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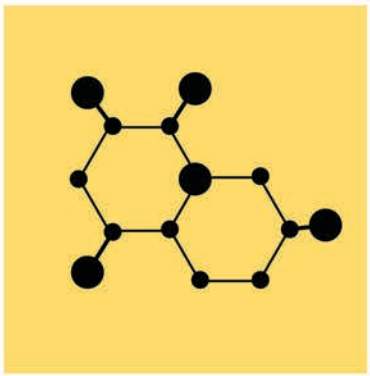
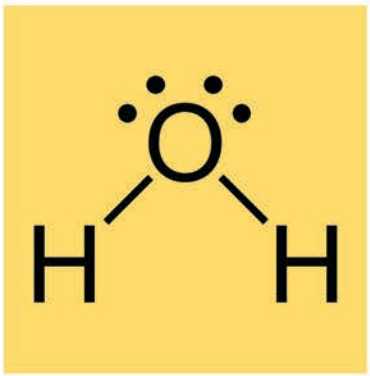


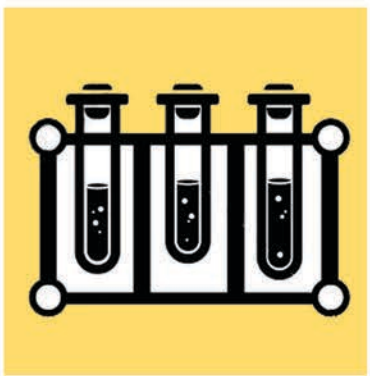
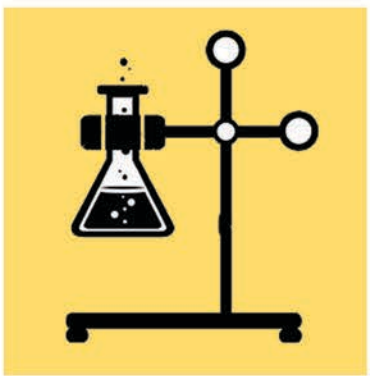


CHEMISTRY

CLASS X

- COVERS PREVIOUS YEARS BOARD QUESTIONS
- SOLUTIONS PROVIDED BY SUBJECT EXPERTS
- COMPREHENSIVE REVISION OF THE SYLLABUS

In accordance with the latest syllabus of Council for the Indian School Certificate Examinations.

ICSE

Most Likely Question Bank

Class X

CHEMISTRY

by
A PANEL OF AUTHORS

OSWAL PUBLISHERS
1/12, Sahitya Kunj, M. G. Road, Agra-282 002

Edition : 2018

ISBN : 978-93-87660-06-9

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Facebook link	**:**	https://www.facebook.com/oswalpublishersindia
Also available on	**:**	amazon.in, Flipkart, snapdeal

Preface

Oswal Publishers take great pride in presenting their series of **"*ICSE Most Likely Question Bank*",** especially for the students preparing for CISCE Board Examination.

This book will help the students in revising the whole syllabus in a comparatively lesser time and will develop the aptitude for effective learning in the subject. This will enable candidates to acquire knowledge and to develop an understanding of the terms, facts, concepts, definitions, fundamental laws, principles and processes.

We hope that this book will instill a sense of confidence in the students and empower them towards achieving their goals and scholastic excellence.

Suggestions for the improvement of the book are invited and shall be gratefully acknowledged.

—The Publisher

How to Prepare for Board Exams Using Oswal's Most Likely Question Bank Categorywise & Chapterwise

The Most Likely Question Bank is a great learning tool for CISCE Examination as it is the most comprehensive and concisely composed set of questions for the students. In order to prepare well for their exams. The students may follow the following approach.

Step 1 : Prepare Your Theory

Students must go through the theory of the Chapters from their textbooks covering the syllabus as per the Council Guidelines.

Step 2 : Understand the Categories

The contents have been arranged as per different 'Category' of Questions. These 'Categories' cover all the different types of questions that the Board asks in their examinations. Each Category in turn covers topics from all the chapters of the syllabus. Eg. Short Answers category will cover the short answer type questions from all the chapters of the syllabus in that subject.

Step 3 : Complete Syllabus Revision

When students revise questions from any single category, they are revising the entire syllabus in different assemblages.

Step 4 : Customised Learning

Students with different learning calibers can customize their preparations. They can refer the objective questions first to get a basic understanding of the chapters and topics then they can take up the most complex categories.

Step 5 : Check Your Progress

Students can check their answers against the solutions given next to the questions. This will save time and help in faster revisions.

Students can benefit tremendously from these series by using them optimally for their exam preparations.

CONTENTS

Question Set 1

Fill in the Blanks

Q. Fill in the blanks in the following statements, with suitable words :

Chapter 1. Periodic Properties and Variations of Properties

1. The modern Periodic Table has ..... periods.
2. Each ..... in the Periodic Table is comprised of elements having the same number of electron shells.
3. Elements in a period, all have the same number of ..... in their atoms.
4. Elements in a group, all have the same number of ..... .
5. The most active metals are located in ..... 1 and 2 of the Periodic Table.
6. The most reactive non-metals comprise group ..... of the Periodic Table.
7. The elements of ..... are known as typical elements.
8. The elements occupying left and right side groups of Periodic Table are called ..... elements.
9. The rare gases are placed in ..... group at the end.
10. Elements from atomic number 57 to ..... occupy same place in Periodic Table. These elements are called .....
11. Actinides are the elements from atomic number ..... to ..... and are radioactive.
12. The actinides and ..... are kept outside the Periodic Table to mark their peculiar properties.
13. The properties of elements are periodic function of their.....
14. The atomic size ..... as we move left to right across the period, because the ..... increases but the ..... remains the same.
15. The metallic character ..... in a group as one moves from top to bottom.
16. The metallic character ..... in a period as one moves from right to left.
17. In a period or in a group, the larger the atomic size of an element, the..... metallic is the element.
18. Moving across a ..... of the periodic table, the elements show increasing ..... character.
19. The amount of energy involved in the reaction X + energy $\rightarrow X^+ + e^-$ is known as the ……of the element X.
20. Across a period, the ionization potential……
21. Down the group, electron affinity……
22. The higher the electron affinity of a non-metal, ... chemically reactive the non-metal is.
23. The tendency to gain an electron ..... on moving down a group and ..... on moving across a period in the Periodic Table.
24. Elements having high ionization potential have ..... electron affinities.
25. The electronegativity of elements ..... across a period and ..... down a group.
26. In general, non-metals are ..... electronegative than metals.
27. On moving from left to right in a given period, the number of shells ..... .
28. Element X belongs to group 2 and period 3 of the Periodic Table. It has ..... electrons in the outer most shell.
29. Each period except period 1 in the Periodic Table begins with ..... and ends up with a ..... .
30. The metallic and non-metallic character depends upon the.....and..... of the elements.
31. The energy required to remove an electron from a neutral isolated gaseous atom and convert it into a positively charged gaseous ion is called…….

Ans.
1. 7
2. period
3. electron shells
4. outer electrons
5. groups
6. 17
7. period 3
8. representative
9. zero
10. 71, lanthanides
11. 89, 103
12. lanthanides
13. atomic number
14. decrease, nuclear charge, number of shells
15. increases
16. decreases
17. more
18. period, non-metallic
19. ionization potential
20. increases
21. decreases
22. more
23. increases; decreases
24. high
25. increases; decreases
26. more
27. remains the same
28. 2 (two)
29. an alkali metal; noble gas
30. atomic size, ionization potential
31. ionization potential

Chapter 2. Chemical Bonding

1. Ionic compounds consist of ..... charged ions.
2. Ionic compounds have ..... melting points due to ..... ionic bonds.
3. The physical state of ionic compounds is ..... .
4. Ionic compound conduct electricity in their ..... .
5. The nature of bond in compounds of alkali and alkaline earth metals is ..... .
6. ..... compounds have low boiling points because of ..... intermolecular forces.
7. In covalent compounds, the bond is formed due to the……of electrons.
8. Melting and boiling points of covalent compounds are generally……
9. Covalent bond is rigid and directional, it is responsible for ..... .
10. Most covalent compounds have density ..... than that of water.
11. The electronegativities of atoms giving covalent molecules are generally ..... .
12. Atoms of the same element combine to form molecules by means of ..... bonds.
13. A solution of a ..... electrolyte will contain both ions and molecules of the solute.
14. In the sodium chloride crystal, each Na^+ ion is surrounded by ..... Cl^- ions and each Cl^- ion by ..... Na^+ ions.
15. In sodium chloride, the Na^+ ion has the ..... configuration and the Cl^- ion has the ..... configuration.
16. A compound conducted electricity in the fused state. The compound is made-up of ..... .
17. The duplet or octet structure of valence shell makes ..... of an element chemically .....
18. The atomic number of oxygen is 8. The total number of electrons in the O^{2-} ion is ..…… .
19. The atomic number of oxygen is 8. The number of protons in the O^{2-} ion is ..... .
20. Two nitrogen atoms join together by sharing ..... pairs of electrons.
21. In NH_4^+ all the four bonds are..... .
22. The water molecules easily break the ..... bonds between the oppositly charged ions. The ions drift in water in all possible directions and hence electrovalent compounds ..... in water.
23. A molecule of……contains a triple bond.
24. ..... are identical to a normal covalent compound.
25. Metals are good ……because they are electron…….
26. Electrovalent compounds have……melting points.

Ans.
1. oppositely
2. high, strong
3. solid state
4. fused state as well as in their aqueous solution
5. ionic bond
6. covalent, weak

7.	sharing	8.	low
9.	definite shape of the molecule	10.	less
11.	high	12.	covalent
13.	strong	14.	six, six
15.	neon, argon	16.	ions
17.	atom, inactive	18.	10
19.	8	20.	three
21.	identical	22.	ionic, dissolve
23.	nitrogen	24.	co-ordinate bond
25.	reducing agents, donors	26.	high

Chapter 3. Study of Acids, Bases and Salts

(a) Salts of strong acids and strong bases in water produce (1) .....solution. Solution of sodium carbonate in water is (2) .....in nature, while the solution of ferric chloride is (3) .....in nature.

Ans. (1) Neutral, (2) basic, (3) acidic.

(b) A solution X turns blue litmus red, so it must contain :
(1) ……ions. Another solution Y turns red litmus blue and therefore, must contain
(2) ……ions. When solutions X and Y are mixed together, the products will be a (3)…… and (4) ……. If a piece of magnesium was put into solution X. (5) …… gas would be evolved.

Ans. (1) hydronium, (2) hydroxide, (3) salt, (4) water, (5) hydrogen.

(c) In making copper sulphate crystals, a black powder called (1) ..... is added to dilute (2) ..... acid and the mixture is warmed. Excess black powder is added to a small volume of acid so as to (3) ..... The excess insoluble black powder is got rid by (4) ..... The resulting clear solution looks (5) ..... in colour. This solution is heated to get rid of some of the (6)..... Slow cooling of the remaining solution (7) ..... of pure copper sulphate.

Ans. (1) Copper oxide, (2) Sulphuric, (3) neutralise the excess of the acid, (4) filtration, (5) blue, (6) copper sulphide as impurity, (7) gives well-defined crystals.

(d) Deliquescence takes place because of the difference in (1) .....of atmospheric (2) .....and that of the deliquescent substance. The vapour pressure of atmospheric humidity is (3) .....than that of the deliquescent substance. The substances which take up water on exposure to atmosphere, without forming a solution are known as (4) ..... substances.

Ans. (1) vapour pressure, (2) humidity, (3) higher, (4) hygroscopic.

(e)
1. An acid is a compound which when dissolved in water gives ..... ions as the only ..... ions.
2. A ..... acid undergoes almost complete dissociation on dissolving in water.
3. An example of mineral acid is .....
4. Vinegar contains ..... acid.
5. Sodium acetate on hydrolysis forms sodium hydroxide and ..... .
6. The basicity of Acetic Acid is …….
7. Metal A reacts with cold water forming hydrogen and new compound B. The anion combined with A in a substance B is named ..... .
8. The solution of sodium carbonate is alkaline due to ..... .
9. The complete reaction between an acid and a base is called ..... .
10. The pH value of a neutral solution is ..... .
11. As the pH of solution decreases, its acidic strength progressively ..... .
12. As the pH of solution increases, the ..... strength of the solution progressively decreases.
13. pH value of lemon juice is ..... than 7.
14. Ammonium hydroxide is a ..... base.
15. Methyl orange turns ..... in acidic solution.
16. The formation of a salt from an acid and a base involves the combination of..... from the acid and the.....from the.....to form..... molecules.

17. A salt which absorbs moisture from the air, but does not change in physical state in called ..... salt.
18. Ammonium chloride is a ..... salt.
19. Sodium hydrogen sulphate is ..... salt.
20. The salt of the acid HNO_2 are called.....and those of the acid HNO_3 are called ..... .
21. Sodium sulphite reacts with dilute sulphuric acid to form sodium sulphate ..... gas and water.
22. Copper (II) chloride reacts with sodium hydroxide to form ..... copper hydroxide and sodium chloride.
23. A chemical reaction between hydronium ions of an acid and OH^- ions of a base to form unionised water is called ..... .
24. Dissolving of aluminium foil in HCl as well as NaOH shows that it is ..... in nature.
25. An example of a deliquescent salt is .....
26. Superphosphate is an example of a compound called..... .
27. The number of H^+ ions of an acid which react completely with one molecule of a base is called its ..... .
28. When a metallic oxide is dissolved in water, the solution formed has high concentration of……ions.
29. The metal which does not react with water or dilute H_2SO_4 but reacts with concentrated H_2SO_4 is…….
30. The metal whose oxide, which is amphoteric, is reduced to metal by carbon reduction…….
31. The divalent metal whose oxide is reduced to metal by electrolysis of its fused salt is…….
32. Higher the pH value of a solution, the more……it is.

Ans.

1.	hydronium, positive	2.	strong
3.	HCl	4.	acetic
5.	acetic acid	6.	1
7.	hydroxyl ion	8.	hydrolysis
9.	neutralization	10.	7
11.	increases	12.	acidic
13.	less	14.	weak
15.	pink	16.	H^+, OH^-, base, water
17.	hygroscopic	18.	soluble
19.	acidic	20.	nitrites, nitrates
21.	Sulphur dioxide	22.	insoluble
23.	neutralization	25.	anhydrous ($CaCl_2$)
24.	amphoteric	26.	acid salt
27.	acidity	28.	OH^-
29.	Cu	30.	Pb
31.	Mg	32.	alkaline

Chapter 4. Analytical Chemistry

1. Salts of normal elements [1 [IA] to 17 (VIIA)] are generally…….
2. Ferrous salts are……in colour.
3. An example of weak alkali solution…….
4. Both ammonium and sodium hydroxide are used in analytical chemistry for identifying..…… of salts.
5. Zinc chloride solution reacts with ammonium hydroxide solution to give a ..... coloured precipitate.
6. Calcium salts with sodium hydroxide give……precipitates.
7. Ammonium hydroxide is a weak alkali which dissociates partially to furnish……OH^- ions which precipitate……metal hydroxides.

8. Sodium zincate and water is obtained on reaction of ……with concentrated caustic soda.
9. …… and ……salt dissolve in sodium hydroxide.
10. Oxides and hydroxides of certain metals such as……are amphoteric in nature.
11. Amphoteric oxides and hydroxides react with an……to give salt and water only.
12. An oxide of a metal which is amphoteric in nature is……
13. $Zn(OH)_2$, $Pb(OH)_2$ and $Al(OH)_3$ are……hydroxides.
14. ……, a white precipitate is soluble in excess NH_4OH.

Ans.
1. colourless
2. light green
3. ammonium hydroxide
4. cations
5. white
6. white
7. insufficient, soluble
8. zinc oxide
9. zinc, lead
10. zinc, lead, aluminium
11. acid as well an alkali
12. Lead oxide, PbO
13. amphoteric
14. AgCl

Chapter 5. Mole Concept and Stoichiometry

1. An……is the smaller unit of matter, which may or may not have an independent existence, but always takes part in a chemical reaction.
2. The relative molecular mass is a number that repesents how many times one…… of a substance is heavier than $\frac{1}{12}$ th mass of carbon $\left[{}^{12}_{6}\mathrm{C}\right]$.
3. The temperature at which all molecular motion ceases is……
4. Whenever the gases react chemically, they do so in…… which bear a simple ratio to each other and to the products, if gaseous, provided the temperature and pressure of reacting gases and products remains the same.
5. Equal volumes of all……under similar conditions of temperature and pressure, contain equal number of molecules.
6. The mass of substance containing particles equal to Avogadro's number is called……
7. The number of atoms present in one molecule of a substance is its……
8. The ratio of certain mass of a gas or vapour to the mass of same volume of hydrogen is its…….
9. The volume occupied by one mole of a gas at S.T.P is……

Ans.
1. atom
2. molecule
3. absolute zero
4. volumes
5. gases
6. mole
7. atomicity
8. vapour density
9. gram molecular volume

Chapter 6. Electrolysis

(a) Molten lead bromide conducts electricity. It is called an (1) ..... It is composed of lead ions and bromide (2) ..... . The lead (3) .....are (4) .....charged and are called (5) ..... . The bromide (6) .....are (7) .....charged and are called (8) ..... . During electrolysis, the lead (9) .....are attracted to the (10) .....charged electrode which is called (11) .....and the bromide. (12) .....are attracted towards the (13) ..... charged electrode which is called (14) ..... .

Ans.
(1) electrolyte (2) ions (3) ions (4) positively
(5) cations (6) ions (7) negatively (8) anions
(9) ions (10) negatively (11) cathode (12) ions
(13) positively (14) anode

(b) Solid lead (II) bromide will not conduct an (1) .....The (2) .....are held in a rigid crystal (3) .....and are not free to move to the (4) ..... . When the solid is (5) ....., it (6) .....and allows the passage of an electric current (7) .....is liberated at the cathode and (8) .....at the anode. The decomposition of an electrolyte by an electric current is called (9) .....

Ans. (1) Electric current (2) ions (3) lattice (4) electrodes
(5) heated (6) melts (7) lead (8) bromine
(9) electrolysis

(c) For electroplating an article with nickel require an (1) …… which must be a solution containing (2) …… ions. The article to be plated is placed as the (3) …… of the cell on which the plating is carried out. The (4) …… of the cell is made from pure nickel. The ions which are attracted to the negative electrode and discharged are called (5) …… .

Ans. (1) electrolyte (2) nickel (3) cathode (4) anode
(5) cations

(d)
1. Electrolysis is the passage of ..... through a liquid or a solution accompanied by a ..... change.
2. An electrically charged atom is called..... .
3. The solution of a substance which conducts electricity is called ..... .
4. An electrolyte is a..... .
5. A weak electrolyte is one which..... .
6. A strong electrolyte is one which..... .
7. Sodium chloride is..... .
8. Water is..... .
9. The electrode where the current enters the electrolyte is called the.....
10. Negative electrode is called the..... .
11. Cations migrate to.....during electrolysis.
12. During electrolysis, anions undergo……at the……
13. The reactions occurring at the cathode during electrolysis involve……
14. …… is a non-electrolyte.
15. Pure water consists almost entirely of ……
16. We can expect that pure water……normally conduct electricity.
17. Elements liberated at the anode during electrolysis are said to be……
18. In solution or in molten state a …… electrolyte consists almost entirely of ions.
19. As we descend the electrochemical series containing cations, the tendency of the cations to get ..... at the cathode increases.
20. The..... the concentration of an ion in a solution, the greater is the probability of its being discharged at its appropriate electrode.
21. In the electrolysis of acidulated water, oxygen is produced by the discharge of…… ions at the anode.
22. …… lead bromide does not conduct electricity.
23. Ionization is a …… process.
24. Hydrogen chloride ……when dissolved in water.
25. A solution of hydrogen chloride gas in water conducts electricity because..... but a solution of hydrogen chloride gas in toluene does not conduct an electric current because..... .
26. The gas given off at cathode during the electrolysis of acidulated water is..... .
27. With platinum electrodes, hydrogen is liberated at the …… and oxygen at the …… during the electrolysis of acidified water.

Ans.
1. electricity, chemical
2. an ion
3. an electrolyte
4. good conductor of electricity
5. is feebly ionized in the solution
6. is completely ionized in the solution

7. strong electrolyte
8. a weak electrolyte
9. anode
10. cathode
11. cathode
12. oxidation, anode
13. reduction
14. sugar
15. molecules
16. will not
17. electronegative
18. strong
19. reduced
20. higher
21. OH^-
22. solid
23. reversible
24. ionizes
25. it ionizes in solution to form free ions; it remains as a single molecule in solution.
26. hydrogen
27. cathode, anode

Chapter 7. Metallurgy

(a)

	X	Y
Normal Electronic Configuration	2,8,7	2,8,2
Nature of oxide	Dissolves in water and turns blue litmus red	Very low solubility in water. Dissolves in hydrochloric acid
Tendency for oxidising and reducing reactions	Tends to oxidise elements and compounds	Tends to act as a reducing agent
Electrical and Thermal conductivity	Very poor electrical conductor Poor thermal conductivity	Good electrical conductor good thermal conductor
Tendency to form alloys and amalgams	No tendency to form alloys	Forms alloys

Using the information above, complete the following :

1. _____ is the metallic element.
2. Metal atoms tend to have a maximum of _____ electrons in the outermost energy level.
3. Non-metallic elements tend to form_____oxides while metals tend to form_____oxides.
4. Non-metallic elements tend to be _____ conductors of heat and electricity.
5. Metals tend to _____ electrons and act as _____ agents in their reactions with elements and compounds.

Ans. 1. Y 2. eight 3. acidic, basic
4. very poor 5. lose, reducing

(b) Fill in the blanks with a suitable word in the following paragraph :

In the smelting, the ore is heated (1) ..... the melting point either along or with some (2) ..... . In calcination, the ore is heated (3) ..... the melting point and thus no (4) ..... occurs in this process. Similar to calcination, (5)..... involves heating at high temperature but chemical change occurs here. The (6) ..... is used only when ore or impurity is (7) ..... in nature.

Ans. (1) above (2) flux, (3) below, (4) chemical change, (5) roasting, (6) magnetic separation, (7) magnetic.

(c) X is an element in the form of a powder. X, burns in oxygen and the product is soluble in water. The solution is tested with litmus. Write down only the word, which will correctly complete each of the following sentences.

1. If X is a metal, then the litmus will turn.....
2. If X is a non-metal, then the litmus will turn.....
3. If X is a reactive metal, then.....will be evolved when X reacts with dilute sulphuric acid.
4. If X is a metal it will form.....oxide, which will form.....solution with water.

Ans. 1. blue, 2. red, 3. hydrogen, 4. basic, alkaline.

(d)
1. The metal other than aluminium present both in magnalium and duralumin is……
2. The ore from which aluminium is extracted must first be treated with ..... so that pure aluminium oxide can be obtained.
3. Aluminum is an important constituent metal in duralumin since it is……
4. In a thermetic mixture, aluminium……iron (III) oxide.
5. Pure aluminium oxide is dissolved in ..... to make a conducting solution.
6. ……is a dark coloured crystalline solid.
7. The divalent metal whose oxide is reduced to metal by electrolysis of its fused salt is ……
8. Pine oil used in froth floatation process act as a ……
9. In dry cells, the zinc container acts as an ……
10. An ..... is a homogeneous mixture of two or more metals or a metal and a ..... .
11. The properties of an alloy are not necessarily ..... between those of its ..... . The M.P. of an alloy is always less than the melting point of its constituent ..... .
12. An alloy in which ..... is present as one of the constituents is called ..... alloy.
13. The alloy that contains lead is ..... .
14. The alloy of nickel and iron is known as……
15. An alloy which is sonorous is……
16. An alloy used for making cases for cartridges is ……
17. The alloy used for making magnets is ..... .
18. ..... is a ferrous alloy.
19. Brass is an alloy of ..... .
20. Bell metal is an alloy of ..... .
21. Type metal is an alloy of ..... .
22. Addition of Tin to……lowers the melting point of alloy solder.
23. Alnico is a mixture of ..... .
24. ……is used in machine parts due to its……tensile strength.
25. The non-metallic component in stainless steel is ……
26. Carbon content of steel is ..... .
27. Stainless steel contains ..... .

Ans.

1.	magnesium	2.	sodium hydroxide solution
3.	light	4.	reduces
5.	cryolite	6.	Iodine
7.	magnesium	8.	water repellant
9.	anode	10.	alloy, non-metal.
11.	intermediate, constituents, metals.	12.	iron, ferrous
13.	solder	14.	invar
15.	bell metal	16.	brass
17.	alnico	18.	manganese steal
19.	Cu and Zn	20.	Cu and Sn
21.	Pb, Sn and Sb	22.	lead
23.	Al, Ni and Co	24.	steel, high
25.	carbon	26.	(0.5 to 1.5)% .
27.	Cr, Ni and C		

Chapter 8 (b). Study of Compounds : Ammonia and Nitric Acid

(a) Most of the nitric acid today is manufactured by Ostwald's process. In this process a mixture of pure dry ammonia and air in the ratio of (1) ……by volume is first compressed and then passed over (2) ……at about (3) ……°C. This results in the oxidation of ammonia into (4) …… which combines with (5) ……of the air to give (6) …… . This is an acidic gas from which nitric acid can be obtained by simply dissolving in (7) …… .

Ans. (1) 10 : 1 (2) platinum gauze
(3) 800 (4) nitric oxide
(5) oxygen (6) nitrogen dioxide
(7) water

(b) Nitrogen and hydrogen combine in the presence of a catalyst to give (1)_____ gas. When the above mentioned gas is passed through water it forms a solution which will be (2) _____ in nature and the solution contains (3)_____ ions and (4) _____ ions. The above solution when added to iron (II) sulphate solution, gives a (5) _____ coloured precipitate of iron (II) hydroxide.

Ans. (1) ammonia (2) alkaline
(3) ammonium (4) hydroxyl
(5) dirty green.

(c) 1. Ammonia in liquid form is ……
2. Ammonia gas is collected by ……
3. Nitric acid is also called as……
4. The alkaline behaviour of liquor ammonia is due to the presence of ……
5. ……is used as a catalyst during preparation of ammonia.
6. Liquor ammonia fortis is a saturated solution of ……
7. ……turns turmeric paper brown.
8. The salt solution which gives white ppt. on the addition of ammonium hydroxide solution is ……
9. Excess of ammonia reduces chlorine to ……
10. The gas most difficult to liquefy is……
11. When ammonium chloride is heated, it undergoes ..... .
12. Heating ammonium chloride with sodium hydroxide produces ..... .
13. Heating a solution of ammonium chloride and sodium nitrite produces ..... .
14. Cold, dilute nitric acid reacts with copper to form……
15. The reaction of ……with dil. nitric acid is an example of neutralisation reaction.
16. Lead nitrate is a……salt of nitric acid.
17. The mineral acid obtained from conc. nitric acid on reaction with a non-metal is……
18. A nitrate which leaves a black residue on heating is……
19. The nitrate which on heating melts and liberates only one neutral gas is ……
20. The oxidised product obtained on reaction with H_2S gas and dil. HNO_3 is ……
21. Ammonium nitrate is used in preparing ……
22. Nitric acid is manufactured by …… process.

Ans. 1. neutral 2. a downward displacement of air
3. aqua fortis 4. OH^- ions
5. Molybdenum 6. NH_4OH
7. Ammonia 8. magnesium chloride
9. NH_4Cl 10. hydrogen
11. thermal dissociation 12. ammonia
13. nitrogen 14. nitric oxide
15. CaO 16. normal
17. H_2SO_4 18. $Cu(NO_3)_2$
19. $NaNO_3$ 20. sulphur
21. explosives 22. Ostwald's

Chapter 8 (c). Study of Compounds : Sulphuric Acid

(a) The conversion of sulphur dioxide into sulphur trioxide is an (1).....therefore, (2)..... during the reaction. The reaction is (3)..... by (4)..... . At low temperature, the reaction is (5)..... so an (6)..... of 500° C and a catalyst is needed, the reaction is accompanied by (7)..... in volume and (8)..... pressure (9)……the yield of sulphur trioxide.

Ans. (1) exothermic reaction, (2) heat is evolved, (3) favoured, (4) low temperature, (5) slow, (6) optimum temperature, (7) decrease, (8) high, (9) favours.

(b)
1. Sulphuric acid is a……acid.
2. The physical property of concentrated sulphuric acid that makes it valuable in preparing other acids is its .....
3. Sulphuric acid absorbs sulphur trioxide and forms……
4. The acid anhydride of sulphuric acid is .....
5. When hot concentrated sulphuric acid is added to sulphur, it gets oxidised to…….
6. The reduced product obtained when hydrogen sulphide reacts with conc. sulphuric acid is……
7. The salt which reacts with dil. sulphuric acid to form insoluble ppt is……
8. The type of salt formed when excess of caustic soda reacts with sulphuric acid is……
9. The gas produced by the action of concentrated sulphuric acid on sodium chloride is…….
10. The dehydrated product obtained when sugar reacts with conc. sulphuric acid is……
11. The chemical formula of oxalic acid is……
12. The sulphur compound used for the identification of several cations is ..... .
13. An explosive prepared by using sulphuric acid is……
14. Sulphuric acid used for making fertilizers is made by the ..... process.

Ans.
1. non-volatile
2. high boiling point
3. pyrosulphuric acid
4. sulphur trioxide
5. sulphur dioxide, SO_2
6. sulphur
7. Lead nitrate $[Pb(NO_3)_2]$
8. normal salt
9. HCl
10. carbon
11. $C_2H_2O_4$
12. hydrogen sulphide
13. trinitrotoluene
14. lead-chamber

Chapter 9. Organic Chemistry

(a) The alkanes form an (1) ..... series with the general formula (2) ..... . The alkanes are (3) ..... (4) ..... which generally undergo (5) ..... reactions.

Ans.
1. homologous
2. C_nH_{2n+2}
3. saturated
4. hydrocarbons
5. substitution

(b)
1. ..... was the first organic compound prepared in laboratory.
2. Organic compounds are generally insoluble in ..... .
3. The compounds of carbon and hydrogen are called ..... .
4. The hydrocarbon containing only single bonds are known as ..... .
5. Alkanes are ..... hydrocarbons.
6. Alkanes are open-chain hydrocarbons in which the carbon atoms are joined by ..... only.
7. The four C—H bonds in the methane molecule are directed towards the corners of a regular ..... .
8. Methane can be prepared by heating ..... with solid ..... .
9. When methane reacts with excess of chlorine, the product obtained is ..... of the molecular formula ..... .

10. Ethane is an .....
11. Ethene reacts with chlorine to give..... products.
12. .....does not react with hydrogen.
13. When methane is heated to a high temperature in the absence of oxygen, it yields ..... and ..... . This reaction is known as ..... or ..... .
14. The general formula C_nH_{2n} represents ..... .
15. Ethene is prepared by the ..... of ethyl alcohol by heating it with ..... .
16. Ethene reacts with chlorine to give ..... the molecular formula of which is ..... .
17. ..... has two carbon atoms joined by a triple covalent bond.
18. Ethene and ethyne are..... hydrocarbons.
19. ..... reacts with bromine to give two different addition products.
20. Ethyne is prepared by the action of ..... on ..... .
21. When ethyne is hydrogenated, the first product is ..... and the final product is ..... .
22. The conversion of ethene to ethane is an example of .....
23. The catalyst used in the conversion of ethene to ethane is commonly .....
24. The product formed when ethene gas reacts with water in the presence of sulphuric acid is……
25. The product of the dehydration of ethyl alcohol is ..... .
26. The conversion of ethanol to ethene is an example of ..... .
27. Converting ethanol to ethene requires the use of ..... .
28. ..... is commonly called as wood spirit.
29. When acetaldehyde is oxidized with acidified potassium dichromate, it forms……
30. Ethanoic acid reacts with ethanol in presence of concentrated H_2SO_4, so as to form a compound and water. The chemical reaction which takes place is called……
31. The ability of carbon atom to link with other carbon atom is known as ..... .
32. Compounds represented by a single molecular formula but having different structural formulae are called ..... and this phenomenon is known as ..... .
33. The name of the compound CH_2Cl_2 is ..... .
34. The compound formed when ethene reacts with hydrogen is…….
35. Conversion of ethene to ethane is an example of…….

Ans.
1. Urea
2. water
3. hydrocarbons
4. alkanes
5. saturated
6. single covalent bonds
7. tetrahedron
8. sodium acetate, sodium hydroxide
9. carbon tetrachloride, CCl_4
10. alkane
11. substitution
12. Ethane
13. carbon, hydrogen, pyrolysis, cracking
14. alkene
15. dehydration, concentrated sulphuric acid
16. ethene dichloride, CH_2Cl_2
17. Ethyne
18. unsaturated
19. Ethyne
20. water, calcium carbide
21. ethene, ethane
22. hydrogenation
23. nickel
24. ethanol
25. ethene
26. dehydration
27. concentrated sulphuric acid
28. Methyl alcohol or methanol
29. acetic acid
30. esterification
31. catenation
32. isomers, isomerism
33. dichloromethane
34. Ethane
35. hydrogenation

❐

Question Set 2

Match the Column

Q. Match the column A with column B :

Chapter 1. Periodic Properties and Variations of Properties

Column A	Column B
1. Proton	An alkaline earth metal
2. Sodium	Halogen
3. Barium	Noble gas
4. Chlorine	An alkali metal
5. Electron	Responsible for nuclear charge
6. Completed shell	Occupied sub-shell.

Ans.

Column A	Column B
1. Proton	Responsible for nuclear charge
2. Sodium	An alkali metal
3. Barium	An alkaline earth metal
4. Chlorine	Halogen
5. Electron	Occupied sub-shell.
6. Completed shell	Noble gas

Chapter 2. Chemical Bonding

Column A	Column B
1. Metal	Methane (CH_4)
2. Covalent compound	Sodium chloride (NaCl)
3. Non-polar	Selenium (Se)
4. Polar	Chloride ion (Cl^-)
5. Non-metal	Aluminium (Al)
6. Electrovalent compound	Carbon dioxide (CO_2)
7. Anion	Hydrogen chloride (HCl)
8. Cation	Potassium ion (K^+)

Ans.

Column A	Column B
1. Metal	Aluminium (Al)
2. Covalent compound	Carbon dioxide (CO_2)
3. Non-polar	Methane (CH_4)
4. Polar	Hydrogen chloride (HCl)
5. Non-metal	Selenium (Se)
6. Electrovalent compound	Sodium chloride (NaCl)
7. Anion	Chloride ion (Cl^-)
8. Cation	Potassium ion (K^+)

Chapter 3. Study of Acids, Bases and Salts

(a)

Column A	Column B
1. Acid salt	Ferrous ammonium sulphate
2. Double salt	Contains only ions
3. Ammonium hydroxide solution	Sodium hydrogen sulphate
4. Dilute hydrochloric acid	Contains only molecules
5. Carbon tetrachloride	Contains ions and molecules

Ans.

Column A	Column B
1. Acid salt	Sodium hydrogen sulphate
2. Double salt	Ferrous ammonium sulphate
3. Ammonium hydroxide solution	Contains ions and molecules
4. Dilute hydrochloric acid	Contains only ions
5. Carbontetrachloride	Contains only molecules

(b)

Column A	Column B
1. Acid salt	Sodium potassium carbonate
2. Mixed salt	Alum
3. Complex salt	Sodium carbonate
4. Double salt	Sodium zincate
5. Normal salt	Sodium hydrogen carbonate

Ans.

Column A	Column B
1. Acid salt	Sodium hydrogen carbonate
2. Mixed salt	Sodium potassium carbonate
3. Complex salt	Sodium zincate
4. Double salt	Alum
5. Normal salt	Sodium carbonate

Chapter 4. Analytical Chemistry

(a)

Column A	Column B
1. Copper (II) nitrate	Green
2. Iron (II) sulphate	White
3. Magnesium chloride	Reddish brown
4. Cobalt chloride	Orange
5. Iron (III) chloride	Blue
6. Potassium dichromate	Black
7. Copper (II) oxide	Yellow

Ans.

Column A	Column B
1. Copper (II) nitrate	Green
2. Iron (II) sulphate	Reddish brown
3. Magnesium chloride	White
4. Cobalt chloride	Blue
5. Iron (III) chloride	Yellow
6. Potassium dichromate	Orange
7. Copper (II) oxide	Black

(b)

Column A	Column B
1. Pb^{2+}	Reddish brown
2. Fe^{2+}	White insoluble in excess
3. Zn^{2+}	Dirty green
4. Fe^{3+}	White soluble in excess
5. Cu^{2+}	White insoluble in excess
6. Ca^{2+}	Blue

Ans.

Column A	Column B
1. Pb^{2+}	White soluble in excess
2. Fe^{2+}	Dirty green
3. Zn^{2+}	White soluble in excess
4. Fe^{3+}	Reddish brown
5. Cu^{2+}	Blue
6. Ca^{2+}	White insoluble in excess

(c)

	Column A	Column B
1.	$Pb(NO_3)_2$ from PbO	Simple displacement
2.	$MgCl_2$ from Mg	Titration
3.	$FeCl_3$ from Fe	Neutralization
4.	$NaNO_3$ from NaOH	Precipitation
5.	$ZnCO_3$ from $ZnSO_4$	Combination

Ans.

	Column A	Column B
1.	$Pb(NO_3)_2$ from PbO	Neutralization
2.	$MgCl_2$ from Mg	Simple displacement
3.	$FeCl_3$ from Fe	Combination
4.	$NaNO_3$ from NaOH	Titration
5.	$ZnCO_3$ from $ZnSO_4$	Precipitation

❐

Question Set 3

Multiple Choice Questions

Q. Choose the correct answer out of the four available choices A, B, C and D given under each question :

Chapter 1. Periodic Properties and Variations of Properties

1. In the periodic table, alkali metals are placed in the group :
   (a) 1 (b) 11
   (c) 17 (d) 18
2. An alkaline earth metal is :
   (a) Palarium (b) Calcium
   (c) Lead (d) Copper
3. The number of electrons present in the valence shell of halogen is :
   (a) 1 (b) 3
   (c) 5 (d) 7
4. If an element A belongs to period 3 and Group II then it will have :
   (a) 3 shells and 2 valence electrons
   (b) 2 shells and 3 valence electrons
   (c) 3 shells and 3 valence electrons
   (d) 2 shells and 2 valence electrons
5. On moving from left to right across a period of the periodic table, the atomic size :
   (a) Decreases
   (b) Increases
   (c) Remains the same
   (d) Sometimes increases and sometimes decreases
6. On moving from left to right across a period of the periodic table, the non-metallic character of the elements :
   (a) Decreases (b) Increases
   (c) Remains the same (d) Depends on the period
7. On moving from left to right across a period of the periodic table, the ionization potential :
   (a) Goes up and down (b) Decreases
   (c) Increases (d) Remains the same
8. Ionisation potential increases over a period from left to right because the :
   (a) Atomic radius increases and nuclear charge increases
   (b) Atomic radius decreases and nuclear charge decreases
   (c) Atomic radius increases and nuclear charge decreases
   (d) Atomic radius decreases and nuclear charge increases
9. On moving from left to right across a period of the periodic table, the electron affinity of the elements in groups 1 to 7 :
   (a) Goes up and then down (b) Decreases and then increases
   (c) Increases (d) Decreases
10. An element in period 3 whose electron affinity is zero :
    (a) Neon (b) Sulphur
    (c) Sodium (d) Argon
11. Among the period 2 elements, the element which has high electron affinity is :
    (a) Lithium (b) Carbon
    (c) Chlorine (d) Fluorine

12. On moving from left to right across a period of the periodic table, the electronegativity :
(a) Depends on the number of valence electrons
(b) Remains the same
(c) Decreases
(d) Increases

13. Among the elements given below, the element with the least electronegativity is :
(a) Lithium (b) Carbon
(c) Boron (d) Fluorine

14. Which of the following would weigh the least ?
(a) 2g atoms of nitrogen (b) 1 mole of silver
(c) 22·4 litres of oxygen gas at 1 atmospheric pressure and 273 K
(d) $6{\cdot}02 \times 10^{23}$ atoms of carbon
[Atomic masses : Ag = 108, N = 14, O = 16, C = 12]

15. The ratio between the number of molecules in 2 g of hydrogen and 32 g of oxygen is :
(a) 1 : 2 (b) 1 : 0·01
(c) 1 : 1 (d) 0·01 : 1 [Given that H = 1, O = 16]

16. An element with the atomic number 19 will most likely combine chemically with the element whose atomic number is :
(a) 17 (b) 11
(c) 18 (d) 20

Ans. (1) (a) (2) (b) (3) (d) (4) (a)
(5) (a) (6) (b) (7) (c) (8) (d)
(9) (c) (10) (d) (11) (d) (12) (d)
(13) (a) (14) (d) (15) (c) (16) (a).

Chapter 2. Chemical Bonding

1. Molecular reactions which are generally slow reactions are shown by :
(a) Covalent compounds (b) Ionic compounds
(c) Co-ordinate compounds (d) Both ionic and covalent compounds

2. The number of electrons lost or gained by an atom refers to :
(a) Electrovalency (b) Covalency
(c) Donation (d) Acceptance

3. The capacity of an atom to attract the shared pair of electrons towards itself is called :
(a) Electronegativity (b) Electron affinity
(c) Sharing of electrons (d) Electron donation

4. Which of the following doesn't represent oxidation ?
(a) Loss of electrons (b) Addition of oxygen
(c) Increase in oxidation number (d) Addition of hydrogen

5. Sodium and sodium ions :
(a) Are chemically same (b) Have same number of electrons
(c) Have same number of protons (d) None of the above

6. A compound which contains all the three types of bonds *i.e.*, ionic, covalent and co-ordinate is :
(a) Sodium chloride (b) Ammonia
(c) Calcium chloride (d) Ammonium chloride

7. The most ionic compound of periodic table is :
(a) Sodium chloride (b) Potassium chloride
(c) Magnesium chloride (d) Caesium chloride

8. The molecule containing a triple covalent bond is :
(a) Ammonia (b) Methane
(c) Water (d) Nitrogen

9. A compound having one lone pair of electrons :
   (a) Water (b) Methane
   (c) Ammonia (d) Hydrogen sulphide

10. A compound X consists of only molecules. Hence X will have :
   (a) A crystalline hard structure
   (b) A low melting point and low boiling point
   (c) An ionic bond
   (d) A strong force of attraction between its molecules

11. Bonding in this molecule can be understood to involve coordinate bonding :
   (a) Carbontetrachloride (b) Hydrogen
   (c) Hydrogen chloride (d) Ammonium chloride

12. Which of the following is a common characteristic of a covalent compound ?
   (a) High melting point
   (b) Consists of molecules
   (c) Always soluble in water
   (d) Conducts electricity when it is in the molten state

Ans. (1) (d) (2) (a) (3) (a) (4) (d)
(5) (c) (6) (d) (7) (d) (8) (d)
(9) (c) (10) (b) (11) (d) (12) (b)

Chapter 3. Study of Acids, Bases and Salts

1. A particular solution contains molecules and ions of the solute so it is a :
   (a) Weak acid (b) Strong acid
   (c) Strong base (d) Salt solution

2. Select the acid which contains four hydrogen atoms in it :
   (a) Formic acid (b) Sulphuric acid
   (c) Nitric acid (d) Acetic acid

3. An organic weak acid is :
   (a) Formic acid (b) Sulphuric acid
   (c) Nitric acid (d) Hydrochloric acid

4. The aqueous solution of the following compounds which contains both ions and molecules is :
   (a) Sulphuric acid (b) Hydrochloric acid
   (c) Nitric acid (d) Acetic acid

5. An acid which is not a hydro acid is :
   (a) H_2S (b) H_2SO_3
   (c) HBr (d) HCl

6. Which one of the following will not produce an acid when made to react with water ?
   (a) Carbon monoxide (b) Carbon dioxide
   (c) Nitrogen dioxide (d) Sulphur trioxide

7. The metal oxide which can react with acid as well as alkali is :
   (a) Silver oxide (b) Copper (II) oxide
   (c) Aluminium oxide (d) Calcium oxide

8. During ionization metals lose electrons, this change can be called :
   (a) Oxidation (b) Reduction
   (c) Redox (d) Displacement

9. The salt which in solution gives a pale green precipitate with sodium hydroxide solution and a white precipitate with barium chloride solution is :
   (a) Iron (III) sulphate (b) Iron (II) sulphate
   (c) Iron (II) chloride (d) Iron (III) chloride

10. An example of a complex salt is :
(a) Zinc sulphate (b) Sodium hydrogensulphate
(c) Iron (II) ammonium sulphate (d) Tetrammine copper (II) sulphate

11. To increase the pH value of neutral solution, we should add :
(a) An acid (b) An acid salt
(c) An alkali (d) A salt

Ans. (1) (a) (2) (d) (3) (a) (4) (c)
(5) (b) (6) (a) (7) (c) (8) (a)
(9) (b) (10) (d) (11) (c).

