YEAR 2020 EXAMINATION

ICSE

Analysis of Pupil Performance

CHEMISTRY

Research Development and Consultancy Division

Council for the Indian School Certificate Examinations

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FOREWORD

This document of the Analysis of Pupils' Performance at the ISC Year 12 and ICSE Year 10 Examination is one of its kind. It has grown and evolved over the years to provide feedback to schools in terms of the strengths and weaknesses of the candidates in handling the examinations.

We commend the work of Mrs. Shilpi Gupta (Deputy Head) and the Research Development and Consultancy Division (RDCD) of the Council who have painstakingly prepared this analysis. We are grateful to the examiners who have contributed through their comments on the performance of the candidates under examination as well as for their suggestions to teachers and students for the effective transaction of the syllabus.

We hope the schools will find this document useful. We invite comments from schools on its utility and quality.

Gerry Arathoon
Chief Executive & Secretary

November 2020

PREFACE

The CISCE has been involved in the preparation of the ICSE and ISC Analysis of Pupil Performance documents since the year 1994. Over these years, these documents have facilitated the teaching-learning process by providing subject/ paper wise feedback to teachers regarding performance of students at the ICSE and ISC Examinations. With the aim of ensuring wider accessibility to all stakeholders, from the year 2014, the ICSE and the ISC documents have been made available on the CISCE website www.cisce.org.

The documents for the ICSE and ISC Examination Year 2020 include a detailed qualitative analysis of the performance of students in different subjects. The purpose of this analysis is to provide insights into how candidates have performed in individual questions set in the question paper. This section is based on inputs provided by examiners from examination centers across the country. It comprises of question wise feedback on the performance of candidates in the form of *Comments of Examiners* on the common errors made by candidates along with *Suggestions for Teachers* to rectify/ reduce these errors. The *Marking Scheme* for each question has also been provided to help teachers understand the criteria used for marking. Topics in the question paper that were generally found to be difficult or confusing by candidates, have also been listed down, along with general suggestions for candidates on how to prepare for the examination/ perform better in the examination.

The Analysis of Pupil Performance document for ICSE for the Examination Year 2020 covers the following subjects/papers: English (English Language, Literature in English), History and Civics, Mathematics, Physics, Chemistry, Commercial Studies and Environmental Science.

Subjects covered in the ISC Analysis of Pupil Performance document for the Year 2020 include English (English Language and Literature in English), Hindi, Physics, Chemistry, Mathematics, Computer Science, History, Political Science, Economics, Commerce, Accounts, and Environmental Science.

I would like to acknowledge the contribution of all the ICSE and the ISC examiners who have been an integral part of this exercise, whose valuable inputs have helped put this document together.

I would also like to thank the RDCD team of Dr. M.K. Gandhi, Dr. Manika Sharma, Mrs. Roshni George and Ms. Mansi Guleria, who have done a commendable job in preparing this document.

We hope that this document will enable teachers to guide their students more effectively and comprehensively so that students prepare for the ICSE/ ISC Examinations, with a better understanding of what is required from them.

Shilpi Gupta
Deputy Head - RDCD

November 2020

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SECTION I (40 Marks)

*Attempt **all** questions from this Section*

Question 1

(a) Choose the correct answer from the options given below: **[5]**

(i) The element with *highest* ionization potential, is:

A. Hydrogen

B. Caesium

C. Radon

D. Helium

(ii) The *inert* electrode used in the electrolysis of acidified water, is:

A. Nickel

B. Platinum

C. Copper

D. Silver

(iii) A compound with *low* boiling point, is:

A. Sodium chloride

B. Calcium chloride

C. Potassium chloride

D. Carbon tetrachloride

(iv) The *acid* which can produce carbon from cane sugar, is:

A. Concentrated Hydrochloric acid

B. Concentrated Nitric acid

C. Concentrated Sulphuric acid

D. Concentrated Acetic acid

(v) The organic compound having a *triple* carbon-carbon covalent bond, is:

A. C_3H_4

B. C_3H_6

C. C_3H_8

D. C_4H_{10}

(b) State *one relevant observation* for each of the following reactions: **[5]**

(i) Action of concentrated nitric acid on copper.

(ii) Addition of excess ammonium hydroxide into copper sulphate solution.

(iii) A piece of sodium metal is put into ethanol at room temperature.

(iv) Zinc carbonate is heated strongly.

(v) Sulphide ore is added to a tank containing oil and water, and then stirred or agitated with air.

(c) Write a balanced chemical equation for each of the following: **[5]**

(i) Reaction of carbon powder and concentrated nitric acid.

(ii) Reaction of excess ammonia with chlorine.

(iii) Reaction of lead nitrate solution with ammonium hydroxide.

(iv) Producing ethane from bromo ethane using Zn / Cu couple in alcohol.

(v) Complete combustion of ethane.

(d) (i) Draw the structural formula for each of the following: **[5]**

1. 2,2 dimethyl pentane
2. methanol
3. Iso propane

(ii) Write the IUPAC name for the following compounds:

1. acetaldehyde
2. acetylene

(e) State one relevant reason for each of the following: **[5]**

(i) Graphite anode is preferred to platinum in the electrolysis of molten lead bromide.

(ii) Soda lime is preferred to sodium hydroxide in the laboratory preparation of methane.

(iii) Hydrated copper sulphate crystals turn white on heating.

(iv) Concentrated nitric acid appears yellow, when it is left for a while in a glass bottle.

(v) Hydrogen chloride gas fumes in moist air.

(f) Calculate: **[5]**

(i) The amount of each reactant required to produce 750 ml of carbon dioxide, when two volumes of carbon monoxide combine with one volume of oxygen to produce two volumes of carbon dioxide.

$$2CO + O_2 \rightarrow 2CO_2$$

(ii) The volume occupied by 80 g of carbon dioxide at STP.

(iii) Calculate the number of molecules in 4.4 gm of CO_2.

[Atomic mass of C= 12, O=16]

(iv) State the law associated in question no. (f)(i) above.

(g) Give *one word or a phrase* for the following statements: **[5]**

(i) The chemical bond formed by a shared pair of electrons, each bonding atom contributing one electron to the pair.

(ii) Electrode used as cathode in electrorefining of impure copper.

(iii) The substance prepared by adding other metals to a base metal in appropriate proportions to obtain certain desirable properties.

(iv) The tendency of an atom to attract electrons to itself when combined in a compound.

