CBSE Class 12 Physics Formula Sheet

97 formulas across 14 chapters — 2025-26 CBSE board exams

Ch 1. Electric Charges and Fields

Coulomb's Law (N)

$F = kq_1q_2/r^2$

k = 9×10^9 N·m²/C², q = charge (C), r = distance (m)

Electric Field due to point charge (N/C or V/m)

$E = kq/r^2$

q = source charge, r = distance

Electric Flux (N·m²/C)

$\Phi = E\cdot A\cdot\cos\theta = \oint E\cdot dA$

Gauss's Law (N·m²/C)

$\Phi = q_enc/\varepsilon_0$

$\varepsilon_0 = 8.85\times10^{-12}$ C²/N·m²

Electric field of infinite line charge (N/C)

$E = \lambda/2\pi\varepsilon_0 r$

λ = linear charge density

Electric field of infinite plane sheet (N/C)

$E = \sigma/2\varepsilon_0$

σ = surface charge density

Electric dipole moment (C·m)

$p = q \times 2l$

Tip: Direction: negative to positive charge

Torque on dipole in uniform field (N·m)

$\tau = pE\ \sin\theta$

Ch 2. Electrostatic Potential and Capacitance

Electric Potential due to point charge (V (Volt))

$V = kq/r$

Potential energy of system of charges (J)

$U = kq_1q_2/r$

Work done in moving charge (J)

$W = q(V_A - V_B)$

Capacitance (F (Farad))

$C = Q/V$

Capacitance of parallel plate capacitor

$C = \varepsilon_0 A/d$

A = plate area, d = plate separation

Capacitors in series
$1/C = 1/C_1 + 1/C_2 + 1/C_3$

Tip: Total capacitance < smallest individual capacitance

Capacitors in parallel
$C = C_1 + C_2 + C_3$

Energy stored in capacitor (J)
$U = \frac{1}{2}CV^2 = Q^2/2C = QV/2$

Effect of dielectric on capacitance
$C' = KC_0$

K = dielectric constant

Ch 3. Current Electricity

Ohm's Law
$V = IR$

V = voltage (V), I = current (A), R = resistance (Ω)

Resistance
$R = \rho L/A$

ρ = resistivity, L = length, A = area

Resistors in series
$R = R_1 + R_2 + R_3$

Resistors in parallel
$1/R = 1/R_1 + 1/R_2 + 1/R_3$

Electric Power (W (Watt))
$P = VI = I^2R = V^2/R$

EMF and terminal voltage
$V = E - Ir$

E = EMF, r = internal resistance, I = current

Kirchhoff's Current Law (KCL)
$\Sigma I_{in} = \Sigma I_{out}$ (at a junction)

Kirchhoff's Voltage Law (KVL)
$\Sigma V = 0$ (around a closed loop)

Wheatstone bridge (balanced)
$P/Q = R/S$

Tip: No current through galvanometer when balanced

Drift velocity
$v_d = I/neA$

n = number density of electrons, e = 1.6×10^{-19} C

Ch 4. Moving Charges and Magnetism

Magnetic force on charge (Lorentz) (N)
$F = qvB \sin\theta$

Magnetic force on current-carrying wire (N)
$F = BIL \sin\theta$

Biot-Savart Law
$dB = (\mu_0/4\pi) \times Idl \sin\theta/r^2$

$\mu_0 = 4\pi \times 10^{-7}$ T·m/A

Magnetic field at centre of circular loop
$B = \mu_0 I/2R$

Ampere's Law
$\oint B \cdot dl = \mu_0 I_{enc}$

Magnetic field inside solenoid
$B = \mu_0 nI$

n = turns per unit length

Tip: Remember: uniform field inside solenoid

Torque on current loop in magnetic field
$\tau = NIAB \sin\theta = MB \sin\theta$

