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INDIAN SCHOOL CERTIFICATE EXAMINATION

YEAR 2028



CHEMISTRY

(862)

Developed by:
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CISCE

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Council for the Indian School Certificate Examinations (CISCE)

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- Trust and fair play.
- Minimum monitoring.
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- Giving freedom to experiment with new ideas and practices.
- Diversity and plurality - the basic strength for evolution of ideas.
- Schools to motivate pupils towards the cultivation of:
  Excellence - The Indian and Global experience.
  Values - Spiritual and cultural - to be the bedrock of the educational experience.
- Schools to have an 'Indian Ethos', strong roots in the national psyche and be sensitive to national aspirations.

CLASS XII

*There will be **two** papers in the subject:*

***Paper I:** Theory - 3 hours ... 70 marks*

***Paper II:** Practical: 3 hours ... 15 marks*

Project Work ... 10 marks

Practical File ... 5 marks

PAPER I (THEORY) : 70 Marks

S.No.	UNIT	TOTAL WEIGHTAGE
1.	Solutions	**Physical Chemistry 25 Marks**
2.	Electrochemistry	
3.	Chemical Kinetics	
4.	d -and f -Block Elements	**Inorganic Chemistry 14 Marks**
5.	Coordination Compounds	
6.	Haloalkanes and Haloarenes	**Organic Chemistry 31 Marks**
7.	Alcohols, Phenols and Ethers	
8.	Aldehydes, Ketones and Carboxylic Acids	
9.	Organic Compounds containing Nitrogen	
10.	Biomolecules	
Total		**70 Marks**

1. Solutions

Study of concentration of solutions of solids in liquids, liquid in liquid, solubility of gases in liquids, solid solutions, Colligative properties - Raoult's law of relative lowering of vapour pressure (1^{st} & 2^{nd}), elevation of boiling point, depression of freezing point and osmotic pressure. Use of colligative properties in determining molecular masses of solutes, abnormal molecular mass association and dissociation, van't Hoff factor.

Normality, molality, molarity, mole fraction, ppm, as measures of concentration. Definition of the above with examples. Simple problems based on the above.

(i) Solubility of gases in liquids – Henry's Law, simple numericals based on the above.

(ii) Raoult's Law for volatile solutes and non-volatile solutes, ideal solution, non-ideal solution. Azeotropic mixtures – definition, types, graphical representation, fractional distillation with examples.

(iii) Colligative properties – definition and examples, and its use in determination of molecular mass.

(a) Relative lowering of vapour pressure: Definition and mathematical expression of Raoult's Law. Determination of relative molecular mass by measurement of lowering of vapour pressure.

(b) Depression in freezing point: molal depression constant (cryoscopic constant) – definition and mathematical expression (derivation included).

(c) Elevation in boiling point method: molal elevation constant (ebullioscopic constant) definition and mathematical expression (derivation included).

(d) *Osmotic pressure: definition and explanation. Natural and chemical semipermeable membranes, reverse osmosis, isotonic, hypotonic and hypertonic solutions. Comparison between diffusion and osmosis. Application of osmotic pressure in the determination of relative molecular mass.*

van't Hoff- Boyle's Law, van't Hoff –Charles' Law, van't Hoff - Avogadro's law.

(e) *Abnormal molecular mass: Dissociation and Association with suitable examples*

(f) *van't Hoff factor for the electrolytes which dissociate and the molecules which associate in solution. Modification of the formula of colligative properties based on van't Hoff factor. Simple problems. Calculation of degree of dissociation and association. Experimental details not required.*

Numerical problems based on all the above methods. Experimental details not required.

2. Electrochemistry

Electrolytic and electrochemical cells. Redox reactions in electrochemical cells. Electromotive Force (emf) of a cell, standard electrode potential, Nernst equation and its application to chemical cells. Relation between Gibbs energy change and emf of a cell.

