

Class XII

Physics

One-page chapter summaries
Large print • CBSE 2026-27 syllabus

1. Electric Charges and Fields — page 2
2. Electrostatic Potential and Capacitance — page 3
3. Current Electricity — page 4
4. Moving Charges and Magnetism — page 5
5. Magnetism and Matter — page 6
6. Electromagnetic Induction — page 7
7. Alternating Current — page 8
8. Electromagnetic Waves — page 9
9. Ray Optics and Optical Instruments — page 10
10. Wave Optics — page 11
11. Dual Nature of Radiation and Matter — page 12
12. Atoms — page 13
13. Nuclei — page 14
14. Semiconductor Electronics: Materials, Devices and Simple Circuits — page 15

Chapter 1: Electric Charges and Fields

Class XII • Physics • CBSE 2026-27

Big idea: Charges exert forces through electric fields; Gauss's law gives the field quickly when there is symmetry.

Key points

- Charge is **quantised** ($q = ne$), **additive** and **conserved**; like charges repel, unlike attract.
- **Coulomb's law**: force $\propto q_1q_2$ and $\propto 1/r^2$; acts along the line joining the charges.
- **Superposition**: net force on a charge = vector sum of forces due to each other charge.
- **Electric field** $E = F/q_0$ (force per unit positive test charge); unit N/C or V/m.
- Field lines start on + and end on – charges, never cross, never form closed loops; crowded lines = strong field.
- **Electric dipole**: charges $\pm q$ separated by $2a$; dipole moment $p = q \times 2a$, directed from $-q$ to $+q$.
- **Gauss's law**: total flux through a closed surface = $q_{\text{enclosed}}/\epsilon_0$, independent of the surface's size or shape.

Formulas & key derivations

- $F = (1/4\pi\epsilon_0) q_1q_2/r^2$, with $1/4\pi\epsilon_0 = 9 \times 10^9 \text{ N m}^2 \text{ C}^{-2}$
- Point charge: $E = (1/4\pi\epsilon_0) q/r^2$
- Dipole, axial ($r \gg a$): $E = (1/4\pi\epsilon_0) 2p/r^3$; equatorial: $E = (1/4\pi\epsilon_0) p/r^3$, opposite to p
- Torque on dipole in uniform E : $\tau = p \times E = pE \sin\theta$; net force = 0
- **Gauss's law**: $\phi = \oint \mathbf{E} \cdot d\mathbf{S} = q/\epsilon_0$
- Long straight wire: $E = \lambda/(2\pi\epsilon_0 r)$; infinite plane sheet: $E = \sigma/(2\epsilon_0)$
- Thin spherical shell: $E = (1/4\pi\epsilon_0) q/r^2$ outside ($r \geq R$); $E = 0$ inside

Exam focus: how to score

- **Derivations: dipole field on axis and on equatorial line; torque on a dipole** (3 marks each).
- Gauss's law applications (wire, sheet, shell): draw the Gaussian surface, state symmetry, then apply $\phi = q/\epsilon_0$.
- Flux depends only on enclosed charge, not on the size of the Gaussian surface: a favourite MCQ.
- Draw field lines for $+q$, $-q$, a dipole and two like charges.

★ Important questions from CBSE sample papers

- Point charge $+Q$ at the centre of a Gaussian sphere; radius doubled. What happens to the flux? (SQP 2026-27, 1 mark)
- State Gauss's theorem; use it to derive E due to an infinitely long straight wire of linear charge density λ . (SQP 2024-25, 3 marks)

Remember: Flux counts only the charge INSIDE: $\phi = q/\epsilon_0$.

Chapter 2: Electrostatic Potential and Capacitance

Class XII • Physics • CBSE 2026-27

Big idea: Potential is work per unit charge; capacitors store charge and energy, and dielectrics increase capacitance.

Key points

- Electrostatic force is **conservative**: work done depends only on the end points, not the path.
- **Potential** V at a point = work done per unit charge in bringing a test charge from infinity; a scalar.
- **Equipotential surfaces**: no work is done moving a charge on them; E is always perpendicular to them.
- Inside a conductor $E = 0$; charge resides on the surface; V is constant throughout and on the surface.
- **Dielectric** gets polarised in a field, reducing the net field, so capacitance rises: $C = KC_0$.
- **Capacitor**: two conductors separated by an insulator; $C = Q/V$, unit farad; depends only on geometry and medium.

Formulas & key derivations

- Point charge: $V = (1/4\pi\epsilon_0) q/r$; dipole: $V = (1/4\pi\epsilon_0) p \cos\theta/r^2$
- **$E = -dV/dr$** (field = negative potential gradient)
- PE of two charges: $U = (1/4\pi\epsilon_0) q_1q_2/r$; dipole in field: $U = -p \cdot E$
- Parallel plate: $C = \epsilon_0 A/d$; with dielectric slab of thickness t : $C = \epsilon_0 A/(d - t + t/K)$
- Series: $1/C = 1/C_1 + 1/C_2 + \dots$; parallel: $C = C_1 + C_2 + \dots$
- Energy stored: $U = \frac{1}{2}CV^2 = \frac{1}{2}QV = Q^2/2C$ (formula only); energy density = $\frac{1}{2}\epsilon_0 E^2$

Exam focus: how to score

- Derive potential due to a dipole and **$E = -dV/dr$** .
- **Capacitance with a dielectric or metal slab** (metal slab: $C = \epsilon_0 A/(d - t)$) is a repeat 3-marker.
- Combination problems: series gives minimum C , parallel gives maximum C .
- Energy of capacitor: no derivation in 2026-27, use the formulae.

★ Important questions from CBSE sample papers

- Find C of a parallel plate capacitor with (I) a dielectric slab and (II) a metallic slab of thickness $t < d$. Which is more and why? (SQP 2024-25, 3 marks)
- Show that $E =$ negative potential gradient. A sphere reaches max potential 5×10^5 V before air breaks down at 2.5×10^6 V/m: find its minimum radius. (SQP 2026-27, 5 marks)
- Why can't an isolated conductor have a large capacitance? Connect 6, 9, 18 μF for minimum and maximum C . (SQP 2026-27, 5 marks)

Remember: Series = smaller than the smallest; parallel = just add.

Chapter 3: Current Electricity

Class XII • Physics • CBSE 2026-27

Big idea: A steady current needs an emf; drift of electrons, resistance and Kirchhoff's rules explain every circuit.

Key points

- **Current** = charge per unit time through an area; needs a closed circuit and a source of **emf**.
- Free electrons move randomly; in a field they gain a small average **drift velocity** opposite to E .
- **Mobility** $\mu = v_d/E$; **relaxation time** τ = average time between collisions.
- **Ohm's law** $V = IR$ is not universal: fails for non-linear, direction-dependent or non-unique V - I (diode, GaAs).
- Resistivity of metals rises with temperature (τ falls); semiconductors' resistivity falls.
- **Internal resistance** r : terminal voltage $V = \varepsilon - Ir$ while the cell delivers current.
- **Kirchhoff's junction rule** = conservation of charge; **loop rule** = conservation of energy.
- **Wheatstone bridge** balanced when no current flows through the galvanometer.

Formulas & key derivations

- $I = neAv_d$; **$v_d = eE\tau/m$**
- $R = \rho l/A$; $\rho = m/(ne^2\tau)$; conductivity $\sigma = 1/\rho$
- $\rho_T = \rho_0[1 + \alpha(T - T_0)]$
- Power $P = VI = I^2R = V^2/R$
- Cells in series: $\varepsilon_{eq} = \varepsilon_1 + \varepsilon_2$, $r_{eq} = r_1 + r_2$; parallel: $\varepsilon_{eq} = (\varepsilon_1 r_2 + \varepsilon_2 r_1)/(r_1 + r_2)$, $1/r_{eq} = 1/r_1 + 1/r_2$
- **Balanced Wheatstone bridge: $P/Q = R/S$**
- Current from a cell: $I = \varepsilon/(R + r)$

Exam focus: how to score

- Derive **$I = neAv_d$ and $\rho = m/(ne^2\tau)$** ; show how ρ depends on temperature.
- Derive the balance condition of a Wheatstone bridge using Kirchhoff's rules (5-mark choice).
- Read V - I graphs of a cell: intercept = emf, slope = $-r$.
- Cells: write ε_{eq} and r_{eq} before substituting.

★ Important questions from CBSE sample papers

- From the V vs I graph of a cell, find (I) its emf and (II) its internal resistance. (SQP 2025-26, 2 marks)
- Explain: a car starts more easily on a warm day; a heater's temperature becomes constant though heat is generated. (SQP 2026-27, 3 marks)
- Using Kirchhoff's laws obtain the balance condition of a Wheatstone bridge. (SQP 2024-25, 5 marks)

Remember: Junction rule saves charge; loop rule saves energy.

Chapter 4: Moving Charges and Magnetism

Class XII • Physics • CBSE 2026-27

Big idea: Moving charges and currents produce magnetic fields and feel magnetic forces.

Key points

- **Lorentz force** $F = q(E + v \times B)$; the magnetic part is perpendicular to v , so it does no work.
- Charge moving $\perp B$ goes in a circle; at an angle it follows a **helix**; frequency independent of speed.
- **Biot-Savart law** gives the field of a current element; **Ampere's law** is easier when there is symmetry.
- **Parallel currents attract**, antiparallel repel; this defines the ampere.
- A current loop is a **magnetic dipole**: $m = NIA$; in uniform B net force is zero, torque $\tau = m \times B$.
- **Moving coil galvanometer**: radial field from a cylindrical soft-iron core makes deflection $\propto$ current.
- Galvanometer $\rightarrow$ **ammeter**: small shunt in parallel; $\rightarrow$ **voltmeter**: high resistance in series.

Formulas & key derivations

- $r = mv/(qB)$; frequency $\nu = qB/(2\pi m)$
- Biot-Savart: $dB = (\mu_0/4\pi) I dl \times r / r^3$
- **Circular loop on axis: $B = \mu_0 I R^2 / [2(x^2 + R^2)^{3/2}]$; at centre $B = \mu_0 I / 2R$**
- Long straight wire (Ampere): $B = \mu_0 I / (2\pi r)$; solenoid: $B = \mu_0 n I$
- Force between parallel wires per length: $F/l = \mu_0 I_1 I_2 / (2\pi d)$
- Galvanometer: $NIA B = k\phi$; current sensitivity $\phi/I = NAB/k$
- **Shunt $S = I_g G / (I - I_g)$; series $R = V/I_g - G$**

Exam focus: how to score

- **Derive B on the axis of a circular loop (Biot-Savart)** and B near a long wire (Ampere).
- Galvanometer: principle, role of radial field, and conversion to ammeter/voltmeter with numerical.
- Define one ampere from force between parallel wires.
- Path of a charge in B : circle, helix (pitch $= v \cos\theta \times T$).

★ Important questions from CBSE sample papers

- Write the force per unit length between two parallel current-carrying wires. Hence define one ampere. (SQP 2025-26, 2 marks)
- Ammeter of resistance 13Ω reading up to 100 A is extended to 750 A : find the shunt. Why is the coil wound on a metal frame? (SQP 2026-27, 3 marks)
- State the principle of a moving coil galvanometer. What makes its scale linear? Convert 49.5Ω , 0.05 A galvanometer to a 5 A ammeter. (SQP 2025-26, 5 marks)

Remember: Shunt = small and parallel (ammeter); big and series (voltmeter).

Chapter 5: Magnetism and Matter

Class XII • Physics • CBSE 2026-27

Big idea: A bar magnet behaves like a solenoid; materials are dia-, para- or ferromagnetic depending on how they respond to a field.

Key points

- Magnetic poles always exist in pairs; cutting a magnet gives two smaller magnets: **no monopoles**.
- A bar magnet is equivalent to a current-carrying **solenoid** (qualitative).
- Field lines form **closed loops**: outside $N \rightarrow S$, inside $S \rightarrow N$; they never cross.
- In a uniform field a bar magnet feels **no net force** but a torque $\tau = m \times B$ (qualitative).
- **Gauss's law for magnetism**: net magnetic flux through any closed surface is zero.
- **Diamagnetic** (Bi, Cu, water, superconductors): weakly repelled, field lines pushed out, χ small negative.
- **Paramagnetic** (Al, Na, O_2): weakly attracted, χ small positive; magnetisation grows as temperature falls.
- **Ferromagnetic** (Fe, Co, Ni): strongly attracted, χ very large; become paramagnetic above the **Curie temperature**.

Formulas & key derivations

- Axial field ($r \gg l$): $B = \mu_0 \cdot 2m / (4\pi r^3)$; equatorial: $B = \mu_0 m / (4\pi r^3)$
- **Gauss's law: $\oint \mathbf{B} \cdot d\mathbf{S} = 0$**
- $H = B_0 / \mu_0$; magnetisation $M = m_{\text{net}} / V$
- $B = \mu_0(H + M)$; $M = \chi H$
- $\mu = \mu_0 \mu_r$; **$\mu_r = 1 + \chi$**

Diagrams, maps & graphs to practise

- Field lines through a diamagnetic vs paramagnetic sample
- Field lines of a bar magnet and of a solenoid

Exam focus: how to score

- **Compare dia, para, ferro**: χ sign/size, μ_r , behaviour in non-uniform field, examples, temperature effect.
- Draw field lines inside dia and para samples (2 marks).
- Numericals on H , B and M for a cored solenoid.
- Superconductor = perfect diamagnet (Meissner effect): repelled by a magnet.

★ Important questions from CBSE sample papers

- A substance has relative permeability 800. What type is it? Write two characteristics. (SQP 2026-27, 2 marks)
- State Gauss's law of magnetism and its significance. (SQP 2026-27, 2 marks)
- Solenoid core $\mu_r = 200$, 2000 turns/m, 1 A: find H , B and magnetisation. (SQP 2025-26, 3 marks)

Remember: Dia dodges, para pulls a little, ferro grabs.

Chapter 6: Electromagnetic Induction

Class XII • Physics • CBSE 2026-27

Big idea: A changing magnetic flux induces an emf; Lenz's law says the induced current always opposes the change.

Key points

- **Magnetic flux** $\Phi = B \cdot A = BA \cos\theta$; unit weber (Wb).
- **Faraday's law**: induced emf equals the rate of change of flux linkage.
- **Lenz's law**: induced current opposes the change producing it: a consequence of energy conservation.
- A rod moving in a field gives **motional emf**.
- **Self-induction**: a changing current in a coil induces a back emf in the same coil; L is electrical inertia.
- **Mutual induction**: changing current in one coil induces emf in a nearby coil; $M_{12} = M_{21}$.
- A magnet falling through a ring or copper tube is slowed ($a < g$) because induced currents oppose its motion.
- L and M depend on geometry (turns, area, length) and the core's permeability.

Formulas & key derivations

- $\varepsilon = -N \frac{d\Phi}{dt}$
- Motional emf: $\varepsilon = Blv$
- Self-induced emf: $\varepsilon = -L \frac{dI}{dt}$; $N\Phi = LI$
- **Long solenoid**: $L = \mu_r \mu_0 n^2 A l$
- Mutual inductance (coaxial solenoids): $M = \mu_0 n_1 n_2 \pi r_1^2 l$
- Energy stored in inductor: $U = \frac{1}{2} LI^2$

Exam focus: how to score

- Apply **Lenz's law to find direction** of induced current (magnet approaching/receding a coil).
- Derive motional emf $\varepsilon = Blv$ and self-inductance of a long solenoid.
- Explain why a falling magnet's acceleration is less than g .
- Ratio problems: how L changes when length, area or turns change.

★ Important questions from CBSE sample papers

- Two identical magnets fall 20 m, one through a copper solenoid and one in air. Compare times taken. (SQP 2025-26, 1 mark)
- A bar magnet falls through a metal ring: why is $a < g$? Side of a triangular coil frame increased 5 times (same turns per length): how does L change? (SQP 2026-27, 3 marks)
- A 50-turn coil of area $5/\pi \text{ cm}^2$ rotates along the axis of a 50 cm, 2000-turn solenoid carrying 5 A. Find the maximum emf. (SQP 2025-26, 3 marks)

Remember: Nature resists change: Lenz is the 'minus' in Faraday.

Chapter 7: Alternating Current

Class XII • Physics • CBSE 2026-27

Big idea: AC voltages and currents vary sinusoidally; L and C oppose AC through reactance, and resonance occurs when $X_L = X_C$.

Key points

- AC: $v = v_m \sin \omega t$; household meters read **rms** values.
- Resistor: current **in phase** with voltage.
- Inductor: current **lags** voltage by $\pi/2$; capacitor: current **leads** by $\pi/2$; average power in each is zero.
- **Phasors** are rotating vectors whose length is the peak value; used to analyse LCR circuits.
- **Resonance** in series LCR: $X_L = X_C$, $Z = R$ (minimum), current maximum; used to tune radios.
- Power factor $\cos \phi$: 1 for pure R, 0 for pure L or C (**wattless current**).
- **AC generator**: coil rotating in B; mechanical $\rightarrow$ electrical energy by EMI.
- **Transformer**: mutual induction on a laminated soft-iron core; works only with AC.

Formulas & key derivations

- $I_{rms} = I_0/\sqrt{2}$, $V_{rms} = V_0/\sqrt{2}$
- $X_L = \omega L$; $X_C = 1/(\omega C)$
- **$Z = \sqrt{R^2 + (X_L - X_C)^2}$; $\tan \phi = (X_L - X_C)/R$**
- **Resonance: $\omega_0 = 1/\sqrt{LC}$** ; $Q = \omega_0 L/R$
- Average power $P = V_{rms} I_{rms} \cos \phi$; $\cos \phi = R/Z$
- Generator: $\varepsilon = NBA\omega \sin \omega t$; $\varepsilon_0 = NBA\omega$
- Transformer: $V_s/V_p = N_s/N_p = I_p/I_s$ (ideal)

Diagrams, maps & graphs to practise

- Phasor diagram of series LCR
- Labelled AC generator and transformer

Exam focus: how to score

- Derive impedance and phase angle of series LCR with a **phasor diagram**.
- **AC generator: diagram + derive $\varepsilon = NBA\omega \sin \omega t$** (5 marks).
- Transformer: principle, diagram, turns ratio, and losses (copper, eddy current, hysteresis, flux leakage).
- A step-up transformer does not violate energy conservation: current steps down.

★ Important questions from CBSE sample papers

- Explain the AC generator with a labelled diagram; derive the instantaneous emf of a coil of N turns, area A, speed ω . (SQP 2024-25, 5 marks)
- Describe, with a labelled diagram, the device that steps up AC voltage; why isn't it 100% efficient? (SQP 2026-27, 5 marks)
- What is resonance in series LCR? Write the resonant frequency and explain its use in radio tuning. (SQP 2026-27, 5 marks)

Remember: ELI the ICE man: Voltage leads in L, Current leads in C.

Chapter 8: Electromagnetic Waves

Class XII • Physics • CBSE 2026-27

Big idea: Changing electric and magnetic fields sustain each other and travel as transverse waves at the speed of light.

Key points

- Maxwell added **displacement current** (from a changing electric field) to Ampere's law, removing its inconsistency.
- Displacement current produces a magnetic field just like conduction current, e.g. between capacitor plates.
- **Accelerated charges** produce EM waves; an oscillating charge radiates at its own frequency.
- Hertz (1887) first produced and detected EM waves in the laboratory.
- E and B oscillate in phase, perpendicular to each other and to the direction of travel: **transverse**.
- EM waves need no medium; all travel at c in vacuum and carry energy and momentum.
- **Spectrum** (increasing wavelength): γ -rays, X-rays, UV, visible, IR, microwaves, radio waves.

Formulas & key derivations

- **Displacement current $i_d = \epsilon_0 d\Phi_E/dt$**
- $E = E_0 \sin(kx - \omega t)$, $B = B_0 \sin(kx - \omega t)$; $k = 2\pi/\lambda$, $\omega = 2\pi\nu$
- **$E_0/B_0 = c$** ; $c = 1/\sqrt{\mu_0\epsilon_0} = 3 \times 10^8 \text{ m/s}$
- In a medium: $v = 1/\sqrt{\mu\epsilon}$; refractive index $n = c/v$
- Uses: radio (communication), microwaves (radar, ovens), IR (remote controls, heating), UV (sterilising, LASIK), X-rays (medical), γ (cancer treatment)

Exam focus: how to score

- Write E or B equation from given data; identify direction from sign of kx and ωt .
- **Order of the spectrum with one source and one use each** (1-2 marks).
- Find n of a medium from $E_0/B_0 = v$ and $n = c/v$.
- Displacement current numerical: $i_d = C dV/dt$.