(v) The reaction in which carboxylic acid reacts with alcohol in the presence of conc. H_2SO_4 to form a substance having a fruity smell.

(h) Fill in the blanks from the choices given in brackets: **[5]**

(i) The polar covalent compound in gaseous state that does not conduct electricity is _____.

(carbon tetra chloride, ammonia, methane)

(ii) A salt prepared by displacement reaction is _____.

(ferric chloride, ferrous chloride, silver chloride)

(iii) The number of moles in 11gm of nitrogen gas is _____.

(0.39, 0.49, 0.29) [atomic mass of N=14]

(iv) An alkali which completely dissociates into ions is _____.

(ammonium hydroxide, calcium hydroxide, lithium hydroxide)

(v) An alloy used to make statues is_____.

(bronze, brass, fuse metal)

Comments of Examiners

(a) (i) Most of the candidates answered it correctly. Some got confused with *Hydrogen*.

(ii) This was answered correctly by most of the candidates. A few candidates chose Nickel as the option.

(iii) Some candidates chose the incorrect option NaCl as they had no idea that CCl_4 is a covalent compound.

Suggestions for Teachers

- *Teach students the trends in the periodic properties of elements in the Periodic Table across a period as well as down a group thoroughly. Emphasize on exceptions.*
- *Give regular quizzes on the knowledge of trends in the periodic properties in the periodic table for practice.*

(iv) Most of them the candidates answered correctly. A few selected concentrated Nitric acid.

(v) This part was well attempted by most of the candidates, but a few chose C_3H_6.

(b) A common error in most of the observations was that candidates either wrote the equation or named the product formed instead of stating the observations. In some cases, incomplete observations were written.

(i) The word '*gas*' was missing in many answers.

(ii) Some candidates did not write the *solubility* of the blue precipitate in excess of ammonium hydroxide solution; instead of writing deep or inky blue solution some wrote "deep blue precipitate is formed".

(iii) A large number of candidates identified it as H2. Some candidates stated that the gas burns with a blue flame instead of stating that a burning splint is put off with a pop sound.

(iv) Some candidates gave only the name of the product and some did not give the confirmatory test for carbon dioxide. A few candidates wrote that it turns yellow. The word '*residue*' was missing in the observations.

(v) Many explained the *Froth Flotation method* instead of the observation. Candidates even wrote that the ore mixes with oil and settles down.

(c) (i) Some candidates did not balance the equations correctly. Some wrote CO instead of CO2, or NO instead of NO2.

(ii) Some candidates wrote the products with excess Chlorine as NCl3 and HCl.

(iii) Most candidates wrote this chemical equation correctly. A few wrote the formula of lead hydroxide incorrectly.

(iv) Many candidates were confused with the condition given - Zn/Cu couple in alcohol.

- *Explain and stress upon the differences between active and inert electrode in the process of electrolysis. Cite examples of inert and active electrodes.*
- *Drill the differences between covalent and electrovalent compounds on the basis of their properties. Comparative study of properties of acids is essential.*
- *Clarify the differences in the general formula of alkanes, alkenes and alkynes.*
- *Explain reactions with all possible questions for students' better understanding and comprehension.*
- *Drill students for observation-based questions. While teaching any chapter, stress upon related observations like colour changes, formation of precipitates, gases temperature, etc.*
- *Explain the meaning of 'relevant observations.*
- *Demonstrate experiments to explain the solubility of precipitates and tests of gases, difference between residue, solution, precipitate, etc.*
- *Insist that whenever a precipitate is formed, solubility of the precipitate must be mentioned.*
- *Instruct students to state the confirmatory tests for identification of gases which are colourless and odourless.*
- *Explain the reactivity of metals with concentrated Nitric acid, with relevant equations.*
- *Ask students to go through the various methods involved in the concentration of Ores.*

(v) A few candidates were confused regarding the products and wrote carbon monoxide instead of carbon dioxide.

(d) (i) 1. Some candidates wrote the condensed formula instead of the structural formula. Many candidates did not understand the difference between straight and branched chain. Some showed carbon skeleton but missed showing the complete structural formula.

2. Most candidates drew the structural formula correctly. A few candidates drew the condensed formula instead.

3. This part of the question was well attempted by most candidates.

(ii) 1. Some candidates wrote the IUPAC name as *methanal* instead of *ethanal*.

2. Most candidates attempted well but some were confused between 'ene' and 'yne'.

(e) (i) Key words were missing in answers.

(ii) Most candidates mentioned that graphite is cheaper and easily available or inert or that platinum is expensive, instead of stating that graphite remains unaffected by bromine vapour.

Most candidates mentioned that soda lime *acts as a catalyst*. Very few candidates gave correct reasoning.

(iii) The words *water of crystallization* was missing in most of the answers. Instead candidates wrote moisture is removed. A few even used an incorrect term *'Amorphous'*

(iv) Many candidates did not mention the word *'dissolves'* or dissolution of the gas. Instead, they simply wrote, due to NO_2.

(v) Most candidates gave a relevant reason. Some wrote, "because it comes in contact with ammonia gas". A few even wrote that it is due to the reaction between HCl and NH_3. Several candidates got confused and wrote "dense white fumes are formed".

- *Give hands-on experience to students in the laboratory for enhancing their observation skills.*
- *Insist upon practicing chemical reactions of acids with metals and non-metals under different conditions.*
- *Explain to candidates that burning of hydrocarbons under complete oxidation, produces carbon dioxide and water.*
- *Explain the logic of balancing chemical equations. Writing of equations should be practiced.*
- *With the help of examples, explain the difference between structural formula and condensed formula.*
- *Familiarize students with the basic rules of the IUPAC nomenclature, the selection of longest chain and the method of numbering.*
- *Drill thoroughly the common names and the corresponding IUPAC names of organic compounds.*
- *Explain the differences in the functional groups especially –OH and –CHO group. Ensure that the students grasp the fact that alcohol ends in 'ol' while aldehydes in 'al'.*
- *Show the students while drawing the structure of organic compounds, that all the valencies of all the 'C' atoms are satisfied.*
- *Practice reasoning-based questions with students while discussing a topic, point out the important key words and encourage them to underline them.*
- *Emphasise on the advantages and disadvantages of the electrode used in the electrolysis process.*
- *Lay stress on the fact that graphite is unaffected by bromine vapours.*

(f) (i) A number of candidates solved this question correctly. Some calculated only the volume of oxygen and missed calculating the volume of carbon monoxide. Some of the candidates instead of calculating *volume*, calculated *mass*. Others ignored the ratio.