Conductance in electrolytic solutions, specific, equivalent and molar conductivity, variations of conductivity with concentration, graphs; Kohlrausch's Law of electrolysis and Faraday's Laws of electrolysis. Dry cell and lead accumulator, fuel cells,corrosion.

(i) *Electrochemical cells: introduction, redox reactions (principle of oxidation and reduction in a cell).*

(ii) *Galvanic cells - introduction; representation, principle – oxidation reduction. Mechanism of production of electric current in a galvanic cell.*

(iii) *Measurement of potential. Single electrode potentials.*

Standard hydrogen electrode (E^o) - definition, preparation, application and limitations.

Standard electrode potential - Measurement of standard electrode potential of Zn^{++}/Zn, Cu^{++}/Cu, half cell (using standard hydrogen electrode).

Cell notation – representation.

Factors affecting electrode potential with explanation - main emphasis on the temperature, concentration and nature of the electrode.

(iv) *Electrochemical series. Its explanation on the basis of standard reduction potential.*

Prediction of the feasibility of a reaction.

(v) *Nernst equation and correlation with the free energy of the reaction with suitable examples.*

Prediction of spontaneity of a reaction based on the cell emf.

Numericals on standard electrode potential of half-cells, cell emf, relationship between free energy and equilibrium constant, standard electrode potential and free energy.

(vi) *Comparison of metallic conductance and electrolytic conductance. Relationship between conductance and resistance. Specific resistance and specific conductance.*

Cell constant: Calculation of cell constant. Meaning of equivalent conductance. Meaning of molar conductance. General relationship between specific conductance, molar conductance and equivalent conductance (units and graphs).

Units, numericals.

Molar conductance of a weak electrolyte at a given concentration and at infinite dilution. Kohlrausch's Law – definition, applications and numericals.

(vii) *Faraday's laws of Electrolysis.*

Faraday's First Law of electrolysis. Statement, mathematical form. Simple problems.

Faraday's Second Law of electrolysis: Statement, mathematical form. Simple problems.

Relation between Faraday, Avogadro's number and charge on an electron. $F = N_A e$ should be given (no details of Millikan's experiment are required).

(viii) *Batteries: Primary and Secondary Cells: Leclanche cell, mercury cell, Lead storage battery and fuel cell – structure, reactions and uses.*

(ix) *Corrosion: Concept, mechanism of electrochemical reaction, factors affecting it and its prevention.*

3. Chemical Kinetics

Meaning of Chemical Kinetics – slow and fast reactions. Rate of a reaction - average and instantaneous rate (graphical representation). Factors affecting rate of reaction: surface area, nature of reactants, concentration, temperature, catalyst and radiation. Order and molecularity of a reaction, rate law and specific rate constant. Integrated rate equations and half-life (only for zero and first order reactions), concept of collision theory (elementary idea, no mathematical treatment). Concept of threshold and activation energy, Arrhenious equation.

(i) *Meaning of chemical kinetics, Scope and importance of Kinetics of the reaction, slow and fast reactions – explanation in terms of bonds.*

(ii) *Rate of Reaction: definition, representation of rate of reaction in terms of reactants and products, determination of rate of reactions graphically, instantaneous and average rate of reaction. Factors affecting rate of reaction.*

(iii) *Law of mass Action: statement and meaning of active mass. Explanation with an example – general reactions.*

(iv) *Effect of concentration of reactants on the rate of a reaction: Qualitative treatment, based on the law of mass Action, statement of rate law, General rate equation – Rate = k (concentration of the reactant)^n, where k is rate constant and n is the order of the reaction, relationship between the rate of the reaction with rate constant with respect to various reactants.*

(v) *Order of a reaction: meaning, relation between order and stoichiometric coefficients in balanced equations, order as an experimental quantity, rate equation for zero order reaction and its unit, mathematical derivation of rate equation for first order reaction, characteristics of first order reaction – rate constant is independent of the initial concentration, units to be derived, definition of half-life period, derivation of expression of half-life period from first order rate equation.*

Problems based on first order rate equation and half-life period.

