SCIENCE (52)

PAPER 2: CHEMISTRY

Aims:

1. To acquire the knowledge of terms, concepts, processes, techniques and principles related to the subject.
2. To develop the ability to apply the knowledge of contents and principles of chemistry in unfamiliar situations.
3. To acquire skills in proper handling of apparatus and chemicals.
4. To develop scientific temper, attitude and problem solving skills.

CLASS IX

*There will be one paper of **one** and **half-hours** duration of 80 marks and Internal Assessment of practical work carrying 20 marks.*

*The paper will be divided into **two** sections, Section I (40 marks) and Section II (40 marks).*

***Section I** (compulsory) will contain short answer questions on the entire syllabus.*

***Section II** will contain six questions. Candidates will be required to answer any **four** of these **six** questions.*

***Note:** All chemical reactions should be studied with reference to the reactants, products, conditions, observations and the (balanced) equation.*

1. Matter and its Composition

(i) Inter-conversion of states of matter; m.p., b.p. (relevant experiments).

(ii) Explanation of change of state of matter on the basis of Kinetic Theory of Matter.

2. Study of Gas Laws

(i) The behaviour of gases under changes of temperature and pressure; explanation in terms of molecular motion (particles, atoms, molecules); Boyle's Law and Charles' Law; absolute (Kelvin) zero; gas equation; simple relevant calculations.

(ii) Relationship between Kelvin Scale and Celsius Scale of temperature; Standard temperature and pressure (reduction to S.T.P. required).

3. Elements, Compounds and Mixtures

(i) General characteristics and differences between elements, compounds and mixtures.

(ii) Separation of mixtures involving use of a solvent, filtration, evaporation and distillation, fractional distillation, simple paper chromatography (limited to separation of colouring matter in ink); immiscible liquids (separating funnel).

(iii) Types of mixtures: of two solids, a solid and a liquid, two liquids, liquid and gas, two gases.

4. The language of Chemistry

Symbol of an element; valency; formulae of radicals and formulae of compounds. Balancing of simple chemical equations.

5. Physical and Chemical Changes

(i) Definitions and comparison of Physical and Chemical changes.

(ii) Conditions for chemical change.

(iii) Types of chemical change.

(iv) Energy changes in a chemical change.

(v) Burning: Definition and conditions of burning.

6. Water

(i) Physical Properties: Water as a compound and as a universal solvent; its physical states and chief physical properties; solutions as 'mixtures' of solids in water; saturated solutions; qualitative effect of temperature on solubility (e.g. solutions of calcium sulphate, potassium nitrate, sodium chloride in water).

(ii) Water of crystallization: removal of water of crystallization; idea of anhydrous substances; air dissolved in water and its biological importance.

(iii) Chemical Properties: The action of cold water on sodium and calcium; the action of hot water on magnesium and steam on iron; reversibility of reaction between iron and steam; reactivity series.

7. Atomic Structure

(i) Atom consists of a nucleus (protons, neutrons) with associated electrons, mass number and atomic number.

(ii) Isotopes of hydrogen, carbon, chlorine. Reason for chemical activity of an atom (electronic configuration). Octet Rule.

8. The Periodic Table

(i) Dobereiner's Triads, Newland's Octaves, Mendeleev's contributions; Modern Periodic Law, the representative periodic table for 8 groups up to period 3.

(ii) Uses of Modern Periodic Table.

- **Study of the First Element -Hydrogen**

Position of the non-metal (Hydrogen) in the periodic table and general group characteristics applied to the above mentioned element.

(i) Hydrogen from water.

(ii) Displacement of hydrogen from dilute sulphuric acid or hydrochloric acid by zinc or iron (no reaction with copper).

(iii) Displacement of hydrogen from alkalis (NaOH, KOH) by Zn, Al.

(iv) The preparation and collection of hydrogen by a standard laboratory method other than electrolysis.

- **Study of the Group 14 (Fourth Group) Element - Carbon**

Position of the non-metal (Carbon) in the periodic table and general group characteristics applied to the above mentioned element.

Natural occurrence; Allotropy (definition); Allotropes of Carbon – diamond, graphite and fullerene; burning of these in O_2 giving CO_2. Other forms of Carbon: wood, bone charcoal, soot, gas carbon – their uses.

- **Study of the Group 15 (Fifth Group) Element - Nitrogen**

Position of the non-metal (Nitrogen) in the periodic table and general group characteristics applied to the above mentioned element.

(i) Laboratory preparation and collection of nitrogen.

(ii) Properties of nitrogen.

- **Study of the Group 16 (Sixth Group) Elements – Oxygen, Sulphur**

Position of the non-metals (Oxygen, Sulphur) in the periodic table and general group characteristics applied to the above mentioned elements.

(i) Occurrence of oxygen in air, water and oxides.