(ii) Most candidates calculated the volume occupied by 80 g of carbon dioxide at STP correctly, but a few made errors in the calculation of M.W of CO_2.

(iii) Some candidates made errors is calculating the number of molecules in 4.4 g of Carbon dioxide. Many calculated the number of moles instead of molecules. A few did not use Avogadro's number.

(iv) Most of the candidates did not **state the law**. They only named it.

(g) (i) Several candidates answered this question correctly, however a few got confused by *coordinate bonding*.

(ii) A few candidates missed associating the word '*pure*'.

(iii) Only a few candidates answered incorrectly.

(iv) Some candidates wrote *electron affinity* instead of *electronegativity*.

(v) Majority of the candidates gave correct answers. A few mentioned it as *'ester'* or *neutralization reaction*.

(h) (i) Most of the candidates answered correctly. Some chose *methane* instead of *ammonia*.

(ii) Some candidates were not able to distinguish between *soluble* and *insoluble salts*. A few even chose *ferric chloride* instead of *ferrous chloride*.

(iii) Most of the candidates answered this question correctly.

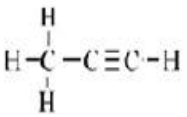
(iv) Many candidates were able to select the correct answer in this part possibly due to the offered options. Very few wrote *ammonium hydroxide*.

- *Teach students that Water of Crystallization is responsible for the colour and crystalline structure of a hydrated salt.*
- *Stress upon the appropriate key words like 'deliquescent', 'anhydrous', 'solubility', etc.*
- *Explain how by changing the conditions of the reaction, the products change. Stress upon mentioning the concentration of reactants, temperature, pressure, catalyst, etc. if any, in each reaction.*
- *Instruct students to read the questions carefully, to underline the values given and to attempt all the parts.*
- *Give sufficient practice with a variety of numerical for clarity of the concepts.*
- *Drill students to identify the law to be applied if the reactants involved are gases.*
- *Acquaint students with the following terms: number of moles, Avogadro's number of atoms / molecules, Relative atomic mass (RAM), Relative molecular mass (RMM), molar mass, molar volume, etc.*
- *Explain the meaning of the word 'state' in the question.*
- *Teach students the various types of bonds with relevant examples.*
- *Guide students that for electro-refining any metal the cathode should always be the pure metal.*
- *Stress upon the differences between the terms electronegativity and electron affinity with suitable examples. Similarly, the difference between the terms 'ester' and 'esterification'.*
- *Explain the differences between polar and non-polar covalent compounds with relevant examples.*

	(v) This question was attempted correctly by most candidates. A few however chose *Brass*.	▪ *Insist upon students to memorize the solubility chart of salts (with suitable method to prepare) on a regular basis.* ▪ *Give reasons for each method of preparation. Sufficient practice in the form of worksheets or assignments should be given to students.* ▪ *Explain ionization of alkali clearly to students and point out the difference between strong & weak alkali and solubility of alkali metals in water.* ▪ *Familiarise students with the composition of alloys and their properties.*

MARKING SCHEME

Question 1

(a)	(i) D or Helium or He (ii) B or Platinum or Pt (iii) D or Carbon tetra chloride or CCl_4 (iv) C or Concentrated sulphuric acid or conc. H_2SO_4 (v) A or C_3H_4 or propyne or prop-1-yne or 1-propyne or 1 propyne or  or $CH_3C \equiv CH$
(b)	(i) Reddish brown or brown or dark brown gas / fumes / vapour is liberated or evolved or released / blue solution / bluish solution formed / a gas with pungent smell is formed which turns potassium iodide paper brown. (for colour of gas - look for **reddish brown** or **brown** word) **Note:** a) **only word 'blue' not accepted.** The **word 'Solution'** is **a must.** No other colour accepted. b) A gas with pungent smell should be followed with a confirmatory test (ii) Inky blue solution / deep blue solution is formed/ azure solution/ **the precipitate** or blue precipitate or pale blue precipitate **dissolves**, or is **soluble** / the precipitate or blue precipitate or pale blue precipitate (dissolves) forms inky blue/ deep blue solution.

Note:

The **word 'Solution is a must'.** The **word precipitate is not accepted if it is not s**upported by the word dissolves or soluble.

(iii) **Bubbles o**f gas is released / **or bubbles** seen/ effervescence is seen/ fizz is formed/ colourless gas is released which extinguishes a burning splinter with a pop sound.

Note: colourless, odourless gas released should be followed by confirmatory test

(iv) A gas is released which turns lime water milky / a gas is released which is no effect / no change on potassium dichromate solution or potassium permanganate solution or a residue which is yellow when hot and white when cold is formed / white residue is left or formed **Note:** acidified word is **not** a must but **the word solution should be mentioned** for potassium dichromate or potassium permanganate

(v) Froth / foam is produced/ lather is seen /bubbles are seen/ ore floats/ particles are seen floating/ lighter particles float/ heavy particles sink / gangue or matrix sink/ mud or soil sinks.

(c)

(i) $C + 4HNO_3 \rightarrow CO_2 + 2H_2O + 4NO_2$

(ii) $8NH_3 + 3Cl_2 \rightarrow 6NH_4Cl + N_2$

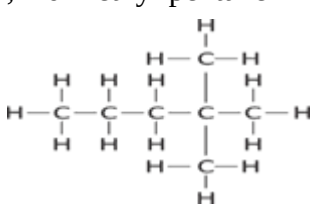
(iii) $Pb(NO_3)_2 + 2NH_4OH \rightarrow Pb(OH)_2 + 2NH_4NO_3$

(iv) $C_2H_5Br + 2[H] \xrightarrow[\text{Couple in alcohol}]{\text{Zn / Cu}} C_2H_6 + HBr \ldots$

(v) $2C_2H_6 + 7O_2 \rightarrow 4CO_2 + 6H_2O$

(d)

(i) 1. 2, 2 dimethyl pentane



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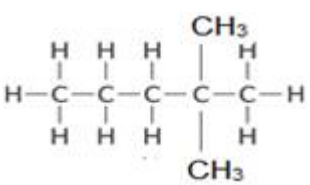
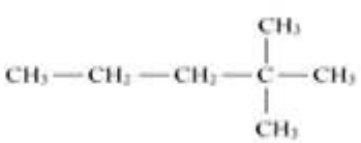