(vi) *Molecularity of the reaction: Meaning – physical picture, Relation between order, molecularity and the rate of a reaction, Differences between order and molecularity of a reaction.*

(vii) *The concept of energy: Exothermic and endothermic reactions, concept of energy barrier, threshold and activation energy, formation of activated complex, effect of catalyst on activation energy and reaction rate.*

(viii) *Collision Theory: Condition for a chemical change – close contact, particles should collide. Collisions to be effective – optimum energy and proper orientation during collision. Energy barrier built-up when the collision is about to take place, Activated complex formation, difference in energy of the reactant and the product – exothermic and endothermic reactions with proper graphs and labelling.*

(ix) *Mechanism of the reaction: meaning of elementary reaction, meaning of complex and overall reaction, explanation of the mechanism of the reaction, slowest step of the reaction. Relationship between the rate expression, order of reactants and products at the rate-determining step, units of rate constant – explanation with suitable examples.*

(x) *Effect of temperature on the rate constant of a reaction: Arrhenius equation – $K=Ae^{-Ea/RT}$, Meaning of the symbols of Arrhenius equation, related graph, evaluation of E_a and A from the graph, meaning of slope of the graph, conversion from exponential to log form of the equation, relationship between the increase in temperature and the number of collisions. Numerical based on Arrhenius equation.*

4. d- and f- Block Elements

Position in the periodic table, occurrence, electronic configuration and characteristics of transition metals, general trends in properties of the 3d-series of transition metals - metallic character, ionisation enthalpy, oxidation states, ionic radii, colour of ions, catalytic property, magnetic properties, interstitial compounds, alloy formation, preparation and properties of $K_2Cr_2O_7$ and $KMnO_4$.

Lanthanoids and actinoids.

(i) d-Block: 3d, 4d and 5d series

Study in terms of metallic character, atomic and ionic radii, ionisation enthalpy, oxidisation states, variable valency, formation of coloured compounds, formation of complexes, alloy formation.

(ii) f-Block: 4f and 5f series

Electronic configuration, atomic and ionic radii, oxidisation states, formation of coloured compounds, formation of complexes, alloy formation. Lanthanoid contraction and its consequences. Chemical reactivity – with oxygen, hydrogen, halogen, sulphur, nitrogen, carbon and water.

Actinoids - oxidation states and comparison with lanthanoids.

(iii) Potassium permanganate: structure, shape, equation of extraction from pyrolusite ore, its oxidising nature in acidic, basic and neutral medium, use in redox titration.

Oxidising nature in acidic [$FeSO_4$, $(COOH)_2.2H_2O$, KI], basic (KI) and neutral (H_2S) mediums to be done.

(iv) Potassium dichromate: structure, shape, equation of extraction from chromite ore and its use in titration. Oxidising nature in acidic, basic and neutral medium, use in redox titration. Interconversion of chromate and dichromate ion (effect of pH).

5. Coordination Compounds

Concept of complexes, definition of ligands, coordination number, oxidation number. IUPAC nomenclature of mononuclear coordination compounds. Isomerism (structural and stereo). Bonding, Werner's theory, VBT and CFT. Colour, magnetic properties and shapes. Importance of coordination compounds (in qualitative analysis, extraction of metals and biological system).

(i) Definition of coordination compounds / complex compounds, differences with a double salt, study of ligands – mono-, bi-, tri-, tetra-, penta-, hexa- and polydentate, chelating ligands, definition of coordination number, its calculation for a complex coordination sphere, study of oxidation state of an element in a complex, its calculation, IUPAC rules of nomenclature of coordination compounds.

(ii) Isomerism – structural, stereo types and examples.

(iii) Valence bond theory of coordination compounds – examples of formation of inner orbital and outer orbital complexes (high and low spin, octahedral, tetrahedral and square planar), prediction of magnetic character.

