# ICSE

# INDIAN CERTIFICATE OF SECONDARY EDUCATION EXAMINATION

## YEAR 2028


# SCIENCE

# CHEMISTRY

# (52)

Developed by:
Research, Development and Curriculum Division (RDCD)
CISCE

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# Council for the Indian School Certificate Examinations (CISCE)

## MISSION STATEMENT

***The Council for the Indian School Certificate Examinations is committed to serving the nation's children, through high quality educational endeavours, empowering them to contribute towards a humane, just and pluralistic society, promoting introspective living, by creating exciting learning opportunities, with a commitment to excellence.***

## ETHOS OF CISCE

- Trust and fair play.
- Minimum monitoring.
- Allowing schools to evolve their own niche.
- Catering to the needs of the children.
- 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.

# SCIENCE (52)
# CHEMISTRY

## SCIENCE Paper - 2

**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 foster scientific temper, ethical attitude, moral values and problem-solving skills for making informed and responsible decisions.
5. To establish linkages between scientific knowledge and other curricular areas.
6. To appreciate India's knowledge traditions and its connection to scientific ideas.
7. To recognise Chemical Science as having an important impact on the environment relating to cycles in nature; natural resources, pollution.

## CLASS IX

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

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

### 1. The Language of Chemistry

(i) Symbol of an element; valency; representation of radicals and formulae of compounds. Balancing of simple chemical equations.

- *Symbol – definition; symbols of the elements used often.*
- *Valency - definition; hydrogen combination and number of valence electrons of the metals and non-metals; mono, di, tri and tetra valent elements.*
- *Radicals – definition; formulae formation, reactivity of radicals, and valencies. Existence of radicals in atmosphere, their effects on living organisms. Reduction or elimination.*
- *Compounds – name and formulae.*
- *Chemical equation – definition and examples of chemical equations with one reactant and two or three products, two reactants and one product, two reactants and two products and two reactants and three or four products; balancing of equations (by hit and trial method).*

(ii) Relative Atomic Masses (atomic weights) and Relative Molecular Masses (molecular weights): either - standard H atom or $1/12^{th}$ of carbon 12 atom.

- *Definitions.*
- *Calculation of Relative Molecular Mass and percentage composition of a compound.*

## 2. Chemical changes and reactions

(i) Types of chemical changes.

- *Direct combination*
- *Decomposition*
- *Displacement*
- *Double decomposition/Double displacement*

*(Double Displacement Reaction of Sodium Sulphate with Barium Chloride; Reaction of Silver Nitrate with Sodium Chloride; Reaction of Lead Nitrate with Potassium Iodide.)*

***(The above to be taught with suitable chemical equations as examples followed by demonstration)**.*

(ii) Energy changes in a chemical change.

*Exothermic and endothermic reactions with examples – evolution/absorption of heat, light and electricity.*

## 3. Water

(i) Water as a universal solvent.

- *Mixtures, solutions, colloids and suspensions.*
- *Solutions as 'mixtures' of solids in water; saturated, unsaturated and supersaturated solutions.*
- *Qualitative effect of temperature on solubility along with solubility curve (e.g. solutions of calcium sulphate, potassium nitrate and sodium chloride in water).*

(ii) Water of Crystallisation-Definition only.

(a) Hydrated substances: *meaning and examples ($CuSO_4.5H_2O$, $FeSO_4.7H_2O$, $Na_2CO_3.10H_2O$, $Na_2SO_4.10H_2O$).*

(b) Anhydrous substances.

*Meaning and examples only ($NaNO_3$, $KCl$, $PbCl_2$, $K_2SO_4$).*

(c) Properties.

- *Efflorescence- definition and examples like Washing soda- $Na_2CO_3.10H_2O$.*
- *Deliquescence- definition and examples like Ferric chloride – $FeCl_3$.*
- *Hygroscopy – definition and examples like Quick lime - CaO, concentrated Sulphuric acid- $H_2SO_4$.*

*(iii)* Drying Agents- *meaning and examples like Quick lime- CaO* and Dehydrating Agents- *meaning and examples like concentrated Sulphuric acid- $H_2SO_4$.*

(iv) Soft water and Hard water.