The methyl branching on the second carbon atom can be from left or right



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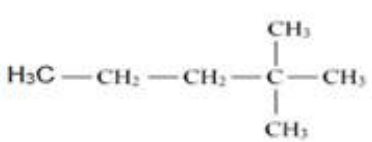
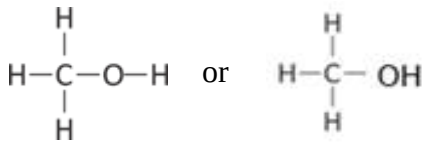
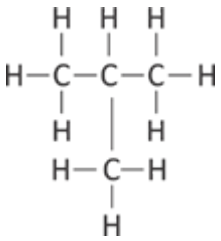


	2. methanol  or 3. Iso-propane  (ii) IUPAC Name 1. ethanal / 1ethanal / ethan- 1-al 2. ethyne / 1 ethyne / eth- 1-yne
(e)	(i) Since graphite anode is unaffected (by the reactive vapours of bromine) or does not react / Platinum is affected by (bromine vapours) or reacts with (bromine vapours) (ii) Since soda lime is not deliquescent or does not attack glass or sodium hydroxide is deliquescent or CaO is a drying agent or CaO absorbs moisture. (iii) As it loses water of crystallization/ loses water/loses definite number of water molecules/ turns anhydrous/ loses five molecules of water/ gets dehydrated (iv) Concentrate nitric acid itself **decomposes to form reddish brown or brown nitrogen dioxide gas** which remains **dissolved** (imparts yellow colour to it). / or NO2 gas formed **dissolves** in the acid to give (yellow colour) (v) As it is highly soluble in water. / high solubility/ absorbs moisture and forms mist/ affinity for water.
(f)	(i) 2 mL of carbon monoxide produces 2 ml of carbon dioxide 750 mL of carbon dioxide produces = 750x2/2 = **750 mL** 1 mL of oxygen produces 2ml of carbon dioxide 750 mL of carbon dioxide produces = 750 x 1/ 2 = **375 mL** Amount of carbon monoxide required is **750 mL** and oxygen is **375 mL** (ii) 44 g of carbon dioxide occupies 22.4 L or 22400 mL 80 g of carbon dioxide occupies = 80 x 22.4 / 44 = **40.72 L** . Or 80 x 22400/44 = **40720 mL**

	(iii) 44 g of $CO_2 \rightarrow 6.023 \times 10^{23}$ 4.4 g of $CO_2 \rightarrow x$ $x = \frac{4.4 \times 6.023 \times 10^{23}}{44}$ = **6.023×10^{22}** (iv) When gases react, they do so in volumes which bears a simple whole number ratio to one another and to the volumes of the products, if gaseous, provided the temperature and pressure of the reacting gases and their products remain constant.
(g)	(i) Covalent bond/ covalent (ii) **pure** (thin block) of copper/ **pure** copper (iii) Alloy (iv) electronegativity/ electronegative property (v) esterification
(h)	(i) ammonia / NH_3 (ii) Ferrous chloride / $FeCl_2$ / Iron(II) chloride (iii) 0.39/ or 11/28 (iv) Lithium hydroxide / calcium hydroxide/ or Formula accepted (v) Bronze

SECTION II (40 Marks)

*Attempt **any four** questions from this Section*

Question 2

(a) The following table represent the elements and the atomic number. **[3]**

With reference to this, answer the following using only the alphabets given in the table.

Element	**Atomic number**
P	13
Q	7
R	10

(i) Which element combines with hydrogen to form a basic gas?

(ii) Which element has an electron affinity zero?

(iii) Name the element, which forms an ionic compound with chlorine.

(b) Draw the electron dot diagram for the compounds given below. Represent the electrons by (**.**) and (**x**) in the diagram. **[3]**

[Atomic No.: Ca = 20, O = 8, Cl = 17, H = 1]

(i) Calcium oxide

(ii) Chlorine molecule

(iii) Water molecule

(c) Choose the correct word which refers to the process of electrolysis from A to E, to match the description (i) to (iv): **[4]**

A: Oxidation B: Cathode C: Anode D: An electrolyte E: Reduction

(i) Conducts electricity in aqueous or in molten state.

(ii) Loss of electron takes place at anode.

(iii) A reducing electrode.

(iv) Electrode connected to the positive end or terminal of the battery.

Comments of Examiners

(a) Most of the candidates attempted this part correctly. Some candidates identified the elements instead of choosing the given alphabets.

(b) (i) A number of candidates did **not draw arrows** to show transfer of electrons. Some drew only one arrow instead of two to show transfer of two valence electrons of calcium. In several cases, electrons of calcium were **not represented differently** from oxygen, or **the charge** on calcium ion and oxide ion was not written. Some drew it as a covalent molecule.

(ii) Many candidates drew orbit structure or showed the electron pair along with the bond. Several candidates were confused regarding the number of electrons that were shared.

(iii) Some candidates forgot to draw the lone pair of electrons on water.

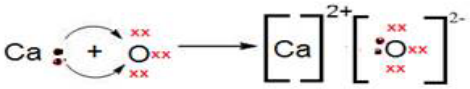
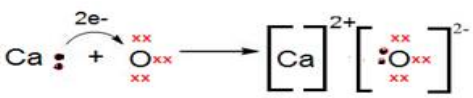
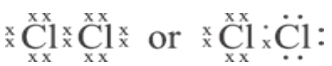
Suggestions for Teachers

- *Advise students to follow the instructions given in the question paper carefully.*
- *Train students to use the letters given in the question.*
- *While explaining, focus on the following points:*
  - *Relation between the number of shells and period number.*
  - *Relation between the number of valence electrons and the group to which the element belongs.*
  - *Periodic properties.*
- *Train students to draw and practice electronic dot structure and orbit structure of the given compounds.*
- *Instruct students to use different symbols for different elements.*

(c)	Most candidates were able to answer this part correctly. However, some were not able to distinguish between *oxidation* and *reduction* reactions.	*Represent the electrons by (.) and (x) in the diagram.* ▪ *Emphasise the importance of arrows and the charge on ion in the electron dot diagrams of electrovalent bonds. Draw attention towards the difference between dot diagram and orbit structure.* ▪ *Ensure students understand the concept of oxidation / reduction on the basis of loss/gain of electrons.* ▪ *Explain all the key terms in electrolysis.* ▪ *Conduct quizzes in class to make multiple and objective type questions easier for students.*

MARKING SCHEME

Question 2

(a)	(i) Q / 7 (ii) R /10 (iii) P /13/ Al/ Aluminium
(b)	(i)  **Or**  (ii)  (iii) 
(c)	(i) D or an electrolyte (ii) A or oxidation (iii) B or cathode (iv) C or anode

Question 3

(a) Baeyer's process is used to concentrate bauxite ore to alumina. **[3]**

Give balanced chemical equations for the reaction taking place for its conversion from bauxite to alumina.