(iv) Crystal field theory – crystal field splitting in tetra and octahedral systems. Explanation of colour and magnetic character.

(v) Stability of coordination compounds (explain stability on the basis of magnitude of K) as mentioned above).

(vi) Importance and uses.

6. Haloalkanes and Haloarenes

Haloalkanes: General formula, nomenclature and classification. Nature of C–X bond, physical and chemical properties, mechanism of substitution reactions, optical rotation.

Haloarenes: Basic idea, nature of C–X bond, substitution reactions (directive influence of halogen in monosubstituted compounds only).

Uses and environmental effects of - dichloromethane, trichloromethane, tetra-chloromethane, iodoform, freons and DDT.

Nature of C-X bond

Naming the halogen derivatives of alkanes by using common system and IUPAC system for mono, di and tri-halo derivatives.

Preparation of haloalkanes from:

- *Alkane and halogen.*
- *Alkene and hydrogen halide.*
- *Alcohols with PX_3, PCl_5 and $SOCl_2$.*
- *Halide exchange method (Finkelstein and Swarts).*
- *Silver salt of fatty acids (Hunsdiecker).*

Physical properties: State, melting point, boiling point and solubility.

Chemical properties: nucleophilic substitution reactions (S_N1, S_N2 mechanism in terms of primary, secondary and tertiary halides) Reaction with: sodium hydroxide, water, sodium iodide, ammonia, primary amine, secondary amine, potassium cyanide, silver cyanide, potassium nitrite, silver nitrite, silver salt of fatty acid and lithium-aluminium hydride.

Elimination reaction (Saytzeff's rule) / β elimination.

Reaction with metals: sodium and magnesium (Wurtz's reaction, Grignard's reagent preparation).

Chloroform and iodoform: preparation and properties.

Structure of freons.

Preparation of haloarenes by Sandmeyer's and Gattermann's reaction, by electrophilic substitution.

Physical properties: State, melting point, boiling point and solubility.

Chemical properties:

- *Electrophilic substitution (chlorination nitration and sulphonation) with mechanism.*
- *Nucleophilic substitution (replacement of chlorine with -OH, $-NH_2$) with mechanism.*
- *Reduction to benzene.*
- *Wurtz-Fittig reaction.*
- *Fittig reaction.*
- *Addition reaction with magnesium (formation of Grignard reagent).*
- *Structure of DDT.*

7. Alcohols, Phenols and Ethers

Alcohols: Classification, general formula, structure and nomenclature. Methods of preparation, physical and chemical properties (of primary alcohols only), identification of primary, secondary and tertiary alcohols, mechanism of dehydration, uses with special reference to methanol and ethanol.

(i) Classification into monohydric, dihydric and polyhydric alcohols, general formulae, structure and nomenclature of alcohols. Difference between primary, secondary and tertiary alcohols in terms of structure, physical properties and chemical properties.

(ii) Methods of preparation:

- *Hydration of Alkenes – direct hydration, indirect hydration, hydroboration oxidation.*
- *From Grignard's reagent.*
- *Hydrolysis of alkyl halides.*
- *Reduction of carbonyl compounds.*
- *From primary amines.*

Manufacture of methanol by Bosch process and ethanol by fermentation of carbohydrates, chemical equations required (only outline of the method of manufacture, detail not required).

Properties:

- *Acidic nature of alcohols:*
- *Reaction with sodium.*
- *Esterification with mechanism.*
- *Reaction with hydrogen halides.*
- *Reaction with PCl_3, PCl_5, and $SOCl_2$.*
- *Reaction with acid chlorides and acid anhydrides.*
- *Oxidation.*
- *Dehydration with mechanism.*

Uses of alcohols.

(iii) Conversion of one alcohol into another.

(iv) Distinction between primary, secondary and tertiary alcohols by Lucas' Test.

Phenols: Classification and nomenclature. Methods of preparation, physical and chemical properties, acidic nature of phenol, electrophilic substitution reactions, uses ofphenols.