M = NIA = magnetic moment

Radius of circular motion in magnetic field
$r = mv/qB$

Ch 5. Magnetism and Matter

Magnetic dipole moment (A·m²)
$M = m \times 2l$

m = pole strength, 2l = magnetic length

Tip: Direction: S-pole to N-pole inside magnet

Torque on magnetic dipole (N·m)
$\tau = MB \sin\theta$

M = magnetic moment, B = external field, θ = angle between M and B

Potential energy of dipole (J)
$U = -MB \cos\theta$

Axial field of bar magnet (short magnet)
$B_{axial} = (\mu_0/4\pi) \times 2M/r^3$

Tip: Qualitative treatment only in exam — direction along M

Equatorial field of bar magnet (short magnet)
$B_{eq} = (\mu_0/4\pi) \times M/r^3$

Tip: Direction opposite to M

Curie's Law
$\chi_m = C/T$

C = Curie constant, T = absolute temperature

Tip: For paramagnetic materials only; ferromagnetics lose magnetism above Curie temperature

Ch 6. Electromagnetic Induction

Magnetic Flux (Weber (Wb))
$\Phi = BA \cos\theta$

Faraday's Law of EMF (V)
$\varepsilon = -d\Phi/dt = -N(d\Phi/dt)$

Motional EMF
$\varepsilon = Blv$

B = field, l = length, v = velocity

Self-inductance (H (Henry))
$\varepsilon = -L(dI/dt)$

Mutual inductance (H)
$\varepsilon_2 = -M(dI_1/dt)$

Energy stored in inductor (J)
$U = \frac{1}{2}LI^2$

Ch 7. Alternating Current

RMS value of AC
$I_{rms} = I_0/\sqrt{2}$ | $V_{rms} = V_0/\sqrt{2}$

Inductive reactance (Ω)
$X_L = \omega L = 2\pi fL$

Capacitive reactance (Ω)
$X_C = 1/\omega C = 1/2\pi fC$

Impedance of LCR circuit (Ω)
$Z = \sqrt{(R^2 + (X_L - X_C)^2)}$

Resonant frequency
$f_0 = 1/2\pi\sqrt{(LC)}$

Tip: At resonance: Z = R (minimum impedance)

Power in AC circuit
$P = V_{rms} \times I_{rms} \times \cos\varphi$

cosφ = power factor

Transformer voltage ratio
$V_s/V_p = N_s/N_p = I_p/I_s$

Ch 8. Electromagnetic Waves

Speed of EM wave in vacuum
$c = 1/\sqrt{(\mu_0\varepsilon_0)} = 3\times10^8$ m/s

Relationship: wavelength, frequency, speed
$c = f\lambda$

f = frequency, λ = wavelength

Displacement current
$I_d = \varepsilon_0 \times d\Phi_E/dt$

Φ_E = electric flux

Tip: Maxwell added this to make Ampere's law consistent

EM spectrum order (increasing frequency)
Radio → Microwave → IR → Visible → UV → X-ray → γ-ray

Tip: Visible range: 400 nm (violet) to 700 nm (red)

Ch 9. Ray Optics

Snell's Law
$n_1 \sin\theta_1 = n_2 \sin\theta_2$

Mirror Formula
$1/f = 1/v + 1/u$

Tip: Use sign convention: distances measured from pole

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

Lens Formula
$1/f = 1/v - 1/u$

Lens Maker's Formula
$1/f = (n-1)[1/R_1 - 1/R_2]$

Magnification (lens)
$m = v/u$

Power of lens (Dioptre (D))
$P = 1/f$ (in metres)

Critical angle
$\sin\theta_c = n_2/n_1 = 1/n$ (if $n_2 = 1$)

