STUDY PARTH

Class 12th Formula Book

NCERT Chapterwise

Physics - Chemistry - Mathematics

All Formulas - All Chapters - One Book

About this book

This formula book has been prepared for Class 12 students studying under the NCERT syllabus (CBSE and other state boards following NCERT). It brings together all the important formulas of Physics, Chemistry and Mathematics in one place, arranged chapterwise, so that revision before exams, unit tests, JEE and NEET becomes fast and stress free. Formulas are kept short and to the point, exactly the way you need them at the time of solving numericals and problems.

How to use this book: go through one chapter at a time along with your NCERT textbook practice. Once you have solved a few questions of a chapter, come back here and revise the related formulas. Keep this book handy during your final revision, a night before exam, or while doing quick practice sessions.

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Physics

Chapterwise NCERT Formulas

Chapter 1

Electric Charges and Fields

1. Coulomb's law: $F = k\, q_1 q_2 / r^2$, where $k = 1/(4\pi\varepsilon_0) = 9 \times 10^9\ N\ m^2\ C^{-2}$
2. Electric field: $E = F / q_0 = k\, Q / r^2$
3. Electric field due to a dipole (axial): $E = 2kp / r^3$
4. Electric field due to a dipole (equatorial): $E = kp / r^3$
5. Torque on a dipole: $\tau = p \times E = pE \sin\theta$
6. Electric flux: $\Phi = E \cdot A = EA \cos\theta$
7. Gauss's law: $\Phi = q_{enc} / \varepsilon_0$
8. Field due to infinite line charge: $E = \lambda / (2\pi\varepsilon_0 r)$
9. Field due to infinite plane sheet: $E = \sigma / (2\varepsilon_0)$
10. Field inside a charged spherical shell: $E = 0$; outside: $E = kQ/r^2$

Chapter 2

Electrostatic Potential and Capacitance

1. Electric potential: $V = kQ / r$
2. Potential difference: $V = W / q$
3. Potential due to a dipole: $V = kp \cos\theta / r^2$
4. Potential energy of two charges: $U = kq_1 q_2 / r$
5. Relation between E and V: $E = -dV/dr$
6. Capacitance: $C = Q / V$
7. Parallel plate capacitor: $C = \varepsilon_0 A / d$
8. Capacitor with dielectric: $C = K\varepsilon_0 A / d$
9. Capacitors in series: $1/C = 1/C_1 + 1/C_2 + \ldots$
10. Capacitors in parallel: $C = C_1 + C_2 + \ldots$
11. Energy stored in capacitor: $U = \frac{1}{2}CV^2 = \frac{1}{2}QV = Q^2/2C$

12. Energy density: $u = \frac{1}{2}\varepsilon_0 E^2$

Chapter 3

Current Electricity

1. Electric current: $I = q / t$
2. Current in terms of drift velocity: $I = nAev_d$
3. Ohm's law: $V = IR$
4. Resistivity: $R = \rho l / A$
5. Conductance: $G = 1/R$, Conductivity: $\sigma = 1/\rho$
6. Resistors in series: $R = R_1 + R_2 + ...$
7. Resistors in parallel: $1/R = 1/R_1 + 1/R_2 + ...$
8. Electric power: $P = VI = I^2R = V^2/R$
9. Temperature dependence: $R_t = R_0(1 + \alpha\Delta T)$
10. Kirchhoff's current law: $\Sigma I = 0$ at a junction
11. Kirchhoff's voltage law: $\Sigma V = 0$ in a closed loop
12. Wheatstone bridge balance: $P/Q = R/S$
13. EMF and internal resistance: $\varepsilon = I(R + r)$

Chapter 4

Moving Charges and Magnetism

1. Force on moving charge: $F = qvB \sin\theta$ ($F = qv \times B$)
2. Force on current carrying conductor: $F = BIL \sin\theta$
3. Biot-Savart law: $dB = (\mu_0/4\pi) \times Idl \sin\theta / r^2$
4. Magnetic field due to long straight wire: $B = \mu_0 I / (2\pi r)$
5. Magnetic field at centre of circular loop: $B = \mu_0 I / (2R)$
6. Magnetic field of a solenoid: $B = \mu_0 nI$