Preparation of phenol from diazonium salt, chlorobenzene (Dow's process) and from benzene sulphonic acid.

Manufacture from Cumene.

Physical properties: state and solubility.

Chemical properties:

- *Acidic character of phenol.*
- *Reaction with sodium hydroxide.*
- *Reaction with sodium.*
- *Reaction with zinc.*
- *Reaction with acetyl chloride and acetic anhydride.*
- *Reaction with phosphorus penta chloride.*
- *Bromination, nitration and sulphonation (Electrophilic substitution reactions).*
- *Kolbe's reaction (formation of salicylic acid).*
- *Reimer – Tiemann reaction.*
- *Test for phenol – $FeCl_3$ test, azo dye test.*

Aliphatic Ethers: General formula, structure and nomenclature. Methods of preparation, physical and chemical properties, uses.

Ethers: structure of ethereal group.

Preparation from alcohol (Williamson's synthesis).

Physical properties: state, miscibility.

Chemical properties:

- *Reaction with chlorine.*
- *Oxidation (peroxide formation).*
- *Reaction with HI.*
- *Reaction with PCl_5.*

Aryl ethers

Physical properties – state and solubility.

Chemical properties – preparation of anisole (Williamson's synthesis), electrophilic substitution (halogenation, nitration and Friedel-Crafts reaction.)

Uses of ether.

8. Aldehydes, Ketones and Carboxylic Acids

Aldehydes and Ketones: Nomenclature, structure of methods of preparation of aldehydes and ketones, physical and chemical properties, mechanism of nucleophilic addition, reactivity of alpha hydrogen in aldehydes and uses.

Preparation:

- *From alcohol.*
- *From alkenes (ozonolysis).*
- *From alkynes (hydration).*
- *From acid chlorides (Rosenmund's reduction, reaction with dialkyl cadmium).*
- *From calcium salt of carboxylic acids.*
- *From nitriles (Stephen reaction, Grignard's reagent).*
- *From esters.*

Physical properties – state and boiling point.

Chemical properties:

- *Nucleophilic addition reactions with mechanism (ammonia and its derivatives, HCN, $NaHSO_3$ and Grignard's reagent).*
- *Oxidation reactions, iodoform reaction.*
- *Reduction: reduction to alcohol and alkanes (Clemmensen's reduction, Wolff-Kishner reduction, Red phosphorus and HI).*
- *Base catalysed reactions (with mechanism): Aldol condensation, cross Aldol condensation, Cannizzaro's reaction.*

Tests: difference between formaldehyde and acetaldehyde; aldehydes and ketones.

Uses of aldehydes and ketones.

Aromatic aldehyde (Benzaldehyde)

Lab preparation from toluene by oxidation with chromyl chloride.

Physical properties: state and stability.

Chemical properties:

- *Oxidation and reduction.*
- *Nucleophilic addition reaction (hydrogen cyanide and sodium bisulphite).*
- *Reactions with ammonia and its derivatives (hydroxyl amine, hydrazine and phenyl hydrazine).*
- *Reaction with phosphorus pentachloride.*
- *Cannizzaro reaction.*
- *Benzoin condensation.*
- *Perkin's reaction.*
- *Electrophilic substitution - halogenation, nitration and sulphonation.*

Test: distinction between aromatic and aliphatic aldehydes.

Uses of benzaldehyde.

Carboxylic Acids: Classification, general formula and structure of carboxylic group. Nomenclature, acidic nature, methods of preparation, physical and chemical properties and uses.

Classification of mono and di carboxylic acids with examples.

Preparation of aliphatic and aromatic carboxylic acid:

- *From alcohols, aldehydes.*
- *From nitriles.*
- *From Grignard's reagent.*

Physical properties: state, boiling point and solubility.