Chapter 4. Analytical Chemistry

1. Salts of which elements are generally coloured :
(a) Transition (b) Normal
(c) Lanthanides (d) Inner-transition.

2. Which one of the following salt solutions on reaction with excess of ammonium hydroxide solution gives a deep blue solution ?
(a) $FeCl_3$ (aq.) (b) $CuSO_4$ (aq.)
(c) $Al_2(SO_4)_3$ (aq.). (d) $ZnSO_4$ (aq.)

3. Which one of the following salt solutions on reaction with excess sodium hydroxide solution gives a clear solution finally ?
(a) $(PbNO_3)_2$ (aq) (b) $CuSO_4$ (aq)
(c) $FeCl_3$ (aq) (d) $ZnSO_4$ (aq.)

4. The precipitate of which of the following compounds is soluble in excess of ammonia solution ?
(a) Iron (II) chloride (b) Magnesium chloride
(c) Copper (II) sulphate (d) Lead nitrate

5. Which one of the following salt solutions on reaction with excess of ammonium hydroxide solution results finally in dissolution of the precipitate first formed ?
(a) $AlCl_3$ (aq.) (b) $FeSO_4$ (aq.)
(c) $Fe(SO_4)_3$ (aq.) (d) $ZnSO_4$ (aq.)

6. Hydroxide of this metal is soluble in sodium hydroxide solution.
(a) Magnesium (b) Lead
(c) Silver (d) Copper

7. The hydroxide which is soluble in excess of NaOH is :
(a) $Zn(OH)_2$ (b) $Fe(OH)_2$
(c) $Fe(OH)_3$ (d) $Al(OH)_3$

8. Name the reagent from the following which can be used to distinguish zinc nitrate solution from magnesium nitrate.
(a) NH_4OH (aq.) (b) NaOH (aq.)
(c) $BaCl_2$ (d) H_2SO_4

9. The oxide and hydroxide of which metal is amphoteric :
(a) Zinc (b) Copper
(c) Iron (d) Manganese

10. Anhydrous iron (III) chloride is prepared by :
(a) Direct combination (b) Simple displacement
(c) Decomposition (d) Neutralization

11. A chloride which forms a precipitate that is soluble in excess of ammonium hydroxide is :
(a) Calcium chloride (b) Ferrous chloride
(c) Ferric chloride (d) Copper chloride

Ans. (1) (b) (2) (b) (3) (a) (4) (c)
(5) (d) (6) (b) (7) (a) (8) (a)
(9) (a) (10) (a) (11) (d).

Chapter 5. Mole Concept and Stoichiometry

1. The temperature at which all molecular motion ceases is :
   (a) 0°C (b) 100°C
   (c) Zero power (d) Absolute zero
2. The volume occupied by 1 mole of gas at STP is :
   (a) 2·24 litres (b) 22·4 litres
   (c) 2·42 litres (d) 2·44 litres
3. The volume occupied by 7 g of nitrogen at STP is :
   (a) 5·4 litres (b) 4·8 litres
   (c) 5·6 litres (d) 4·6 litres
4. Which law states that "under the same conditions of temperature and pressure, equal volumes of all gases contain the same number of molecule."
   (a) Avogadro's law (b) Gay Lussac's Law
   (c) Mole Law (d) Law of conservation of mass
5. What is the value of Avogadro number ?
   (a) $6{\cdot}022 \times 10^{23}$ (b) $6{\cdot}022 \times 10^{-23}$
   (c) $6{\cdot}22 \times 10^{23}$ (d) $6{\cdot}22 \times 10^{-23}$
6. One atomic mass unit is how much part the mass of carbon-12 atoms ?
   (a) $\frac{1}{4}$ (b) $\frac{1}{12}$
   (c) $\frac{1}{8}$ (d) $\frac{1}{16}$
7. The number of atoms present in one molecule of an element is called its :
   (a) Molecular number (b) Atomic number
   (c) Avogadro's number (d) Atomicity
8. The vapour density of carbon dioxide [C = 12, O = 16] is :
   (a) 12 (b) 16
   (c) 44 (d) 22
9. The empirical formula of hexane is :
   (a) C_2H_7 (b) C_5H_8
   (c) C_3H_7 (d) C_4H_7
10. If empirical formula of an organic compound is CH_2O then its molecular formula can be :
   (a) $C_2H_2O_2$ (b) C_2H_4O
   (c) C_3H_6O (d) $C_6H_{12}O_6$

Ans. (1) (d) (2) (b) (3) (c) (4) (a)
(5) (a) (6) (b) (7) (d) (8) (d)
(9) (c) (10) (d).

Chapter 6. Electrolysis

1. Identify the weak electrolyte from the following :
   (a) Sodium Chloride solution (b) Dilute Hydrochloric acid
   (c) Dilute Sulphuric acid (d) Aqueous acetic acid

2. Which of these will act as a non-electrolyte ?
   (a) Liquid carbon tetrachloride
   (b) Acetic acid
   (c) Sodium hydroxide aqueous solution
   (d) Potassium chloride aqueous solution
3. During ionisation metals lose electrons, this change can be called :
   (a) Oxidation (b) Reduction
   (c) Redox (d) Displacement
4. The metallic electrode which does not take part in an electrolytic reaction.
   (a) Cu (b) Ag
   (c) Pt (d) Ni
5. When dilute sodium chloride is electrolysed using graphite electrodes, the cation is discharged at the cathode most readily.
   (a) Na^+ (b) OH^-
   (c) H^+ (d) Cl^-
6. During electrolysis of NaCl, the gas released at anode is :
   (a) Chlorine (b) Oxygen
   (c) Hydrogen (d) None of the above
7. During the electrolysis of molten lead bromide which of the following takes place :
   (a) Bromine is released at the cathode
   (b) Lead is deposited at the anode
   (c) Bromine ions gain electrons
   (d) Lead is deposited at the cathode
8. A compound which liberates reddish brown gas around the anode during electrolysis in its molten state is :
   (a) Sodium chloride (b) Copper (II) oxide
   (c) Copper (II) sulphate (d) Lead (II) bromide
9. When fused lead bromide is electrolysed we observe :
   (a) a silver grey deposit at anode and a reddish brown deposit at cathode
   (b) a silver grey deposit at cathode and a reddish brown deposit at anode
   (c) a silver grey deposit at cathode and reddish brown fumes at anode
   (d) silver grey fumes at anode and reddish brown fumes at cathode.
10. The vessel in which electrolysis of Lead bromide is carried out is :
    (a) Clay crucible (b) Glass vessel
    (c) Silica crucible (d) Aluminium vessel
11. The ion which is discharged at the cathode during the electrolysis of copper sulphate solutions using copper electrodes as anode and cathode.
    (a) Cu^{2+} (b) OH^-
    (c) SO_4^{2-} (d) H^+
12. An aqueous electrolyte consists of the ions mentioned in the list, the ion which could be discharged most readily during electrolysis.
    (a) Fe^{2+} (b) Cu^{2+}
    (c) Pb^{2+} (d) H^+
13. During silver plating of an article using potassium argentocyanide as an electrolyte, the anode material should be :
    (a) Cu (b) Ag
    (c) Pt (d) Fe
14. The particles present in strong electrolytes are :
    (a) only molecules (b) mainly ions
    (c) ions and molecules (d) only atoms

Ans. (1) (d) (2) (a) (3) (a) (4) (c)
(5) (c) (6) (b) (7) (d) (8) (d)
(9) (c) (10) (c) (11) (a) (12) (b)
(13) (b) (14) (b)

Chapter 7. Metallurgy

1. An element of an inorganic compound found in nature is known as :
   (a) Mineral (b) Ore
   (c) Both (a) and (b) (d) None of these
2. Which one of the following is not true of metals ?
   (a) Metals are good conductors of electricity.
   (b) Metals are malleable and ductile.
   (c) Metals form non-polar covalent compounds.
   (d) Metal will have 1 or 2 or 3 electrons in their valence shell.
3. Which ore is metalloid ?
   (a) C (b) Germanium
   (c) Si (d) Tin
4. A chemical process of extracting a metal from its ore is known as :
   (a) Mineralogy (b) Metallurgy
   (c) Liquation (d) None of the above
5. A mineral from which the metal is extracted economically is known as :
   (a) Matrix (b) Gangue
   (c) Ore (d) None of these
6. An unwanted earthly material associated with tin ore as impurity is known as :
   (a) Gangue (b) Flux
   (c) Froth (d) None of these
7. The process of heating the ore strongly in excess of air so that the volatile impurities are removed and the ore is changed to oxide is known as :
   (a) Calcination (b) Roasting
   (c) Froth floatation (d) Leaching
8. Heating an ore in a limited supply of air or in the absence of air at a temperature just below its melting point is known as :
   (a) Smelting (b) Ore dressing
   (c) Calcination (d) Bessemerisation
9. Smelting is carried out in :
   (a) Blast furnace (b) Muffle furnace
   (c) Open Heat furnace (d) Electric furnace
10. The salt which is least likely to be found in minerals is :
    (a) Chloride (b) Sulphate
    (c) Sulphite (d) Nitrate
11. The commonest method of extraction of metals from oxide ores involves :
    (a) Reduction with carbon (b) Reduction with aluminium
    (c) Reduction with hydrogen (d) Electrolytic method
12. Froth floatation process for the concentration of ores is an illustration of the practical application of :
    (a) Adsorption (b) Absorption
    (c) Sedimentation (d) Coagulation
13. In the froth floatation process for the purification of ores, the ore particles float because :
    (a) They are light (b) Their surface is not easily wetted by water
    (c) They bear electrostatic charge (d) They are insoluble

14. Froth floatation method may be used to increase the concentration of mineral in :
(a) Chalcopyrites (b) Bauxite
(c) Haematite (d) Calamine

15. Sulphide ore is generally concentrated by :
(a) Roasting (b) Froth floatation process
(c) Reduction by carbon (d) Tempering

16. The main ore used for the extraction of iron is :
(a) Haematite (b) Calamine
(c) Bauxite (d) Cryolite

17. The process used to convert impure alumina to pure alumina is :
(a) Roasting (b) Electrolytic refining
(c) Purification (d) Baeyer's Process

18. The part of fluorspar (CaF_2) which is added in small quantities in the electrolytic reduction of alumina dissolved in fused cryolite (Na_3AlF_6) is :
(a) As a catalyst
(b) To make the fused mixture very conducting
(c) To lower the temperature of the melt
(d) To decrease the rate of oxidation of carbon at the anode

19. The electrolyte used for electroplating an article with silver is :
(a) Silver nitrate solution
(b) Silver cyanide solution
(c) Sodium argentocyanide solution
(d) Nickel sulphate solution

20. Aluminium powder is used in thermite welding because :
(a) It is a strong reducing agent
(b) It is a strong oxidising agent
(c) It is corrosion resistant
(d) It is a good conductor of heat

21. The metals zinc and tin are present in the alloy :
(a) Solder (b) Brass
(c) Bronze (d) Duralumin

22. In electrolytic refining of metals the impure metal is made :
(a) Cathode (b) Salt bridge
(c) Anode (d) Electrode

23. Stainless steel does not contain :
(a) Cr (b) Al
(c) C (d) Ni

24. This is not an alloy of copper :
(a) Brass (b) Bronze
(c) Solder (d) Duralumin

25. The two main metals in bronze are :
(a) Copper and zinc (b) Copper and lead
(c) Copper and nickel (d) Copper and tin

Ans. (1) (a) (2) (c) (3) (a) (4) (b)
(5) (c) (6) (a) (7) (b) (8) (c)
(9) (a) (10) (d) (11) (a) (12) (b)
(13) (b) (14) (a) (15) (b) (16) (a)
(17) (d) (18) (c) (19) (c) (20) (a)
(21) (c) (22) (c) (23) (b) (24) (d)
(25) (c).

Chapter 8 (a). Study of Compounds : Hydrogen Chloride

1. An aqueous solution of HCl gas is named.
   (a) Aqua fortis (b) Aqua regia
   (c) Oil of vitriol (d) Muriatic acid
2. An acid which is not a monobasic acid.
   (a) HNO_3 (b) HCOOH
   (c) H_2SO_4 (d) HCl
3. An acid which is not an oxidising agent.
   (a) H_2SO_4 (b) HCl
   (c) HNO_3 (d) CH_3COOH
4. Hydrogen chloride gas being highly soluble in water is dried by :
   (a) Anhydrous calcium chloride (b) Phosphorous penta oxide
   (c) Quick lime (d) Concentrated sulphuric acid
5. A substance which reacts with conc. HCl to liberate chlorine :
   (a) PbO (b) $PbCl_2$
   (c) PbO_2 (d) Pb_3O_4
6. A metal which reacts with dil HCl to liberate hydrogen.
   (a) Zn (b) Cu
   (c) Ag (d) Pb
7. Gas liberated when dil. HCl gas is added to iron (II) sulphide.
   (a) Hydrogen gas (b) Chlorine gas
   (c) Hydrogen sulphide gas (d) Carbon dioxide gas
8. Gas liberated when hydrochloric acid reacts with galena.
   (a) Sulphur dioxide (b) Carbon dioxide
   (c) Nitrogen (d) Hydrogen sulphide
9. The gases which react chemically to form a solid :
   (a) $H_{2(g)}$ and $Cl_{2(g)}$ (b) $NH_{3(g)}$ and $HCl_{(g)}$
   (c) $CO_{2(g)}$ and $SO_{2(g)}$ (d) $NO_{2(g)}$ and $CO_{2(g)}$
10. Constant boiling mixtures are known as :
    (a) Constant compounds (b) Woulfe's compound
    (c) Distillators (d) Azeotropes
11. Aqua regia is a mixture of :
    (a) Dilute hydrochloric acid and concentrated nitric acid
    (b) Concentrated hydrochloric acid and dilute nitric acid
    (c) Concentrated hydrochloric acid [1 part] and concentrated nitric acid [3 parts]
    (d) Concentrated hydrochloric acid [3 parts] and concentrated nitric acid [1 part]
12. The aim of the fountain experiment is to prove that :
    (a) HCl turns blue litmus red (b) HCl is denser than air
    (c) HCl is highly soluble in water (d) HCl fumes in moist air

Ans. (1) (d) (2) (c) (3) (b) (4) (d)
(5) (c) (6) (a) (7) (c) (8) (d)
(9) (b) (10) (d) (11) (d) (12) (c).

Chapter 8 (b). Study of Compounds : Ammonia and Nitric Acid

1. Ammonia can be obtained by adding water to :
   (a) Ammonium chloride (b) Ammonium nitrite
   (c) Magnesium nitride (d) Magnesium nitrate
2. Ammonia is soluble in water because :
   (a) A polar molecule (b) An acid
   (c) A base (d) A simple covalent compound

3. Nitrogen gas can be obtained by heating :
   (a) Ammonium nitrate (b) Ammonium nitrite
   (c) Magnesium nitride (d) Ammonium chloride

4. The nitrate which evolves laughing gas on decomposition :
   (a) Ferric nitrate (b) Calcium nitrate
   (c) Sodium nitrate (d) Ammonium nitrate

5. Rotten egg smell is due to the liberation of :
   (a) HCl gas (b) Cl_2 gas
   (c) H_2S gas (d) SO_2 gas

6. The temperature at which catalytic oxidation of ammonia is carried out :
   (a) 200°C (b) 800°C
   (c) 1000°C (d) 500°C

7. With excess of chlorine, NH_3 forms :
   (a) NH_4Cl (b) NCl_3
   (c) NOCl (d) N_2Cl

8. Liquid NH_3 is employed in refrigerator, because :
   (a) It is more basic (b) It is stable hydride
   (c) It has a high dipole moment (d) It has high heat of evaporation

9. Ammonia nitrate is used in :
   (a) Lining vessels (b) Paints
   (c) Textile industry (d) Preparing explosives

10. The brown ring test is used for the detection of :
   (a) CO_3^{2-} (b) NO_3^-
   (c) SO_3^{2-} (d) Cl^-

11. The composition of brown ring formed at the junction is :
   (a) $FeSO_4.OH$ (b) $FeSO_4.NO$
   (c) $FeSO_4.H_2O$ (d) $FeSO_4$

12. Which acid is prepared by Ostwald's process :
   (a) Nitric acid (b) Oleic acid
   (c) Sulphuric acid (d) Tartaric acid

Ans. (1) (c) (2) (a) (3) (b) (4) (d)
(5) (c) (6) (b) (7) (b) (8) (d)
(9) (d) (10) (b) (11) (b) (12) (a).

Chapter 8 (c). Study of Compounds : Sulphuric Acid

1. Pyrosulphuric acid is the chemical name of :
   (a) Green vitriol (b) White vitriol
   (c) Oleum (d) Gypsum

2. In the given equation identify the role played by concentrated sulphuric acid
   $S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$:
   (a) Non-volatile acid (b) Oxidising agent
   (c) Dehydrating agent (d) None of the above

3. When dilute sulphuric acid reacts with iron sulphide, the gas evolved is :
   (a) Hydrogen sulphide (b) Sulphur dioxide
   (c) Sulphur trioxide (d) Vapour of sulphuric acid

4. When sulphuric acid is added to sodium carbonate brisk effervesence is produced which is due to :
   (a) Evolution of H_2S gas (b) Evolution of Cl_2 gas
   (c) Evolution of CO_2 gas (d) Evolution of O_2 gas

5. When hot concentrated sulphuric acid is added to sulphur it gets oxidised to :
   (a) H_2S (b) SO_2
   (c) O_3 (d) HSO_4

6. When concentrated sulphuric acid reacts with NaOH, the product formed is :
   (a) Sodium hydroxide (b) Sodium sulphate
   (c) Sodium carbonate (d) Sodium hydrogen sulphate

7. Dilute sulphuric acid will produce a white precipitate when added to a solution of :
   (a) Copper nitrate (b) Zinc nitrate
   (c) Lead nitrate (d) Sodium nitrate

8. Corrosive action of H_2SO_4 on skin is due to :
   (a) Exothermic nature (b) Volatile nature
   (c) Dehydrating character (d) Oxidising nature

9. Nitroglycerine and nitrotoluene are :
   (a) Fertilizers (b) Explosives
   (c) Fibres (d) Detergents

10. The molecular formula of epsom salt is :
   (a) $MgSO_4 \cdot 5H_2O$ (b) $FeSO_4 \cdot 7H_2O$
   (c) $MgSO_4 \cdot 7H_2O$ (d) $MgSO_4 \cdot 6H_2O$

Ans. (1) (c) (2) (b) (3) (a) (4) (c)
(5) (b) (6) (b) (7) (c) (8) (c)
(9) (b) (10) (a).

Chapter 9. Organic Chemistry

1. The property of carbon of form chains and rings is called :
   (a) Catenation (b) Polymerisation
   (c) Cracking (d) Hydrogenation

2. Two neighbours of a homologous series differ by :
   (a) CH (b) CH_2
   (c) CH_3 (d) CH_4

3. Heating sodium acetate with soda lime produces :
   (a) Methane (b) Ethane
   (c) Ethene (d) Ethyne

4. The number of C–H bonds in ethane molecule are :
   (a) Four (b) Six
   (c) Eight (d) Ten

5. Halogenation of alkane can be carried out in :
   (a) Dark (b) Bright light
   (c) UV light (d) Diffused sunlight

6. The unsaturated hydrocarbons undergo :
   (a) a substitution reaction (b) an oxidation reaction
   (c) an addition reaction (d) None of the above

7. An organic compound undergoes addition reactions and gives a red colour precipitate with ammoniacal cuprous chloride. Therefore, the organic compound could be
   (a) Ethane (b) Ethene
   (c) Ethyne (d) Ethanol

8. The I.U.P.A.C. name of acetylene is :
   (a) Propane (b) Propyne
   (c) Ethene (d) Ethyne

9. Acetylene polymerises into benzene by joining :
   (a) 3 molecules (b) 2 molecules
   (c) 4 molecules (d) 6 molecules

10. The organic compound mixed with ethanol to make it spurious is :
   (a) Methanol (b) Methanoic acid
   (c) Methanal (d) Ethanoic acid

11. Dehydrohalogenation of X with alcoholic KOH produces ethene. X is :
   (a) Ethyl chloride (b) Methyl chloride
   (c) Ethylene dichloride (d) None

12. The functional group present in acetic acid is :
   (a) Ketonic $>C=O$ (b) Hydroxyl —OH
   (c) Aldehydic —CHO (d) Carboxyl —COOH

13. The resulting ester, when ethyl alcohol and acetic acid are mixed together :
   (a) CH_3COOCH_3 (b) $C_2H_5COOC_2H_5$
   (c) $CH_3COOC_2H_5$ (d) $C_2H_5COOCH_3$

14. An acid used for removing ink stains :
   (a) Acetic acid (b) Oxalic acid
   (c) Malic acid (d) Formic acid

15. Which compound is used as an antifreeze agent :
   (a) Propene (b) Acetylene
   (c) Ethylene glycol (d) Methanol

16. Identify the statement which does not describe the property of alkenes :
   (a) They are unsaturated hydrocarbons
   (b) They decolourise bromine water
   (c) They can undergo addition as well as substitution reactions
   (d) They undergo combustion with oxygen forming carbon dioxide and water

17. If the molecular formula of an organic compound is $C_{10}H_{18}$ it is :
   (a) Alkene (b) Alkane
   (c) Alkyne (d) Not a hydrocarbon

Ans. (1) (a) (2) (b) (3) (a) (4) (b)
(5) (d) (6) (c) (7) (c) (8) (d)
(9) (a) (10) (a) (11) (a) (12) (d)
(13) (c) (14) (b) (15) (c) (16) (c)
(17) (c).

❐

Question Set 4

Give One Word/Chemical Term

Chapter 1. Periodic Properties and Variations of Properties

1. The law that groups elements in family of three.
2. The law where every 8th element repeats properties.
3. The law where repetition of properties varies periodically.
4. Horizontal arrangement of elements.
5. Vertical arrangement of elements.
6. The elements present in the first period.
7. The first three alkali metals.
8. Elements with 1, 2 or 3 electrons in the last shell.
9. Elements with 4, 5, 6 or 7 electrons in the last shell.
10. Elements with 8 electrons in the last shell.
11. Elements where the penultimate shell is being filled with electrons.
12. A non-metal which has three electrons in the outermost shell.
13. The largest atom in the third period.
14. The smallest atom in the third period.
15. The most metallic element in the third period.
16. The most non-metallic element in the third period.
17. The element which is the most electronegative in the third period.
18. Most active non-metal.
19. A metal which is a liquid at room temperature.
20. A liquid non-metal.
21. The transition element whose electronic configuration does not agree with the general pattern.
22. The element with the least ionization potential in the third period.
23. The amount of energy released when an atom in the gaseous state accepts an electron to form an anion.
24. The element which has the highest electron affinity in the third period.
25. The electrons present in the outermost shell of an atom.

Ans.

1. Law of triads
2. Newland's Law of Octaves
3. Mendeleev's Periodic Law
4. Periods
5. Groups
6. Hydrogen and Helium
7. Lithium, sodium and potassium
8. Metals
9. Non-metals
10. Rare gases
11. Transitional metals
12. Gallium
13. Sodium
14. Chlorine
15. Sodium
16. Chlorine
17. Chlorine
18. Fluorine
19. Mercury
20. Bromine
21. Palladium
22. Sodium
23. Electron affinity
24. Chlorine
25. Valence electrons

Chapter 2. Chemical Bonding

1. A bond formed by the transfer of electrons.
2. A bond formed by the sharing of electrons.

3. A bond formed by a shared pair of electrons with both electrons coming from the same atom.
4. Bond present in metallic chloride and between two chlorine atoms.
5. Electrons lost or gained by an atom in compound formation.
6. Ions formed by the loss and gain of electrons respectively.
7. The process in which an atom lose electrons.
8. The process in which an atom gain electrons.
9. An inert gas which contain triple bond.
10. A molecule with little affinity.
11. Two molecules, which are polar.
12. A polar covalent molecule.
13. A non-polar covalent compound.
14. A covalent molecule which on dissolving form ions.
15. A molecule with one lone pair and three bond pairs.
16. A molecule with two lone pairs and two bond pairs.

Ans.

1. Electrovalent bond
2. Covalent bond
3. Coordinate bond
4. Electrovalent, covalent.
5. Electrovalency
6. Cation and anion respectively
7. Oxidation
8. Reduction
9. Nitrogen
10. Methane
11. Hydrogen chloride, Ammonia.
12. Hydrogen chloride (HCl)
13. Carbon dioxide (CO_2)
14. HCl
15. Ammonia (NH_3)
16. Water (H_2O)

Chapter 3. Study of Acids, Bases and Salts

1. Name the acids, which are used in food stuffs.
2. Two monobasic acids containing nitrogen.
3. Two dibasic acids containing sulphur.
4. Strong acid containing chlorine.
5. Two gases–one of which is basic and which combine to give a solid
6. Basic anhydride of calcium hydroxide.
7. Product obtained when lime water dries up.
8. Three common indicators to indicate presence of acids and alkalies.
9. This gas turns moist lead acetate paper black.
10. The compound which is responsible for the green colouration when sulphur dioxide is passed through acidified potassium dichromate solution.
11. The compound responsible for the brown ring during the brown ring test of nitrate ion.
12. A salt formed by incomplete neutralisation of an acid by a base.
13. This salt gives nitrogen dioxide on heating.
14. This compound is an acid salt.
15. On heating, this salt changes from green to black.
16. On treating with concentrated sulphuric acid, this salt changes from blue to white.
17. A compound which is insoluble in cold water, but soluble in hot water.
18. A compound whose aqueous solution is neutral in nature.
19. Three metals that can form bases when treated with water.
20. Acid anhydride of sulphuric acid.
21. The process in which a substance absorbs moisture from the atmospheric air to become moist, and ultimately dissolves in the absorbed water.
22. A compound which is deliquescent.
23. Name an acidic hygroscopic substance.

24. Name a basic hygroscopic substance.
25. Name any two efflorescent substances.

Ans.
1. Citric acid, tartaric acid and acetic acid
2. Nitric acid and nitrous acid
3. Sulphuric acid and sulphurous acid
4. Hydrochloric acid
5. Ammonia and hydrogen chloride
6. Calcium oxide
7. Calcium oxide and carbon dioxide
8. Litmus, methyl orange, phenolphthalein
9. Hydrogen sulphide
10. Chromium sulphate
11. Nitroso Iron (II) sulphate
12. Acid salt
13. $Pb(NO_3)_2$
14. Methane
15. $CuCO_3$
16. $CuSO_4.5H_2O$
17. Lead (II) chloride
18. Sodium chloride
19. Sodium, calcium and potassium
20. Sulphur trioxide
21. Deliquescence
22. Caustic Soda (NaOH)
23. Sulphuric acid, or oil of vitriol
24. Calcium oxide
25. Copper sulphate (Blue vitriol) and Washing soda (Sodium carbonate)

Chapter 4. Analytical Chemistry

1. Name two coloured and two colourless metal ions.
2. A strong and weak alkali.
3. A salt of zinc which is efflorescent.
4. The ion responsible for the blue colour of an aqueous solution of a salt.
5. One metal which forms more than one type of positive ions.
6. A yellow monoxide that dissolves in hot and concentrated caustic alkali.
7. A chloride which gives reddish brown precipitate with sodium hydroxide solution.
8. A metallic hydroxide which is insoluble in caustic soda but soluble in excess of NH_4OH.
9. A metal that evolves a gas which burns with a pop sound when boiled with alkali solutions.
10. An oxide which dissolves in both acid as well as base.
11. An amphoteric oxide.
12. A metallic hydroxide soluble in excess of ammonium hydroxide solution.

Ans.
1. Coloured-Cu^{2+}, Fe^{2+} colourless—Mg^{2+}, Pb^{2+}
2. Sodium hydroxide (NaOH), ammonium hydroxide (NH_4OH)
3. Zinc sulphate ($ZnSO_4$)
4. Copper
5. Iron
6. Lead monoxide, PbO
7. Ferric chloride
8. Copper hydroxide, $Cu(OH)_2$
9. Zinc, Zn
10. Lead oxide, PbO
11. Aluminium oxide (Al_2O_3)
12. Zinc hydroxide, $Zn(OH)_2$

Chapter 5. Mole Concept and Stoichiometry

1. The law which states that—"under similar conditions of temperature and pressure the volume of gases taking part in a chemical reaction bear a simple whole number ratio".
2. The volume occupied by one mole of a gas at STP is.
3. Equal volumes of gases under similar conditions of temperature and pressure contain equal number of molecules.
4. The number of atoms present in 12 g of carbon $\left[{}^{12}_{6}\mathrm{C}\right]$.

5. It is a number that represents how many times an atom of an element is heavier tha $\frac{1}{12}$th mass of carbon atom.
6. The molecular weight of an element expressed in grams.
7. The ratio of the mass of a certain volume of gas to the mass of an equal volume of hydrogen under the same conditions of temperature and pressure.
8. A formula of a chemical substance which tells the actual number of atoms in one molecule of a substance.
9. A formula which shows the simplest whole number ratio.

Ans.
1. Gay Lussac's law
2. 22·4 litres.
3. Avogadro's law
4. $6{\cdot}023 \times 10^{23}$ atoms
5. Atomic weight
6. Gram-molecular weight
7. Vapour density
8. Molecular formula
9. Empirical formula

Chapter 6. Electrolysis

1. The fundamental particles of the atoms that move when electric current is passed through a metal wire.
2. The type of substances which undergo decomposition in aqueous solution form when electric current passes through them.
3. The type of materials which neither in solution nor in molten state allows an electric current to pass through it.
4. The process by which a particle gains or loses electrons.
5. The process by which an electrovalent substance breaks up into free mobile ions in the molten or aqueous form.
6. An acid which is added during electrolysis of water.
7. The acid used in electrolysis of water.
8. Electrodes used in electrolysis of copper sulphate.
9. A material used for making attackable electrodes.
10. Liquid which does not conduct electricity.
11. Electrolytic deposition of a superior metal on a baser metal.
12. Electrolyte used in the process of silver plating.
13. Electrolyte used in the process of nickel plating.
14. A suitable cathode used in the electrorefining of copper.
15. Impurities which remain behind at the bottom of the cell.
16. Process used for obtaining highly electropositive metals.

Ans.
1. Electron
2. Strong electrolytes
3. Non-electrolytes
4. Ionization
5. Dissociation
6. Conc. H_2SO_4
7. Sulphuric acid
8. Platinum electrodes
9. Platinum
10. Non-electrolyte
11. Electroplating
12. Potassium argento cyanide
13. Nickel ammonium sulphate
14. Sheets of pure copper metal
15. Anode mud
16. Electrometallurgy

Chapter 7. Metallurgy

(a) Name the metals which can be extracted from the following ores :

1. Haematite
2. Malachite
3. Cinnabar
4. Barytes
5. Cuprite
6. Bauxite
7. Galena
8. Zinc Blende

9. Iron Pyrites
10. Epsom
11. Calamine
12. Dolomite

Ans. 1. Iron
2. Copper
3. Mercury
4. Barium
5. Copper
6. Aluminium
7. Lead
8. Zinc
9. Iron
10. Magnesium
11. Zinc
12. Magnesium

(b) Name an ore which is :

1. An oxide
2. A hydrated oxide
3. A carbonate
4. A sulphate
5. A sulphide
6. A nitrate
7. A phosphate
8. A chloride

Ans. 1. Haematite (Fe_2O_3)
2. Bauxite ($Al_2O_3.2H_2O$)
3. Magnetite ($MgCO_3$)
4. Gypsum ($CaSO_4.2H_2O$)
5. Galena (PbS)
6. Chile salt-peter ($NaNO_3$)
7. Rock phosphate [$Ca_3(PO_4)_2$]
8. Horn silver (AgCl)

(c) Name the property of a metal by virtue of which it :

1. Can be beaten into thin sheets
2. Can be drawn into wires
3. Possesses tensile strength
4. Is good conductor of heat
5. Is good conductor of electricity
6. Dissolves into another metal
7. Is liberated at cathode
8. Can cut a non-metal
9. Is heavier than a non-metal
10. Acts as a reducing agent.

Ans. 1. Malleability
2. Ductility
3. Tenacity
4. Thermal conductivity
5. Electrical conductivity
6. Alloy formation
7. Electropositive nature
8. Hardness
9. Density
10. Donor of electrons

(d) 1. Name a metal which is found abundantly in the earth's crust.
2. Name two metals which have a high degree of malleability.
3. Name any two metals which are both malleable and ductile.
4. Name the metal which is a good conductor of both heat and electricity.
5. Name a metal which can be cut even with a knife.
6. Name a metal which is not ductile, malleable and tenacious.
7. Name a metal which is a poor conductor.
8. A metal which exists in liquid state at room temperature.
9. Name the metal which floats in water.
10. Name the metal which is stored in kerosene oil.
11. Name a metal which has a low melting point.
12. Name a metal which has acidic oxide.
13. Name the metal that burns in air with a golden flame.
14. Name a metal which forms anions which are liberated at anode.
15. The metal which combines directly with sulphur on heating.
16. The burning metal which combines directly with nitrogen.
17. The molten metal which gives white fumes while reacting with chlorine.
18. A metal which reacts reversibly with steam.
19. Metal which is rendered passive on reaction with concentrated nitric acid.

20. Name a metal which is used in accumulators or car batteries.
21. Name a metal which is used for galvanizing iron.
22. Name a metal which is used as silver paper.
23. Name a metal which is used in a torch cell.
24. Name a metal which is used in flashlight photography.
25. Name a metal which is used in vapour lamps.
26. Name a non-metal which has shiny appearance.
27. Name a non-metal which is the hardest substance known.
28. Name a non-metal which has high melting and boiling points.
29. Name a non-metal which is a good conductor of heat and electricity.
30. Name a non-metal which forms alloys with metals.
31. Name a non-metal which is electropositive in nature.
32. Name a non-metal which forms a neutral oxide.
33. Name a non-metallic element which forms both acidic and neutral oxides.
34. Name a non-metal which posses metallic lustre and sublimes on heating.
35. Name a non-metallic element which is a liquid at ordinary temperatures.
36. The non-metal, which forms two compounds, while reacting with chlorine.
37. The process of removal of gangue from ore.
38. Name the Sulphide ore of mercury.
39. The most common ore of aluminium.
40. Name the process used for the enrichment of sulphide ore.
41. The formula of slag.
42. The chemical name of slag.
43. The major impurity associated with iron obtained from blast furnace.
44. The process of coating thin layer of zinc over the surface of iron.
45. The process by which zinc is purified.
46. Gas obtained when zinc blende is roasted.
47. Name one alloy each of aluminium and iron.
48. Name the alloy of zinc used in simple voltaic cells.
49. The elements added to iron to form stainless steel.
50. Name the metal which is alloyed with zinc to form brass.
51. Name an element from which fencing wire is made.
52. Name the purest form of iron.
53. Two elements, whose hydroxides are easily soluble in water and form alkaline solutions.
54. One metal, which forms more than one type of positive ions.
55. One ion responsible for blue colour of an aqueous solution of copper sulphate.
56. The alloy of steel with a minimum of 10·5% chromium content by mass.
57. Name the solution used to react with Bauxite as a first step in obtaining pure aluminium oxide in the Baeyer's process.
58. Name the compound added to pure alumina to lower the fusion temperature during the electrolytic reduction of alumina.
59. The process of coating of iron with zinc.
60. An alloy of lead and tin that is used in electrical circuits.
61. An ore of zinc containing its sulphide.
62. A metal oxide that can be reduced by hydrogen.

Ans.
1. Aluminium
2. Silver and Aluminium
3. Gold and Silver
4. Aluminium
5. Sodium
6. Arsenic

7. Bismuth
8. Mercury
9. Sodium
10. Sodium
11. Sodium
12. Antimony Oxide [Sb_2O_3]
13. Sodium
14. Manganese in the form of permanganate ions [MnO_4^-]
15. Iron
16. Magnesium
17. Sodium
18. Iron
19. Iron
20. Lead
21. Zinc
22. Aluminium
23. Zinc
24. Magnesium
25. Sodium
26. Iodine
27. Diamond
28. Carbon
29. Graphite
30. Carbon
31. Hydrogen
32. Hydrogen, (forms neutral oxide, water)
33. Carbon
34. Iodine
35. Bromine
36. Phosphorous
37. Concentration
38. Cinnabar
39. Bauxite
40. Froath floatation process
41. $CaSiO_3$
42. Calcium silicate
43. Carbon
44. Galvanization
45. Distillation
46. Sulphur dioxide
47. Stainless steel is an alloy of iron and duralium is an alloy of aluminium
48. Amalgamated zinc
49. Chromium (Cr) and Nickel (Ni)
50 Copper
51. Soft-iron
52. Wrought-iron
53. Sodium and Potassium
54. Iron which forms Fe^{2+} and Fe^{3+}
55. Cupric ion (Cu^{2+})
56. Stainless steel
57. Sodium hydroxide (NaOH)
58. Cryolite
59. Galvanisation
60. Solder
61. Zinc blende
62. Copper oxide

Chapter 8. (a) Study of Compounds : Hydrogen Chloride

1. The gas obtained when rock salt reacts with conc. sulphuric acid.
2. Give the name of a chemical, which on being added to sodium chloride, will produce hydrogen chloride gas.
3. Name the experiment use for the density of hydrogen chloride.
4. Drying agent for hydrogen chloride gas.
5. Compound which cannot be used to dry hydrogen chloride gas.
6. A polar covalent compound which on dissolving in water produces ions.
7. The experiment which demonstrates extreme solubility of hydrogen chloride gas.
8. A compound formed when iron reacts with hydrogen chloride.
9. Name one lead compound that can be used to oxidise HCl to chlorine.
10. The gas evolved when Mangnese (IV) oxide and concentrated hydrochloric acid are heated.
11. Two colourless gases, when mixed, form white dense fumes. Name the two gases and white dense fumes.
12. A gas evolved when HCl is added to red lead.
13. Two compounds of lead which combine with conc. HCl to liberate chlorine.
14. A substance which reacts with conc. HCl to liberate chlorine.

15. The colour of a gas evolved when conc. hydrochloric acid is heated with manganese dioxide.
16. A gas evolved when metal carbonates reacts with hydrogen chloride.
17. An acid which is not an oxidising agent.
18. A mixture of three parts of conc. HCl and one part of conc. nitric acid.
19. Name chemical in which gold can be dissolved.

Ans.

1. Hydrogen chloride gas
2. Conc. sulphuric acid
3. Fountain experiment
4. Concentrated sulphuric acid
5. Quick lime, CaO
6. Hydrogen chloride gas
7. Fountain experiment
8. Iron (II) chloride
9. Lead dioxide or Red lead
10. Chlorine (Cl_2).
11. Two gases : hydrogen chloride and ammonia. White dense fumes : ammonium chloride
12. Chlorine
13. Lead dioxide and red lead (Pb_3O_4)
14. PbO_2
15. Greenish yellow
16. Carbon dioxide, CO_2
17. Hydrogen chloride, HCl
18. Aqua regia
19. Aqua regia

Chapter 8. (b) Study of Compounds : Ammonia and Nitric Acid

1. An element that acts as a promoter in the industrial preparation of ammonia.
2. A compound used to dry ammonia.
3. A catalyst used during Haber's process.
4. Products obtained by the catalytic oxidation of ammonia.
5. Ammonium salt used in the preparation of alum.
6. A fertilizer that reacts slowly with moisture to give ammonia.
7. A fertilizer made by combining ammonia and carbon dioxide.
8. The product of oxidation of ammonia in Ostwald process.
9. A compound which is manufactured by the oxidation of ammonia.
10. Experiment which demonstrates the extreme solubility of ammonia.
11. The fertilizer formed when nitrogen is reacted with calcium carbide at high temperature.
12. A white ppt. formed when an aqueous solution of the compound is added to a solution of barium chloride
13. A colourless gas which becomes reddish brown when it comes in contact with atmosphere.
14. The common name of carbamide.
15. An explosive formed when ammonia and chlorine react together.
16. The compound known by the name, Aqua fortis.
17. A catalyst used in the manufacture of nitric acid by ostwald's process.
18. The process by which nitric acid is obtained on a large scale.
19. Salt used in the laboratory to prepare nitric acid.
20. The compound that makes laboratory acid yellow.
21. Organic liquid that bursts into flames when sprayed into highly conc. nitric acid.
22. Gas obtained by treating copper with dilute nitric acid.
23. Products obtained by heating concentrated nitric acid.
24. Insoluble component present in super phosphate of lime.
25. The gas produced by the action of dil. HNO_3 on copper.
26. A compound formed when nitric acid and hydrochloric acid reacts together.
27. The property of nitric acid which allows it to react with copper.
28. A concentrated acid which oxidies sulphur directly to H_2SO_4.
29. The gas produced when copper reacts with conc. HNO_3.

30. A gas which possess the smell of rotten eggs.
31. The test carried out with freshly prepared ferrous sulphate.
32. A nitrate which leaves behind no residue on heating.
33. A solution which gives nitrogen dioxide with copper.

Ans.

1. Molybdenum
2. Quick lime (CaO)
3. Finely divided iron
4. Nitric oxide and water vapour
5. Ammonium sulphate
6. Nitrolium ($CaCN_2$)
7. Urea (NH_2CONH_2)
8. Nitrogen (II) oxide (nitric oxide) and steam
9. Nitric acid
10. Fountain experiment
11. Nitrogen
12. Ammonium sulphate
13. Nitric oxide
14. Urea
15. NCl_3
16. Nitric acid
17. Platinum
18. Ostwald's process
19. Sodium or potassium nitrate
20. Nitrogen dioxide (NO_2)
21. Turpentine
22. Nitric oxide
23. Water, nitrogen dioxide and oxygen
24. Calcium sulphate
25. Nitric oxide
26. Nitrosyl Chloride
27. Oxidising agent
28. Conc. HNO_3
29. NO_2
30. H_2S
31. Brown ring test
32. Ammonium nitrate
33. Conc. HNO_3

Chapter 8. (c) Study of Compounds : Sulphuric Acid

1. Acid commonly known as oil of vitriol.
2. Calatyst used during contact process.
3. Promoter used in contact process.
4. Atomicity of sulphur.
5. Basicity of sulphuric acid.
6. Acid obtained by dissolving sulphur dioxide in water.
7. A black coloured substance formed when sugar is dehydrated.
8. Bleaching agent used to bleach delicate articles.
9. Name the solution which turns colourless when sulphur dioxide gas is passed through it.
10. Name an acid that cannot be used to obtain sulphur dioxide, from sulphites.
11. Give the chemical name and common name of a reagent used in photographic work.
12. The process involved during the bleaching action of sulphur dioxide.
13. A neutral oxide of carbon formed when formic acid reacts with concentrated sulphuric acid.
14. Name the chemical used to test hydrogen sulphide.
15. Name an orange colour solution which turns in green colour when sulphur dioxide gas is passed through it.
16. An organic acid which on reaction with concentrated sulphuric acid, produces two oxides of carbon.
17. The solution which turns black on coming in contact with hydrogen sulphide.
18. Green coloured compound formed when SO_2 is passed through acidified $K_2Cr_2O_7$.
19. Process by which sulphur is boiled with rubber.