- *Meaning (in terms of action of soap).*
- *Advantages and disadvantages of soft water and hard water.*
- *Types and causes of hardness.*

(v) Removal of Temporary and Permanent hardness.

- *Removal of hardness*

  *(i) By boiling*
  *(ii) By addition of washing soda*

- *Making water potable- Filtration, Chlorination, Defluoridation, Role of Alum in purification of water. Common diseases due to polluted water-diarrhoea, typhoid, cholera, dysentery, hepatitis A, polio, cancer and organ damage.*

## 4. Atomic Structure and Chemical bonding

(i) Structure of an Atom, discovery of nucleus, electrons, Rutherford's and Bohr's model of an atom, mass number and atomic number, Isotopes and Octet Rule.

- *Definition of an atom.*
- *Constituents of an atom - nucleus (protons, neutrons) with associated electrons; mass number, atomic number.*
- *Rutherford's experiment (gold foil), the conclusions, merits and demerits.*
- *Bohr's model- Simplified form (Mathematical expressions not required).*
- *Electron distribution in the orbits - $2n^2$ rule, Octet rule. Reason for chemical activity of an atom.*
- *Definition and examples of isotopes (hydrogen, carbon, chlorine).*

(ii) Electrovalent and covalent bonding, ions and electrons, radicals, structures of various compounds – orbit structure.

(a) Electrovalent Bond.

- *Definition*
- *Ion formation*
- *Atomic orbit structure for the formation of Electrovalent compounds (e.g. NaCl, $MgCl_2$, CaO)*

(b) Covalent Bond.

- *Definition*
- *Atomic orbit structure for the formation of Covalent molecules on the basis of duplet and octet of electrons (examples: hydrogen, chlorine, oxygen, nitrogen, hydrogen chloride, water, ammonia, carbon tetrachloride, methane).*
- *Radical formation on breaking a covalent bond.*

## 5. The Periodic Table

Dobereiner's Triads, Newland's law of Octaves, Mendeleev's contributions; Modern Periodic Law, the Modern Periodic Table (Groups and periods).

- *General idea of Dobereiner's triads, Newland's law of Octaves, Mendeleev's periodic law*-limited to principles, examples, merits and limitations.
- *Discovery of Atomic Number and its use as a basis for Modern Periodic law.*
- *Modern Periodic Table (Groups 1 to 18 and periods 1 to 7).*

  ***(Placement of Transition and Inner transition elements to be mentioned).***
- *Special reference to Alkali metals (Group 1), Alkaline Earth metals (Group 2), Halogens (Group 17) and Zero Group (Group 18).*

## 6. Study of the First Element -Hydrogen

Position of the non-metal (Hydrogen) in the periodic table and general group characteristics with reference to valency electrons, burning, ion formation applied to the above-mentioned element.

(i) Hydrogen from: water, dilute acids and alkalis.

(a) Hydrogen from water.

- *The action of cold water on sodium, potassium and calcium.*
- *The action of hot water on magnesium.*
- *The action of steam on aluminium, zinc, and red-hot iron; (reversibility of reaction between iron and steam).*
- *The action of steam on non-metal (carbon).*

***Students can be shown the action of sodium and calcium on water in the laboratory. They must be asked to make observations and write equations for the above reactions. Application of activity series for the above-mentioned reactions.***

(b) Displacement of hydrogen from dilute acids.

- *The action of dilute sulphuric acid or hydrochloric acid on metals: Mg, Al, Zn and Fe.*
- *Reasons for not using other metals and dilute nitric acid.*

(c) Displacement of hydrogen from alkalis.

*The action of Alkalis ((NaOH, KOH) on Al, Zn and Pb – unique nature of these elements.*

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

*The reason for using zinc in the laboratory preparation, the removal of impurities in the hydrogen gas, the precautions during the collection of the gas.*

(iii) Industrial manufacture of hydrogen by Bosch process.

- *Main reactions and conditions.*
- *Separation of $CO_2$ and CO from hydrogen.*

(iv) Oxidation and reduction reactions.