Chemical properties:

- *Acidic character: (aliphatic, aromatic carboxylic acids with the effect of substituents on the acidic character – to be dealt with in detail)*
- *Reaction with active metals, alkalies, carbonates and bicarbonates,*
- *Formation of acid derivatives.*
- *Decarboxylation (chemical and Kolbe's electrolytic reaction).*
- *HVZ reactions.*
- *Substitution of benzene ring (meta directive effect of carboxylic acid group) nitration and sulphonation.*

Tests for acids: formic acid, acetic acid and benzoic acid.

Uses of formic acid, acetic acid and benzoic acid.

9. Organic compounds containing Nitrogen

Aliphatic Amines: General formula and, classification of amines. Structure of the amino group, nomenclature. Methods of preparation, physical and chemical properties, uses, identification of primary, secondary and tertiary amines.

- *Amines*

  Nomenclature, classification with examples, structure, general formula.

  Methods of preparation:

  - *From alcohol.*
  - *From alkyl halide.*
  - *From cyanide.*
  - *From amide (Hofmann's degradation).*
  - *From nitro compounds.*
  - *Gabriel phthalimide Synthesis.*

  Physical properties: comparison between primary, secondary and tertiary amines in terms of – state, solubility, boiling point (hydrogen bonding), comparison with alcohols.

  Chemical properties:

  - *Basic character of amines – comparison between primary, secondary and tertiary alkyl amines/ ammonia/ aniline. Effect of substituents on the basic strength of aniline.*
  - *Alkylation and acylation with mechanism.*
  - *Reaction with nitrous acid.*
  - *Carbylamine reaction.*

    Distinction between primary, secondary and tertiary amines (Hinsberg's Test).

Aniline

Preparation reduction of nitrobenzene.

Physical properties – state, solubility and boiling point.

Chemical properties:

- *Reaction with HCl and H_2SO_4.*
- *Acetylation, alkylation.*
- *Benzoylation.*
- *Carbylamine reaction.*
- *Diazotisation.*
- *Electrophilic substitution (bromination, nitration and sulphonation).*

Tests for aniline.

Uses of aniline.

Cyanides and Isocyanides

Methods of preparation:

Cyanides:

- *From alkyl halide.*
- *From amide.*

Isocyanides:

- *From alkyl halide.*

From primary amines

Diazonium salts: Preparation, chemical reactions and importance in synthetic organic chemistry.

Preparation from aniline;

Properties: Sandmeyer's reaction, Gattermann reaction and Balz – Scheimann reaction, replacement of diazo group by – H, -OH, $-NO_2$, coupling reaction with phenol and aniline.

10. Biomolecules

Carbohydrates – Definition, Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), D-L configuration oligosaccharides (sucrose, lactose, maltose), polysaccharides (starch, cellulose, glycogen); Importance of carbohydrates.

Carbohydrates: definition, classification - mono (aldose, ketose), oligo (di, tri, tetra saccharides) and polysaccharides with examples: reducing sugars and non-reducing sugars – examples and uses.

Establishment of structures for glucose and fructose (open and cyclic) heating with HI, reaction with hydroxylamine, bromine water, acetic anhydride, nitric acid and phenyl hydrazine.

Test for glucose and fructose (bromine water test with equation).

Disaccharides – structures of sucrose, maltose and lactose (glycosidic linkage).

Polysaccharides – starch, cellulose, glycogen.

Proteins – structural units of proteins. Basic idea of - amino acids, peptide bond, polypeptides, proteins, structure of proteins - primary, secondary, tertiary structure and quaternary structures (qualitative idea only), denaturation of proteins. Enzymes, hormones - elementary idea only.

Proteins: Amino acids – general structure, classification and zwitter ion formation. Isoelectric point.

Classification of proteins on the basis of molecular shape; primary, secondary, tertiary and quaternary, structures of proteins, denaturation of proteins. (Definitions only. Details and diagrams are not required).

Vitamins - Classification and functions.

Vitamins A, B, C, D, E and K: classification (fat soluble and water soluble), deficiency diseases. (Chemical names and structures are not required).