(b) Complete the following by selecting the *correct option* from the choices given: **[3]**

(i) pH of acetic acid is greater than dilute sulphuric acid. So acetic acid contains _____ concentration of H^+ ions. *(greater, same, low)*

(ii) The indicator which does not change colour on passage of HCl gas is _____. *(methyl orange, moist blue litmus, phenolphthalein)*

(iii) The acid which cannot act as an oxidizing agent is _____. *(conc. H_2SO_4, conc. HNO_3, conc. HCl)*

(c) Match the gases given in column I to the identification of the gases mentioned in column II: **[4]**

Column I	**Column II**
(i) Hydrogen sulphide	A. Turns acidified potassium dichromate solution green.
(ii) Nitric oxide	B. Turns lime water milky.
(iii) Carbon dioxide	C. Turns reddish brown when it reacts with oxygen.
(iv) Sulphur dioxide	D. Turns moist lead acetate paper silvery black.

Comments of Examiners

(a) Most candidates did not write all three equations correctly. A few did not balance the equations. Many candidates wrote the wrong formula for $NaAlO_2$. The third reaction was written correctly by most candidates.

(b) (i) Most candidates attempted it correctly.
(ii) This part was attempted correctly by most candidates.
(iii) In this part, many candidates overlooked the word 'not' and instead wrote the oxidizing agent. Majority of the candidates selected the incorrect option **conc. nitric acid** instead of conc. hydrochloric acid.

Suggestions for Teachers

- *Teach the process of extraction thoroughly.*
- *Stress upon writing balanced chemical equations. Various reactions involved in the concentration process (Baeyer's process) should be explained.*
- *Advise students to learn the chemical reactions with necessary conditions and their balanced chemical equations.*

(c)	Most candidates answered correctly but some were not sure of the tests for gases. Some wrote that Nitric oxide turns lead acetate paper silvery black. Others got mixed up with the options of hydrogen sulphide and sulphur dioxide.	▪ *Ensure students are able to distinguish between strong and weak acid on the basis of H+ ion concentration.* ▪ *Discuss in detail the types of acids and bases on the basis of dissociation /ionization whether complete / partial or no dissociation / ionization.* ▪ *Demonstrate the effect of pH and indicators on acids and alkalis for better understanding/retention.* ▪ *Point out the properties of nitric acid, sulphuric acid and hydrochloric acid to help students understand the differences.* ▪ *During practical classes encourage students to observe carefully, the tests for different gases liberated, to enable them to identify the gases correctly.*

MARKING SCHEME

Question 3

(a)	(i) $Al_2O_3.2H_2O + 2\ NaOH \xrightarrow{150^o\text{-}200^o C} 2NaAlO_2 + 3H_2O$ (ii) $NaAlO_2 + 2H2O \xrightarrow{50^o\text{-}60^o C} NaOH + Al(OH)_3$ (iii) $2Al(OH)_3 \xrightarrow{1100^o C} Al2O_3 + 3H_2O$
(b)	(i) low or less (ii) Phenolphthalein (iii) Concentrated HCl
(c)	(i) D or turns moist lead acetate paper silvery black (ii) C or turns reddish brown when it reacts with oxygen (iii) B or turns lime water milky

	(iv) A or turns acidified potassium dichromate solution green / **B** or turns lime water milky or **A and B**

Question 4

(a) Differentiate between the following pairs based on the information given in the brackets. **[3]**

(i) Conductor and electrolyte (conducting particles)

(ii) Cations and anions (formation from an atom)

(iii) Acid and Alkali (formation of type of ions)

(b) Draw the structures of isomers of pentane. **[3]**

(c) Hydrogen chloride gas is prepared in the laboratory using concentrated sulphuric acid and sodium chloride. Answer the questions that follow based on this reaction: **[4]**

(i) Give the balanced chemical equation for the reaction with suitable condition(s) if any.

(ii) Why is concentrated sulphuric acid used instead of concentrated nitric acid?

(iii) How is the gas collected?

(iv) Name the drying agent not used for drying the gas.

Comments of Examiners

(a) (i) Many candidates could not answer this part correctly. The differences were not based on the specified parameters. Some wrote atoms in place of ions.

(ii) Most candidates wrote cations migrate towards cathode and anions towards anode or anions are negatively charged and cations are positively charged. Some were confused and wrote that cations gain electrons while anions lose electrons.

(iii)Answered correctly by majority of the candidates.

(b) Most candidates drew the first isomer correctly but could not draw the other two isomers. Some candidates drew only two isomers. Branched structures were not drawn correctly. Some

Suggestions for Teachers

- *Point out the similarities and differences between electrolyte and non - electrolyte, cation and anion, conductors, and non-conductors.*
- *Ensure that the students can identify the particles present in electrolyte, non-electrolyte and conductors, respectively.*
- *Guide students to read the instruction in brackets carefully before answering the question.*
- *Teach isomerism thoroughly and encourage students to draw the related structures. Explain the isomers with both IUPAC names and common names.*

missed out H atoms or the count of carbon atoms went incorrect. Many candidates did not understand the difference between straight and branched chain.

(c) (i) Several candidates did not mention the condition or wrote incorrect condition. Some used **greater than sign** instead of less than sign.
(ii) Almost all attempted correctly.
(iii) Some candidates wrote that the gas was collected by downward displacement of air.
(iv) Some candidates missed out the word 'not used', hence, identified the drying agent as Conc. H_2SO_4 instead of CaO and P_2O_5.

- *Point out the difference between condensed formula and structural formula with the help of examples. Videos showing isomerism can be shown- how carbon atoms are rearranging themselves resulting in formations of isomers.*
- *Train students to write balanced chemical equations along with the conditions.*
- *In laboratory preparation, point out clearly the products formed.*
- *Discuss the physical and chemical properties of HCl gas and the method of collection.*
- *Explain the methods of preparation of compounds with relevant diagrams, for better understanding of the aspects /procedure involved in the preparation.*

MARKING SCHEME

Question 4

(a) (i) Conductor – conduction due to electrons

Electrolyte – conduction due to ions.