*Differences in terms of addition and removal of oxygen / hydrogen.*

- *Electronic concept (Gain/loss of electrons).*
- *Oxidizing and Reducing agents.*
- *Redox reaction.*

## 7. 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, Charles's Law and absolute zero; gas equation; simple relevant calculations.

- *The behaviour of gases under changes of temperature and pressure; explanation in terms of molecular motion (particles, atoms, molecules).*
- *Mathematical derivation & Graphical representation of Boyle's Law: statement, mathematical form, simple calculations.*
- *Mathematical derivation & Graphical representation of Charles's Law: statement, mathematical form, simple calculations.*
- *Absolute zero on Kelvin scale of temperature.*
- *Gas equation $P_1 V_1 / T_1 = P_2 V_2 / T_2$; simple relevant calculations based on gas equation.*

(ii) Relationship between Kelvin scale and Celsius Scale of temperature; Standard temperature and pressure.

*Conversion of temperature from Celsius Scale to Kelvin scale and vice versa. Standard temperature and pressure (Simple calculations on conversion of temperature and on standard temperature and pressure).*

## 8. Atmospheric and Environmental Chemistry

**Atmospheric Pollution.**

(a) Acid Rain- Composition, cause and its impact.

*Sulphur in fossil fuels giving oxides of sulphur when burnt. High temperatures in furnaces and internal combustion engines produce oxides of nitrogen. (Equations to be included.). Effects of acid rain on soil chemistry and water bodies.*

(b) Global warming.

Greenhouse gases-their sources and ways of reducing their presence in the atmosphere.

*(Water Vapour, carbon dioxide, methane and oxides of nitrogen.)*

(c) Ozone depletion.

- *Formation of ozone- relevant equations.*
- *Functions of ozone in the atmosphere.*
- *Destruction of the ozone layer- Chemicals responsible for this to be named but reactions not required.*

**Water Pollution.**

Water – composition and substances that are present in it, beneficial and potentially harmful to life.

- *Benefits: Dissolved oxygen for aquatic life, essential minerals for life.*
- *Harmful: Contamination* with *toxic heavy metals (Special mention to 'Minamata disease'); plastics; sewage, pesticides in water bodies.*

## 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 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. Action of heat on the following compounds.

   (a) copper carbonate, zinc carbonate
   (b) washing soda, copper sulphate crystals
   (c) zinc nitrate, copper nitrate, lead nitrate
   (d) ammonium chloride, iodine, ammonium dichromate

   Make observations, identify the products and make deductions where possible.

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

   (a) a sodium salt
   (b) a potassium salt
   (c) a calcium salt
   (d) a copper salt

3. 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.

4. Experiments related to Double Displacement Reaction (examples).

   (a) Reaction of Sodium Sulphate with Barium Chloride.
   (b) Reaction of Silver Nitrate with Sodium Chloride.
   (c) Reaction of Lead Nitrate with Potassium Iodide.

5. Find out the sources of pollution of water bodies in the locality. Suggest preventive steps to control it.

# CLASS X

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

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

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

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

*Definitions and trends of the following periodic properties in groups and periods should be studied:*

- *atomic size*
- *metallic character*
- *non-metallic character*
- *ionisation potential*
- *electron affinity*
- *electronegativity*

(ii) Periodicity on the basis of atomic number for elements.

- *Detailed study of the modern periodic table restricted to Period 4 (up to Calcium). Elements beyond this are to be introduced only for familiarisation of the placement of elements in the Periodic table and are excluded from assessment.*
- *Periodicity and other related properties of **the alkali metals, alkaline earth metals, halogen groups and zero group elements.***

***(Explanation on the basis of nuclear charge and shells, not orbitals.)***

## 2. Chemical Bonding

Electrovalent, covalent and co-ordinate bonding, structures of various compounds, Electron dot structure.

(a) Electrovalent bonding.