★ Important questions from CBSE sample papers

- A capacitor ($A = 0.001 \text{ m}^2$, $d = 0.0001 \text{ m}$) has voltage changing at 10^8 V/s . Find the displacement current. (SQP 2024-25, 1 mark)
- B amplitude 510 nT along $\hat{k}$, wave along $+x$ in vacuum, $\omega = 60 \times 10^6 \text{ rad/s}$: write the expression for E. (SQP 2025-26, 2 marks)
- Given E and B equations of a wave in a medium, find the refractive index, frequency and identify the wave. (SQP 2026-27, 2 marks)

Remember: Gamma X-rays Use Visible Infrared Micro Radio: high to low frequency.

Chapter 9: Ray Optics and Optical Instruments

Class XII • Physics • CBSE 2026-27

Big idea: Light travels in straight lines, reflecting and refracting by simple rules that let us design lenses, microscopes and telescopes.

Key points

- **Cartesian sign convention:** distances along incident light positive; measured from the pole/optical centre.
- **Snell's law:** $\sin i / \sin r = n_{21}$. Denser medium bends light towards the normal.
- **Total internal reflection** (denser $\rightarrow$ rarer, $i >$ critical angle): optical fibres, diamond sparkle, mirage, prisms.
- **Power** of lens $P = 1/f$ (diopetre); lenses in contact: powers add.
- At **minimum deviation** the ray passes symmetrically through the prism ($i = e$).
- **Compound microscope:** short-focus objective and eyepiece; **telescope:** long-focus large-aperture objective.
- **Reflecting telescopes** (Cassegrain): no chromatic aberration, easier to support large mirrors.

Formulas & key derivations

- Mirror: $1/v + 1/u = 1/f$; lens: **$1/v - 1/u = 1/f$** ; $m = v/u$ (lens)
- Spherical surface: $n_2/v - n_1/u = (n_2 - n_1)/R$
- **Lens maker's: $1/f = (n_{21} - 1)(1/R_1 - 1/R_2)$**
- $\sin i_c = 1/n$
- Prism: $A + \delta = i + e$; $n = \sin[(A + \delta_m)/2] / \sin(A/2)$
- Microscope: $m = m_o \times m_e \approx (L/f_o)(D/f_e)$; simple microscope $m = 1 + D/f$
- Telescope (normal adjustment): $m = f_o/f_e$; length = $f_o + f_e$

Diagrams, maps & graphs to practise

- Ray diagrams: compound microscope, refracting telescope, Cassegrain telescope
- Refraction through a prism

Exam focus: how to score

- **Derive lens maker's formula** and the prism relation $A + \delta = i + e$ (5-mark choice).
- Microscope/telescope numericals: always find the objective image first.
- TIR questions: compare i with i_c ; say whether ray refracts or reflects.
- Neat ray diagrams with arrows earn marks.

★ Important questions from CBSE sample papers

- Diamond $n = 2.42$: a ray inside strikes the surface at 30° ; refraction or TIR? Why do cut diamonds sparkle? (SQP 2026-27, 3 marks)
- Derive lens maker's formula. Equi-convex lens, $n = 1.55$, $f = 10$ cm: find R . (SQP 2025-26, 5 marks)
- Compound microscope $f_o = 2$ cm, $f_e = 5$ cm, object at 2.2 cm: find image position and magnifying power (final image at infinity). (SQP 2026-27, 5 marks)

Remember: Lens maker: $(n - 1) \times$ curvature difference.

Chapter 10: Wave Optics

Class XII • Physics • CBSE 2026-27

Big idea: Light is a wave: Huygens' wavefronts explain reflection and refraction, and superposition gives interference and diffraction.

Key points

- **Wavefront:** surface of constant phase. Point source → spherical; distant source → plane.
- **Huygens' principle:** every point on a wavefront is a source of secondary wavelets; the new wavefront is their forward envelope.
- Wave theory predicts light is **slower in a denser medium** ($v_1/v_2 = n_2/n_1$): verified later (Foucault).
- **Coherent sources:** same frequency with constant phase difference; needed for sustained interference.
- Two independent bulbs are not coherent; YDSE makes coherent sources by splitting one wavefront.
- Constructive: path difference $n\lambda$; destructive: $(n + \frac{1}{2})\lambda$. Fringes are equally spaced.
- **Diffraction** at a single slit: central bright maximum twice as wide as the others (qualitative).
- Wider slit → narrower central maximum.

Formulas & key derivations

- **Huygens: $\sin i/\sin r = v_1/v_2 = n_2/n_1$ (Snell's law)**
- Reflection: angle of incidence = angle of reflection (from equal triangles)
- **YDSE fringe width $\beta = \lambda D/d$** (final expression only)
- Intensity: $I = 4I_0 \cos^2(\phi/2)$
- Single slit minima: $a \sin \theta = n\lambda$; central maximum width = $2\lambda D/a$

Diagrams, maps & graphs to practise

- Plane wavefront refracted at a surface (rarer → denser)
- Plane wavefront reflected from a plane mirror

Exam focus: how to score

- **Prove Snell's law and law of reflection using Huygens' construction** (3 marks; diagram carries a mark).
- Fringe-width numericals and effect of changing λ , D , d or medium.
- Conditions for sustained interference; coherent vs incoherent sources.
- Compare interference and diffraction patterns.

★ Important questions from CBSE sample papers

- In YDSE, $d = 0.25$ mm, $D = 1.0$ m, $\lambda = 500$ nm. Assertion: fringe width is 2.0 mm. (SQP 2026-27, 1 mark)
- Light of 4000 Å and 6000 Å in YDSE: least distance from the central maximum where a dark fringe is obtained? (SQP 2024-25, 2 marks)
- Derive Snell's law using Huygens' wave theory. What prediction was later verified? (SQP 2026-27, 3 marks)
- Draw the reflected wavefront for a plane wave on a plane surface and verify the laws of reflection. (SQP 2025-26, 3 marks)

Remember: Fringe width $\beta = \lambda D/d$: longer light, wider fringes.

Chapter 11: Dual Nature of Radiation and Matter

Class XII • Physics • CBSE 2026-27

Big idea: Light shows particle behaviour (photons) in the photoelectric effect, and moving particles show wave behaviour.

Key points

- **Work function** ϕ_0 : minimum energy needed to free an electron from a metal surface.
- Hertz and Lenard observed emission of electrons when UV light fell on metal surfaces.
- Photocurrent $\propto$ **intensity**; stopping potential depends on **frequency** and metal, not intensity.
- Below the **threshold frequency** ν_0 no emission, however intense the light; emission is **instantaneous**.
- Wave theory cannot explain these; Einstein: light consists of **photons** of energy $h\nu$.
- Millikan's experiments confirmed Einstein's equation and gave h .
- **de Broglie**: moving particles have wavelength $\lambda = h/p$; noticeable only for tiny masses like electrons.

Formulas & key derivations

- Photon: $E = h\nu = hc/\lambda$; $p = h/\lambda$
- **Einstein: $K_{\max} = h\nu - \phi_0 = eV_0$** ; $\phi_0 = h\nu_0$
- **de Broglie: $\lambda = h/p = h/\sqrt{2mK} = h/\sqrt{2mqV}$**
- Electron: $\lambda = 1.227/\sqrt{V}$ nm
- $hc \approx 1240$ eV nm (quick conversion)

Diagrams, maps & graphs to practise

- Photocurrent vs anode potential (different intensities, different frequencies)
- Stopping potential V_0 vs frequency ν (slope h/e)
- λ vs $1/\sqrt{V}$ (straight line, slope $h/\sqrt{2mq}$)

Exam focus: how to score

- **Graphs: I vs V and V_0 vs ν** : say what changes the saturation current and what changes V_0 .
- Explain three features of photoelectric effect that wave theory fails to explain.
- Case-study questions (4 marks) appear regularly on this chapter.
- de Broglie numericals: compare λ for particles with the same K or the same V .

★ Important questions from CBSE sample papers

- Assertion: de Broglie wavelength of a freely falling body keeps decreasing. Reason: its momentum increases. (SQP 2024-25, 1 mark)
- Platinum ($\phi_0 = 5.63$ eV) lit by 1.6×10^{15} Hz: find minimum wavelength associated with the ejected electron. (SQP 2024-25, 2 marks)
- Plot λ vs $1/\sqrt{V}$ for a particle of mass m , charge q ; obtain the slope. (SQP 2025-26, 2 marks)
- Case study: define work function; why doesn't higher intensity raise $K_{\max}$? (SQP 2026-27, 4 marks)

Remember: Intensity decides HOW MANY electrons; frequency decides HOW FAST.

Chapter 12: Atoms

Class XII • Physics • CBSE 2026-27

Big idea: Rutherford found the tiny nucleus; Bohr's quantised orbits explain the stability of hydrogen and its line spectrum.

Key points

- **Thomson model:** positive sphere with embedded electrons (plum pudding); failed.
- **Rutherford α -scattering** (gold foil): most α pass undeflected, only $\sim 0.14\%$ deflected by more than 1° , very few bounce back.
- Conclusion: positive charge and almost all mass in a **tiny nucleus** ($\sim 10^{-4}$ of atomic size).
- **Impact parameter** b : small $b \rightarrow$ large scattering; $b = 0 \rightarrow$ head-on, α bounces back.
- Rutherford model fails: accelerating electron should spiral in; cannot explain line spectra.
- **Bohr's postulates:** stationary orbits, $L = nh/2\pi$, photon emitted on jump: $h\nu = E_i - E_f$.
- de Broglie: allowed orbit holds a whole number of wavelengths, $2\pi r_n = n\lambda$.
- Line spectra are a **fingerprint** of each element. Bohr model works only for single-electron atoms.

Formulas & key derivations

- Closest approach: $r_0 = 2Ze^2/(4\pi\epsilon_0 K)$
- **$r_n = n^2 h^2 \epsilon_0 / (\pi m e^2)$; $r_1 = 0.53 \text{ \AA}$ ($r \propto n^2$)**
- $v_n = e^2 / (2\epsilon_0 n h) \propto 1/n$
- **$E_n = -me^4 / (8\epsilon_0^2 n^2 h^2) = -13.6/n^2 \text{ eV}$**
- $KE = -E$, $PE = 2E$ (total energy negative: electron is bound)
- Ionisation energy of H = 13.6 eV

Exam focus: how to score

- **Derive r_n , v_n and E_n for the hydrogen atom** (Bohr model).
- α -scattering: observations $\rightarrow$ conclusions; distance of closest approach numericals.
- Which transition gives longest/shortest wavelength: compare energy gaps.
- Bohr's quantisation explained by de Broglie standing waves.

★ Important questions from CBSE sample papers

- Distance of closest approach of an α -particle is d at speed V ; for $d/2$, what speed? (SQP 2024-25, 1 mark)
- How does impact parameter affect the α -particle trajectory? Value for head-on collision? (SQP 2025-26, 2 marks)
- Why are hydrogen spectral lines an element's fingerprint? Minimum photon energy to ionise ground-state H? (SQP 2026-27, 2 marks)
- State Bohr's quantisation condition; how does de Broglie's hypothesis explain stationary orbits? (SQP 2026-27, 2 marks)

Remember: Radius grows as n^2 , energy shrinks as $1/n^2$.

Chapter 13: Nuclei

Class XII • Physics • CBSE 2026-27

Big idea: The nucleus is held by a strong short-range force; its mass defect is the binding energy that fission and fusion release.

Key points

- Nucleus contains **protons** (Z) and **neutrons** (N); mass number $A = Z + N$.
- **Isotopes**: same Z; **isobars**: same A; **isotones**: same N.
- $1 \text{ u} = 1/12 \text{ mass of a } ^{12}\text{C} \text{ atom} = 1.66 \times 10^{-27} \text{ kg} = 931.5 \text{ MeV}/c^2$.
- Nuclear density ($\sim 10^{17} \text{ kg/m}^3$) is the **same for all nuclei**.
- **Nuclear force**: strongest, short-range (few fm), charge-independent, attractive (repulsive below $\sim 0.8 \text{ fm}$).
- Nucleus mass < sum of nucleon masses: **mass defect** $\rightarrow$ **binding energy**.
- BE/nucleon $\sim 8 \text{ MeV}$ for $A = 30\text{-}170$; **peak $\approx 8.75 \text{ MeV}$ at $A = 56$ (iron): most stable.**
- **Fission** (heavy $\rightarrow$ middle) and **fusion** (light $\rightarrow$ heavier) both increase BE/nucleon, so release energy. Fusion powers stars.

Formulas & key derivations

- $R = R_0 A^{1/3}$, $R_0 = 1.2 \text{ fm}$
- **Mass defect $\Delta M = [Zm_p + (A - Z)m_n] - M$**
- $BE = \Delta M c^2$; BE per nucleon = BE/A
- $E = mc^2$; $1 \text{ u} \leftrightarrow 931.5 \text{ MeV}$
- Q-value = (initial mass – final mass) c^2
- Example: $^{235}\text{U} + n \rightarrow ^{133}\text{Sb} + ^{99}\text{Nb} + 4n$

Diagrams, maps & graphs to practise

- BE per nucleon vs mass number curve (mark Fe-56, fission and fusion regions)

Exam focus: how to score

- **Draw the BE/nucleon curve** and use it to explain fission and fusion.
- Binding energy and Q-value numericals: show mass defect first, then multiply by 931.5.
- Density independent of A: prove from $R \propto A^{1/3}$.
- Properties of nuclear force (2 marks).

★ Important questions from CBSE sample papers

- Ratio of nuclear densities of nuclei with $A = 8$ and $A = 27$? (SQP 2025-26, 1 mark)
- From the BE/nucleon curve, identify nuclei likely to undergo fission and fusion; justify. (SQP 2024-25, 2 marks)
- Atomic mass of ^{16}O is 15.99493 u: calculate the binding energy per nucleon. (SQP 2026-27, 3 marks)
- Write the fission reaction of Pu-239 into Xe and Zr; find the energy released. (SQP 2025-26, 3 marks)

Remember: Iron sits at the top: both splitting and joining climb towards it.

Chapter 14: Semiconductor Electronics: Materials, Devices and Simple Circuits

Class XII • Physics • CBSE 2026-27

Big idea: Band gaps decide conductors, insulators and semiconductors; a p-n junction diode lets current flow one way and rectifies AC.

Key points

- **Energy bands:** valence band (filled) and conduction band separated by a gap E_g .
- Metals: bands overlap ($E_g \approx 0$); semiconductors: $E_g < 3$ eV (Si 1.1 eV, Ge 0.72 eV); insulators: $E_g > 3$ eV.
- **Intrinsic** (pure) semiconductor: $n_e = n_h$; conductivity rises with temperature.
- **n-type:** pentavalent donors (P, As, Sb); electrons majority. **p-type:** trivalent acceptors (B, Al, In); holes majority.
- Doped crystal stays **electrically neutral**.
- **p-n junction:** diffusion and drift create a **depletion layer** of immobile ions and a barrier potential.
- **Forward bias** (p to +): barrier and depletion width fall, large current (mA). **Reverse bias:** barrier rises, tiny current (μ A).
- **Rectifier:** half-wave uses one diode; full-wave uses two diodes with a centre-tapped transformer.

Formulas & key derivations

- $n_e \times n_h = n_i^2$
- Insulator $E_g > 3$ eV; semiconductor 0.2-3 eV; metal ≈ 0
- Cut-in (knee) voltage: Si ≈ 0.7 V, Ge ≈ 0.2 -0.3 V
- **Full-wave output frequency = 2 × input (50 Hz → 100 Hz);** half-wave = same as input

Diagrams, maps & graphs to practise

- Energy band diagrams of metal, semiconductor, insulator; p- and n-type
- I-V characteristics in forward and reverse bias
- Half-wave and full-wave rectifier circuits with input/output waveforms

Exam focus: how to score

- **Full-wave rectifier: circuit, working and waveforms** (3 marks).
- Band diagrams: draw and label E_c , E_v , donor/acceptor levels.
- Explain formation of depletion region and effect of bias on its width.
- Diode-circuit MCQs: decide which diodes are forward biased first.

★ Important questions from CBSE sample papers

- Draw energy band diagram of a p-type semiconductor at $T = 0$ K and at room temperature. (SQP 2024-25, 3 marks)
- With a circuit diagram, explain the working of a full-wave rectifier. (SQP 2025-26, 3 marks)
- Compare band diagrams of metals, insulators and semiconductors; why is diamond an insulator but tin a conductor? (SQP 2026-27, 3 marks)

Remember: Forward = flow; reverse = block. Two diodes = double frequency.

Class XII

Chemistry

One-page chapter summaries
Large print • CBSE 2026-27 syllabus

1. Solutions — page 2
2. Electrochemistry — page 3
3. Chemical Kinetics — page 4
4. The d- and f-Block Elements — page 5
5. Coordination Compounds — page 6
6. Haloalkanes and Haloarenes — page 7
7. Alcohols, Phenols and Ethers — page 8
8. Aldehydes, Ketones and Carboxylic Acids — page 9
9. Amines — page 10
10. Biomolecules — page 11

Chapter 1: Solutions

Class XII • Chemistry • CBSE 2026-27

Big idea: Colligative properties depend only on the NUMBER of solute particles.

Key points

- **Molality** (m) does not change with temperature; **molarity** (M) does.
- **Henry's law**: gas solubility $\propto$ partial pressure. Higher K_H = lower solubility; solubility falls as T rises.
- **Raoult's law**: partial vapour pressure $\propto$ mole fraction. Ideal solution: $\Delta H_{\text{mix}} = 0$, $\Delta V_{\text{mix}} = 0$.
- **Positive deviation**: weaker A-B forces, $\Delta V > 0$ (acetone + CS_2 , ethanol + acetone) $\rightarrow$ minimum-boiling azeotrope.
- **Negative deviation**: stronger A-B forces, $\Delta V < 0$ (acetone + chloroform, phenol + aniline) $\rightarrow$ maximum-boiling azeotrope (68% HNO_3).
- Osmotic pressure suits proteins/polymers. 0.9% NaCl is isotonic with blood.
- **van 't Hoff factor i**: > 1 for dissociation (KCl), < 1 for association (ethanoic acid in benzene).

Formulas, definitions & facts

- $p_{\text{total}} = x_1 p_1^\circ + x_2 p_2^\circ$; Henry: $p = K_H \cdot x$
- $(p_1^\circ - p_1)/p_1^\circ = x_2$
- $\Delta T_b = i \cdot K_b \cdot m$; $\Delta T_f = i \cdot K_f \cdot m$; $\pi = i \cdot CRT$
- $M_2 = K \times w_2 \times 1000 / (\Delta T \times w_1)$
- $i = 1 + \alpha(n - 1)$ for dissociation

Exam focus: how to score

- Molar mass numericals from ΔT_f , ΔT_b , π or VP lowering: formula, units, i.
- Deviations from Raoult's law with ΔV , ΔH and an example.
- Henry's law uses: soda fizz, divers (bends), altitude.

★ Important questions from CBSE sample papers

- 10 mL acetone + 10 mL CS_2 is not 20 mL. Comment. What if CS_2 is replaced by chloroform? (SQP 2026-27, 2 marks)
- 100 g of solute A in 1000 g water lowers vapour pressure by 50%. Find molar mass of A. (SQP 2026-27, 2 marks)
- Vapour pressure of 1 molal MgCl_2 , 70% dissociated ($p^\circ = 23.8$ mm Hg)? (SQP 2025-26, 3 marks)

Remember: Positive deviation pushes apart (volume up); Negative deviates closer (volume down).

Chapter 2: Electrochemistry

Class XII • Chemistry • CBSE 2026-27

Big idea: Redox makes electricity (galvanic cell) or is driven by it (electrolytic cell).

Key points

- Galvanic: anode (–) oxidation, cathode (+) reduction. Daniell cell $E^\circ = 1.10 \text{ V}$; salt bridge keeps neutrality.
- More negative E° = stronger reducing agent; SHE = 0 V.
- On dilution κ falls, but Λ_m rises. Strong electrolyte: $\Lambda_m = \Lambda^\circ_m - A\sqrt{c}$. Weak: use **Kohlrausch's law**.
- $1 \text{ F} = 96487 \text{ C mol}^{-1}$. Electrolysis products depend on E° and overpotential.
- Mercury cell gives constant 1.35 V. **Lead storage battery** is secondary; H_2SO_4 density falls on discharge.
- H_2 – O_2 **fuel cell**: ~70% efficient, pollution-free (Apollo).
- Rusting is electrochemical; protect by paint, galvanising, sacrificial Mg/Zn.

Formulas, definitions & facts

- $E^\circ_{\text{cell}} = E^\circ_{\text{cathode}} - E^\circ_{\text{anode}}$
- $E = E^\circ - (0.059/n) \log Q$ (298 K)
- $\Delta G^\circ = -nFE^\circ$; $\log K = nE^\circ/0.059$
- $\Lambda_m = \kappa \times 1000 / C$; $\alpha = \Lambda_m/\Lambda^\circ_m$
- $\text{Pb} + \text{PbO}_2 + 2\text{H}_2\text{SO}_4 \rightarrow 2\text{PbSO}_4 + 2\text{H}_2\text{O}$
- Fuel cell: $\text{O}_2 + 2\text{H}_2\text{O} + 4e^- \rightarrow 4\text{OH}^-$; $2\text{H}_2 + 4\text{OH}^- \rightarrow 4\text{H}_2\text{O} + 4e^-$

Exam focus: how to score

- Nernst numericals (E , K , ΔG°): the top 3–5 mark item; show n .
- Kohlrausch expressions; Λ_m vs $\sqrt{c}$ graphs.
- Electrolysis products and charge in faradays.