(ii) The preparation and collection of oxygen in the laboratory e.g. from: (i) hydrogen peroxide (ii) potassium chlorate with manganese (IV) oxide. (iii) oxygen from higher oxides like Pb_3O_4, PbO_2.

(iii) Density of oxygen as compared to air.

(iv) Solubility of oxygen in water.

(v) The burning of common elements in oxygen (e.g. carbon, sulphur, phosphorus, sodium, calcium, magnesium, iron); burning of a candle in air – products formed: water and carbon dioxide.

(vi) Conditions for and prevention of rusting.

(vii) Sulphur - extraction by Frasch process. Structure and process.

(viii) Chemical properties of sulphur.

(ix) Uses of sulphur.

- **Study of Group 17 (Seventh Group) Element - Chlorine**

  Position of the non-metal (Chlorine) in the periodic table and general group characteristics applied to the above mentioned element.

  (i) Preparation and collection of chlorine; refer to the density, solubility and poisonous nature of chlorine; oxidation of concentrated hydrochloric acid by MnO_2; NaCl and concentrated sulphuric acid and MnO_2; bleaching powder; PbO_2 and Pb_3O_4.

  (ii) Reaction of chlorine with burning sodium, hot iron, phosphorus. Sodium hydroxide solutions, cold and hot, potassium iodide solution, hydrogen sulphide and ammonia; uses of Chlorine: in water purification, bleaching agent, manufacture of hydrochloric acid and other important uses.

9. Study of Carbon Monoxide and Carbon Dioxide

(i) Carbon monoxide formed by incomplete combustion of carbon or carbon compounds (e.g. exhaust fumes from cars); methods of preparing and collecting carbon monoxide (preparation of CO from oxalic and formic acids); conversion of CO_2 into CO and vice-versa; separation of CO_2 or CO from a mixture of the two; reducing property of CO with reference to metallic oxides (refer to the density, solubility and poisonous nature of carbon monoxide).

(ii) Carbon dioxide: an oxide of carbon; its formation when charcoal, wood or other organic substances (e.g. ethanol) are burned in air or oxygen; the main concept that hydrocarbons mostly contain carbon and hydrogen, which on burning produce water and carbon dioxide should be understood (can be demonstrated by burning of candle).

(iii) Obtaining CO_2 from sodium hydrogen carbonate and carbonates; reaction with quicklime, slaked lime, lime water and their important uses.

(iv) The reactions of carbon dioxide with lime water, sodium hydroxide solution and magnesium; difference between CO and CO_2 with reference to their densities, combustibility and action of lime water; use of carbon dioxide in refrigeration, fire extinguishers and photosynthesis.

INTERNAL ASSESSMENT OF PRACTICAL WORK

Candidates will be asked to observe to the effect of reagents and/or of heat on substances supplied to them. The exercises will be simple and may include the recognition and identification of certain gases listed below.

Gases: Hydrogen, Oxygen, Carbon dioxide, Chlorine, Hydrogen chloride, Sulphur dioxide, Hydrogen sulphide, Ammonia, Water vapour, Nitrogen dioxide.

Candidates are expected to have completed the following minimum practical work.

Simple experiments on:

1. Heat the given (unknown) substance, make observations, identify any products and make deductions where possible.
   (a) copper carbonate, zinc carbonate
   (b) washing soda, copper sulphate crystals
   (c) zinc nitrate, copper nitrate, lead nitrate
   (d) ammonium chloride, iodine, ammonium dichromate
2. Add dilute sulphuric acid to the unknown substance, warm if necessary, make observation, identify the product and make deductions.
   (a) a sulphide
   (b) a carbonate
   (c) a metal

3. Apply the flame test to identify the metal in the unknown substance.

   (a) a sodium salt

   (b) a potassium salt

   (c) a calcium compound

4. The percentage composition of a mixture of powdered salt and water-washed sand.

   The experiment would test techniques in dissolving, filtering or decanting, washing and weighing. It may be counted out as taking too much time. The weakness could be met by supplying a given weight of the mixture; also by choosing sand of such grain size that filtering or decanting will not be slow and yet not so large that separation of salt and sand cannot be done simply by sorting out mechanically the sand from the salt. The experiment should take about 20 minutes using 10g mixture (4g sand, 6g salt).

5. Simple experiments based on hard water and soft water – identification of hardness – simple softening – by heating the temporary hard water, using washing soda and advantage of using detergents over soap in hard water.

CLASS X

*There will be one paper of **one** and a **half-hours** duration of 80 marks and Internal Assessment of practical work carrying 20 marks.*

*The paper will be divided into **two** sections, Section I (40 marks) and Section II (40 marks).*

***Section I** (compulsory) will contain short answer questions on the entire syllabus.*

***Section II** will contain six questions. Candidates will be required to answer any **four** of these **six** questions.*

***Note:** All chemical reactions should be studied with reference to the reactants, products, conditions, observations and the (balanced) equation.*

1. Periodic Properties and variations of Properties – Physical and Chemical

(i) Periodic properties and their variations in groups and periods.