7. Ampere's circuital law: $\oint B.dl = \mu_0 I$

8. Force between two parallel wires: $F/l = \mu_0 I_1 I_2 / (2\pi d)$

9. Torque on current loop: $\tau = NIAB \sin\theta$

10. Magnetic moment of loop: $m = NIA$

11. Radius of circular path of charge in B: $r = mv / (qB)$

12. Moving coil galvanometer: $I = (k/NAB)\ \theta$

Chapter 5

Magnetism and Matter

1. Magnetic dipole moment of bar magnet: $m = q_m \times 2l$

2. Magnetic field on axial line: $B = \mu_0 2m / (4\pi r^3)$

3. Magnetic field on equatorial line: $B = \mu_0 m / (4\pi r^3)$

4. Torque on bar magnet in field: $\tau = mB \sin\theta$

5. Magnetising field intensity: $H = B/\mu_0 - M$

6. Magnetic susceptibility: $\chi = M/H$

7. Relative permeability: $\mu_r = 1 + \chi$

8. Curie's law: $\chi = C/T$

Chapter 6

Electromagnetic Induction

1. Magnetic flux: $\Phi = B.A = BA \cos\theta$

2. Faraday's law: $\varepsilon = -N\, d\Phi/dt$

3. Motional EMF: $\varepsilon = Blv$

4. Self inductance: $\Phi = LI$, $EMF = -L\, dI/dt$

5. Mutual inductance: $\Phi_2 = MI_1$

6. Solenoid self inductance: $L = \mu_0 n^2 Al$

7. Energy stored in inductor: $U = \frac{1}{2}LI^2$

8. Lenz's law: induced current opposes the change in flux

Chapter 7

Alternating Current

1. AC voltage: $V = V_0 \sin\omega t$

2. RMS value: $V_{rms} = V_0/\sqrt{2}$, $I_{rms} = I_0/\sqrt{2}$

3. Inductive reactance: $X_L = \omega L$

4. Capacitive reactance: $X_C = 1/(\omega C)$

5. Impedance of RLC series: $Z = \sqrt{(R^2 + (X_L - X_C)^2)}$

6. Resonant frequency: $\omega_0 = 1/\sqrt{(LC)}$

7. Power in AC circuit: $P = V_{rms} I_{rms} \cos\varphi$

8. Quality factor: $Q = \omega_0 L / R$

9. Transformer equation: $V_s/V_p = N_s/N_p = I_p/I_s$

Chapter 8

Electromagnetic Waves

1. Speed of EM wave: $c = 1/\sqrt{(\mu_0 \varepsilon_0)} = 3 \times 10^8$ m/s

2. Relation between E and B: $E_0/B_0 = c$

3. Energy density of EM wave: $u = \frac{1}{2}\varepsilon_0 E^2 + B^2/(2\mu_0)$

4. Speed in medium: $v = c/n$, where $n = \sqrt{(\varepsilon_r \mu_r)}$

Chapter 9

Ray Optics and Optical Instruments

1. Mirror formula: $1/v + 1/u = 1/f$

2. Magnification (mirror): $m = -v/u = h'/h$

3. Refraction at spherical surface: $n_2/v - n_1/u = (n_2-n_1)/R$

4. Lens maker's formula: $1/f = (n-1)(1/R_1 - 1/R_2)$

5. Thin lens formula: $1/v - 1/u = 1/f$

6. Magnification (lens): $m = v/u$

7. Power of lens: $P = 1/f$ (in metres)

8. Lens in combination: $1/f = 1/f_1 + 1/f_2$, $P = P_1 + P_2$

9. Snell's law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$

10. Critical angle: $\sin\theta_c = 1/n$

11. Prism formula: $A + \delta = i + e$, $n = \sin[(A+\delta_m)/2] / \sin(A/2)$

12. Magnifying power of simple microscope: $m = 1 + D/f$

13. Magnifying power of compound microscope: $m = (L/f_o)(D/f_e)$

14. Magnifying power of telescope: $m = f_o/f_e$

Chapter 10

Wave Optics