Prism formula
$n = \sin[(A+\delta_m)/2] / \sin(A/2)$

A = prism angle, δ_m = minimum deviation

Ch 10. Wave Optics

Condition for bright fringes (YDSE)
$y_n = n\lambda D/d$

D = screen distance, d = slit separation

Fringe width
$\beta = \lambda D/d$

Condition for dark fringes
$y_n = (2n-1)\lambda D/2d$

Resolving power of telescope
$\theta = 1.22\lambda/D$

D = aperture diameter

Ch 11. Dual Nature of Radiation and Matter

Photoelectric equation (Einstein)
$KE_{max} = hf - \varphi = hf - hf_0$

h = 6.626×10^{-34} J·s, φ = work function

de Broglie wavelength
$\lambda = h/mv = h/p$

p = momentum

Threshold frequency
$f_0 = \varphi/h$

Stopping potential
$eV_0 = KE_max = hf - \varphi$

Ch 12. Atoms

Bohr's quantisation condition
$mvr_n = nh/2\pi$

n = orbit number, h = 6.626×10^{-34} J·s

Tip: Angular momentum is quantised in multiples of h/2π

Radius of Bohr orbit
$r_n = n^2a_0/Z$

a_0 = 0.529 Å, Z = atomic number, n = orbit number

Energy of Bohr orbit (Hydrogen)
$E_n = -13.6/n^2$ eV

Tip: Total energy is negative (bound state); KE = |E_n|, PE = 2E_n

Wavelength of spectral line (Rydberg)
$1/\lambda = R[1/n_1^2 - 1/n_2^2]$

R = 1.097×10^{7} m^{-1}, $n_2 > n_1$

Distance of closest approach (α-scattering)
$r_0 = k\cdot(2e)(Ze)/KE_\alpha = 2kZe^2/(\frac{1}{2}mv^2)$

Tip: All KE of α-particle converts to electrostatic PE at this point

Ch 13. Nuclei

Nuclear radius
$R = R_0A\text{^}(1/3)$

R_0 = 1.2×10^{-15} m = 1.2 fm, A = mass number

Mass defect
$\Delta m = [Z\cdot m_p + (A-Z)\cdot m_n] - M_nucleus$

Binding energy
$BE = \Delta m \times 931.5$ MeV (when Δm in u)

Tip: Higher BE/A → more stable nucleus; Fe-56 has highest BE/A ≈ 8.8 MeV

Binding energy per nucleon
$BE/A = \Delta m \times 931.5/A$ MeV per nucleon

Mass-energy equivalence
$E = mc^2$

1 u = 931.5 MeV/c^2

Radioactive decay law
$N = N_0e\text{^}(-\lambda t)$

λ = decay constant (s^{-1})

Activity (Becquerel (Bq) = 1 decay/s; 1 Curie = 3.7×10^{10} Bq)
$A = \lambda N = A_0 e^{\wedge}(-\lambda t)$

Half-life
$T_{1/2} = 0.693/\lambda$

Mean life
$\tau = 1/\lambda = 1.44\ T_{1/2}$

Ch 14. Semiconductor Electronics

Mass action law
$n_e \times n_h = n_i^2$

n_i = intrinsic carrier concentration

Tip: n-type: n_e >> n_h (electrons majority); p-type: n_h >> n_e (holes majority)

Half-wave rectifier output
$V_{dc} = V_m/\pi \ \mid\ I_{dc} = I_m/\pi$

Tip: Only one half cycle used; efficiency ≈ 40.6%

Full-wave rectifier output
$V_{dc} = 2V_m/\pi \ \mid\ I_{dc} = 2I_m/\pi$

Tip: Both half cycles used; efficiency ≈ 81.2%

Transistor current relation
$I_E = I_B + I_C$

Tip: Emitter current splits into base and collector currents

Current gain α (common base)
$\alpha = I_C/I_E$

Tip: α < 1 (typically 0.95–0.99)

Current gain β (common emitter)
$\beta = I_C/I_B$

Tip: β >> 1 (typically 20–200); most common transistor configuration

Relation between α and β
$\beta = \alpha/(1-\alpha) \ \mid\ \alpha = \beta/(1+\beta)$

Voltage gain (CE amplifier)
$A_V = -\beta(R_C/R_{in})$

Tip: Negative sign indicates 180° phase inversion in CE configuration