Ans.

1. Sulphuric acid
2. V_2O_5 or platinised asbestos
3. Potassium oxide
4. Eight
5. Dibasic
6. Sulphurous acid

7. Carbon or sugar charcoal
8. Moist sulphur dioxide
9. Potassium permanganate
10. Nitric acid
11. Sodium thiosulphate
12. Reduction
13. Carbon monoxide
14. Lead acetate
15. Potassium dichromate
16. Oxalic acid
17. Lead acetate, lead nitrate solution
18. Chromium sulphate
19. Vulcanization

Chapter 9. Organic Chemistry

1. Name the organic compound which was first synthesized.
2. A simplest hydrocarbon.
3. The shape of methane molecule.
4. Hydrocarbons containing a $-\overset{\overset{O}{\|}}{C}-$ functional group.
5. An organic compound whose functional group is carboxyl.
6. The compound with –OH as the part of its structure.
7. The compound with –COOH as the part of its structure.
8. The compounds having same molecular formula but different structural formula.
9. Homologue of homologous series with general formula C_nH_{2n}.
10. The next higher homologue of methyl alcohol.
11. The type of reactions alkenes undergo.
12. The type of reactions alkanes undergo.
13. The hydrocarbon which contributes towards greenhouse effect.
14. A reaction in which hydrogen of an alkane is replaced by a halogen.
15. Process by which ethene is obtained from ethanol.
16. A hydrocarbon which on catalytic hydrogenation gives a saturated hydrocarbon.
17. The catalyst used during hydrogenation of alkene.
18. A white solid which on treatment with water liberate acetylene.
19. The chemical name of the gas, which evolves in the marshy lands in the form of bubbles.
20. The solution which detects the presence of unsaturation in the given hydrocarbon.
21. An organic compound used as a thermometric liquid.
22. Hydrocarbon, which increases the rate of fruit ripening.
23. A compound which is used in making denatured spirit.
24. A gas which forms explosive mixture with air.
25. A solution used for storing biological specimens.
26. An unsaturated hydrocarbon used for welding purposes.
27. Process by which ethane is obtained from ethene.
28. A hydrocarbon which contributes towards the greenhouse effect.
29. Distinctive reaction that takes place when ethanol is treated with acetic acid.
30. The property of elements by virtue of which atoms of the element can link to each other in the form of a long chain or ring structure.
31. Reaction when an alkyl halide is treated with alcoholic potassium hydroxide.
32. The catalyst used in the conversion of ethyne to ethane.

Ans.

1. Urea
2. Methane
3. Tetrahedral
4. Carbonyl compounds alkanones
5. Acetic acid
6. Ethanol
7. Ethanoic acid
8. Isomer
9. Ethene
10. Ethyl alcohol, C_2H_5OH

11. Addition reaction
12. Substitution reaction
13. Methane
14. A substitution reaction—halogenation
15. Dehydration
16. Ethene
17. Nickel
18. Calcium carbide
19. Methane gas
20. Bromine solution in carbon tetrachloride or Alkaline potassium permanganate
21. Ethanol
22. Ethene
23. Methyl alcohol
24. Acetylene
25. Formalin
26. Ethyne
27. Hydrogenation
28. Methane (CH_4)
29. Esterification
30. Catenation
31. Nickel or platinum
31. Dehydrohalogenation

Chapter 10. Practical Chemistry

1. A molecule of diatomic gas with a triple bond.
2. A compound with six water of crystallisation.
3. A black coloured reducing agent.
4. A trivalent metal.
5. A mixed salt.
6. A stable carbonate.
7. A green coloured carbonate.
8. A blue coloured nitrate.
9. A nitrate which does not leave behind solid residue on heating.
10. The nitrate which gives a black residue on heating.
11. A black metallic oxide which dissolves in nitric acid to give greenish blue solution.
12. A salt soluble in hot water but insoluble in cold water.
13. A chloride which dissolves in ammonia to give a complex.
14. A solution which can absorb oxygen.
15. A double salt used for the sediment fo muddy water.
16. A hydrated salt that is blue in colour.
17. The salt formed when aluminium react with potassium hydroxide.
18. The salt which gives a yellow residue on heating.

Ans.

1. N_2 molecule
2. Cobalt chloride
3. Charcoal
4. Aluminium
5. Bleaching powder
6. Sodium carbonate
7. Copper carbonate
8. Copper nitrate
9. Ammonium nitrate
10. Copper nitrate
11. Copper oxide
12. Lead chloride
13. Silver chloride
14. Alkaline pyrogallol
15. Potash alum
16. Lead nitrate
17. Potassium aluminate
18. $CuSO_4 \cdot 5H_2O$

❒

Question Set 5

Identification of Gases

Chapter 8 (b). Study of Compounds : Ammonia and Nitric Acid

Q. Name the gas evolved in the following cases :

1. The gas produced when excess ammonia reacts with chlorine.
2. The gas produced when copper reacts with concentrated nitric acid.
3. The gas produced when magnesium reacts with dil. nitric acid.
4. The gas produced when ammonium nitrite undergoes a thermal decomposition.
5. The gas produced when dry ammonia and oxygen are ignited.
6. The gas evolved when dry ammonia and oxygen are passed over heated platinum and then allowed to cool.
7. The gas produced when ammonia gas is passed over heated litharge.
8. The gas produced when concentrated nitric acid is added to copper.
9. The gas produced when sodium nitrate is heated.
10. The gas produced when ammonium nitrate is heated.
11. The gas produced when sodium carbonate reacts with dilute nitric acid.
12. The gases produced when silver nitrate is heated.
13. The gas produced when ammonia burns in an atmosphere of oxygen without any catalysts.
14. Calcium hydroxide and ammonium chloride.
15. Sodium nitrite and ammonium chloride.

Ans.

1. Nitrogen
2. Nitrogen dioxide
3. Hydrogen
4. Nitrogen
5. Nitrogen
6. Nitrogen dioxide
7. Nitrogen
8. Nitrogen dioxide
9. Oxygen
10. Nitrous oxide (Laughing gas N_2O)
11. Carbon dioxide
12. Nitrogen dioxide and oxygen
13. Nitrogen
14. Ammonia gas
15. Nitrogen gas

Chapter 8 (c). Study of Compounds : Sulphuric Acid

1. The gas which turns acidified potassium dichromate clear green.
2. The gas produced on reaction of dilute sulphuric acid with a metallic sulphide.
3. The gas released when sodium carbonate is added to a solution of sulphur dioxide.
4. The gas produced by the action of concentrated sulphuric acid on sodium chloride.
5. The gas evolved when dilute sulphuric acid is added to sodium sulphite.

Ans.

1. Sulphur dioxide
2. Hydrogen sulphide
3. Carbon dioxide
4. Hydrogen chloride
5. Sulphur dioxide

Chapter 10. Practical Chemistry

1. A colourless gas which forms an explosive mixture with air and water is the only product of combustion.
2. A colourless gas which rekindles glowing splint but cannot be used for breathing.
3. A colourless gas which burns with a pale blue flame, forming carbon dioxide gas as the only product.

4. A colourless gas having a sharp pungent smell, which gives dense white fumes with HCl.
5. A colourless gas having a choking smell, which causes coughing.
6. An extremely soluble gas in water, which forms dense white fumes with ammonia solution.
7. A colourless gas having a disagreeable smell which it turns lead acetate paper black.
8. A colourless gas which is neither combustible nor does it support combustion. It does not turn lime water milky.
9. A colourless gas which on coming in contact with air, forms a reddish-brown gas.
10. A reddish-brown gas obtained when lead nitrate crystals are strongly heated.
11. A colourless gas which bleaches moist coloured flowers.
12. A coloured gas which bleaches moist coloured flowers.
13. Two gases which react with ammonia to form dense white fumes.
14. The gas evolved on reaction of aluminium with boiling concentrated caustic alkali solution.
15. The gas produced when excess ammonia reacts with chlorine.
16. A gas which turns acidified potassium dichromate clear green.
17. The gas produced when copper reacts with concentrated nitric acid.
18. The gas produced on reaction of dilute sulphuric acid with a metallic sulphide.
19. Dilute hydrochloric acid reacts with sodium sulphite.
20. Dilute hydrochloric acid reacts with iron (II) sulphide.

Ans.

1. Hydrogen gas
2. Nitrous oxides (N_2O) gas
3. Carbon monoxide gas
4. Ammonia gas
5. Sulphur dioxide gas
6. Hydrochloric acid gas
7. Hydrogen sulphide gas
8. Nitrogen gas
9. Nitric oxide (NO) gas
10. Nitrogen dioxide gas
11. Sulphur dioxide gas
12. Chlorine gas
13. HCl gas and chlorine gas
14. Hydrogen gas
15. Nitrogen gas
16. Sulphur dioxide gas
17. Nitrogen dioxide gas
18. Hydrogen sulphide gas
19. Sulphur dioxide
20. Hydrogen sulphide

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Question Set 6

State the Observation

Chapter 4. Analytical Chemistry

Q. What do you observe when (write equations if necessary) :

1. Sodium hydroxide solution is slowly added and then in excess to zinc sulphate solution.
2. To a solution of lead nitrate small amount of sodium hydroxide is added and then excess of sodium hydroxide is added.
3. When sodium hydroxide is added to a solution of ferric chloride write equation for the reaction taking place.
4. Ammonium hydroxide solution is added to Iron (II) sulphate solution.
5. Ammonium hydroxide is added to iron (III) sulphate solution.
6. Ammonium hydroxide solution is slowly added and then in excess to copper sulphate solution.
7. Ammonium hydroxide is added to zinc sulphate solution. Write the name and the formula of the final product.
8. Ammonium hydroxide solution is added to copper (II) nitrate solution in small quantities and then in excess.
9. Ammonium hydroxide solution is added to zinc nitrate solution in minimum quantities and then in excess.
10. Ammonium hydroxide solution is added to iron (III) chloride solution.

Ans. 1. Sodium hydroxide solution when slowly added to zinc sulphate solution, a white precipitate of zinc hydroxide is obtained, which is soluble in excess of sodium hydroxide to form a clear solution of sodium zincate.

$$ZnSO_4 + 2NaOH \longrightarrow \underset{\text{White ppt.}}{Zn(OH)_2 \downarrow} + Na_2SO_4$$

$$Zn(OH)_2 + 2NaOH \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2 \downarrow} + 2H_2O$$

2. A curdy white precipitate of lead hydroxide is formed which dissolves in excess NaOH giving a colourless solution.
3. When sodium hydroxide solution is added to ferric chloride, a reddish brown precipitate of ferric hydroxide, insoluble even in the excess of the sodium hydroxide, is obtained.

$$FeCl_3 + 3NaOH \longrightarrow \underset{\text{(Reddish brown)}}{Fe(OH)_3 \downarrow} + 3NaCl$$

4. A dirty green ppt. of ferrous hydroxide $Fe(OH)_2$, insoluble in excess of NH_4OH, is formed.
5. A reddish brown precipitate of iron (III) hydroxide is formed.
6. Ammonium hydroxide solution, when slowly added to copper sulphate solution, light blue precipitate of copper hydroxide is obtained, which is soluble in excess of ammonium hydroxide to form an intense deep blue solution of tetra amine cupric sulphate.

$$CuSO_4 + 2NH_4OH \longrightarrow \underset{\text{Pale blue ppt..}}{Cu(OH)_2 \downarrow} + (NH_4)_2SO_4$$

$$CuSO_4 + 4NH_4OH \longrightarrow \underset{\substack{\text{Tetra amine cupric sulphate}\\ \text{(soluble complex) Deep blue solution.}}}{[Cu(NH_3)_4]SO_4} + 4H_2O$$

7. White ppt. of $Zn(OH)_2$ formed which redissolves to give a colourless solution of tetra-amine zinc sulphate $[Zn(NH_3)_4]SO_4$.
8. Initially a light blue ppt. is formed which on addition of excess of ammonium hydroxide dissolves and a deep inky blue solution is formed.
9. Initially a white ppt. is formed which disappears (dissolves) in excess of ammonium hydroxide.
10. A reddish brown ppt. of ferric hydroxide insoluble in excess of NH_4OH is formed.

Chapter 7. Metallurgy

1. When powdered zinc is added to copper sulphate solution.
2. When powdered copper is added to zinc sulphate solution.
3. When a rod of zinc metal is dipped into the solution of copper sulphate.
4. When a zinc granule is added to copper sulphate solution.
5. When zinc nitrate crystals are strongly heated.
6. When a piece of calcium is dropped into a trough of water.
7. When a piece of sodium is added to water.
8. When hydrogen is passed over a heated metallic oxide.
9. When a strip of copper is kept immersed in the solution of silver nitrate.
10. Zinc metal is heated in air at 500°C.
11. Zinc metal is treated with ferric sulphate.
12. What happens to the (a) aluminium oxide, (b) iron (III) oxide, when bauxite is treated with sodium hydroxide solution.
13. When iron filings are strongly heated.
14. When a finely ground (powdered) mixture of iron filings and sulphur is heated.

Ans. 1. Zinc displaces reddish brown copper from copper sulphate solution and zinc sulphate is formed.

$$Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu$$

2. No reaction takes place because copper is less reactive than zinc.
3. Zinc displaces copper from the solution of copper sulphate.
4. A gelatinous white ppt. of zinc sulphate ($ZnSO_4$) is formed and the blue coloured solution of copper sulphate decolourises because of its formation.
5. A precipitate of zinc oxide (ZnO) is formed with the evolution of NO_2 and O_2 gases. The precipitate (ZnO) formed is yellow when hot and white when cold.

   A reddish brown gas (NO_2) thus liberated has a pungent, irritating odour which turns potassium iodide paper brown.

   A colourless and odourless gas (O_2) thus liberated rekindles a glowing splinter.
6. When a piece of calcium is dropped into water, a vigorous reaction takes place and a colourless, odourless gas hydrogen is evolved, which can be collected in a test tube and water becomes alkaline due to the formation of calcium hydroxide.

$$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2\uparrow$$

7. When a small piece of sodium is dropped into water, producing hydrogen gas, which catches fire, the solution becomes alkaline due to the formation of sodium hydroxide.

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2\uparrow$$

8. When hydrogen is passed over heated metallic oxide, it is oxidized into water (its corresponding oxide) and the metallic oxide is reduced to free metal.

$$\underset{\text{Metallic oxide}}{MO} + H_2 \longrightarrow H_2O + \underset{\text{Free metal}}{M}$$

9. Copper is more reactive than silver. So it displaces silver from silver nitrate solution.
10. Zinc metal is heated in air at 500°C, the metal burns with bluish-white flame and forms philosopher's wool.

$$2Zn + O_2 \xrightarrow{500°C} \underset{\text{Zinc oxide}}{ZnO}$$

11. Zinc metal reduces ferric sulphate to ferrous sulphate. Zinc is a powerful reducing agent.

$$\underset{\text{Ferric sulphate}}{Fe_2(SO_4)_3} + Zn \longrightarrow \underset{\text{Ferrous sulphate}}{2FeSO_4} + ZnSO_4$$

12. (a) Aluminium oxide dissolves in NaOH solution to form sodium meta-aluminate.

    (b) The iron (III) oxide remains undissolved in the sodium.

13. When iron filings are strongly heated in the presence of atmospheric oxygen, iron is oxidized to form reddish brown ferric oxide.

$$4Fe + 3O_2 \longrightarrow \underset{\text{Iron (III) oxide.}}{2Fe_2O_3}$$

14. When the mixture of iron filings and sulphur is heated, iron combines with sulphur to form a black powder of iron sulphide. During heating the mixture begins to glow, as it is an exothermic reaction.

$$Fe + S \longrightarrow \underset{\text{Iron (II) sulphide}}{FeS}$$

Chapter 8. (a) Study of Compounds : Hydrogen Chloride

1. Hydrogen chloride gas is passed through silver nitrate solution.
2. Hydrogen chloride gas comes in contact with ammonia solution.
3. Hydrogen chloride gas is passed through lead nitrate solution and the product thus formed is heated.
4. A few drops of dilute hydrochloric acid are added to silver nitrate solution followed by addition of ammonium hydroxide solution.
5. Dilute hydrogen chloride is added to lead nitrate solution.
6. Copper sulphide is treated with dilute hydrochloric acid.
7. Manganese dioxide is treated with concentrated hydrochloric acid.
8. Copper oxide is treated with conc. hydrochloric acid.
9. Magnesium strip is dropped in dil. hydrochloric acid.
10. When platinum is added to a solution of aqua regia.
11. Dilute hydrochloric acid is added to copper carbonate.
12. Dilute hydrochloric acid is added to sodium thiosulphate.

Ans.

1. A white precipitate is formed which is soluble in excess of ammonium hydroxide.
2. Dense white fumes are observed.
3. A white precipitate is formed which gets dissolved on heating.
4. A white precipitate of silver chloride ($AgCl_2$) is formed which dissolves in excess of NH_4OH.
5. A white precipitate of lead chloride ($PbCl_2$) is obtained. It is insoluble in cold water but soluble in hot water.
6. Rotten egg smell of hydrogen sulphide (H_2S) gas will be given out.
7. Black coloured manganese dioxide on reacting with conc. hydrochloric acid gives light brown coloured solution with the evolution of greenish yellow coloured gas.
8. Black coloured copper oxide on reacting with conc. hydrochloric acid gives blue coloured solution with the evolution of greenish yellow coloured gas which turns moist starch iodide paper blue black, turns moist blue litmus to red and finally bleaches it to white.
9. Magnesium metal slowly dissolves with the evolution of a colourless and odourless gas which burns off with a popping sound.
10. Platinum dissolves in the solution of aqua regia.
11. When dilute hydrochloric acid is added to copper carbonate, a brisk effervescence is seen due to the evolution of CO_2, with the formation of copper chloride.

$$CuCO_3(s) + 2HCl(aq) \longrightarrow CuCl_2(aq) + H_2CO_3(aq)$$
$$\longrightarrow CuCl_2(aq) + H_2O(l) + CO_2(g)$$

12. Sodium thiosulphate reacts with dilute hydrochloric acid to produce sodium chloride, gas of sulphur dioxide, water and sulphur in a yellow solid form.

$$Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + S + H_2O + SO_2$$

Chapter 8. (b) Study of Compounds : Ammonia and Nitric Acid

1. A piece of moist red litmus paper is placed in a gas jar of ammonia.
2. Solution of ammonium chloride and sodium hydroxide are mixed and heated.
3. Ammonia is dissolved in water.
4. When a glass rod dipped in hydrochloric acid is introduced into a gas jar full of ammonia, dense white fumes are produced.
5. An aqueous solution of ammonia is added to a solution of ferric chloride.
6. Excess of ammonia is passed through an aqueous solution of lead nitrate.
7. Ammonia is passed through excess chlorine.
8. Ammonia is passed through black copper oxide.
9. Ammonia is passed through yellow lead oxide.
10. Ammonia gas is burnt in an atmosphere of oxygen in the absence of catalyst.
11. When a jar filled with ammonia gas is inverted in a trough filled with water.
12. A fertilizer containing an ammonium salt gets spoiled, if accidentally mixed with slaked lime.
13. Copper turnings are heated with concentrated nitric acid.
14. Nitric acid reacts with glycerol.
15. Nitric acid reacts with phenol in presence of conc. sulphuric acid.
16. When a few drops of concentrated nitric acid are dropped on hot saw dust.
17. When a little water is added to a yellow coloured nitric acid.
18. Concentrated nitric acid is added to copper.
19. Action of nitric acid on limestone.
20. Action of heat on concentrated nitric acid.
21. Nitric acid comes in contact with skin.
22. An aqueous solution of KI(aq) is added to HNO_3.
23. Hot and conc. nitric acid is added to sulphur.

Ans.

1. A piece of moist red litmus paper turns blue when it is placed in a gas jar of ammonia. This is because of the basic nature of ammonia gas.
2. Ammonia gas is produced when ammonium chloride (NH_4Cl) and sodium hydroxide (NaOH) is heated.

$$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3 \uparrow$$

3. Ammonia dissolves in water to form a weak base, NH_4OH.

$$NH_3 + H_2O \rightleftharpoons \underset{\text{Ammonium hydroxide}}{NH_4OH}$$

4. Hydrochloric acid present on the glass rod reacts with ammonia to form dense white fumes of ammonium chloride.

$$NH_3 + HCl \longrightarrow NH_4Cl$$

5. When an aqueous solution of ammonia is added to ferric chloride solution, a reddish brown precipitate of ferric hydroxide is produced which is insoluble even in the excess of ammonium hydroxide.

$$FeCl_3 + 3NH_4OH \longrightarrow \underset{\substack{\text{Ferric hydroxide}\\ \text{(Reddish brown ppt.)}}}{Fe(OH)_3\downarrow} + 3NH_4Cl$$

6. A white coloured precipitate of lead hydroxide [$Pb(OH)_2$] is formed which is insoluble in an excess of ammonia solution.
7. When ammonia is passed through excess of chlorine, a highly explosive yellow liquid of nitrogen trichloride is obtained.

$$NH_3 + 3Cl_2 \longrightarrow \underset{\substack{\text{Nitrogen trichloride}\\ \text{(highly explosive)}\\ \text{(yellow liquid)}}}{NCl_3} + 3HCl$$

8. When ammonia is passed through black copper oxide, it changes to red copper.
9. When ammonia is passed through yellow lead oxide, it changes to silvery white lead.

$$\underset{\substack{\text{Lead}\\\text{Oxide}\\\text{(yellow)}}}{3PbO} + 2NH_3 \xrightarrow{\Delta} \underset{\substack{\text{Lead}\\\text{(silvery}\\\text{white)}}}{3Pb} + N_2 + 3H_2O$$

10. A greenish yellow flame is observed when ammonia gas is burnt in an atmosphere of oxygen in the absence of catalyst.
11. Ammonia is highly soluble in water. When a jar of ammonia is inverted in a trough of water, a low pressure is created in a jar and the water rushes up, as the gas dissolves in water.
12. Slaked lime is a strong alkali, which reacts with ammonium salt present in fertilizer to liberate ammonia gas.

$$(NH_4)_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + 2NH_3 + 2H_2O$$

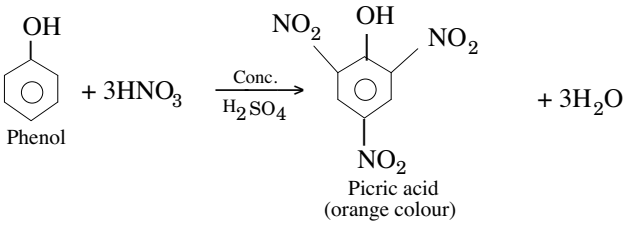
13. When copper turnings are heated with concentrated nitric acid, copper nitrate, water and nitrogen dioxide gas (which has reddish brown colour and pungent smell) is evolved.

$$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$$

14. Nitric acid react with glycerol in presence of conc. H_2SO_4 below 25°C to form glycerol tri-nitrate.

$$\underset{\substack{\text{Glycerol}}}{\begin{array}{l}CH_2OH\\|\\CHOH\\|\\CH_2OH\end{array}} + 3HNO_3 \xrightarrow[H_2SO_4]{\text{Conc.}} \underset{\substack{\text{Nitroglycerine}}}{\begin{array}{l}CH_2ONO_2\\|\\CHONO_2\\|\\CH_2ONO_2\end{array}} + 3H_2O$$

15. Nitric acid reacts with phenol in presence of conc. sulphuric acid to form orange coloured compound, picric acid.



Picric acid
(orange colour)

16. Hot saw dust catches fire. This is because concentrated nitric acid decomposes to give oxygen at a higher temperature.

$$4HNO_3 \longrightarrow 4NO_2 + 2H_2O + O_2$$

Oxygen gas is a supporter of combustion and it supports the combustion of hot saw dust, which catches fire.

17. The yellow colouration of nitric acid is due to the decomposition of nitric acid into nitrogen dioxide and other oxides of nitrogen. When a little water is added, all these oxides of nitrogen are dissolved and thus the acid becomes colourless.
18. When conc. HNO_3 is added to copper, a reddish brown gas (NO_2) having pungent smell is evolved.
19. Carbon dioxide gas is liberated when nitric acid reacts with limestone.

$$CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2 \uparrow$$

20. When conc. HNO_3 is heated, it rapidly decomposes to reddish brown nitrogen dioxide gas alongwith the formation of water and oxygen gas

$$4HNO_3 \xrightarrow{\Delta} 2H_2O + 4NO_2\uparrow + O_2\uparrow$$

21. The acid produces yellow stain on skin and wood, since skin and wood contain protein. The protein reacts with nitric acid to produce xanthoproteic complex compound. This compound is yellow in colour.

22. When HNO_3 is added to KI(aq), it is oxidised to Iodine. During the reaction, violet colour vapours of iodine is observed.

$$2KI + 4HNO_3 \longrightarrow \underset{\text{violet colour vapours}}{2KNO_3} + 2H_2O + 2NO_2 + I_2\uparrow$$

23. A dense brown fumes of nitrogen dioxide (NO_2) gas are evolved.

$$S + \underset{\text{Hot conc.}}{6HNO_3} \xrightarrow{\Delta} H_2SO_4 + 2H_2O + 6NO_2\uparrow$$

Chapter 8. (c) Study of Compounds : Sulphuric Acid

1. Concentrated sulphuric acid is added to a lump of blue vitriol.
2. Crystal of $FeSO_4.7H_2O$ (Green) is placed in conc. sulphuric acid.
3. Lead nitrate is treated with dilute sulphuric acid.
4. Dilute sulphuric acid is added to barium chloride.
5. Sodium chloride is heated with conc. sulphuric acid.
6. Dil. sulphuric acid is added to a solution of barium chloride and lead nitrate.
7. Dilute sulphuric acid is added to iron sulphide.
8. Bleaching powder is heated with dil. sulphuric acid.
9. Zinc metal is treated with dil sulphuric acid.
10. Carbon is heated with conc. sulphuric acid.
11. Sugar is heated with conc. sulphuric acid.

Ans. 1. When concentrated sulphuric acid is added to hydrated copper sulphate, it loses its water of crystallization and thus white annhydrous copper (II) sulphate is formed. In other words,

The blue coloured hydrated (II) sulphate turns white due to the loss of water of crystallization.

$$\underset{\substack{\text{Hydrated copper sulphate}\\\text{(Blue crystals)}}}{CuSO_4.5H_2O} + \underset{\text{Conc.}}{[H_2SO_4]} \longrightarrow \underset{\substack{\text{Anhydrous copper}\\\text{sulphate}\\\text{(White crystals)}}}{CuSO_4} + [H_2SO_4.5H_2O]$$

2. When the green coloured hydrated salt $FeSO_4.7H_2O$ is placed in conc. H_2SO_4, it lose the water molecules and the solution becomes white. The colour and crystalline nature of hydrated salt is due to presence of water of crystallization in it.

$$\underset{\text{(Green)}}{FeSO_4.7H_2O} + H_2SO_4 \longrightarrow \underset{\substack{\text{Iron sulphate}\\\text{(White)}}}{FeSO_4} + 7H_2O$$

3. Lead nitrate solution reacts with dilute sulphuric acid to form a white precipitate of lead sulphate, which is insoluble in all mineral acids.

$$Pb(NO_3)_2 + H_2SO_4 \longrightarrow \underset{\text{White ppt.}}{PbSO_4\downarrow} + 2HNO_3$$

4. Barium chloride solution when added to dilute sulphuric acid, a thick white precipitate of barium sulphate is obtained which is insoluble in all mineral acids. Hydrochloric acid is also formed.

$$BaCl_2 + H_2SO_4 \longrightarrow BaSO_4\downarrow + 2HCl$$

5. Sodium chloride when heated with concentrated sulphuric acid, liberates pungent fumes of hydrogen chloride gas and sodium sulphate is formed.

$$2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + \underset{\substack{\text{Hydrochloric}\\\text{acid}}}{2HCl}$$

6. When dil. sulphuric acid is added to a solution of barium chloride and lead nitrate it forms a white precipitate of barium sulphate and lead sulphate respectively.

$$BaCl_2 + \underset{\text{Dil.}}{H_2SO_4} \longrightarrow 2HCl + BaSO_4\downarrow$$

$$Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2HNO_3$$

7. Iron sulphide reacts with dilute sulphuric acid to form iron (II) sulphate with the evolution of hydrogen sulphide gas, which has a rotten egg smell.

$$FeS + H_2SO_4 \longrightarrow FeSO_4 + \underset{\text{Hydrogen sulphide}}{H_2S\uparrow}$$

8. When bleaching powder is heated with dilute sulphuric acid, chlorine gas is liberated and calcium sulphate is formed along with water.

$$CaOCl_2 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + \underset{\text{Chlorine}}{Cl_2\uparrow}$$

9. Zinc metal reacts with dilute sulphuric acid to liberate hydrogen gas and zinc sulphate is formed.

$$Zn + H_2SO_4 \longrightarrow \underset{\text{White ppt.}}{ZnSO_4\downarrow} + \underset{\text{Hydrogen}}{H_2\uparrow}$$

10. When carbon is heated with concentrated sulphuric acid, it is oxidised to carbon dioxide and the acid is reduced to sulphur dioxide.

$$C + 2H_2SO_4 \longrightarrow CO_2 + 2SO_2 + 2H_2O$$

11. Sulphuric acid acts as a dehydrating agent. When sugar is heated with concentrated sulphuric acid, charring of sugar takes place due to the loss of water molecules and black charred residue is formed.

$$\underset{\text{Sugar}}{C_{12}H_{22}O_{11}} + H_2SO_4 \longrightarrow \underset{\substack{\text{Sugar charcoal}\\\text{(black)}}}{12C\downarrow} + 11H_2O$$

Chapter 9. Organic Chemistry

1. Methane gas is burnt in air.
2. A mixture of sodium acetate and soda lime is heated.
3. When a mixture of acetylene with twice its volume of hydrogen is passed over nickel as catalyst at about 200°C.
4. Ethylene is heated at 400°C under very high pressure in traces of oxygen.
5. A mixture of ethylene and hydrogen is passed over nickel at 150°C.
6. Ethylene combines with hydrogen chloride.
7. Ethylene reacts with chlorine.
8. Ethene is oxidized with alkaline $KMnO_4$ solution.
9. Ethene is burnt in excess of oxygen.
10. Ethene reacts with bromine.
11. Ethene is bubbled through a solution of bromine in tetrachloromethane (carbon tetrachloride).
12. Calcium carbide is boiled with water.
13. Acetylene is oxidized with alkaline $KMnO_4$ solution.
14. Ethyne is bubbled through a solution of bromine in carbon tetrachloride.
15. Ethyl alcohol is heated at 300°C temperature, in presence of copper catalyst.
16. Ethanol is burnt in air.
17. Acetic acid and ethyl alcohol react in the presence of sulphuric acid.
18. Sodium propionate is heated with soda lime.

Ans.

1. Methane gas burns in air with a blue flame and produces carbon dioxide and water. A large amount of heat energy is liberated during the reaction.
2. When a mixture of sodium acetate and soda lime is heated, colourless and odourless methane gas is liberated.
3. When mixture of acetylene and hydrogen is heated at 200°C temperature, ethane is formed.

$$C_2H_2 + 2H_2 \xrightarrow[\text{temp.}]{200°C} \underset{\text{Ethane}}{C_2H_6}$$

4. When ethylene is heated at 400°C under very high pressure in traces of oxygen, it polymerises to form polyethylene or polyethene

$$n C_2H_4 \xrightarrow[\text{High pressure}]{400\,^\circ C} \underset{\text{Polyethylene}}{-(CH_2-CH_2-)_n}$$

5. When a mixture of ethylene and hydrogen is passed over nickel at 150°C it forms ethane.

$$\underset{\text{Ethylene}}{CH_2 = CH_2} + H_2 \xrightarrow[150\,^\circ C]{Ni} \underset{\text{Ethane}}{CH_3-CH_3}$$

6 Ethylene (unsaturated) combines with hydrogen chloride and results in the formation of an addition product chloroethane.

$$CH_2 = CH_2 + HCl \longrightarrow \underset{\text{Chloroethane}}{\begin{array}{l} CH_3-CH_2 \\ \quad | \\ \quad Cl \end{array}}$$

7. When ethylene is treated with chlorine, it combines and results in the formation of saturated 1, 2-dichloro ethane.

$$\underset{\text{Ethylene (unsaturated)}}{CH_2 = CH_2} + Cl\text{-}Cl \longrightarrow \underset{\text{1, 2-dichloroethane (saturated)}}{\begin{array}{l} \quad\quad Cl \\ \quad\quad | \\ CH_2 - CH_2 \\ | \\ Cl \end{array}}$$

8. Ethene gets oxidized with $KMnO_4$ and produce glycol.

$$H_2C = CH_2 + [O] \xrightarrow{KMnO_4} \underset{\text{Glycol}}{\begin{array}{l} CH_2OH \\ | \\ CH_2OH \end{array}} + H_2O$$

9. A large amount of heat liberated with sooty flame is produced when, ethene is burnt in excess of oxygen.

$$H_2C = CH_2 + 3O_2 \longrightarrow 2CO_2 + 2H_2O + \text{Heat}$$

10. When ethene reacts with bromine, addition reaction takes place. A molecule of bromine is added to the molecule of ethene forming dibromoethane. The almond colour of bromine is discharged.
11. Colour of bromine gets decolourised.
12. Calcium carbide is boiled with water to form acetylene and calcium hydroxide.

$$CaC_2 + H_2O \longrightarrow \underset{\text{Acetylene}}{CH \equiv CH} + Ca(OH)_2$$

13. Acetylene gets oxidized with alkaline $KMnO_4$ solution to produce oxalic acid.

$$\begin{array}{l} CH \\ \| \\ CH \end{array} + 4[O] \xrightarrow{KMnO_4} \underset{\text{Oxalic acid}}{\begin{array}{l} COOH \\ | \\ COOH \end{array}}$$

14. Brown colour of bromine disappears due to the formation of ethylene tetrachloride.
15. Ethyl alcohol is heated at 300°C temp. in presence of copper catalyst to form acetaldehyde.

$$CH_3CH_2OH + 2H \xrightarrow[300^\circ C]{Cu} CH_3 - CHO$$

16. Ethanol burns in air with a blue flame, producing carbon dioxide and water. During the reaction, large amount of heat energy is liberated.
17. When acetic acid and ethyl alcohol react in the presence of sulphuric acid, esterification process takes place and ethyl acetate is formed.
18. Ethane is prepared by heating a dry mixture of sodium propionate and soda-lime.

$$C_2H_5\,COONa + NaOH \xrightarrow[\Delta]{CaO} \underset{\text{Ethane}}{C_2H_6} + Na_2O_3$$

Chapter 10. Practical Chemistry

1. Chlorine water is exposed to sunlight.
2. Piece of moist red litmus is placed in the gas jar of ammonia.
3. Piece of moist blue litmus paper is placed in the jar of chlorine.
4. Copper hydroxide is heated in a glass tube.
5. Lead nitrate is heated in a glass tube.
6. Copper carbonate is heated in a glass tube.
7. SO_2 is bubbled through acidified $KMnO_4$ solution.
8. AgCl is shaken with ammonium hydroxide.
9. Anhydrous calcium chloride is exposed to air.
10. Barium chloride solution is added to dil H_2SO_4.
11. Dry red rose petals are placed in the jar of sulphur dioxide.
12. Paper soaked in potassium permangnate solution is introduced into a gas jar of sulphur dioxide.
13. Ammonia gas is burnt in an atmosphere of oxygen in the absence of a catalysts.
14. Moist blue litmus is introduced into a gas jar of sulphur dioxide.
15. Ammonia gas is bubbled through red litmus solution.
16. Neutral litmus solution is added to sodium carbonate solution.
17. Hydrogen sulphide gas is passed through the lead acetate solution.
18. Glass rod dipped in ammonium hydroxide is brought near the mouth of the concentrated hydrochloric acid bottle.
19. A piece of iron is placed in copper sulphate solution (only colour change is recorded).
20. Barium chloride solution is mixed with sodium sulphate solution.

Ans.

1. Bubbles of colourless gas oxygen are observed.
2. The red litmus paper turns blue.
3. The blue litmus turns red and finally white (due to bleaching).
4. Colourless odourless gas evolves. Residue turns black in colour.
5. A crackling sound is heard. Brown gas evolves and the residue turns lime yellow in colour.
6. Colourless odourless gas evolves. Residue turns black in colour.
7. The pink colour of potassium permangnate disappears.
8. The white precepitate dissolves to form colourless solution.
9. It absorbs moisture and forms saturated solution.
10. A white precipitate of barium sulphate is formed.
11. Red rose petals turn white.
12. Paper turns pink to white.
13. Ammonia burns with a green flame.
14. Litmus turns blue to red then gets bleached.
15. The red litmus solution turns blue.
16. Neutral litmus solution turns blue.
17. Solution turns silver black due to lead sulphide formation.
18. Dense white fumes are observed.
19. Pale blue solution slowly turns pale green.
20. When barium chloride is added to sodium sulphate, the products are sodium chloride (which remains in the solution) and barium sulphate precipitate (which settles down as a white precipitate).

$$BaCl_2 + Na_2SO_4 \longrightarrow \underset{\text{(white ppt.)}}{BaSO_4 \downarrow} + 2NaCl$$

❐

Question Set 7

Define/Explain the Following

Chapter 1. Periodic Properties and Variations of Properties

1. Typical elements.
2. Transition elements.
3. Actinides
4. Rare earths.
5. Transuranium elements.
6. Bridge elements
7. Ionization potential
8. Electron affinity

Ans. 1. The elements of the third period (Na, Mg, Al, Si, P, S, Cl, Ar) are called the typical elements. Each of these elements represent the general properties of all the elements of its group.

2. The elements which possesses partially filled *d*-orbital in its penultimate shell are called transition elements.

3. The 15 elements beginning with actinium and have atomic numbers 89 to 103 are called actinides.

4. The sixth period has 15 elements with atomic numbers 57 to 71 (La-Lu), beginning with lanthanum. These 15 elements are very much alike chemically and are known as rare earths or lanthanides.

5. The elements beyond uranium U, in the seventh period are called transuranium elements. These elements do not occur naturally. They all have been prepared artificially.

6. The elements of second period are called bridge elements because they connect their own group elements with the elements of next group lying diagonally to them in the periodic table *e.g.,* Li (Lithium) and Mg (Magnesium).

7. It is the amount of energy required to remove an electron from the outer most (valence) shell of an isolated gaseous atom.

8. It is the amount of energy released when an electron is added to the outer most (valence) shell of an isolated gaseous atom.

Chapter 2. Chemical Bonding

1. Chemical bond
2. Electrovalent bond
3. Electrovalency
4. Covalent bond
5. Polar covalent bond
6. Non-polar covalent bond
7. Co-ordinate bond.
8. Lone pair
9. Hydronium ion
10. Electropositive elements
11. Electronegative elements

Ans. 1. An attractive force which hold atoms, ions or molecules together, is known as a chemical bond or linkage.

2. A chemical bond formed by transfer of one or more electrons between two atoms, is known as electrovalent or polar ionic bond.

3. The number of electrons lost or gained by an atom, is called the electrovalency of that element.

4. The bond formed by equal contribution and mutual sharing of electrons between two atoms so that both the atoms acquire the stable nearest noble gas configuration i.e., get their octet complete is called covalent bond.

5. When a covalent bond is formed between two atoms having different electronegativities, the shared pair of electrons is attracted more towards the atom having higher electronegativity. This atom acquires a partial negative charge other atom acquires a partial positive charge.

6. When a covalent bond is formed between two identical atoms of the same element, the shared pair of electrons is attracted equally by both the bonded atoms. Such a covalent bond is called non-polar covalent bond. *e.g.,* Cl–Cl, H–H etc.
7. A co-ordinate bond is a special type of covalent bond which is formed by one side sharing of lone pair of electron between the two atoms.
8. Lone pair is defined as the pair of electrons which are not shared by any of the reacting atoms. Lone pair of electrons is actually responsible for its basic nature. Example of lone pairs are NH_3, H_2O.
9. It is a hydrogen ion in association with a molecule of water. In a water molecule, the oxygen atom has two pairs of unshared electrons. The hydrogen ion does not have any electron in the valence shell. Hence, it shares a pair of electrons from the oxygen atom by means of co-ordinate valency to from an H_3O^+ ion.
10. Elements producing cations are known as electropositive elements, e.g. Na^+, K^+, etc.
11. Those elements which produce anions are called as electronegative elements, *e.g.*, Cl^-, N^{3-} etc.

Chapter 3. Study of Acids, Bases and Salts

1. An acid
2. A base
3. An alkali
4. Salts
5. Normal salt
6. Acid salt
7. Basic salt

Ans. 1. A compound which on dissolving in water furnishes a proton [Hydrogen ion (H^+)] as the only positively charged ion is called acid or it is a compound which dissolves in water to form hydronium ion, *i.e.*, HCl, H_2SO_4 etc.
2. A base is a compound which combines with the hydronium ion (H_3O^+) of an acid to form salt and water only, or it is the oxide or hydroxide of a metal which will neutralize the acid.
3. An alkali is a compound, which on dissolving in water furnishes OH^- ions as only negative ions, *e.g.,* NaOH, KOH etc. The soluble bases are called alkali.
4. A salt is an ionic compound which when dissolved in water, yields a positive ion other than hydrogen ion (H^+) and a negative ion other than hydroxyl ion (OH^-).
5. A normal salt is one which does not contain any of ionisable or replaceable hydrogen atoms in its molecule. For example : NaCl, Na_2SO_4, AgCl, $FeCl_3$ etc.
6. An acid salt contains one or more partially replaceable hydrogen ions (H^+) in it. For example : $NaHCO_3$, $KHSO_3$, $Ca(HCO_3)_2$ etc.
7. A basic salt is formed as a result of incomplete neutralisation of a base by an acid. It contains replaceable hydroxyl ions (OH^-). For example : $CuCO_3$, $Cu(OH)_2$, $PbCO_3$, $Pb(OH)_2$ etc.

Chapter 5. Mole Concept and Stoichiometry

1. Gay Lussac's law of gaseous volumes
2. S.T.P.
3. Absolute Zero
4. Avogadro's law
5. Atomic weight
6. Gram atom
7. Gram molecule
8. Molar volume of gas
9. Vapour Density
10. Torr
11. Atomicity of a gas
12. Molecular formula of a compound
13. Empirical formula of a compound

Ans. 1. It states that whenever gases react they always do so in volumes which bear a simple whole number ratio to one another and to the volume of gaseous products, provided that all the volumes are being measured under similar conditions of temperature and pressure.
2. S.T.P. stands for standard temperatutre and pressure. The standard temperature is 273K and the standard pressure is 1 atm. pressure.
3. The hypothetical temperature (– 273°C) at which a gas will have zero volume is known as Absolute Zero. This temperature is not attainable in practice and all gases condense to liquid state before this temperature is attained.

