CLASS 12 — SCIENCE SAMPLE PAPER

Physics & Chemistry — Full Syllabus Practice Paper

Time Allowed: 3 Hours **Maximum Marks:** 100

General Instructions: (i) All questions are compulsory. (ii) The paper is divided into sections as marked. (iii) Read each question carefully before answering. (iv) Draw diagrams wherever necessary.

SECTION A — Physics (Very Short Answer, 1 mark each)

Answer in one word or one sentence.

1. State Coulomb's law of electrostatics.

2. Define electric field intensity and state its SI unit.

3. State Gauss's law and write its mathematical form.

4. Define electric potential due to a point charge.

5. Write the formula for capacitance of a parallel plate capacitor with a dielectric.

6. State Kirchhoff's current law and voltage law.

7. State the Wheatstone bridge balance condition.

8. State Biot-Savart law.

9. Write the expression for the magnetic field at the centre of a current-carrying circular loop.

10. State Ampere's circuital law.

11. State Faraday's law of electromagnetic induction.

12. State Lenz's law.

13. Define self-inductance and mutual inductance.

14. Write the formula for impedance of a series RLC circuit.

15. Define resonant frequency of an LCR circuit.

16. Write the transformer equation relating primary and secondary voltage.

17. State Snell's law of refraction.

18. Write the lens maker's formula.

19. State Einstein's photoelectric equation.

20. Define work function of a metal.

21. Write the de Broglie wavelength formula.

22. State the radioactive decay law and define half-life.

23. Write the relation between mass defect and binding energy.

SECTION B — Physics (Short Answer, 2-3 marks each)

Show complete derivations/calculations.

1. Derive an expression for the electric field due to a uniformly charged infinite plane sheet using Gauss's law.

2. Derive the expression for capacitance of a parallel plate capacitor without dielectric.

3. Derive the condition for the balance of a Wheatstone bridge.

4. Two resistors of 4Ω and 6Ω are connected in parallel. Find the equivalent resistance and total current if a 12V battery is connected across them.

5. Derive an expression for the magnetic field on the axis of a current-carrying circular loop.

6. State and explain Faraday's laws of electromagnetic induction with the help of an experiment.

7. Derive an expression for the impedance of a series LCR circuit connected to an AC source.

8. Derive the mirror formula for a concave mirror using ray diagrams.

9. Derive the lens maker's formula for a thin convex lens.

10. Explain Young's double slit experiment and derive the expression for fringe width.

11. State Einstein's photoelectric equation and explain how it accounts for the threshold frequency.

12. Derive Bohr's formula for the energy of an electron in the nth orbit of a hydrogen atom.

13. Explain the working of a p-n junction diode as a rectifier, with a circuit diagram.

SECTION C — Chemistry (Very Short Answer, 1 mark each)

Answer in one word or one sentence.

1. State Raoult's law for a solution of volatile liquids.

2. Define molal elevation constant (Kb).

3. Define van't Hoff factor. What does it indicate about association or dissociation?

4. Write the Nernst equation for a general electrode reaction.

5. State Faraday's first law of electrolysis.

6. Define molar conductivity and state its unit.

7. State Kohlrausch's law.

8. Define order and molecularity of a reaction.

9. Write the integrated rate law for a first-order reaction.

10. State the Arrhenius equation and define activation energy.

11. Define adsorption. Differentiate between physisorption and chemisorption.

12. Write the general electronic configuration of d-block elements.

13. Define coordination number of a complex ion.

14. State Werner's theory of coordination compounds (in brief).

15. Differentiate between SN1 and SN2 reaction mechanisms.

16. What is Lucas reagent used for?

17. Write the equation for Williamson's ether synthesis.

18. Define aldol condensation with a general example.

19. What is the iodoform test used for?

20. Define a peptide bond.

SECTION D — Chemistry (Short Answer, 2-3 marks each)

Show complete steps/calculations.

1. Calculate the boiling point elevation of a solution containing 6 g of urea (molar mass 60 g/mol) in 200 g of water. (Kb of water = 0.52 K kg/mol)

2. Calculate the EMF of a cell using the Nernst equation, given standard electrode potentials of Zn^{2}■/Zn and Cu^{2}■/Cu electrodes (E° = –0.76 V and +0.34 V).

3. Derive the integrated rate equation for a first-order reaction and show that its half-life is independent of initial concentration.

4. Explain the mechanism of an SN1 reaction with a suitable example, showing the intermediate formed.

5. Explain crystal field theory for an octahedral complex, describing the splitting of d-orbitals into t2g and eg levels.

6. Distinguish between Raoult's law for ideal and non-ideal solutions with suitable graphs.

7. Explain the Cannizzaro reaction with a suitable example and write the mechanism in brief.

8. Explain the factors affecting the rate of a chemical reaction (concentration, temperature, catalyst, surface area).

9. Write short notes on Williamson's synthesis and its use in preparing ethers.

10. Explain the differences between primary, secondary, and tertiary amines with respect to basicity in aqueous solution.

SECTION E — Long Answer (5 marks each)

Answer in detail with diagrams and complete derivations.

1. Derive an expression for the electric field due to an electric dipole at a point on its axial line and at a point on its equatorial line.

2. State Kirchhoff's laws and use them to derive the balance condition of a Wheatstone bridge. Explain how a meter bridge is used to determine an unknown resistance.

3. Derive an expression for the self-inductance of a long solenoid, and explain the energy stored in an inductor carrying current.

4. Describe Young's double slit experiment in detail with a labelled diagram, and derive the expression for the width of interference fringes.

5. Explain the working of a p-n junction diode as a half-wave and full-wave rectifier with circuit diagrams and output waveforms.

6. Derive the Nernst equation for a general electrochemical cell and explain its application in determining the equilibrium constant of a reaction.

7. Explain the mechanism of nucleophilic substitution reactions (SN1 and SN2) in haloalkanes with suitable examples, and discuss the factors affecting the rate of each.

8. Describe the preparation, properties, and important reactions of aldehydes and ketones, including the aldol condensation and Cannizzaro reaction.