★ Important questions from CBSE sample papers

- Charge needed to get 1 mol of M from M_2O_3 ? (SQP 2026-27, 1 mark)
- Why connect iron pipes to Mg? Electrode reactions for electrolysis of molten MgCl_2 . (SQP 2026-27, 2 marks)
- $\Lambda_m(\text{NaCl}) = 123.9$ at 0.010 M and 120.7 at 0.040 M. Find Λ°_m and A . (SQP 2026-27, 3 marks)

Remember: AN OX, RED CAT: anode oxidation, reduction at cathode.

Chapter 3: Chemical Kinetics

Class XII • Chemistry • CBSE 2026-27

Big idea: How fast reactions go, and how concentration, temperature and catalysts change it.

Key points

- **Rate law** comes from experiment, not from the balanced equation.
- **Order**: sum of powers; can be 0 or fractional. **Molecularity**: elementary step only, never 0.
- **Zero order**: rate = k, constant throughout (NH_3 on hot Pt); $t_{1/2} \propto [\text{R}]_0$.
- **First order**: $t_{1/2} = 0.693/k$, independent of $[\text{R}]_0$.
- **Pseudo first order**: one reactant in excess (acid hydrolysis of ester, inversion of sucrose).
- Effective collisions need energy $\geq$ threshold AND proper orientation.
- **Catalyst** lowers E_a ; does not change ΔG or K .

Formulas, definitions & facts

- Zero: $k = ([\text{R}]_0 - [\text{R}])/t$; $t_{1/2} = [\text{R}]_0/2k$
- First: $k = (2.303/t) \log([\text{R}]_0/[\text{R}])$
- Units of k: $(\text{mol L}^{-1})^{1-n} \text{s}^{-1}$
- $k = A e^{(-E_a/RT)}$; slope of $\log k$ vs $1/T = -E_a/2.303R$
- $\log(k_2/k_1) = (E_a/2.303R)(1/T_1 - 1/T_2)$
- First order: $t_{75\%} = 2 t_{1/2}$

Exam focus: how to score

- First-order and Arrhenius numericals (3–5 marks).
- Order from units of k or from graphs.
- Order vs molecularity; catalyst on energy diagram.

★ Important questions from CBSE sample papers

- $t_{1/2}$ of a first-order reaction is 16 min. Time for 75% completion? (SQP 2026-27, 1 mark)
- 'Rate stays constant during the reaction.' Always true, or only under conditions? (SQP 2026-27, 2 marks)
- $\log k$ vs $1/T$ has slope -4250 K . Find E_a . (SQP 2026-27, 3 marks)

Remember: 0.693 over k: first-order half-life ignores how much you start with.

Chapter 4: The d- and f-Block Elements

Class XII • Chemistry • CBSE 2026-27

Big idea: Partly filled d orbitals give variable oxidation states, colour, magnetism and catalysis.

Key points

- Zn, Cd, Hg (d^{10}) are not regarded as transition elements.
- Many unpaired electrons $\rightarrow$ high melting point and enthalpy of atomisation.
- Mn shows most oxidation states (+2 to +7). Mn^{3+} oxidising ($\rightarrow d^5$); Cr^{2+} reducing ($\rightarrow d^3$). Cu^+ disproportionates.
- Colour from d-d transitions; d^0/d^{10} ions (Sc^{3+} , Zn^{2+}) colourless.
- Catalysts (Fe in Haber, V_2O_5), interstitial compounds, alloys.
- **Lanthanoid contraction** (poor 4f shielding): Zr and Hf almost same size.
- Lanthanoids mainly +3; actinoids show more states and are radioactive.

Formulas, definitions & facts

- $\mu = \sqrt{n(n+2)}$ BM
- $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow 8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$
- $2CrO_4^{2-} + 2H^+ \rightleftharpoons Cr_2O_7^{2-} + H_2O$
- $Cr_2O_7^{2-} + 14H^+ + 6e^- \rightarrow 2Cr^{3+} + 7H_2O$
- $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$
- $MnO_4^- + 8H^+ + 5e^- \rightarrow Mn^{2+} + 4H_2O$

Exam focus: how to score

- 'Account for' reasons: m.p., colour, E° trends, oxidation states.
- Compare μ by counting unpaired electrons.
- **Balanced ionic equations of $KMnO_4/K_2Cr_2O_7$.**

★ Important questions from CBSE sample papers

- Balance $SO_3^{2-} + MnO_4^- + H^+ \rightarrow$. Why does Ti melt lower than Cr? (SQP 2026-27, 2 marks)
- Highest magnetic moment: Ti^{2+} , Co^{2+} or Fe^{2+} ? Why is Fe a good Haber catalyst? (SQP 2026-27, 3 marks)
- Why: lowest oxide basic, highest acidic; Cr hard but Hg liquid. (SQP 2024-25, 3 marks)

Remember: More unpaired electrons: higher melting point, stronger magnetism.

Chapter 5: Coordination Compounds

Class XII • Chemistry • CBSE 2026-27

Big idea: A metal bonded to ligands by coordinate bonds; structure explains colour, magnetism, isomerism.

Key points

- **Werner:** primary valency = oxidation state (ionisable); secondary = coordination number.
- Ligands: di-/polydentate, **chelate**, **ambidentate** ($\text{NO}_2^-/\text{ONO}^-$, $\text{SCN}^-/\text{NCS}^-$).
- Isomers: ionisation, linkage, coordination, hydrate; geometrical (cis/trans, fac/mer), optical.
- **$[\text{Co}(\text{en})_3]^{3+}$ and cis- $[\text{PtCl}_2(\text{en})_2]^{2+}$ are optically active**; trans forms are not.
- **VBT:** $[\text{NiCl}_4]^{2-}$ sp^3 tetrahedral; $[\text{Ni}(\text{CN})_4]^{2-}$ dsp^2 square planar.
- **CFT:** strong-field ligands pair electrons when $\Delta_o > P$ (low spin).
- Anhydrous CuSO_4 white (no ligand field). Carbonyls: **synergic bonding**.

Formulas, definitions & facts

- Series: $\text{I}^- < \text{Br}^- < \text{Cl}^- < \text{F}^- < \text{OH}^- < \text{H}_2\text{O} < \text{NH}_3 < \text{en} < \text{CN}^- < \text{CO}$
- $\Delta_t = (4/9) \Delta_o$
- d^4 : $\Delta_o < P \rightarrow t_{2g}^3 e_g^1$; $\Delta_o > P \rightarrow t_{2g}^4 e_g^0$
- $[\text{Co}(\text{NH}_3)_6]^{3+}$: $d^2\text{sp}^3$, diamagnetic

Exam focus: how to score

- IUPAC name $\leftrightarrow$ formula (anionic ligands -o, metal in anion -ate).
- Hybridisation, geometry, magnetism; t_{2g}/e_g filling.
- AgCl precipitate or conductivity $\rightarrow$ ionisable Cl^- .

★ Important questions from CBSE sample papers

- Which is tetrahedral: $[\text{Ni}(\text{CN})_4]^{2-}$, $[\text{Cu}(\text{NH}_3)_4]^{2+}$, $[\text{NiCl}_4]^{2-}$, $[\text{Co}(\text{en})_3]^{3+}$? (SQP 2026-27, 1 mark)
- $\text{PdCl}_2 \cdot 4\text{NH}_3$ gives 2 mol AgCl . Primary and secondary valency of Pd? (SQP 2026-27, 1 mark)
- Formula of diaquasilver(I) dichloridoargentate(I). (SQP 2025-26, 1 mark)

Remember: Strong field: spins pair (low spin). Weak field: spread out (high spin).

Chapter 6: Haloalkanes and Haloarenes

Class XII • Chemistry • CBSE 2026-27

Big idea: The polar C-X bond makes haloalkanes ready for substitution and elimination.

Key points

- Alcohol + **SOCl₂ is best** (by-products SO₂, HCl are gases).
- HBr + alkene: Markovnikov; with peroxide, anti-Markovnikov.
- b.p.: RI > RBr > RCl; falls with branching.
- **SN2**: one step, **inversion**; 1° > 2° > 3°.
- **SN1**: carbocation, **racemisation**; 3° > 2° > 1°; allylic/benzylic fast.
- KCN → nitrile; AgCN → isocyanide. Alc. KOH → alkene (**Zaitsev**).
- Aryl halides resist substitution; o/p -NO₂ helps. CHCl₃ in dark bottles (phosgene); freons deplete ozone.

Formulas, definitions & facts

- Finkelstein: RCl + NaI → RI + NaCl (dry acetone)
- Swarts: CH₃Br + AgF → CH₃F + AgBr
- Sandmeyer: ArN₂⁺Cl⁻ + CuCl/HCl → ArCl + N₂
- Wurtz: 2RX + 2Na → R-R (dry ether)
- Wurtz-Fittig: ArX + RX + 2Na → Ar-R
- RX + Mg → RMgX (Grignard)

Exam focus: how to score

- SN1 vs SN2: steps, stereochemistry, reactivity order.
- Named reactions; 'explain why'.
- Major product: Markovnikov, Zaitsev, KCN vs AgCN.

★ Important questions from CBSE sample papers

- (–)-2-Bromohexane + NaOH gives (+)-hexan-2-ol. SN1 or SN2? Inversion or retention? (SQP 2026-27, 1 mark)
- Nitro or methoxy: which raises chlorobenzene's reactivity towards NaOH? Why? (SQP 2026-27, 2 marks)
- Explain: Finkelstein uses dry acetone; neopentyl chloride boils lower than isopentyl chloride. (SQP 2025-26, 2 marks)

Remember: SN2 flips like an umbrella; SN1 forms a carbocation and racemises.

Chapter 7: Alcohols, Phenols and Ethers

Class XII • Chemistry • CBSE 2026-27

Big idea: The -OH and -O- groups decide acidity, boiling point and reactions.

Key points

- **Hydroboration-oxidation** gives anti-Markovnikov alcohol.
- Grignard + HCHO $\rightarrow$ 1°; other aldehydes $\rightarrow$ 2°; ketones $\rightarrow$ 3° alcohol.
- Phenol from cumene (acetone by-product). H-bonding raises b.p.
- **Acidity: phenol > water > alcohol**. $-\text{NO}_2$ raises it; $-\text{CH}_3$ lowers it.
- Dehydration: $3^\circ > 2^\circ > 1^\circ$. Oxidation: $1^\circ \rightarrow$ aldehyde (PCC); $2^\circ \rightarrow$ ketone.
- Bromine water + phenol $\rightarrow$ 2,4,6-tribromophenol (white ppt).
- Ethers by **Williamson** (1° halide + alkoxide); anisole + HI $\rightarrow$ phenol + CH_3I .

Formulas, definitions & facts

- Kolbe: phenoxide + CO_2 , H^+ $\rightarrow$ salicylic acid
- Reimer-Tiemann: phenol + CHCl_3 + NaOH $\rightarrow$ salicylaldehyde
- $\text{R-X} + \text{R'ONa} \rightarrow \text{R-O-R'} + \text{NaX}$
- Ethanol + conc. H_2SO_4 : 413 K ether; 443 K ethene
- Phenol + Zn dust $\rightarrow$ benzene

Exam focus: how to score

- Acidity of substituted phenols with reasons (case-based).
- Conversions; Kolbe, Reimer-Tiemann, Williamson.
- Mechanism: acid dehydration of ethanol.

★ Important questions from CBSE sample papers

- From pKa data: pKa of 2,4,6-trinitrophenol? Acidity order of p-halophenols? (SQP 2026-27, 4 marks)
- Propanol dehydrated at 140 °C and 180 °C: major products? (SQP 2024-25, 3 marks)
- Convert: butan-2-one $\rightarrow$ 3-methylpentan-3-ol; phenol $\rightarrow$ benzene; chloroethane $\rightarrow$ ethoxyethane. (SQP 2025-26, 3 marks)

Remember: Pull electrons (NO_2): more acidic. Push (CH_3): less.

Chapter 8: Aldehydes, Ketones and Carboxylic Acids

Class XII • Chemistry • CBSE 2026-27

Big idea: The polar C=O invites nucleophilic addition; -COOH adds acidity.

Key points

- **Aldehydes more reactive than ketones** (less hindrance, fewer alkyl groups).
- Additions: HCN, NaHSO₃ (purifies aldehydes), Grignard, alcohols (dry HCl), NH₂-Z at pH ≈ 3.5.
- Tollens' and Fehling's: aldehydes. Iodoform: methyl ketones. 2,4-DNP: both.
- α-H → aldol; no α-H → Cannizzaro.
- Acidity rises with EWG: CF₃COOH > ClCH₂COOH > HCOOH > CH₃COOH.
- -COOH + NaHCO₃ → CO₂ (test). Acid chloride > anhydride > ester > amide.

Formulas, definitions & facts

- Rosenmund: RCOCl + H₂ (Pd-BaSO₄) → RCHO
- Etard: toluene + CrO₂Cl₂ → benzaldehyde
- Clemmensen (Zn-Hg/HCl), Wolff-Kishner (NH₂NH₂, KOH): C=O → CH₂
- Aldol: 2CH₃CHO → CH₃CH(OH)CH₂CHO
- Cannizzaro: 2HCHO + KOH → CH₃OH + HCOOK
- HVZ: RCH₂COOH + X₂/red P → RCHXCOOH

Exam focus: how to score

- **Named reactions with equations** (most asked).
- Tests to distinguish pairs; flowcharts.
- Order of acidity, reactivity, ease of oxidation.

★ Important questions from CBSE sample papers

- Name and complete: 2CH₃CHO → aldol; toluene → benzaldehyde (CrO₂Cl₂); >C=O → >CH₂. (SQP 2026-27, 3 marks)
- Why pH ~3.5 for NH₂-Z addition; why NaHSO₃ purifies aldehydes? (SQP 2026-27, 2 marks)
- Flowchart: identify methanol, acetaldehyde, acetic acid using NaHCO₃ and 2,4-DNP. (SQP 2026-27, 2 marks)

Remember: No α-H: Cannizzaro. α-H: Aldol. CH₃CO-: Iodoform.

Chapter 9: Amines

Class XII • Chemistry • CBSE 2026-27

Big idea: Nitrogen's lone pair makes amines bases; diazonium salts open many syntheses.

Key points

- **Gabriel phthalimide**: pure 1° aliphatic amines only, not aniline.
- **Hoffmann bromamide**: amide → amine with one carbon less.
- Basicity (water): $(\text{C}_2\text{H}_5)_2\text{NH} > (\text{C}_2\text{H}_5)_3\text{N} > \text{C}_2\text{H}_5\text{NH}_2 > \text{NH}_3$.
- **Aniline is a weaker base** than NH_3 (lone pair in ring).
- **Hinsberg**: 1° → soluble in alkali; 2° → insoluble; 3° → no reaction.
- Nitration of aniline gives ~47% meta (anilinium). **Acetylate first** for mono-substitution.
- Diazotisation at 273–278 K; no Friedel–Crafts on aniline.

Formulas, definitions & facts

- $\text{RCONH}_2 + \text{Br}_2 + 4\text{NaOH} \rightarrow \text{RNH}_2 + \text{Na}_2\text{CO}_3 + 2\text{NaBr} + 2\text{H}_2\text{O}$
- Carbylamine: $\text{RNH}_2 + \text{CHCl}_3 + 3\text{KOH} \rightarrow \text{RNC}$ (foul) (1° only)
- $\text{ArNH}_2 + \text{NaNO}_2 + 2\text{HCl} \rightarrow \text{ArN}_2^+\text{Cl}^-$
- $\text{ArN}_2^+ + \text{CuCN} \rightarrow \text{ArCN}$; + HBF_4 , heat → ArF ; + $\text{H}_3\text{PO}_2 \rightarrow \text{ArH}$
- $\text{ArN}_2^+ + \text{phenol (alkaline)} \rightarrow \text{orange azo dye}$

Exam focus: how to score

- Basicity/pK_b order with reasons.
- Diazonium conversions step by step.
- Tests for 1°/2°/3° amines.

★ Important questions from CBSE sample papers

- X gives a foul smell with CHCl_3 and alc. KOH. Which reaction produces X? (SQP 2026-27, 1 mark)
- Convert: nitrobenzene → fluorobenzene; benzoic acid → benzylamine. (SQP 2026-27, 2 marks)
- Convert nitrobenzene → 4-bromobenzenamine. (SQP 2025-26, 1 mark)

Remember: Hinsberg: 1° dissolves in alkali, 2° stays solid, 3° stays out.

Chapter 10: Biomolecules

Class XII • Chemistry • CBSE 2026-27

Big idea: Carbohydrates, proteins, enzymes, vitamins, nucleic acids, hormones: the chemistry of life.

Key points

- **Reducing sugars** reduce Tollens'/Fehling's: glucose, maltose, lactose. **Sucrose is non-reducing.**
- Glucose gives no Schiff's test or NaHSO_3 adduct → **cyclic pyranose form** (α , β anomers).
- Starch = amylose (soluble) + amylopectin (80–85%); cellulose = β -D-glucose.
- Amino acids are **zwitter ions**; essential ones come from diet.
- Proteins: primary to quaternary; fibrous (keratin) vs globular (insulin).
- **Denaturation** destroys 2°/3° structure (curdling milk, boiled egg).
- Vitamins A, D, E, K fat-soluble; B, C water-soluble. DNA: $\text{A}=\text{T}$, $\text{G}\equiv\text{C}$; RNA has U.

Formulas, definitions & facts

- Glucose + HI → n-hexane ; + Br_2 water → gluconic acid
- Glucose + HNO_3 → saccharic acid
- Sucrose → glucose + fructose (invert sugar)
- Nucleotide = base + sugar + phosphate
- Deficiency: A night blindness; C scurvy; D rickets; K slow clotting

Exam focus: how to score

- Glucose reactions; evidence for cyclic structure.
- Reducing vs non-reducing; hydrolysis products.
- Protein structure, DNA vs RNA, vitamin diseases.

★ Important questions from CBSE sample papers

- $\text{HOOC}-\text{CH}_2-\text{CH}_2-\text{CH}(\text{NH}_2)-\text{COOH}$, made in our body: acidic or neutral, essential or not? (SQP 2026-27, 1 mark)
- How does casein change when lemon juice is added to milk? (SQP 2026-27, 1 mark)
- Why does glucose, but not sucrose, reduce Fehling's reagent? (SQP 2025-26, 1 mark)

Remember: A, D, E, K are stored in fat; B and C wash out daily.

Class XII

Biology

One-page chapter summaries
Large print • CBSE 2026-27 syllabus

1. Sexual Reproduction in Flowering Plants — page 2
2. Human Reproduction — page 3
3. Reproductive Health — page 4
4. Principles of Inheritance and Variation — page 5
5. Molecular Basis of Inheritance — page 6
6. Evolution — page 7
7. Human Health and Disease — page 8
8. Microbes in Human Welfare — page 9
9. Biotechnology: Principles and Processes — page 10
10. Biotechnology and its Applications — page 11
11. Organisms and Populations — page 12
12. Ecosystem — page 13
13. Biodiversity and its Conservation — page 14

Chapter 1: Sexual Reproduction in Flowering Plants

Class XII • Biology • CBSE 2026-27

Big idea: Pollination and double fertilisation turn ovules into seeds and ovaries into fruits.

Key points

- **Anther**: bilobed, tetrasporangiate; innermost wall layer **tapetum** nourishes pollen. Pollen mother cell ($2n$) → meiosis → pollen grains (n).
- Pollen **exine** is made of **sporopollenin**, the most resistant organic material; has **germ pores**.
- Megaspore mother cell → 4 megaspores, 1 survives → 3 mitoses → **8-nucleate, 7-celled embryo sac** (egg + 2 synergids, 3 antipodals, central cell with 2 polar nuclei).
- Pollination: **autogamy**, **geitonogamy** (another flower, same plant), **xenogamy**.
- **Outbreeding devices**: pollen and stigma maturing at different times, different positions, **self-incompatibility**, unisexual flowers.
- **Double fertilisation**: syngamy (male gamete + egg → zygote, $2n$) + triple fusion (male gamete + 2 polar nuclei → PEN, $3n$).
- **Apomixis**: seed without fertilisation. **Polyembryony** (citrus, mango). **Parthenocarpy**: seedless fruit (banana).

Key facts & ploidy

- Zygote $2n$; endosperm $3n$; egg, synergids, pollen n ; nucellus $2n$.
- Castor, maize: stop autogamy only. Papaya (dioecious): stops both.
- Hybridisation: **emasculation** → **bagging** → pollinate → rebag.