4. It states that equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules.
5. Atomic weight of an element is the ratio between the mass of 1 atom of that element and $\frac{1}{12}$ of the mass of C–12 isotope.

$$\text{Atomic weight} = \frac{\text{Mass of one atom of the element}}{1/12 \text{ of the mass of C–12 isotope}}$$

6. It is the quantity of an element whose weight in grams is numerically equal to the atomic weight of the element. It is expressed in a.m.u.
7. It is the quantity of a substance whose weight in grams is numerically equal to the molecular weight of the substance.
8. The volume occupied by one gram molecular weight of a gas at S.T.P. is always equal to 22·4 litres. This volume is called molar volume of a gas.
9. It is the ratio between the masses of equal volumes of a gas and hydrogen under the same conditions of temperature and pressure.
10. The pressure exerted by 1mm of Mercury (Hg) column is called one torr.

$$1 \text{ atm} = 760 \text{ mm Hg} = 760 \text{ torr} = 1{\cdot}013 \times 10^5 \text{ Pa}$$

11. Atomicity of a gas is the number of atoms present in one molecule of a gas. For example, a gas which contains only one atom is called monoatomic. Similarly, a gas which contains two atoms is called diatomic.
12. Molecular formula represents the actual number of atoms of various elements present in a molecule of a compound.
13. It is the simplest formula of a compound as it represents the simplest whole number ratio between the atoms of various elements present in a molecule of a compound.

Chapter 6. Electrolysis

1. Electrolysis
2. Electrolytes.
3. Strong electrolyte
4. Weak electrolytes
5. Non-electrolytes
6. Electrolytic cell
7. Electrodes
8. Cathode
9. Anode
10. Ions
11. Cations
12. Anions
13. Ionisation
14. Dissociation
15. Reduction
16. Oxidation
17. Ionic equation
18. Electroplating
19. Electrometallurgy

Ans.

1. The process due to which, a chemical compound in aqueous or fused state conducts direct electric current and at the same time undergoes chemical decomposition, due to the discharge of charged ions is called electrolysis.
2. An electrolyte is a substance, which in the fused state or in aqueous solution conducts an electric current and itself is decomposed as a result of electric current passing through it. For example sodium chloride, potassium chloride and acidulated water.
3. An electrolyte having high degree of dissociation, is termed as strong electrolyte and hence it is completely dissociated in solution.
4. The compounds which in their fused state or aqueous solution are feebly ionised and are poor conductors of electricity are called weak electrolytes. For example, acetic acid, oxalic acid.
5. Non-electrolytes are substances which do not allow the current to pass through them either in the molten state or in aqueous solution. Non electrolytes are non-ionic.

6. The vessel in which electrolysis is carried out consisting of two electrodes and an electrolyte is called an electrolytic cell or voltameter.
7. The graphite or metal plates or rods, through which current enters or leaves an electrolyte, are called electrodes.
8. The electrode which is connected to the negative terminal of a battery, or a cell, is called cathode. The current from electrolyte leaves through cathode.
9. The electrode which is connected to the positive terminal of a battery, or a cell, is called anode. The current enters the electrolyte from anode.
10. When a chemical compound in fused state or in aqueous solution, breaks up into electrically charged atoms or group of atoms, then they are collectively called ions. For example, K^+, Mg^{2+}, Ca^{2+}, F^-, I^-, S^{2-}
11. The positively charged ions, which migrate towards cathode on the passage of electric current, are called cations. The cations accept electrons from cathode and change to neutral atoms. For example, Na^+, Ca^{2+}, K^+.
12. The negatively charged ions, which migrate towards anode on the passage of electric current are called anions. The anions donate electrons to anode and change to neutral atoms. For example, Cl^-, I^-, OH^-.
13. The process of formation of positively and negatively charged ions from molecules which are not initially in the ionic state is called ionisation. *e.g.,* Polar covalent compound HCl.
$$HCl \rightleftharpoons H^+ + Cl^-$$
14. The process of separation of ions which are already present in an ionic compound is called electric dissociation. *e.g.,* electrovalent compounds, NaCl.
$$NaCl \rightleftharpoons Na^+ + Cl^-$$
15. A process of gaining of electrons by a cation to form neutral atom (or gaining of electrons by an electronegative atom to form an anion) is called reduction. Reduction takes place at cathode.
16. A process of loss of electrons by an atom to form a cation (or loss of electrons by an anion to form atom) is called oxidation. Oxidation takes place at anode.
17. A chemical equation which represents the actual atoms (unionised) or ions or radicals taking part in a chemical reaction by the actual exchange of electrons is called an ionic equation.
18. The process of depositing a metal, generally a superior metal like silver, gold, chromium or nickel over another metal or article with the help of electric current is called electroplating**.**
19. The process of extracting metals from their ores with the help of electrolysis is called electrometallurgy. Highly electronegative metals like Na, K, Mg, Ca and Al are extracted by electrolysis of their fused halides or oxides.

Chapter 7. Metallurgy

1. Metal
2. Metalloids
3. Metallurgy
4. Ore
5. Gangue or Matrix
6. Slag
7. Flux
8. Roasting
9. Calcination
10. Alloy
11. Galvanized iron
12. Passive iron
13. Hardening of steel
14. Tempering of steel
15. Case hardening of steel
16. Amalgams

Ans.

1. A metal is an element which forms a positive ion by the loss of electrons. They are hard, malleable, ductile, lustrous, sonorous and also good conductors of heat and electricity.
2. Elements which exhibit the properties of both metals and non-metals, are called metalloids. They are also known as semimetals. For example, Arsenic, Antimony and Bismuth.
3. The processes involved in the extraction of pure metals from their ore are collectively called metallurgy.
4. Those minerals from which, the metals are extracted commercially at a comparatively low cost and with minimum effort, are called ores of the metals.

5. The unwanted impurities which are associated with ore are called gangue or matrix. *e.g.,* stone, clay etc.
6. A fusible mass produced by the combination of flux and gangue is called slag.
7. A flux is a substance which is added to refine metals by combining with impurities to form a molten mixture that can be readily removed.
8. The process of strongly heating the ore in excess of air is called roasting.
9. The process of heating the ore in a limited supply of air, such that temperature is not sufficient to melt the ore is called calcination.
10. An alloy is a homogeneous mixture of either two or more metals or a metal and a non-metal which are mixed together in definite proportion in their molten state.
11. Iron sheets with their surface covered with zinc coating either by electrolysis or by dipping them in molten zinc are known as galvanised iron sheets.
12. Iron dipped in conc. nitric acid and rendered unreactive due to the formation of the layer of ferric oxide, is known as passive iron.
13. When steel heated to a temperature of 750°C to 800°C and then suddenly plunged into cold water or cold oil, the process is called hardening of steel.
14. The process of heating the hardened steel to some fixed temperature and then cooling it slowly is called tempering or annealing of steel.
15. The process of heating mould steel with powdered carbon in clay moulds, such that its upper surface becomes very hard, but inner surface remains soft and spongy is called case hardening of steel.
16. An alloy of mercury with, one or more other metals is called on amalgan, *e.g.,* zinc amalgam, sodium amalgam, etc.

Chapter 9. Organic Chemistry

1. Catenation
2. Hydrocarbons
3. Functional group
4. Isomerism
5. Homologous series
6. Pyrolysis
7. Fermentation

Ans. 1. The property of self-linking of carbon atoms through covalent bonds to form long, straight or branched chain and rings of different sizes is called catenation.

2. Hydrocarbons are the compounds made up of only carbon and hydrogen *e.g.,* CH_4, C_2H_5.
3. An atom of compounds of the same family in which each member differ from its adjacent.
4. Compounds having the same molecular formula, but different structural formula, are called 'Isomers' of one another and this phenomenon is called 'Isomerism'.
5. A series of compounds of the same family in which each member differ from its adjacent member by one CH_2 unit, is called homologous series.
6. The process of decomposition of an organic compound into elements on heating is called pyrolysis.
7. The process of slow decomposition of complex organic compounds into similar substances, in presence of enzymes is called fermentation.

❐

Question Set 8

Balancing/Writing the Chemical Equations

Chapter 3. Study of Acids, Bases and Salts

(a) Write correctly balanced equations for the following reactions :

1. Molten sodium and chlorine.
2. Nitrogen and oxygen, when lightning strikes.
3. Iron and dilute sulphuric acid.
4. Decomposition of hypochlorous acid in sunlight.
5. Decomposition of potassium nitrate.
6. Sodium thiosulphate is reacted with dilute hydrochloric acid.
7. Calcium bicarbonate reacts with dilute hydrochloric acid.
8. Dilute sulphuric acid is poured over sodium sulphate.
9. Lead nitrate solution is added to sodium chloride solution.
10. Zinc is heated with sodium hydroxide solution.
11. Lead sulphate from lead nitrate solution and dilute sulphuric acid.
12. Copper sulphate from copper and concentrated sulphuric acid.
13. Lead chloride from lead nitrate solution and sodium chloride solution.
14. Ammonium sulphate from ammonia and dilute sulphuric acid.
15. Sodium chloride from sodium carbonate solution and dilute hydrochloric acid.
16. Magnesium and dilute sulphuric acid.
17. Zinc carbonate and dilute sulphuric acid.
18. Copper oxide and dilute sulphuric acid.
19. Ferric hydroxide reacts with nitric acid.
20. Zinc oxide dissolves in sodium hydroxide.

Ans.

1. $2Na + Cl_2 \longrightarrow 2NaCl$
2. $N_2 + O_2 \longrightarrow 2NO$
3. $Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2$
4. $2HClO \xrightarrow{\text{Sunlight}} 2HCl + O_2$
5. $2KNO_3 \longrightarrow 2KNO_2 + O_2$
6. $Na_2S_2O_3 + 2HCl \longrightarrow 2NaCl + SO_2 + \ + S \downarrow + H_2O$
7. $Ca(HCO_3)_2 + 2HCl \longrightarrow CaCl_2 + 2H_2O + 2CO_2 \uparrow$
8. $Na_2SO_3 + H_2SO_4$ (dilute) $\longrightarrow Na_2SO_4 + H_2O + SO_2 \uparrow$
9. $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$
10. $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2 \uparrow$
11. $Pb(NO_3)_2 + H_2SO_4 \longrightarrow PbSO_4 \downarrow + 2HNO_3$
    Lead nitrate; Sulphuric acid; Lead sulphate; Nitric acid
12. $Cu + 2H_2SO_4 \longrightarrow CuSO_4 + 2H_2O + SO_2$
    Copper; Sulphuric acid; Copper sulphate; Water; Sulphur dioxide
13. $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$
    Lead nitrate; Sodium chloride; Lead chloride; Sodium nitrate

14. $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$
Ammonia; Sulphuric acid; Ammonium sulphate

15. $Na_2CO_3 + 2HCl \longrightarrow NaCl + H_2O + CO_2$
Sodium carbonate; Hydrochloric acid; Sodium chloride; Water; Carbon dioxide

16. $MgO + H_2SO_4$ (dil.) $\longrightarrow MgSO_4 + H_2\uparrow$

17. $ZnCO_3 + H_2SO_4 \longrightarrow ZnSO_4 + H_2O + CO_2 \uparrow$

18. $CuO + H_2SO_4$ (dil.) $\longrightarrow CuSO_4 + H_2O$

19. $Fe(OH)_3 + 3HNO_3 \longrightarrow Fe(NO_3)_3 + 3H_2O$

20. $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$

(b) Write the equation for the laboratory preparation of the following salts.

1. Iron(II) sulphate from iron.
2. Copper sulphate from copper.
3. Lead sulphate from lead nitrate.
4. Sodium sulphate from sodium carbonate.
5. Copper sulphate from copper(II) oxide.
6. Iron(III) chloride from iron.
7. Potassium sulphate from potassium hydroxide solution.
8. Lead chloride from lead carbonate (two equations).
9. Zinc sulphate from zinc.
10. Sodium sulphate from sodium hydroxide.
11. Lead(II) chloride from lead nitrate.
12. Copper(II) sulphate from copper carbonate.
13. Calcium carbonate from calcium chloride.
14. Sodium sulphate from sodium carbonate.
15. Zinc carbonate from zinc nitrate.

Ans. 1. $Fe + H_2SO_4 \xrightarrow{\text{dil.}} FeSO_4 + H_2 \uparrow$

2. $Cu + 2H_2SO_4 \xrightarrow{\text{conc.}} CuSO_4 + 2H_2O + SO_2$

3. $Pb(NO_3)_2 + H_2SO_4 \xrightarrow{\text{dil.}} PbSO_4 + 2HNO_3$

4. $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$

5. $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$
Copper(II) oxide; Copper sulphate

6. $2Fe + 3Cl_2 \longrightarrow 2FeCl_3$
Iron; Chlorine; Ferric chloride

7. $2KOH + H_2SO_4 \xrightarrow[200°C]{\text{Temp. above}} K_2SO_4 + 2H_2O$
Potassium hydroxide; Potassium sulphate

8. $PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2 \uparrow$
Lead carbonate (insoluble salt); Lead nitrate (soluble salt)

$Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$
Lead nitrate; Lead chloride

9. $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2 \uparrow$
(dil.)

10. $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$
(dil.)

11. $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$

12. $CuCO_3 + H_2SO_4 \longrightarrow CuSO_4 + H_2O + CO_2$
Copper carbonate; (dil.); Copper(II) sulphate

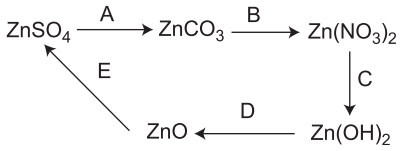
13. $CaCl_2 + Na_2CO_3 \longrightarrow CaCO_3 + 2NaCl$

14. $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$
Sodium carbonate; dil. sulphuric acid; Sodium sulphate

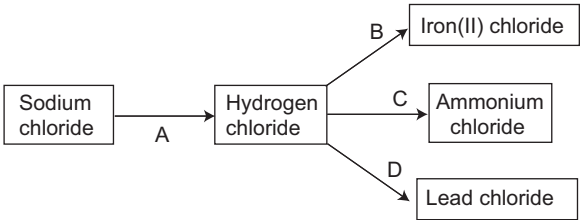
15. $Zn(NO_3)_2 + Na_2CO_3 \longrightarrow ZnCO_3 + 2NaNO_3$
Zinc nitrate; Sodium carbonate; Zinc carbonate; Sodium nitrate

(c) Study the following conversion schemes :

1. Give the equations for the following conversions A to E.



2. Refer to the flow chart diagram below and give balanced equations with conditions, if any, for the following conversions A to D.



3. Lead $\xrightarrow{A}$ Lead(II) oxide $\xrightarrow{B}$ Lead(II) nitrate $\xrightarrow{C}$ Lead(II) hydroxide
$\downarrow$ **D**
Lead(II) carbonate

(i) For each of the conversions A to D in the above state briefly how the conversions can be carried out.

(ii) Write equations for the conversions.

4. For each of the conversion in the scheme given below, state briefly in words or by means of chemical equation, how the conversion is carried out ?

Copper $\xleftarrow{A}$ Copper(II) oxide $\xrightarrow{B}$ Copper sulphate
$\downarrow$ **D** $\downarrow$ **C**
Copper(II) carbonate Copper sulphide

5. How are the following conversions carried out ? Give balanced chemical equations only.

$$PbO \underset{D}{\overset{A}{\rightleftharpoons}} Pb(NO_3)_2 \xrightarrow{B} Pb(OH)_2$$
$Pb(NO_3)_2 \xrightarrow{C}$ (**E** $\downarrow$) $PbCl_2$

$$Zn \xrightarrow{A} ZnS \xrightarrow{B} ZnSO_4 \xrightarrow{C} Zn(OH)_2$$
E $\downarrow$ **F** $\downarrow$ $\downarrow$ **D**
H_2S $ZnCO_3 \xrightarrow{G} ZnO$

$$Fe \xrightarrow{A} FeS \xrightarrow{B} FeCl_2 \xrightarrow{C} Fe(OH)_2$$
E $\downarrow$ **F** $\downarrow$ $\downarrow$ **D**
H_2S $FeCO_3 \xrightarrow{G} FeO$

$$Fe \xrightarrow{A} FeCl_3 \xrightarrow{B} Fe(OH)_3 \xrightarrow{C} Fe_2O_3$$

Ans. 1. [A] $ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$
Zinc sulphate; Sodium carbonate; Zinc carbonate; Sodium sulphate

[B] $ZnCO_3 + 2HNO_3 \longrightarrow Zn(NO_3)_2 + H_2O + CO_2$
Zinc carbonate; Nitric acid; Zinc nitrate; Water

[C] $Zn(NO_3)_2 + 2NaOH \longrightarrow Zn(OH)_2 + 2NaNO_3$
Zinc nitrate; Sodium hydoxide; Zinc hydroxide; Sodium nitrate

[D] $Zn(OH)_2 \xrightarrow{\text{Heated}} ZnO + H_2O$
Zinc hydroxide; Zinc oxide; Water

[E] $ZnO + H_2SO_4 \longrightarrow ZnSO_4 + H_2O$
Zinc oxide; Sulphuric acid; Zinc sulphate; Water

2. [A] $NaCl + H_2SO_4 \xrightarrow{\Delta < 200°C} NaHSO_4 + HCl\uparrow$
conc.; Hydrogen chloride

[B] $2HCl + Fe \longrightarrow FeCl_2 + H_2$
Iron(II) chloride

[C] $HCl_{(g)} + NH_{3(g)} \longrightarrow NH_4Cl$
Ammonium chloride

[D] $2HCl + Pb(NO_3)_{2(aq)} \longrightarrow PbCl_2\downarrow + 2HNO_3$
(dil.); Lead chloride

3. [A] Lead(II) oxide, when heated with powdered coke, reduced to metallic lead and carbon monoxide is formed.

$$PbO + C \longrightarrow Pb + CO$$

[B] Lead(II) oxide, when dissolved in the dilute nitric acid, lead nitrate is formed.

$$PbO + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O$$
Lead nitrate

[C] Lead(II) nitrate is dissolved in water and then sodium hydroxide solution is added, a white precipitate of lead hydroxide is obtained.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 + 2NaNO_3$$

[D] Lead(II) nitrate is dissolved in water and then concentrated solution of sodium carbonate is added, a white precipitate of lead (II) carbonate is obtained.

$$Pb(NO_3)_2 + Na_2CO_3 \longrightarrow PbCO_3 + 2NaNO_3$$

4. [A] Copper(II) oxide, when heated with coke powder is reduced to metallic copper.

$$CuO + C \longrightarrow Cu + CO$$
Metallic copper

[B] Copper(II) oxide is dissolved in dilute sulphuric acid to form copper sulphate.

$$CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$$
Copper sulphate

[C] Copper sulphate is dissolved in water and hydrogen sulphide gas is passed, a black precipitate of copper sulphide is formed.

$$CuSO_4 + H_2S \longrightarrow CuS + H_2SO_4$$
Black ppt.

[D] Copper(II) oxide is dissolved in dilute hydrochloric acid to form copper chloride. To the solution of copper chloride, when a saturated solution of sodium carbonate is added, a light blue precipitate of copper(II) carbonate is formed.

$$CuCl_2 + Na_2CO_3 \longrightarrow CuCO_3 + 2NaCl$$

5. (i) [A] $PbO + 2HNO_3 \xrightarrow[\text{(dil.)}]{} Pb(NO_3)_2 + H_2O$

[B] $Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 + 2NaNO_3$

[C] $Pb(OH)_2 \xrightarrow{\Delta} PbO + H_2O$

[D] $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2$

[E] $Pb(NO_3)_2 + 2NaCl \longrightarrow PbCl_2 + 2NaNO_3$

(ii) [A] $Zn + S \xrightarrow{\Delta} ZnS$

[B] $ZnS + H_2SO_4 \xrightarrow[\text{(dil.)}]{} ZnSO_4 + H_2S$

[C] $ZnSO_4 + 2NaOH \longrightarrow Zn(OH)_2 + Na_2SO_4$

[D] $Zn(OH)_2 \xrightarrow{\Delta} ZnO + H_2O$

[E] $ZnS + 2HCl \xrightarrow[\text{(dil.)}]{} ZnCl_2 + H_2S$

[F] $ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$

[G] $ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$

(iii) [A] $Fe + S \xrightarrow{\Delta} FeS$

[B] $FeS + 2HCl \xrightarrow[\text{(dil.)}]{} FeCl_2 + H_2S$

[C] $FeCl_2 + 2NaOH \longrightarrow Fe(OH)_2 + 2NaCl$

[D] $Fe(OH)_2 \xrightarrow{\Delta} FeO + H_2O$

[E] $FeS + 2HCl \longrightarrow FeCl_2 + H_2S$

[F] $FeCl_2 + Na_2CO_3 \longrightarrow FeCO_3 + 2NaCl$

[G] $FeCO_3 \xrightarrow{\Delta} FeO + CO_2$

(iv) [A] $2Fe + 3Cl_2 \xrightarrow[\text{Dry}]{} 2FeCl_3$

[B] $FeCl_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaCl$

[C] $2Fe(OH)_3 \xrightarrow{\Delta} Fe_2O_3 + 3H_2O$

(d) How can the following be converted to the respective chloride, sulphate and nitrate salts ? Give equations :

1. Magnesium, 2. Zinc, 3. Iron, 4. Lead carbonate, 5. Copper oxide, 6. Potassium hydroxide, 7. Copper hydroxide, 8. Ammonium hydroxide.

Ans. 1. $\underset{\text{Magnesium}}{Mg(s)} + \underset{\text{Hydrochloric acid}}{2HCl(aq.)} \longrightarrow \underset{\text{Magnesium chloride}}{MgCl_2(aq.)} + \underset{\text{Hydrogen}}{H_2(g)}$

2. $\underset{\text{Zinc}}{Zn(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4(aq.)} \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4(aq.)} + \underset{\text{Hydrogen}}{H_2(g)}$

3. $\underset{\text{Iron}}{Fe(s)} + \underset{\text{Sulphur}}{S(s)} \longrightarrow \underset{\text{Iron(II) Sulphide}}{FeS(s)}$

4. $\underset{\text{Lead carbonate}}{PbCO_3(s)} + \underset{\text{Nitric acid}}{2HNO_3(aq.)} \longrightarrow \underset{\text{Lead nitrate}}{Pb(NO_3)_2(aq.)} + H_2O(l) + CO_2(g)$

5. $\underset{\text{Copper oxide}}{CuO(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4(aq.)} \longrightarrow \underset{\text{Copper sulphate}}{CuSO_4(aq.)} + H_2O(l)$

6. $\underset{\text{Potassium hydroxide}}{2KOH} + \underset{\text{Carbon dioxide}}{CO_2(g)} \longrightarrow \underset{\text{Potassium carbonate}}{K_2CO_3(aq.)} + H_2O(l)$

7. $\underset{\text{Copper hydroxide}}{Cu(OH)_2(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4(aq.)} \longrightarrow \underset{\text{Copper sulphate}}{CuSO_4(aq.)} + 2H_2O$

8. $\underset{\text{Ammonium hydroxide}}{3NH_4OH(aq.)} + \underset{\text{Phosphoric acid}}{H_3PO_4(aq.)} \longrightarrow \underset{\text{Ammonium phosphate}}{(NH_4)_3PO_4(aq.)} + 3H_2O(l)$

(e) Action of dil. acids on :

(i) Carbonates (ii) Bicarbonates

(iii) Sulphites (iv) Sulphides

Ans. (i) $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

(ii) $NaHCO_3 + HNO_3 \longrightarrow NaNO_3 + H_2O + CO_2$

(iii) $ZnSO_3 + 2HCl \longrightarrow ZnCl_2 + H_2O + SO_2$

(iv) $2KHSO_3 + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O + 2SO_2$

Chapter 4. Analytical Chemistry

Write balanced chemical equations to show the reactions of the following :

1. Aluminium and caustic potash solution.
2. Aluminium oxide and sodium hydroxide.
3. Aluminium oxide and potassium hydroxide.
4. Zinc oxide and potassium hydroxide.
5. Zinc is heated with sodium hydroxide solution.
6. Zinc oxide dissolves in sodium hydroxide.
7. Caustic soda solution and zinc oxide.
8. Caustic soda solution and aluminium oxide.
9. Caustic soda solution and lead monoxide.
10. Action of KOH on $CuSO_4$
11. Action of KOH on $CaSO_4$
12. Action of KOH on $ZnSO_4$
13. Action of KOH on $Fe_2(SO_4)_3$.
14. Action of sodium hydroxide on freshly precipitated aluminium hydroxide.
15. Zinc oxide is treated with sodium hydroxide solution.

Ans. 1. $\underset{\text{Aluminium}}{2Al} + \underset{\text{Caustic potash}}{2KOH} + 2H_2O \longrightarrow \underset{\text{Potassium aluminate}}{2KAlO_2} + 3H_2\uparrow$

2. $\underset{\text{Aluminium oxide}}{Al_2O_3} + \underset{\text{Sodium hydroxide}}{2NaOH} \longrightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + H_2O$

3. $\underset{\text{Aluminium oxide}}{Al_2O_3} + \underset{\text{Potassium hydroxide}}{2KOH} \longrightarrow \underset{\text{Potassium aluminate}}{2KAlO_2} + H_2O$

4. $\underset{\text{Zinc oxide}}{ZnO} + \underset{\text{Potassium hydroxide}}{2KOH} \longrightarrow \underset{\text{Potassium zincate}}{K_2ZnO_2} + H_2O$

5. $Zn + 2NaOH \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2\uparrow$

6. $ZnO + 2NaOH \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2O$

7. $\underset{\text{Zinc oxide}}{ZnO} + \underset{\text{Caustic soda}}{2NaOH} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + \underset{\text{Water}}{H_2O}$

8. $Al_2O_3 + 2NaOH \longrightarrow 2NaAlO_2 + H_2O$
Aluminium oxide; Caustic soda; Sodium meta aluminate; Water

9. $PbO + 2NaOH \longrightarrow Na_2PbO_2 + H_2O$
Lead oxide; Caustic soda; Sodium plumbite; water

10. $CuSO_4 + 2KOH \longrightarrow Cu(OH)_2 \downarrow + K_2SO_4$
Copper sulphate Blue solution; Potassium hydroxide; Copper hydroxide (Blue ppt.); Potassium sulphate

$Cu(OH)_2 + KOH \longrightarrow$ No reaction
(Excess)

11. $MgSO_4 + 2KOH \longrightarrow Mg(OH)_2 \downarrow + K_2SO_4$
Magnesium sulphate; Potassium hydroxide; Magnesium hydroxide (A white ppt.); Potassium sulphate

$Mg(OH)_2 + KOH \longrightarrow$ No reaction
(Excess)

12. $ZnSO_4 + 2KOH \longrightarrow Zn(OH)_2 + K_2SO_4$
Zinc sulphate (Colourless); Potassium hydroxide; Zinc hydroxide (White ppt.); Potassium sulphate

$Zn(OH)_2 + 2KOH \longrightarrow K_2ZnO_2 + 2H_2O$
(Excess); Potassium zincate (Water soluble)

13. $Fe_2(SO_4)_3 + 6KOH \longrightarrow 2Fe(OH)_3 + 3K_2SO_4$
Ferric sulphate (Brown); Potassium hydroxide; Ferric hydroxide (Reddish brown ppt.); Potassium sulphate

$Fe(OH)_3 + KOH \longrightarrow$ No reaction
(Excess)

14. $Al(OH)_3 + NaOH \xrightarrow{\Delta} NaAlO_2 + 2H_2O$
Aluminium hydroxide; Sodium meta-aluminate

15. $ZnO + 2NaOH \longrightarrow Na_2ZnO_2 + H_2O$
Zinc oxide; Sodium zincate

Chapter 6. Electrolysis

(a) Write equations for the reactions taking place at cathode and at anode during the electrolysis of :

1. Acidified nickel sulphate solution with nickel electrode.
2. Acidified copper sulphate solution with copper electrode.
3. Acidified copper sulphate solution with platinum electrode.
4. Acidulated water with inert electrode.
5. Molten lead bromide with inert electrodes.
6. Electroplating a spoon with silver.

Ans. 1. Cathode : $Ni^{2+} + 2e^- \longrightarrow Ni$

Anode : $Ni - 2e^- \longrightarrow Ni^{2+}$

2. Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$

Anode : $Cu - 2e^- \longrightarrow Cu^{2+}$

3. Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$

Anode : $OH^- - e^- \longrightarrow OH$

$4OH^- \longrightarrow 2H_2O + H_2$

4. Cathode : $H^+ + e^- \longrightarrow [H]$

$2[H] \longrightarrow H_2$

Anode : $OH^- - e^- \longrightarrow OH$

$4OH \longrightarrow 2H_2O + O_2$

5. Cathode : $Pb^{2+} + 2e^- \longrightarrow Pb$

Anode : $2Br^- - 2e^- \longrightarrow 2[Br]$

$2[Br] \longrightarrow Br_2$

6. Cathode : $AgNO_3 \longrightarrow Ag^+ + NO_3^-$

$Ag^+ + e^- \longrightarrow Ag$

Anode : $NO_3^- - e^- \longrightarrow NO_3$

$Ag + NO_3 \longrightarrow AgNO_3$

(b) Complete and balance the following equations :

1. $CH_3COOH \rightleftharpoons$ …… + ……
2. $4H^+ +$ …… $\longrightarrow 2H_2$
3. $Ag^+ +$ …… $\longrightarrow Ag$
4. $Cl^- - 1e^- \longrightarrow$ ……
5. $CuSO_4(aq.) \rightleftharpoons$ …… + ……
6. $H_2O \rightleftharpoons$ …… + ……
7. $AgNO_3 \rightleftharpoons$ …… + ……
8. $4OH^- -$ …… $\longrightarrow 4OH$
9. $Na[Ag(CN)_2] \rightleftharpoons$ …… + …… + ……
10. $NiSO_4 \rightleftharpoons$ …… + ……

Ans. 1. $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

2. $4H^+ + 4e^- \longrightarrow 2H_2$
3. $Ag^+ + e^- \longrightarrow Ag$
4. $Cl^- - e^- \longrightarrow Cl$
5. $CuSO_4(aq.) \rightleftharpoons Cu^{2+} + SO_4^{2-}$
6. $H_2O \rightleftharpoons H^+ + OH^-$
7. $AgNO_3 \rightleftharpoons Ag^+ + NO_3^-$
8. $4OH^- - 4e^- \longrightarrow 4OH$
9. $Na[Ag(CN)_2] \rightleftharpoons Na^+ + Ag^+ + 2CN^-$
10. $NiSO_4 \rightleftharpoons Ni^{2+} + SO_4^{2-}$

(c) Write equations for the reactions taking place at the two electrodes (mentioning clearly the name of the electrode) during the electrolysis of :

1. Acidified copper sulphate solution with copper electrodes.
2. Molten lead bromide with inert electrodes.

Ans. 1. $CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^-$

$\therefore$ $CuSO_4$ undergoes dissociation reaction.

Cathode : $Cu^{2+} + 2e^- \longrightarrow Cu$

Anode : $Cu - 2e^- \longrightarrow Cu^{2+}$

2. $PbBr_2 \rightleftharpoons Pb^{2+} + 2Br^-$

Cathode : $Pb^{2+} + 2e^- \longrightarrow Pb$

Anode : $2Br^- - 2e^- \longrightarrow Br_2\uparrow$

Chapter 7. Metallurgy

(a) Write balanced chemical equation :

1. The reduction of metallic oxide inside the blast furnace.
2. Formation of slag inside the blast furnace.
3. Heating of aluminium hydroxide.
4. Reaction of zinc with hot concentrated sodium hydroxide.
5. Reduction of zinc oxide.
6. Burning of aluminium in air.
7. Reduction of ferric oxide by aluminium powder.
8. Calamine is heated.
9. Zinc placed in ferrous sulphate solution.
10. Reduction of copper oxide by hydrogen.

11. Reduction of iron(III) oxide by carbon monoxide.
12. Reduction of lead(II) oxide by carbon.
13. Action of heat on aluminium hydroxide.
14. Zinc is treated with dilute sulphuric acid.
15. Action of copper sulphate solution on zinc.
16. Action of steam on zinc.

Ans. 1. $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3O_2$

2. $CaO + SiO_2 \longrightarrow CaSiO_3$

3. $2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O$

4. $Zn + 2NaOH \longrightarrow Na_2ZnO_2 + H_2$

5. $ZnO + C \longrightarrow Zn + CO$

6. $4Al + 3O_2 \xrightarrow{\Delta} 2Al_2O_3$

$2Al + N_2 \xrightarrow{\Delta} 2AlN$

7. $Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$

8. $ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2$

9. $Zn + FeSO_4 \longrightarrow ZnSO_4 + Fe$

10. $CuO + H_2 \longrightarrow Cu + H_2O$

11. $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

12. $PbO + C \longrightarrow Pb + CO$

13. $2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2$

14. $Zn + \underset{\text{(Dil.)}}{H_2SO_4} \longrightarrow ZnSO_4 + H_2\uparrow$

15. $Zn + CuSO_4 \longrightarrow ZnSO_4 + Cu.$

16. $Zn + \underset{\text{Steam}}{H_2O} \longrightarrow \underset{\text{Zinc oxide}}{ZnO} + H_2\uparrow$

(b) Complete and balance the following equations :

1. $Zn + HCl \longrightarrow$

2. $Ag_2O \longrightarrow$

3. $Al_2O_3 + NaOH \xrightarrow{\Delta}$

4. $Al(OH)_3 \xrightarrow{\Delta}$

5. $ZnCO_3 \xrightarrow{\Delta}$

6. $ZnO + H_2SO_4 \xrightarrow{\Delta}$

7. $NaAlO_2 + H_2O \xrightarrow{\Delta}$

8. $Al + N_2 \xrightarrow{\Delta}$

9. $Al + NaOH + H_2O \xrightarrow{\Delta}$

10. $ZnS + O_2 \xrightarrow{\Delta}$

11. $Fe_2O_3 + CO \longrightarrow$

12. $Al + Fe_2O_3 \xrightarrow{\Delta}$

Ans. 1. $Zn + \underset{\text{(Dil.)}}{2HCl} \longrightarrow ZnCl_2 + H_2\uparrow$

2. $2Ag_2O \xrightarrow{\Delta} 4Ag + O_2\uparrow$

3. $Al_2O_3 + 2NaOH \xrightarrow{\Delta} 2NaAlO_2 + H_2O$

4. $2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O$

5. $ZnCO_3 \xrightarrow{\Delta} ZnO + CO_2\uparrow$

6. $ZnO + H_2SO_4 \xrightarrow{\Delta} ZnSO_4 + H_2O$

7. $NaAlO_2 + 2H_2O \xrightarrow{\Delta} NaOH + Al(OH)_3\downarrow$

8. $2Al + N_2 \xrightarrow{\Delta} 2AlN$

9. $2Al + 2NaOH + 2H_2O \xrightarrow{\Delta} 2NaAlO_2 + 3H_2\uparrow$

10. $2ZnS + 3O_2 \xrightarrow{\Delta} 2ZnO + 2SO_2\uparrow$

11. $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2\uparrow$

12. $2Al + Fe_2O_3 \xrightarrow{\Delta} Al_2O_3 + 2Fe$

Chapter 8 (a). Study of Compounds : Hydrogen Chloride

(a) Write balanced equations for the reaction of dilute hydrochloric acid with each of the following :

1. Iron
2. Sodium hydrogen carbonate
3. Iron(II) sulphide
4. Sodium sulphite
5. Sodium thiosulphate solution
6. Calcium bicarbonate
7. Calcium carbonate
8. Sodium hydroxide
9. Zinc metal
10. Potassium permanganate
11. Red lead heated
12. Magnesium metal
13. Ammonium hydroxide.
14. Magnesium sulphite.
15. Sodium hydrogen sulphide.
16. Manganese dioxide.

Ans. 1. $Fe + 2HCl \xrightarrow{(Dil.)} FeCl_2 + H_2$

2. $NaHCO_3 + HCl \xrightarrow{(Dil.)} NaCl + H_2O + CO_2$

3. $FeS + 2HCl \xrightarrow{(Dil.)} FeCl_2 + H_2S$

4. $Na_2SO_3 + 2HCl \xrightarrow{(Dil.)} 2NaCl + SO_2 + H_2O$

5. $Na_2S_2O_3 + 2HCl \xrightarrow{(Dil.)} 2NaCl + H_2O + SO_2 + S\downarrow$

6. $Ca(HCO_3)_2 + 2HCl \xrightarrow{(Dil.)} CaCl_2 + 2H_2O + 2CO_2\uparrow$ (Calcium chloride)

7. $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$

8. $NaOH + HCl \longrightarrow NaCl + H_2O$

9. $Zn + 2HCl \longrightarrow ZnCl_2 + H_2$

10. $2KMnO_4 + 16\,HCl \xrightarrow{(Conc.)} 2KCl + 2NaCl_2 + 8H_2O + 5Cl_2(g)$

11. $Pb_3O_4 + 8HCl \xrightarrow{(Conc.)} 3PbCl_2 + 4H_2O + Cl_2(g)$

12. $Mg + 2HCl\,(g) \longrightarrow MgCl_2 + H_2(g)$

13. $NH_4OH + HCl \longrightarrow NH_4Cl + H_2O$ (Ammonium hydroxide)

14. $\underset{\text{Magnesium sulphite}}{MgSO_3} + 2HCl \longrightarrow MgCl_2 + SO_2 + H_2O$

15. $NaHS + HCl \longrightarrow \underset{\text{Sod. hydrogen sulphide}}{NaCl} + H_2S\,(g)$

16. $\underset{\text{Manganese dioxide}}{MnO_2} + \underset{\text{(Conc.)}}{4HCl} \xrightarrow{\text{Boiling}} MnCl_2 + 2H_2O + \underset{\text{Chlorine gas}}{Cl_2\uparrow}$

(b) Write balanced equation for the reaction of hydrochloric acid with each of the following :

1. Marble chips
2. Calcium sulphite
3. Lead nitrate solution.
4. Mangnese oxide.

Ans. 1. $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2\uparrow$

2. $CaSO_3 + 2HCl \longrightarrow CaCl_2\downarrow + H_2O + SO_2\uparrow$

3. $Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2\downarrow + 2HNO_3$

4. $MnO_2 + 4HCl \longrightarrow MnCl_2 + 2H_2O + Cl_2$

(c) Complete and balance the following equations :

1. $KCl + \underset{\text{(Conc.)}}{H_2SO_4} \xrightarrow{<200°C}$
2. $KCl + \underset{\text{(Conc.)}}{H_2SO_4} \xrightarrow{>200°C}$
3. $Cu + \underset{\text{(Dil.)}}{HCl} \longrightarrow$
4. $CuO + \underset{\text{(Dil.)}}{HCl} \longrightarrow$
5. $CuO + [O] + \underset{\text{(Conc.)}}{HCl} \longrightarrow$
6. $Cu(NO_3)_2 + HCl \longrightarrow$
7. $K_2O + HCl \longrightarrow$
8. $HCl \xrightarrow{500°C}$
9. $Zn + HCl \longrightarrow$
10. $Na_2SO_3 + HCl \longrightarrow$
11. $Mg(HCO_3)_2 + HCl \longrightarrow$
12. $PbS + HCl \longrightarrow$
13. $CaCO_3 + HCl \longrightarrow$
14. $KHSO_3 + HCl \longrightarrow$
15. $K_2Cr_2O_7 + HCl \longrightarrow$
16. $P_2O_5 + HCl \longrightarrow$
17. $MnO_2 + HCl \xrightarrow{\Delta}$
18. $CaOCl_2 + HCl \xrightarrow{\Delta}$
19. $HCl + HNO_3 \longrightarrow$
20. $ZnS + HCl \longrightarrow$

Ans. 1. $KCl + \underset{\text{(Conc.)}}{H_2SO_4} \xrightarrow{<200°C} KHSO_4 + HCl$

2. $2KCl + \underset{\text{(Conc.)}}{H_2SO_4} \xrightarrow{>200°C} K_2SO_4 + 2HCl$

3. $Cu + \underset{\text{(Dil.)}}{2HCl} \longrightarrow CuCl_2 + H_2\uparrow$

4. $CuO + \underset{\text{(Dil.)}}{2HCl} \longrightarrow CuCl_2 + H_2O$

5. $CuO + [O] + 4HCl \xrightarrow[(Conc.)]{} CuCl_2 + 2H_2O + Cl_2$
6. $Cu(NO_3)_2 + 2HCl \longrightarrow CuCl_2 + 2HNO_3$
7. $K_2O + 2HCl \longrightarrow 2KCl + H_2O$
8. $2HCl \xrightarrow{500°C} H_2 + Cl_2$
9. $Zn + 2HCl \longrightarrow ZnCl_2 + H_2\uparrow$
10. $Na_2SO_3 + 2HCl \longrightarrow 2NaCl + H_2O + SO_2\uparrow$
11. $Mg(HCO_3)_2 + 2HCl \longrightarrow MgCl_2 + H_2O + CO_2\uparrow$
12. $PbS + 2HCl \longrightarrow PbCl_2 + H_2O\uparrow$
13. $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2\uparrow$
14. $KHSO_3 + HCl \longrightarrow KCl + H_2O + SO_2\uparrow$
15. $K_2Cr_2O_7 + 14HCl \xrightarrow[(Conc.)]{} 2KCl + 2CrCl_3 + 7H_2O + 3Cl_2\uparrow$
16. $2P_2O_5 + 3HCl \longrightarrow POCl_3 + 3HPO_3$
17. $MnO_2 + 4HCl \xrightarrow[(Conc.)]{\Delta} MnCl_2 + 2H_2O + Cl_2\uparrow$
18. $CaOCl_2 + 2HCl \xrightarrow[(dil.)]{\Delta} CaCl_2 + H_2O + Cl_2$
19. $3HCl + HNO_3 \xrightarrow[(Conc.)]{} NOCl + 2H_2O + 2[Cl]$ (Conc.)
20. $ZnS + 2HCl \longrightarrow ZnCl_2 + H_2S\uparrow$

Chapter 8 (b). Study of Compounds : Ammonia and Nitric Acid

(a) Write balanced chemcial equation for the following :

1. Reaction of hydrogen chloride with ammonia.
2. The preparation of ammonia from ammonium chloride and calcium hydroxide.
3. Magnesium heated in nitrogen.
4. Action of concentrated nitric acid an copper.
5. Action of heat on silver nitrate.
6. Reaction of nitric acid with sodium bicarbonate.
7. Laboratory preparation of nitric acid.
8. Chlorine reacts with excess of ammonia.
9. Ferric hydroxide reacts with nitric acid.
10. Action of heat on ammonium nitrate.
11. Dilute nitric acid producing carbon dioxide.
12. Reaction between copper and concentrated nitric acid.
13. Burning of ammonia in oxygen.
14. Catalytic oxidation of ammonia.
15. Action of heat on ammonium chloride
16. Copper and concentrated nitric acid.
17. Copper oxide and dilute nitric acid.
18. Action of conc. HNO_3 on sulphur.
19. Action of conc. HNO_3 on phosphorus.
20. Action of conc. HNO_3 on carbon.
21. Action of conc. HNO_3 on iodine.
22. Dilute nitric acid and copper.
23. Ammonia with lead oxide.
24. Ammonia with copper oxide.
25. Ammonia with excess chlorine.
26. Action of water in magnesium nitride.

27. Burning of ammonia in oxygen.
28. Catalytic oxidationof ammmonia.
29. Aluminium nitride and water.
30. Potassium nitrate and concentrated sulphuric acid.
31. Concentrated nitric acid and copper.
32. Action of heat on ammonium nitrate.
33. Nitrogen monoxide and oxygen.
34. Dilute nitric acid and sodium carbonate.
35. Decomposition of nitric acid.