(ii) Relation between atomic number for light elements (proton number) and periodicity and atomic mass for light elements; the modern periodic table up to period 3 (students to be exposed to the complete modern periodic table but no questions will be asked on elements beyond period 3 – Argon); periodicity and other related properties to be described in terms of shells (not orbitals); special reference to the alkali metals and halogen groups.

2. Chemical Bonding – Covalent and ionic compounds – structures of various compounds – orbit structure and electron dot structure

(i) Types of bonding: electrovalent and covalent. Compounds: characteristic properties of electrovalent and covalent compounds and differences between them; oxidation and reduction in terms of loss or gain of electrons by atoms of an element.

(ii) Structure of electrovalent compounds: NaCl, $MgCl_2$, CaO; covalent molecules like hydrogen, chlorine, nitrogen, water, ammonia, carbon tetrachloride, methane.

(iii) Coordinate Bond: Formation of H_3O^+ and NH_4^+ ion.

3. Study of Acids, Bases and Salts

(i) Simple definitions in terms of the molecules and their characteristic properties.

(ii) Ions present in mineral acids, alkalis and salts and their solutions; use of litmus to test for acidity and alkalinity.

(iii) Definition of salt; types of salts.

(iv) General properties of salts:

- Deliquescence, efflorescence, water of crystallization.

- Decomposition of bicarbonates, carbonates, chlorides and nitrates by appropriate acids with heating if necessary (relevant laboratory work must be done).

(v) Preparation: laboratory preparation of salts (normal and acid salts) – relevant laboratory work is essential.

4. Analytical Chemistry – Use of Ammonium Hydroxide and Sodium Hydroxide and Standard Tests

(i) On solution of salts: colour of salt and its solution; formation and colour of hydroxide precipitated for solutions of salts of Mg, Fe, Cu, Zn and Pb; special action of ammonium hydroxide on solutions of copper salts.

(ii) On certain metals and their oxides (relevant laboratory work is essential).

5. Mole Concept and Stoichiometry

(i) Gay Lussac's Law of Combining Volumes; Avogadro's Law.

(ii) Refer to the atomicity of hydrogen, oxygen, nitrogen and chlorine (proof not required).

(iii) Relative atomic masses (atomic weight) and relative molecular masses (molecular weights): either H=1 or $^{12}C=12$ will be accepted; molecular mass = 2×vapour density (formal proof not required). Deduction of simple (empirical) and molecular formula from the percentage composition of a compound; the molar volume of a gas at S.T.P.; simple calculations based on chemical equations; both reacting weight and volumes.

6. Electrolysis

(i) Electrolytes and non-electrolytes.

(ii) Substances containing molecules only, ions only, both molecules and ions.

(iii) An elementary study of the migration of ions, illustrated by the electrolysis of: molten lead bromide; acidified water with platinum electrodes and aqueous copper (II) sulphate with copper electrodes; electron transfer at the electrodes.

(iv) Application of electrolysis: electroplating with nickel and silver; purification of copper.

(v) Acids, bases and salts as electrolytes: reference should be made to the activity series as indicating the tendency of metals, e.g. Na, Mg, Fe, Cu, to form ions; action of alkalis on certain metals and their oxides; action of acids on oxides and salts.

7. Metallurgy

(i) Definition of Metal and Non-metals.

(ii) Position of the metals (alkali metals and alkaline earth metals) in the Periodic table and general characteristics applied to these elements.

(iii) Comparison of Metals and Non-metals.

(iv) General properties with special reference to physical properties: state, lustre, melting point, density, ductility, malleability, brittleness, conduction of electricity (exceptions to be specifically noted - e.g. graphite, mercury); chemical properties: a metal forms at least one basic oxide; non-metal, an acidic or neutral oxide; discharge of metallic ions at the cathode from fused metallic chlorides (link with bonding and ion formation); many metals liberate hydrogen from dilute HCl and H_2SO_4.

(v) Reduction of metallic oxides; some can be reduced by hydrogen, carbon and carbon monoxide (e.g. copper oxide, lead oxide, iron (II) oxide) and some cannot (e.g. Al_2O_3, MgO - refer to activity series).

(vi) Extraction of metals based on the activity series.

(vii) Metals and their alloys: common ores of iron, aluminium and zinc. Extraction of Aluminium

(a) Uses of iron, aluminium and zinc and their alloys.

(b) Other important alloys – bronze, fuse metal.