Diagrams, maps & graphs to practise

- T.S. of anther; L.S. of anatropous ovule
- 7-celled embryo sac; dicot embryo

Exam focus: how to score

- Ploidy questions are frequent: name the cell and give n , $2n$ or $3n$.
- Geitonogamy: functionally cross, genetically self. Write both halves.

★ Important questions from CBSE sample papers

- Geitonogamy can be compared with cross-pollination as well as self-pollination. Comment. (SQP 2026-27, 2 marks)
- Name the two products of double fertilisation, their ploidy, and which develops first. (SQP 2026-27, 3 marks)
- Explain how autogamy is prevented in castor and papaya. (SQP 2024-25, part of 5 marks)

Remember: Egg + male gamete = $2n$ embryo; polar nuclei + male gamete = $3n$ endosperm.

Chapter 2: Human Reproduction

Class XII • Biology • CBSE 2026-27

Big idea: Gametes meet in the oviduct; the embryo implants and grows in the uterus.

Key points

- Testes in scrotum, 2–2.5 °C below body temperature. **Sertoli cells** nourish sperm; **Leydig cells** secrete androgens.
- Female: ovaries, oviduct (ampulla), uterus (endometrium), cervix, vagina.
- **Spermatogenesis** from puberty: spermatogonium (2n) → primary spermatocyte → secondary spermatocytes (n) → spermatids → sperm.
- **Oogenesis** starts before birth; ovulation releases a **secondary oocyte**; meiosis II ends only when a sperm enters.
- **Menstrual cycle** (~28 days): menstrual (3–5 days) → follicular → **LH surge** → **ovulation (~day 14)** → luteal (corpus luteum, progesterone).
- Fertilisation in the **ampulla** → morula (8–16 cells) → blastocyst. **Trophoblast** implants; **inner cell mass** forms the embryo.
- Placenta secretes **hCG, hPL**, oestrogens, progestogens. Birth: **foetal ejection reflex** + oxytocin; **colostrum** has antibodies.

Key facts & numbers

- Primary spermatocyte = 46 chromosomes; secondary spermatocyte, spermatid, sperm = 23.
- LH → Leydig cells (androgens); FSH → Sertoli cells (spermiogenesis).
- Baby's sex is decided by the sperm (X or Y).

Diagrams, maps & graphs to practise

- Male and female reproductive systems
- Seminiferous tubule; ovary section; sperm

Exam focus: how to score

- Flow charts of spermatogenesis and oogenesis with ploidy earn full marks.
- Link FSH, LH surge and progesterone to each phase of the cycle.

★ Important questions from CBSE sample papers

- Madhuri's cycles vary from 20 to 45 days with heavy bleeding. How might absence of an LH surge explain this? (SQP 2026-27, 4 marks)
- A blood test is negative for hCG. What does it imply? Which tissue produces hCG? (SQP 2024-25, 2 marks)
- Explain embryonic development from morula till establishment of pregnancy. (SQP 2023-24, 3 marks)

Remember: Morula → blastocyst → trophoblast implants → placenta makes hCG.

Chapter 3: Reproductive Health

Class XII • Biology • CBSE 2026-27

Big idea: Healthy reproduction needs safe birth control, STI prevention and help for infertility.

Key points

- Legal marriage age: 18 (female), 21 (male). Ideal contraceptive: user-friendly, reversible, few side effects.
- **Natural**: periodic abstinence (days 10–17), withdrawal, **lactational amenorrhea** (up to ~6 months after birth).
- **Barriers**: condoms (also block STIs), diaphragms, cervical caps. **IUDs** (CuT, Multiload 375, LNG-20) suit **spacing children**.
- **Pills** stop ovulation and implantation; **Saheli** is non-steroidal, once a week. Emergency: within **72 hours**.
- **Terminal**: vasectomy, tubectomy. **MTP** is relatively safe up to 12 weeks (MTP Amendment Act, 2017).
- **STIs**: gonorrhoea, syphilis, herpes, chlamydiasis, hepatitis-B, HIV. Hepatitis-B, herpes, HIV are not fully curable.
- **ART**: IVF-ET; **ZIFT** (embryo up to 8 blastomeres → fallopian tube); **IUT** (more than 8 → uterus); **GIFT**; **ICSI**; **IUI**.

How each method works

- Copper IUD: Cu ions cut sperm motility and fertilising capacity.
- Hormone IUD: uterus unsuitable for implantation, cervix hostile to sperm.
- GIFT: donor ovum into the fallopian tube of a female who cannot make ova.
- ICSI: sperm injected into ovum. IUI: semen placed in uterus (low count).

Exam focus: how to score

- Case questions: match the couple's problem to ZIFT, IUT, GIFT, ICSI or IUI and justify.
- Match each situation to a contraceptive and its mode of action.
- Condom is the only method that also prevents STIs.

★ Important questions from CBSE sample papers

- Female A has blocked fallopian tubes; male B has very low sperm count. Which two ARTs would you recommend? Justify. (SQP 2026-27, 3 marks)
- Suggest a contraceptive: Mohini wants protection from conception and STIs; Lalita wants no more children; Geeta wants a reversible method. (SQP 2025-26, 3 marks)
- Suggest a suitable ART for five couples with different test reports and justify. (SQP 2023-24, 5 marks)

Remember: ≤ 8 blastomeres → ZIFT (tube); > 8 → IUT (uterus).

Chapter 4: Principles of Inheritance and Variation

Class XII • Biology • CBSE 2026-27

Big idea: Genes on chromosomes pass to offspring in predictable patterns, with exceptions.

Key points

- Mendel used **garden pea** (7 trait pairs). Laws: **dominance**, **segregation**, **independent assortment**.
- **Incomplete dominance**: snapdragon (F2 1:2:1). **Co-dominance + multiple alleles**: ABO blood groups (I^A , I^B , i).
- **Chromosomal theory**: Sutton & Boveri. Morgan (*Drosophila*) found **linkage**; Sturtevant mapped genes by recombination.
- **Polygenic**: human skin colour. **Pleiotropy**: one gene, many effects (phenylketonuria).
- Sex: humans XX/XY (father decides); birds ZW female; honey bee **haplodiploid** (unfertilised egg → male).
- **Haemophilia, colour blindness: sex-linked recessive**. Sickle-cell, thalassemia, PKU: autosomal recessive.
- **Down's** (trisomy 21), **Klinefelter's** (44+XXY), **Turner's** (44+XO).

Ratios & key facts

- Monohybrid F2: 3:1 (phenotype), 1:2:1 (genotype). Dihybrid: **9:3:3:1**. Test cross: 1:1.
- ABO: 6 genotypes, 4 phenotypes.
- Sickle-cell: GAG → GUG; glutamic acid → valine at 6th position of β -globin.

Diagrams, maps & graphs to practise

- Monohybrid and dihybrid Punnett squares
- Pedigree symbols; sex-linked pedigree

Exam focus: how to score

- Write genotypes, gametes, Punnett square and ratio: each step carries marks.
- Incomplete dominance = blend; co-dominance = both show.
- X-linked recessive pedigrees mostly affect males.

★ Important questions from CBSE sample papers

- Mice: cross $Rrbb \times RrBb$; draw the Punnett square, give the ratio and Running-Black count in 64 offspring. (SQP 2026-27, 3 marks)
- How can a single gene mutation cause phenylketonuria? Explain pleiotropy. (SQP 2026-27, 3 marks)
- A foetus has 45 chromosomes with one X. Name the condition and how it arises. (SQP 2023-24, 3 marks)

Remember: Dominance, segregation, assortment; then exceptions: blend, both, many.

Chapter 5: Molecular Basis of Inheritance

Class XII • Biology • CBSE 2026-27

Big idea: DNA stores information, copies itself, and is read into RNA and protein.

Key points

- Double helix (Watson & Crick): antiparallel; A=T, G≡C; 10 bp per turn, 3.4 nm pitch. **Nucleosome** = histone octamer + 200 bp.
- DNA is genetic material: Griffith, Avery-MacLeod-McCarty, **Hershey-Chase** (³²P DNA entered bacteria, ³⁵S protein did not).
- **Semi-conservative replication**: Meselson & Stahl (¹⁵N). Leading strand continuous; lagging in **Okazaki fragments**, joined by ligase.
- Transcription unit: **promoter** – structural gene – **terminator**. Coding strand matches mRNA (T→U).
- Eukaryotic hnRNA: **splicing** (introns out), **capping** (5'), **tailing** (poly-A, 3').
- **Code**: triplet; AUG = start (Met); UAA, UAG, UGA = stop; degenerate, unambiguous, near-universal. tRNA = adapter.
- **Lac operon**: lactose (inducer) binds repressor, so z, y, a are transcribed. **DNA fingerprinting** uses VNTRs.

Numbers & enzymes

- Length = bp × 0.34 nm. Human DNA ≈ 2.2 m; genome ≈ 3 × 10⁹ bp, ~30,000 genes.
- Bacteria: σ factor starts, ρ factor stops transcription.
- RNA pol I → rRNA; II → hnRNA; III → tRNA, 5S rRNA, snRNA.
- z = β-galactosidase, y = permease, a = transacetylase.

Diagrams, maps & graphs to practise

- Nucleosome; replication fork
- Transcription unit; lac operon

Exam focus: how to score

- Write template, coding and mRNA strands with 5'/3' polarity.
- Count amino acids from AUG to the codon before the stop; remove introns first.
- Substitution vs frameshift (insertion/deletion) mutations.

★ Important questions from CBSE sample papers

- A DNA stretch suffers two UV errors. Name each mutation type and give the amino acid sequence formed. (SQP 2026-27, 5 marks)
- How is the rate of initiation of RNA polymerase at a promoter regulated in prokaryotes? (SQP 2025-26, 2 marks)
- Describe the steps of Southern blot hybridisation using radiolabelled VNTR as a probe. (SQP 2024-25, 3 marks)

Remember: DNA → RNA → protein; AUG starts, UAA/UAG/UGA stop.

Chapter 6: Evolution

Class XII • Biology • CBSE 2026-27

Big idea: Life arose from chemicals; natural selection on variation has shaped every species.

Key points

- Earth $\approx$ 4.5 billion years old; life $\sim$ 4 billion years ago. **Miller**: CH_4 , H_2 , NH_3 , water vapour at 800°C $\rightarrow$ amino acids.
- **Homologous organs** (divergent: forelimbs of whale, bat, human) vs **analogous** (convergent: wings of butterfly and bird).
- Selection today: **industrial melanism** (peppered moth); antibiotic resistance.
- **Adaptive radiation**: Darwin's finches, Australian marsupials.
- **Darwin**: natural selection of the fittest. **de Vries**: mutation, saltation (evening primrose).
- **Hardy-Weinberg** disturbed by gene flow, genetic drift, mutation, recombination, natural selection.
- Selection: **stabilising, directional, disruptive**. Humans: Homo habilis (650–800 cc) $\rightarrow$ H. erectus (900 cc) $\rightarrow$ Neanderthal (1400 cc) $\rightarrow$ H. sapiens.

Formula & key facts

- **$p^2 + 2pq + q^2 = 1$** ; $p + q = 1$. $2pq$ = heterozygotes.
- Homologous: Bougainvillea thorn, Cucurbita tendril. Analogous: sweet potato, potato.
- Founder effect: a small group drifts into a new population.

Diagrams, maps & graphs to practise

- Miller's apparatus; homologous forelimbs
- Three types of natural selection (graphs)

Exam focus: how to score

- Hardy-Weinberg sums: find q from q^2 first, then p and $2pq$.
- Classify examples correctly as homologous or analogous.
- Giraffe neck = directional selection.

★ Important questions from CBSE sample papers

- Movement of landmasses changed animal distribution and evolution. Explain with two examples. (SQP 2026-27, 2 marks)
- Beetles in H-W equilibrium: 40% red (bb). Find % heterozygous and frequency of BB . (SQP 2024-25, 4 marks)
- Name the three types of natural selection shown and graph the result after generations. (SQP 2023-24, 3 marks)

Remember: Homologous = same origin, different job; analogous = same job, different origin.

Chapter 7: Human Health and Disease

Class XII • Biology • CBSE 2026-27

Big idea: Pathogens, cancer and drugs threaten health; immunity and awareness protect it.

Key points

- **Typhoid:** *Salmonella typhi* (Widal test). **Pneumonia:** *Streptococcus*, *Haemophilus*. **Common cold:** rhino viruses.
- **Malaria:** *Plasmodium* via female *Anopheles*; sporozoites → liver → RBCs; **haemozoin** causes chill and fever.
- **Amoebiasis** (*Entamoeba*), **ascariasis** (*Ascaris*), **filariasis** (*Wuchereria*), **ringworm** (*Microsporum*, *Trichophyton*). Dengue, chikungunya: *Aedes*.
- **Innate immunity:** barriers. **Acquired:** B cells (antibodies), T cells (cell-mediated).
- **Secondary (anamnestic) response** is faster and stronger due to memory cells: basis of vaccines. Passive = ready-made antibodies.
- **HIV** multiplies in macrophages, destroys **helper T cells**; tested by ELISA. Cancer spreads by **metastasis**.
- Drugs: opioids (heroin), cannabinoids, cocaine. **Dependence** brings withdrawal symptoms.

Key facts

- Antibody = H_2L_2 ; IgA, IgM, IgE, IgG. Colostrum gives IgA.
- Primary lymphoid: bone marrow, thymus. Secondary: spleen, lymph nodes, tonsils, Peyer's patches.

Diagrams, maps & graphs to practise

- Life cycle of *Plasmodium*; antibody structure
- Replication of HIV

Exam focus: how to score

- Give pathogen + vector + symptom together.
- Graphs: primary vs secondary response; HIV vs helper T count.
- Active vs passive immunity with an example each.

★ Important questions from CBSE sample papers

- How does addiction differ from dependence? Why must long-term users keep raising the dose? (SQP 2026-27, 3 marks)
- A mosquito-borne non-viral disease causes recurring fever. Explain the cause and how the pathogen multiplies in humans. (SQP 2024-25, 4 marks)
- Explain the role of primary and secondary lymphoid organs with examples. (SQP 2023-24, 5 marks)

Remember: Memory cells make the second attack weaker: that is why vaccines work.

Chapter 8: Microbes in Human Welfare

Class XII • Biology • CBSE 2026-27

Big idea: Microbes make food, medicines and fuel, clean sewage, and protect crops.

Key points

- **Lactobacillus**: curd, more vitamin B12. **Saccharomyces cerevisiae**: bread, alcoholic drinks. Swiss cheese holes: CO₂ from Propionibacterium.
- **Penicillin** (Fleming); use antibiotics judiciously to avoid resistance.
- Acids: citric (Aspergillus niger), acetic (Acetobacter), butyric (Clostridium), lactic (Lactobacillus).
- **Sewage**: primary (filter, settle) → secondary (aeration; **flocs** eat organic matter, BOD falls) → anaerobic digesters → biogas.
- **Biogas** (mostly methane) from **methanogens** (Methanobacterium); gobar gas by IARI and KVIC.
- **Biocontrol**: ladybird (aphids), Bt (caterpillars), Trichoderma, **Nucleopolyhedrovirus (baculovirus)**.
- **Biofertilisers**: Rhizobium, Azotobacter, Azospirillum; Anabaena, Nostoc (paddy); **Glomus** mycorrhiza (phosphorus).

Microbe → product

- Streptokinase: clot buster. Cyclosporin A: immunosuppressant. Statins (Monascus): lower cholesterol.
- **BOD**: O₂ used by microbes in 1 L water; high BOD = high pollution.
- Baculoviruses are species-specific: safe for non-target insects.

Exam focus: how to score

- Pair each microbe with its product.
- Explain why BOD falls in the aeration tank.
- Justify NPV/Bt as eco-friendly, species-specific biocontrol.

★ Important questions from CBSE sample papers

- A farmer used Nucleopolyhedrovirus on cabbage loopers. Justify the choice; suggest another IPM strategy. (SQP 2026-27, 4 marks)
- Explain the role of the three main sources of biofertilisers. (SQP 2024-25, 3 marks)
- The aeration tank of a sewage plant fails. Explain the impact on treatment and BOD. (SQP 2023-24, 3 marks)

Remember: High BOD = dirty water; flocs eat organic matter to bring it down.

Chapter 9: Biotechnology: Principles and Processes

Class XII • Biology • CBSE 2026-27

Big idea: Recombinant DNA technology cuts, joins and copies genes, then grows them in hosts.

Key points

- Core: **genetic engineering** + **bioprocess engineering**. First rDNA: Cohen & Boyer, 1972.
- **Restriction enzymes** cut at **palindromes**, leaving **sticky ends**; **DNA ligase** joins them.
- **Gel electrophoresis**: DNA moves to anode; small pieces go farther; ethidium bromide stain.
- **Vector** needs **ori**, a **selectable marker**, cloning sites (pBR322). Plants: **Agrobacterium** Ti plasmid; animals: retroviruses.
- **Insertional inactivation**: insert in lacZ → **colourless colonies** = **recombinant**; blue = non-recombinant.
- Entry: CaCl₂ + heat shock (42 °C), microinjection, **gene gun**. Break cells: lysozyme, cellulase, chitinase; **chilled ethanol** precipitates DNA.
- **PCR**: denaturation → primer annealing → extension (**Taq polymerase**). Then bioreactors and downstream processing.

Key facts

- EcoRI: E = Escherichia, co = coli, R = strain RY 13, I = first found.
- BamHI palindrome: 5'-GGATCC-3' / 3'-CCTAGG-5'.
- pBR322: BamHI, Sall in tetR; PstI, PvuI in ampR.

Diagrams, maps & graphs to practise

- EcoRI cut forming rDNA; pBR322 map
- PCR cycle; stirred-tank bioreactor

Exam focus: how to score

- Insert in tetR: cell resists ampicillin, becomes tetracycline-sensitive.
- Explain why recombinants are colourless in blue-white selection.
- Use cellulase only for plant cells; lysozyme for bacteria.

★ Important questions from CBSE sample papers

- How have pathogens been modified into vectors? Describe one plant and one animal vector. (SQP 2026-27, 3 marks)
- Explain how PCR amplifies a small amount of template DNA. (SQP 2024-25, 3 marks)
- Why is insertional inactivation preferred to antibiotic resistance to detect recombinants? (SQP 2025-26, 2 marks)

Remember: Cut (restriction enzyme), join (ligase), carry (vector), copy (PCR).

Chapter 10: Biotechnology and its Applications

Class XII • Biology • CBSE 2026-27

Big idea: Biotech gives pest-proof crops, human insulin, gene therapy and transgenic animals.

Key points

- GM crops: stress-tolerant, fewer pesticides, less post-harvest loss, better nutrition (golden rice).
- **Bt cotton**: cry genes from **Bacillus thuringiensis**; inactive **protoxin** turns active in alkaline gut, makes pores in midgut cells.
- **RNA interference**: dsRNA silences mRNA of nematode **Meloidogyne incognita**.
- **Insulin**: chains A and B made in E. coli, joined by disulphide bonds (Eli Lilly, 1983).
- **Gene therapy**: 1990, girl with **ADA deficiency**; ADA cDNA into lymphocytes by retroviral vector.
- Diagnosis: PCR, **ELISA** (antigen-antibody). **Transgenic animals** (>95% mice): disease study, vaccine safety.
- **Rosie** cow: human protein milk (2.4 g/L, α -lactalbumin). **GEAC** checks GM safety; **biopiracy** (basmati patent).

Key facts

- cryIAC, cryIIAb → cotton bollworms; cryIAb → corn borer.
- Permanent ADA cure: gene into marrow cells at early embryo stage.
- Transgenic = organism carrying a foreign gene.

Exam focus: how to score

- Bt: protoxin → alkaline activation → pores → cell lysis → death.
- RNAi: nematode, Agrobacterium vector, dsRNA silencing.
- Ethics questions: give one clear concern (safety, biodiversity, patent).

★ Important questions from CBSE sample papers

- Rosie's milk has 2.4 g/L α -lactalbumin. Which milk gives least? Predict an ethical concern if raised further. (SQP 2026-27, 2 marks)
- Explain how biotechnology helps prevent nematode infestation and raise yield. (SQP 2024-25, 5 marks)
- GM corn resisted corn borers. Name the gene and explain Bt's effect on the pest. (SQP 2023-24, 3 marks)

Remember: Bt toxin wakes up only in the insect's alkaline gut.

Chapter 11: Organisms and Populations

Class XII • Biology • CBSE 2026-27

Big idea: Populations grow, age and interact with other species.