Ans. 1. $HCl + NH_3 \longrightarrow NH_4Cl.$

2. $2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2NH_3 + 2H_2O$
Calcium chloride; Ammonia; water

3. $3Mg + N_2 \longrightarrow Mg_3N_2$
Magnesium nitrite

4. $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2\uparrow$
Nitric acid; Copper(II) nitrate

5. $2AgNO_3 \xrightarrow{\Delta} 2Ag + 2NO_2 + O_2$
Silver

6. $NaHCO_3 + HNO_3 \longrightarrow NaOH + H_2O + CO_2\uparrow$

7. $NaNO_3 + H_2SO_4 \xrightarrow{\Delta < 200°C} NaHSO_4 + HNO_3.$
Sodium nitrate; (Conc.); Sodium hydrogen sulphate; Nitric acid

8. $3Cl_2 + 8NH_3 \longrightarrow 6NH_4Cl + N_2$
Ammonium chloride

9. $Fe(OH)_3 + 3HNO_3 \longrightarrow Fe(NO_3)_3 + 3H_2O$
Iron(III) nitrate

10. $NH_4NO_3 \xrightarrow{\Delta} N_2O + 2H_2O$
Ammonium nitrate; Nitrous oxide; Water

11. $Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + H_2O + CO_2\uparrow$
Carbon dioxide gas

12. $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$
(Conc.); Nitrogen dioxide

13. $4NH_3 + 3O_2 \longrightarrow 6H_2O + 2N_2 + Heat$
Ammonia; Oxygen; Water; Nitrogen

14. $4NH_3 + 5O_2 \xrightarrow{800°C} 6H_2O + 4NO + Heat$
$4NO + 2O_2 \rightleftharpoons 4NO_2\uparrow$
(Brown gas)

15. $NH_4Cl \xrightarrow{\Delta} NH_3 + HCl$

16. $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

17. $CuO + 2HNO_3 \longrightarrow Cu(NO_3)_2 + H_2O$
(Dil.)

18. $S + 6HNO_3 \xrightarrow{\Delta} H_2SO_4 + 6NO_2 + 2H_2O$

19. $2P + 10HNO_3 \longrightarrow 2H_3PO_4 + 10NO_2 + 2H_2O$

20. $C + 4HNO_3 \xrightarrow{\Delta} H_2CO_3 + 4NO_2 + H_2O$
Carbonic acid

21. $I_2 + 10HNO_3 \xrightarrow{\Delta} 2HIO_3 + 10NO_2 + 4H_2O$
(Conc.); Iodic acid

22. $3Cu + 8HNO_3 \longrightarrow 3Cu(NO_3)_2 + 2NO + 4H_2O$

23. $3PbO + 2NH_3 \longrightarrow 3Pb + 3H_2O + N_2$ (Yellow → White)
24. $3CuO + 2NH_3 \longrightarrow 3Cu + 3H_2O + N_2\uparrow$ (Black → Reddish)
25. $NH_3 + 3Cl_2 \longrightarrow NCl_3 + 3HCl$ (Cl_2: Excess)
26. $Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3\uparrow$
27. $4NH_3 + 3O_2 \xrightarrow{\Delta} 2N_2 + 6H_2O$
28. $4NH_3 + 5O_2 \xrightarrow[Pt]{800°C} 4NO\uparrow + 6H_2O$
29. $AlN + 3H_2O \longrightarrow Al(OH)_3\downarrow + NH_3\uparrow$
30. $KNO_3 + H_2SO_4 \xrightarrow{< 200°C} KHSO_4 + HNO_3$ (H_2SO_4: Conc.)
31. $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + NO_2\uparrow$ (HNO_3: Conc.)
32. $NH_4NO_3 \xrightarrow{\Delta} 2H_2O + N_2O$ (N_2O: Laughing gas)
33. $2NO + O_2 \xrightarrow{\Delta} 2NO_2\uparrow$
34. $Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + H_2O + CO_2\uparrow$ (HNO_3: Dil.)
35. $4HNO_3 \xrightarrow[Sunlight]{\Delta} 4NO_2\uparrow + 2H_2O + O_2\uparrow$

(b) Complete and balance the following equations :

1. $Mg_3N_2 + 6H_2O \longrightarrow$
2. $2NH_3 + 3CuO \longrightarrow$
3. $8NH_3 + 3Cl_2 \longrightarrow$
4. $4NH_3 + 5O_2 \longrightarrow$
5. $NH_4OH + H_2SO_4 \longrightarrow$
6. $(NH_4)_2SO_4 + Ca(OH)_2 \longrightarrow$
7. $NH_3 + O_2 \longrightarrow$
8. $NH_3 + HCl \longrightarrow$
9. $NH_3 + Cl_2 \longrightarrow$
10. $NH_3 + H_2SO_4 \longrightarrow$ (H_2SO_4: Conc.)
11. $NH_3 + CaCl_2 \longrightarrow$
12. $NH_3 + P_2O_5 + H_2O \longrightarrow$
13. $Mg_3N_2 + H_2O \longrightarrow$
14. $NH_3 + O_2 \xrightarrow[800°C]{Pt}$
15. $Ca + N_2 \longrightarrow$
16. $N_2 + H_2 \xrightarrow[Fe]{450°C}$
17. $NH_3 + H_2SO_4 \longrightarrow$
18. $FeCl_3 + NH_4OH \longrightarrow$
19. $NH_3 + CO_2 \xrightarrow[150\ atm.]{150°C}$
20. $NH_3 + Cl_2 \longrightarrow$ (Cl_2: Excess)
21. $NH_4OH + HNO_3 \longrightarrow$ (HNO_3: Excess, Pt.)

22. $NH_3 + O_2 \longrightarrow$
23. $Na_2CO_3 + HNO_3 \longrightarrow$
24. $C + \underset{\text{(Conc.)}}{HNO_3} \longrightarrow$
25. $KI + \underset{\text{(Conc.)}}{HNO_3} \longrightarrow$
26. $H_2S + \underset{\text{(Conc.)}}{HNO_3} \longrightarrow$
27. $Pb + \underset{\text{(Conc.)}}{HNO_3} \longrightarrow$
28. $\underset{\text{(Conc.)}}{HNO_3} + \underset{\text{(Conc.)}}{HCl} \longrightarrow$
29. $SO_2 + HNO_3 \longrightarrow$
30. $Ag + \underset{\text{(Conc.)}}{HNO_3} \longrightarrow$

Ans.
1. $Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3\uparrow$
2. $2NH_3 + 3CuO \longrightarrow N_2\uparrow + 3H_2O + 3Cu$
3. $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2\uparrow$
4. $4NH_3 + 5O_2 \longrightarrow 4NO\uparrow + 6H_2O$
5. $2NH_4OH + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + 2H_2O$
6. $(NH_4)_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + 2NH_3 + 2H_2O$
7. $4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$
8. $NH_3 + HCl \longrightarrow NH_4Cl$
9. $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$
10. $2NH_3 + \underset{\text{(Conc.)}}{H_2SO_4} \longrightarrow (NH_4)_2SO_4$
11. $8NH_3 + CaCl_2 \longrightarrow CaCl_2.8NH_3$
12. $6NH_3 + P_2O_5 + 3H_2O \longrightarrow 2(NH_4)_3PO_4$
13. $Mg_3N_2 + 6H_2O \longrightarrow 3Mg(OH)_2 + 2NH_3(g)$
14. $4NH_3 + 5O_2 \xrightarrow[800°C]{Pt} 4NO + 6H_2O$
15. $3Ca + N_2 \longrightarrow Ca_3N_2$
16. $N_2 + 3H_2 \xrightarrow[Fe]{450°C} 2NH_3$
17. $2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$
18. $FeCl_3 + 3NH_4OH \longrightarrow Fe(OH)_3\downarrow + 3NH_4Cl$
19. $2NH_3 + CO_2 \xrightarrow[150\ atm.]{150°C} \underset{\text{Urea}}{NH_2CONH_2} + H_2O$
20. $\underset{\text{Excess}}{8NH_3} + 3Cl_2 \longrightarrow N_2 + 6HN_4Cl$
21. $NH_4OH + HNO_3 \longrightarrow NH_4NO_3 + H_2O$
22. $4NH_3 + 5O_2 \xrightarrow{Pt.} 4NO\uparrow + 6H_2O$
23. $Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + H_2O + CO_2$
24. $C + \underset{\text{(Conc.)}}{4HNO_3} \longrightarrow CO_2\uparrow + 4NO_2\uparrow + 2H_2O$
25. $2KI + \underset{\text{(Conc.)}}{4HNO_3} \longrightarrow 2KNO_3 + 2NO_2\uparrow + I_2\uparrow + 2H_2O$
26. $H_2S + \underset{\text{(Conc.)}}{2HNO_3} \longrightarrow 2H_2O + 2NO_2\uparrow + S\uparrow$

27. $Pb + \underset{\text{(Conc.)}}{4HNO_3} \longrightarrow Pb(NO_3)_2 + 2NO_2 \uparrow + 2H_2O$

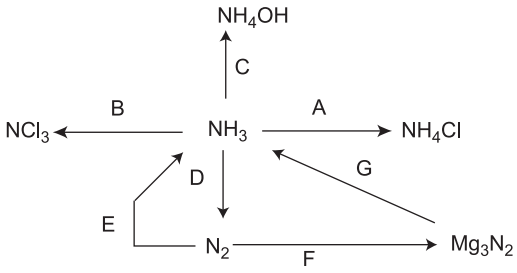
28. $\underset{\text{(Conc.)}}{HNO_3} + \underset{\text{(Conc.)}}{3HCl} \longrightarrow \underset{\text{Nascent}}{NOCl} + \underset{\text{Chlorine}}{2[Cl]} + 2H_2O$

29. $SO_2 + 2HNO_3 \longrightarrow H_2SO_4 + 2NO_2 \uparrow$

30. $3Ag + \underset{\text{(Dil.)}}{4HNO_3} \longrightarrow 3AgNO_3 + NO + 2H_2O$

(c) How are the following conversions carried out ? Give equations only :

1. $NH_3 \xrightarrow{\mathbf{A}} NO \xrightarrow{\mathbf{B}} NO_2 \xrightarrow{\mathbf{C}} HNO_3 \xrightarrow{\mathbf{D}} Cu(NO_3)_2$

2. 

3. $Na_2CO_3 \xrightarrow{\mathbf{A}} NaNO_3 \xrightarrow{\mathbf{B}} O_2$

4. $NH_4Cl \underset{\mathbf{B}}{\overset{\mathbf{A}}{\rightleftharpoons}} NH_3 \xrightarrow{\mathbf{C}} NH_4OH \xrightarrow{\mathbf{D}} Cu(OH)_2 \xrightarrow{\mathbf{E}} CuO \underset{\mathbf{F}}{\overset{\mathbf{G}}{\rightleftharpoons}} Cu(NO_3)_2$

Ans. 1. A. $4NH_3 + 5O_2 \xrightarrow[800°C]{Pt} 4NO + 6H_2O$

B. $2NO + O_2 \longrightarrow 2NO_2$

C. $4NO_2 + 2H_2O + O_2 \longrightarrow 4HNO_3$

D. $CuO + \underset{\text{(Dil.)}}{2HNO_3} \longrightarrow Cu(NO_3)_2 + H_2O$

2. A. $\underset{\text{(Excess)}}{8NH_3} + 3Cl_2 \longrightarrow 6NH_4Cl$

OR

$NH_3 + HCl \longrightarrow NH_4Cl$

B. $NH_3 + \underset{\text{(Excess)}}{3Cl_2} \longrightarrow NCl_3 + 3HCl$

C. $NH_3 + H_2O \longrightarrow NH_4OH$

D. $4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$

E. $N_2 + 3H_2 \underset{\substack{400–500°C \\ 200–1000 \text{ atm.}}}{\overset{Fe/MO}{\rightleftharpoons}} 2NH_3 + \Delta$

F. $\underset{\text{Burning}}{3Mg} + N_2 \longrightarrow Mg_3N_2$

G. $Mg_3N_2 + 6H_2O \xrightarrow{Warm} 3Mg(OH)_2 + 2NH_3$

3. A. $Na_2CO_3 + 2HNO_3 \longrightarrow 2NaNO_3 + CO_2 + H_2O$

B. $2NaNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$

4. A. $NH_4Cl + NaOH \xrightarrow{\Delta} NaCl + H_2O + NH_3$

OR

$2NH_4Cl + Ca(OH)_2 \xrightarrow{\Delta} CaCl_2 + 2H_2O + 2NH_3$

B. $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$

OR

$$NH_3 + HCl \longrightarrow NH_4Cl$$

C. $NH_3 + H_2O \longrightarrow NH_4OH$

D. $CuSO_4 + 2NH_4OH \longrightarrow Cu(OH)_2 + (NH_4)_2SO_4$

E. $Cu(OH)_2 \xrightarrow{\Delta} CuO + H_2O$

F. $CuO + \underset{\text{(Dil.)}}{2HNO_3} \longrightarrow Cu(NO_3)_2 + H_2O$

G. $2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4NO_2 + O_2$

(d) Write the reactions involved in the preparation of nitric acid.

Ans. (i) $4NH_3 + 5O_2 \xrightarrow[(700 - 800°C)]{Pt} 4NO + 6H_2O + 210 \text{ kcal}$

(ii) $2NO + O_2 \longrightarrow 2NO_2$

(iii) $4NO_2 + O_2 + 2H_2O \longrightarrow 4HNO_3$

(e) 1. Catalytic oxidation of ammonia.
2. Action of concentrated nitric acid on sulphur.
3. Laboratory preparation of nitric acid.
4. Reaction of ammonia with nitric acid.
5. When excess of ammonia is treated with chlorine.
6. An equation to illustrate the reducing nature of ammonia.

Ans. 1. The equation for catalytic oxidation of ammonia is :

$$\underset{\text{Ammonia}}{4NH_3} + 5O_2 \longrightarrow \underset{\text{Nitric oxide}}{4NO} + 6H_2O$$

Catalyst is a wire mesh consisting of platinum and rhodium.

2. $\underset{\text{Sulphur}}{S(s)} + \underset{\text{Nitric acid}}{6HNO_3(aq)} \longrightarrow \underset{\text{Water}}{2H_2O(l)} + \underset{\text{Sulphuric acid}}{H_2SO_4(aq)} + \underset{\text{Nitrogen dioxide}}{6NO_2(g)}$

3. $\underset{\text{Potassium nitrate}}{KNO_3(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4(l)} \longrightarrow \underset{\text{Nitric acid}}{HNO_3(l)} + \underset{\text{Potassium hydrogen sulphate}}{KHSO_4(s)}$

4. Ammonia reacts with nitric acid to produce ammonium nitrate

$$\underset{\text{Ammonia}}{NH_3(g)} + \underset{\text{Nitric acid}}{HNO_3(aq)} \longrightarrow \underset{\text{Ammonium nitrate}}{NH_4NO_3(s)}$$

5. $8NH_3 + 3Cl_2 \longrightarrow 6NH_4Cl + N_2$

6. $2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + N_2$

Chapter 8 (c). Study of Compounds : Sulphuric Acid

(a) Write balanced chemical equation for the following :

1. Action of concentrated sulphuric acid on carbon.
2. Dilute sulphuric acid producing hydrogen.
3. Dilute sulphuric acid is poured over sodium sulphite.
4. Zinc reacts with conc. sulphuric acid.
5. Sodium bicarbonate and dilute sulphuric acid.
6. Sodium nitrate and conc. sulphuric acid.
7. Iron reacts with dil. sulphuric acid.
8. Sulphur is heated with concentrated sulphuric acid.
9. Concentrated sulphuric acid is poured over sugar.
10. Dilute sulphuric acid with copper carbonate.
11. Dilute sulphuric acid with lead nitrate solution.
12. Dilute sulphuric acid with zinc hydroxide.

13. Concentrated sulphuric acid with barium chloride.
14. Concentrated sulphuric acid with sulphur trioxide.
15. Sodium sulphite with dilute sulphuric acid.
16. Concentrated sulphuric acid with potassium chloride.
17. Concentrated sulphuric acid with zinc nitrate.
18. Concentrated sulphuric acid with potassium nitrate.
19. Potassium hydrogen carbonate and sulphuric acid.
20. Sodium nitrate and concentrated sulphuric acid.

Ans. 1. $C + \underset{\text{(Conc.)}}{2H_2SO_4} \longrightarrow \underset{\text{Carbon dioxide}}{CO_2} + 2H_2O + \underset{\text{Sulphur dioxide}}{2SO_2}$

2. $H_2SO_4 + Zn \longrightarrow ZnSO_4 + H_2$

3. $Na_2SO_3 + H_2SO_4 \longrightarrow \underset{\text{Sodium sulphate}}{Na_2SO_4} + H_2O + SO_2\uparrow$

4. $Zn + 2H_2SO_4 \longrightarrow ZnSO_4 + 2H_2O + SO_2$

5. $NaHCO_3 + H_2SO_4 \longrightarrow NaHSO_4 + H_2O + CO_2$

6. $NaNO_3 + H_2SO_4 \longrightarrow NaHSO_4 + HNO_3$

7. $Fe + \underset{\text{(Dil.)}}{H_2SO_4} \longrightarrow FeSO_4 + H_2\uparrow$

8. $S + 2H_2SO_4 \longrightarrow 2H_2O + \underset{\text{Sulphur dioxide}}{3SO_2}$

9. $C_{12}H_{22}O_{11} + H_2SO_4 \longrightarrow 12C + 11H_2O + H_2SO_4$

10. $CuCO_3 + \underset{\text{(Dil.)}}{H_2SO_4} \longrightarrow CuSO_4 + H_2O + CO_2\uparrow$

11. $Pb(NO_3)_2 + \underset{\text{(Dil.)}}{H_2SO_4} \longrightarrow PbSO_4\downarrow + 2HNO_3$

12. $Zn(OH)_2 + \underset{\text{(Dil.)}}{H_2SO_4} \longrightarrow ZnSO_4 + 2H_2O$

13. $BaCl_2 + \underset{\text{(Conc.)}}{H_2SO_4} \longrightarrow \underset{\text{White ppt.}}{BaSO_4\downarrow} + 2HCl$

14. $SO_3 + \underset{\text{(Conc.)}}{H_2SO_4} \longrightarrow \underset{\text{Oleum}}{H_2SO_3O_7}$

15. $Na_2SO_3 + \underset{\text{(Dil.)}}{H_2SO_4} \longrightarrow Na_2SO_4 + H_2O + SO_2\uparrow$

16. $KCl + \underset{\text{(Conc.)}}{H_2SO_4} \longrightarrow KHSO_4 + HCl$

17. $Zn(NO_3)_2 + H_2SO_4 \longrightarrow ZnSO_4 + 2HNO_3$

18. $KNO_3 + H_2SO_4 \xrightarrow{< 200°C} KHSO_4 + HNO_3$

19. $2KHCO_3 + H_2SO_4 \longrightarrow K_2SO_4 + 2H_2O + CO_2\uparrow$

20. $NaNO_3 + \underset{\text{(Conc.)}}{H_2SO_4} \longrightarrow NaHSO_4 + HNO_3$

(b) Complete and balance the following chemical equations :

1. $SO_3 + \underset{\text{(Conc.)}}{H_2SO_4} \longrightarrow$
2. $Zn + \underset{\text{(Dil.)}}{H_2SO_4} \longrightarrow$
3. $Na_2SO_3 + H_2SO_4 \longrightarrow$
4. $NaCl + \underset{\text{(Conc.)}}{H_2SO_4} \xrightarrow{200°C}$

5. $S + H_2SO_4 \xrightarrow[\text{(Conc.)}]{} $

6. $C_6H_{12}O_6 \xrightarrow[\Delta]{\text{Conc. } H_2SO_4}$

7. $HCOOH \xrightarrow[\Delta]{\text{Conc. } H_2SO_4}$

8. $H_2C_2O_4 \xrightarrow[\Delta]{\text{Conc. } H_2SO_4}$

9. $H_2S + H_2SO_4 \xrightarrow[\text{(Conc.)}]{}$

10. $Cu + H_2SO_4 \xrightarrow[\text{(Conc.)}]{}$

Ans. 1. $SO_3 + H_2SO_4 \xrightarrow[\text{(Conc.)}]{} H_2S_2O_7$

2. $Zn + H_2SO_4 \xrightarrow[\text{(Dil.)}]{} ZnSO_4 + H_2\uparrow$

3. $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2\uparrow$

4. $NaCl + H_2SO_4 \xrightarrow[\text{(Conc.)}]{< 200°C} NaHSO_4 + HCl$

5. $S + 2H_2SO_4 \xrightarrow[\text{(Conc.)}]{} 3SO_2\uparrow + 2H_2O$

6. $C_6H_{12}O_6 \xrightarrow[\Delta]{\text{Conc. } H_2SO_4} 6C + 6H_2O$

7. $HCOOH \xrightarrow[\Delta]{\text{Conc. } H_2SO_4} CO\uparrow + H_2O$

8. $H_2C_2O_4 \xrightarrow[\Delta]{\text{Conc. } H_2SO_4} CO\uparrow + CO_2\uparrow + H_2O$

9. $H_2S + H_2SO_4 \xrightarrow[\text{(Conc.)}]{} 2H_2O + SO_2\uparrow + S\downarrow$

10. $Cu + 2H_2SO_4 \xrightarrow[\text{(Conc.)}]{} CuSO_4 + SO_2\uparrow + 2H_2O$

(c) Give balanced chemical equations for the action of sulphuric acid on each of the following :

1. Potassium hydrogen carbonate
2. Sulphur

Ans. 1. $\underset{\substack{\text{Potassium}\\\text{hydrogen}\\\text{carbonate}}}{2KHCO_3} + \underset{\substack{\text{Sulphuric}\\\text{acid}\\\text{(dil.)}}}{H_2SO_4} \longrightarrow \underset{\substack{\text{Potassium}\\\text{sulphate}}}{K_2SO_4} + \underset{\text{Water}}{2H_2O} + \underset{\substack{\text{Carbon}\\\text{dioxide}}}{2CO_2\uparrow}$

2. $\underset{\text{Sulphur}}{S} + \underset{\substack{\text{Sulphuric}\\\text{acid (conc.)}}}{2H_2SO_4} \longrightarrow \underset{\substack{\text{Sulphuric}\\\text{dioxide}}}{3SO_2\uparrow} + \underset{\text{Water}}{2H_2O}$

Chapter 9. Organic Chemistry

(a) 1. Monochloro ethane is hydrolysed with aqueous KOH.

2. A mixture of sodalime and sodium acetate is heated.
3. Ethanol under high pressure and low temperature is treated with acidified potassium dichromate.
4. Water is added to calcium carbide.
5. Ethanol reacts with sodium at room temperature.
6. Reaction between 1, 2-dibromoethane and alcoholic potassium hydroxide.
7. Preparation of ethane from sodium propionate.
8. Preparation of ethanol from monochloroethane and aq. sodium hydroxide.
9. A saturated hydrocarbon from iodomethane.
10. An unsaturated hydrocarbon from an alcohol.

11. An unsaturated hydrocarbon from calcium carbide.
12. An alcohol from ethyl bromide.
13. Reaction between ethyl alcohol and acetic acid.
14. Reaction of chlorine with excess of methane.
15. Addition of chlorine to ethene at ordinary temperature.
16. Burning of ethanol in air.
17. Preparation of ethane from sodium propionate.
18. Preparation of ethene from iodoethane.
19. Preparation of ethyne from calcium carbide.
20. Preparation of methanol from iodomethane.
21. A mixture of methane and oxygen is heated in the presence of metallic oxide.
22. A mixture of methane and air is heated at 400°C .
23. Excess chlorine react with methane.
24. Excess chlorine react with ethane.

Ans. 1. $C_2H_5Cl + \underset{(aq.)}{KOH} \longrightarrow C_2H_5OH + KCl$

2. $CH_3COONa + NaOH \xrightarrow[(Soda\ lime)]{CaO} \underset{Methane}{CH_4} + Na_2CO_3$

3. $CH_3CH_2OH + 2O \xrightarrow[K_2Cr_2O_7]{Acidified} \underset{Acetic\ acid}{CH_3COOH} + H_2O\uparrow$

4. $CaC_2 + 2H_2O \longrightarrow \underset{Calcium\ hydroxide}{Ca(OH)_2} + C_2H_2\uparrow$

5. $2C_2H_5OH + 2Na \longrightarrow \underset{Sodium\ ethoxide}{2C_2H_5ONa} + H_2\uparrow$

6. $CH_2Br{\cdot}CH_2Br + 2KOH \xrightarrow[(Alc.)]{} \underset{Ethyne}{CH{\equiv}CH} + 2KBr + 2H_2O$

7. $\underset{Sodium\ proprionate}{C_2H_5COONa} + NaOH \xrightarrow{CaO} \underset{Ethane}{C_2H_6} + \underset{Sodium\ carbonate}{Na_2CO_3}$

8. $\underset{\substack{Mono-\\chloro-\\ethane}}{C_2H_5Cl} + \underset{(aq.)}{NaOH} \longrightarrow \underset{Ethanol}{C_2H_5OH} + \underset{\substack{Sodium\\chloride}}{NaCl}$

9. $\underset{Iodomethane}{CH_3I} + 2[H] \longrightarrow \underset{Methane}{CH_4} + HI$

10. $\underset{Ethanol}{C_2H_5OH} + \underset{Conc.}{H_2SO_4} \xrightarrow{170°C} \underset{Ethene}{C_2H_4} + H_2SO_4 + H_2O$

11. $\underset{Calcium\ carbide}{CaC_2} + 2H_2O \longrightarrow Ca(OH)_2 + \underset{Ethyne}{C_2H_2}$

12. $\underset{Ethyl\ bromide}{C_2H_5Br} + \underset{(aq.)}{KOH} \longrightarrow \underset{Ethanol}{C_2H_5OH} + KBr$

13. $\underset{Acetic\ acid}{CH_3COOH} + \underset{Ethyl\ alcohol}{C_2H_5OH} \longrightarrow \underset{Ethyl\ acetate}{CH_3COOC_2H_5} + H_2O$

14. $CH_4 + Cl_2 \xrightarrow{CH_2} CH_3Cl + HCl$

15. $\underset{Ethene}{CH_2 = CH_2} + Cl_2 \xrightarrow[(solvent)]{CCl_4} \underset{Ethylene\ chloride}{CH_2Cl{-}CH_2Cl}$

16. $\underset{Ethanol}{C_2H_5OH} + \underset{(Air)}{O_2} \longrightarrow \underset{Carbon\ dioxide}{2CO_2} + \underset{Water}{2H_2O}$

17. $CH_3CH_2COONa + NaOH \xrightarrow{CaO} C_2H_6 + Na_2CO_3$

18. $CH_3CH_2I + KOH \xrightarrow{\Delta} C_2H_4 + KI + H_2O$
(Alc.)

19. $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

20. $CH_3I + KOH \longrightarrow CH_3OH + KI$
(aq.)

21. $CH_4 + O_2 \xrightarrow{\text{Molybdenum}} \underset{\text{Formaldehyde}}{HCHO} + H_2O$

22. $CH_4 \xrightarrow{400°C} \underset{\text{Formic acid}}{HCOOH}$

23. $\underset{\text{Methane}}{CH_4} + 4Cl_2 \longrightarrow \underset{\text{Carbon tetrachloride}}{CCl_4} + 4HCl$

24. $\underset{\text{Ethane}}{CH_3–CH_3} \xrightarrow{Cl_2} \underset{\text{Ethyl chloride}}{CH_3CH_2Cl} + HCl$

$CH_3CH_3Cl \xrightarrow{Cl_2} \underset{\text{Dichloroethane}}{C_2H_4Cl_2}$

(b) How will you bring about the following conversion :

1. Methane to methyl chloride.
2. Methane to methyl alcohol.
3. Methane to formaldehyde.
4. Methane to formic acid.
5. Ethane to ethyl chloride.
6. Ethane to ethyl alcohol.
7. Ethane to acetaldehyde.
8. Ethane to acetic acid.
9. Ethane to ethene.
10. Ethyne to ethene.
11. Ethene to ethane.
12. Ethyne to ethane.
13. Methane to formic acid.
14. Ethane to acetic acid.
15. Ethane to hexachloroethane

Ans. 1. When a mixture of methane and chlorine in the ratio of 1 : 1 by volume is exposed to diffused sunlight, methyl chloride is formed.

$$\underset{\text{Methane}}{CH_4} + Cl_2 \xrightarrow[\text{Diffused sunlight}]{\text{Chlorination}} \underset{\text{Methyl chloride}}{CH_3Cl} + HCl$$

2. Methane is first converted into methyl chloride by chlorination, in the presence of diffused sunlight. Methyl chloride on hydrolysis forms methyl alcohol.

$$CH_4 + Cl_2 \xrightarrow[\text{Diffused sunlight}]{\text{Chlorination}} \underset{\text{Methyl chloride}}{CH_3Cl} + HCl$$

$$\underset{\text{Methyl chloride}}{CH_3Cl} + KOH\,(aq.) \xrightarrow{\text{Hydrolysis}} \underset{\text{Methyl alcohol or Methanol}}{CH_3OH} + KCl + H_2O$$

3. Methyl alcohol obtained from above is subjected to oxidation with sodium dichromate and dilute sulphuric acid to form formaldehyde.

$$\underset{\text{Methane}}{CH_4 + Cl_2} \xrightarrow{\text{Diffused sunlight}} \underset{\text{Methyl chloride}}{CH_3Cl} + HCl$$

$$\underset{\text{Methyl chloride}}{CH_3Cl} + KOH\,(aq.) \xrightarrow{\text{Hydrolysis}} \underset{\text{Methyl alcohol or Methanol}}{CH_3OH} + KCl + H_2O$$

$$\underset{\text{Methyl alcohol}}{CH_3OH} + [O] \xrightarrow[\text{Oxidation}]{Na_2Cr_2O_7/\text{Dil. } H_2SO_4} \underset{\text{Formaldehyde}}{HCHO} + H_2O$$

4. Formaldehyde obtained from above, when subjected to oxidation with sodium dichromate and dilute sulphuric acid, forms formic acid.

$$\underset{\text{Methane}}{CH_4 + Cl_2} \xrightarrow{\text{Diffused sunlight}} \underset{\text{Methyl chloride}}{CH_3Cl} + HCl$$

$$\underset{\text{Methyl chloride}}{CH_3Cl} + KOH\,(aq.) \xrightarrow{\text{Hydrolysis}} \underset{\text{Methyl alcohol or Methanol}}{CH_3OH} + KCl + H_2O$$

$$\underset{\text{Methyl alcohol}}{CH_3OH} + [O] \xrightarrow[\text{Oxidation}]{Na_2Cr_2O_7/\text{Dil. } H_2SO_4} \underset{\text{Formaldehyde}}{HCHO} + H_2O$$

$$HCHO + [O] \xrightarrow[\text{Oxidation}]{Na_2Cr_2O_7/\text{Dil. } H_2SO_4} \underset{\text{Formic acid}}{HCOOH}$$

5. When equal volumes of ethane and chlorine are exposed to diffused sunlight, they react to form ethyl chloride (monochloro ethane).

$$\underset{\text{Ethane}}{CH_3 — CH_3} + Cl_2 \longrightarrow \underset{\text{Ethyl chloride}}{CH_3 — CH_2Cl} + HCl$$

6. When equal volumes of ethane and chlorine are exposed to diffused sunlight, they form ethyl chloride, which when treated with aqueous solution of potassium hydroxide (KOH), undergoes hydrolysis to form ethyl alcohol.

$$\underset{\text{Ethane}}{CH_3 — CH_3} + Cl_2 \longrightarrow \underset{\text{Ethyl chloride}}{CH_3 — CH_2Cl} + HCl$$

$$\underset{\text{Ethyl chloride}}{CH_3 — CH_3Cl} + \underset{\text{hydroxide}}{\text{KOH (aq) Potassium}} \longrightarrow \underset{\text{(Ethanol)}}{\text{Ethyl alcohol}}\ C_2H_5 — OH + KCl$$

7. Ethane is first converted to ethyl chloride by chlorination. Ethyl chloride undergoes hydrolysis, when treated with aqueous solution of potassium hydroxide, resulting in the formation of ethyl alcohol. Ethyl alcohol undergoes oxidation in the presence of sodium dichromate, acidified with dilute sulphuric acid, which provides nascent oxygen and oxidise ethyl alcohol to acetaldehyde (ethanol).

$$\underset{\text{Ethane}}{C_2H_6} + Cl_2 \xrightarrow{\text{Chlorination}} \underset{\text{Ethyl chloride}}{C_2H_5Cl} + HCl$$

$$\underset{\text{Ethyl chloride}}{C_2H_5Cl} + KOH\ (aq.) \xrightarrow[\text{Ethyl alcohol}]{\text{Hydrolysis}} C_2H_5OH + HCl$$

$$\underset{\text{Ethyl alcohol}}{C_2H_5OH} + [O] \xrightarrow{Na_2Cr_2O_7/\text{Dil. } H_2SO_4} \underset{\text{Acetaldehyde}}{CH_3 — CHO} + H_2O$$

8. Acetaldehyde when subjected to oxidation with sodium or potassium dichromate and dilute sulphuric acid, gets oxidized to form acetic acid.

$$\underset{\text{Ethane}}{C_2H_6} + Cl_2 \xrightarrow{\text{Chlorination}} \underset{\text{Ethyl chloride}}{C_2H_5Cl} + HCl$$

$$\underset{\text{Ethyl chloride}}{C_2H_5Cl} + KOH\ (aq.) \xrightarrow[\text{Ethyl alcohol}]{\text{Hydrolysis}} C_2H_5OH + HCl$$

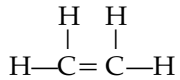
$$\underset{\text{Ethyl alcohol}}{C_2H_5OH} + [O] \xrightarrow{Na_2Cr_2O_7/\text{Dil. } H_2SO_4} \underset{\text{Acetaldehyde}}{CH_3 — CHO} + H_2O$$

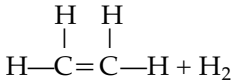
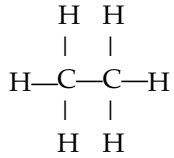
$$CH_3 — CHO + [O] \xrightarrow{Na_2Cr_2O_7/\text{Dil. } H_2SO_4} \underset{\text{Acetic acid}}{CH_3 — COOH}$$

9. Ethane on chlorination forms ethyl chloride which when treated with alcoholic KOH, undergoes, dehydrochlorination to form ethene.

$$\underset{\text{Ethane}}{CH_3 — CH} + Cl_2 \xrightarrow{\text{Chlorination}} \underset{\text{Ethyl chloride}}{CH_2 — CH_2 — Cl} + HCl$$

$$\underset{\text{Ethyl chloride}}{\begin{array}{l} H\ \ Cl \\ |\ \ | \\ H—C—C—H \\ |\ \ | \\ H\ \ H \end{array}} + KOH\ (alc.) \longrightarrow \underset{\text{Ethene or Ethylene}}{\begin{array}{l} \\ \\ H—C = C—H \\ |\ \ | \\ H\ \ H \end{array}} + KCl + H_2O$$

10. $H-C\equiv C-H + H-H \xrightarrow{Pd}$ 
Acetylene (Ethyne) Ethene

11.  $\xrightarrow{Ni}$ 
Ethene Ethane

12. $CH\equiv CH \xrightarrow[H_2]{Pd} C_2H_4 \xrightarrow[H_2]{Ni} C_2H_6$
Ethyne Ethene Ethane

13. $CH_4 \xrightarrow{Cl_2} CH_3Cl \xrightarrow{NaOH} CH_4OH \xrightarrow{[O]} HCHO \xrightarrow{[O]} HCOOH$
Methane Methyl chloride Methanol Formaldehyde Formic acid

14. $C_2H_6 \xrightarrow{Cl_2} CH_3CH_2Cl \xrightarrow{NaOH} C_2H_5OH$
Ethane Ethyl chloride Ethyl alcohol

$C_2H_5OH \xrightarrow{[O]} CH_3CHO \xrightarrow{[O]} CH_3COOH$
Acetaldehyde Acetic acid

15. $C_2H_6 + Cl_2 \longrightarrow C_2H_5Cl + HCl$
Ethane

$C_2H_5Cl + Cl_2 \longrightarrow C_2H_4Cl_2 + HCl$

$C_2H_4Cl_2 + Cl_2 \longrightarrow C_2H_3Cl_3 + HCl$

$C_2H_3Cl_3 + Cl_2 \longrightarrow C_2H_2Cl_4 + HCl$

$C_2H_2Cl_4 + Cl_2 \longrightarrow C_2HCl_5 + HCl$

$C_2HCl_5 + Cl_2 \longrightarrow C_2Cl_6 + HCl$
Hexachloroethane

(c) Give balanced chemical equations for the following conversions :

1. Ethanoic acid to ethyl ethanoate.
2. Calcium carbide to ethyne.
3. Sodium ethanoate to methane.
4. Burning of ethane in plentiful supply of air.
5. Action of water on calcium carbide.
6. Heating of ethanol at 170°C in the presence of conc. sulphuric acid.
7. Preparation of ethane from sodium propionate.

Ans. 1. $CH_3COOH(l) + C_2H_5OH(l) \xrightarrow{Conc.\ H_2SO_4} CH_3COOC_2H_5(l) + H_2O(l)$
Ethanoic acid Ethanol Ethyl ethanoate Water

2. $CaC_2(s) + 2H_2O(l) \longrightarrow Ca(OH)_2(s) + C_2H_2(g)$
Calcium carbide Calcium hydroxide Ethyne

3. $CH_3COONa(s) + NaOH(s) \longrightarrow Na_2CO_3(s) + CH_4(g)$
Sodium ethanoate Sodium hydroxide (from soda lime) Sodium carbonate Methane

4. $2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$

5. $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + C_2H_2$

6. $C_2H_5OH \xrightarrow[170°C]{Conc.\ H_2SO_4} C_2H_4 + H_2O$

7. $C_2H_5COONa + NaOH \xrightarrow[\Delta]{CaO} C_2H_6 + Na_2CO_3$
Sodium propionate Sodium hydroxide Ethane Sodium carbonate

❐

Question Set 9

IUPAC Naming/Writing the Structural Formula

Chapter 7. Metallurgy

Q. Give the chemical formulae of the following naturally occuring ores :

1. Cryolite
2. Galena
3. Corundum
4. Dolomite
5. Zincite
6. Malachite
7. Cinnabar
8. Gypsum
9. Horn silver
10. Epsom salt
11. Haematite
12. Bauxite

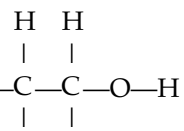
Ans. 1. Na_3AlF_6
2. PbS
3. Al_2O_3
4. $CaCO_3.MgCO_3$
5. ZnO
6. $CuCO_3.Cu(OH)_2$
7. HgS
8. $CaSO_4.2H_2O$
9. AgCl
10. $MgSO_4.\ 7H_2O$
11. Fe_2O_3
12. $Al_2O_3.2H_2O$

Chapter 9. Organic Chemistry

(a) Give the structural formula of the following :

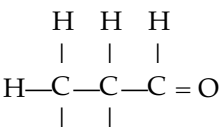
1. Ethanol
2. 1-propanal
3. Ethanoic acid
4. 1, 2, dichloroethane
5. An isomer of *n*-butane
6. 2-propanol
7. Diethyl ether
8. Methanoic acid
9. Ethanal
10. Ethyne
11. Acetone
12. 2-methyl propane
13. Ethanoic acid
14. But-2-yne
15. Two isomers of Butane
16. Ethane
17. Vinegar
18. Marsh gas
19. An alcohol
20. 2-Butyne
21. 2, 3-dimethyl butane
22. Propanoic acid

Ans. 1.



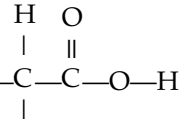
Ethanol

2.



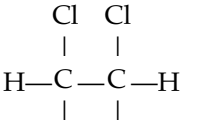
1-Propanal

3.



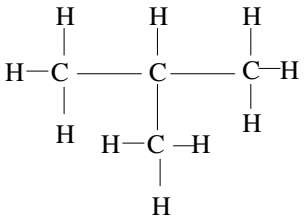
Ethanoic acid

4.



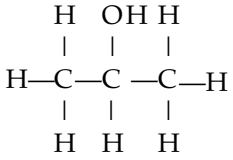
1, 2-dichloro ethane

5.



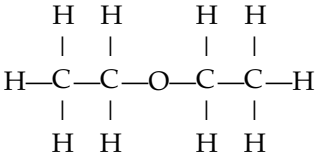
2-methyl propane (an isomer of *n*-butane)

6.



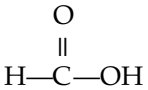
2-propanol

7.



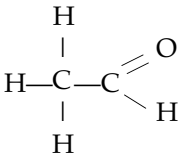
Diethyl ether

8.



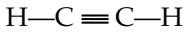
Methanoic acid

9.



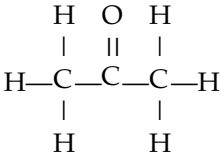
Ethanal

10.



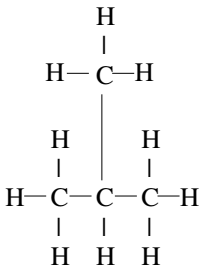
Ethyne

11.



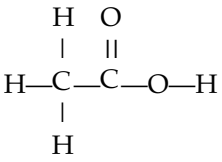
Acetone

12.



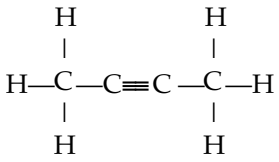
2-methyl propane

13.



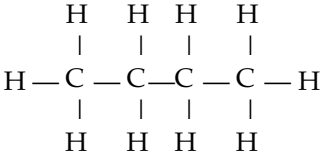
Ethanoic acid

14.



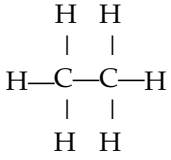
But-2-yne

15.

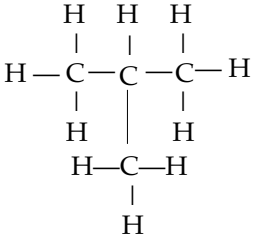


Normal butane

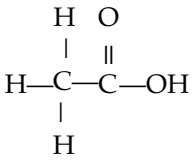
16.

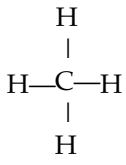


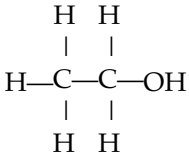
Ethane

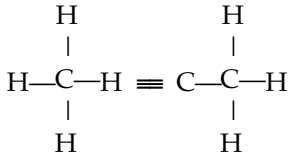


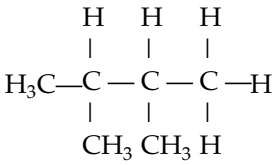
Iso-butane

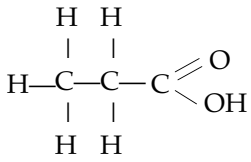
17. 
Vinegar

18. 
Marsh gas

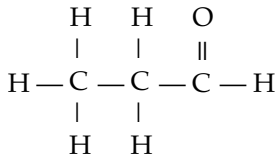
19. 
Alcohol

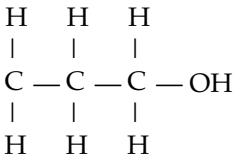
20. 
2-butyne

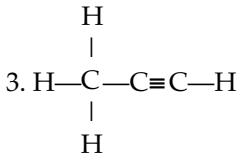
21. 
2, 3-dimethyl butane

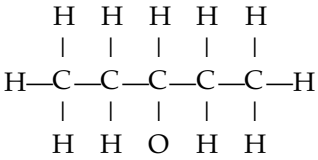
22. 
Propanoic acid

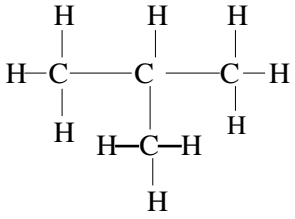
(b) Give the correct IUPAC name structural formulae given below :

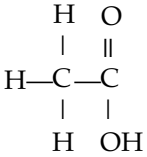
1. 