1. Young's double slit fringe width: $\beta = \lambda D/d$

2. Path difference for bright fringe: $\Delta x = n\lambda$

3. Path difference for dark fringe: $\Delta x = (n + ½)\lambda$

4. Resolving power of microscope: $RP = 2n \sin\theta / \lambda$

5. Resolving power of telescope: $RP = a / 1.22\lambda$

6. Brewster's law: $\tan\theta_B = n$

7. Malus's law: $I = I_0 \cos^2\theta$

Chapter 11

Dual Nature of Radiation and Matter

1. Photoelectric equation (Einstein): $E = h\nu = \varphi_0 + KE_{max}$
2. Work function: $\varphi_0 = h\nu_0$
3. Stopping potential: $eV_0 = h\nu - \varphi_0$
4. de Broglie wavelength: $\lambda = h/p = h/mv$
5. de Broglie wavelength (electron accelerated by V): $\lambda = h/\sqrt{(2meV)}$

Chapter 12

Atoms

1. Bohr radius: $r_n = n^2h^2\varepsilon_0 / (\pi me^2) = n^2 \times 0.529$ Å
2. Energy of electron in nth orbit: $E_n = -13.6/n^2$ eV
3. Frequency of emitted photon: $h\nu = E_i - E_f$
4. Rydberg formula: $1/\lambda = R(1/n_1^2 - 1/n_2^2)$

Chapter 13

Nuclei

1. Nuclear radius: $R = R_0A^{1/3}$, $R_0 = 1.2$ fm
2. Mass defect: $\Delta m = [Zm_p + (A-Z)m_n] - M$
3. Binding energy: $E_b = \Delta mc^2$
4. Radioactive decay law: $N = N_0e^{-\lambda t}$
5. Half life: $T_{1/2} = 0.693/\lambda$
6. Mean life: $\tau = 1/\lambda$
7. Activity: $A = \lambda N$

Chapter 14

Semiconductor Electronics

1. Diode equation (forward biased): current increases exponentially with forward voltage
2. Ripple factor of rectifier: $r = I_{rms}(AC) / I_{dc}$
3. Transistor current relation: $I_E = I_B + I_C$
4. Current gain (common base): $\alpha = I_C/I_E$
5. Current gain (common emitter): $\beta = I_C/I_B$
6. Relation between α and β: $\beta = \alpha/(1-\alpha)$

Chemistry

Chapterwise NCERT Formulas

Chapter 1

Solutions

1. Mass percentage: w/w % = (mass of solute / mass of solution) × 100
2. Mole fraction: $x_A = n_A / (n_A + n_B)$
3. Molarity: M = moles of solute / volume of solution (L)
4. Molality: m = moles of solute / mass of solvent (kg)
5. Raoult's law: $p_1 = x_1 p_1^0$
6. Relative lowering of vapour pressure: $(p_1^0 - p_1)/p_1^0 = x_2$
7. Elevation in boiling point: $\Delta T_b = K_b m$
8. Depression in freezing point: $\Delta T_f = K_f m$
9. Osmotic pressure: $\pi = MRT$
10. Van't Hoff factor: i = observed colligative property / normal colligative property

Chapter 2

Electrochemistry

1. Nernst equation: $E_{cell} = E°_{cell} - (RT/nF) \ln Q$
2. Nernst equation (log form, 298K): $E_{cell} = E°_{cell} - (0.0591/n) \log Q$
3. Relation of Gibbs energy and EMF: $\Delta G = -nFE_{cell}$
4. Equilibrium constant: $\Delta G° = -RT \ln K = -nFE°_{cell}$
5. Molar conductivity: $\Lambda_m = \kappa / c$
6. Kohlrausch's law: $\Lambda_m^0 = \nu_+ \Lambda_+^0 + \nu_- \Lambda_-^0$
7. Faraday's first law: m = ZIt
8. Faraday's second law: $m_1/m_2 = E_1/E_2$ (equal charge passed)