Key points

- Attributes: birth rate, death rate, sex ratio, **age pyramid**: expanding (triangle), stable (bell), declining (urn).
- Growth: $N_{t+1} = N_t + [(B + I) - (D + E)]$.
- **Exponential** (J-curve): unlimited resources. **Logistic** (S-curve) levels off at carrying capacity **K**.
- **Mutualism** (+/+): lichens, mycorrhiza, fig-wasp; Ophrys orchid 'sexual deceit'.
- **Predation** (+/-): Cactoblastis moth controlled prickly pear. Defences: camouflage, toxins (Monarch butterfly).
- **Competition** (-/-): Gause's **competitive exclusion**; Balanus excluded Chthamalus. **Resource partitioning**: MacArthur's warblers.
- **Parasitism** (+/-): Cuscuta, cuckoo. **Commensalism** (+/0): orchid on mango, cattle egret.

Equations & key facts

- Exponential: $\frac{dN}{dt} = rN$; $N_t = N_0 e^{rt}$.
- Logistic: $\frac{dN}{dt} = rN (K - N)/K$.
- India's r (1981) = 0.0205. Amensalism: -/0.

Diagrams, maps & graphs to practise

- Age pyramids
- J and S growth curves

Exam focus: how to score

- Broad-based pyramid = growing; urn = declining.
- Give +/- signs and one example for each interaction.
- Explain coexistence by resource partitioning.

★ Important questions from CBSE sample papers

- A nematode lives in ants without killing them. What interaction is this? Why is early harm bad for it? (SQP 2026-27, 3 marks)
- Warblers feed on different parts of a spruce tree. How do they co-exist? Does Gause's principle apply? (SQP 2024-25, 3 marks)
- Comment on Japan's age pyramids for 1950, 2007 and 2050. (SQP 2025-26, 3 marks)

Remember: J-curve = unlimited food; S-curve = stops at K.

Chapter 12: Ecosystem

Class XII • Biology • CBSE 2026-27

Big idea: Energy flows one way from the sun, losing about 90% at each level.

Key points

- Ecosystem = biotic + abiotic parts; **stratification**: trees, shrubs, herbs.
- **GPP** = total photosynthesis; **NPP = GPP – R**. Biosphere NPP ≈ 170 billion tons/year; oceans only 55.
- **Decomposition**: fragmentation → leaching → catabolism → humification → mineralisation.
- Fast if warm, moist, nitrogen-rich; slow with lignin, chitin, cold.
- Under 50% of sunlight is **PAR**; plants capture 2–10% of it.
- Energy flow is **unidirectional**; **10 per cent law**.
- Biomass pyramid is **inverted in sea**; **energy pyramid is always upright**.

Formulas & key facts

- $NPP = GPP - R$.
- $1000\text{ J} \rightarrow 100\text{ J} \rightarrow 10\text{ J} \rightarrow 1\text{ J}$ up the chain.
- Standing crop = living biomass at a given time.
- Inverted pyramid of numbers: one tree, many insects.

Diagrams, maps & graphs to practise

- Pyramids of number, biomass, energy
- Decomposition cycle

Exam focus: how to score

- Numericals: compute NPP or energy at each level with units.
- Why energy pyramid is never inverted: heat lost at every level.
- Draw pyramids from data and label trophic levels.

★ Important questions from CBSE sample papers

- Region X: GPP 3500, R 1300 g/m²/year. Calculate NPP; give its significance. (SQP 2026-27, 2 marks)
- Organic waste in a compost pile shrinks over weeks. Explain the processes and organisms involved. (SQP 2026-27, 5 marks)
- Biomass: phytoplankton 4, zooplankton 11, small fish 25, large fish 37 kg/m². Draw the pyramid; upright or inverted? (SQP 2023-24, 2 marks)

Remember: Energy never goes back: 10% moves up, 90% is lost as heat.

Chapter 13: Biodiversity and its Conservation

Class XII • Biology • CBSE 2026-27

Big idea: Life's variety is unevenly spread, fast disappearing, and must be protected.

Key points

- Levels: **genetic** (Rauwolfia; 50,000+ rice strains), **species**, **ecological**.
- ~1.5 million species described (May: ~7 million). India: **2.4% land, 8.1% species**; 12 mega-diversity countries.
- **Latitudinal gradient**: tropics richest (Colombia ~1400 birds, Greenland 56): stable, less seasonal, more sunlight.
- **Species-area**: $\log S = \log C + Z \log A$; $Z = 0.1-0.2$ (0.6–1.2 for large areas).
- 784 extinctions in 500 years (IUCN 2004): dodo, quagga, Steller's sea cow.
- **Evil Quartet**: habitat loss (main cause), over-exploitation, **alien species** (Nile perch), **co-extinction**.
- **In situ**: 34 hotspots, biosphere reserves, national parks, **sacred groves**. **Ex situ**: zoos, seed banks, cryopreservation.

Key facts

- Why conserve: narrowly utilitarian (25% drugs), broadly utilitarian (Amazon ~20% O₂), ethical.
- India's hotspots: Western Ghats & Sri Lanka, Indo-Burma, Himalaya.
- Sacred groves: Khasi & Jaintia Hills, Aravalli Hills, Western Ghats.

Diagrams, maps & graphs to practise

- Species-area curve
- Pie chart of global species diversity

Exam focus: how to score

- Case studies: name each Evil Quartet threat with an example.
- Give two reasons why tropics have more species.
- In situ vs ex situ with two examples each.

★ Important questions from CBSE sample papers

- Green Valley X faces plant over-harvest, an alien grass, falling endemic trees and fire. Identify four threats; suggest an in-situ step. (SQP 2026-27, 5 marks)
- Why conserve biodiversity? Explain two causes of its loss. (SQP 2024-25, 5 marks)
- Give three reasons why ecologists give no figures for prokaryote diversity. (SQP 2023-24, 3 marks)

Remember: Evil Quartet: Habitat loss, Over-exploitation, Aliens, Co-extinction.

Class XII

Mathematics

One-page chapter summaries
Large print • CBSE 2026-27 syllabus

1. Relations and Functions — page 2
2. Inverse Trigonometric Functions — page 3
3. Matrices — page 4
4. Determinants — page 5
5. Continuity and Differentiability — page 6
6. Application of Derivatives — page 7
7. Integrals — page 8
8. Application of Integrals — page 9
9. Differential Equations — page 10
10. Vector Algebra — page 11
11. Three Dimensional Geometry — page 12
12. Linear Programming — page 13
13. Probability — page 14

Chapter 1: Relations and Functions

Class XII • Mathematics • CBSE 2026-27

Big idea: A relation links elements of two sets; a function is a relation giving each input exactly one output.

Key points

- A **relation** R from A to B is any subset of $A \times B$; a relation on A is a subset of $A \times A$.
- **Empty relation**: $R = \emptyset$. **Universal relation**: $R = A \times A$.
- **Reflexive**: $(a, a) \in R$ for every $a \in A$.
- **Symmetric**: $(a, b) \in R \Rightarrow (b, a) \in R$.
- **Transitive**: $(a, b) \in R$ and $(b, c) \in R \Rightarrow (a, c) \in R$.
- **Equivalence relation = reflexive + symmetric + transitive**; it splits A into disjoint **equivalence classes**.
- **One-one (injective)**: $f(x_1) = f(x_2) \Rightarrow x_1 = x_2$. **Onto (surjective)**: range = codomain.
- **Bijjective** = one-one and onto.

Definitions & quick checks

- Equivalence class $[a] = \{x \in A : (x, a) \in R\}$
- Onto test: solve $y = f(x)$ for x and check x lies in the domain for every y in codomain
- Not one-one: find $x_1 \neq x_2$ with $f(x_1) = f(x_2)$ (e.g. $f(x) = x^2$ on $\mathbb{R}$: $f(-1) = f(1)$)
- A finite set $A \rightarrow A$: one-one $\Leftrightarrow$ onto

Exam focus: how to score

- **5-mark: prove a relation is an equivalence relation** — check all three properties with general elements.
- To disprove a property, one clear **counter-example** is enough.
- Injective/surjective questions: state domain and codomain clearly; codomain decides onto.
- Case studies (4 marks) give real situations (e.g. traffic flow) — write R as ordered pairs first.

★ Important questions from CBSE sample papers

- $A = \mathbb{N} \times \mathbb{N}$; $(a, b) R (c, d)$ iff $a^2 + d^2 = b^2 + c^2$. Check whether R is an equivalence relation. (SQP 2026-27, 5 marks)
- $R: (-\infty, \infty) \rightarrow [0, \infty)$, $R = \{(x, y): y = x^2 + 5\}$. Is it a function? If so, is it injective? surjective? (SQP 2026-27, 5 marks)
- Traffic flows $A \rightarrow B$, $A \rightarrow C$, $A \rightarrow D$, $B \rightarrow C$, $B \rightarrow E$, $C \rightarrow E$, $D \rightarrow E$, $D \rightarrow C$. Is the flow reflexive? transitive? Justify. (SQP 2025-26, 4 marks)

Remember: RST = Reflexive, Symmetric, Transitive $\rightarrow$ Equivalence.

Chapter 2: Inverse Trigonometric Functions

Class XII • Mathematics • CBSE 2026-27

Big idea: Trig functions become invertible only after restricting their domain to a principal value branch.

Key points

- Trig functions are not one-one on $\mathbb{R}$, so we restrict domains to make them **bijective** and then invert.
- $\sin^{-1}x$ is the **inverse function**, not $(\sin x)^{-1} = 1/\sin x$.
- The branch with the standard range is the **principal value branch**; its value is the **principal value**.
- Graph of $y = \sin^{-1}x$ is the graph of $y = \sin x$ reflected in the line **$y = x$** .
- $\sin(\sin^{-1}x) = x$ for $x \in [-1, 1]$; $\sin^{-1}(\sin x) = x$ only for $x \in [-\pi/2, \pi/2]$.
- Always give answers **inside the principal range**.

Domains & principal ranges (must learn)

- **$\sin^{-1}: [-1, 1] \rightarrow [-\pi/2, \pi/2]$ $\cos^{-1}: [-1, 1] \rightarrow [0, \pi]$**
- $\tan^{-1}: \mathbb{R} \rightarrow (-\pi/2, \pi/2)$ $\cot^{-1}: \mathbb{R} \rightarrow (0, \pi)$
- $\sec^{-1}: \mathbb{R} - (-1, 1) \rightarrow [0, \pi] - \{\pi/2\}$
- $\operatorname{cosec}^{-1}: \mathbb{R} - (-1, 1) \rightarrow [-\pi/2, \pi/2] - \{0\}$
- $\sin^{-1}(-x) = -\sin^{-1}x$; $\tan^{-1}(-x) = -\tan^{-1}x$
- $\cos^{-1}(-x) = \pi - \cos^{-1}x$; $\cot^{-1}(-x) = \pi - \cot^{-1}x$

Graphs to practise

- Graphs of $\sin^{-1}x$, $\cos^{-1}x$, $\tan^{-1}x$ (swap axes of $\sin$, $\cos$, $\tan$ on their principal branches)

Exam focus: how to score

- Mostly 1-mark MCQs and 2-mark questions: principal values, domains, graph identification.
- **Domain of $\sin^{-1}(g(x))$ or $\cos^{-1}(g(x))$: solve $-1 \leq g(x) \leq 1$** ; for $\sec^{-1}(g(x))$ solve $|g(x)| \geq 1$.
- Assertion-Reason often tests principal ranges.

★ Important questions from CBSE sample papers

- Domain of $\sec^{-1}(2x)$ is? (SQP 2026-27, 1 mark)
- Find the value of $\cot^{-1}(2 \cos(\sin^{-1}(\sqrt{3}/2)))$. (SQP 2026-27, 1 mark)
- Find the domain of $\cos^{-1}(3x - 2)$. (SQP 2025-26, 2 marks)
- Evaluate $\tan(\tan^{-1}(-1) + \pi/3)$. (SQP 2025-26, 2 marks)

Remember: $\sin$ & $\tan$: centre at 0 ($-\pi/2$ to $\pi/2$); $\cos$ & $\cot$: start at 0 (0 to π).

Chapter 3: Matrices

Class XII • Mathematics • CBSE 2026-27

Big idea: A matrix is an ordered rectangular array of numbers with its own rules of algebra.

Key points

- Order $m \times n$ = m rows, n columns; mn elements.
- Types: column, row, **square**, **diagonal**, **scalar**, **identity I**, **zero O**.
- Equal matrices: same order and every corresponding element equal.
- Add/subtract only matrices of the **same order**; kA multiplies every element by k .
- **AB is defined only if columns of A = rows of B** ; $(m \times n)(n \times p)$ gives $m \times p$.
- Multiplication is **not commutative**: $AB \neq BA$ in general; $AB = O$ is possible with $A \neq O$, $B \neq O$.
- **Transpose** A' : rows become columns.
- If $AB = BA = I$, B is the **inverse** of A ; the inverse, if it exists, is **unique**.

Properties to remember

- $(A')' = A$, $(kA)' = kA'$, $(A + B)' = A' + B'$
- **$(AB)' = B'A'$**
- **Symmetric**: $A' = A$. **Skew symmetric**: $A' = -A$ (diagonal elements are 0)
- $A = \frac{1}{2}(A + A') + \frac{1}{2}(A - A')$ (symmetric + skew symmetric)
- $A(BC) = (AB)C$, $A(B + C) = AB + AC$, $IA = AI = A$
- $(AB)^{-1} = B^{-1}A^{-1}$

Exam focus: how to score

- 1-mark MCQs: order of product, symmetric matrix entries, solving for unknowns by equality.
- Show each element of a product clearly (row $\times$ column); arithmetic slips cost marks.
- **Express a matrix as sum of symmetric and skew symmetric parts** — a favourite.

★ Important questions from CBSE sample papers

- $A = \begin{bmatrix} 2 & 1 & -2 \\ 3a & 0 & 4 \\ b & 2c & 1 \end{bmatrix}$ is symmetric. Find $\sqrt{6a + 2b + 3c}$. (SQP 2026-27, 1 mark)
- If $\begin{bmatrix} 1 & x \end{bmatrix} \cdot \begin{bmatrix} 1 & 0 \\ 0 & 2 \end{bmatrix} \cdot \begin{bmatrix} 4 \\ -1 \end{bmatrix} = O$, find x . (SQP 2026-27, 1 mark)
- $P = \begin{bmatrix} 2 & 0 & 0 \\ 0 & 1 & 2 \end{bmatrix}$, $Q = \begin{bmatrix} 1 & 0 \\ 0 & 2 \\ 1 & 0 \end{bmatrix}$: find PQ and QP (whichever defined) and the inverse of the product if it exists. (SQP 2026-27, 3 marks)

Remember: Rows of the first $\times$ columns of the second; order matters.

Chapter 4: Determinants

Class XII • Mathematics • CBSE 2026-27

Big idea: Every square matrix has a number, its determinant, that tells us if it is invertible and solves equations.

Key points

- Determinant defined for **square matrices** only; $|A|$ for orders 1, 2, 3.
- Expand a 3×3 along any row or column — pick the one with most zeros.
- **Minor** M_{ij} : determinant left after deleting row i , column j . **Cofactor** $A_{ij} = (-1)^{i+j} M_{ij}$.
- **adj A** = transpose of the cofactor matrix.
- A is **singular** if $|A| = 0$; **A^{-1} exists only if $|A| \neq 0$ (non-singular)**.
- Area of triangle from vertices; area is zero $\Rightarrow$ points are **collinear**.
- System $AX = B$: unique solution $X = A^{-1}B$ when $|A| \neq 0$.

Formulas

- $\begin{vmatrix} a & b \\ c & d \end{vmatrix} = ad - bc$
- $\Delta = a_{11}A_{11} + a_{12}A_{12} + a_{13}A_{13}$ (expansion by cofactors)
- **$A^{-1} = (1/|A|) \cdot \text{adj } A$** ; $A(\text{adj } A) = (\text{adj } A)A = |A| I$
- $|\text{adj } A| = |A|^{n-1}$ (order n); $|AB| = |A||B|$; $|kA| = k^n|A|$
- Area = $\frac{1}{2} |x_1(y_2 - y_3) + x_2(y_3 - y_1) + x_3(y_1 - y_2)|$ (take absolute value)
- $|A| = 0$ and $(\text{adj } A)B \neq O \Rightarrow$ no solution (inconsistent); $|A| = 0$ and $(\text{adj } A)B = O \Rightarrow$ infinitely many or none

Exam focus: how to score

- **5-mark: solve a system of 3 equations using matrix inverse** — write $AX = B$, find $|A|$, $\text{adj } A$, A^{-1} , then X .
- Check your A^{-1} by verifying $AA^{-1} = I$ if time permits.
- Case study: form equations from a word problem (baskets, prices) into matrix form.

★ Important questions from CBSE sample papers

- $P = \begin{bmatrix} 2 & 1 \\ 0 & 1 \end{bmatrix}$ and $|Q| = 3$ (same order). Find $|\text{adj}(PQ)|$. (SQP 2026-27, 1 mark)
- Baskets A, B, C with given kg of apples, oranges, pomegranates cost ₹2750, ₹3500, ₹4100. Write matrix form, find adjoint, and price per kg using inverse. (SQP 2026-27, 4 marks)
- $A = \begin{bmatrix} 3 & -6 & -1 \\ 2 & -5 & -1 \\ -2 & 4 & 1 \end{bmatrix}$, $B = \begin{bmatrix} 1 & -2 & -1 \\ 0 & -1 & -1 \\ 2 & 0 & 3 \end{bmatrix}$: find AB and hence solve $3x - 6y - z = 3$, $2x - 5y - z + 2 = 0$, $-2x + 4y + z = 5$. (SQP 2025-26, 5 marks)

Remember: Inverse = adjoint $\div$ determinant (never divide by zero).

Chapter 5: Continuity and Differentiability

Class XII • Mathematics • CBSE 2026-27

Big idea: A function is continuous if its graph has no break; differentiable if it is also smooth (no sharp corner).

Key points

- f is **continuous at c** if $\lim_{(x \rightarrow c)} f(x) = f(c)$: $\text{LHL} = \text{RHL} = f(c)$.
- Sum, difference, product, quotient (denominator $\neq 0$) of continuous functions are continuous.
- **Differentiable $\Rightarrow$ continuous, but not conversely** ($|x|$ is continuous, not differentiable at 0).
- **Chain rule** for composite functions: $d/dx f(g(x)) = f'(g(x)) \cdot g'(x)$.
- **Implicit** functions: differentiate both sides w.r.t. x , collect dy/dx .
- **Logarithmic differentiation** for $[u(x)]^{v(x)}$ or long products: take log first.
- **Parametric**: $x = f(t)$, $y = g(t) \Rightarrow dy/dx = (dy/dt)/(dx/dt)$.
- **Second derivative** $d^2y/dx^2 = d/dx(dy/dx)$.

Derivatives to know

- $d/dx(\sin^{-1}x) = 1/\sqrt{1-x^2}$; $d/dx(\cos^{-1}x) = -1/\sqrt{1-x^2}$
- $d/dx(\tan^{-1}x) = 1/(1+x^2)$
- $d/dx(e^x) = e^x$; $d/dx(\log x) = 1/x$ ($x > 0$)
- $d/dx(a^x) = a^x \log a$
- Parametric 2nd derivative: $d^2y/dx^2 = d/dt(dy/dx) \div (dx/dt)$

Exam focus: how to score

- Continuity/differentiability at a point of a piecewise function: find k from $\text{LHL} = \text{RHL} = f(c)$.
- **3-mark: logarithmic differentiation of $x^{\log x} + (\log x)^x$ type** — split into $u + v$ and differentiate each.
- Parametric d^2y/dx^2 : don't forget to divide by dx/dt again.
- Write each step; marks are split $\frac{1}{2} + 1 + \frac{1}{2}$ per step in schemes.

★ Important questions from CBSE sample papers

- $f(x) = ax^2 + b$ ($x \leq 1$), $bx^2 + ax + c$ ($x > 1$), $b \neq 0$, is differentiable at $x = 1$. Which triplet (a, b, c) is possible? (SQP 2026-27, 1 mark)
- If $y = \sin(x + y)$ and $dy/dx = 0$, prove that $y = \pm 1$. (SQP 2026-27, 2 marks)
- If $y = x^{(\log x)} + (\log x)^x$, $x > 1$, find dy/dx . (SQP 2026-27, 3 marks)
- If $x = a(\theta - \sin \theta)$, $y = a(1 - \cos \theta)$, find d^2y/dx^2 . (SQP 2025-26, 3 marks)

Remember: $\text{LHL} = \text{RHL} = f(c)$ means continuous; corners kill differentiability.

Chapter 6: Application of Derivatives

Class XII • Mathematics • CBSE 2026-27

Big idea: The derivative measures rate of change and finds where functions rise, fall and peak.