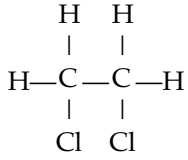
2. 

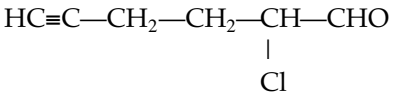
3. 

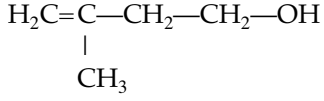
4. 

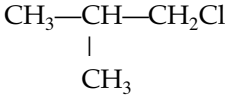
5. 

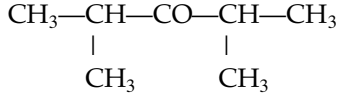
6. 

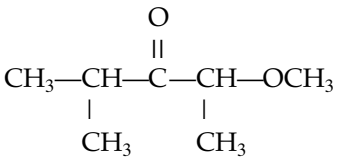
7. 

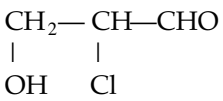
8. 

9. 

10. 

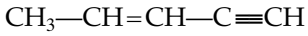
11. 

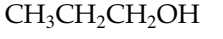
12. 

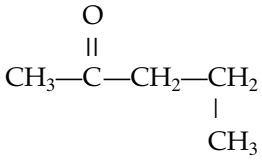
13. 

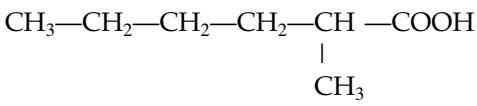
14. 

15. 

16. 

17. 

18. 

19. 

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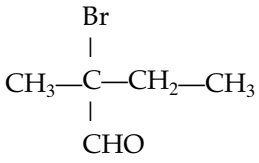
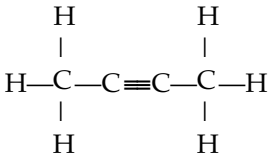
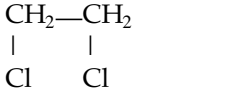
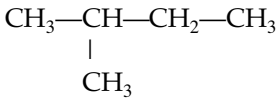
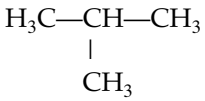
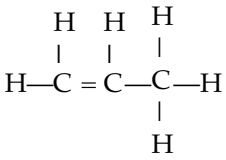
21. 

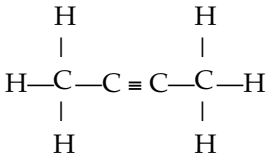
22. 

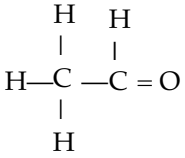
23. 

24. 

25. 

26. 

27. 

28. 

Ans.
1. Propanal
2. Propan-1-ol
3. Propyne
4. Pentan-3-ol
5. 2-methyl propane
6. Ethanoic acid
7. 1, 2-dichloroethane
8. 2-chloro hex-5-yn-1-al
9. 3-methyl-but-3-en-1-ol
10. 1-chloro-2-methyl propane
11. 2, 4-dimethyl-pentan-3-one
12. 2-methoxy-4-pentan-3-one
13. 2-chloro-3-hydroxy propanal
14. Ethanedioic acid
15. Pent-1-en-4-yne
16. Pent-3-en-1-yne
17. Propane-1-ol
18. Pentan-2-one
19. 2-methyl pentanoic acid
20. Hexan-3-one
21. 2-bromo, 2-methyl butanol
22. But-2-yne
23. 1, 2,-dichloro ethane
24. 2-methyl butane

25. 2-methyl propane
26. Propene
27. 2-butyne
28. Ethanal

(c) Give the formula of the next higher homologue of :

1. Methanol
2. Ethane
3. Ethene
4. Ethyne
5. Propyl
6. Methanoic acid
7. Propane
8. Butene
9. Pentane
10. Methanal

Ans. 1. Ethanol — C_2H_5OH
2. Propane — C_3H_8
3. Propene — C_3H_6
4. Propyne — C_3H_4
5. Butyl — C_4H_9
6. Ethanoic acid — CH_3COOH
7. Butane — C_4H_{10}
8. Pentene — C_5H_{10}
9. Hexane — C_6H_{14}
10. Ethanal — CH_3CHO

❐

Question Set 10

Chemical Tests

Chapter 3. Study of Acids, Bases and Salts

Q. How will you distinguish between the following pairs of compounds :

1. Iron(II) chloride and Iron(III) chloride.
2. Lead nitrate and copper nitrate.
3. Zinc oxide and calcium oxide.
4. Sodium carbonate and sodium nitrate.
5. Sodium sulphate and sodium sulphite.
6. How will you distinguish between ammonium hydroxide and sodium hydroxide using copper sulphate solution ?

Ans. 1. Iron(II) chloride is dissolved in water and then sodium hydroxide is added. A dirty green precipitate is obtained which confirms the presence of iron(II) chloride.

$$FeCl_2 + 2NaOH \longrightarrow Fe(OH)_2 + 2NaCl$$

Iron(III) chloride is also dissolved in water and then sodium hydroxide solution is added. A reddish brown precipitate is obtained, which confirms the presence of iron(III) chloride.

$$FeCl_3 + 3NaOH \longrightarrow Fe(OH)_3 + 3NaCl$$

2. Lead nitrate is dissolved in water and then sodium hydroxide solution is added, a white precipitate is obtained, which is soluble in excess of sodium hydroxide.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow Pb(OH)_2 + 2NaNO_3$$

Copper nitrate is dissolved in water and sodium hydroxide solution is added, a light blue precipitate of copper hydroxide is obtained.

$$Cu(NO_3)_2 + 2NaOH \longrightarrow Cu(OH)_2 + 2NaNO_3$$

3. Zinc oxide is dissolved in dilute hydrochloric acid to form zinc chloride and then sodium hydroxide solution is added, a white precipitate is obtained, which is soluble in excess of sodium hydroxide to form a clear solution.

$$ZnO + 2HCl \longrightarrow ZnCl_2 + H_2O$$

$$ZnCl_2 + 2NaOH \longrightarrow Zn(OH)_2 + 2NaCl$$

$$Zn(OH)_2 + 2NaOH \longrightarrow \underset{\substack{\text{Sodium zincate}\\\text{(A clear solution)}}}{Na_2ZnO_2} + 2H_2O$$

Calcium chloride is obtained by dissolving calcium oxide in dilute hydrochloric acid. To the solution of calcium chloride, sodium hydroxide solution is added, a white precipitate of calcium hydroxide is obtained, which is insoluble even in the excess of sodium hydroxide.

$$CaO + 2HCl \longrightarrow CaCl_2 + H_2O$$

$$CaCl_2 + 2NaOH \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2} + 2NaCl$$

4. Sodium carbonate when treated with dilute hydrochloric acid, a vigorous reaction takes place and a colourless, odourless gas carbon dioxide is evolved which turns lime water milky.

$$Na_2CO_3 + 2HCl \longrightarrow 2NaCl + H_2O + CO_2$$

Sodium nitrate when mixed with copper filings and heated with concentrated sulphuric acid, reddish brown fumes of nitrogen dioxide are evolved.

$$2NaNO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + 2HNO_3$$

$$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2NO_2 + 2H_2O$$

5. Sodium sulphate is dissolved in water and barium chloride solution is added, an insoluble white precipitate of barium sulphate is obtained.

$$Na_2SO_4 + BaCl_2 \longrightarrow \underset{\text{White ppt.}}{BaSO_4} + 2NaCl$$

Sodium sulphite is warmed with dilute sulphuric acid, a colourless gas with a pungent and suffocating smell is evolved. When this gas is bubbled through acidified solution of potassium dichromate, it turns its colour from orange to green.

$$Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2$$

$$K_2Cr_2O_7 + H_2SO_4 + 3SO_2 \longrightarrow K_2SO_4 + Cr_2(SO_4)_3 + H_2O$$

6. When ammonium hydroxide solution is added drop by drop to copper sulphate solution, a pale blue or bluish white precipitate is formed which is soluble in excess of ammonium hydroxide and a deep blue or inky blue solution is formed with excess of ammonium hydroxide.

$$CuSO_4 + 2NH_4OH \longrightarrow Cu(OH)_2 + (NH_4)_2SO_4$$

$$Cu(OH)_2 + 4NH_4OH \longrightarrow [Cu(NH_3)_4](OH)_2 + 4H_2O$$

Copper solution forms a blue precipitate with sodium hydroxide solution. It is insoluble in excess of NaOH.

$$\underset{\text{Copper sulphate}}{CuSO_4} + \underset{\text{Sodium hydroxide}}{2NaOH} \longrightarrow \underset{\text{Copper hydroxide}}{Cu(OH)_2} + \underset{\text{Sodium sulphate}}{Na_2SO_4}$$

Chapter 4. Analytical Chemistry

1. Zinc nitrate solution and calcium nitrate solution.
2. Sodium nitrate solution and sodium chloride solution.
3. Iron(III) chloride solution and copper chloride solution.
4. Iron(II) sulphate solution and copper(II) sulphate solution.
5. Zinc nitrate solution and calcium nitrate solution.
6. Iron(II) chloride and Iron(III) chloride solution.

Ans. 1. Add NaOH solution in excess to the two solutions. The one in which white ppt. initially formed dissolves in excess of NaOH solution is $Zn(NO_3)_2$ solution and the other is $Ca(NO_3)_2$ solution.

2. Add freshly prepared ferrous sulphate solution to the two solutions. Then by the side of the test tube, pour conc. sulphuric acid to each slowly. The one in which brown ring appears is sodium nitrate solution while the other is sodium chloride solution.

3. Add NaOH solution to both the solutions. The one which gives a reddish brown ppt. is iron(III) chloride solution and the one which gives blue ppt. is copper chloride solution.

4. When sodium hydroxide solution is added to iron(II) sulphate solution, a dirty green precipitate is formed. When sodium hydroxide solution is added to copper(II) sulphate solution, light blue precipitate is formed.

5. When ammonium hydroxide is added to zinc nitrate solution, a white precipitate is formed. The white precipitate dissolves when excess of ammonium hydroxide is added.

   When ammonium hydroxide is added to calcium nitrate solution, no visible reaction occurs even with the addition of excess of NH_4OH.

6. When sodium hydroxide is added to iron(II) chloride, dirty green precipitate of $Fe(OH)_2$ is formed.

$$FeCl_2 + 2NaOH \longrightarrow Fe(OH)_2 \downarrow + 2NaCl$$

When sodium hydroxide is added to iron(III) chloride, reddish brown precipitate is formed.

$$FeCl_3 + 2NaOH \longrightarrow Fe(OH)_3 + 3NaCl$$

Chapter 8. (a) Study of Compounds : Hydrogen Chloride

1. Manganese dioxide and copper(II) oxide.
2. Hydrogen chloride gas and carbon dioxide gas.
3. Give three tests for HCl gas.

Ans. 1. When conc. hydrogen chloride is added to manganese dioxide, greenish yellow gas (Cl_2) is liberated.

$$MnO_2 + \underset{\text{(Conc.)}}{4HCl} \longrightarrow MnCl_2 + 2H_2O + \underset{\text{Greenish yellow gas}}{Cl_2}\uparrow$$

When conc. hydrogen chloride is added to copper(II) oxide, no gas is liberated but the solution turns bluish because of the formation of copper chloride.

$$CuO + \underset{\text{(Conc.)}}{HCl} \xrightarrow{\Delta} \underset{\substack{\text{Greenish}\\ \text{blue solution}}}{CuCl_2} + H_2O$$

2. When hydrogen chloride gas is passed into silver nitrate solution, it forms a curdy white precipitate of silver chloride.

$$HCl + AgNO_3 \longrightarrow \underset{\substack{\text{Curdy}\\ \text{white ppt.}}}{AgCl}\downarrow + HNO_3$$

When carbon dioxide gas is passed into lime water, it forms a milky white precipitate of calcium carbonate.

$$CO_2 + Ca(OH)_2 \longrightarrow \underset{\text{Milky white ppt.}}{CaCO_3} + H_2O$$

3. (i) When a glass rod dipped in ammonia, solution is held near the vapours of the acid, it form a dense white fumes of ammonium chloride.
   (ii) When hydrochloric acid is treated with silver nitrate solution, it forms curdy white precipitate which is soluble in excess of ammonium hydroxide solution.
   (iii) When hydrochloric acid is boiled with manganese dioxide, greenish yellow chlorine gas is evolved.

Chapter 8. (b) Study of Compounds : Ammonia and Nitric Acid

1. Dilute hydrochloric acid and dilute nitric acid.
2. Ammonium ion and hydroxide ion.
3. Nitric oxide gas and nitrous oxide gas.
4. Dilute hydrochloric acid and dilute sulphuric acid.
5. Oxygen gas and nitrous oxide gas.

Ans. 1. Silver nitrate solution when added to dil. hydrochloric acid will give a white ppt. and when added to dil. nitric acid no change will be observed.
2. When iron(II) sulphate solution is added to ammonium ion, dirty green precipitate is obtained. No change will be observed with hydroxide ion.
3. If reddish brown fumes are produced in the atmosphere of oxygen then the given sample of gas is nitric oxide and if no brown fumes are produced and the mixture remains colourless, then the gas is nitrous oxide.
4. Dilute sulphuric acid will give a white precipitate of barium sulphate with barium chloride solution whereas no visible reaction occurs with dilute hydrochloric acid.
5. Carbon (red hot) burns in oxygen to form carbon dioxide gas only, but in nitrous oxide it forms carbon dioxide gas and nitrogen.

Chapter 8. (c) Study of Compounds : Sulphuric Acid

1. Dilute sulphuric acid and dilute hydrochloric acid.
2. Chlorine gas and sulphur dioxide gas.
3. How will you distinguish between dilute hydrochloric acid and dilute sulphuric acid using lead nitrate solution ?

Ans. 1. When barium chloride solution is added to the dilute sulphuric acid, thick white precipitate of barium sulphate is formed which is insoluble in any mineral acid such as nitric acid or hydrochloric acid.

$$BaCl_2 + \underset{\text{(dil.)}}{H_2SO_4} \longrightarrow BaSO_4 \downarrow + 2HCl$$

With dilute hydrochloric acid, no effect is observe.

2. Chlorine gas turns starch iodide paper blue and sulphur dioxide gas turns moist acidified potassium dichromate paper green.

3. On adding lead nitrate to both acids, we will get a white precipitate. On heating the solution, the one whose precipitate will redissolve will be dil. HCl and the one with insoluble precipitate will be dil. H_2SO_4. Actually on adding lead nitrate to HCl, $PbCl_2$ precipitates out and on heating the solution it redissolves. But in case of H_2SO_4, $PbSO_4$ is formed which is insoluble even on heating it.

$$Pb(NO_3)_2 + \underset{\text{(dil.)}}{2HCl} \longrightarrow PbCl_2 + 2HNO_3$$

$$Pb(NO_3)_2 + \underset{\text{(dil.)}}{H_2SO_4} \longrightarrow PbSO_4 + 2HNO_3$$

Chapter 9. Organic Chemistry

1. Ethene and ethane.
2. Ethyne and ethane.
3. Alkanes, alkenes and alkynes.

Ans. 1. Ethene gas decolourises bromine solution and potassium permanganate solution. But, ethane gas does not change the colour of these solutions.

2. Ethyne gas forms a white precipitate with ammonical solution of silver nitrate and red ppt. with ammonical solution of copper(I) chloride. But, ethane does not respond to such tests.

3.

S.No.	Test	Alkanes	Alkenes	Alkynes
(i)	Bromine Test. Add a few drops of sol. of bromine in carbon tetrachloride to the hydrocarbon.	No change takes place.	The red colour of bromine is decolourised.	The red colour of bromine is decolourised.
(ii)	Alkaline Potassium Permanganate Test : Add a few drops of alkaline pot. permanganate sol. To the hydrocarbon.	No change takes place.	The purple colour of Potassium permanganate is decolourised.	The purple colour of potassium permanganate is decolourised.
(iii)	Ammoniacal Cuprous Chloride Test : Add a few drops of ammonical cuprous chloride sol. to the hydrocarbon.	No change takes place.	No change takes place.	A red ppt. of copper acetylide is formed.

Chapter 10. Practical Chemistry

1. Zinc sulphate solution and zinc chloride solution.
2. Iron(II) chloride solution and iron(III) chloride solution.
3. Calcium nitrate solution and calcium chloride solution.
4. Sodium carbonate and sodium sulphite.
5. Ferrous nitrate and lead nitrate.
6. Manganese dioxide and copper(II) oxide.
7. Sodium chloride and sodium nitrate.

8. Calcium nitrate and lead nitrate.
9. Lead nitrate and zinc nitrate.
10. Sodium sulphite and sodium sulphate.
11. Ammonium chloride and ammonium nitrate.
12. Zinc carbonate and lead carbonate.
13. Potassium chloride and sodium chloride.
14. Powdered coke and manganese dioxide.
15. Copper oxide and manganese dioxide.
16. Washing soda and baking soda.
17. Potassium nitrate and potassium nitrite.
18. Mercuric oxide and red lead.
19. Ferrous ions and ferric ions.

Ans. 1. When $BaCl_2$ solution is added to the given solution, $ZnSO_4$ gives a white ppt. while no ppt. is obtained with $ZnCl_2$ solution.

2. When NaOH solution is added to the given solution, iron(II) chloride gives dirty green ppt. while reddish brown ppt. is obtained with iron(III) chloride.

3. When $AgNO_3$ solution is added to the given solution, $CaCl_2$ solution will give a white ppt. while no change is observed with calcium nitrate solution.

4. Sodium carbonate when treated with dil. H_2SO_4 will liberate colourless odourless gas with brisk effervescence. The gas will turn lime water milky and will have no effect on acidified potassium permanganate solution.

   Sodium sulphite when treated with dil. H_2SO_4 will liberate a colourless gas having suffocating smell of burning sulphur. The gas will turn acidified potassium permanganate solution from pink to colourless.

5. Aqueous ferrous nitrate when treated with NaOH solution gives a dirty green ppt. Aqueous lead nitrate when treated with NaOH solution gives a white ppt. which dissolves in excess of NaOH.

6. When manganese dioxide is heated with conc. HCl a pungent smelling greenish yellow chlorine gas is evolved.

   When copper oxide is heated with conc. HCl no such gas is evolved.

7. On heating with conc. H_2SO_4 sodium chloride gives pungent colourless gas which turns silver nitrate solution curdy white, whereas sodium nitrate gives a brown gas which shows no effect on silver nitrate solution.

8. Aqueous solution of calcium nitrate gives a white precipitate with sodium hydroxide which is insoluble in excess of sodium hydroxide solution. The aqueous solution of lead nitrate gives a white precipitate with caustic soda solution which dissolves in excess of caustic soda solution.

9. Aqueous solution of lead nitrate gives white precipitate with ammonium hydroxide which is insoluble in excess ammonium hydroxide while the solution of zinc nitrate gives a white precipitate which is soluble in excess ammonium hydroxide.

10. Solution of both gives white precipitate with barium chloride solution. The precipitate of barium sulphite is soluble in dil. hydrochloric acid, white the precipitate of barium sulphite is insoluble in dil. hydrochloric acid.

11. Heat each of the salt strongly in a hard glass test tube. In case of ammonium chloride, sublimation takes place and white powdery deposits settles near the mouth of test tube. In case of ammonium nitrate, an explosion takes place and nitrous oxide and stream are given off. No residue is left in the test tube.

12. Heat each of the carbonates strongly in a hard glass test tube. In case of zinc carbonate, residue is yellow when hot and white then cold. In case of lead carbonate, residue is reddish-brown when hot and yellow when cold.

13. Make a thick paste of each salt in HCl. Take a small amount of the paste on clean platinum wire and introduce it in non-luminous bunsen flame. In case of potassium chloride, a non-persistent lilac flame is formed. In case of sodium chloride, a persistent golden yellow flame is formed.
14. Heat each of the substances with conc. hydrochloric acid. In case of coke, no visible reaction takes place. In case of manganese dioxide, greenish-yellow chlorine gas is evolved.
15. Warm each of the oxides with dilute hydrochloric acid. In case of copper oxide, a greenish-blue solution of copper chloride is formed. In case of manganese dioxide, no reaction takes place.
16. Heat each of the salt strongly in a hard glass test tube and pass the gas evolved through lime-water. In case of washing soda, lime-water does not turn milky. In case of baking soda, lime-water turns milky.
17. Treat each of the salts with dilute sulphuric acid and warm gently. In case of potassium nitrate, no visible reaction takes place. In case of potassium nitrite, reddish-brown gas, nitrogen dioxide is given off.
18. Heat each of the oxides strongly in a hard glass test tube. In case of mercuric oxide, tiny droplets of mercury are seen near the mouth of the test tube and residue is black in colour. In case of red lead, no tiny droplets are seen. The residue is reddish-brown when hot and yellow when cold.
19. Treat the solution of each ion with sodium hydroxide solution. In case of ferrous ions, a dirty green ppt. of ferrous hydroxide is formed. In case of ferric ions, a reddish-brown ppt. of ferric hydroxide is formed.

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Question Set 11

Reasoning Based Questions

Chapter 1. Periodic Properties and Variations of Properties

Q. 1. Explain why the elements placed in the same group of the periodic table have the same chemical properties ?

Ans. Elements placed in the same group of the periodic table have the same chemical properties because they have the same number of valence electrons in the outermost shell of their atoms.

Q. 2. Why group IA elements are called alkali metals ?

Ans. Group IA elements are called alkali metals because their hydroxides are soluble in water and form strong bases.

Q. 3. Why sodium is a metal while sulphur is a non-metal ?

Ans. Sodium has a larger atomic radii and lower ionization potential than sulphur. Hence sodium is a metal while sulphur is a non metal.

Q. 4. Alkali metals are good reducing agents.

Ans. Alkali metals are good reducing agents because alkali metals have one valence electron which they lose to attain stability. Hence, they themselves undergo oxidation causing reduction of others and are good reducing agents.

Q. 5. Why are the elements sodium and chlorine in the same period of the periodic table ?

Ans. Elements sodium and chlorine are in the same period of the periodic table because the atoms of both the elements have three shells containing the electrons.

Q. 6. Sodium atom, Na forms the positive ion Na^+, but chlorine atom Cl, does not form the positive Cl^+ ion.

Ans. Sodium is the first element of period 3 whereas chlorine is the last but one element of the same period. Since ionization potential increases across a period, the ionization potential of Na is much smaller than that of Cl. Hence, Na can lose an electron to form Na^+ ion whereas Cl cannot lose an electron to form Cl^+ ion.

Q. 7. Potassium atom is larger than sodium atom. Why ?

Ans. Potassium is placed below sodium in group 1. It, therefore has one more electron shell. Na atom has three electron shells (2, 8, 1); K atom has four (2, 8, 8, 1). So, potassium atom is bigger than sodium atom.

Q. 8. Magnesium atom is smaller than calcium atom. Why ?

Ans. Magnesium atom precedes calcium atom in the same group, *i.e.,* group 2. Magnesium atom has got three electron shells (2, 8, 2) whereas calcium atom has four electron shells (2, 8, 8, 2). So, calcium atom is larger than the sodium atom.

Q. 9. Magnesium atom is smaller than sodium atom. Why ?

Ans. Magnesium come after sodium in the same period. Atoms of both elements have three electron shells (Na : 2, 8, 1 : Mg : 2, 8, 2). But the nuclear charge of sodium is + 11 and that of magnesium is + 12. Hence, the electron shells are pulled inward more strongly in Mg atom than in Na atom. Hence, Mg atom is smaller than Na atom.

Q. 10. Which is larger Na^+ or K^+ ? Why ?

Ans. K^+ is larger than Na^+ because the ionic radius increases in a particular group on moving from top to bottom due to increase in the principle energy shell though the number or electrons in the valence shell remain the same.

Q. 11. Mg^{2+} ions is smaller than O^{2-} ion although both are iso-electronic. Explain.

Ans. Mg^{2+} ion is smaller than O^{2-} ion though both are iso-electronic. The nuclear charge in Mg^{2+} is + 12 and O^{2-} is + 8, so with the increase in nuclear charge the size decreases and, hence $O^{2-} > Mg^{2+}$.

Q. 12. Why the atomic size decreases in a period as we move from left to right ?

Ans. As we move from left to right across a period, the number of shells remain the same. As the atomic number increases, the nuclear charge increases and there is a greater attraction between the nucleus and the electrons. The atomic size, therefore, decreases across a period.

Q. 13. The reducing power of elements increases as one goes down a group ?

Ans. When an atom loses an electron then the element is said to be a reducing agent. The reducing power of an element depends upon how quickly it can lose electrons. In case of electrons held very loosely by the nucleus such element can easily lose their valence electrons and hence, higher reducing agent.

Q. 14. The reducing power of elements decreases as on one move from left to right in a period ?

Ans. The reducing power of an element depends upon, how quickly it can lose electrons in the valence shell. As one moves from left to right in periodic table, the electrons in valence shell are held more tightly because of increase of nuclear charge. Thus, the tendency of atoms to lose their electrons gradually decreases and so does the reducing power.

Q. 15. Why the oxidising power of elements increases on moving from left to right along a period in the periodic table ?

Ans. Oxidising power of elements increases on moving from left to right along a period in the periodic table because on moving from left to right along a period in the periodic table the electron affinity of elements increases.

Q. 16. Why ionization potential of the element increases across a period ?

Ans. Ionization potential of an element is the amount of energy required to remove one or more electrons from the outermost shell of an isolated gaseous atom.

Across a period, the atomic radii decreases because of increase in nuclear charge due to addition of electrons which results in greater attraction of valence shell electrons. Hence, ionization potential increases.

Q. 17. Why the second ionization energy of an element is greater than its first ionization energy ?

Ans. More energy is required to remove an electron as it holds more firmly by the unipositive ion. Thus, the second ionization energy of an element is greater than its first ionization energy.

Q. 18. Why is ionisation energy of O less than that of N ?

Ans. Ionisation energy of O is less than that of N because it is very easy to remove electrons from oxygen than from nitrogen. Hence, ionisation energy of O is less than that of N.

Q. 19. Noble gases have zero electron affinity values.

Ans. Noble gases have zero electron affinity values because they have stable electronic configuration and have no tendency to take an additional electron. Hence, no energy is released and their electron affinity is zero.

Q. 20. Why elements with low ionization potential exhibit metallic properties ?

Ans. Metallic character increases with decrease in ionization potential. Lower the value of ionization potential, the greater is the tendency of an atom to lose electrons.

Chapter 2. Chemical Bonding

Q. 1. Why atoms combine with one another ?

Ans. The cause of chemical combination between atoms of the various elements is their tendency to acquire nearest stable noble gas configuration of octet of electrons and duplet of electrons in case of hydrogen atoms in their outermost shells.

Q. 2. Why do certain elements form ions ?

Ans. Every particle (molecule, atom or ion) has the tendency to attain the state of lowest energy. As atoms of all elements except the noble gases, have one to seven electrons in their outermost shell, therefore, they are not in the state of minimum energy. They are reactive. In order to attain a minimum state of energy, *i.e.,* to acquire a duplet or octet structure in their valence shell, they either donate or accept electrons. In this process, they become charged particles or ions.

Q. 3. Why all atoms other then noble gas atoms are reactive ?

Ans. All atoms other then noble gas atoms are reactive because they are short of octet in their outermost shell. They tend to attain eight electrons in their outermost shell to acquire nearest inert gas electronic configuration.

Q. 4. Why a molecule of hydrogen is more stable than the uncombined atoms ?

Ans. When a molecule of hydrogen is formed from the atoms, energy is released (104 kcal/mol). The molecules possessing lower energy are more stable, than the atoms. Hence molecule of hydrogen is more stable than uncombined atoms.

Q. 5. Why is hydrogen ion called proton ?

Ans. An atom of hydrogen has one proton in its nucleus and one electron in its valence shell. It donates its valence electron, the residual ion consists of a single proton. It is on account of this fact, that hydrogen ion is called proton.

Q. 6. A cation is smaller than the atom from which it is formed. Why ?

Ans. In the formation of a cation, the atom loses the electrons of its outer shell. Thus, the cation has one electron shell less than the atom, from which it is formed. So, it is smaller than the atom.

Q. 7. An anion carries negative charge. Why ?

Ans. When an atom forms an anion, it gets one or more electrons (from another atom) in its outer shell. As the number of electrons in the outer shell is increased, the repulsion between them increases. This makes the shell expand outward. Further, since the number of protons remains the same as in the neutral atom, the nucleus attracts the increased number o f electrons less strongly. For these reasons the anion is bigger than the parent atom.

Q. 8. Why electrovalent compounds form hard crystals ?

Ans. The crystals of electrovalent compounds are made up of crystal lattice containing oppositely charged ions. Each cation is surrounded by a definite number of anions and vice-versa. Their is a great electrostatic force of attraction among these oppositely charged ions and as a result, ionic compounds form hard crystals.

Q. 9. Why electrovalent compounds have high melting, boiling points and low volatility ?

Ans. There is a strong force of attraction among the oppositely charged ions in the crystals of electrovalent compounds. Therefore, a large amount of energy is required to separate them. Due to these strong forces of attraction, ionic compounds have high melting and boiling points and low volatility.

Q. 10. Why electrovalent compounds in crystalline state do not conduct electricity ?

Ans. Electrovalent compounds in crystalline state do not conduct electricity because the oppositely charged ions in them are held together by a strong electrostatic force of attraction. These ions occupy fixed position in the crystals and do not move when an electric field is applied.

Q. 11. Why do electrovalent compounds usually dissolve in water and molecular compounds dissolve in organic solvents ?

Ans. Water is polar molecule. It hydrates ions by its polar attraction and pulls the ions apart. In covalent compounds the polar charge on molecules is weak and does not have that much of attractive force on the molecules, organic solvents exert a greater polar attraction on covalent molecules and hence dissolve them.

Q. 12. Why ionic compounds are generally soluble in water, but insoluble in organic solvents ?

Ans. The water molecules have high dielectric constant thus, water molecules easily break the ionic bonds between the ions. The ions drift in water in all possible directions and hence, ionic compounds dissolve in water, while organic solvents are non-polar in nature and hence, cannot break the ionic bonds. Thus, the ionic compounds do not dissolve in them.

Q. 13. Why molten NaCl conduct electricity but, CCl_4 does not ?

Ans. Molten NaCl contains Na^+ and Cl^- ions, which are free to move, hence it conducts electricity. Whereas Liquid CCl_4 does not contain any charged particles to conduct electricity.

Q. 14. Why is sodium ion (Na^+) not reactive, but sodium metal is very reactive ?

Ans. Sodium ion has eight electrons in its valency shell and it is the minimum state of energy, while the sodium metal has one electron in valency shell, so the sodium metal is very reactive, whereas sodium ion (Na^+) is not reactive.

Q. 15. Why covalent compounds are generally liquids or gases ?

Ans. In covalent compounds, the molecules are held together by weak Vander Waals forces. In liquids, the molecules are weakly attracted whereas in gases, these forces are almost non-existent. Hence, they are generally liquids or gases.

Q. 16. Why all covalent compounds are bad conductor of electricity ?

Ans. The covalent compounds do not have positive or negative ions in their fused state. Thus, when electric potential is supplied, no ions migrate to opposite poles and hence no conduction of electric current takes place. Thus all covalent compounds are bad conductor of electricity.

Q. 17. Why covalent compounds have low melting point and boiling point ?

Ans. The force of attraction between the molecules is very weak and so the amount of energy needed to separate them is small, consequently they have low melting points and boiling points.

Q. 18. Why most of the covalent compounds have density less than that of water ?

Ans. The covalent molecules are held very weakly by Vander Waals forces. Thus, there are large inter molecular spaces between the molecules. In other words the number of molecules per unit volume is less. Thus mass per unit is also less and hence, covalent compound have low density.

Q. 19. Why do covalent compounds exist as gases, liquids or soft solids ?

Ans. Covalent compounds exists as gases, liquids or soft solids because they have weak forces of attraction between their molecules.

Q. 20. Why hydrogen chloride can be termed as a polar covalent compound ?

Ans. Pure covalent bond exists between two elements which have similar electronegativities. In hydrogen chloride, chlorine being more electronegative attracts the shared pair of electrons towards itself. As a result hydrogen acquires partial positive charge and chlorine gets partial negative charge. Thus, hydrogen chloride can be termed as a polar covalent compound.

Q. 21. Why is methane molecule regarded as a non-polar covalent compound ?

Ans. It has been found that a methane molecule has a three-dimensional tetrahedral structure. The four carbon hydrogen tetrahedral structure. The four carbon hydrogen bonds are directed towards the four corners of tetrahedron. In such a configuration, none of the participating atoms is more electrically charged as compared to other atoms. Hence methane molecule is a non polar covalent compound.

Q. 22. Why the melting and boiling points of coordinate compounds are higher than covalent compounds and lower than ionic compounds ?

Ans. A coordinate bond is a union of one electrovalent and one covalent bond, the volatility of these compounds lies between that of covalent and ionic compounds. Thus, their melting and boiling points are higher than covalent compounds and lower than ionic compounds.

Chapter 3. Study of Acids, Bases and Salts

Q. 1. Hydrochloric acid is considered as a strong acid whereas acetic acid is a weak acid. Why ?

Ans. Hydrochloric acid is considered as a strong acid because it dissociates completely in water.

$$HCl\ (aq.) \rightleftharpoons H^+\ (aq.) + Cl^-\ (aq.)$$

Acetic acid is a weak acid as it dissociates partially when dissolved in water. Most of its molecules remain in molecular form in the solution.

$$CH_3COOH\ (aq) \rightleftharpoons CH_3COO^-\ (aq) + H^+\ (aq)$$

Q. 2. Why dilute sulphuric acid is stronger acid than concentrated sulphuric acid ?

Ans. The presence of water in dilute sulphuric acid increases the hydrogen ion concentration. Hence it is a stronger acid than concentrated sulphuric acid which contains comparatively less water.

Q. 3. Acetic acid is monobasic. Why ?

Ans. Acetic acid is monobasic because it has one ionisable hydrogen ion and combines with one hydroxyl ion of the base to give a single salt and water.

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

$$NaOH + CH_3COOH \longrightarrow CH_3COONa + H_2O$$

Q. 4. Carbonic acid is a dibasic acid. Why ?

Ans. Carbonic acid (H_2CO_3) is a dibasic acid because it has two replaceable hydrogen atoms and hence it combines with two hydroxyl groups of the bases to form two kinds of salt and water.

$$H_2CO_3 \rightleftharpoons HCO_3^- + H^+$$

$$HCO_3^- \rightleftharpoons CO_3^{2-} + H^+$$

The displacement of two hydrogen atoms takes place in two steps.

Q. 5. Sodium hydroxide is a monoacidic base. Why ?

Ans. Sodium hydroxide is a mono-acidic base as it combines with only one hydrogen ion.

$$NaOH\ (aq) + HCl\ (aq) \longrightarrow NaCl\ (aq) + H_2O\ (l)$$

Q. 6. An aqueous solution of the salt ammonium chloride is acidic in nature while an aqueous solution of sodium chloride is neutral. Why ?

Ans. Ammonium chloride is a salt of weak base and strong acid, it undergoes salt hydrolysis to produce an acidic solution whereas sodium chloride is a salt of strong acid and strong base, it does not undergo salt hydrolysis hence its solution remains neutral.

Q. 7. An aqueous solution of the zinc sulphate is acidic in nature. Why ?

Ans. When zinc sulphate is dissolved in water, it is hydrolysed to form sulphuric acid and zinc hydroxide. Sulphuric acid is a strong acid, while zinc hydroxide is a weak base, hence, the solution is acidic in nature.

$$ZnSO_4 + 2H_2O \longrightarrow \underset{\text{Weak base}}{Zn(OH)_2} + \underset{\text{Strong acid}}{H_2SO_4}$$

Q. 8. An aqueous solution of ammonium acetate is neutral in nature. Why ?

Ans. Ammonium acetate, when dissolved in water is hydrolysed to form ammonium hydroxide and acetic acid. Ammonium hydroxide and acetic acid both are weak alkali and acid respectively, hence the solution is neutral in nature.

Q. 9. An aqueous solution of sodium carbonate is alkaline and that of ammonium chloride is acidic in behaviour. Why ?

Ans. Both of these salts react with water. Sodium carbonate reacts with water, producing a strong alkali, sodium hydroxide and a weak acid, carbonic acid. Hence, the solution is alkaline :

$$Na_2CO_3 + H_2 \rightleftharpoons 2NaOH + H_2CO_3$$

Ammonium chloride reacts with water to produce ammonium hydroxide, a weak alkali and hydrochloric acid, a strong acid. Hence the solution is acidic :

$$NH_4Cl + H_2 \rightleftharpoons NH_4OH + HCl$$

Q. 10. A universal indicator is more meaningful than an ordinary indicator.

Ans. A universal indicator is better than an ordinary indicator as it not only shows whether the solution is acidic or basic but also gives the pH values (approx.) by giving a wide range of colours corresponding to different pH values.

Q. 11. The heat of neutralization of a strong acid with strong base is always the same. Why ?

Ans. Strong acids, strong bases and their salts ionize completely in the solution. Consider the neutralization of hydrochloric acid by sodium hydroxide, which is as follows :

$$NaOH + HCl \longrightarrow NaCl + H_2O + Q \text{ cals.}$$

On ionization, we have

$$Na^+ + OH^- + H^+ + Cl^- \longrightarrow Na^+ + Cl^- + H_2O + Q \text{ cals.}$$

$$H^+ + OH^- \longrightarrow H_2O + Q \text{ cals.}$$

This shows that heat of neutralization of a strong acid by a strong base is nothing, but heat of formation of water molecule from hydrogen and hydroxyl ions, hence it is in the same and fixed quantity.

Q. 12. Lime juice has a sour taste while lime water is slightly bitter. Why ?

Ans. Lime juice contains citric acid which imparts a sour taste to it while lime water is alkaline and hence bitter to taste.

Q. 13. While mixing strong sulphuric acid and water, why is the acid always poured slowly into water instead of water into the acid ?

Ans. When concentrated sulphuric acid is mixed with water, it evolves a considerable amount of heat. This heat is liberated due to the hydration of hydrogen ions derived from the acid.

$$H^+ + H_2O \longrightarrow H_3O^+ + \text{Heat}$$

Due to the production of heat, the water may be vapourised into steam and spill out corrosive drops of acid. To avoid this, the acid is always slowly added to water.

Q. 14. It is necessary to find out the ratio of reactants required in the preparation of sodium sulphate. Why ?

Ans. In the preparation of sodium sulphate, sodium hydroxide and sulphuric acid are both soluble and excess of any of them can not be removed by filtration. Thus it is necessary to find out the ratio of the solutions of the two reactants required for complete neutralisation.

Q. 15. Lead chloride can not be prepared by the action of hydrochloric acid on lead sulphate directly. Why ?

Ans. An insoluble salt can not be prepared from another insoluble salt and since both lead chloride and lead sulphate are insoluble salt, we can not prepare lead chloride by the action of hydrochloric acid on lead sulphate directly.

Q. 16. Sodium sulphite (Na_2SO_3) and sodium hydrogen sulphite ($NaHSO_3$) are salts of sodium but sodium sulphite is called a normal salt and sodium hydrogen sulphite is called an acid salt. Why ?

Ans. Sodium hydrogen sulphite has replaceable hydrogen in its molecule so it is called an acid salt but sodium sulphite does not have, so it is called a normal salt.

$$NaHSO_3 \rightleftharpoons Na^+ + HSO_3^-$$

$$HSO_3 \rightleftharpoons H^+ + SO_3^{2-}$$

Q. 17. Fused calcium chloride is used in a desiccator. Why ?

Ans. Calcium chloride is a deliquescent substance, it absorbs water up to such an extent that it finally dissolves in it and more over, it does not react with water. When calcium chloride is put in a desiccator, it absorbs all water vapours present in it and thus dry atmosphere is created inside.

Q. 18. Why zinc chloride is stored in air-tight bottles.

Ans. Zinc chloride absorbs moisture from the atmosphere and turns into solution because it is a deliquescent substance. In order to prevent this, it is stored in air tight bottles.

Q. 19. The solution of sodium carbonate is alkaline in nature. Why ?

Ans. Sodium carbonate when dissolved in water is hydrolysed to form a weak acid, carbonic acid and a strong base sodium hydroxide. Hence, an aqueous solution of sodium carbonate is alkaline in nature.

$$Na_2CO_3 + 2H_2O \longrightarrow \underset{\text{Weak acid}}{H_2CO_3} + \underset{\text{Strong base}}{2NaOH}$$

Q. 20. Why fused calcium chloride is used in the preparation of $FeCl_3$?

Ans. $FeCl_3$ is highly deliquescent, so it is kept dry with the help of fused calcium chloride and is used in the preparation of $FeCl_3$.

Chapter 5. Mole Concept and Stoichiometry

Q. 1. "When stating the volume of a gas, the pressure and temperatrue should be also given." Why ?

Ans. It is because, the volume of a gas changes, if the pressure or temperature or both change. Thus, while stating the stating the volume of a gas pressure and volume has to be specified alongwith volume.

Q. 2. "The number of atoms in one mole of hydrogen is twice the number of atoms in 1 mole of helium at the same temperature and pressure." Why ?

Ans. It is because, hydrogen is a diatomic gas, whereas helium is monoatomic gas. As number of atoms in one molecule of hydrogen are double, as compared to one molecule of helium, therefore one mole of hydrogen has double the atoms, as compared to helium at the same temperature and pressure.

Q. 3. Why is the term relative atomic mass used for atomic mass of an element ?

Ans. Since the actual mass of an atom of element is extremely small, for comparing the masses of atoms of different elements, the mass of an atom of some light element is fixed as standard and the masses of other atoms are expressed relative to the standard mass, so the term relative atomic mass is used.

Q. 4. Why relative atomic mass is compared with 1/12 of carbon ?

Ans. Naturally occurring hydrogen has three isotopes ($_1H^1$, $_1H^2$ and $_1H^3$) and its relative atomic mass works out 1·008 rather than 1. Atomic mass of carbon is 12. Thus, 1/12 mass of carbon work out as 1. It is on account of the above reason that 1/12 mass of carbon is used for comparing relative atomic masses of other elements.

Q. 5. Why atomic weight of many elements are fractional ?

Ans. The atomic weight of all the elements, is never whole number but the atomic weights of many elements are fractional. The atomic weight of an element is fractional because the atomic weight of an element is actually the average relative weight of all the naturally occurring isotopes of the element.

Chapter 6. Electrolysis

Q. 1. Why are acids, bases and salts classified as electrolytes ?

Ans. Acids, bases and salts are classified as electrolytes because these compounds dissociate into ions, conduct electricity and undergo chemical decomposition at the same time.

Q. 2. Metals like potassium, calcium, sodium, etc., can be extracted only by electrolysis.

Ans. Metals like K, Ca, Na, etc., can be extracted only by electrolysis because conventional reducing agents such as coke, carbon monoxide, hydrogen do not supply sufficient energy to break ionic bonds between the active metals and their chlorides or oxides.

Q. 3. Dilute acids are strong electrolytes. Why ?

Ans. Dilute acids produce a large number of hydronium ions, so they behave like strong electrolytes.