- *Electron dot structure of Electrovalent compounds NaCl, $MgCl_2$, CaO, $K_2O$, $Na_2O$, $Na_3N$.*
- *Characteristic properties of electrovalent compounds – state of existence, melting and boiling points, conductivity (heat and electricity), dissociation in solution and in molten state to be linked with electrolysis.*

(b) Covalent Bonding.

- *Electron dot structure of covalent molecules on the basis of duplet and octet of electrons.*
- *Non-polar covalent compounds (example: hydrogen, chlorine, oxygen, nitrogen, carbon tetrachloride, methane.)*
- *Polar Covalent compounds – based on difference in electronegativity.*

  *Examples – HCl, $NH_3$ and $H_2O$ including structures.*
- *Characteristic properties of Covalent compounds – state of existence, melting and boiling points, conductivity (heat and electricity), ionisation in solution.*

  ***Comparison of Electrovalent and Covalent compounds**.*

(c) Coordinate Bonding.

- *Definition*
- *The lone pair effect of the oxygen atom of the water molecule and the nitrogen atom of the ammonia molecule to explain the formation of $H_3O^+$ and $OH^-$ ions in water and $NH_4^+$ ion.*

***The meaning of lone pair; the formation of hydronium ion and ammonium ion must be explained with the help of electron dot diagrams.***

## 3. Study of Acids, Bases and Salts

(i) Simple definitions of acids and bases and their characteristic properties.

(ii) Ions present in mineral acids, alkalis and salts and their solutions; use of common acid-base indicator (litmus, methyl orange and phenolphthalein) and pH paper to test for acidity and alkalinity.

- *Examples with equation for the ionisation/dissociation of ions of acids, bases and salts.*
- *Acids form hydronium ions (only positive ions) which turn blue litmus red, alkalis form hydroxyl ions (only negative ions) with water which turns red litmus blue.*
- *Salts are formed by partial or complete replacement of the hydrogen ion of an acid by a metal.* ***(To be explained with suitable examples like formation of $NaHSO_4$ and $Na_2SO_4$.)***
- *Introduction to pH scale to test for acidity, neutrality and alkalinity by using pH paper or Universal indicator.*

(iii) Definition of salt; Neutralisation and types of salts.

*Types of salts: normal salts, acid salt, basic salt, complex salts (definition and examples like*

*Acid salt- NaHSO4, Basic Salt – $Cu(OH)NO_3$, Complex salt – $[Cu(NH_3)_4]SO_4$.*

(iv) Classification of an acid on the basis of concentration, ionisation capacity or strength and number of hydrogen ions.

(v) Classification of a base on the basis of solubility in water and ionisation capacity or strength and number of hydroxyl ions.

(vi) Action of dilute acids on salts.

*Decomposition of hydrogen carbonates, carbonates, hydrogen sulphites, sulphites and sulphides by appropriate acids with heating if necessary.*

(vii) Methods of preparation of Normal salts with **relevant equations**.

Methods included are:

- *Direct combination*
- *Displacement*
- *Precipitation (double decomposition)*
- *Neutralisation* of *insoluble base*
- *Neutralisation of an alkali (titration)*
- *Action of dilute acids on carbonates and bi-carbonates*

## 4. Analytical Chemistry

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

*On solution of salts*.

- *Colour of salt and its solution.*
- *Action on addition of Sodium Hydroxide to solution of Fe, Cu, Zn, Ca, Mg and Pb salts drop by drop in excess. Formation and colour of hydroxide precipitated to be highlighted with the help of equations.*
- *Action on addition of Ammonium Hydroxide to solution of Fe, Cu, Zn, Ca, Mg and Pb salts drop by drop in excess. Formation and colour of hydroxide precipitated to be highlighted with the help of equations.*
- *Special action of Ammonium Hydroxide on solutions of copper salts and sodium hydroxide on ammonium salts.*

(ii) Action of alkalis (*NaOH, KOH)* on certain metals, their oxides and hydroxides.

*The metals must include aluminium, zinc and lead, their oxides and hydroxides, which react with caustic alkalis (NaOH, KOH), showing the amphoteric nature of these substances*.