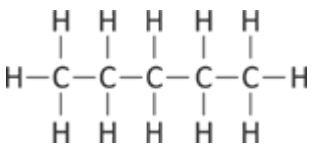
(ii) Cations are formed by the **loss of electrons** from an atom / or **oxidation** of an atom / **donating electrons**

Anions are formed by the **gain of electrons** by an atom / **reduction** of an atom/ **accepting electrons**

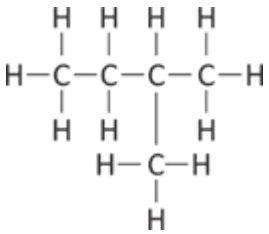
(iii) Acid – forms H+ ions or hydronium (ions in solution) or H_3O+ or hydrogen ions

Alkali – forms hydroxyl (ion) or OH – (in solution) or hydroxide ion/hydroxide

(b) (i) pentane



(ii) 2 methyl butane



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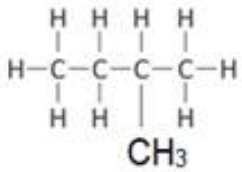
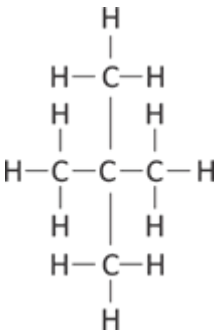


(iii) 2, 2 dimethyl propane



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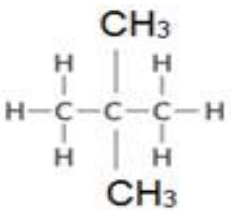


(c) (i) $NaCl + (conc.)\ H_2SO_4 \xrightarrow{< 200\,^oC \text{ or less than } 200} NaHSO_4 + HCl$

(ii) **Concentrated H_2SO_4** is **non-volatile / least volatile / less volatile/ has high boiling point** and (hence can displace the more volatile HCl gas from the salt)

OR

Concentrated nitric acid is **a volatile** acid / **low boiling** point and (will displace out itself along with HCl gas)

(iii) Upward displacement of air/ downward delivery / downward delivery of gas

(iv) Quick lime / calcium oxide / phosphorus pentoxide

Question 5

(a) Distinguish between the following pairs of compounds using a reagent as a chemical test: **[3]**

(i) Calcium nitrate and Zinc nitrate solution.

(ii) Ammonium sulphate crystals and Sodium sulphate crystals.

(iii) Magnesium chloride and Magnesium nitrate solution.

(b) Calculate the percentage of: **[3]**

(i) Fluorine

(ii) Sodium and

(iii) Aluminium

in sodium aluminium fluoride [Na_3AlF_6], to the nearest whole number.

[Atomic Mass: Na = 23, Al= 27, F= 19]

(c) (i) State the volume occupied by 40 gm of methane at STP, if its vapour density (V.D.) is 8. **[4]**

(ii) Calculate the number of moles present in 160 gm of NaOH.

[Atomic Mass: Na = 23, H= 1, O= 16]

Comments of Examiners

(a) A number of candidates chose the incorrect reagent; others could not write the correct observations. Some candidates differentiated on the basis of thermal decomposition. Several wrote the reactions or named the product instead of writing the observations. Majority distinguished between each pair, using different chemical reagents; at times, the observations were not correct. Several candidates wrote the correct observation without mentioning the reagent.

(b) (i) Almost all the candidates answered this part correctly. However, a few calculated the molecular weight of Na_3AlF_6 incorrectly while others did not substitute the values properly.

(ii) Most of the candidates could do this part correctly. Some candidates, instead of **multiplying 3 x 23** for sodium, calculated the percentage with **only 23.**

(iii) Almost all candidates attempted this subpart correctly.

Suggestions for Teachers

- *Teach students steps and techniques to differentiate salts.*
- *Ensure students are clear about the cation and anion test using sodium hydroxide and ammonium hydroxide.*
- *Train students to state the result of the test with both substances, besides mentioning the choice of reagent.*
- *Ensure that students learn the various reagents and reactions involved in the anions' tests.*
- *Emphasise that conc. Sulphuric acid cannot be used if the salt provided is in solution form.*
- *Teach Analytical chemistry thoroughly. Insist upon the correlation between practical and theoretical knowledge.*
- *Give adequate practice on problems based on percentage composition as well as calculation of molecular weight.*

(c)	(i) Several candidates did the calculation taking the value of vapour density as '8', instead of calculating RMM= 2 x VD i.e., '16' (ii) Some candidates calculated molecular weight of NaOH incorrectly. A large number of candidates made incorrect substitution and/or calculated *mass* instead of *moles*. Some even calculated number of molecules in place of moles.	▪ *Train students to solve numerical problems stepwise.* ▪ *Ensure students have clarity regarding molecules, moles, molecular weight, vapour density, etc.* ▪ *Give ample practice in numericals so that the concept of mole, mass-mass and mass-volume relationship becomes clear to students.*

MARKING SCHEME

Question 5

(a)	(i) **Add NaOH / KOH / dil H_2SO_4** to both the solutions Calcium nitrate forms a white **precipitate** which is **insoluble** in excess of NaOH while Zinc nitrate forms a **g**elatinous white **precipitate soluble in excess.** **With (dilute) Sulphuric acid …** Calcium nitrate forms a white **precipitate** while Zinc nitrate **does not form precipitate** Or **With NH_4OH** - Calcium nitrate **no reaction** or **no precipitate** while with Zinc nitrate it forms a (gelatinous white) **precipitate** soluble in excess / or **white** gelatinous precipitate with zinc nitrate (ii) Add **any alkali / base** Ammonium sulphate produces a **pungent colourless gas** or colourless gas is released which turns red litmus blue. While there is **no reaction** with sodium sulphate. Or **no pungent gas released** (iii) Add **silver nitrate / lead nitrate** solution to both / or perform brown ring test for nitrates Magnesium chloride forms a white **precipitate** while there is **no reaction** with magnesium nitrate. Or Magnesium chloride **does not form** brown ring with Brown ring test while magnesium nitrate **forms a brown ring**
(b)	Molecular weight of Na_3AlF_6 = 23x3 + 27 + 19x6 = 210 (i) percentage of F = 114 x 100 / 210 = or **54.28% or 54.2 % or 54%** (ii) percentage of Na = 69x100/210 = or **32.85% or 32.8% or 33%** (iii) percentage of Al = 27 x 100 / 210 = or **12.85%** or **12.8%** or **13%**