Key points

- dy/dx = **rate of change** of y w.r.t. x ; $dy/dt = (dy/dx)(dx/dt)$ for related rates.
- $f'(x) > 0$ on an interval $\Rightarrow$ **strictly increasing**; $f'(x) < 0 \Rightarrow$ **strictly decreasing**.
- $f'(x) = 0$ points are **critical / stationary points**; they split the number line into intervals.
- **First derivative test**: f' changes $+$ to $- \Rightarrow$ local maximum; $-$ to $+$ $\Rightarrow$ local minimum.
- **Second derivative test**: $f'(c) = 0$ and $f''(c) < 0 \Rightarrow$ **maximum**; $f''(c) > 0 \Rightarrow$ **minimum**.
- $f''(c) = 0$: test fails, use first derivative test.
- **Absolute max/min on $[a, b]$** : compare f at critical points and at end points a, b .

Useful results

- Circle: $A = \pi r^2$, $C = 2\pi r$. Sphere: $V = (4/3)\pi r^3$, $S = 4\pi r^2$
- Cone: $V = (1/3)\pi r^2 h$. Cylinder: $V = \pi r^2 h$
- Profit $P(x) = R(x) - C(x)$

Exam focus: how to score

- Related rates (3 marks): write the formula, differentiate w.r.t. t , then substitute values (not before!).
- Increasing/decreasing: factorise $f'(x)$, mark critical points, test signs in each interval.
- **Case study on maxima (profit, WQI, cost): stationary point $\rightarrow$ second derivative test $\rightarrow$ value.**
- Optimisation word problems: write the quantity in one variable before differentiating.

★ Important questions from CBSE sample papers

- Values of x for which the derivative of $y = x^4$ is greater than y . (SQP 2026-27, 1 mark)
- A drone's circular area of vision grows at 44 m^2 per metre of height; radius grows at 6 m/s . Find rate of rise of height when $r = 14 \text{ m}$. (SQP 2026-27, 3 marks)
- WQI $W(x) = 35 + 1.6x - 0.02x^2$: find the stationary point and maximum WQI by second derivative test. (SQP 2026-27, 4 marks)
- A melting ice ball loses volume at a rate proportional to its surface area. Prove its radius decreases at a constant rate. (SQP 2025-26, 3 marks)

Remember: Slope + up, slope – down; f'' negative = peak (frown), positive = valley (smile).

Chapter 7: Integrals

Class XII • Mathematics • CBSE 2026-27

Big idea: Integration reverses differentiation (antiderivatives) and finds the limit of a sum (definite integral).

Key points

- $\int f(x)dx = F(x) + C$ where $F'(x) = f(x)$; C is the constant of integration.
- Methods: **substitution, trig identities, partial fractions, integration by parts.**
- **Partial fractions** for proper rational functions; divide first if improper.
- **By parts** (ILATE order to choose first function): $\int u v dx = u \int v dx - \int (u' \int v dx) dx$.
- **Fundamental Theorem:** $\int_a^b f(x)dx = F(b) - F(a)$.
- Definite integral needs **no + C**; change limits when you substitute.

Standard integrals & properties

- $\int dx/(x^2 - a^2) = (1/2a) \log|(x - a)/(x + a)| + C$; $\int dx/(x^2 + a^2) = (1/a) \tan^{-1}(x/a) + C$
- $\int dx/\sqrt{a^2 - x^2} = \sin^{-1}(x/a) + C$; $\int dx/\sqrt{x^2 \pm a^2} = \log|x + \sqrt{x^2 \pm a^2}| + C$
- $\int \sqrt{a^2 - x^2} dx = (x/2)\sqrt{a^2 - x^2} + (a^2/2) \sin^{-1}(x/a) + C$
- **$\int e^x[f(x) + f'(x)]dx = e^x f(x) + C$**
- **$\int_a^b f(x)dx = \int_a^b f(a + b - x)dx$; $\int_0^a f(x)dx = \int_0^a f(a - x)dx$**
- $\int_{-a}^a f = 2\int_0^a f$ if f even; $= 0$ if f odd
- $\int_0^{2a} f = 2\int_0^a f$ if $f(2a - x) = f(x)$; $= 0$ if $f(2a - x) = -f(x)$

Exam focus: how to score

- Biggest unit (Calculus = 35 marks): expect 2, 3 and 5-mark integrals.
- **Definite integrals using property $f(a + b - x)$** — add the two forms of I to get $2I$.
- For $|x - k|$ integrals, split the limits where the expression changes sign.
- Write substitution and new limits explicitly; marking schemes give $\frac{1}{2}$ mark for them.

★ Important questions from CBSE sample papers

- If $\int dx/(1 + e^{2x}) = x - P \log(1 + e^{2x}) + C$, find P . (SQP 2026-27, 1 mark)
- Evaluate $\int dx / (x\sqrt{x^6 - 1})$. (SQP 2026-27, 2 marks)
- Evaluate $\int$ from $-a$ to a of $\sqrt{(a - x)/(a + x)} dx$. (SQP 2026-27, 5 marks)
- Evaluate $\int_0^1 \log(1 + x)/(1 + x^2) dx$. (SQP 2025-26, 5 marks)

Remember: ILATE picks u ; $a + b - x$ simplifies definite integrals.

Chapter 8: Application of Integrals

Class XII • Mathematics • CBSE 2026-27

Big idea: Definite integrals give the area enclosed between curves, lines and the axes.

Key points

- Area between $y = f(x)$, x -axis, $x = a$, $x = b$: $A = \int_a^b y \, dx$.
- Area between $x = g(y)$, y -axis, $y = c$, $y = d$: $A = \int_c^d x \, dy$.
- If the curve is **below** the x -axis, the integral is negative — take its **absolute value**.
- Part above and part below the axis: find each area separately and add.
- Curves in syllabus: **lines, circles, parabolas, ellipses** (standard form only).
- Use **symmetry** (e.g. $4 \times$ first-quadrant area for circle/ellipse).
- Always find **points of intersection** first to fix limits.

Results worth knowing

- Circle $x^2 + y^2 = a^2$: area $= \pi a^2$
- **Ellipse $x^2/a^2 + y^2/b^2 = 1$: area $= \pi ab$** ($A = 4 \int_0^a (b/a) \sqrt{a^2 - x^2} \, dx$)
- Between two curves: $A = \int_a^b [f(x) - g(x)] \, dx$ with $f \geq g$
- $\int_0^a \sqrt{a^2 - x^2} \, dx = \pi a^2/4$

Sketches to practise

- Shade the region for: parabola $y^2 = 4ax$ with a line; circle with a line; ellipse; $y = |x + 1|$ over an interval

Exam focus: how to score

- **Always draw a neat sketch and shade the region** — it carries marks in 5-mark answers.
- Steps rewarded: correct figure, intersection points, correct integral set-up, evaluation.
- Write final answer in **square units**.

★ Important questions from CBSE sample papers

- Using integration, find the area of the region $\{(x, y): 0 \leq y \leq \sqrt{4 - x^2}, x \geq 2 - y\}$. (SQP 2026-27, 5 marks)
- Using integration, find the area bounded by $y^2 = 2x$ and the line $x - 2y = 0$. (SQP 2026-27, 5 marks)
- Sketch $y = |x + 1|$, evaluate $\int_{-4}^2 |x + 1| \, dx$, and say what the value represents. (SQP 2025-26, 3 marks)

Remember: Sketch → intersect → integrate → square units.

Chapter 9: Differential Equations

Class XII • Mathematics • CBSE 2026-27

Big idea: Equations involving derivatives; solving them gives a family of curves or one particular curve.

Key points

- **Order** = order of the highest derivative present.
- **Degree** = power of the highest-order derivative, when the equation is a **polynomial in derivatives**; else not defined.
- **General solution** has arbitrary constants (a family of curves); **particular solution** has none (use given condition).
- **Variables separable**: write as $g(y)dy = f(x)dx$ and integrate both sides.
- **Homogeneous**: $dy/dx = F(x, y)$ with $F(\lambda x, \lambda y) = F(x, y)$; put $y = vx$.
- **Linear**: $dy/dx + Py = Q$ (P, Q functions of x or constants).
- Linear in x : $dx/dy + P_1x = Q_1$ (P_1, Q_1 functions of y) — use I.F. = $e^{\int P_1 dy}$.

Solution recipes

- Homogeneous: $y = vx \Rightarrow dy/dx = v + x dv/dx$
- **Integrating factor I.F. = $e^{\int P dx}$**
- **Solution: $y \times (\text{I.F.}) = \int (Q \times \text{I.F.}) dx + C$**
- For dx/dy form: $x \times (\text{I.F.}) = \int (Q_1 \times \text{I.F.}) dy + C$

Exam focus: how to score

- Identify the type first; wrong type = wrong method.
- Linear DE (3–5 marks): bring to standard form $dy/dx + Py = Q$ before finding P .
- Particular solution: substitute the given condition to find C — easy mark, don't skip.
- Order/degree MCQs: remove radicals/fractions in derivatives before judging degree.

★ Important questions from CBSE sample papers

- Find the particular solution of $x dy + (y - x^2 e^x) dx = 0$, given $y(1) = 0$. (SQP 2026-27, 3 marks)
- Find the particular solution of $(x^2 + y^2) dy = xy dx$, given $y(0) = 1$. (SQP 2026-27, 3 marks)
- Solve $y + d/dx(xy) = x(\sin x + x)$. (SQP 2025-26, 5 marks)
- The solution of $x dx + y dy = 0$ represents a family of: lines / parabolas / circles / ellipses? (SQP 2025-26, 1 mark)

Remember: Separate, substitute ($y = vx$), or multiply by $e^{\int P dx}$.

Chapter 10: Vector Algebra

Class XII • Mathematics • CBSE 2026-27

Big idea: Vectors have magnitude and direction; dot and cross products measure angles, projections and areas.

Key points

- Position vector of $P(x, y, z)$: $r = x\hat{i} + y\hat{j} + z\hat{k}$; $|r| = \sqrt{x^2 + y^2 + z^2}$.
- **Direction cosines** l, m, n : cosines of angles with axes; $l^2 + m^2 + n^2 = 1$.
- Types: **zero, unit, co-initial, collinear, equal, negative** vectors.
- Vector $AB = (x_2 - x_1)\hat{i} + (y_2 - y_1)\hat{j} + (z_2 - z_1)\hat{k}$.
- Addition by **triangle / parallelogram law**.
- **Section formula**: point dividing PQ in $m : n$ internally has p.v. $(mb + na)/(m + n)$.
- $a \cdot b = 0 \Leftrightarrow a \perp b$; $a \times b = 0 \Leftrightarrow a \parallel b$ (non-zero vectors).
- $a \times b$ is **perpendicular** to both a and b ; $b \times a = -(a \times b)$.

Formulas

- Unit vector $\hat{a} = a/|a|$
- **$a \cdot b = |a||b| \cos \theta = a_1b_1 + a_2b_2 + a_3b_3$**
- Projection of a on $b = (a \cdot b)/|b|$
- $a \times b = |a||b| \sin \theta \hat{n} = \text{determinant } \begin{vmatrix} \hat{i} & \hat{j} & \hat{k} \\ a_1 & a_2 & a_3 \\ b_1 & b_2 & b_3 \end{vmatrix}$
- **Area of parallelogram (adjacent sides a, b) = $|a \times b|$; triangle = $\frac{1}{2}|a \times b|$**
- $|a \times b|^2 + (a \cdot b)^2 = |a|^2|b|^2$

Exam focus: how to score

- Common MCQs: magnitude, unit vector, angle with an axis, perpendicular vector.
- 2-mark: use $|a \times b|^2 + (a \cdot b)^2 = |a|^2|b|^2$ to find a magnitude quickly.
- Area of triangle/parallelogram via cross product — show the determinant.

★ Important questions from CBSE sample papers

- If $2\hat{i} - u\hat{j} + 3\hat{k}$ has magnitude 4, find u . (SQP 2026-27, 1 mark)
- $|a| = \sqrt{6}$, $a \cdot b = 1$ and $b \times a = 3\hat{i} + 4\hat{j} - 2\hat{k}$. Find $|b|$. (SQP 2026-27, 2 marks)
- $OA = \hat{i} + \hat{j} + \hat{k}$, $OB = 3\hat{i} - \hat{j} + 3\hat{k}$; OP is a median of ΔOAB . Find area of parallelogram with sides OA and OP . (SQP 2025-26, 2 marks)

Remember: Dot gives a number (cos); cross gives a vector (sin, area).

Chapter 11: Three Dimensional Geometry

Class XII • Mathematics • CBSE 2026-27

Big idea: Lines in space are described by a point and a direction; we find angles and distances between them.

Key points

- **Direction ratios** a, b, c are proportional to direction cosines l, m, n .
- Line through (x_1, y_1, z_1) and (x_2, y_2, z_2) has d.r.s $x_2 - x_1, y_2 - y_1, z_2 - z_1$.
- Vector equation of line: $r = a + \lambda b$ (through point a , parallel to b).
- Cartesian: $(x - x_1)/a = (y - y_1)/b = (z - z_1)/c$.
- **Skew lines**: neither parallel nor intersecting (lie in different planes).
- Lines $\perp \Leftrightarrow a_1a_2 + b_1b_2 + c_1c_2 = 0$; parallel $\Leftrightarrow a_1/a_2 = b_1/b_2 = c_1/c_2$.
- Foot of perpendicular from a point: take a general point on the line, use dot product = 0.

Formulas

- $l = a/\sqrt{a^2 + b^2 + c^2}$, similarly m, n
- Angle between lines: $\cos \theta = |a_1a_2 + b_1b_2 + c_1c_2| / (\sqrt{a_1^2 + b_1^2 + c_1^2} \sqrt{a_2^2 + b_2^2 + c_2^2})$
- **Shortest distance (skew):** $d = |(\mathbf{b}_1 \times \mathbf{b}_2) \cdot (\mathbf{a}_2 - \mathbf{a}_1)| / |\mathbf{b}_1 \times \mathbf{b}_2|$
- **Parallel lines** $r = \mathbf{a}_1 + \lambda \mathbf{b}$, $r = \mathbf{a}_2 + \mu \mathbf{b}$: $d = |\mathbf{b} \times (\mathbf{a}_2 - \mathbf{a}_1)| / |\mathbf{b}|$
- Lines intersect $\Leftrightarrow$ shortest distance = 0

Exam focus: how to score

- Convert Cartesian to standard form first: coefficient of x, y, z must be 1 (e.g. $(2y + 3)/4 \rightarrow (y + 3/2)/2$; $2 - z \rightarrow (z - 2)/(-1)$).
- Case study: check parallel/not parallel from direction ratios, then shortest distance (2 marks).
- Line $\perp$ to two lines: direction = $\mathbf{b}_1 \times \mathbf{b}_2$.

★ Important questions from CBSE sample papers

- Angle made by $\hat{i} + \hat{j} + \sqrt{2} \hat{k}$ with the positive z -axis. (SQP 2026-27, 1 mark)
- Line through $(2, 6, 5)$ and $(3, p, 7)$ is parallel to line joining $(-4, 3, 4)$ and $(-1, 0, q)$. Find q/p . (SQP 2026-27, 2 marks)
- Find the foot of perpendicular from $(2, 1, 4)$ on $x - 2 = (2y + 3)/4 = 2 - z$, and the line through it and $(2, 1, 4)$. (SQP 2026-27, 3 marks)
- Laser beams $l_1: r = (\lambda + 1)\hat{i} + (3\lambda + 2)\hat{j} + (3 - \lambda)\hat{k}$, $l_2: r = 2(\mu + 1)\hat{i} + (3\mu - 1)\hat{j} + (\mu + 1)\hat{k}$. Show not parallel; find shortest distance. (SQP 2026-27, 4 marks)

Remember: Point + direction = line; cross the directions for shortest distance.

Chapter 12: Linear Programming

Class XII • Mathematics • CBSE 2026-27

Big idea: Maximise or minimise a linear objective under linear constraints by checking corner points.

Key points

- **Objective function** $Z = ax + by$ is optimised; x, y are **decision variables**.
- **Constraints**: linear inequalities; **non-negative restrictions** $x \geq 0, y \geq 0$.
- **Feasible region**: common region of all constraints; points in it are **feasible solutions**.
- **Corner Point Theorem: optimal value (if it exists) occurs at a corner point of the feasible region.**
- **Bounded** region: both max and min exist.
- If max (min) occurs at two corners, it occurs at **every point** on the segment joining them.

Corner point method

- 1. Draw constraint lines; shade feasible region
- 2. Find all corner points (solve pairs of lines)
- 3. Evaluate Z at each corner; pick largest/smallest
- **Unbounded region, max M found: check if $ax + by > M$ has any common point with region; if none, M is the max**
- (For min m : check $ax + by < m$)

Graph to practise

- Graph lines like $x + y = 6, y = 2x, y = 2$; test origin to decide which side to shade

Exam focus: how to score

- 3-mark graphical LPP: correct graph + corner points + table of Z values + conclusion.
- Label lines and corner points clearly on the graph.
- For unbounded regions, the extra open half-plane check is often required for full marks.
- Reading constraints off a given graph is a common 2-mark/1-mark question.

★ Important questions from CBSE sample papers

- Solve graphically: Maximise $Z = 40x + 30y$ subject to $x + y \leq 6, 2x \geq y, y \geq 2$. (SQP 2026-27, 3 marks)
- Feasible region of an LPP is shown in a figure: write all the constraints on the decision variables. (SQP 2026-27, 2 marks)
- Maximise $Z = 2x + y$ subject to $x + y \leq 1200, x + y \geq 600, y \leq x/2, x \geq 0, y \geq 0$. (SQP 2025-26, 3 marks)

Remember: Graph, corners, table, conclude.

Chapter 13: Probability

Class XII • Mathematics • CBSE 2026-27

Big idea: Conditional probability updates chances using new information; Bayes' theorem works backwards from effect to cause.

Key points

- **Conditional probability** $P(E|F)$: probability of E given F has occurred, $P(F) \neq 0$.
- $P(S|F) = P(F|F) = 1$; $P(E'|F) = 1 - P(E|F)$.
- **Multiplication theorem**: $P(E \cap F) = P(F) P(E|F) = P(E) P(F|E)$.
- **Independent events**: $P(E \cap F) = P(E) P(F)$; then E' and F' etc. are also independent.
- Independent $\neq$ mutually exclusive (exclusive means $P(E \cap F) = 0$).
- **Partition**: $E_1, \dots, E_n$ pairwise disjoint, union = S, each $P(E_i) > 0$.
- Random variables and distributions are **not** in the 2026-27 syllabus.

Formulas

- $P(E|F) = P(E \cap F) / P(F)$
- $P(E \cup F) = P(E) + P(F) - P(E \cap F)$
- Exactly one of A, B: $P(A)P(B') + P(A')P(B)$ (if independent)
- **Total probability**: $P(A) = \sum P(E_i) P(A|E_i)$
- **Bayes**: $P(E_i|A) = P(E_i)P(A|E_i) / \sum P(E_j)P(A|E_j)$

Exam focus: how to score

- Bayes' theorem (5 marks or case study): define events $E_1, E_2, \dots$ and A in words first.
- Make a table of $P(E_i)$ and $P(A|E_i)$ — reduces errors and earns step marks.
- Conditional MCQs on dice/cards: list the reduced sample space.

★ Important questions from CBSE sample papers

- A die is thrown twice. Find $P(\text{at least one } 4 \mid \text{sum is a multiple of } 5)$. (SQP 2026-27, 1 mark)
- A, B independent, $P(A) = 1/6$, $P(B) = k$; $P(\text{exactly one occurs}) = 1/3$. Find k. (SQP 2026-27, 1 mark)
- Smartwatch users: Alpha 45%, Beta 30%, Gamma 15%, Delta 10%; false alert rates 0.01, 0.02, 0.05, 0.01. Find $P(\text{false alert})$ and $P(\text{Beta} \mid \text{false alert})$. (SQP 2026-27, 5 marks)
- $P(\text{Mehul selected}) = 0.4$, $P(\text{exactly one selected}) = 0.5$, independent. Find $P(\text{Rashi selected})$ and $P(\text{at least one})$. (SQP 2025-26, 3 marks)

Remember: Given F? Divide by P(F). From effect to cause? Bayes.

Class XII

English Core

One-page chapter summaries
Large print • CBSE 2026-27 syllabus

1. The Last Lesson (Flamingo, Prose 1) — page 2
2. Lost Spring (Flamingo, Prose 2) — page 3
3. Deep Water (Flamingo, Prose 3) — page 4
4. The Rattrap (Flamingo, Prose 4) — page 5
5. Indigo (Flamingo, Prose 5) — page 6
6. Poets and Pancakes (Flamingo, Prose 6) — page 7
7. The Interview (Flamingo, Prose 7) — page 8
8. Going Places (Flamingo, Prose 8) — page 9
9. My Mother at Sixty-six (Flamingo, Poem 1) — page 10
10. Keeping Quiet (Flamingo, Poem 2) — page 11
11. A Thing of Beauty (Flamingo, Poem 3) — page 12
12. A Roadside Stand (Flamingo, Poem 4) — page 13
13. Aunt Jennifer's Tigers (Flamingo, Poem 5) — page 14
14. The Third Level (Vistas 1) — page 15
15. The Tiger King (Vistas 2) — page 16
16. Journey to the End of the Earth (Vistas 3) — page 17
17. The Enemy (Vistas 4) — page 18
18. On the Face of It (Vistas 5) — page 19
19. Memories of Childhood (Vistas 6) — page 20
20. Reading Skills + Notice & Invitation (Sections A-B) — page 21
21. Letters, Article & Report (Section B) — page 22

Chapter 1: The Last Lesson (Flamingo, Prose 1)

Class XII • English Core • CBSE 2026-27

Big idea: Alphonse Daudet shows how we value our language and freedom only when they are taken away.

