CBSE NCERT · Class 12 · Physics

Physics

ORIGINAL STUDY COMPANION
PADIKAM
CLASS 12 | SCIENCE
Physics
CBSE / NCERT core lessons | Academic year 2026-27
14 chapter lessons
Quick explanations, core points, exam practice and chapter-specific notation in one consistent format.
Padikam explanations are independently written. Official textbooks are used as the coverage map, chapter sequence and terminology reference.

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Study rhythm
Read the quick explanation, recall the core points aloud, then answer the prompts without looking back. Use the official textbook links for full prescribed readings, activities and diagrams.
Textbook and verification links
1. https://cbseacademic.nic.in/web_material/CurriculumMain27/SecPart2/Physics_SecP2_2026-27.pdf
2. https://ncert.nic.in/textbook.php
3. https://ncert.nic.in/textbook.php?leph1=0-8
4. https://ncert.nic.in/textbook.php?leph2=0-6
5. https://cbseacademic.nic.in/curriculum_2027.html

CHAPTER 01
Electric Charges and Fields
Quick understanding
Electric charge produces an electric field; superposition lets us add the effects of many charges without changing the contribution of each one.
Core points Check your learning
Charge is quantised and conserved. Explain the central idea of Electric Charges and Fields in your own words.
Coulomb force acts along the line joining two point charges. Apply one idea from Electric Charges and Fields to a textbook-style example or
Gauss law is most useful when symmetry makes the source.
field constant on a surface.
Equation and notation

$F = (1 / 4\pi\varepsilon_0)(q_1 q_2 / r^2)$
$E = F / q_0$
$\Phi E = \oint E \cdot dA = q(\text{enclosed}) / \varepsilon_0$
SYMBOLS AND UNITS
F: electrostatic force (N) q_1, q_2, q_0: electric charge (C)
r: separation (m) E: electric field (N C^{-1})
ΦE: electric flux (N m^2 C^{-1}) ε_0: permittivity of free space (F m^{-1})
One-line recall Charge is quantised and conserved.

CHAPTER 02
Electrostatic Potential and Capacitance
Quick understanding
Potential measures electric potential energy per unit charge, while a capacitor stores separated charge and energy.
Core points Check your learning
Potential is a scalar, so contributions add algebraically. Explain the central idea of Electrostatic Potential and Capacitance in your own words.
An equipotential surface is everywhere perpendicular to the electric field. Apply one idea from Electrostatic Potential and Capacitance to a textbook-style example or source.
Dielectrics increase capacitance by reducing the effective field.
Equation and notation
$V = W / q$
$C = Q / V$
$C(\text{parallel plate}) = \varepsilon_0 A / d$
$U = \frac{1}{2} C V^2$
SYMBOLS AND UNITS
V: electric potential (V) W, U: work or stored energy (J)
Q, q: charge (C) C: capacitance (F)
A: plate area (m^2) d: plate separation (m)
One-line recall Potential is a scalar, so contributions add algebraically.

CHAPTER 03
Current Electricity
Quick understanding
A steady current is the organised drift of charge through a conductor under an electric field.
Core points Check your learning
Ohm law describes linear conductors at fixed physical conditions. Explain the central idea of Current Electricity in your own words.
Resistivity is a material property; resistance also depends on dimensions. Apply one idea from Current Electricity to a textbook-style example or source.
Kirchhoff rules express conservation of charge and energy in circuits.
Equation and notation
$I = Q / t$
$V = IR$
$R = \rho l / A$
$P = VI = I^2 R = V^2 / R$
SYMBOLS AND UNITS
I: electric current (A) Q: charge (C)

t: time (s) V: potential difference (V)
R: resistance (Ω) ρ: resistivity (Ω m)
l: conductor length (m) A: cross-sectional area (m²)
P: electric power (W)
One-line recall Ohm law describes linear conductors at fixed physical conditions.

CHAPTER 04
Moving Charges and Magnetism
Quick understanding
Moving charges create magnetic fields and experience forces that depend on velocity, field strength and direction.
Core points Check your learning
The magnetic force is perpendicular to both velocity Explain the central idea of Moving and field. Charges and Magnetism in your own words.
Acurrent element follows the Biot-Savart law.
Apply one idea from Moving Charges
Parallel currents exert measurable forces on each and Magnetism to a textbook-style other.
example or source.
Equation and notation
$F = q(v \times B)$
$F = I(l \times B)$
$r = mv / qB$
$B(\text{long wire}) = \mu_0 I / 2\pi r$
SYMBOLS AND UNITS
F: magnetic force (N) q: charge (C)
v: velocity (m s^{-1}) B: magnetic flux density (T)
I: current (A) l: conductor length vector (m)
r: orbit radius or distance (m) m: particle mass (kg)
μ_0: permeability of free space (H m^{-1})
One-line recall The magnetic force is perpendicular to both velocity and field.