(c)	(i) 16 g of CH_4 occupy = 22.4 L at STP $\therefore$ 40 g of CH_4 occupy = 22.4 x 40 / 16 or 22400 x 40/16 = or **56 L** or **56000 mL** (ii) Number of moles of NaOH = weight in grams / molecular weight = 160 / 40 = **4 moles**

Question 6

(a) Identify the salts **P, Q, R** from the following observations: **[3]**

(i) Salt **P** has light bluish green colour. On heating, it produces a black coloured residue. Salt **P** produces brisk effervescence with dil. HCl and the gas evolved turns lime water milky, but no action with acidified potassium dichromate solution.

(ii) Salt **Q** is white in colour. On strong heating, it produces buff yellow residue and liberates reddish brown gas. Solution of salt **Q** produces chalky white insoluble precipitate with excess of ammonium hydroxide.

(iii) Salt **R** is black in colour. On reacting with concentrated HCl, it liberates a pungent greenish yellow gas which turns moist starch iodide paper blue black.

(b) Identify the substance underlined in each of the following: **[3]**

(i) The <u>electrode</u> that increases in mass during the electro-refining of silver.

(ii) The <u>acid</u> that is a dehydrating as well as a drying agent.

(iii) The <u>catalyst</u> used to oxidize ammonia into nitric oxide.

(c) Copy and complete the following paragraph using the options given in brackets: **[4]**

Alkenes are a homologous series of (i) _____ (saturated / unsaturated) hydrocarbons characterized by the general formula (ii) _____ (C_nH_{2n+2} / C_nH_{2n}). Alkenes undergo (iii) _____ (addition / substitution) reactions and also undergo (iv) _____ (hydrogenation / dehydrogenation) to form alkanes.

Comments of Examiners

(a) Candidates who had knowledge of practical chemistry found this question easy. Some common mistakes made by candidates were as follows:

(i) Few candidates made errors in identifying the salt. Some identified it as *calcium carbonate* instead of *copper carbonate*.

Suggestions for Teachers

- *Demonstrate the reaction of conc. HCl on both the black compounds namely CuO and MnO_2 to help students to see the colour and understand the difference between the compounds.*

(ii) Some candidates were confused and identified the salt as *zinc nitrate***.**

(iii)Several candidates mistook the black compound to be *Copper oxide***.**

(b) (i) Many candidates gave incorrect answers and mentioned *anode* instead of *cathode*.

(ii) The word *concentrated* was missing in some cases. Candidates only mentioned the substance as *sulphuric acid*.

(iii)The part was well attempted by most candidates. Some candidates wrote *Fe* instead of *platinum*. A few mentioned it as V_2O_5.

(c) Most of the candidates answered this question correctly.

A few got confused in the following fill in the blanks and wrote:

- [ii] C_nH_{2n+2}
- [iii] substitution
- [iv] dehydrogenation.

- *Train students to identify salt from the observations given.*
- *Enhance students' Practical knowledge. Encourage them to perform, observe and infer from the experiments.*
- *Supplement theory with practical demonstration so that students can recall observations easily.*
- *Train students to write **dilute** or **concentrated** whenever reference is made to any acid.*
- *Tabulate the various catalyzed reactions with conditions wherever mentioned and highlight the catalysts in each case, for easy recapitulation.*
- *Stress on the general formula of alkanes, alkenes, and alkynes and also help students to understand the difference between saturated and unsaturated hydrocarbons through their structures.*
- *Tabulate the properties of Hydrocarbons to enable students to compare and contrast between alkanes, alkenes and alkynes.*
- *Insist on students to identify the feasibility of reactions of saturated and unsaturated hydrocarbons.*
- *Clarify the terms dehydrogenation and hydrogenation giveing relevant examples.*

MARKING SCHEME

Question 6

(a)	(i) $CuCO_3$ or copper carbonate or copper(II) carbonate (ii) $Pb(NO_3)_2$ or lead nitrate or lead(II) nitrate (iii) MnO_2 or manganese dioxide or manganese (IV) oxide ….
(b)	(i) cathode or negative electrode or reducing electrode or **pure silver** or **pure Silver** strip or **pure silver** metal or pure Ag (ii) concentrated sulphuric acid or conc. H_2SO_4

	(iii) Platinum or Pt or Cu(copper) or Ni (Nickel) or Rh (Rhodium)
(c)	(i) Unsaturated (ii) C_nH_{2n} (iii) Addition (iv) Hydrogenation

Question 7

(a) Write balanced chemical equations, for the preparation of the given salts (i) to (iii) by using the methods A to C respectively: **[3]**

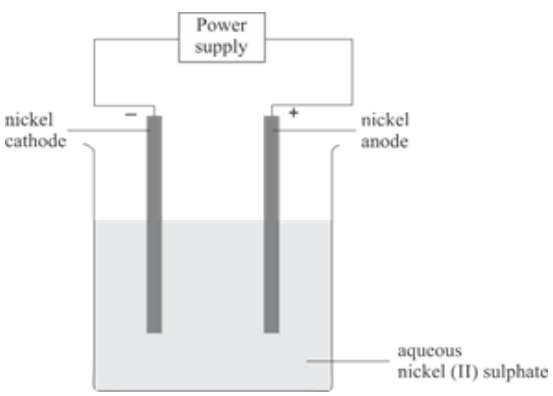
A: Neutralization B: Precipitation C: Titration

(i) Copper sulphate
(ii) Zinc carbonate
(iii) Ammonium sulphate

(b) Name the following elements: **[3]**

(i) An alkaline earth metal present in group 2 and period 3.
(ii) A trivalent metal used to make light tools.
(iii) A monovalent non-metal present in fluorspar.

(c) An aqueous solution of nickel (II) sulphate was electrolyzed using nickel electrodes. Observe the diagram and answer the questions that follow: **[4]**



(i) What do you observe at the **cathode** and **anode** respectively?
(ii) Name the cation that remains as a spectator ion in the solution.
(iii) Which equation for the reaction at the anode is correct?