8. Study of Compounds

- **Hydrogen Chloride**

  Hydrogen chloride: preparation of hydrogen chloride from sodium chloride; refer to the density and solubility of hydrogen chloride (fountain experiment); reaction with ammonia; acidic properties of its solution.

- **Ammonia**

  (i) Ammonia: its laboratory preparation from ammonium chloride and collection; ammonia from nitrides like Mg_3N_2 and AlN and ammonium salts; preparation from air and from ammonium nitrite; Manufacture by Haber's Process; density and solubility of ammonia (fountain experiment); aqueous solution of ammonia; its reactions with hydrogen chloride and with hot copper (II) oxide and chlorine; the burning of ammonia in oxygen; uses of ammonia.

  (ii) The catalytic oxidation of ammonia, as the source of nitric acid; simple diagram for a catalytic oxidation of ammonia in the laboratory (with conditions and reactions only).

- **Nitric Acid and Nitrates:**

  (i) Nitric Acid: one laboratory method of preparation of nitric acid from potassium nitrate or sodium nitrate. Nitric acid as an oxidizing agent.

  (ii) Nitrates: salts of nitric acid. Action of heat on the nitrates of potassium, sodium, lead, copper and ammonium.

- **Sulphur Dioxide, Hydrogen Sulphide and Sulphuric Acid**

  (i) Formation of sulphur dioxide by burning sulphur and by the action of dilute acid on sodium sulphite and other sulphites; one laboratory method of preparing and collecting sulphur dioxide; density and solubility; ease of liquefaction and poisonous nature of sulphur dioxide; comparison of bleaching action of chlorine and sulphur dioxide; reactions of sulphur dioxide with water, sodium hydroxide solution and chlorine. Uses, including: manufacturing of sulphuric acid by first converting SO_2 to SO_3; bleaching and food preserving.

  (ii) Hydrogen sulphide: its peculiar smell and its tendency to form sulphides and be converted to sulphur (study of its preparation not required).

  (iii) Sulphuric Acid: its behaviour as an acid when dilute, as an oxidizing agent when concentrated - oxidation of carbon and sulphur; as a dehydrating agent - dehydration of sugar and copper (II) sulphate crystals; its non-volatile nature.

9. Organic Chemistry

(i) Introduction to Organic compounds.

(ii) Structure and Isomerism.

(iii) Homologous series.

(iv) Simple nomenclature.

(v) Hydrocarbons: alkanes, alkenes, alkynes.

(vi) Alcohols: methanol, ethanol – preparation and properties; its uses.

(vii) Carboxylic acids (aliphatic - mono carboxylic acid): Acetic acid – properties and uses of acetic acid.

INTERNAL ASSESSMENT OF PRACTICAL WORK

Candidates will be asked to observe the effect of reagents and/or of heat on substances supplied to them. The exercises will be simple and may include the recognition and identification of certain gases and ions listed below. The examiners will not, however, be restricted in their choice to substances containing the listed ions.

Gases: Hydrogen, Oxygen, Carbon dioxide, Chlorine, Hydrogen chloride, Sulphur dioxide, Hydrogen sulphide, Ammonia, Water vapour, Nitrogen dioxide.

Ions: Calcium, Copper, Iron, Lead, Zinc and Ammonium, Carbonate, Chloride, Nitrate, Sulphide, Sulphite and Sulphate.

Knowledge of a formal scheme of analysis is not required. Semi-micro techniques are acceptable but candidates using such techniques may need to adapt the instructions given to suit the size of the apparatus being used.

Candidates are expected to have completed the following minimum practical work:

1. Make a solution of the unknown substance: add sodium hydroxide solution or ammonium hydroxide solution, make observations and give your deduction. Warming the mixture may be needed. Choose from substances containing Ca^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Pb^{2+}, Zn^{2+}, NH_4^+.
2. Supply a solution of a dilute acid and alkali. Determine which is acidic and which is basic, giving two tests for each.
3. Add concentrated hydrochloric acid to each of the given substances, warm, make observations, identify any product and make deductions: (a) copper oxide (b) manganese dioxide.
4. Use of pH in soil analysis, water analysis, medical field – simple identification with universal indicator.

EVALUATION

The assignments/project work are to be evaluated by the subject teacher and by an External Examiner. (The External Examiner may be a teacher nominated by the Principal, who could be from the faculty, **but not teaching the subject in the section/class**. For example, a teacher of Chemistry of Class VIII may be deputed to be an External Examiner for Class X Chemistry projects.)

The Internal Examiner and the External Examiner will assess the assignments independently.

Award of marks (20 Marks)

Subject Teacher (Internal Examiner)	10 marks
External Examiner	10 marks

The total marks obtained out of 20 are to be sent to the Council by the Principal of the school.

The Head of the school will be responsible for the entry of marks on the mark sheets provided by the Council.

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