Chapter 3

Chemical Kinetics

1. Rate of reaction: Rate = $-\Delta[R]/\Delta t = \Delta[P]/\Delta t$
2. Rate law: Rate = $k[A]^m[B]^n$
3. Zero order integrated rate law: $[A] = [A]_0 - kt$
4. First order integrated rate law: $k = (2.303/t) \log([A]_0/[A])$
5. Half life (zero order): $t_{1/2} = [A]_0/2k$
6. Half life (first order): $t_{1/2} = 0.693/k$
7. Arrhenius equation: $k = Ae^{-Ea/RT}$
8. Arrhenius equation (log form): $\log k = \log A - Ea/(2.303RT)$

Chapter 4

p-Block Elements

1. Oxidation states of nitrogen range from -3 to +5
2. Ostwald's process: $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
3. Haber's process: $N_2 + 3H_2 \leftrightarrows 2NH_3$
4. Contact process (SO_2 to SO_3): $2SO_2 + O_2 \leftrightarrows 2SO_3$
5. Basicity and acidity trends depend on electronegativity and size down the group

Chapter 5

d and f Block Elements

1. Electronic configuration of d-block: $(n-1)d^{1-10}\ ns^{0-2}$
2. Magnetic moment: $\mu = \sqrt{(n(n+2))}$ BM, where n = number of unpaired electrons
3. General oxidation states increase then decrease across a transition series
4. Lanthanoid contraction causes steady decrease in atomic and ionic radii across the series

Chapter 6

Coordination Compounds

1. Werner's coordination number = number of ligand donor atoms bonded to central metal
2. EAN rule: EAN = Atomic number of metal - oxidation state + 2 × coordination number
3. Crystal field splitting energy: Δ_0 (octahedral) and Δ_t (tetrahedral), $\Delta_t = (4/9)\Delta_0$
4. IUPAC nomenclature follows: ligands (alphabetical) + metal + oxidation state in roman numeral

Chapter 7

Haloalkanes and Haloarenes

1. S_N2 reaction: rate = k[substrate][nucleophile], proceeds with inversion of configuration
2. S_N1 reaction: rate = k[substrate], proceeds via carbocation intermediate
3. Rate of dehydrohalogenation follows Saytzeff's rule (more substituted alkene major product)

Chapter 8

Alcohols, Phenols and Ethers

1. Lucas test distinguishes 1°, 2°, 3° alcohols by reaction rate with $ZnCl_2$/HCl
2. Williamson's ether synthesis: R-X + R'ONa → R-O-R' + NaX
3. Acidity order: phenol > alcohol due to resonance stabilisation of phenoxide ion

Chapter 9

Aldehydes, Ketones and Carboxylic Acids

1. Aldol condensation forms β-hydroxy aldehyde/ketone from carbonyl compound with α-hydrogen

2. Cannizzaro reaction: disproportionation of aldehydes without α-hydrogen in strong base
3. Ka of carboxylic acid: Ka = $[H^+][RCOO^-] / [RCOOH]$
4. Acidity order of carboxylic acids depends on electron withdrawing/donating substituents

Chapter 10

Amines

1. Basicity of amines in gas phase: 3° > 2° > 1° > NH_3 (steric and solvation effects alter this in water)
2. Hofmann bromamide degradation: $RCONH_2 + Br_2 + 4NaOH \rightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O$
3. Diazotisation: $ArNH_2 + NaNO_2 + 2HCl \rightarrow ArN_2^+Cl^- + NaCl + 2H_2O$

Chapter 11

Biomolecules

1. Glucose is an aldohexose: $C_6H_{12}O_6$
2. Peptide bond formation: $-COOH + H_2N- \rightarrow -CO-NH- + H_2O$
3. Zwitterion form of amino acid: $R-CH(NH_3^+)-COO^-$
4. DNA base pairing: Adenine pairs with Thymine, Guanine pairs with Cytosine

