Maths-JEE-Mains-Formulas

October 20, 2025

Class	Lesson	Concept	Formula / Key Point	Explanation of variables
11	**Sets**	Union	[$A \cup B = \{x : x \in A \text{ or } x \in B\}$]	A, B are sets; x is an element belonging to A or B
		Intersection	[$A \cap B = \{x : x \in A \text{ and } x \in B\}$]	A, B are sets; x is an element common to both A and B
		Complement	[$A' = U - A$]	A is a subset of universal set U; A' is complement of A
		Cardinality	[$n(A \cup B) = n(A) + n(B) - n(A \cap B)$]	$n(X)$ is number of elements in set X
11	**Relations & Functions**	Function	A relation where every input has exactly one output	Input = domain element, Output = range element
		Domain and Range	Set of inputs (domain), outputs (range)	Domain = all possible inputs; Range = all possible outputs
		Types of Functions	One-one, onto, bijective	Describes function properties
11	**Trigonometry**	Identities	[$\sin^2 x + \cos^2 x = 1$, $1 + \tan^2 x = \sec^2 x$, $1 + \cot^2 x = \csc^2 x$]	x is the angle in radians or degrees
		Angle Formulas	[$\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$]	A, B are angles
		Double Angle	[$\sin 2A = 2 \sin A \cos A$, $\cos 2A = \cos^2 A - \sin^2 A$]	A is angle
11	**Complex Numbers**	General Form	[$z = a + ib$]	a, b are real numbers; $i = \sqrt{-1}$
		Conjugate	[$\bar{z} = a - ib$]	Conjugate of z
		Modulus	[$\lvert z \rvert = \sqrt{a^2 + b^2}$]	Magnitude of complex number z
11	**Quadratic Equations**	Roots	[$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$]	a, b, c are coefficients of $ax^2 + bx + c = 0$
		Discriminant	[$D = b^2 - 4ac$]	D determines nature of roots

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		Sum & Product of Roots	[$\alpha+\beta=-\frac{b}{a}$, $\alpha\,\beta=\frac{c}{a}$]	α, β are roots
11	**Sequence & Series**	AP nth Term	[$a_n = a + (n-1)d$]	a = first term, d = common difference, n = term number
		AP Sum	[$S_n = \frac{n}{2}[2a + (n-1)d]$]	Sum of first n terms in AP
		GP nth Term	[$a_n = ar^{n-1}$]	a = first term, r = common ratio
		GP Sum (finite)	[$S_n = a\frac{r^n-1}{r-1}$, $r \neq 1$]	Sum of first n terms in GP
		GP Sum (infinite)	[$S_\infty = \frac{a}{1-r}$, $\lvert r\rvert < 1$]	Sum of infinite GP
11	**Permutation & Combination**	Permutation	[${}_nP_r = \frac{n!}{(n-r)!}$]	Number of arrangements of r objects from n
		Combination	[${}_nC_r = \frac{n!}{r!\,(n-r)!}$]	Number of ways to choose r objects from n
		Property	[${}_nC_r = {}_nC_{n-r}$]	Symmetry property
11	**Binomial Theorem**	Expansion	[$(x+a)^n = \sum_{k=0}^{n} \binom{n}{k} x^{n-k}a^k$]	n = power; k = index; $\binom{n}{k}$ = binomial coefficient
		General Term	[$T_{k+1} = \binom{n}{k} x^{n-k}a^k$]	Term number $k+1$
11	**Straight Lines**	Slope	[$m = \frac{y_2-y_1}{x_2-x_1}$]	Slope of line through points (x_1, y_1) and (x_2, y_2)
		Point-Slope Form	[$y - y_1 = m(x - x_1)$]	Equation of line with slope m through (x_1, y_1)
		Slope-Intercept Form	[$y = mx + c$]	m = slope, c = y-intercept
		Distance	[$\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$]	Distance between two points
		Angle Between Lines	[$\tan\theta = \left\lvert \frac{m_1-m_2}{1+m_1m_2} \right\rvert$]	θ = angle between lines with slopes m_1, m_2
11	**Conic Sections**	Circle	[$(x-h)^2 + (y-k)^2 = r^2$]	Center at (h, k); radius = r
		Parabola	[$y^2 = 4ax$, $x^2 = 4ay$]	a = distance from vertex to focus
		Ellipse	[$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$]	a, b = semi-major and semi-minor axes

