# CHEMISTRY (862)

## 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**

*There will be no overall choice in the paper. Candidates will be required to answer **all** questions. Internal choice will be available in two questions of 2 marks each, two questions of 3 marks each and all the three questions of 5 marks each.*

| S.No. | UNIT | TOTAL WEIGHTAGE |
|---|---|---|
| 1. | Solid State | **Physical Chemistry 25 Marks** |
| 2. | Solutions | |
| 3. | Electrochemistry | |
| 4. | Chemical Kinetics | |
| 5. | Surface Chemistry | |
| 6. | General Principles and Processes of Isolation of Elements | **Inorganic Chemistry 20 Marks** |
| 7. | p -Block Elements | |
| 8. | d -and f -Block Elements | |
| 9. | Coordination Compounds | |
| 10. | Haloalkanes and Haloarenes | **Organic Chemistry 25 Marks** |
| 11. | Alcohols, Phenols and Ethers | |
| 12. | Aldehydes, Ketones and Carboxylic Acids | |
| 13. | Organic Compounds containing Nitrogen | |
| 14. | Biomolecules | |
| 15. | Chemistry in Everyday Life | |
| **TOTAL** | | **70 Marks** |

**PAPER I –THEORY – 70 Marks**

## 1. Solid State

Solids: their classification based on different binding forces such as: ionic, covalent molecular; amorphous and crystalline solids (difference), metals. Type of unit cell in two dimensional and three-dimensional lattices, number of atoms per unit cell (all types). Calculation of density of unit cell, packing in solids, packing efficiency, point defects and magnetic properties.

*(i) Crystalline and amorphous solids.*

*(ii) Definition of crystal lattice, unit cell; types of unit cell (scc, fcc, bcc); calculation of the number of atoms per unit cell; relationship between radius, edge length and nearest neighbour distance. Calculation of density of unit cell, formula of the compound – numericals based on it; packing in 3 – D, packing fraction in scc, fcc, bcc with derivation.*

*(iii) Characteristics of crystalline solids; ionic (NaCl), metallic (Cu), atomic (diamond and graphite).*

*(iv) Point defects: Stoichiometric, non-stoichiometric and impurity defects (F- centres).*

*(v) Magnetic properties: diamagnetic and paramagnetic.*

## 2. Solutions

Study of concentration of solutions of solids in liquids, liquid in liquid, solubility of gases in liquids, Colligative properties - Raoult's law of relative lowering of vapour pressure, elevation of boiling point, depression of freezing point, osmotic pressure. Use of colligative properties in determining molecular masses of solutes.

*Normality, molality, molarity, mole fraction 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.*

*(ii) Raoult's Law for volatile solutes and non-volatile solutes, ideal solution, non-ideal solution. Azeotropic mixtures – definition and types.*

*(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.*

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

## 3. 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, Kohlrausch's Law of electrolysis and Faraday's Laws of electrolysis.

*(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 - definition, preparation, application and limitations.*

*Standard electrode potential ($E^o$) - 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, 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).*

## 4. 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 first order reactions). 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,*

*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) 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.*

## 5. Surface Chemistry

Absorption and Adsorption - physisorption and chemisorption, factors affecting adsorption of gases on solids and liquids.

Colloidal state distinction between true solutions, colloids and suspension; lyophilic, lyophobic multi-molecular, macromolecular and associated colloids; properties of colloids; Brownian movement, Tyndall effect, coagulation and electrophoresis.

*(i) Difference between absorption and adsorption: definition of physisorption and chemisorption and their differences.*

*Factors affecting adsorption of gases on solids.*

*(ii) Colloidal State: Thomas Graham classified the substances as crystalloid and colloid, classification of substances on the basis of the particle size i.e. true solution, sol and suspension, colloidal system is heterogeneous. lyophilic and lyophobic colloid; classification of colloidal solutions as micro, macro and associated colloids.*

*Properties of colloidal solutions: Brownian movement, Tyndall effect, coagulation, electrophoresis (movement of dispersed phase), Protection of colloids, Gold number and Hardy- Schulze rule.*

*Application of colloids in daily life.*

## 6. General Principles and Processes of Isolation of Elements

Metals: metallurgy, ores, principles and methods of extraction - concentration, oxidation, reduction, electrolytic refining. Occurrence and principles of extraction of copper, zinc, iron and silver.

*(i) Definition of minerals, ores and metallurgy; principle ores of iron, copper, zinc and silver.*

*Methods of concentration of ores: hydraulic washing, magnetic separation, froth floatation method.*

*Extraction of metal from concentrated ore – calcination, roasting and thermal reduction.*

*Metallurgy of iron, copper, zinc and silver.*

*Refining of metals.*

*(ii) Uses of metals and their alloys.*

## 7. p-Block Elements

### Group-15 Elements

Position in the periodic table, occurrence, electronic configuration, oxidation states, trends in physical and chemical properties. Nitrogen: preparation properties and its uses; compounds of nitrogen. Ammonia and nitric acid – preparation and properties.