Key points

- Setting: a village school in **Alsace**, France, after the region passed into **Prussian** hands (Franco-Prussian War).
- **Franz** is late, fears a scolding on **participles**; sees a crowd at the town-hall bulletin board.
- School is strangely quiet, 'as quiet as Sunday morning'; M. Hamel wears his special Sunday clothes.
- Village elders (old Hauser, the former mayor, postmaster) sit on the back benches to pay respect.
- **The order has come from Berlin to teach only German in Alsace and Lorraine** — this is the last French lesson.
- Franz feels regret; his books and M. Hamel suddenly seem like old friends.
- Hamel admits parents and he himself (sending pupils to water flowers) put off learning.
- At noon the church clock strikes, Prussian trumpets sound; Hamel writes '**Vive La France!**' and dismisses the class.

Characters, themes & key quotes

- **Franz**: careless boy who grows sensitive and patriotic in one morning.
- **M. Hamel**: strict teacher, devoted for forty years; dignified in grief.
- Themes: **linguistic chauvinism**, love of mother tongue, procrastination, loss of freedom.
- **"When a people are enslaved, as long as they hold fast to their language it is as if they had the key to their prison."**
- "Will they make them sing in German, even the pigeons?"

Exam focus: how to score

- Explain the irony: Franz values French only when he can no longer learn it.
- Link 'order from Berlin' to loss of identity; quote the 'key to their prison' line.
- Extract MCQs test tone (exclamations = intense emotion), sensory details and inference.

★ Important questions from CBSE sample papers

- What role does the French language play in 'The Last Lesson', in the context of the narrator's feelings towards it? (SQP 2025-26, 2 marks)
- What does the contrasting imagery of the church clock and the Prussian trumpets represent? (SQP 2024-25, 2 marks)
- Extract: 'What a thunderclap these words were to me!' — what was the writer's purpose in using the metaphor of a 'thunderclap'? (SQP 2024-25, 1 mark)

Remember: Language = key to the prison; Franz learns too late.

Chapter 2: Lost Spring (Flamingo, Prose 2)

Class XII • English Core • CBSE 2026-27

Big idea: Anees Jung shows how poverty and tradition steal the childhood of India's poor children.

Key points

- Subtitle: 'Stories of Stolen Childhood'; two real case studies narrated by the author.
- **Saheb-e-Alam** ('lord of the universe') — a ragpicker in **Seemapuri**, Delhi; family came from Dhaka after storms swept away fields.
- Seemapuri: squatters from Bangladesh (1971), mud homes, no sewage; **survival means rag-picking**.
- Garbage is 'gold': survival for elders, 'wrapped in wonder' for children.
- Saheb later works at a tea stall for ₹800 and meals — 'no longer his own master'.
- **Mukesh** in **Firozabad**, the bangle-making centre; 20,000 children work near hot glass furnaces, often losing eyesight.
- Bangle-makers are trapped by **caste/karam** and the vicious circle of sahuikars, middlemen, police, bureaucrats, politicians.
- **Mukesh dares to dream: "I want to be a motor mechanic."**

Characters, themes & key quotes

- Themes: child labour, poverty, broken promises, lost dreams, hope.
- "Garbage to them is gold."
- "Can a god-given lineage ever be broken?" — Mukesh's grandmother.
- Savita soldering glass: 'hands move mechanically like the tongs of a machine'.
- Saheb's steel canister 'seems heavier than the plastic bag' — loss of freedom.

Exam focus: how to score

- Contrast Saheb (resigned) and Mukesh (dares to dream) — key 2-mark point.
- Name the two traps: family/caste and the vicious circle of exploiters.
- Value-based answers: illegality of child labour, need for education and organisation.

★ Important questions from CBSE sample papers

- Explain why the bangle makers of Firozabad are unable to imagine an alternative future despite their hardships. (SQP 2026-27, 2 marks)
- What is the significance of a narrator in 'Lost Spring' as opposed to a plain narrative? (SQP 2025-26, 2 marks)
- Identify an instance of hope or resilience in 'Lost Spring' and analyse how it reflects one of the story's themes. (SQP 2024-25, 2 marks)

Remember: Saheb loses freedom; Mukesh keeps a dream.

Chapter 3: Deep Water (Flamingo, Prose 3)

Class XII • English Core • CBSE 2026-27

Big idea: William O. Douglas tells how he conquered a deep fear of water through will, training and persistence.

Key points

- At three or four, waves on a California beach knocked him down — the first fear.
- At ten or eleven he learns to swim at the **Y.M.C.A. pool, Yakima** (safer than the treacherous Yakima River).
- A muscular older boy tosses 'Skinny' into the **nine-foot deep end**; he nearly drowns.
- Plan to spring up from the bottom fails; he goes down repeatedly, then blacks out ('curtain of life').
- The fear ruins fishing, canoeing, swimming in the Cascades for years.
- One October he hires an **instructor**: belt, rope and pulley; 'piece by piece, he built a swimmer'; can swim by April.
- Tests himself: Lake Wentworth (two miles), then **Warm Lake** — "Well, Mr Terror, what do you think you can do to me?"
- Lesson: conquering fear sets one free to live fully.

Characters, themes & key quotes

- Theme: fear, courage, determination, will to live.
- **"All we have to fear is fear itself."** — Roosevelt
- "In death there is peace. There is terror only in the fear of death."
- Vivid sensory narration: yellow glow, aching lungs, legs paralysed.

Exam focus: how to score

- Describe stages of training in order (rope-belt, breathing, kicking, integrating).
- Show how the first-person, sensory style makes panic real for the reader.
- Draw the larger meaning: fear of fear is the real enemy.

★ Important questions from CBSE sample papers

- What does William Douglas's experience in Deep Water suggest about the nature of fear and anticipation? (SQP 2026-27, 2 marks)
- What lesson can individuals learn from Douglas's experience in overcoming his fear of water? (SQP 2025-26, 2 marks)
- What might be the impact on the reader if the narration were more informative than sensory? (SQP 2023-24, 2 marks)

Remember: Pool → panic → instructor → Warm Lake → freedom.

Chapter 4: The Rattrap (Flamingo, Prose 4)

Class XII • English Core • CBSE 2026-27

Big idea: Selma Lagerlöf shows that kindness and trust can awaken the goodness in even a petty thief.

Key points

- A poor **peddler** sells rattraps, begs and steals; thinks **the whole world is a big rattrap** baiting people.
- An old **crofter** hosts him, shows off his **thirty kronor**; the peddler later steals it.
- Lost in the forest, he realises he himself is caught in a rattrap.
- At **Ramsjö ironworks** the **ironmaster** mistakes him for old comrade **Captain von Stahle**.
- **Edla Willmansson**, the ironmaster's daughter, persuades him to spend Christmas; treats him kindly.
- Truth comes out; the ironmaster wants to throw him out but Edla insists he stays for Christmas.
- He leaves a rattrap gift with the **thirty kronor** for the crofter, signed **Captain von Stahle**.
- Edla's compassion redeemed him — he was 'raised to captain'.

Characters, themes & key quotes

- Peddler: lonely, cynical, but has goodness within.
- Edla: compassionate, perceptive, true Christian spirit.
- Symbol: **the rattrap = material temptations that trap people**.
- Themes: loneliness, redemption, human goodness, Christmas spirit.

Exam focus: how to score

- Explain the rattrap metaphor and how the peddler himself is trapped.
- Contrast Edla's trust with her father's anger; show cause of the change.
- Quote the letter's meaning: he was treated as a captain, so behaved like one.

★ Important questions from CBSE sample papers

- How does the Christmas episode influence the peddler's perception of human relationships? (SQP 2026-27, 2 marks)
- Explain how the rattrap symbolises the dual aspects of human nature. (SQP 2024-25, 2 marks)
- How does the setting of the remote forest location contribute to the overall tone and mood of the story? (SQP 2023-24, 2 marks)

Remember: Treated as a captain, the thief became one.

Chapter 5: Indigo (Flamingo, Prose 5)

Class XII • English Core • CBSE 2026-27

Big idea: Louis Fischer recounts Gandhi's Champaran struggle (1917): the first triumph of civil disobedience in modern India.

Key points

- At the **Lucknow Congress, Dec 1916**, poor sharecropper **Rajkumar Shukla** begs Gandhi to visit Champaran.
- Landlords forced tenants to grow indigo on **3/20 (15%) of land** and give the crop as rent.
- When synthetic indigo came, planters demanded compensation from peasants.
- Gandhi goes to **Motihari**; served notice to leave; refuses; a huge crowd gathers. **Civil disobedience triumphed** — case dropped.
- Lawyers decide to court jail with Gandhi — Rajendra Prasad: a lesson in courage.
- Settlement: planters agree to refund **25%** — Gandhi accepts; the principle of surrender of prestige mattered.
- Within a few years planters left; land returned to peasants.
- Gandhi opened schools in six villages, improved health and sanitation; Kasturbai taught cleanliness.

Characters, themes & key quotes

- **Gandhi**: humble, persistent, practical; insists on **self-reliance**.
- **C.F. Andrews**: Gandhi refuses his help — 'you want him to stand by you' shows weakness.
- "The British could not order me about in my own country."
- Themes: freedom, non-violence, courage, self-reliance, social reform.

Exam focus: how to score

- Give dates/places correctly: Lucknow 1916, Champaran 1917, Motihari.
- Explain why 25% refund was a victory — fear of the peasants removed.
- Long answer: link to exploitation in A Roadside Stand or power in Poets and Pancakes.

★ Important questions from CBSE sample papers

- What factor/s were largely instrumental in the victory of the peasants in 'Indigo'? (SQP 2024-25, 2 marks)
- What can be inferred from Rajendra Prasad's recorded upshot of the lawyer consultations at Motihari? (SQP 2023-24, 2 marks)
- How do 'Indigo' and 'A Roadside Stand' highlight the theme of exploitation, and what similarities do they reveal about the plight of marginalised communities? (SQP 2025-26, 5 marks)

Remember: Shukla → Champaran → 15% indigo → 25% refund → self-reliance.

Chapter 6: Poets and Pancakes (Flamingo, Prose 6)

Class XII • English Core • CBSE 2026-27

Big idea: Asokamitran's humorous memoir of Gemini Studios, Madras, in the early days of Indian film-making.

Key points

- **Pancake** = brand of make-up bought in truckloads; make-up room had incandescent lights — 'fiery misery'.
- Make-up staff from many regions: **national integration long before A.I.R. and Doordarshan**.
- Strict hierarchy; the 'office boy' (in his forties) makes up crowd players and blames **Subbu** for his failure.
- **Kothamangalam Subbu**: No. 2 at Gemini, loyal to the Boss, endlessly creative, poet, actor, generous host.
- The **legal adviser** accidentally ended an actress's career by playing back her outburst.
- Story Department closed — 'a lawyer lost his job because the poets were asked to go home'.
- MRA (Moral Re-Armament) troupe welcomed, 1952; plays 'Jotham Valley' influenced Tamil theatre.
- English poet **Stephen Spender**'s speech baffles everyone; later the author finds his name in **The God That Failed** and The Encounter.

Characters, themes & key quotes

- Author (worked cutting newspaper clippings): observant, ironic.
- **The Boss** = S.S. Vasan, founder (1940).
- Themes: irony, satire of studio life, frustration, talent vs luck.
- Tone: gentle humour and self-mockery.

Exam focus: how to score

- Identify irony and humour with examples (office boy, lawyer, Spender).
- Character sketch of Subbu: loyal, versatile, charitable.
- Compare dreamers: office boy / Subbu vs Sophie (Going Places).

★ Important questions from CBSE sample papers

- Extract: what does the phrase 'fiery misery' suggest about the intense lighting? (SQP 2026-27, 1 mark)
- What does the story of Subbu's success in the film industry reveal about the importance of loyalty, creativity and versatility? (SQP 2023-24, 2 marks)
- How can the office boy, who harbours dreams, be compared to Sophie from 'Going Places'? Consider their ambitions and obstacles. (SQP 2025-26, 5 marks)

Remember: Pancake make-up, poet Subbu, puzzling Spender.

Chapter 7: The Interview (Flamingo, Prose 7)

Class XII • English Core • CBSE 2026-27

Big idea: Part I weighs the merits and harms of interviews; Part II shows a great interview with Umberto Eco.

Key points

- Part I (Christopher Silvester): invented a little over 130 years ago, the interview is now a commonplace of journalism.
- Supporters: it is a source of truth, 'an art'. Critics see it as intrusive.
- **V.S. Naipaul**: people are 'wounded by interviews and lose a part of themselves'.
- **Lewis Carroll** had 'a just horror of the interviewer'; **Rudyard Kipling called it 'immoral', 'a crime'**.
- **H.G. Wells** called it an 'ordeal'; **Saul Bellow**: like 'thumbprints on his windpipe'.
- Denis Brian: interviews give us our most vivid impressions of contemporaries.
- Part II: **Mukund Padmanabhan** (The Hindu) interviews **Umberto Eco**, professor at Bologna, expert in semiotics.
- Eco uses **interstices** (empty spaces) to write; **The Name of the Rose** (1980) sold over 10 million copies.

Characters, themes & key quotes

- Eco: 'a professor who writes novels on Sundays'.
- His academic writing is playful, personal, narrative — he tells the story of his research.
- Success of the novel: 'a mystery'; written at the right time — 10 years earlier or later it 'wouldn't have been the same'.
- Themes: celebrity, privacy, art of writing.

Exam focus: how to score

- List views for and against interviews with names — quick 2-mark points.
- Explain 'interstices' and Eco's productivity.
- Comment on the question-answer format and conversational style.

★ Important questions from CBSE sample papers

- According to the interview, how did Umberto Eco make his academic writing accessible to readers? (SQP 2026-27, 2 marks)
- How does Rudyard Kipling's refusal to be interviewed point towards the intrusive and unwelcome nature of interviews? (SQP 2025-26, 2 marks)
- Eco says if he had written The Name of the Rose ten years earlier or later it wouldn't have been the same. What could he have meant? (SQP 2023-24, 2 marks)

Remember: Kipling hates it; Eco fills interstices.

Chapter 8: Going Places (Flamingo, Prose 8)

Class XII • English Core • CBSE 2026-27

Big idea: A.R. Barton explores adolescent fantasy and hero-worship in a working-class girl's dreams.

Key points

- **Sophie** dreams of a boutique, acting or being a fashion designer; friend **Jansie** knows both are 'earmarked for the **biscuit factory**'.
- Home is cramped: mother's crooked back, father in a vest, little brother **Derek**.
- She admires brother **Geoff**, an apprentice mechanic, whose silent, separate world she longs to share.
- She claims she met **Danny Casey, young Irish football prodigy**, in the arcade by Royce's window.
- Father scoffs; Geoff doubts; she says Casey promised to meet her next week with an autograph.
- Family watches United play; Casey scores — Sophie feels proud as if she shared it.
- She waits by the canal under a tree; **he never comes**. She tells herself people won't believe her.
- Fantasy is her escape from a dull, limited reality.

Characters, themes & key quotes

- Sophie: imaginative, restless, unrealistic; Jansie: practical, gossipy.
- Father: rough, sceptical, a football fan; Geoff: quiet, almost grown up.
- Themes: **fantasy vs reality**, hero-worship, class limits, family.
- "Takes money, Soaf, something like that." — Jansie

Exam focus: how to score

- Contrast Sophie with Jansie (dreamer vs realist).
- Explain the title: Sophie wants to go places but stays trapped.
- Long answers often pair Sophie with Subbu/the office boy or Keeping Quiet.

★ Important questions from CBSE sample papers

- Extract: why does Sophie's father refer to knowing 'a man who had known Tom Finney'? (SQP 2026-27, 1 mark)
- Extract: the delicate bow on her mother's apron and her crooked back highlight the theme of _____. (SQP 2025-26, 1 mark)
- How do Sophie and Subbu compare and contrast in their aspirations, constraints and pursuit of dreams? (SQP 2024-25, 5 marks)

Remember: Sophie dreams of Casey; the biscuit factory waits.

Chapter 9: My Mother at Sixty-six (Flamingo, Poem 1)

Class XII • English Core • CBSE 2026-27

Big idea: Kamala Das captures a daughter's fear of losing her ageing mother, hidden behind a smile.

Key points

- Driving from her parents' home to **Cochin** airport, the poet sees her mother dozing beside her.
- Mother's face is **ashen like that of a corpse** — she realises with pain her mother is old.
- She looks away at **young trees sprinting** and merry children spilling out of homes — life and youth.
- At security check she looks again: mother is wan, pale 'as a late winter's moon'.
- She feels 'that old familiar ache, my childhood's fear' — fear of separation and death.
- She hides her feelings: 'see you soon, Amma' and smiles, smiles, smiles.

Characters, themes & key quotes

- Themes: ageing, mortality, parent-child love, helplessness.
- **Simile**: 'ashen like that of a corpse'; 'pale as a late winter's moon'.
- Contrast: old mother vs sprinting trees and merry children.
- Repetition 'smile and smile and smile' = forced cheer, hidden anxiety.
- Whole poem is **one sentence** — a single flow of thought.

Exam focus: how to score

- Explain both similes and the contrast imagery (very frequent).
- Interpret parting words and smile: hope, reassurance, suppressed fear.
- Use poetic devices by name for appreciation marks.

★ Important questions from CBSE sample papers

- Kamala Das uses imagery and restraint to convey unspoken anxiety rather than overt grief. Comment. (SQP 2026-27, 2 marks)
- Interpret the use of visual imagery by Kamala Das in her poem to depict the passage of time. (SQP 2024-25, 2 marks)
- Extract: what does the imagery of the 'ashen face' of the mother suggest about her physical condition? (SQP 2025-26, 1 mark)

Remember: Ashen face, sprinting trees, winter moon, forced smile.

Chapter 10: Keeping Quiet (Flamingo, Poem 2)

Class XII • English Core • CBSE 2026-27

Big idea: Pablo Neruda urges a moment of silence and stillness for introspection, peace and understanding.

Key points

- 'Now we will count to twelve / and we will all keep still' — twelve = hours, months, zodiac: universal time.
- Not speaking any language: no barriers between people.
- An 'exotic moment / without rush, without engines' — a sudden strangeness, togetherness.
- Fishermen would not harm whales; the salt-gatherer would look at his hurt hands — reflection on cruelty and self-harm.
- War-makers of 'green wars, wars with gas, wars with fire' would walk with their brothers in the shade.
- **"What I want should not be confused / with total inactivity."** — 'I want no truck with death'.
- Silence might end 'this sadness / of never understanding ourselves'.
- **The Earth teaches us:** what seems dead later proves to be alive.

Characters, themes & key quotes

- Themes: introspection, peace, brotherhood, environment, life vs death.
- Symbol: Earth's seasons — life under apparent stillness.
- "Victory with no survivors" — futility of war.
- Free verse; varying stanza lengths; tone calm and persuasive.

Exam focus: how to score

- Explain: keeping quiet ≠ inactivity or death.
- Explain the Earth image and the 'sadness'.
- Link with Going Places/Roadside Stand in long answers (silence, inner conflict).

★ Important questions from CBSE sample papers

- What does the reference to fishermen not harming whales and the man gathering salt looking at his hurt hands signify? (SQP 2025-26, 2 marks)
- Extract: the putting on of 'clean clothes' by the warmongers symbolises _____. (SQP 2024-25, 1 mark)
- As Pablo Neruda, write a letter advising Robert Frost about his conflicted emotions in 'A Roadside Stand'. (SQP 2023-24, 5 marks)

Remember: Count to twelve, keep still, learn from the Earth.

Chapter 11: A Thing of Beauty (Flamingo, Poem 3)

Class XII • English Core • CBSE 2026-27

Big idea: John Keats says beauty is an eternal source of joy that binds us to life despite suffering.

Key points

- Excerpt from '**Endymion: A Poetic Romance**'.
- "**A thing of beauty is a joy for ever**": its loveliness increases, never passes into nothingness.
- Beauty keeps 'a bower quiet for us' — peace, sweet dreams, health, quiet breathing.
- Every day we weave 'a flowery band to bind us to the earth'.
- This is in spite of despondence, lack of noble natures, gloomy days and dark ways.
- Some shape of beauty 'moves away the pall / From our dark spirits'.
- Beautiful things: sun, moon, trees, sheep, daffodils, clear rills, musk-rose blooms, grandeur of the mighty dead, lovely tales.
- "**An endless fountain of immortal drink, / Pouring unto us from the heaven's brink.**"

Characters, themes & key quotes

- Themes: permanence of beauty, nature, hope amid suffering.
- **Metaphors**: bower, flowery band, pall, endless fountain.
- Beauty is a gift from heaven, immortal.
- Rhyme in couplets (aabb); Romantic poetry.