CHAPTER 05
Magnetism and Matter
Quick understanding
Amagnetic dipole responds to an external field, and magnetic materials differ through the way their internal moments align.
Core points Check your learning
Abar magnet is well modelled as a dipole. Explain the central idea of Magnetism and Matter in your own words.
Earth has a measurable magnetic field with declination and dip. Apply one idea from Magnetism and Matter to a textbook-style example or
Diamagnetic, paramagnetic and ferromagnetic source.
substances respond differently.
Equation and notation
$\tau = m \times B$
$U = -m \cdot B$
$B(\text{axial dipole}) = (\mu_0 / 4\pi)(2m / r^3)$
SYMBOLS AND UNITS

τ: torque (N m) m: magnetic dipole moment (Am²)
B: magnetic flux density (T) U: potential energy (J)
r: distance from dipole centre (m)
One-line recall A bar magnet is well modelled as a dipole.

CHAPTER 06
Electromagnetic Induction
Quick understanding
A changing magnetic flux produces an emf whose direction opposes the change that causes it.
Core points Check your learning
Faraday law gives the magnitude of induced emf. Explain the central idea of
Electromagnetic Induction in your own
Lenz law fixes direction and expresses energy
words.
conservation.
Apply one idea from Electromagnetic
Self and mutual inductance quantify flux linkage per
Induction to a textbook-style example or
current change.
source.
Equation and notation
$\Phi B = \int B \cdot dA$
$\varepsilon = -N \, d\Phi B / dt$
$\varepsilon L = -L \, dI / dt$
$U = \frac{1}{2} LI^2$
SYMBOLS AND UNITS
ΦB: magnetic flux (Wb) B: magnetic flux density (T)
A: area (m²) ε: induced emf (V)
N: number of turns t: time (s)
L: inductance (H) I: current (A)
One-line recall Faraday law gives the magnitude of induced emf.

CHAPTER 07
Alternating Current
Quick understanding
Alternating current varies periodically, so rms values and phase relations are used to compare its
effects with direct current.
Core points Check your learning
A resistor, inductor and capacitor produce different Explain the central idea of Alternating
phase relations. Current in your own words.
Impedance combines resistance and reactance. Apply one idea from Alternating Current
to a textbook-style example or source.
Resonance occurs when inductive and capacitive
reactances cancel.
Equation and notation
$v = V_m \sin \omega t$
$V_{rms} = V_m / \sqrt{2}$
$Z = \sqrt{(R^2 + (X_l - Xc)^2)}$
$\omega_0 = 1 / \sqrt{(LC)}$
SYMBOLS AND UNITS
v, V_m, V_{rms}: voltage values (V) ω: angular frequency (rad s^{-1})
t: time (s) Z, R, X_l, Xc: impedance, resistance and reactances (Ω)
L: inductance (H) C: capacitance (F)

One-line recall A resistor, inductor and capacitor produce different phase relations.

CHAPTER 08
Electromagnetic Waves
Quick understanding
Time-varying electric and magnetic fields sustain each other and travel through space as transverse electromagnetic waves.
Core points Check your learning
Electromagnetic waves need no material medium. Explain the central idea of
Electromagnetic Waves in your own
Electric field, magnetic field and propagation
words.
direction are mutually perpendicular.
Apply one idea from Electromagnetic
All bands share the same vacuum speed but differ in
Waves to a textbook-style example or
frequency and wavelength.
source.
Equation and notation
$c = 1 / \sqrt{(\mu_0 \varepsilon_0)}$
$c = v\lambda$
$E_0 / B_0 = c$
SYMBOLS AND UNITS
c: speed of light in vacuum (m s^{-1}) μ_0: permeability of free space (H m^{-1})
ε_0: permittivity of free space (F m^{-1}) v: frequency (Hz)
λ: wavelength (m) E_0: electric-field amplitude (V m^{-1})
B_0: magnetic-field amplitude (T)
One-line recall Electromagnetic waves need no material medium.

CHAPTER 09
Ray Optics and Optical Instruments
Quick understanding
Geometrical optics follows rays through reflection and refraction to locate images and analyse instruments.
Core points Check your learning
Use the Cartesian sign convention consistently. Explain the central idea of Ray Optics
and Optical Instruments in your own
Total internal reflection requires incidence from
words.
denser to rarer medium above the critical angle.
Apply one idea from Ray Optics and
The eye, microscope and telescope use
Optical Instruments to a textbook-style
combinations of lenses.
example or source.
Equation and notation
$1/f = 1/v - 1/u$
$m = h_i / h_o = v / u$
$n_1 \sin i = n_2 \sin r$
Power $P = 1/f$
SYMBOLS AND UNITS
f, u, v: focal length, object distance and image distance m: magnification, dimensionless
(m)

