MATHEMATICS FORMULA BOOK

CLASS 12

Complete Formula & Concept Book (CBSE/NCERT)

Covers: Complete syllabus formulas
Use: Quick revision & exam preparation
Format: Chapter-wise formula reference

All formulas, identities, theorems & results in one place

1 Relations and Functions

Reflexive
(a,a) ∈ R for all a

Symmetric
(a,b)∈R ⇒ (b,a)∈R

Transitive
(a,b),(b,c)∈R ⇒ (a,c)∈R

Bijective Function
One-one and onto

2 Inverse Trigonometric Functions

Function	Range (Principal)
$\sin^{-1}x$	$[-\pi/2, \pi/2]$
$\cos^{-1}x$	$[0, \pi]$
$\tan^{-1}x$	$(-\pi/2, \pi/2)$
$\cot^{-1}x$	$(0, \pi)$
$\sec^{-1}x$	$[0,\pi] - \{\pi/2\}$
$\operatorname{cosec}^{-1}x$	$[-\pi/2,\pi/2] - \{0\}$

$\sin^{-1}x + \cos^{-1}x$
$= \pi/2$

$\tan^{-1}x + \cot^{-1}x$
$= \pi/2$

$\tan^{-1}x + \tan^{-1}y$
$\tan^{-1}[(x+y)/(1-xy)]$

$2\tan^{-1}x$
$\sin^{-1}[2x/(1+x^2)]$

3 Matrices

Order of Matrix
m × n (rows × columns)

Scalar Multiplication
(kA)ij = k·Aij

Transpose Properties
(A')' = A; (A+B)' = A'+B'; (AB)' = B'A'

Symmetric Matrix
A' = A

Skew-Symmetric Matrix
A' = −A

4 Determinants

2×2 Determinant
|A| = ad − bc for [[a,b],[c,d]]

Area of Triangle (Determinant)
½|x1(y2−y3)+x2(y3−y1)+x3(y1−y2)|

Adjoint
adj(A) = transpose of cofactor matrix

Inverse of Matrix
$A^{-1} = adj(A)/|A|$

Solving AX=B
$X = A^{-1}B$

5 Continuity and Differentiability

Continuity at x=a
$\lim(x\to a)\ f(x) = f(a)$

Chain Rule
$dy/dx = dy/du \cdot du/dx$

d/dx (uv)
$u'v + uv'$

d/dx (u/v)
$(u'v-uv')/v^2$

d/dx (tan x)
$\sec^2 x$

d/dx ($\sin^{-1}x$)
$1/\sqrt{(1-x^2)}$

d/dx ($\cos^{-1}x$)
$-1/\sqrt{(1-x^2)}$

d/dx ($\tan^{-1}x$)
$1/(1+x^2)$

d/dx (a^x)
$a^x \ln a$

Logarithmic Differentiation
Take ln both sides, then differentiate

6 Applications of Derivatives

Rate of Change
dy/dx at given point

Increasing Function
$f'(x) > 0$

Decreasing Function
$f'(x) < 0$

Tangent Slope
m = dy/dx at point

Normal Slope
$m = -1/(dy/dx)$

Local Maxima/Minima
f'(x)=0 and check sign of f''(x)

Second Derivative Test
f''(x)<0 ⇒ Max; f''(x)>0 ⇒ Min

7 Integrals

Function	Integral
x^n	$x^{n+1}/(n+1) + C$
$1/x$	$\ln\|x\| + C$
e^x	$e^x + C$
a^x	$a^x/\ln a + C$
$\sin x$	$-\cos x + C$
$\cos x$	$\sin x + C$
$\sec^2 x$	$\tan x + C$
$\operatorname{cosec}^2 x$	$-\cot x + C$
$\sec x \tan x$	$\sec x + C$
$1/\sqrt{(1-x^2)}$	$\sin^{-1}x + C$
$1/(1+x^2)$	$\tan^{-1}x + C$
$1/\sqrt{(x^2+a^2)}$	$\ln\|x+\sqrt{(x^2+a^2)}\| + C$
$1/(x^2-a^2)$	$(1/2a)\ln\|(x-a)/(x+a)\| + C$
$1/(a^2-x^2)$	$(1/2a)\ln\|(a+x)/(a-x)\| + C$
$\sqrt{(a^2-x^2)}$	$(x/2)\sqrt{(a^2-x^2)} + (a^2/2)\sin^{-1}(x/a) + C$

Integration by Parts
$\int uv\,dx = u\int v\,dx - \int[u'\int v\,dx]\,dx$

Definite Integral (Fundamental Theorem)
$\int_a^b f(x)dx = F(b) - F(a)$

Property
$\int_a^b f(x)dx = \int_a^b f(a+b-x)dx$

8 Applications of Integrals

Area under Curve
$\int_a^b y\,dx$

Area Between Two Curves
$\int_a^b [f(x)-g(x)]\,dx$

9 Differential Equations

Order & Degree
Order = highest derivative; Degree = power of highest derivative

Variable Separable Form
$f(y)dy = g(x)dx$

Linear Differential Equation
$dy/dx + Py = Q$

Integrating Factor
IF = e^∫P dx

Solution (Linear DE)
y·IF = ∫Q·IF dx + C

10 Vector Algebra

Magnitude of Vector
$|a| = \sqrt{(a1^2+a2^2+a3^2)}$

Unit Vector
$\hat{a} = a/|a|$

Dot Product
$a \cdot b = |a||b|\cos\theta = a_1b_1+a_2b_2+a_3b_3$

Cross Product
$a \times b = |a||b|\sin\theta\ \hat{n}$

Cross Product (Determinant)
$a \times b = \begin{vmatrix} i & j & k \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$

Scalar Triple Product
$[a\ b\ c] = a \cdot (b \times c)$

Projection of a on b
$(a \cdot b)/|b|$

11 Three Dimensional Geometry

Direction Cosines
$l^2+m^2+n^2 = 1$

Line (Vector Form)
$r = a + \lambda b$

Line (Cartesian Form)
$(x-x_1)/a = (y-y_1)/b = (z-z_1)/c$

Plane (Vector Form)
$r \cdot \hat{n} = d$

Plane (Cartesian Form)
$Ax + By + Cz = D$

Angle Between Two Lines
$\cos\theta = |b_1 \cdot b_2|/(|b_1||b_2|)$

Distance of Point from Plane
$|Ax_1+By_1+Cz_1-D|/\sqrt{(A^2+B^2+C^2)}$

Shortest Distance (Skew Lines)
$|(a_2-a_1) \cdot (b_1 \times b_2)|\ /\ |b_1 \times b_2|$

12 Linear Programming

- Objective function: Z = ax + by (to maximize/minimize)
- Constraints define feasible region (convex polygon)
- Optimal value occurs at corner points (vertices) of feasible region

13 Probability

Conditional Probability
$P(A|B) = P(A \cap B)/P(B)$

Multiplication Theorem
$P(A \cap B) = P(A) \cdot P(B|A)$

Independent Events
$P(A \cap B) = P(A) \cdot P(B)$

Bayes' Theorem
$P(A_i|B) = P(A_i)P(B|A_i)\ /\ \Sigma P(A_j)P(B|A_j)$

Total Probability Theorem
$P(B) = \Sigma P(A_i)P(B|A_i)$

Binomial Distribution
$P(X=r) = {}^nC_r\ p^r q^{n-r}$

Mean of Binomial Distribution

np

Variance of Binomial Distribution

npq

— End of Class 12 Formula Book —