Q. 4. Sea water is a strong electrolyte. Why ?

Ans. Sea water is a strong electrolyte because sodium chloride dissolved in it dissociates completely into free mobile ions.

$$Na^+ Cl^- \rightleftharpoons Na^+ + Cl^-$$

Q. 5. Copper is a good conductor of electricity, but it is a non-electrolyte. Why ?

Ans. During metallic conduction, the chemical properties of copper are intact as it does not undergo chemical decomposition. Since, the flow of electricity only produces heat and energy and no new products are formed copper metal is thus a good conductor of electricity but is a non-electrolyte.

Q. 6. A solution of ionic compound is an electrolyte, while that of covalent compound is non-electrolyte ?

Ans. The solution of ionic compound has free ions, which can migrate to cathode and anode and discharge. Thus, solution of ionic compound is good conductor of electricity and hence is an electrolyte. However, a solution of covalent compound, consists of only molecules and does not have any free ions, which could migrate to cathode or anode. Hence, it is a non-electrolyte.

Q. 7. Explain, why hydrochloric acid is a conductor of electricity ?

Ans. Hydrochloric acid dissociates into ions in aqueous solution as follows :

$$HCl \rightleftharpoons H^+ + Cl^-$$

When a current is passed through in aqueous solution of HCl, the ions move towards their respective electrodes. Thus, the hydrochloric acid is a conductor of electricity.

Q. 8. Does wax conduct electricity ? Give reason to justify your answer.

Ans. No, wax does not conduct electricity because wax, being a covalent compound, does not have positively or negatively charged ions which could not be weakened by heating or in aqueous solution. Therefore due to absence of free ions, wax does not conduct electricity.

Q. 9. Mercury is a liquid and allows the flow of electricity, though it is not an electrolyte.

Ans. An electrolyte is a substance which on dissolving in water breaks up into positively and negatively charged ions. But mercury is a metal, so on dissolving in water, it can not break up into cations and anions. When electric current passes through mercury it does not undergo any decomposition and no new substance is formed. Electric current passes through mercury due to the presence of free electrons in its penultimate shell and not due to the formation of ions. Hence, mercury is a metallic conductor and not an electrolyte.

Q. 10. A solution of cane sugar does not conduct electricity, but a solution of sodium chloride is a good conductor.

Ans. The sugar cane solution is a covalent compound. When it is dissolved in water, it does not dissociate to give free ions which could migrate to cathode or anode. Hence, sugar solution is a bad conductor of electricity.

The sodium chloride solution mainly consists of free sodium and chloride ions which could migrate to positively charged electrodes. Hence, solution of sodium chloride is a good conductor of electricity.

Q. 11. Why does blue colour of $CuSO_4$ solution slowly disappear when iron rod is dipped in it ?

Ans. When an iron rod is dipped in $CuSO_4$ solution, iron displaces copper from $CuSO_4$ to form $FeSO_4$ which is light green in colour.

$$\underset{}{Fe\ (s)} + \underset{\text{Blue}}{CuSO_4\ (aq)} \longrightarrow \underset{}{Cu\ (s)} + \underset{\text{Light Green}}{FeSO_4\ (aq.)}$$

$$\underset{}{Fe} + \underset{\text{Blue}}{Cu^{2+}} \longrightarrow \underset{\text{Light Green}}{Fe^{2+}} + \underset{}{Cu}$$

Q. 12. During electrolysis high voltage is not favoured. Why ?

Ans. During electrolysis high voltage is not favoured because the electrolytic conduction increases with rise in temperature, *i.e.,* decrease in resistance. Increase in resistance can only be obtained by applying low voltage during electrolysis. Thus, only electricity is suitable as reducing agent which provides unlimited amount of energy to break ionic bonds easily.

Q. 13. While electrolysing concentrated sulphuric acid, the bulb glows very dimly but when diluted, the bulb glows brightly. Why ?

Ans. Concentrated (99%) sulphuric acid behaves like a weak electrolyte as it has very little hydronium ions in it. But when added to water, it becomes diluted and produces a large number of hydronium ions. Now, it behaves like a stronger electrolyte and hence the bulb glows brightly.

Q. 14. Why electrolysis of acidulated water is considered example of electrolysis ?

Ans. Electrolysis of acidulated water is considered as an example of electrolysis because the amount of sulphuric acid does not change when water is electrolysed. The sulphuric acid just helps in increasing the conductivity of water.

Q. 15. Why should water be acidified before proceeding with the electrolysis of water ?

Ans. Water should be acidified before proceeding with the electrolysis of water because water is a non-electrolyte, so it can be electrolytically decomposed by removing the H^+ and OH^- ions continuously because the negligible ionization of water yields H^+ and OH^- ions which recombine to form a water molecule, then another molecule will ionize. Sulphuric acid is used to remove these ions.

$$H_2O\ (l) \rightleftharpoons H^+\ (aq) + OH^-\ (aq)$$

$$H_2SO_4\ (aq) \rightleftharpoons 2H^+\ (aq) + SO_4^{2-}\ (aq)$$

Q. 16. Hydroxyl (OH^-) ion is lower in the activity series, than chloride ion. Yet when a concentrated solution of hydrochloric acid is subjected to electrolysis, the hydroxyl ion does not get discharged.

Ans. If an electrolyte has a much higher concentration of ions that are higher in the electrochemical series than those that are lower, then the higher gets discharged in preference to the lower one. Concentrated hydrochloric acid being strong electrolyte gets fully dissociated furnishing H^+ and Cl^- ion. Water is less dissociated into H^+ and OH^- ion. Thus, concentration of chloride ion is more as compared to OH^- ion and hence, chloride ion (Cl^-) are discharged in preference to the OH^- ion.

Chapter 7. Metallurgy

Q. 1. Why are metals called reducing agents ?

Ans. They tend to lose electrons and act as reducing agents.

Q. 2. Why are non-metals called oxidizing agents ?

Ans. They tend to gain electrons and act as oxidising agents.

Q. 3. Why iron is not found in free state in nature ?

Ans. Iron is quite reactive metal, it easily combines with other metals. Iron thus occurs in nature in the form of its compounds and not as a free element.

Q. 4. Iron liberates hydrogen from dilute sulphuric acid, while silver cannot. Why ?

Ans. In activity series of metal, iron occupies a higher position than hydrogen, while silver is placed below hydrogen, hence iron is more reactive than silver and is able to displace hydrogen from dilute sulphuric acid.

$$Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2\uparrow$$

Q. 5. Zinc displaces lead from lead nitrate solution, while gold is unable to do so. Why ?

Ans. Zinc is above lead in the metal activity series. It is more reactive than lead while gold, a noble metal, lies far below lead in the activity series and it is less reactive or highly unreactive. Zinc reacts with lead nitrate solution to precipitate lead and zinc nitrate is formed. There is no reaction between gold and lead nitrate.

$$\underset{\text{Lead nitrate}}{Pb(NO_3)_2} + Zn \longrightarrow \underset{\text{Zinc nitrate}}{Zn(NO_3)_2} + \underset{\text{Lead}}{Pb\downarrow}$$

$$\underset{\text{Lead nitrate}}{Pb(NO_3)_2} + Au \longrightarrow \text{No reaction.}$$

Q. 6. Why is sodium metal always stored under kerosene oil ?

Ans. Sodium is a very reactive metal and on exposure to moist air, the surface of sodium metal is tarnished due to the formation of sodium carbonate.

$$4Na + O_2 \longrightarrow 2Na_2O.$$

$$Na_2O + H_2O \longrightarrow 2NaOH$$

$$2NaOH + CO_2 \longrightarrow \underset{\text{Sodium Carbonate}}{Na_2CO_3} + H_2O$$

To avoid this sodium is always kept under kerosene oil.

Q. 7. Why carbon can reduce copper(II) oxide to copper but not calcium oxide to calcium ?

Ans. Carbon can reduce copper(II) oxide to copper but not calcium oxide to calcium because carbon has greater affinity for oxygen than copper and less affinity for oxygen than calcium.

Q. 8. Aluminium is highly electropositive metal, in spite of it aluminium does not oxidise rapidly in air. Why ?

Ans. In moist air, a thin layer of aluminium oxide is formed on it quickly which protects aluminium to oxidise. This is the reason why aluminium does not oxidise rapidly in air.

Q. 9. Why extraction of aluminium is difficult ?

Ans. Extraction of aluminium is difficult because :

(i) Pure aluminium oxide melts at 2050°C only. So, a large amount of energy is needed to maintain this high temperature.

(ii) A good amount of the aluminium vaporises at this temperature.

(iii) Fused alumina does not conduct electricity well.

Q. 10. During the extraction of aluminium, cryolite and fluorspar are added to alumina. Why ?

Ans. Cryolite and fluorspar are added to alumina :

(i) To lower the melting point of aluminium.

(ii) To make alumina a good conductor of electricity.

(iii) Cryolite acts as a solvent for alumina.

Q. 11. Aluminium transmission wires are preferred to copper transmission wires. Why ?

Ans. (i) Aluminium is lighter than copper.

(ii) It is a good conductor of electricity.

(iii) Aluminium is cheaper than copper.

Q. 12. Why in construction work alloy duralumin is used rather than aluminium ?

Ans. In construction work alloy duralumin is used rather than aluminium because duralumin is harder, stronger and more resistant to corrosin.

Chapter 8. (a) Study of Compounds : Hydrogen Chloride

Q. 1. Mixture of sodium chloride and concentrated sulphuric acid does not heated above the temperature of 170°C while preparing hydrogen chloride. Why ?

Ans. The mixture of sodium chloride and concentrated sulphuric acid is not heated above 170°C in preparing hydrogen chloride gas because at a higher temperature sodium sulphate is formed which is a hard substance and difficult to remove from the reaction flask.

$$2NaCl + H_2SO_4 \longrightarrow Na_2SO_4 + 2HCl$$

Q. 2. Hydrogen chloride gas cannot be dried over quick lime. Why ?

Ans. Hydrogen chloride gas cannot be dried over quick lime because quick lime is basic in nature and combines with moist hydrogen chloride gas forming calcium chloride.

Q. 3. Quick lime and phosphorus pentaoxide cannot be used for drying hydrochloric acid gas. Why ?

Ans. Quick lime and phosphorus pentaoxide cannot be used for drying HCl gas, because both reacts with HCl.

$$CaO + 2HCl \longrightarrow CaCl_2 + H_2O$$
$$2P_2O_5 + 3HCl \longrightarrow 3HPO_3 + POCl_3$$

Q. 4. Hydrogen chloride is not collected over water. Why ?

Ans. Hydrogen chloride is not collected over water because it is highly soluble in water.

Q. 5. When the stopper of a bottle full of hydrogen chloride gas is opened there are fumes in the air ?

Ans. When the stopper of a bottle full of hydrogen chloride gas is opened there are fumes in the air because hydrogen chloride gas has an affinity for water, hence, when the stopper is opened it immediately reacts with water vapour present in the atmosphere which leads to the formation of fumes.

Q. 6. Dilute hydrochloric acid cannot be concentrated by distilling (boiling) the dilute acid. Why ?

Ans. When dilute hydrochloric acid is distilled, a constant boiling mixture containing 20 - 24% of hydrochloric acid distills over unchanged at 760 mm Hg pressure. This constant boiling mixture cannot be separated into its constituents by simply distilling.

Q. 7. Anhydrous HCl is a poor conductor while aqueous HCl is an excellent conductor. Why ?

Ans. Anhydrous HCl is a poor conductor while aqueous HCl is an excellent conductor because anhydrous HCl does not contain any free ions. But when HCl is dissolved in water, it dissociates into hydronium ion (H_3O^+) and chloride ion (Cl^-). Due to the presence of free ions, aqueous solution of HCl conducts electricity.

Q. 8. Sodium is not used to prepare hydrogen from hydrochloric acid (or any other acid). Why ?

Ans. Sodium is not used to prepare hydrogen from acids because sodium metal is highly reactive. So, the reaction with acids is much exothermic and there are more chances of explosion. It is also very dangerous to handle sodium metal.

Q. 9. Silver nitrate crystals are dissolved in distilled water and not in tap water in order to prepare a solution of silver nitrate as a laboratory reagent. Why ?

Ans. Tap water always contains some amount of dissolved sodium chloride. Thus when the solution of silver nitrate is prepared in tap water, it reacts to form curdy white precipitate of silver chloride.

$$AgNO_3 + NaCl \longrightarrow AgCl + NaNO_3$$

To prevent the above chemical reaction, the solution of silver nitrate is prepared in distilled water.

Q. 10. Water for drinking purpose and in swimming pools, is treated with chlorine. Give reason.

Ans. Water for drinking purpose and in swimming pools is treated with chlorine because it sterilises the water. Due to its strong oxidizing action, it destroys bacteria, fungus and other micro-organisms.

Q. 11. Why is it inadvisable to use bleaching powder as a disinfectant when it is mixed with acids ?

Ans. When an acid is mixed into bleaching powder, chlorine gas is liberated which pollutes the atmosphere and makes it unsafe for breathing.

$$CaOCl_2 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + Cl_2$$

Q. 12. Give reasons why :

(i) Sodium chloride will conduct electricity only in fused or aqueous solution state.

(ii) In the electroplating of an article with silver, the electrolyte sodium argento-cynide solution is preferred over silver nitrate solution.

(iii) Although copper is a good conductor of electricity, it is a non-electrolyte.

Ans. (i) Sodium chloride ions in the solid state are held by the electrostatic force of attraction, thus are not free to move and conduct electricity but in th fused state, the crystal lattice breaks down and the charged particles (ions) are free to move and thus are able to conduct electricity.

(ii) In aqueous solution of sodium argento-cyanide, silver ions migrate slowly as compared to in silver nitrate, thereby, ensuring even deposition of silver metal on the articles to be electroplated.

(iii) Copper is a good conductor of electricity but it is a non-electrolyte because it is a solid metal and has no mobile ions to conduct electricity.

Chapter 8. (b) Study of Compounds : Ammonia and Nitric Acid

Q. 1. Ammonia cannot be obtained in laboratory from ammonium nitrate and sodium hydroxide. Why ?

Ans. Ammonia cannot be obtained in laboratory from ammonium nitrate and sodium hydroxide because ammonium nitrate on heating decomposes explosively with the formation of nitrous oxide and water.

Q. 2. Why ammonia gas is not collected over water ?

Ans. Ammonia gas is not collected over water because it is highly soluble in water.

Q. 3. Ammonia cannot be dried by bubbling through concentrated sulphuric acid. Why ?

Ans. Ammonia gas cannot be dried by bubbling through concentrated sulphuric acids as it reacts with sulphuric acid to form ammonium sulphate.

$$2NH_3 + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

Q. 4. Quick lime is the only drying agent used for drying ammonia gas. Why ?

Ans. Quick lime is basic in nature and hence does not react with ammonia, which is also basic in nature, whereas all other drying agents are acidic in nature and hence react with ammonia.

$$\underset{\text{(conc.)}}{2NH_3} + H_2SO_4 \longrightarrow (NH_4)_2SO_4$$

$$\underset{\text{(anhydrous)}}{CaCl_2} + 8NH_3 \longrightarrow CaCl_2.8NH_3$$

$$6NH_3 + P_2O_5 + 3H_2O \longrightarrow 2(NH_4)_3.PO_4$$

Q. 5. Aqueous solution of ammonia gives a pungent smell. Why ?

Ans. Aqueous solution of ammonia gives a pungent smell because it is produced due to bacterial decomposition of urea (NH_2CONH_2), present in urine.

Q. 6. Ammonia solution is used as laboratory reagent to identify metal ions. Why ?

Ans. Ammonium hydroxide can precipitate insoluble hydroxide of metals from their salt solutions. Thus, it is used in analytical analysis of salts in laboratory.

Q. 7. Aqueous solution of ammonia turns red litmus blue. Give reason.

Ans. This is because ammonia on dissolving in water furnishes ammonium (NH_4^+) ions and hydroxyl (OH^-) ions. The presence of OH^- ions in the solution turns red litmus blue.

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

Q. 8. Ammonia solution is used to remove oil and grease stains from clothes. Give reason.

Ans. When ammonium chloride is heated and rubbed with the metal, the ammonia formed removes grease, oil, etc. It emulsifies fats, grease, etc.

$$\underset{\text{Ammonium chloride}}{NH_4Cl\ (s)} \longrightarrow \underset{\text{Ammonia}}{NH_3\ (g)} + \underset{\text{Hydrogen chloride}}{HCl\ (g)}$$

The hydrogen chloride formed removes the oxides of metals and thus cleans the metal surfaces before soldering, tinning, etc.

Q. 9. Liquid ammonia is used as refrigerant in ice plants. Give reason.

Ans. Liquid ammonia is used as a refrigerant as it has high latent heat of vaporisation equal to 5700 cals/mole and a low boiling point. When liquid ammonia evaporates, it takes large amount of heat from surroundings, resulting in the fall in temperature.

$$NH_3 \xrightarrow{\text{Vaporises}} NH_3\ (gas) - 5700\ cals.$$

Q. 10. During the manufacture of nitric acid by Ostwald's process excess of oxygen is taken. Give reason.

Ans. Excess of oxygen is taken during the manufacture of nitric acid by Ostwald's process because each and every step requires oxygen.

Q. 11. In the laboratory preparation of nitric acid, it can be obtained below 200°C or above 200°C, but the lower temperature is preferred. Why ?

Ans. The lower temperature is favoured due to the following reasons :

(i) The glass apparatus may break at higher temperature.

(ii) A significant amount of nitric acid gets decomposed at higher temperature.

(iii) At higher temperature, potassium or sodium sulphate are formed, which cannot be easily removed from the apparatus.

Q. 12. Conc. HCl is not used in place of conc. H_2SO_4 to prepare nitric acid from KNO_3. Why ?

Ans. Conc. HCl is not used in place of conc. H_2SO_4 for the preparation of conc. HNO_3 from KNO_3 because conc. HCl is volatile and hence, nitric acid vapours will carry HCl vapours. Lower volatility of conc. H_2SO_4 is used in the preparation of conc. HNO_3.

Q. 13. Only all-glass apparatus should be used for the preparation of nitric acid. Why ?

Ans. Nitric acid is highly corrosive and hence destroys rubber and cork of the apparatus. Therefore, only all glass apparatus should be used for the preparation of nitric acid.

Q. 14. Pure nitric acid take on a yellowish brown colour when exposed to light. Why ?

Ans. When pure HNO_3 is exposed to light it decomposes to give a reddish brown NO_2 gas which dissolves in undecomposed nitric acid to give yellowish brown colour.

Q. 15. Concentrated nitric acid fumes when kept open. Why ?

Ans. Concentrated nitric acid fumes when kept open because it contains considerable amount of nitrogen dioxide which escapes when exposed.

Q. 16. Nitric acid stains the skin yellow. Give reason.

Ans. Dilute nitric acid reacts with the proteins of the skin and forms a yellow compound called xanthoproteic acid. Hence, the skin becomes yellow. Conc. nitric acid causes blisters on the skin and is highly corrosive.

Q. 17. Iron is rendered passive with fuming nitric acid. Why ?

Ans. Iron is rendered passive with fuming nitric acid because of the formation of reddish brown layer of iron oxide which prevents its further reaction with the acid.

Q. 18. In Haber's process before the gases are allowed to enter the oxidation chamber, the gases are sufficiently cooled. Why ?

Ans. The gases are cooled so that the complete oxidation of nitric oxide takes place or the rate of forward reaction increases or to minimize the decomposition of nitrogen dioxide.

Q. 19. The mixture of nitrogen and hydrogen gases entering the catalyst chamber must be pure. Why ?

Ans. The mixture of nitrogen and hydrogen gases entering the catalyst chamber must be pure, because the presence of carbon dioxide, carbon monoxide and traces of sulphur compound poison the catalyst. Therefore, the removal of these catalyst poison from nitrogen and hydrogen is very essential.

Q. 20. Aluminium does not react with nitric acid of any concentration. Why ?

Ans. Aluminum metal is not attacked by nitric acid of any concentration because of the thin and unreactive protective layer of aluminum oxide formed on the metallic surface due to the reaction of aluminium metal with oxygen of air.

Q. 21. Nitrogen obtained from air is more dense as compared to nitrogen obtained from chemicals. Why ?

Ans. Nitrogen obtained from air contains traces of inert gases and therefore, it is more dense as compared to chemical nitrogen.

Q. 22. Burning magnesium continues to burn in nitric oxide, while burning sulphur is extinguished. Why ?

Ans. The heat produced by burning of magnesium is quite sufficient to decompose nitric oxide into nitrogen and oxygen. The oxygen so obtained supports combustion, but the burning of sulphur does not decompose nitric oxide hence it is extinguished.

Q. 23. During a thunderstorm, the rain water contains traces of nitric acid. Why ?

Ans. Nitrogen present in atmosphere combines with oxygen to form nitric oxide in the presence of electric spark due to lightening produced from a thunderstorm. Nitric oxide is further oxidized to nitrogen dioxide. Nitrogen dioxide dissolves in water in the presence of oxygen of air to form nitric acid.

$$N_2 + O_2 \longrightarrow 2NO$$

$$2NO + O_2 \longrightarrow 2NO_2$$

$$4NO_2 + O_2 + 2H_2O \longrightarrow \underset{\text{Nitric acid}}{4HNO_3}$$

Q. 24. Colourless nitric oxide forms brown fumes in air. Give reason.

Ans. Nitric oxide is oxidized by the oxygen of air to form brown coloured nitrogen dioxide :

$$2NO + O_2 \longrightarrow \underset{\substack{\text{Nitrogen dioxide}\\ \text{(Brown colour)}}}{2NO_2}$$

Q. 25. Nitric oxide gives a black colour with ferrous sulphate solution. Why ?

Ans. Nitric oxide gives a black colour solution, when it is passed through ferrous sulphate solution because nitric oxide combines with ferrous sulphate to form a black coloured complex compound known as ''Nitroso ferrous sulphate''.

$$FeSO_4 + NO \longrightarrow \underset{\text{Nitroso ferrous Sulphate}}{[Fe(NO)]\ SO_4}$$

Q. 26. Nitrous oxide supports combustion more vigorously than air does. Give reason.

Ans. The percentage of oxygen present in nitrous oxide is more than air and it readily decomposes to form oxygen, which supports combustion. Nitrous oxide contains 36·37% of available oxygen, while air contains 21% of oxygen.

Chapter 8. (c) Study of Compounds : Sulphuric Acid

Q. 1. Why concentrated sulphuric acid is called the 'oil of vitriol' ?

Ans. Concentrated sulphuric acid is called 'Oil of vitriol' because of its oily appearance and the fact that it is present in vitrous or glassy substances like ferrous sulphate, alum, etc.

Q. 2. For the production of concentrated sulphuric acid, sulphur trioxide is not directly dissolved in water. Why ?

Ans. For the production of concentrated sulphuric acid, sulphur trioxide is not directly dissolved in water because with water, sulphur trioxide forms a mist of fine drops of sulphuric acid.

Q. 3. The impurity of arsenic oxide must be removed before passing the mixture of sulphur dioxide and air through the catalytic chamber in contact process. Why ?

Ans. This is because the impurity of arsenic oxide makes the catalyst poisonous.

Q. 4. Why concentrated sulphuric acid is kept in air tight bottles ?

Ans. Concentrated sulphuric acid readily absorbs moisture from atmosphere and gets diluted. Hence, it is kept in air tight bottles.

Q. 5. Why the level of concentrated sulphuric acid gets higher if it is left in an open vessel for a week ?

Ans. This is due to the hygroscopic nature of sulphuric acid. It absorbs water vapour from the atmosphere.

Q. 6. Why sulphuric acid behaves as an acid when diluted with water ?

Ans. When sulphuric acid is diluted with water, it ionizes almost completely into hydrogen ions (H^+) and sulphate ions (SO_4^{2-})

$$H_2SO_4 \rightleftharpoons \underset{}{H^+} + \underset{\text{Hydrogen sulphate ion}}{HSO_4^-}$$

$$HSO_4^- \rightleftharpoons H^+ + \underset{\text{Sulphate ion}}{SO_4^{2-}}$$

Since presence of H^+ ions imparts acidic character, therefore, solution of sulphuric acid in water behaves as an acid.

Q. 7. Why the wooden shelves on which conc. sulphuric acid bottles are kept, stained black ?

Ans. Concentrated sulphuric acid is a very powerful dehydrating agent. It removes atoms of hydrogen and oxygen in the form of water from the cellulose $[(C_6H_{12}O_5)_n]$, leaving behind carbon. It is black carbon which appears in the form of black stains.

Q. 8. A black spongy mass is formed, when concentrated sulphuric acid is added to sugar. Why ?

Ans. Sulphuric acid has great affinity for water, hence when concentrated sulphuric acid is added to sugar, it absorbs water from sugar by removing hydrogen and oxygen atoms in the ratio of 2 : 1 from sugar molecules. The sugar is charred producing black spongy mass of carbon, which is known as sugar charcoal.

$$\underset{\text{Sugar}}{C_{12}H_{22}O_{11}} + H_2SO_4 \longrightarrow \underset{\text{Sugar charcoal}}{12C} + [H_2SO_4 + 11H_2O]$$

Q. 9. When blue crystals of copper(II) sulphate are added to concentrated sulphuric acid crystals turn white. Why ?

Ans. Hydrated copper(II) sulphate, when added to concentrated sulphuric acid, loses water of crystallization and thus white anhydrous copper(II) sulphate is formed. The blue coloured hydrated copper(II) sulphate turns white due to the loss of water of crystallization.

$$\underset{\substack{\text{Hydrated copper}\\ \text{sulphate}\\ \text{(Blue crystals)}}}{CuSO_4.5H_2O} + H_2SO_4 \longrightarrow \underset{\substack{\text{Anhydrous copper}\\ \text{sulphate}\\ \text{(White crystals)}}}{CuSO_4} + [H_2SO_4.5H_2O]$$

Q. 10. Why brisk effervescence is seen when H_2SO_4 is added to sodium carbonate ?

Ans. Brisk effervescence are seen due to the evolution of carbon dioxide gas.

Chapter 9. Organic Chemistry

Q. 1. Hydrocarbons are excellent fuels. Give reason.

Ans. Hydrocarbons are excellent fuels because they ignite easily at low temperature and liberate large amount of heat without producing harmful products.

Q. 2. Why alkanes are so inert ?

Ans. It is because in a molecule, a reactive site has one or more unshared pairs of electrons and a polar bond or an electron deficient atom. Alkanes have none of these, that is why they are so inert.

Q. 3. Why alkanes are insoluble in water ?

Ans. Alkanes are insoluble in water because alkanes are called hydrophobic hydrocarbons. They have phobia for water. These are insoluble because these cannot make hydrogen bonds with water molecules.

Q. 4. Methane is called as marsh gas. Why ?

Ans. Methane is called as marsh gas because methane is formed by the decomposition of plant and animal matter lying under water in marshy areas.

Q. 5. Methane does not undergo addition reactions, but ethene does. Why ?

Ans. Methane does not undergo addition reactions, but ethene does because methane is saturated hydrocarbon while ethene is an unsaturated hydrocarbon. Addition reactions are characteristic properties of unsaturated hydrocarbons.

Q. 6. Why it is dangerous to burn methane in an insufficient supply of air ?

Ans. It is dangerous to burn methane in an insufficient supply of air because it will form carbon monoxide which is poisonous for human beings as it cuts off the oxygen supply by forming carboxy haemoglobin in the blood.

Q. 7. Why light or heat is necessary for chlorination of alkanes ?

Ans. The Cl–Cl bond must be broken to form Cl radicals, before the chlorination of alkanes can commence. The breaking of bond requires energy which is supplied either by heat or light.

Q. 8. Ethene undergoes addition reactions with halogens whereas ethane undergoes substitution reactions. Why ?

Ans. Ethene is an unsaturated hydrocarbon so, it adds up a molecule of halogen to give a saturated compound, whereas, ethane is a saturated hydrocarbon compound and hence, can only undergo substitution reaction with halogen.

$$\underset{\substack{\text{Ethene}\\(\text{Unsaturated})}}{CH_2 = CH_2} + Cl_2 \longrightarrow \underset{\substack{\text{addition product}\\(\text{Saturated})}}{CH_2Cl—CH_2Cl}$$

Q. 9. Alkynes are unsaturated hydrocarbons. Give reason.

Ans. Alkynes have triple bonds, so they are unsaturated hydrocarbon.

Q. 10. Why ethyne is more reactive than ethane ?

Ans. Ethyne is an unsaturated hydrocarbon with a triple covalent bond. Ethane is a saturated hydrocarbon and hence is less reactive than ethyne.

Q. 11. Acetylene burns with sooty flame. Why ?

Ans. Acetylene has higher proportion of carbon and all carbon in it does not burn completely. Hence, unburnt carbon particles make the flame sooty.

Q. 12. Why pure acetic acid is known as glacial acetic acid ?

Ans. Pure acetic acid is known as glacial acetic acid because on cooling below its melting point (17°C) it solidifies and forms little ice-like crystals.

❐

Question Set 12

Short Questions

Chapter 1. Periodic Properties and Variations of Properties

Q. 1. State Newland's law of octaves. Why did the law of octaves fail ? Write three important drawbacks of Newland's classification.

Ans. **Newland's law of octaves :** The elements with similar properties occur each time after every seven elements. Just the same way as the repetition of musical node in a octave.

The law failed because of the following reasons :

(i) The law was applicable only upto calcium. It could not include the other elements beyond calcium.

(ii) With the discovery of rare gases, it was the ninth element and not the eighth element having similar chemical properties.

Drawbacks of Newland's classification :

(i) Newland did not gave any place to transition elements.

(ii) Atomic weights were not correctly estimated.

(iii) Certain elements did not fit into the scheme.

Q. 2. Answer the following questions regarding Mendeleev's modified periodic table.

(i) How many periods are there in Mendeleev's periodic table ?

(ii) How many groups are there in Mandeleev's periodic table ?

(iii) How many groups consist of normal elements and transitional elements in Mendeleev's periodic table ?

(iv) Which group of elements was missing from Mendeleev's original periodic table ?

(v) What is the number of first and last vertical column ?

(vi) In which vertical column hydrogen is placed.

(vii) What are horizontal rows known as ? How many are they in number ?

(viii) How many elements are there in the first horizontal row ?

(ix) How many elements are there in the second and third horizontal rows each ?

Ans. (i) There are seven periods in Mendeleev's periodic table.

(ii) There are nine groups, numbered from 0 to 8.

(iii) The groups IA, IIA, IIIA, IVA, VA, VIA and VIIA consist normal elements and groups, IIIB, IVB, VB, VIB, VIIB and IB, IIB consist of transition elements.

(iv) Zero group (Noble gases).

(v) The first column is numbered zero, whereas last group is numbered 8.

(vi) Hydrogen is placed in IA group.

(vii) The horizontal rows in periodic table are known as periods. There are seven periods in all.

(viii) There are only two elements in the first period.

(ix) The second and third periods have eight elements each.

Q. 3. What is modern periodic law ? Name the elements of 'first transition series'.

Ans. The modern periodic law states that, "The properties of elements are the periodic functions of their electronic configuration". Scandium, titanium, vanadium, chromium, manganese, iron, cobalt, nickel, copper, zinc.

Q. 4. Who gave modern periodic law ? What is meant by a group in the periodic table ?

Ans. Henry Moseley gave the modern periodic law. Vertical column in a periodic table are called groups.

Q. 5. How many vertical columns are there in the modern periodic table ? State whether the ionization potential increases or decreases on going down a group.

Ans. 18 vertical columns are there in the modern periodic table. Ionization potential decreases on going down a group.

Q. 6. How many elements are in the second period of modern periodic table ? Write the names of first and last elements of second period.

Ans. There are eight elements in the second period of the periodic table. Lithium (Li) and neon (Ne) are the first and last element of the second period.

Q. 7. How many elements are in the third period of modern periodic table ? Write the names of first and last elements of third period.

Ans. Eight elements in the third period of the periodic table. Sodium (Na) and Argon (Ar) are the first and last elements of the third period.

Q. 8. How many elements are in the fourth, fifth and sixth period of modern periodic table ?

Ans. There are 18, 18 and 32 elements in the fourth, fifth and sixth period of the periodic table respectively.

Q. 9. Which period is the shortest one ? In which period maximum number of elements are present ?

Ans. The first period is the shortest period in the periodic table as it has only two elements *i.e.*, H and He. The period in which the maximum number of elements are present is 6th period. It is the longest period of the periodic table as it has 32 elements.

Q. 10. Give the number of the group and the period, of the element having three shells with three electrons in valence shell.

Ans. The element having three shells with three electrons in valence shell belong to 13th group and 3rd period.

Q. 11. What are the main characteristic of the last elements in the periodic table ? What is the general name given to such elements ?

Ans. The main characteristic of the last elements in the periods is the presence of 8 electrons in their valence shell (*i.e.*, octet is complete). The general name of such elements are noble gases or inert gases.

Q. 12. What are typical elements ? Give the 'liquid elements' in periodic table.

Ans. Na, Mg, Al, Si, P, S, Cl, Ar are the elements present in third short period in periodic table. These elements are known as typical elements. Francium, mercury and bromine are known as liquid elements.

Q. 13. What are iso-electronic ions ? Account for the decrease in size of the following iso-electronic ions :

$$O^{2-} > F^{-} > Mg^{2+} > Al^{3+}$$

Ans. Iso-electronic ions are of different elements having the same number of electrons but differ from one another in magnitude of nuclear charge. The order of decrease in size is as follows :

Ions	O^{2-} >	F^{-} >	Na^{+} >	Mg^{2+} >	Al^{3+}
Nuclear charge	+8	+9	+11	+12	+13

On moving from left to right, the nuclear charge goes on increasing and the electrons are pulled more and more strongly decreasing the size of the ions.

Q. 14. Give the formula of one species positively charged and one negatively charged that will be iso-electronic with Ne.

Ans. Cation iso-electronic to neon = Mg^{2+}.

Anion iso-electronic to neon = F^{-}.

Q. 15. (i) State the number of elements in period 1, period 2, and period 3 of the periodic table.
(ii) Name the elements in Period 1.
(iii) What happens to atomic size of elements on moving from left to right in a period ?

Ans. (i) Period 1 contains 2 elements; period 2 contains 8 elements; period 3 contains 8 elements.
(ii) Hydrogen and helium.
(iii) The atomic size of elements decreases on moving from left to right in period.

Q. 16. (i) What is the common feature of the electronic configurations of the elements at the end of period 2 and period 3 ?

(ii) If an element is in group 7 (or group 7A) is it likely to be metallic or non-metallic character ?

(iii) Supply the missing word from those in brackets.
If an element has one electron in its outermost energy level (shell) then it is likely to be……(metallic/non-metallic)

Ans. (i) The atoms of the elements at the end of period 2 and period 3 contains 8 electrons in their outermost shell.

(ii) Non-metallic.

(iii) Metallic.

Q. 17. An element Z has atomic number 16. Answer the following questions on Z :

(i) State the period and group to which Z belongs.

(ii) Is Z a metal or a non-metal ?

(iii) State the formula between Z and hydrogen.

(iv) What kind of a compound is this ?

Ans. (i) 3rd period, group 16th (ii) Z is a non-metal

(iii) H_2Z (iv) Covalent compound.

Q. 18. What is similar in the electronic structure of Li, Na and K ?

Ans. The electronic configuration of Li = 2, 1.

The electronic configuration of Na = 2, 8, 1.

The electronic configuration of K = 2, 8, 8, 1.

All the three have one electron in the outermost shell which they lose to form positively charged species, *i.e.,* Li^+, Na^+ and K^+.

Q. 19. Answer the following questions regarding group 17 *i.e.,* halogens of the periodic table.

(i) What are halogens ?

(ii) Which group and sub-group are they placed in ?

(iii) What is their valency ?

(iv) Why are they called halogens ?

(v) Why do they not occur free in nature ?

Ans. (i) Halogens are the members of VII A group which have seven electrons in the outermost shell.

(ii) They are placed in group VII and sub-group A.

(iii) Their valency is –1.

(iv) They are called halogens because chlorine which is a halogen, in the form of sodium chloride is the most abundant salt in nature. Halogen means salt producer.

(v) They do not occur free in nature because they all are very reactive as they need just one electron to complete their outermost shell and every member of the halogen group tries to attain stable electronic configuration.

Q. 20. State the factors which affect or influence the atomic size of the elements in a periodic table.

Ans. Factors which affect the atomic size of the elements in a periodic table are :

(i) Magnitude of nuclear charge (ii) Number of shells

(iii) Screening or shielding effect

Q. 21. In group 1 of the periodic table, three elements X, Y and Z have ionic radii 1.33Å, 0.95Å and 0.60Å respectively. Giving a reason, arrange them in the order of increasing atomic numbers in the group.

Ans. X – 1.33Å; Y – 0.95 Å; Z – 0.60 Å.

The order of increasing atomic numbers is : Z < Y < X.

This order is due to the fact, that greater is the ionic radii, greater is the atomic number of the element. As the ionic radii increases, the number of electrons increases, *i.e.,* the atomic number increases.

Q. 22. (i) A boy has reported the radii of Cu, Cu^+ and Cu^{2+} as 0.96Å, 1.22Å and 0.72Å respectively. However, it has been noticed that he interchanged the values by mistake. Assign correct values to different species.

(ii) Account for the difference in size of Na^+ (0.96Å) and Mg^{2+} (0.65Å) both of which have the same number of electrons.

Ans. (i) Cu = 1.22Å; Cu^+ = 0.96Å; Cu^{2+} = 0.72Å.

(ii) Mg^{2+} (0.65Å) is smaller than Na^+ (0.96Å) because as the effective nuclear charge per electron increases, the electrons are more strongly attracted and pulled towards the nucleus which causes a decrease in size of the Mg^{2+} ion.

Q. 23. What do you know about metallic character of an element ?

Ans. It is the property of an element by virtue of which an element possess utmost of 3 electrons in its outermost shell and because of this it is able to form positive ions by loosing there electrons.

Q. 24. What is shielding effect or screening effect ? How does it govern the ionization energy of an atom ?

Ans. When the number of inner electrons is greater, then they shield the outermost electron from the nucleus in such a way that the outermost electron becomes free from any nuclear attraction. This is called the shielding or screening effect.

The shielding effect makes the electron very less firmly held by the nucleus on descending a group, so the ionisation energy decreases down a group.

Q. 25. A group of elements in the periodic table are given below (Boron is first member of the group and Thallium is the last).

Boron

Aluminium

Gallium

Indium

Thallium

Answer the following questions in relation to the above group of elements :

(i) Which element has the most metallic character ?

(ii) Which element would be expected to have the highest electro-negativity ?

(iii) If the electronic configuration of Aluminium is 2, 8, 3, how many electrons are there in the outer shell of Thallium ?

(iv) The atomic number of Boron is 5. Write the chemical formula of the compound formed when Boron reacts with Chlorine.

(v) Will the elements in the group to the right of this Boron group be more metallic or less metallic in character ? Justify your answer.

Ans. (i) Thallium (ii) Boron

(iii) Three (iv) BCl_3

(v) Less metallic. Metallic character decreases from left to right in the periodic table.

Q. 26. Arrange the following elements as directed

(i) Ar, He, Ne (in increasing order of electron shells)

(ii) Li, F, C, O (in increasing order of electron affinity)

(iii) Cl, Mg, P, Na (in increasing order of atomic size)

(iv) Cl, Li, F, N (in increasing order of electronegativity)

(v) Cl, S, Al, Na (in increasing order of ionisation potential)

(vi) Increasing order of atomic size. (vii) Increasing non-metallic character

(viii) Increasing ionisation potential. (ix) Increasing electron affinity.

(x) Decreasing electronegativity.

Ans. (i) Increasing order of number of electron shells : He, Ne, Ar

(ii) Increasing order of electron affinity : Li, C, O, F

(iii) Increasing order of atomic size : Cl, P, Mg, Na

(iv) Increasing order of electronegativity : Li, N, Cl, F

(v) Increasing order of ionisation potential : Cl, S, Al, Na.

(vi) F > Cl > Br > I. (vii) I < Br < Cl < F. (viii) I < Br < Cl < F.

(ix) F < Cl < Br < I. (x) F > Cl > Br > I.

Q. 27. (i) Arrange I, Cl and Br in an increasing order of their atomic size.

(ii) Arrange the following in the increasing order of their ionisation potential ?
Li, Be, B, C, N, O, F.

(iii) What are the following groups known as :
(a) Group I (b) Group VII (c) Group VIIIA.

(iv) What was the significance of the Dobereiner triads or what is the achievement of Dobereiner's Triads ?

(v) Arrange the following nine elements into three Doberiner's triads. The atomic weights of some of these elements are to the left of their symbols. Supply the atomic weights of other elements by calculation.

^{137}Ba ^{80}Br ^{40}Ca ^{127}I K Cl ^{7}Li Sr ^{23}Na.

(vi) An element X belongs to 3rd period and group II of the periodic table. State :
(a) The number of valence electrons (b) Valency
(c) Metal or non-metal (d) Name of the element.

Ans. (i) Cl < Br < I.

(ii) Li < Be < B < C < N < O < F.

(iii) (a) Group I : Alkali metals (b) Group VII : Halogens
(c) Group VIII A : Noble gases.

(iv) This was the first attempt to relate the properties of the elements to their atomic weights.

(v) (a) ^{7}Li ^{23}Na ^{39}K
(b) ^{40}Ca $^{88\cdot5}$Sr ^{137}Ba
(c) ^{33}Cl ^{80}Br ^{127}I

(vi) (a) 2 (b) + 2 (c) Metal (d) Magnesium.

Q. 28. How does the chemical reactivity of alkali metals and halogens vary ?

Ans. The reactivity of alkali metals increases as we move down the group. As the atomic number increases, the atomic radius also increases and the single electron in the valence shell is located further away from the nucleus. Hence, Li is least reactive and Francium is the most reactive. In case of halogens, the reactivity gradually decreases as we move down the group. All of them require one electron to complet, the outermost shell and the nuclear attraction is greater on the nearest shell (*i.e.*, IInd shell in F) than in the fathest shell (*i.e.*, VI shell in iodine). Hence, F is most reactive and I is least reactive.

Q. 29. How do the following change, on going from left to right in a period of the periodic table ? Give example in support of your answer.

(i) Chemical reactivity of elements. (ii) Nature of oxides of the elements.

Ans. (i) The alkali metals are highly reactive. The chemical reactivity of elements decreases from left to right in a period of the Periodic Table, *e.g.*, in the 3rd period, the order of chemical reactivity is :

$$Na > Mg > Al > Si > P > S > Cl$$

The order of chemical reactivity is the reverse of the order of electronegativity.

(ii) Oxides of elements in a particular period become less basic and finally becomes acidic in character, *e.g.*, oxides of third period :

Na_2O	MgO	Al_2O_3	SiO_2	P_2O_5	SO_3	Cl_2O_7
Strongly basic	Basic	Amphoteric	Feebly acidic	Acidic	More acidic	Most acidic

Q. 30. The elements of one short period of the Periodic Table are given below in order from left to right :

Li Be B C O F Ne

(i) To which period do these elements belong ?

(ii) One element of this period is missing. Which is the missing element and where should it be placed ?

(iii) Which one of the elements in this period shows the property of catenation ?

(iv) Place the three elements fluorine, beryllium and nitrogen in the order of increasing electronegativity.

(v) Which one of the above elements belongs to the halogen series ?

Ans. (i) 2^{nd} period (ii) Nitrogen. It should be placed between carbon and oxygen.