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		Hyperbola	[$\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$]	a, b = real numbers defining hyperbola shape
11	**3D Geometry**	Distance in 3D	[$\sqrt{(x_2-x_1)^2 + (y_2-y_1)^2 + (z_2-z_1)^2}$]	Distance between points (x_1, y_1, z_1) and (x_2, y_2, z_2)
		Section Formula	[$\left(\frac{mx_2+nx_1}{m+n}, \frac{my_2+ny_1}{m+n}, \frac{mz_2+nz_1}{m+n}\right)$]	Divides segment in ratio $m : n$
11	**Limits & Derivatives**	Limit Laws	[$\lim_{x\to a} f(x) = L$]	Limit of function f as x approaches a
		Standard Limits	[$\lim_{x\to 0} \frac{\sin x}{x} = 1$, $\lim_{x\to 0} \frac{1-\cos x}{x^2} = \frac{1}{2}$]	Standard trigonometric limits
		Derivatives	[$\frac{d}{dx}x^n = nx^{n-1}$, $\frac{d}{dx}\sin x = \cos x$]	Derivative formulas
11	**Mathematical Reasoning**	Logical Connectives	And ( ), Or ( ), Not ($\neg$), If-then ($\rightarrow$), Iff ( )	Basic logical operators
		Contrapositive	[$\neg q \rightarrow \neg p$]	Negation of p and q
11	**Statistics**	Mean	[$\bar{x} = \frac{\sum f_i x_i}{\sum f_i}$]	x_i values, f_i frequencies
		Variance	[$\sigma^2 = \frac{\sum (x_i - \bar{x})^2}{n}$]	n = total number of observations
		Standard Deviation	[$\sigma = \sqrt{\sigma^2}$]	Square root of variance
11	**Probability**	Basic Probability	[$P(A) = \frac{\text{Favourable}}{\text{Total}}$]	Probability of event A
		Complement	[$P(A') = 1 - P(A)$]	Probability of complement of A
		Addition Rule	[$P(A \cup B) = P(A) + P(B) - P(A \cap B)$]	Probability of union of A and B
		Independence	[$P(A \cap B) = P(A) \cdot P(B)$]	For independent events A and B
12	**Relations & Functions**	Types of Relations	Reflexive: $(a, a) \in R$ Symmetric: If $(a, b) \in R$ then $(b, a) \in R$ Transitive: If $(a, b), (b, c) \in R$ then $(a, c) \in R$	a, b, c are elements in set; R is a relation defined on the set
		Equivalence Relation	Relation which is reflexive, symmetric, and transitive	Same as above
		Functions	One-one, Onto, Inverse Function, Composite Function	Functions mapping elements from one set to another
12	**Inverse Trigonometric Functions**	Principal Values	[$\sin^{-1} x$, $\cos^{-1} x$, $\tan^{-1} x$ defined on restricted domains]	x is a real number within the domain of respective functions