*(i) General introduction, electronic configuration, occurrence, oxidation states. Trends in physical properties; chemical properties with hydrogen, oxygen and halogens.*

*(ii) Nitrogen - Laboratory preparation, decomposition (ammonium dichromate). Properties and uses.*

*(iii) Ammonia – Preparation and manufacture. Properties: reaction with oxygen, copper oxide, chlorine, hydrochloric acid, formation of complexes. Uses.*

*(iv) Nitric Acid - Preparation and manufacture. Properties: reaction with copper (dilute and concentrated $HNO_3$), carbon and sulphur. Uses.*

**Group-16 Elements**

Position in the periodic table, occurrence, electronic configuration, oxidation states, trends in physical and chemical properties. Ozone – methods of preparation. Compounds of sulphur: preparation, properties and uses of sulphur-dioxide.

*(i) Electronic configuration, oxidation states, occurrence. Trends in physical properties; chemical properties with hydrogen, oxygen and halogens.*

*(ii) Ozone: manufacture by Siemen's ozoniser, thermal decomposition of ozone, its oxidising nature – reaction with lead sulphide, potassium iodide and mercury, its uses.*

*(iii) Sulphur dioxide: laboratory and industrial preparation from sulphites and sulphide ores, reaction of sulphur dioxide with NaOH, $Cl_2$, $KMnO_4$.*

**Group-17 Elements**

Position in the periodic table, occurrence, electronic configuration, oxidation states, trends in physical and chemical properties; Preparation, properties and uses of chlorine, Interhalogen compounds.

*(i) General introduction, electronic configuration, oxidation states. Trends in physical properties and chemical properties (hydrogen, oxygen, halogens and metals).*

*(ii) Chlorine – preparation from $MnO_2$ and HCl, from NaCl, $MnO_2$ and conc. $H_2SO_4$ (only equations), reactions of chlorine with $H_2S$, $NH_3$, cold, dilute NaOH and hot, concentrated NaOH.*

*(iii) Interhalogen compounds – structure, hybridisation and shapes: XX', $XX'_3$, $XX'_5$, $XX'_7$.*

**Group-18 Elements**

Position in the periodic table, occurrence, electronic configuration, trends in physical and chemical properties, inert nature, uses.

*(i) General introduction, electronic configuration, occurrence, trends in physical; chemical properties, state and low reactivity.*

*(ii) Hybridisation, shape and structure of xenon compounds with fluorine and oxygen.*

*(iii) Uses of noble gases.*

## 8. 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.

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.*

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

*Electronic configuration, atomic and ionic radii, oxidisation states, formation of coloured compounds, formation of complexes. Lanthanoid contraction and its consequences.*

*Actinoids - oxidation states and comparison with lanthanoids.*

## 9. Coordination Compounds

Concept of complexes, definition of ligands, coordination number, oxidation number. IUPAC nomenclature of mononuclear coordination compounds. Isomerism (structural). 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 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) Importance and uses.*

**10. 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).

*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.*

*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).*
- *Nucleophilic substitution (replacement of chlorine with -OH, $-NH_2$).*
- *Reduction to benzene.*
- *Wurtz-Fittig reaction.*
- *Fittig reaction.*
- *Addition reaction with magnesium (formation of Grignard reagent).*

**11. 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.

*(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.*

*Properties:*

- *Acidic nature of alcohols:*

- *Reaction with sodium.*
- *Esterification.*
- *Reaction with hydrogen halides.*
- *Reaction with $PCl_3$, $PCl_5$, and $SOCl_2$.*
- *Reaction with acid chlorides and acid anhydrides*
- *Oxidation.*
- *Dehydration.*

*(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.

– *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.

*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 $PCl_5$.*

**12. Aldehydes, Ketones and Carboxylic Acids**

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

*Preparation:*

- *From alcohol.*
- *From alkenes (ozonolysis).*
- *From alkynes (hydration).*
- *From acid chlorides (Rosenmund's reduction).*
- *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 (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: Aldol condensation, cross Aldol condensation, Cannizzaro's reaction.*

*Tests: difference between formaldehyde and acetaldehyde; 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.*

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

*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.*

## 13. 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.*
  - *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.*

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

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

**14. Biomolecules**

**Carbohydrates –** Definition, Classification (aldoses and ketoses), monosaccahrides (glucose and fructose), D-L configuration.

*Carbohydrates: definition, classification - mono (aldose, ketose): reducing sugars and non-reducing sugars – examples.*

*Heating with HI, reaction with hydroxylamine, bromine water, acetic anhydride, nitric acid.*
*Test for glucose and fructose (bromine water test with equation).*

**Proteins** – structural units of proteins. Basic idea of - amino acids, peptide bond, polypeptides, proteins.

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

*Classification of proteins on the basis of molecular shape; denaturation of proteins. (Definitions only. Details and diagrams 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.*

**15. Chemistry in Everyday Life**

**Chemicals in medicines -** analgesics, tranquilizers antiseptics, disinfectants, antimicrobials, antifertility drugs, antibiotics, antacids, antihistamines.

*In medicine: antipyretics, analgesics, tranquillisers, antiseptics, disinfectants, anti-microbials, anti-fertility drugs, antihistamines, antibiotics, antacids.*
*Definition, common examples, uses.*
*Differences between antiseptics and disinfectants.*

*Structure not required.*

**Chemicals in food -** preservatives, artificial sweetening agents, elementary idea of antioxidants.

*Preservatives: role, example (Sodium benzoate).*
*Artificial sweetening agents: role, examples (aspartame, saccharine, sucralose and alitame).*

## 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. 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. |
| **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 |