1. $Ni \rightarrow Ni^{2+} + 2e^-$
2. $Ni + 2e^- \rightarrow Ni^{2+}$
3. $Ni^{2+} \rightarrow Ni + 2e^-$
4. $Ni^{2+} + 2e^- \rightarrow Ni$

Comments of Examiners

(a) Most candidates matched the salt with the method of preparation instead of writing balanced chemical equations. Common errors made in the subparts were as follows:

Reactants selected were incorrect.

(i) Some candidates used copper sulphate as the reactant or used sodium sulphate instead of sulphuric acid.

(ii) Some candidates took carbonic acid as one of the reactants.

(iii) Either the reactants selected were incorrect, or formula of ammonium sulphate written was incorrect in some cases.

(b) (i) Most candidates attempted this question correctly, but some wrote one element of period 2 and another element from group 3.

(ii)Some candidates could not relate the term *trivalent metal* and made errors.

(iii) Some candidates named *calcium* as they might have missed out on the word *non - metal*.

(c) Many candidates could not give the correct observation at the cathode/anode. Some candidates did not associate the correct electrode with the observation given.

(i)Some wrote the cathode and anode reactions, instead of the observations, while some wrote observations in the reverse way.

(ii) Several candidates were not able to identify the spectator ions - all possible ions were mentioned.

(iii)Majority of the candidates selected an incorrect option.

Suggestions for Teachers

- *Discuss the preparation of salts pointing out the reasons why certain salts are prepared by using a certain method while others are not.*
- *Advise students to write the chemical reaction for preparation of salts stepwise, that is:*
  - *Write the name of the salt and identify its solubility;*
  - *Identify the method of preparation;*
  - *Decide the reactants;*
  - *Write the complete balanced equation.*
- *Familiarise the students with the fact that generally all salts of sodium, potassium and ammonium are soluble and hence titration is employed as a procedure to carry out neutralization reactions for soluble base.*
- *Familiarise students with the Periodic table and the position of elements in different groups and periods based on the electronic configuration.*
- *Explain the meaning of the terms monovalent, divalent and trivalent.*
- *Teach students to identify metals / non-metals based on their properties.*
- *Ensure candidates write electrode equation correctly. Tabulate the various electrode reactions and highlight the observations at the cathode and anode in each case for easy recapitulations.*
- *Explain the different types of observation-based questions and the questions based on naming the products.*
- *Enumerate the various changes occurring at both electrodes during*

electrolysis instead of focusing on any one observation.

- *Explain electroplating with the help of a chart or a video, to enable students to observe the changes taking place at the respective electrodes.*
- *Familiarise students with the reaction taking place at the cathode and anode respectively; also make them familiar with the reactions in terms of electron transfer and how to represent them using equations.*
- *Revise frequently the terms Cations, Anions, Spectator ions, the concept of loss and gain of electrons at the Anode and Cathode, Oxidising and Reducing electrode, etc.*

MARKING SCHEME

Question 7

(a)	(i) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$ Or $Cu(OH)_2 + H_2SO_4 \rightarrow CuSO_4 + 2H_2O$ Or $CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$ Or $Cu(HCO_3)_2 + H_2SO_4 \rightarrow CuSO_4 + 2H_2O + 2CO_2$ (ii) $ZnCl_2 + Na_2CO_3 \rightarrow ZnCO_3 + 2NaCl$ **(or any soluble salts of zinc along with carbonates of sodium, potassium or ammonium as reactants)** (iii) $2NH_4OH + H_2SO_4 \rightarrow (NH_4)_2SO_4 + 2H_2O$ Or $2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$
(b)	(i) Magnesium or Mg (ii) Aluminium or Al (iii) Fluorine or F
(c)	(i) **Cathode** – silvery metal **deposited or coated or sticks** / nickel or **metal is deposited or coated or sticks** / silvery deposit/increases in size or mass **Anode –** Size decreases / reduction in mass / Anode dissolves/ Anode Diminishes/ Anode loses weight (ii) Hydrogen ion or H+ or hydrogen (iii) 1 or $Ni \rightarrow Ni^{2+} + 2e-$ Or $Ni - 2e- \rightarrow Ni^{2+}$

GENERAL COMMENTS

Topics found difficult/ confusing by candidates

- Properties of Ionic and covalent compounds
- Writing balanced chemical equations for the given chemical reactions
- Identification of gases and compounds
- Drawing structural formulae of organic compound
- Drawing of isomers
- Methods of preparation of salts
- Identifying the salts from the given observations
- Electron dot diagram
- Oxidation / Reduction reaction applied to electrolysis
- Reactions and observation at cathode and anode
- Problems based on Mole concept
- Observation based questions on practical chemistry
- Distinguishing between pairs of compound by using a particular reagent
- Reaction of ammonia with excess chlorine and vice versa
- Oxidation and reduction in terms of loss and gain of electrons
- IUPAC names, common names and numbering of the carbon atoms in the chain
- Usage of the sign < and >
- Electro-negativity and Electron affinity
- Reasoning type questions

Suggestions for Students

- Refer to the syllabus while going through each topic.
- Practice writing balanced chemical equations.
- Focus on the colour / solubility of precipitates formed using reagents such as Sodium hydroxide and Ammonium hydroxide.
- Practice answering observation-based questions.
- Prepare flow diagrams, short notes, tables for facts and concepts.
- Learn the Laws and definitions well with the correct terms/key words.
- Acquire knowledge of solubilities of salts especially in deciding the methods of preparation of salts.

- Expose yourselves to variety of questions by solving past years' Question Papers.
- Utilize the 15 minutes' reading time given in the question paper thoroughly and choose the correct questions to attempt.
- Develop the habit of solving numerical problems stepwise and try to solve as many types of numerical problems, as possible.
- Always write down the structural formula of organic compounds with all the bonds properly visible.
- Show functional group in expanded form and not in the condensed form.
- Answer reasoning questions in points by focusing on the main reason.
- Learn all reactions along with the specific conditions.
- Remember to distinguish between a pair of compounds using a single reagent, stating that one gives the characteristic reaction while the other does not.
- Read the questions carefully and answer what is required, *e.g.*, do not write products for observation-based questions or the formula for a question where 'name' is asked.
- Develop an interest in experimentation and enhance the observational skills which will help in liking the subject.
- Read the chapters thoroughly to get a very clear concept of the subject matter.
- Ensure all aspects of the syllabus are covered and avoid selective study of topics.