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		Properties	[$\sin^{-1} x + \cos^{-1} x = \frac{\pi}{2}$, $\tan^{-1} x + \cot^{-1} x = \frac{\pi}{2}$]	x is a real number; π is the constant pi
		Addition Formulas	[$\tan^{-1} x + \tan^{-1} y = \tan^{-1}\left(\frac{x+y}{1-xy}\right)$ (if $xy < 1$)]	x, y are real numbers; domain condition: $xy < 1$
12	**Matrices**	Types of Matrices	Square, Diagonal, Scalar, Identity, Zero Matrix	Classifications of matrix types
		Matrix Operations	Addition, Subtraction, Multiplication, Transpose	Basic matrix operations
		Determinant	For (2×2): [$\lvert A\rvert = ad - bc$]; For (3×3): Expansion by minors	A is matrix; a, b, c, d are entries of matrix
		Inverse Matrix	[$A^{-1} = \frac{1}{\lvert A\rvert}\text{adj}\, A$ (if $\lvert A\rvert \neq 0$)]	A^{-1} is inverse of matrix A; $\lvert A\rvert$ determinant; adj = adjoint
12	**Determinants**	Properties	[$\lvert A\rvert = \lvert A^T\rvert$, If two rows/columns are equal, then $\lvert A\rvert = 0$]	$\lvert A\rvert$ is determinant; A^T transpose
		Expansion	Expansion along row or column	Method to compute determinant
		Cramer's Rule	[$x = \frac{\lvert D_x\rvert}{\lvert D\rvert}$, etc.]	$\lvert D\rvert$ is determinant of coefficient matrix; $\lvert D_x\rvert$ is determinant with column replaced
12	**Continuity & Differentiability**	Continuity	[f continuous at $x = a$ if $\lim_{x\to a} f(x) = f(a)$]	f is function; $x \to a$ means approaching a
		Differential	f differentiable at $x = a$ if derivative exists; differentiability $\Rightarrow$ continuity	$f'(x)$ derivative of $f(x)$
		Derivative Formulas	[$(x^n)' = nx^{n-1}$, $(\sin x)' = \cos x$, $(\ln x)' = \frac{1}{x}$]	Standard derivatives; x variable, n constant
12	**Applications of Derivatives**	Tangent & Normal	Slope of tangent = $f'(x)$; Equation of tangent and normal lines	$f'(x)$ is derivative at x
		Incr/Decr	[$f'(x) > 0$ increasing, $f'(x) < 0$ decreasing]	$f'(x)$ first derivative
		Maxima & Minima	[$f'(x) = 0$ and sign changes of $f'(x)$ for maxima/minima]	$f'(x)$ is first derivative
12	**Integrals**	Indefinite Integral	[$\int x^n dx = \frac{x^{n+1}}{n+1} + C$, $\int e^x dx = e^x + C$]	$n \neq -1$, C is constant of integration
		Definite Integral	[$\int_a^b f(x)\, dx = F(b) - F(a)$ where $F'(x) = f(x)$]	$F'(x) = f(x)$, a, b are integration limits
		Properties	Linearity, additivity over intervals	Basic integral properties

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12	**Applications of Integrals**	Area under curve	[Area $= \int_a^b \lvert f(x)\rvert \, dx$]	$f(x)$ function; limits a to b
		Area between curves	[$\int_a^b (f(x) - g(x))\, dx$, where $f(x) \geq g(x)$]	$f(x)$ upper curve; $g(x)$ lower curve
12	**Differential Equations**	Order and Degree	Order: highest derivative order; Degree: power of highest derivative	Definitions of order & degree
		Separable Equations	[$\frac{dy}{dx} = g(x)\, h(y)$]	y dependent variable; x independent
		General Solution	Solution includes arbitrary constants; particular solution satisfies conditions	General vs particular solution
12	**Vectors**	Vector Operations	Addition, subtraction, scalar multiplication	Basic vector operations
		Dot Product	[$\vec{a} \cdot \vec{b} = \lvert\vec{a}\rvert \, \lvert\vec{b}\rvert \cos\theta = a_1 b_1 + a_2 b_2 + a_3 b_3$]	$\vec{a}, \vec{b}$ are vectors; θ angle between; a_i, b_i components
		Cross Product	[$\vec{a} \times \vec{b}$ is a vector perpendicular to both $\vec{a}$ and $\vec{b}$]	$\vec{a}, \vec{b}$ vectors
12	**Three Dimensional Geometry**	Direction Cosines	Cosines of angles with coordinate axes: l, m, n	l, m, n are direction cosines
		Equation of Line	[$\frac{x-x_1}{l} = \frac{y-y_1}{m} = \frac{z-z_1}{n}$]	(x_1, y_1, z_1) point; l, m, n direction ratios
		Equation of Plane	[$ax + by + cz + d = 0$]	(a, b, c) is normal vector
12	**Linear Programming**	Objective Function	[$Z = ax + by$]	a, b are coefficients; x, y are variables to optimize
		Feasible Region	Set of points satisfying constraints	Region in domain satisfying constraints
		Corner Point Method	Evaluate Z at vertices of feasible region to find optimum	Method to find optimum at vertices
12	**Probability**	Conditional Probability	[$P(A\lvert B) = \frac{P(A \cap B)}{P(B)}$, $P(B) > 0$]	A, B are events
		Multiplication Rule	[$P(A \cap B) = P(A)\, P(B\lvert A) = P(B)\, P(A\lvert B)$]	Joint and conditional probabilities
		Bayes Theorem	[$P(A_i\lvert B) = \frac{P(A_i)\, P(B\lvert A_i)}{\sum_j P(A_j)\, P(B\lvert A_j)}$]	A_i are mutually exclusive events; B is given event