Exam focus: how to score

- List things of beauty and things causing suffering separately.
- Explain 'flowery band' and 'endless fountain' images.
- Relate to real life: beauty helps us cope with hardship.

★ Important questions from CBSE sample papers

- Extract: the image of 'a bower quiet for us' is best interpreted as beauty functioning as a _____. (SQP 2026-27, 1 mark)
- Based on 'A Thing of Beauty', how can recognising the lasting value of beauty help someone cope with challenges? (SQP 2025-26, 2 marks)
- Extract: the 'endless fountain of immortal drink' is an apt analogy for the tales of the mighty dead because _____. (SQP 2023-24, 1 mark)

Remember: Beauty = joy for ever, a flowery band to the earth.

Chapter 12: A Roadside Stand (Flamingo, Poem 4)

Class XII • English Core • CBSE 2026-27

Big idea: Robert Frost portrays the plight of poor rural folk ignored by rich city people and false benefactors.

Key points

- A little old house with a little new shed at the edge of a busy road: a roadside stand that 'too pathetically pled'.
- They want not charity ('a dole of bread') but **some city money** to improve their lives.
- 'Polished traffic' passes with 'a mind ahead'; some are annoyed that the artless signs spoil the landscape.
- They sell wild berries, golden squash; crossly say: keep your money if you want to be mean.
- The poet is hurt more by 'the trusting sorrow of what is unsaid'.
- Plans to resettle them near theatre and store: **"greedy good-doers, beneficent beasts of prey"**.
- They wait all day for the squeal of brakes; cars stop only to turn, ask the way, or ask for gas.
- Poet wishes to end their pain at one stroke, then asks how he would like that himself.

Characters, themes & key quotes

- Themes: rural-urban divide, poverty, exploitation, hypocrisy of welfare.
- **Oxymoron**: 'greedy good-doers', 'beneficent beasts of prey'.
- "Of all the thousand selfish cars that pass, / Just one to inquire what a farmer's prices are."
- Tone: sympathy, irony, anger.

Exam focus: how to score

- Explain the two complaints (city folk vs rural folk).
- Explain oxymorons and the government's false promises.
- Pair with Indigo/Aunt Jennifer's Tigers for exploitation and inequality.

★ Important questions from CBSE sample papers

- Extract: why does the poet clarify that the stand is not asking for 'a dole of bread'? (SQP 2026-27, 1 mark)
- Extract: 'greedy good-doers' and 'beneficent beasts of prey' illustrate the ____ (irony/satire) in the situation. (SQP 2024-25, 1 mark)
- Analyse 'A Roadside Stand' and 'Aunt Jennifer's Tigers' for the theme of inequality and its impact on the bearers. (SQP 2024-25, 5 marks)

Remember: Little shed, speeding cars, greedy good-doers.

Chapter 13: Aunt Jennifer's Tigers (Flamingo, Poem 5)

Class XII • English Core • CBSE 2026-27

Big idea: Adrienne Rich contrasts a woman oppressed in marriage with the proud, fearless tigers she embroiders.

Key points

- Aunt Jennifer's tigers 'prance across a screen' — bright topaz denizens of a world of green.
- They do not fear the men beneath the tree; they pace in 'sleek chivalric certainty'.
- Her fingers flutter through the wool; she finds even the ivory needle hard to pull — fear and weakness.
- **"The massive weight of Uncle's wedding band"** sits heavily on her hand.
- Even in death her terrified hands will lie 'still ringed with ordeals she was mastered by'.
- **The tigers will go on prancing, proud and unafraid** — art outlives the artist.

Characters, themes & key quotes

- Symbols: **tigers** = freedom, courage, her suppressed desires; **wedding band** = patriarchal burden.
- 'Ringed': wedding ring and the circle of ordeals.
- Themes: oppression of women, art as escape, freedom vs bondage.
- Rhyming couplets (aabb); bright colours vs her fear.

Exam focus: how to score

- Explain the contrast between Aunt and her tigers (most asked).
- Interpret 'massive weight' and 'ringed'.
- Speaker's attitude: sympathy and quiet feminist protest.

★ Important questions from CBSE sample papers

- What does Aunt Jennifer's portrayal of the tigers suggest about her suppressed desires? (SQP 2026-27, 2 marks)
- How might the message of the poem be different if the last four lines were omitted? (SQP 2023-24, 2 marks)
- Extract: 'still ringed' refers to the literal ____ (shape of the embroidery panel / wedding band on her finger) and the figurative ring of constraints. (SQP 2025-26, 1 mark)

Remember: Tigers prance free; Aunt's hand bears the heavy ring.

Chapter 14: The Third Level (Vistas 1)

Class XII • English Core • CBSE 2026-27

Big idea: Jack Finney blends fantasy and reality to show modern man's longing to escape stress and fear.

Key points

- **Charley** says he found a **third level** at **Grand Central Station**, New York.
- His psychiatrist friend **Sam** calls it 'a waking-dream wish fulfilment' — escape from an unhappy modern world.
- Charley's stamp collecting is also called a 'temporary refuge from reality'.
- On the third level: gas lights, old-fashioned clothes, a small Currier & Ives locomotive; newspaper dated **June 11, 1894**.
- He wants tickets to **Galesburg, Illinois** (1894) for himself and wife **Louisa**; his modern money is rejected.
- He draws three hundred dollars and buys old currency, but never finds the corridor again.
- Sam disappears; Charley finds in his stamp collection a **first-day cover letter from Sam, postmarked July 18, 1894**.
- Sam is now living in Galesburg of 1894; he says the third level exists.

Characters, themes & key quotes

- Charley: imaginative, insecure, nostalgic.
- Sam: psychiatrist who himself escapes to the past.
- Themes: **escapism**, nostalgia, modern insecurity, fantasy vs reality.
- Technique: first-person, blurred line between real and imaginary.

Exam focus: how to score

- Explain why Charley wants to escape and what the third level symbolises.
- Explain the irony of Sam's letter at the end.
- Diary-entry or narrative-technique questions appear as 5-markers.

★ Important questions from CBSE sample papers

- Elaborate on Charley's fascination with the third level and the way he relates to the past. (SQP 2026-27, 2 marks)
- Interpret the significance of both literal and metaphorical journeys in 'The Third Level'. (SQP 2024-25, 2 marks)
- Discuss the narrative techniques used in 'The Third Level' and how they convey escapism and nostalgia. (SQP 2024-25, 5 marks)

Remember: Grand Central → 1894 → Galesburg → Sam's letter.

Chapter 15: The Tiger King (Vistas 2)

Class XII • English Core • CBSE 2026-27

Big idea: Kalki's satire mocks the arrogance of rulers who try to defy fate and kill wild animals for pride.

Key points

- The **Maharaja of Pratibandapuram** (Sir Jilani Jung Jung Bahadur) is the 'Tiger King'.
- Astrologers foretell death; the **ten-day-old baby speaks**: 'Let tigers beware!' — he will die by a tiger.
- Told he will die by the 100th tiger, he bans tiger hunting for others and vows to kill 100.
- He risks his throne: bribes a British officer's wife with ~fifty diamond rings.
- Kills seventy in ten years; marries a princess from a state rich in tigers to reach **ninety-nine**.
- Desperate, he raises land tax; the dewan plants an old tiger from People's Park, Madras.
- The king's bullet misses; the tiger only faints; hunters kill it secretly.
- A **wooden toy tiger** for his son's third birthday: a sliver pricks his hand; infection, surgery — he dies. 'The hundredth tiger took its revenge.'

Characters, themes & key quotes

- Themes: satire on power, arrogance, cruelty to animals, fate.
- Irony: killer of tigers dies from a toy tiger.
- Characters: Maharaja (proud, stubborn), Dewan (servile, clever).
- Techniques: humour, exaggeration, foreshadowing, dramatic irony.

Exam focus: how to score

- Explain the irony of the death (most asked).
- Comment on the satire on rulers and on ecological imbalance.
- Narrative technique: story told with the end revealed early.

★ Important questions from CBSE sample papers

- Examine the outcome of the Tiger King's actions in the light of the prophecy and comment on his belief about controlling fate. (SQP 2026-27, 2 marks)
- Discuss the significance of the toy tiger in the climax of 'The Tiger King'. (SQP 2024-25, 2 marks)
- Analyse how the narrative technique used in 'The Tiger King' enhances the impact of the story. (SQP 2025-26, 5 marks)

Remember: 99 real tigers, killed by a wooden one.

Chapter 16: Journey to the End of the Earth (Vistas 3)

Class XII • English Core • CBSE 2026-27

Big idea: Tishani Doshi's Antarctic trip shows how the planet's past and future can be read in its ice.

Key points

- Author travels aboard the Russian research vessel **Akademik Shokalskiy** to Antarctica, the coldest, driest, windiest continent.
- Started from Madras; crossed nine time zones, six checkpoints; over 100 hours of travel.
- 650 million years ago India and Antarctica were part of **Gondwana**.
- Antarctica holds half-million-year-old carbon records in its ice-cores — vital to climate change debate.
- Never sustained a human population — relatively 'pristine'.
- **Students on Ice** (led by Canadian Geoff Green) takes high school students there to inspire respect for the planet.
- Phytoplankton feed the Southern Ocean food chain; ozone depletion harms them.
- Lesson: **take care of the small things and the big things will fall into place**

Characters, themes & key quotes

- Themes: climate change, environment, global warming, human impact.
- Students are future policy-makers; seeing is believing.
- 'Walk on the ocean': walking on a metre-thick ice pack above 180 metres of salt water.
- Tone: informative, reflective, urgent.

Exam focus: how to score

- Explain why Antarctica is the place to study the Earth's past and future.
- Explain the importance of Students on Ice programme.
- Explain the phytoplankton metaphor.

★ Important questions from CBSE sample papers

- Describe the idea that emerges from the author's portrayal of Antarctica as a warning rather than a destination. (SQP 2026-27, 2 marks)
- How can programmes like 'Students on Ice' help raise awareness about environmental issues? (SQP 2025-26, 2 marks)
- Extract: how does the absence of a human population in Antarctica make it significant in the climate change debate? (SQP 2023-24, 1 mark)

Remember: Gondwana past, ice-core records, small things matter.

Chapter 17: The Enemy (Vistas 4)

Class XII • English Core • CBSE 2026-27

Big idea: Pearl S. Buck explores a Japanese doctor's conflict between duty as a healer and loyalty to his nation.

Key points

- Wartime Japan. **Dr Sadao Hoki**, surgeon trained in America, and wife **Hana** find a wounded American POW on their beach.
- Duty as a doctor wins: they take him in; Sadao removes the bullet and saves him.
- The old gardener and servants disapprove; **Yumi refuses to wash him**; Hana does it herself.
- Servants leave the house, fearing punishment.
- Sadao tells the **General**, who offers private **assassins** to kill the prisoner quietly.
- The assassins never come; the General admits he 'thought of nothing but myself' and forgot his promise.
- Sadao gives the prisoner a boat, food and clothes to row to an island and wait for a Korean fishing boat.
- Ending: 'I wonder why I could not kill him?' — humanity wins over hatred.

Characters, themes & key quotes

- **Sadao**: patriotic but a true doctor; humanity over nationalism.
- **Hana**: compassionate, brave.
- **General**: selfish, needs Sadao for his operation.
- Themes: **humanity vs patriotism**, moral dilemma, war.

Exam focus: how to score

- Discuss Sadao's dilemma with evidence: doctor vs patriot.
- Compare Hana and Sadao's responses.
- Comment on the General's selfishness and the irony of his help.

★ Important questions from CBSE sample papers

- Dr Sadao's decision to shelter an enemy soldier places him in a moral dilemma. Assess whether it can be seen as an act of moral courage. (SQP 2026-27, 5 marks)
- Justify how Sadao's character arc is more central to the moral dilemma as opposed to Hana's. (SQP 2025-26, 5 marks)
- Explain the superiority Hana is convinced about when she says 'Stupid Yumi... a wounded helpless man!' (SQP 2023-24, 2 marks)

Remember: A doctor first, a patriot second.

Chapter 18: On the Face of It (Vistas 5)

Class XII • English Core • CBSE 2026-27

Big idea: Susan Hill's play shows how acceptance and a positive outlook can heal the pain of physical disability.

Key points

- **Derry**, 14, with a face burned by acid, enters **Mr Lamb**'s garden thinking it empty.
- Mr Lamb has a **tin leg** (lost in war); kids call him 'Lamey-Lamb', but he doesn't mind.
- Derry is bitter and isolated; he overheard a woman say 'a face only a mother could love'.
- Mr Lamb: 'The gate's open' — welcomes all, listens to his bees 'singing'.
- He tells the story of a man who shut himself in a room, afraid of everything, and was killed by a falling picture.
- Mr Lamb shows that people's looks are not the whole of them: 'Not the whole of you'.
- Derry promises to return to help pick crab apples; his mother forbids him, but he goes back.
- **Mr Lamb falls from the ladder; Derry returns to find him lying still** (implied death) — yet Derry now wants to face the world.

Characters, themes & key quotes

- Derry: angry, lonely, self-pitying → hopeful.
- Mr Lamb: wise, cheerful, lonely too.
- Themes: **loneliness, disability, acceptance, positive attitude.**
- "I'm not afraid. People are afraid of me."

Exam focus: how to score

- Compare Derry and Mr Lamb; show how Lamb changes Derry.
- Explain the title: appearances vs inner self.
- Tragic ending — but hope survives in Derry.

★ Important questions from CBSE sample papers

- Discuss how Mr Lamb's outlook challenges Derry's fear-driven self-image and shapes his understanding of self-worth. (SQP 2026-27, 5 marks)
- What does Derry's remark, 'Think, you might have been blinded...', reveal about his perspective on how people console others? (SQP 2025-26, 2 marks)
- How does Susan Hill subtly portray a blend of pessimism and optimism in 'On the Face of It'? (SQP 2024-25, 2 marks)

Remember: Burned face, tin leg, open gate.

Chapter 19: Memories of Childhood (Vistas 6)

Class XII • English Core • CBSE 2026-27

Big idea: Two women from marginalised communities recall childhood humiliation and their spirit of resistance.

Key points

- **I. The Cutting of My Long Hair — Zitkala-Sa** (Gertrude Simmons Bonnin, Native American).
 - First day at a missionary school in 'the land of apples': harsh noises, stiff shoes, rules at the breakfast table.
 - Friend **Judewin** warns that their hair will be cut; among her people **shingled hair was for cowards** or mourners.
 - She hides under a bed; is dragged out, tied fast in a chair; loses her long braids — 'Then I lost my spirit'.
- **II. We Too are Human Beings — Bama** (Tamil Dalit writer, from **Karukku**).
 - In third class she sees an elder carry a **vadai packet by its string** so as not to 'pollute' it — she laughs.
 - Her elder brother **Annan** explains untouchability; she is furious.
 - Annan: education is the way to dignity — 'Work hard and learn'. She studies hard and stands first.

Characters, themes & key quotes

- Themes: **racism and casteism**, loss of identity, education as resistance.
- Both narrators rebel: Zitkala-Sa by struggle, Bama by learning.
- "I was only one of many little animals driven by a herder."
- Autobiographical first-person accounts.

Exam focus: how to score

- Compare the two narratives: different cultures, similar oppression.
- Explain the vadai incident and Annan's advice.
- Diary-entry style 5-markers are common.

★ Important questions from CBSE sample papers

- Extract: according to Annan, what is the main reason the community is denied honour and respect? (SQP 2026-27, 1 mark)
- What does Zitkala-Sa's description of being 'tossed about in the air like a wooden puppet' reveal about her feelings? (SQP 2025-26, 2 marks)
- How can we say that the vadai packet incident reveals the writer lacked the maturity to understand untouchability? (SQP 2023-24, 2 marks)

Remember: Shingled hair and the vadai packet — both fight back.

Chapter 20: Reading Skills + Notice & Invitation (Sections A-B)

Class XII • English Core • CBSE 2026-27

Big idea: Paper = 80 marks: Reading 22 + Creative Writing 18 + Literature 40; Internal Assessment 20 (Listening 5, Speaking 5, Project 10).

Key points

- **Reading (22):** two unseen passages, **700-750 words combined**: Q1 factual/descriptive/literary (12 marks), Q2 case-based with data/charts (10 marks).
- Question types: MCQs, fill-ins, vocabulary by inference, and short answers in **about 40 words (2 marks)**.
- Tip: read questions first; quote paragraph evidence; for chart passages compare numbers (e.g. % growth).
- **Notice (Q3, 4 marks):** **up to 50 words**, one of two. Marks: Format 1 / Content 2 / Accuracy 1.
- Content: what, who, when (date, time), where, how to register, contact.
- **Invitation/Reply (Q4, 4 marks):** up to 50 words, formal (third person) or formal letter/reply (first person). Marks: Format 1 / Content 2 / Accuracy 1.
- Reply: thank, accept/decline, refer to event, date, venue.

Formats that earn the Format mark

- **Notice** (per marking scheme): **box**; name of issuing organisation (top centre); word NOTICE (centre); date of issue (left); heading; body; name, designation & signature (bottom left).
- Notice: ½ mark lost if 1-2 aspects missing; zero format mark if more than two missing.
- **Formal invitation:** third person — '...request(s) the pleasure of your company...' + occasion, date, time, venue, RSVP.
- **Reply:** sender's address, date, receiver, body (thanks + acceptance/regret), name.

Exam focus: how to score

- Stay within 50 words; extra words do not add marks.
- Always box the notice and give a catchy heading.
- Write in passive/impersonal style for notices; no 'Dear'.

★ Important questions from CBSE sample papers

- You are Rishitha Menon of the Horizon Club, Bala Vidyalaya, Chennai. Draft a notice inviting senior students to a one-day workshop on project work and presentation skills. (SQP 2026-27, 4 marks)
- As Ananya, lead coordinator, Media Club, St. Xavier's School, draft a formal invitation to Ishaan Grover to be keynote speaker at a seminar on Digital Storytelling & Ethics. (SQP 2026-27, 4 marks)
- As Dr. Sameer, write a formal reply accepting an invitation to judge a 'Waste-to-Wealth' project competition. (SQP 2026-27, 4 marks)

Remember: Notice: Box, Name, NOTICE, Date, Heading, Body, Sign — in 50 words.

Chapter 21: Letters, Article & Report (Section B)

Class XII • English Core • CBSE 2026-27

Big idea: Q5 Letter and Q6 Article/Report: 5 marks each, 120-150 words, one of two.

Key points

- **Q5 Letter (5):** letter to the editor (suggestions/opinion on public issues) or **job application with bio-data/resume**.
- Marks: Format 1 / Organisation of ideas 1 / Content 2 / Accuracy 1.
- Letter to editor: close with **Yours truly**. Job application: close with **Yours sincerely**.
- Job letter content: refer to the advertisement, show suitability, submit application; bio-data as a separate enclosure.
- **Q6 Article/Report (5):** descriptive and analytical; same 1/1/2/1 marking.
- Article: title + by-line; introduction, body (cues + own ideas), conclusion.
- Report: headline, by-line, place & date; para 1 = what, who, when, where; para 2 = how/details; para 3 = steps, outcome, witness quotes.

Formats that earn the Format mark

- **Formal letter:** sender's address, date, receiver's address, subject, salutation (Sir/Madam), body, complimentary close, name.
- **Bio-data:** personal details, educational qualifications (as advertised), work experience, skills/achievements, references.
- **Article:** Title — By: Name, Class; 3-4 paragraphs.
- **Report:** Headline — By: Name (designation); Place, Date; past tense, third person.

Exam focus: how to score

- Use all the given cues + your own ideas — this is the Content (2) mark.
- Organise in clear paragraphs with linkers — the Organisation mark.
- Leave 3-4 minutes to check spelling and grammar (1 mark).

★ Important questions from CBSE sample papers

- As Kavya, write a letter to the Editor proposing a 'Community Food Redistribution Initiative' to tackle food wastage at social events. (SQP 2026-27, 5 marks)
- As Ranjay Thakur, apply for the post of Sustainable Tourism Coordinator at 'EcoTrails India', with a detailed bio-data. (SQP 2026-27, 5 marks)
- Write an article for your school magazine on why Digital Wellness should be integrated into the school curriculum. (SQP 2026-27, 5 marks)
- As Prem Kumar, write a report on the launch of the 'Tobacco Free Youth Campaign' in your school. (SQP 2026-27, 5 marks)

Remember: Editor = Yours truly; Job = Yours sincerely + bio-data.