## 5. Mole Concept and Stoichiometry

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

- *Idea of mole – a number just as a dozen, a gross (Avogadro's number).*
- *Avogadro's Law - statement and explanation.*
- *Gay Lussac's Law of Combining Volumes. – Statement and explanation.*
- *Molar volume- "the mass of 22.4 litres of any gas at S.T.P. is equal to its molar mass."* ***(proof not required).***
- *Simple calculations based on the molar volume and Gay Lussac's law.*

(ii) Atomicity of Hydrogen, Oxygen, Nitrogen and Chlorine with equations for the formation of HCl, $NH_3$ and NO ***(proof not required).***

(iii) Vapour Density and its relation to relative molecular mass.

- *Molecular mass = 2× vapour density* ***(formal proof not required)***
- *Deduction of simple (empirical) and molecular formula from.*
  - *(a) the percentage composition of a compound.*
  - *(b) the masses of combining elements.*

(iv) Mole and its relation to mass.

- *Relating mole and atomic mass; arriving at gram atomic mass and then gram atom; atomic mass is a number dealing with one atom; gram atomic mass is the mass of one mole of atoms.*
- *Relating mole and molecular mass arriving at gram molecular mass and gram molecule – molecular mass is a number dealing with a molecule, gram molecular mass is the mass of one mole of molecules.*
- *Simple calculations based on relation of mole to mass, volume and Avogadro's number.*

(v) Simple calculations based on chemical equations

*Related to weight and volumes of both reactants and products*.

## 6. Electrolysis

(i) Electrolytes and non-electrolytes.

*Definitions and examples.*

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

- *Substances containing molecules only, ions only, both molecules and ions.*
- *Examples relating their composition with their behaviour as* ***strong and weak electrolytes as well as non-electrolytes****.*

(iii) Definition and explanation of electrolysis, electrolyte, electrode, anode, cathode, anion, cation, oxidation and reduction (on the basis of loss and gain of electrons).

(iv) Difference between metallic conduction (electrolysis) and electrolytic conduction.

(v) An elementary study of the migration of ions, with reference to the factors with examples influencing selective discharge of ions (reference should be made to the activity series as indicating the tendency of metals e.g. Na, Mg, Fe, Cu, to form ions) illustrated by the electrolysis of:

- *Molten lead bromide*
- *acidified water with platinum electrodes*
- *Aqueous copper (II) sulphate with copper electrodes and platinum electrodes; electron transfer at the electrodes.*

***The above electrolytic processes can be studied in terms of electrolyte used, electrodes used, ionization reaction, anode reaction, cathode reaction, use of selective discharge theory, wherever applicable.***

(vi) Applications of electrolysis.

- *Electroplating with nickel and silver, choice of electrolyte for electroplating (nickel sulphate solution and sodium argentocyanide) with equations.*
- *Electrorefining of copper with equations.*

## 7. Metallurgy

(i) Occurrence of metals in nature.

- *Mineral and ore – Meaning; definition of mineral, ore, gangue, matrix, Flux and slag.*
- *Common ores of iron, aluminium and zinc.*

(ii) Stages involved in the extraction of metals.

*(a) Pulverization, dressing of the ore- hydrolytic method, magnetic separation, froth flotation method.*

*(b) Conversion of concentrated ore to its oxide- roasting and calcination (definition, examples with equations).*

*(c) Reduction of metallic oxides- some can be reduced by hydrogen, carbon and carbon monoxide (e.g. copper oxide, lead (II) oxide, iron (III) oxide and zinc oxide) and some active metal oxides can be reduced by electrolysis only (e.g. $Al_2O_3$, MgO).*

*(d) Electrorefining – As a process of obtaining pure metal from an impure metal.*

(iii) Extraction of Aluminium.

*(a) Chemical method for purifying bauxite by using NaOH – Baeyer's Process only.*

*(b) Electrolytic extraction – Hall Heroult's process only:*

*Structure of electrolytic cell – the various components as part of the electrolyte, electrodes and electrode reactions.*

***Description of the changes occurring, purpose of the substances used and the main reactions with their equations.***

(iv) Alloy and Amalgam – composition and uses.

