 2,\ D_4 = 9,\ D_5 = 44.$

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