Maths

Chapterwise NCERT Formulas

Chapter 1

Relations and Functions

1. Reflexive relation: $(a,a) \in R$ for every $a \in A$
2. Symmetric relation: $(a,b) \in R \Rightarrow (b,a) \in R$
3. Transitive relation: $(a,b), (b,c) \in R \Rightarrow (a,c) \in R$
4. Composition of functions: $(gof)(x) = g(f(x))$
5. For invertible f: $f^{-1}(f(x)) = x$

Chapter 2

Inverse Trigonometric Functions

1. $\sin^{-1}x + \cos^{-1}x = \pi/2$
2. $\tan^{-1}x + \cot^{-1}x = \pi/2$
3. $\sec^{-1}x + \text{cosec}^{-1}x = \pi/2$
4. $\tan^{-1}x + \tan^{-1}y = \tan^{-1}[(x+y)/(1-xy)]$
5. $2\tan^{-1}x = \sin^{-1}(2x/(1+x^2)) = \tan^{-1}(2x/(1-x^2))$
6. Range of $\sin^{-1}x$: $[-\pi/2, \pi/2]$; Range of $\cos^{-1}x$: $[0, \pi]$

Chapter 3

Matrices

1. Order of matrix: $m \times n$ (m rows, n columns)
2. Scalar multiplication: $(kA)_{ij} = k \times A_{ij}$
3. Matrix multiplication: $(AB)_{ij} = \Sigma A_{ik}B_{kj}$
4. Transpose properties: $(A')' = A$, $(A+B)' = A'+B'$, $(AB)' = B'A'$
5. Symmetric matrix: $A' = A$; Skew-symmetric: $A' = -A$
6. Every square matrix: $A = \frac{1}{2}(A+A') + \frac{1}{2}(A-A')$ (symmetric + skew-symmetric)

Chapter 4

Determinants

1. Determinant of 2×2: $|A| = ad - bc$, for $A = [[a,b],[c,d]]$
2. Area of triangle: $\frac{1}{2}|x_1(y_2-y_3) + x_2(y_3-y_1) + x_3(y_1-y_2)|$
3. Adjoint: adj(A) = transpose of cofactor matrix
4. Inverse of matrix: $A^{-1} = \text{adj}(A)/|A|$, $|A| \neq 0$
5. Solution of linear equations (Cramer's rule): $x = D_x/D$, $y = D_y/D$, $z = D_z/D$
6. Matrix equation: $AX = B \Rightarrow X = A^{-1}B$

Chapter 5

Continuity and Differentiability

1. Continuity at x=a: $\lim(x\to a) f(x) = f(a)$
2. Product rule: $(uv)' = u'v + uv'$
3. Quotient rule: $(u/v)' = (u'v - uv')/v^2$
4. Chain rule: $dy/dx = (dy/du)(du/dx)$
5. $d/dx(\sin x) = \cos x$, $d/dx(\cos x) = -\sin x$, $d/dx(\tan x) = \sec^2 x$
6. $d/dx(e^x) = e^x$, $d/dx(\log x) = 1/x$, $d/dx(a^x) = a^x \ln a$
7. Derivative of inverse trig: $d/dx(\sin^{-1}x) = 1/\sqrt{(1-x^2)}$
8. Logarithmic differentiation used when $y = f(x)^{g(x)}$
9. Mean Value Theorem: $f'(c) = [f(b)-f(a)] / (b-a)$

Chapter 6

Application of Derivatives

1. Rate of change: dy/dx gives rate of change of y with respect to x

2. Increasing function: $f'(x) \geq 0$; Decreasing function: $f'(x) \leq 0$
3. Tangent line: $y - y_1 = f'(x_1)(x - x_1)$
4. Normal line: $y - y_1 = -1/f'(x_1) \times (x - x_1)$
5. Approximation: $\Delta y \approx f'(x)\Delta x$
6. Maxima/minima: $f'(x) = 0$ and check sign of $f''(x)$ ($f''<0$ maxima, $f''>0$ minima)