*Composition and uses of Stainless steel, magnalium, duralumin, brass, bronze, fuse metal / solder.*

## 8. Study of Compounds

### A. 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.

- *Preparation of hydrogen chloride from sodium chloride; the laboratory method of preparation can be learnt in terms of reactants, product, condition, equation, diagram or setting of the apparatus, procedure, observation, precaution, collection of the gas and identification.*
- *Simple experiment to show the density of the gas (Hydrogen Chloride) –heavier than air.*
- *Solubility of hydrogen chloride (fountain experiment); setting of the apparatus, procedure, observation, inference.*
- *Method of preparation of hydrochloric acid by dissolving the gas in water- the special arrangement and the mechanism by which the back suction is avoided should be learnt.*
- *Reaction with ammonia.*
- *Acidic properties of its solution - reaction with metals, their oxides, hydroxides and carbonates, decomposition of carbonates, bicarbonates, sulphites, bisulphites, sulphides.*
- *Aqua regia composition and uses.*
- *Precipitation reactions with silver nitrate solution and lead nitrate solution.*
- *Tests for HCl gas, Hydrochloric acid and Chloride ions (Only $AgNO_3$ test for Identification of Chloride ion.)*

### B. Ammonia

Ammonia: its laboratory preparation from ammonium chloride and collection; ammonia from nitrides like $Mg_3N_2$, AlN and ammonium salts. 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, lead (IV) oxide and chlorine; the burning of ammonia in oxygen; uses of ammonia.

- *Laboratory preparation from ammonium chloride and collection; (the preparation to be studied in terms of, setting of the apparatus and diagram, procedure, observation, collection and identification).*
- *Ammonia from nitrides like $Mg_3N_2$, and AlN using warm water.*
- *Ammonia from ammonium salts using alkalies.*
- *Manufacture by Industrial Process- Haber's Process (along with explanations and schematic diagram.)*
- *Density and solubility of ammonia (fountain experiment).*
- *The burning of ammonia in oxygen.*
- *The catalytic oxidation of ammonia (with conditions and reaction).*
- *Its reactions with hydrogen chloride and with hot copper (II) oxide, lead (IV) oxide and chlorine (both chlorine in excess and ammonia in excess).*

  ***Conditions and observations must be emphasized.***

- *Aqueous solution of ammonia - reaction with sulphuric acid, nitric acid, hydrochloric acid and solutions of iron (III) chloride, iron (II) sulphate, lead nitrate, zinc nitrate and copper sulphate.*
- *Uses of ammonia - manufacture of fertilisers, explosives, nitric acid, refrigerant gas (Chlorofluro carbon – and its suitable alternatives which are non-ozone depleting), and cleansing agents.*
- *Tests for ammonia.*

### C. Nitric Acid

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

- *Laboratory preparation of nitric acid from potassium nitrate or sodium nitrate; the laboratory method to be studied in terms of reactants, products, conditions, equations, setting up of apparatus, diagram, precautions, collection and identification.*
- *Manufacture of Nitric acid by Ostwald's process (Equations with conditions, where applicable; explanations and schematic diagram).*
- *As an oxidising agent: its reaction with copper, carbon, sulphur.*
- *Acidic properties of its solution – reaction with magnesium and manganese, oxides, hydroxides, carbonates, hydrogen carbonate, sulphites and hydrogen sulphites.*
- *Test for nitric acid and nitrate ion.*

### D. Sulphuric Acid

Large scale preparation, 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.

- *Manufacture by Contact Process- Equations with conditions where applicable (with reason and schematic diagrams only).*
- *Its behaviour as an acid when dilute -reaction with metal, metal oxide, hydroxide, carbonate, hydrogen carbonate, sulphite, hydrogen sulphite and sulphide.*
- *Sulphuric acid as dibasic acid.*
- *Concentrated sulphuric acid as an oxidizing agent - the oxidation of carbon and sulphur.*
- *Concentrated sulphuric acid as a dehydrating agent- (a) the dehydration of sugar (b) Copper (II) sulphate crystals.*
- *Non-volatile nature of sulphuric acid - reaction with sodium or potassium chloride and sodium or potassium nitrate.*
- *Tests for sulphuric acid and sulphate radical.*

## 9. Organic Chemistry

(i) Introduction to Organic compounds.