h_i, h_o: image and object height (m) n_1, n_2: refractive indices, dimensionless
i, r: angles of incidence and refraction P: lens power (D)
One-line recall Use the Cartesian sign convention consistently.
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CHAPTER 10
Wave Optics
Quick understanding
Wave optics explains interference, diffraction and polarisation by superposing coherent wave disturbances.
Core points Check your learning
Huygens principle constructs a new wavefront from Explain the central idea of Wave Optics
secondary wavelets. in your own words.
Stable fringes require coherent sources. Apply one idea from Wave Optics to a
textbook-style example or source.
Polarisation demonstrates the transverse nature of
light.
Equation and notation
Path difference $\Delta = d \sin \theta$
$\beta = \lambda D / d$
$I = I_1 + I_2 + 2\sqrt{(I_1 I_2)} \cos \varphi$
SYMBOLS AND UNITS
Δ: path difference (m) d: slit separation (m)
θ: observation angle β: fringe width (m)
λ: wavelength (m) D: screen distance (m)
I, I_1, I_2: intensities (W m^{-2}) φ: phase difference (rad)
One-line recall Huygens principle constructs a new wavefront from secondary wavelets.
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CHAPTER 11
Dual Nature of Radiation and Matter
Quick understanding
Radiation and matter reveal wave or particle behaviour depending on how they are observed.
Core points Check your learning
The photoelectric effect supports quantised photon Explain the central idea of Dual Nature of
energy. Radiation and Matter in your own words.
Stopping potential measures maximum photoelectron Apply one idea from Dual Nature of
kinetic energy. Radiation and Matter to a textbook-style
example or source.
de Broglie wavelength associates a wave with
moving matter.
Equation and notation
$E = h\nu = hc / \lambda$
$K_{max} = h\nu - \varphi = eV_0$
$\lambda = h / p$
SYMBOLS AND UNITS
E: photon energy (J) h: Planck constant (J s)
v: frequency (Hz) c: light speed (m s^{-1})
λ: wavelength (m) K_{max}: maximum kinetic energy (J)
φ: work function (J) e: elementary charge (C)
V_0: stopping potential (V) p: momentum (kg m s^{-1})
One-line recall The photoelectric effect supports quantised photon energy.
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CHAPTER 12

Atoms

Quick understanding

Atomic spectra arise because electrons in atoms occupy discrete energy states and exchange photons during transitions.

Core points Check your learning

Rutherford scattering established a small positive nucleus. Explain the central idea of Atoms in your own words.

Bohr quantisation explains the hydrogen spectrum. Apply one idea from Atoms to a textbook-style example or source.

A lower energy level is more tightly bound.

Equation and notation

$mvr = nh / 2\pi$

$E_n = -13.6 / n^2$ eV

$h\nu = |E_2 - E_1|$

SYMBOLS AND UNITS

m: electron mass (kg) v: electron speed (m s^{-1})

r: orbit radius (m) n: principal quantum number

h: Planck constant (J s) E_n: energy of nth level (eV)

ν: photon frequency (Hz)

One-line recall Rutherford scattering established a small positive nucleus.

CHAPTER 13

Nuclei

Quick understanding

Nuclear stability depends on the balance of forces and is measured through mass defect, binding energy and radioactive change.

Core points Check your learning

Isotopes share atomic number but differ in neutron number. Explain the central idea of Nuclei in your own words.

Binding energy per nucleon helps compare stability. Apply one idea from Nuclei to a textbook-style example or source.

Radioactive decay is probabilistic for one nucleus but predictable for a large sample.

Equation and notation

$E = \Delta m c^2$

$N = N_0 e^{-\lambda t}$

$T_{1/2} = \ln 2 / \lambda$

Activity $A = \lambda N$

SYMBOLS AND UNITS

E: binding energy (J) Δm: mass defect (kg)

c: light speed (m s^{-1}) N, N_0: number of undecayed nuclei

λ: decay constant (s^{-1}) t: time (s)

$T_{1/2}$: half-life (s) A: activity (Bq)

One-line recall Isotopes share atomic number but differ in neutron number.

CHAPTER 14

Semiconductor Electronics: Materials, Devices and Simple Circuits

Quick understanding

Controlled charge carriers make semiconductor junctions useful for rectification, regulation and digital switching.

Core points Check your learning

Doping creates n-type or p-type material without Explain the central idea of

giving the crystal a net charge. Semiconductor Electronics: Materials, Devices and Simple Circuits in your own words.

Forward bias lowers a junction barrier; reverse bias raises it.

Apply one idea from Semiconductor Electronics: Materials, Devices and Simple Circuits to a textbook-style example or source.

Equation and notation

$I = I_0(e^{(V/\eta V_t)} - 1)$

$V_o \approx V_i - V(\text{diode})$

AAND B = A · B; AOR B = A + B

SYMBOLS AND UNITS

I: diode current (A) I_0: reverse saturation current (A)

V: junction voltage (V) η: ideality factor, dimensionless

V_t: thermal voltage (V) V_i, V_o: input and output voltage (V)

A, B: Boolean inputs 0 or 1

One-line recall Doping creates n-type or p-type material without giving the crystal a net charge.

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