Chapter 7

Integrals

1. $\int x^n dx = x^{n+1}/(n+1) + C, n \neq -1$
2. $\int 1/x \, dx = \ln|x| + C$
3. $\int e^x dx = e^x + C$
4. $\int \sin x \, dx = -\cos x + C, \int \cos x \, dx = \sin x + C$
5. $\int \sec^2 x \, dx = \tan x + C$
6. $\int dx/\sqrt{(a^2-x^2)} = \sin^{-1}(x/a) + C$
7. $\int dx/(a^2+x^2) = (1/a)\tan^{-1}(x/a) + C$
8. Integration by parts: $\int uv \, dx = u\int v \, dx - \int(u'\int v \, dx)dx$
9. Definite integral: $\int_a^b f(x)dx = F(b) - F(a)$
10. Property: $\int_0^a f(x)dx = \int_0^a f(a-x)dx$

Chapter 8

Application of Integrals

1. Area under curve: $A = \int_a^b y \, dx$
2. Area between two curves: $A = \int_a^b [f(x) - g(x)]dx$
3. Area with respect to y-axis: $A = \int_c^d x \, dy$

Chapter 9

Differential Equations

1. Order = highest derivative present; Degree = power of highest order derivative
2. Variable separable form: dy/f(y) = dx/g(x), integrate both sides
3. Homogeneous equation: dy/dx = F(y/x), substitute y = vx
4. Linear differential equation: dy/dx + Py = Q, Integrating factor IF = $e^{\int P dx}$
5. General solution using IF: y × IF = ∫(Q × IF)dx + C

Chapter 10

Vector Algebra

1. Magnitude of vector: $|a| = \sqrt{(x^2+y^2+z^2)}$
2. Unit vector: $\hat{a} = a / |a|$
3. Dot product: $a.b = |a||b|\cos\theta = a_1b_1+a_2b_2+a_3b_3$
4. Cross product: $a \times b = |a||b|\sin\theta\, \hat{n}$
5. Scalar triple product: [a b c] = a.(b×c)
6. Projection of a on b: (a.b)/|b|
7. Section formula: r = (mb + na)/(m+n)

Chapter 11

Three Dimensional Geometry

1. Direction cosines relation: $l^2 + m^2 + n^2 = 1$
2. Line through point with direction ratios: $(x-x_1)/a = (y-y_1)/b = (z-z_1)/c$
3. Angle between two lines: $\cos\theta = |a_1a_2+b_1b_2+c_1c_2| / (\sqrt{\Sigma a_1^2}\ \sqrt{\Sigma a_2^2})$
4. Equation of plane: ax + by + cz = d
5. Distance of point from plane: $|ax_1+by_1+cz_1-d| / \sqrt{(a^2+b^2+c^2)}$
6. Distance between two points: $\sqrt{[(x_2-x_1)^2+(y_2-y_1)^2+(z_2-z_1)^2]}$

Chapter 12

Linear Programming

1. Objective function: $Z = ax + by$, to be optimised (maximised/minimised)
2. Constraints are linear inequalities defining the feasible region
3. Optimal solution occurs at a corner point (vertex) of the feasible region

Chapter 13

Probability

1. Conditional probability: $P(A|B) = P(A \cap B) / P(B)$
2. Multiplication theorem: $P(A \cap B) = P(A) \times P(B|A)$
3. Bayes' theorem: $P(A_i|B) = P(A_i)P(B|A_i) / \Sigma P(A_j)P(B|A_j)$
4. Independent events: $P(A \cap B) = P(A) \times P(B)$
5. Mean of random variable: $\mu = \Sigma x_i p_i$
6. Variance: $\sigma^2 = \Sigma x_i^2 p_i - \mu^2$
7. Binomial distribution: $P(X=r) = {}^nC_r\, p^r\, q^{n-r}$

Thank you for downloading

We hope this formula book makes your Class 12 exam preparation faster, easier and less stressful. Keep revising these formulas regularly along with practice questions for the best results in your board exams and competitive exams like JEE and NEET.

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