- *Unique nature of Carbon atom – tetra valency, catenation.*
- *Formation of single, double and triple bonds, straight chain, branched chain, cyclic compounds (only benzene structure).*

(ii) Structure and Isomerism.

- *Structure of compounds with single, double and triple bonds.*
- *Structural formulae of hydrocarbons. Structural formula must be given for: alkanes, alkenes, alkynes up to 5 carbon atoms.*
- *Isomerism – structural (chain, position).*

(iii) Homologous series – characteristics with examples.

*Alkane, alkene, alkyne series and their gradation in properties and the relationship with the molecular mass or molecular formula.*

(iv) Simple nomenclature.

*Simple nomenclature of the hydrocarbons with simple functional groups – (halides, double bond, triple bond, alcoholic, aldehydic, carboxylic ketone, ether and ester) longest chain rule and smallest number for functional groups rule – trivial and IUPAC names (compounds with only one functional group).*

(v) Hydrocarbons: alkanes, alkenes, alkynes.

- *Alkanes - general formula; methane (greenhouse gas) and ethane - methods of preparation from sodium ethanoate (sodium acetate), sodium propanoate (sodium propionate), from iodomethane (methyl iodide) and bromoethane (ethyl bromide). Complete and incomplete combustion of methane and ethane, reaction of methane and ethane with chlorine through substitution.*
- *Alkenes – (unsaturated hydrocarbons with a double bond); ethene as an example. Methods of preparation of ethene by dehydro halogenation reaction and dehydration reactions.*
- *Alkynes - (unsaturated hydrocarbons with a triple bond); ethyne as an example of alkyne; Methods of preparation from calcium carbide and 1,2 dibromoethane).*

***Only main properties, particularly addition products with hydrogen and halogen namely $Cl_2$, $Br_2$ and $I_2$ pertaining to alkenes and alkynes.***

- *Uses of methane, ethane, ethene, ethyne.*

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

- *Preparation of ethanol by hydrolysis of alkyl halide.*
- *Properties – Physical: Nature, Solubility, Density, Boiling Points. Chemical: Combustion, action with sodium, ester formation with acetic acid, dehydration with conc. Sulphuric acid to prepare ethene.*
- *Denatured, methylated alcohol or spirit and spurious alcohol.*
- *Important uses of Ethanol.*

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

- *Structure of acetic acid.*
- *Properties of Acetic Acid: Physical properties – odour (vinegar), glacial acetic acid (effect of sufficient cooling to produce ice like crystals). Chemical properties – action with litmus, alkalis, and alcohol (idea of esterification).*
- *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**: Copper, Iron, Lead, Zinc, Magnesium and Ammonium, Carbonate, Chloride, Nitrate, Calcium, 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. Action of heat on the following substances:

   (a) Copper carbonate, zinc carbonate

   (b) zinc nitrate, copper nitrate, lead nitrate

   Make observations, identify the products and make deductions where possible (equations not required).

2. Action of dilute sulphuric acid on the following substances.

   (a) a metal

   (b) a carbonate

   (c) a sulphide

   (d) a sulphite

   Make observations, identify the gas evolved and make deductions.

3. 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 $Cu^{2+}$, $Fe^{2+}$, $Fe^{3+}$, $Pb^{2+}$, $Zn^{2+}$, $Mg^{2+}$, $Ca^{2+}$, $NH_4^+$.

4. Supply a solution of a dilute acid and alkali. Determine which is acidic and which is basic, giving two tests for each.

5. 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.

6. Revisit: Apply the flame test to identify the metal in the unknown substance.

   (a) a sodium salt

   (b) a potassium salt

   (c) a calcium salt

   (d) a copper salt

## 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 Head of the school, 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 CISCE by the Head of the school.

The Head of the school will be responsible for the online entry of marks on CISCE's CAREERS portal by the due date.

***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 |