Nucleic Acids - DNA and RNA.

Nucleic acids: basic unit – purine and pyrimidine, DNA – structure (double helical), RNA (No chemical structure required). Differences between DNA and RNA.

PAPER II (PRACTICAL WORK) : 15 Marks

Candidates are required to complete the following experiments:

1. Titrations

Oxidation-reduction titrations: potassium manganate (VII) / ammonium iron (II) sulphate; potassium manganate (VII) / oxalic acid.

The candidate may be required to determine the percentage purity of a compound and the number of molecules of water of crystallization in hydrated salts. In such experiments sufficient working details including recognition of the end point will be given.

Candidates will be required to calculate:

- *Molarity*
- *Concentration in grams L^{-1} / molecular mass*
- *Number of molecules of water of crystallisation/ percentage purity.*

NOTE: Molarity must be calculated upto 4 decimal places at least, in order to avoid error.

OBSERVATION TABLE

S. No.	(A)	(B)	(B – A)
	Initial burette reading (ml)	Final burette reading (ml)	Difference (ml)
1			
2			
3			

- Concordant reading is to be used for titre value. Concordant reading is two consecutive values which are exactly the same. Average will not be accepted as titre value.
- The table is to be completed in ink only. Pencil is not to be used.
- Overwriting will not be accepted in the tabular column.

Observations:

- Pipette size (should be same for all the candidates at the centre).
- Titre value (concordant value).

2. Study of the rate of reaction

The candidates will be required, having been given full instructions, to carry out an experiment on the rate of reaction, e.g. reaction between sodium thiosulphate and hydrochloric acid (using different concentrations for either), magnesium and dil. sulphuric acid/ dil. hydrochloric acid (using different concentrations).

- *Graph of volume vs. time and its interpretation.*
- *Relationship between concentration and rate, volume and rate and time and rate.*

3. Identification of the following compounds and functional groups based on observations

- Alcoholic group - glycerol
- Aldehyde group- formaldehyde
- Ketonic group – acetone
- Carboxylic group – benzoic acid

- Amino group - aniline

***Please Note: Carbylamine and acrolein tests should not be performed.**

The student should learn to differentiate between colours, solution, ring and precipitate.

4. Characteristic tests of carbohydrates and proteins

- Carbohydrates – glucose
- Proteins – powdered milk

Identification should be of 'Carbohydrate' and 'Protein' ,not of individual substances.

5. Experiments related to pH change using pH paper or universal indicator

- Determination of pH of some solutions obtained from fruit juice, solutions of known and varied concentrations of acids, bases and salts.
- Comparison of pH of the solutions of strong and weak acids of the same concentration.

Use of universal indicator/pH paper must be taught to the students.

6. Electrochemistry

Setting up a simple voltaic cell.

Variation of cell potential in $Zn/Zn^{2+}//Cu^{2+}/Cu$ with change in concentration of electrolyte ($CuSO_4$, $ZnSO_4$) at room temperature.

7. Qualitative analysis

Qualitative analysis: identification of single salt containing one anion and one cation:

Anions: CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}, SO_4^{2-}, NO_3^-, CH_3COO^-, Cl^-, Br^-, I^-, $C_2O_4^{2-}$, PO_4^{3-}.

Cations: NH_4^+, Pb^{2+}, Cu^{2+}, Al^{3+}, Fe^{3+}, Zn^{2+}, Mn^{2+} , Ni^{2+}, Co^{2+}, Ba^{2+}, Sr^{2+}, Ca^{2+}, Mg^{2+}.

NOTE:

Chromyl chloride test not to be performed.

For wet test of anions, sodium carbonate extract must be used (except for carbonate).

(Insoluble salts such as lead sulphate, barium sulphate, calcium sulphate, strontium sulphate will not be given).

Anions: Dilute acid group – CO_3^{2-}, NO_2^-, S^{2-}, SO_3^{2-}

Concentrated Acid Group – NO_3^-, Cl^-, Br^-, I^-, CH_3COO^-.

Special Group - SO_4^{2-}, PO_4^{3-}, *$C_2O_4^{2-}$.*

Cations: Group Zero: NH_4^+

Group I: Pb^{2+}

Group II: Cu^{2+}, Pb^{2+}

Group III: Al^{3+}, Fe^{3+}

Group IV: Zn^{2+}, Mn^{2+}, Ni^{2+}, Co^{2+}

Group V: Ba^{2+}, Sr^{2+}, Ca^{2+}

Group VI: Mg^{2+}

NOTE:

- *Formal analytical procedure is required for Qualitative Analysis.*
- *Specific solvent for O.S. to be used;*
- *Before adding Group III reagents to the filtrate of Group II, H_2S must be removed followed by boiling with conc. Nitric acid.*
- *The right order for buffer (NH_4Cl and NH_4OH) must be used.*
- *The flame test with the precipitate obtained in Group V for Ba^{2+}, Sr^{2+}, Ca^{2+} will also be accepted as a confirmatory test.*

For wet test of anions, sodium carbonate extract must be used (except for carbonate).

PATTERN OF CHEMISTRY
PRACTICAL PAPER

Questions in the practical paper will be set as follows:

Question 1	**Volumetric Analysis**
Question 2	**Any one or a combination of the following experiments:**
	• Study of the rate of reaction.
	• Identification of the organic compounds and functional groups based on observations.
	• Characteristic tests of carbohydrates and proteins.
	• Experiments related to pH determination using pH paper or universal indicator.
	• Electrochemistry.
Question 3	**Qualitative Analysis (single salt).**

PROJECT WORK AND PRACTICAL FILE : 15 Marks

Project Work – 10 Marks

The project work is to be assessed by a Visiting Examiner appointed locally and approved by the Council.

The candidate is to creatively execute **one** project/assignment on an aspect of Chemistry. Teachers may assign or students may select a topic of their choice. Following is only a suggestive list of projects.

Suggested Evaluation criteria for Project Work:

- Introduction / purpose
- Contents
- Analysis/ material aid (graph, data, structure, pie charts, histograms, diagrams, etc.)
- Presentation
- Bibliography

Suggested Assignments:

1. Amino acids: Peptides, structure and classification, proteins structure and their role in the growth of living beings.
2. Nucleic Acid: DNA and RNA – their structure. Unique nature. Importance in evolution and their characteristic features.
3. Carbohydrates and their metabolism, Blood -haemoglobin and respiration.
4. Vitamins and hormones
5. Simple idea of chemical evolution.
6. Natural polymers (any **five**) - structure, characteristics, uses. Synthetic polymers (any **five) -** method of preparation, structure, characteristics and uses.
7. Types of Dyes - methods of preparation, characteristics and uses.
8. Chemicals in medicines: antiseptics, antibiotics, antacids, etc. and their uses.
9. Preparation of soap, nail polish, boot polish, varnish, nail polish remover, shampoo and perfumes.
10. Chemicals and chemical processes in forensic studies.

11. Insecticides, pesticides and chemical fertilisers.
12. Ancient Indian medicines and medicinal plants.
13. Organic Chemistry in Nutrition, Food Science and Biotechnology.
14. Effect of Green House Gases.
15. How Plastics have changed the world, both socially and economically.

Practical File – 5 Marks

The Visiting Examiner is required to assess students on the basis of the Chemistry Practical file maintained by them during the academic year.

NOTE: According to the recommendation of International Union of Pure and Applied Chemistry (IUPAC), the groups are numbered from 1 to 18 replacing the older notation of groups IA …. VIIA, VIII, IB …… VIIB and 0. However, for the examination both notations will be accepted.

Old notation	IA	IIA	IIIB	IVB	VB	VIB	VIIB	VIII			IB	IIB	IIIA	IVA	VA	VIA	VIIA	0
New notation	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18