(iii) Carbon (iv) Beryllium < Nitrogen < Fluorine

(v) Fluorine

Q. 31. (i) Electron affinities of two elements A and B are given as follows :

A = 3.79 electron volts and B = 3.56 electron volts

Which of them will ionize more easily and why ?

(ii) A, B and C are the elements or a Dobereiner's triad. If the atomic mass of A is 7 and that of C is 39, what should be the atomic mass of B ?

(iii) Account for the difference in size of Fe^{3+} as Fe^{2+} = 0.76Å and Fe^{3+} = 0.64Å.

Ans. (i) A will ionize more easily than B because more is the electron affinity of an element, the more will be the tendency to accept electrons and hence get ionized easily.

(ii)

A	B	C
7	?	39

$$\text{At. mass of B} = \frac{7 + 39}{2} = \frac{46}{2} = 23.$$

(iii) The size of Fe^{3+} (0.64Å) is smaller than the size of Fe^{2+} (0.76Å) because the effective nuclear charge per electron increases. The electron are more strongly attracted and pulled towards the nucleus. This causes decrease in the size of the Fe^{3+} ion.

Q. 32. (i) For each of the following pairs, predict which one has greater ionization energy and greater electron affinity ?

(a) I, I^- (b) B, C (c) Li, Li^+

(ii) Select the correct order of radii of three species : Ca, Ca^+ and Ca^{2+} :

(a) $Ca > Ca^+ > Ca^{2+}$ (b) $Ca^{2+} > Ca^+ > Ca$

(c) $Ca^+ > Ca > Ca^{2+}$ (d) $Ca^+ > Ca^{2+} > Ca$

Assign suitable reason.

Ans. (i)

Ionisation Energy		Electron Affinity	
(a)	$I^- > I$	(i)	$I > I^-$
(b)	$C > B$	(ii)	$C > B$
(c)	$Li^+ > Li$	(iii)	$Li > Li^+$

(ii) The correct order of radii is (a), *i.e.*, $Ca > Ca^+ > Ca^{2+}$.

This is because due to the loss of electron, the effective nuclear charge per electron increases, the electrons are more strongly attracted and pulled towards the nucleus. This causes a decrease in the size of the positive ion.

Q. 33. (i) The elements calcium, strontium and barium were put in one group or family on the basis of their similar properties :

(a) What are those similar properties ?

(b) What is the usual name of the group or family ?

(ii) Chlorine, bromine and iodine elements were put in one group on the basis of their similar properties :

(a) What are those similar properties ?

(b) What is the common name of this group or family ?

Ans. (i) (a) All the three have the same number of valence electrons in their outermost shell, *i.e.*, 2. So they are reactive, non-metallic, have low ionisation energy and low electron affinity.

(b) The name of this group is alkaline earth metals.

(ii) (a) All are non-metals and bad conductors of heat and electricity; diatomic in the gaseous state and form ionic compounds with non-metals.

(b) The common name of this group or family is halogens.

Q. 34. Two different elements A and B have atomic number 12 and 14 respectively, write down :

(i) The electronic configuration of X and Y, using the notation $1s^2$, $2s^2 2p^6$…… .

(ii) The groups of periodic table to which they belong.

(iii) The principal oxidation states.

(iv) The formulae of their simplest chlorides.

(v) The explanation for the following :

The chloride of one is a good conductor of electricity in molten state while the other which is liquid, is not.

Ans. (i) The electronic configuration of A and B are :

$$A = 1s^2, 2s^2\ 2p^6, 3s^2$$

$$B = 1s^2, 2s^2\ 2p^6, 3s^2 3p^2$$

(ii) A belongs to IInd and B belongs to IVth group of the Periodic Table.

(iii) The principal oxidation states of A and B are 2 and 4, respectively.

(iv) The formulae of their chlorides are ACl_2 and BCl_4, respectively.

(v) The chloride of A is an electrovalent compound and conducts electricity in molten state. The chloride of B is a liquid covalent compound, hence is nota good conductor of electricity.

Q. 35. (i) An element has an atomic number 16. State

(a) the period to which it belongs (b) the number of valence electrons

(c) whether it is a metal or non-metal

(ii) Within a group where would you expect to find the element with :

(a) The greatest metallic character (b) The largest atomic size

Ans. (i) (a) 3rd period (b) Six electrons (c) Non-metal

(ii) (a) At the bottom of the group (b) At the bottom of the group

Q. 36. With reference to the first three periods of the modern periodic table, answer the questions given below :

(i) Write the formula of the sulphate of the element with atomic number 13.

(ii) Name the element which has the highest ionisation potential.

(iii) What features of the atomic structure accounts for the similarities in the chemical properties of the elements in group VIIA of the periodic table ?

(iv) How many electrons are present in the valence shell of the element with atomic number 18 ?

(v) What is the electronic configuration of the element in the third period which gains one electron to change into an anion ?

(vi) What is the name given to the energy released when an atom in its isolated gaseous state accepts an electron to form an anion ?

(vii) What type of bonding will be present in the oxide of the element with atomic number 1 ?

Ans. (i) $Al_2(SO_4)_3$ (ii) Helium

(iii) Seven electrons in their valence shells (iv) Eight

(v) 2, 8, 7 (vi) Electron affinity

(vii) Covalent bonding

Chapter 2. Chemical Bonding

Q. 1. The combination of atoms to form molecules is based on octet rule. Give two limiations of this rule.

Ans. (i) It cannot explain the formation of molecules like BeF_2, BF_3 in which the central atom has less than 8 electrons in its valence shell.

(ii) It cannot explain the formation of molecules such as PF_5, SF_6 etc., in which central atom has more than eight electrons in its valence shell.

Q. 2. Write the general characteristics of electrovalent compounds.

Ans. The general characteristics of electrovalent compounds are :

(i) Electrovalent compounds are mostly crystalline in nature.

(ii) Electrovalent compounds form hard crystals. These crystals are usually brittle.

(iii) Electrovalent compounds have high density with high melting and boiling points.

(iv) Electrovalent compounds are soluble in polar solvents.

(v) Electrovalent compounds exhibit isomorphism.

(vi) They react very fast.

Q. 3. On what factors the formation of an electrovalent compound depends ?

Ans. The formation of an ionic or electrovalent compound depends on the following factors :

(i) **Low ionisation energy :** Lesser is the ionisation energy of an atom, greater will be its tendency to form cation by losing the valence electron. Metals with lower ionisation energy values have a greater tendency to form ionic bonds.

(ii) **High electron affinity :** Higher the value of electron affinity, greater will be the tendency of the atom to gain electron and form an anion. Elements with high electron affinity values form ionic compounds.

(iii) **High lattice energy :** The higher is the value of lattice energy, greater will be the electrostatic force of attraction between the oppositely charged ions and hence ionic compounds are formed with greater ease by release of energy.

Q. 4. What are the salient features of electrovalency ?

Ans. Some salient features of electrovalency are as follows :

(i) An electrovalent bond is formed by loss or gain or transfer of electrons.

(ii) Ions are formed during the formation of an electrovalent bond.

(a) Positive ions $\longrightarrow$ Cations (Na^+, K^+, Ca^{2+}, etc.)

(b) Negative ions $\longrightarrow$ Anions (Cl^-, O^{2-}, N^{3-}, etc.)

(iii) An electrostatic force of attraction exist between the oppositely charged ions.

(iv) There is one fixed direction in space among the ions.

Q. 5. Write the important characteristics of covalent compounds.

Ans. The important characteristics of covalent compounds are as follows :

(i) Usually covalent compounds exist in gaseous, liquid or amorphous state.

(ii) Covalent compounds have low melting or boiling points.

(iii) Except for graphite, covalent compounds are bad conductors of electricity.

(iv) Covalent compounds are soluble in non polar solvents (usually organic solvents). Polar covalent compounds are however soluble in polar solvents.

(v) Covalent compounds contain molecules and they undergo reactions slowly.

(vi) Many covalent compounds exhibit various types of isomerism.

Q. 6. (i) Name the charged particles which attract one another to form electrovalent compounds.

(ii) In the formation of electrovalent compounds, electrons are transferred from one element to another. How are electrons involved in the formation of a covalent compound ?

(iii) The electronic configuration of nitrogen is 2, 5. How many electrons in the outer shell of a nitrogen atom are not involved in the formation of a nitrogen molecule ?

(iv) In the formation of magnesium chloride (by direct combination between magnesium and chlorine), name the substance that is oxidised and the substance that is reduced.

Ans. (i) Cation and anion

(ii) There is mutual sharing of electrons to form a covalent compound.

(iii) 2

(iv) Magnesium is oxidised and chlorine is reduced.

Q. 7. In the formation of compound XY_2, atom X gives one electron to each Y atom. What is the nature of bond to XY_2 ? Give four properties of XY_2.

Ans. The bond in XY_2 is ionic.

Properties :

(i) It is hard and brittle.

(ii) It is soluble in water.

(iii) It has high melting and boiling point.

(iv) It does not conduct electric current in the solid state but conducts electric current in the molten or dissolved state.

Q. 8. There are three elements E, F, G with atomic numbers 19, 8 and 17 respectively.

(i) Classify the elements as metals and non-metals.

(ii) Give the molecular formula of the compound formed between E and G and state the type of chemical bond in this compound.

Ans. (i)

	Z	EC	
E	19	2, 8, 8, 1	Metal
F	8	2, 6	Non-metal
G	17	2, 8, 7	Non-metal

(ii) E – 2, 8, 8, 1

$E - 1e^- \rightarrow E^{+1}$

G – 2, 8, 7

$G + 1e^- \rightarrow G^{-1}$

E^{+1} G^{-1}

E G $\Rightarrow$ $\boxed{EG}$

Type of bond $\Rightarrow$ Ionic bond.

Q. 9. (i) Give one property of hydrogen chloride which agrees with it being a covalent compound.

(ii) Give one property of magnesium chloride which agrees with it being an ionic compound.

(iii) Name one compound which is covalent, but on dissolving in water conducts electricity ?

(iv) Which property of the above compound agrees with the being of a covalent compound ?

Ans. (i) Hydrogen chloride is a gas at room temperature and in dry state it is a bad conductor of electricity.

(ii) Magnesium chloride in the molten state or in aqueous solution is a good conductor of electricity and therefore is an ionic compound.

(iii) Hydrogen chloride.

(iv) Hydrogen chloride is a gas. In dry state, it is bad conductor of electricity. Hence, it is a covalent compound.

Q. 10. A compound has the formula H_2Y (Y = Non-metal). State the following :

(i) The outer electronic configuration of Y.

(ii) The valency of Y.

(iii) The bonding present in H_2Y.

(iv) The formula of the compound formed between calcium [$^{40}_{20}$Ca] and Y.

Ans. (i) Y has six electrons in its valence shell

(ii) 2 (iii) Covalent

(iv) $Ca : + \dot{\underset{\cdot\cdot}{\underset{\cdot\cdot}{Y}}}: \longrightarrow Ca^{2+} [:\dot{\underset{\cdot\cdot}{\underset{\cdot\cdot}{Y}}}:]^{2-}$ or $Ca^{2+} Y^{2-}$

2, 8, 8, 2 2, 8, 8, 2 or CaY

Q. 11. Elements X, Y and Z have atomic number 6, 9 and 12 respectively. Which will :

(i) form an anion (ii) form a cation

(iii) has four electrons in its valence shell.

Element	Atomic No.	Electronic configuration
X	6	2, 4
Y	9	2, 7
Z	12	2, 8, 2

Ans. (i) Y will form an anion (ii) Z will form a cation

(iii) X has four electrons in its valence shell.

Q. 12. (i) Name two compounds that are covalent when taken pure but produce ions when dissolved in water.

(ii) For each compound, give the formulae of the ions formed in aqueous solutions.

(iii) Give the structure of hydroxyl ion.

Ans. (i) Hydrogen chloride and hydrogen bromide.

(ii) $HCl + H_2O \longrightarrow H_3O^+ + Cl^-$

$HBr + H_2O \longrightarrow H_3O^+ + Br^-$

(iii) Hydroxyl ion has the structure $[\ :\ddot{O}—H\ ]^-$

Q. 13. How is a coordinate bond formed ?

Ans. The formation of coordinate bond between two atoms occurs in the following steps as :

Example : In the first step the donor atom (say A) transfers one electron of its lone pair to the acceptor atom (say B). Due to this the atom A develops a unit positive charge and atom B develops a unit negative change. This charge is known as formal charge and is similar to the formation of an ionic bond.

In the second step the two electrons, one each with A^+ and B^- are shared by both the ions. This is similar to the formation of covalent bond.

$$A : + B \longrightarrow A^+. + {}^{\cdot}B^-$$

$$A^+. + {}^{\cdot}B^- \longrightarrow A : B \text{ or } A \longrightarrow B$$

Thus, a coordinate bond is equivalent to a combination of an electrovalent bond and a covalent bond. Hence it is also called a semipolar bond or dative bond.

Q. 14. What are the characteristics of coordinate compounds ?

Ans. The general characteristics of coordinate compounds are as follows :

(i) Coordinate compounds are identical to normal covalent compounds.

(ii) It is rigid and has directional properties.

(iii) These compounds are soluble in non-polar solvents and insoluble in polar solvent.

(iv) These compounds behave as non-conductors of electricity.

(v) The melting and boiling points are higher than covalent compounds and lower than ionic compounds.

(vi) These are stable compounds.

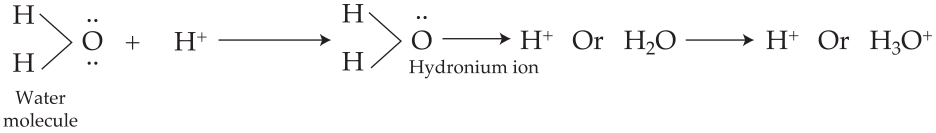
Q. 15. Which conditions are necessary for the formation of coordinate bond ?

Ans. For the formation of a coordinate bond the atom acting as a donor must have one unshared pair of electrons which may be donated by it to the acceptor atom. The acceptor atom must have an empty orbital to accept the lone pair of electrons.

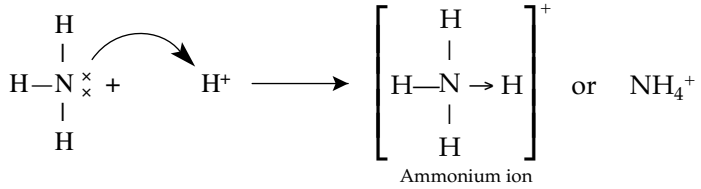
Q. 16. Explain the formation of H_3O^+ and NH_4^+ ion.

Ans. **Formation of Hydronium ion (H_3O^+) :** This ion is formed by the combination of H_2O molecule and H^+ ion. The water molecule has two O—H covalent bonds and central oxygen atom has two lone pairs of electrons. H^+ ion has one vacant 1*s*-orbital. During the formation of H_3O^+, one pair of lone pair from O-atom is donated to the vacant 1*s*-orbital of H^+ ion and O → H^+ coordinate

bond is formed. Thus H_3O^+ ion contains two O—H covalent bonds and one O → H^+ coordinate bond. After the formation O → H^+ coordinate bond becomes identical to the two O—H covalent bonds. Hence in H_3O^+ ion all the three bonds are identical.



Formation of NH_4^+ Ammonium ion : This ion is formed by the combination of NH_3 molecule and H^+ ion. In NH_3 molecule each of three H-atoms is linked to N-atom by a covalent bond. Thus in this molecule N-atom is left with a lone pair of electrons after completing its octet by sharing three of its valence shell electrons with three H-atoms. The electrons of lone pair on N-atom are donated to H^+ ion and thus a N—H coordinate bond is established in NH_4^+ ion.



Q. 17. What is lone pair effect ? In what kind of compound does this effect occur ?

Ans. When the unshared pair of electrons around an atom in the middle of a molecule is completely shared by another atom or an ion, it is called lone pair effect. Lone pair effect is shown by polar covalent compounds such as HCl and NH_3.

Q. 18. (i) Which of the following is not a common characteristic of an electrovalent compound ?

(a) High melting point

(b) Conducts electricity when motten

(c) Consists of oppsitely charged ions

(d) Ionises when disolved in water

(ii) What are the terms defined below :

(a) A bond formed by a shared pair of electrons with both electrons coming from the same atom.

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

Ans. (i) (d)

(ii) (a) Coordinate bond (b) Covalent bond

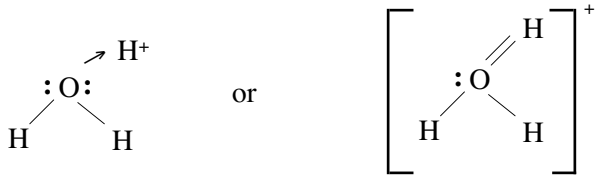
Q. 19. (i) Acids dissolve in water to produce positively charged ions. Draw the structure of these positive ions.

(ii) Explain why carbon tetrachloride does not dissolve in water.

(iii) Elements Q and S react together to form an ionic compound. Under normal conditions, which physical state will the compound QS exist in ?

(iv) Can Q and S, both be metals ? Justify your answer.

Ans. (i)



(ii) Carbon tetrachloride does not dissolves in water because carbon tetrachloride is a non-polar covalent compound whereas water is a polar covalent solvent.

(iii) Solid state.

(iv) No Q and S both can not be metals because to form an ionic compound if one element gives electrons, the other element should accept electrons. Metals can only lose electrons to provide positive ions.

Q. 20. Predict the type of bonding in the following molecules :

(i) Oxygen (ii) Calcium oxide
(iii) Water (iv) Methane
(v) Ammonium ion (vi) Nitrogen
(vii) Magnesium chloride (viii) Carbon dioxide
(ix) Carbon tetrachloride (x) Hydrogen chloride
(xi) Hydrogen cyanide

Ans. (i) Covalent bond (ii) Ionic bond
(iii) Covalent bond (iv) Covalent bond
(v) Covalent bond (vi) Ionic bond
(vii) Covalent bond (viii) Covalent bond
(ix) Covalent bond (x) Covalent bond
(xi) Covalent and coordinate bonds.

Chapter 3. Study of Acids, Bases and Salts

Q. 1. Solution A is a strong acid, solution B is a weak acid, solution C is a strong alkali.
(i) Which solution contains solute molecules in addition to water molecules.
(ii) Which solution could be a solution of glacial acetic acid ?
(iii) Give an example of a solution which is a weak alkali.

Ans. (i) B (ii) B (iii) Ammonium hydroxide

Q. 2. (i) What is basicity of an acid. Give examples.
(ii) Give the basicity of nitric acid, acetic acid and phosphoric acid.
(iii) State two properties of an acid.
(iv) On what factors the strength of an acid depend ?
(v) Name an acid used : (a) as a flavour and to preserve food, (b) in a drink, (c) to remove ink spots, (d) as an eye wash.

Ans. (i) The number of replaceable hydrogen atoms, present in one molecule of an acid is known as basicity of the acid. For example hydrochloric acid is a monobasic acid, sulphuric acid is a dibasic acid and phosphoric acid is a tribasic acid.

(ii) Nitric acid (HNO_3) $\longrightarrow$ Monobasic
Acetic acid (CH_3COOH) $\longrightarrow$ Monobasic
Phosphoric acid (H_3PO_4) $\longrightarrow$ Tribasic.

(iii) (a) An acid turns methyl orange into pink and blue litmus to red.
(b) An acid with a base forms salt and water only.

$$\underset{\text{(Alkali)}}{NaOH} + \underset{\text{(Acid)}}{HCl} \longrightarrow \underset{\text{(Salt)}}{NaCl} + \underset{\text{(Water)}}{H_2O}$$

(iv) The strength of an acid depends on the following factors :
(a) Reactivity of the acid. (b) Degree of ionisation to H^+ ion.

(v) (a) Citric acid. (b) Carbonic acid.
(c) Oxalic acid. (d) Boric acid.

Q. 3. (i) What is acidity of a base. Give examples.
(ii) State three properties of an alkali.

Ans. (i) The number of hydroxyl ions that one molecule of a base gives on dissociation is known as acidity of a base. *e.g.,* The acidity of sodium hydroxide (NaOH) is one, it is a monoacid, the acidity of $Ca(OH)_2$ is two, it is a diacid base, $Al(OH)_3$ is a triacid base.

(ii) An alkali turns :
(a) Red litmus blue (b) Phenolphthalein to pink (c) Methyl orange to yellow.

Q. 4. Name the kind of particles present in :
(i) Sodium hydroxide solution. (ii) Carbonic acid (iii) Sugar solution.

Ans. (i) Sodium ions and hydroxide ions.
(ii) Carbonic acid molecules, carbonate ions and hydronium ions.
(iii) Sugar molecules and water molecules.

Q. 5. Solution A is a sodium hydroxide solution. Solution B is a weak acid. Solution C is dilute sulphuric acid. Which solution will :

(i) Liberate sulphur dioxide from sodium sulphite.

(ii) Give a white precipitate with zinc sulphate solution.

(iii) Contain solute molecules and ions.

Ans. (i) C (ii) A (iii) B

Q. 6. (i) What are indicators ?

(ii) Name three indicators and their colours in different medium.

(iii) What is reaction of neutralization ?

(iv) Give two practical application of neutralization.

Ans. (i) Indicators are complex organic compounds, which are used to distinguish between acidic and alkaline solutions by the abrupt change in their colour, *e.g.* litmus, methyl orange and phenolpthalein.

(ii) The three indicators and their colours in different medium are given below :

Indicator	Colour in acidic solution	Colour in alkaline solution
(i) Litmus	Red	Blue
(ii) Methyl orange	Red	Yellow
(iii) Phenolphthalein	Colourless	Pink

(iii) Neutralization is an exothermic reaction, in which an acid reacts with a base to form a salt and water only.

$$\underset{\text{Base}}{NaOH} + \underset{\text{Acid}}{HNO_3} \longrightarrow \underset{\text{Salt}}{NaNO_3} + \underset{\text{Water}}{H_2O}$$

In the reaction of neutralization, the hydrogen ions of an acid combines with the hydroxyl ions of an alkali to form water, at the same time a salt is formed.

(iv) (a) Acidity of soil is reduced by adding slaked lime.

(b) Antacid tablets are given to a person suffering from acidity.

Q. 7. (i) Explain pH value of a solution.

(ii) What is the pH of :

(a) Pure water (b) Milk (c) Human blood

(iii) The pH value of three solutions is given below. Which one of them is acidic, neutral and alkaline in nature ?

(a) pH = 7 (b) pH = 10 (c) pH = 3

(iv) What is pH number assigned to a solution ?

Ans. (i) pH value of a solution is the negative logarithm to the base 10 of hydrogen ion concentration expressed in gram-ions per litre.

$$pH = \log_{10} [H^+]$$

pH value = 7 indicates a neutral solution.

pH value > 7 indicates an alkaline solution.

pH value < 7 indicates an acidic solution.

(ii) The pH of :

(a) Pure water is 7 (b) Milk is 6·6 (c) Human blood is 7·3

(iii) (a) Neutral (b) Alkaline (c) Acidic

(iv) It is a number assigned to express the acidity or alkalinity of a solution which varies from 1 to 14. The pH number less than 7 indicates acidity, while pH number more than 7 indicates alkalinity. The pH of pure water is 7 and it is neutral.

Q. 8. (i) (a) What is the purpose of the pH scale ?

(b) What is the pH of pure water.

(c) A is a soluble acidic oxide, B is a soluble base compared to the pH of pure water, what will be the pH of : (i) a solution of A, (ii) a solution of B.

(ii) Taking sodium carbonate as an example, give the meaning of the following terms :
(a) Water of crystallization (b) Anhydrous (c) Efflorescence.

Ans. (i) (a) To measure the degree of acidity or alkalinity.
(b) The pH of pure water is equal to 7.
(c) (i) The pH is less than 7. (ii) The pH is more than 7.

(ii) (a) Water of crystallization is that definite number of water molecules which a crystal contain when it is crystallizing out from an aqueous solution. *e.g.,* Sodium carbonate crystal contains 10 molecules of water *i.e.,* $Na_2CO_3 . 10H_2O$.
(b) When $Na_2CO_3.10H_2O$ is heated, the water of crystallization is evaporated leaving anhydrous sodium carbonate Na_2CO_3.
(c) The loss of water by a hydrate salt on exposure to air is called efflorescence, *e.g.* $Na_2CO_3.10H_2O$ on exposure to air, looses 9 molecules of water of crystallization.

$$Na_2CO_3 . 10H_2O \xrightarrow{Air} Na_2CO_3 . H_2O + 9H_2O.$$

Q. 9. A solution has a pH of 7 explain how you would :
(i) (a) Increase its pH, (b) Decrease its pH.
(ii) If a solution changes the colour of litmus red to blue what can you say about its pH ?
(iii) What can you say about the pH of a solution that liberates carbon dioxide from sodium carbonate.

Ans. (i) (a) pH is increased by adding any caustic alkali to solution.
(b) pH is decreased by adding any mineral acid to solution.
(ii) pH of solution is more than 7.
(iii) pH of solution is less than 7.

Q. 10. (i) The pH value is utilised in medicine and agriculture. Explain.
(ii) The pH value of pure water is 7. Compare the pH values of sulphur dioxide solution and ammonia solution with that of pure water.
(iii) How does pH value of a solution and hydrogen ion concentration of solution vary ?

Ans. (i) (a) **In medicine :** The pH values of urine and blood are used to diagnose various diseases.
(b) **In agriculture :** The pH of soil is checked to ensure fast growth of crops. For example, citrus fruits need slightly alkaline soil, rice crop needs an acidic soil, sugarcane needs a neutral soil.
(ii) Sulphur dioxide is a non-metal oxide, such oxides are acidic with pH less then 7. Ammonia solution is alkaline with pH more than 7.
(iii) Both varies inversely. It is seen that lower the pH value the greater the H^+ ion concentration and higher the pH value the lower the H^+ ion concentration.

Q. 11. You are provided with the following chemicals :
Ammonium hydroxide, chlorine, copper oxide, iron, lead nitrate and dilute sulphuric acid; using only chemicals of this given list, write equation for the following salt preparations :
(i) A salt by direct combination.
(ii) A soluble salt by neutralisation of an alkali.
(iii) A soluble salt from an insoluble base.
(iv) A salt by double decomposition (Precipitation).
(v) A soluble salt from a metal.

Ans. (i) $2Fe + 3Cl_2 \longrightarrow \underset{\text{Ferric chloride.}}{2FeCl_3}$

(ii) $2NH_4OH + H_2SO_4 \longrightarrow (NH_4)_2SO_4 + 2H_2O.$

(iii) $\underset{\text{Insoluble base}}{CuO} + H_2SO_4 \longrightarrow \underset{\text{Soluble salt}}{CuSO_4} + H_2O$

(iv) $Pb(NO_3)_2 + H_2SO_4 \longrightarrow \underset{\text{(ppt.)}}{PbSO_4 \downarrow} + 2HNO_3$

(v) $Fe + H_2SO_4 \longrightarrow \underset{\text{Soluble Salt (Ferrous sulphate)}}{FeSO_4} + H_2$

Q. 12. How many types of salts can be prepared from orthophosphoric acid ? Is there any difference in the salts formed by the acid ?

Ans. There are three types of salts prepared from orthophosphoric acid [H_3PO_4], two acidic salts and one normal salt. These salts are obtained by the stepwise replacement of hydrogen atom from orthophosphoric acid. For example :

$$NaOH + H_3PO_4 \longrightarrow \underset{\text{Sodium di-hydrogen phosphate}}{NaH_2PO_4} + H_2O$$

$$NaOH + NaH_2PO_4 \longrightarrow \underset{\text{Di-sodium hydrogen phosphate}}{Na_2HPO_4} + H_2O$$

$$NaOH + Na_2HPO_4 \longrightarrow \underset{\text{Sodium phosphate}}{Na_3PO_4} + H_2O$$

The acidic salts obtained from orthophosphoric acid have the capacity to ionize further to yield hydrogen ion and thus they can change blue litmus paper red, whereas normal salt does not.

Q. 13. Zinc sulphate is called a 'salt', sulphur dioxide an 'acidic oxide' and lead monoxide a 'basic oxide'. What is meant by these terms ?

Ans. (i) Zinc sulphate is a salt, because it is formed by the complete replacement of the hydrogen of sulphuric acid by zinc.

$$Zn + H_2SO_4 \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + H_2$$

(ii) Sulphur dioxide is an acidic oxide, because it is an oxide of non-metal, which dissolves in water to form an acid known as sulphurous acid. It reacts with a base to form salt and water.

$$SO_2 + H_2O \longrightarrow \underset{\text{Sulphurous acid}}{H_2SO_3}$$

$$SO_2 + 2NaOH \longrightarrow \underset{\text{Sodium sulphite}}{Na_2SO_3} + H_2O$$

(iii) Lead monoxide is a basic oxide, because it is a metallic oxide and it reacts with an acid to form salt and water only.

$$PbO + 2HCl \longrightarrow \underset{\text{Lead chloride}}{PbCl_2} + H_2O$$

Q. 14. (i) From the list of substances given below, choose the pair required to prepare the salt (a) to (c) in laboratory and write down the relevant equations.

The substances are :

Chlorine, iron, lead, lead nitrate solution, sodium nitrate solutions, iron(III) carbonate, lead carbonate, iron(III) chloride, sodium hydroxide solution and dilute hydrochloric acid.

The salts are :

(a) Sodium chloride. (b) Lead chloride.

(c) Anhydrous iron(III) chloride.

(ii) All ammonium salts are decomposed on heating. What other properties do ammonium salts have in common ?

Ans. (i) (a) Hydrochloric acid and sodium hydroxide solution react to form sodium chloride.

$$HCl + NaOH \longrightarrow NaCl + H_2O$$

This reaction represent the formation of a salt by the acid base neutralization.

(b) Lead chloride prepared by adding dilute hydrochloric acid to a solution of lead nitrate.

$$Pb(NO_3)_2 + 2HCl \longrightarrow PbCl_2 + 2HNO_3$$

(c) Anhydrous iron(III) chloride is obtained from action of dry Cl_2 gas over heated powdered iron in a pyrex tube.

$$2Fe + 3Cl_2 \text{ (dry)} \longrightarrow 2FeCl_3$$

(ii) On heating, ammonium salt dissociates into ammonia and HCl. The other property of ammonium salt is that when heated with alkali, NH_3 is formed.

$$NH_4Cl + NaOH \longrightarrow NaCl + H_2O + NH_3$$

Q. 15. Give equation and indicate briefly, how will you prepare crystals of zinc sulphate from zinc filings ?

Ans. Take about 50 cm^3 of dilute sulphuric acid in a beaker and add 5 g of zinc filings and heat it on a wire gauge with constant stirring. Zinc metal reacts with dilute sulphuric acid to liberate hydrogen gas and zinc sulphate is formed.

$$Zn + H_2SO_4 \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + H_2$$

More zinc filings are added till dilute sulphuric acid is completely consumed and effervescence of hydrogen stops. Filter the solution to remove undissolved zinc and collect the filtrate in an evaporating dish. Heat the solution till a saturated solution is obtained. Cool the solution to obtain the crystals of zinc sulphate with seven molecules of water of crystallization.

$$ZnSO_4 + 7H_2O \longrightarrow \underset{\text{Heptahydrate zinc sulphate}}{ZnSO_4.7H_2O}$$

Q. 16. Give equations and indicate briefly the procedure, you would adopt to prepare :

(i) Crystals of ferrous sulphate from iron filings.

(ii) Crystals of zinc sulphate from zinc carbonate.

(iii) Copper(II) carbonate from copper(II) sulphate.

Ans. (i) Take about 50 cm^3 of dilute sulphuric acid in a beaker and heat it on a wire gauge. Add iron fillings with constant stirring till effervescence of hydrogen stops. Filter to remove excess of iron fillings and evaporate the solution till a saturated solution is formed. Cool the solution, the crystals of ferrous sulphate are separated.

$$Fe + H_2SO_4 \longrightarrow FeSO_4 + H_2.$$

(ii) Take about 5 gm of zinc carbonate in a beaker, add dilute sulphuric acid and heat till whole of zinc carbonate is dissolved and effervescence of carbon dioxide stops. Filter the solution in an evaporating dish and heat it till a saturated solution is formed. Allow to cool the solution to obtain the crystals of zinc sulphate.

$$ZnCO_3 + H_2SO_4 \longrightarrow ZnSO_4 + H_2O + CO_2$$

$$ZnSO_4 + 7H_2O \longrightarrow \underset{\text{Hydrated zinc(II) sulphate}}{ZnSO_4.7H_2O}$$

(iii) Take about 5 gm of copper(II) sulphate in a beaker and dissolve it in water. Now add a concentrated solution of sodium carbonate to this solution. A light blue precipitate of copper(II) carbonate is obtained. Filter the solution, the sodium sulphate passes into the filtrate and the blue precipitate of copper carbonate is obtained as a residue on the filter paper.

$$CuSO_4 + Na_2CO_3 \longrightarrow \underset{\text{Light blue colour}}{CuCO_3} + Na_2SO_4$$

Q. 17. Name, from the list of substances given below, the substance which you would use to prepare each of the following salts named in Part (i) to (iv).

The substances are :

Dilute sulphuric acid, copper, lead, dilute nitric acid, dilute hydrochloric acid, copper oxide, lead carbonate, sodium carbonate, sodium and zinc.

(i) Lead sulphate (ii) Copper sulphate

(iii) Sodium sulphate (iv) Zinc sulphate

(v) What are the two steps necessary to change lead carbonate into lead chloride ?

(vi) Give the name of a soluble lead salt and write the equation for the action of heat on this salt.

Ans. (i) For lead sulphate lead carbonate and dilute sulphuric acid are required.

(ii) For copper sulphate copper oxide and dilute sulphuric acid are required.

(iii) For sodium sulphate sodium carbonate and dilute sulphuric acid are required.

(iv) For zinc sulphate zinc and dilute sulphuric acid are required.

(v) $$PbCO_3 + 2HNO_3 \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$$

$$Pb(NO_3)_2 + HCl \longrightarrow PbCl_2 + HNO_3$$

(vi) Lead nitrate, $2Pb(NO_3)_2 \xrightarrow{\Delta} 2PbO + 4NO_2 + O_2\uparrow$

Q. 18. Name the method used for preparation of the following salts from the list given below :

(i) Sodium nitrate (ii) Iron(III) chloride

(iii) Lead chloride (iv) Zinc sulphate

(v) Sodium hydrogen sulphate

List :

(a) Simple displacement (b) Neutralization

(c) Decomposition by acid (d) Double decomposition

(e) Direct synthesis

Ans. (i) (b) Neutralisation (ii) (e) Direct synthesis

(iii) (d) Double decomposition (iv) (a) Simple displacement

(v) (c) Decomposition by acid

Q. 19. Name three classes of substances, which react with an acid to form salts. Write equations to describe their reactions with suitable acids.

Ans. Three different classes of substances are a metal, a base and a metallic carbonate, which react with an acid to form salts.

(i) Zinc, a metal reacts with dilute sulphuric acid to form zinc sulphate and hydrogen gas is liberated.

$$Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$$

(ii) Sodium hydroxide, a base reacts with dilute nitric acid to form sodium nitrate and water.

$$NaOH + HNO_3 \longrightarrow NaNO_3 + H_2O$$

(iii) Magnesium carbonate a metallic carbonate reacts with dilute hydrochloric acid to form magnesium chloride, water and carbon dioxide gas is liberated.

$$MgCO_3 + 2HCl \longrightarrow MgCl_2 + H_2O + CO_2$$

Q. 20. Making use only of substances chosen from those given below :

Dilute Sulphuric Acid	Sodium Carbonate
Zinc	Sodium sulphite
Lead	Calcium carbonate

Give the equations for the reactions by which you could obtain :

(i) Hydrogen (ii) Sulphur dioxide

(iii) Carbon dioxide (iv) Zinc carbonate

Ans. (i) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

(ii) $Na_2SO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + SO_2$

(iii) $Na_2CO_3 + H_2SO_4 \xrightarrow{\Delta} Na_2SO4 + H_2O + CO_2$

OR

$CaCO_3 \xrightarrow{\Delta} CaO + CO_2$

(iv) $Zn + H_2SO_4 \longrightarrow ZnSO_4 + H_2$

$ZnSO_4 + Na_2CO_3 \longrightarrow ZnCO_3 + Na_2SO_4$

Q. 21. Which of the following salts give acidic solutions, alkaline solutions, and neutral solutions in water :

potassium nitrate, KNO_3; ammonium sulphate, $(NH_4)_2SO_4$; potassium carbonate, K_2CO_3; sodium chloride, NaCl; sodium acetate, $CH_3.COONa$; and copper sulphate, $CuSO_4$.

(i) Acidic solutions .....

(ii) Alkaline solutions .....

(iii) Neutral solutions .....

Ans. (i) **Acidic solutions :** ammonium sulphate $(NH_4)_2SO_4$, copper sulphate $(CuSO_4)$.

(ii) **Alkaline solutions :** potassium carbonate (K_2CO_3), sodium acetate (CH_3COONa).

(iii) **Neutral solutions :** potassium nitrate (KNO_3), sodium chloride (NaCl).

Q. 22. (i) Name four soluble salts.

(ii) Name four insoluble salts.

Ans. (i) (a) Zinc sulphate (b) Iron(II) sulphate

(c) Copper(II) sulphate (d) Sodium sulphate

(ii) (a) Calcium carbonate (b) Lead sulphate

(c) Silver chloride (d) Barium sulphate

Q. 23. (i) What happens to the crystals of washing soda when exposed to air ? Name the phenomenon exhibited.

(ii) Classify the following compounds into : Deliquescent, Efflorescent, None of these

(a) Magnesium chloride crystals (b) Zinc chloride crystals

(c) Lead nitrate crystals (d) Ferrous sulphate crystals

(e) Lead chloride (f) Copper sulphate crystals

(g) Zinc hydroxide (h) Magnesium chloride

Ans. (i) When exposed to air washing soda crystals lose their water of crystallisation and become amorphous.

$\therefore$ The phenomenon is called **efflorescence**.

(ii) (a) Deliquescent (b) Deliquescent (c) None of these

(d) None of these (e) None of these (f) Efflorescent

(g) None of these (h) Highly deliquescent

Q. 24. Answer the questions given below, relating your answers only to salts given in the following list :

Sodium chloride, calcium chloride, copper sulphate.5-water.

(i) What name is given to the water in compound copper sulphate. 5-water ?

(ii) If copper sulphate. 5-water is heated, the water is driven off leaving anhydrous copper sulphate.

(a) What is the colour of anhydrous copper sulphate ?

(b) By what means, other than heating, could you dehydrate copper sulphate. 5-water and obtain anhydrous copper sulphate ?

(iii) What is deliquescence.

(iv) Which one of the salts in the given list is deliquescent ?

Ans. (i) Water of crystallization

(ii) (a) White (b) By adding conc. H_2SO_4

(iii) compounds that take up enough water from the air to dissolve in the water, are called deliquescent, *e.g.,* calcium chloride ($CaCl_2$) and sodium hydroxide are deliquescent.

(iv) Calcium chloride

Q. 25. $CuSO_4.5H_2O$, $Na_2CO_3.10H_2O$, CaO and anhydrous calcium chloride are chemicals commonly available in laboratory. Answer the following questions relating your answer to the list of chemicals given above.

(i) Which salt is blue in colour ? (ii) Which salt is efflorescent in nature ?

(iii) Which salt is hydroscopic in nature ? (iv) Which salt is deliquescent in nature ?

(v) State your observations when solution of calcium chloride is mixed with solution of sodium carbonate.

Ans. (i) $CuSO_4.5H_2O$ is blue in colour.

(ii) $Na_2CO_3.10H_2O$ is efflorescent in nature.

(iii) CaO is hydroscopic in nature.

(iv) Anhydrous calcium chloride is deliquescent in nature.

(v) A white ppt. of calcium carbonate appears when the solutions of $CaCl_2$ and Na_2CO_3 are mixed. The white ppt. gradually settles at the base of test tube.

Q. 26. (i) Give chemical names of the following :
(a) Green vitriol (b) Blue vitriol (c) White vitriol
(ii) State the colour of the following salts :
(a) Copper chloride (b) Ferric chloride
(c) Copper nitrate (d) Lead nitrate
(e) Magnesium carbonate (f) Zinc hydroxide
(iii) State the colours of the aqueous solution of the following salts :
(a) Calcium sulphate crystals (b) Ferrous chloride crystals
(c) Ferric chloride crystals (d) Ferrous sulphate crystals
(e) Ferric sulphate crystals (f) Copper sulphate crystals

Ans. (i) (a) Green vitriol—Ferrous sulphate (b) Blue vitriol—Copper sulphate
(c) White vitriol—Zinc sulphate
(ii) (a) Brown (anhydrous) (b) Black (anhydrous) (c) Blue
(d) White (e) White (f) White
(iii) (a) Colourless (b) Blue green (c) Yellow
(d) Green (e) Yellowish white (f) Blue

Q. 27. What is the action of dilute acids on the following :
(i) Sulphites (ii) Carbonates
(iii) Sulphides (iv) Bicarbonates

Ans. (i) $ZnSO_3 + 2HCl \longrightarrow ZnCl_2 + H_2O + SO_2$
(ii) $ZnS + 2HCl \longrightarrow ZnCl_2 + H_2S$
(iii) $CaCO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + CO_2$
(iv) $NaHCO_3 + HNO_3 \longrightarrow NaNO_3 + H_2O + CO_2$

Q. 28. State the action of a base :
(i) on acid (ii) on carbonates

Ans. (i) $NaOH + HCl \longrightarrow NaCl + H_2O$
(ii) $2KOH + CO_2 \longrightarrow K_2CO_3 + H_2O$

Chapter 4. Analytical Chemistry

Q. 1. What are the use of sodium and ammonium hydroxide in analytical chemistry ?

Ans. Sodium hydroxide and ammonium hydroxide are used in analytical chemistry to precipitate insoluble metal hydroxide.

Q. 2. Out of the following metallic ions : Al^{3+}, Ca^{2+}, Cu^{2+}, Pb^{2+} and Zn^{2+}; which one forms a white hydroxide which dissolves in an excess of either aqueous sodium hydroxide or ammonium hydroxide ?

Ans. Zn^{2+}.

Q. 3. Which reagent can be used to distinguish a solution containing a lead salt from a solution containing a zinc salt ?

Ans. Ammonium hydroxide.

Q. 4. A metal, whose alloy is used in the construction of aircrafts, in the powdered form was added to sodium hydroxide solution, a colourless gas was evolved and after the reaction was over, the solution was colourless.
(i) Name the powdered metal added to sodium hydroxide solution.
(ii) Name the gas evolved.

Ans. (i) Aluminium (ii) Hydrogen

Q. 5. State the colour of the precipitate observed when caustic soda solution is added to the following solutions (prepared in water) :
(i) Copper sulphate crystals (ii) Ferrous sulphate crystals
(iii) Ferric chloride crystals (iv) Lead nitrate crystals
(v) Zinc chloride crystals (vi) Calcium chloride
(vii) Zinc sulphate.

Ans. (i) Blue (ii) Dull green (iii) Reddish brown
(iv) White (v) White (vi) White curdy
(vii) White gelatinous.

Q. 6. The questions (i) to (v) refer to the following salt solutions listed A to F :

(A) Copper nitrate (B) Iron(II) sulphate.
(C) Iron(III) chloride (D) Lead nitrate
(E) Magnesium sulphate (F) Zinc chloride.

(i) Which two solutions will give a white precipitate when treated with dilute hydrochloric acid followed by barium chloride solution ?

(ii) Which two solutions will give a white precipitate when treated with dilute nitric acid followed by silver nitrate solution ?

(iii) Which solution will give a white precipitate when either dilute hydrochloric acid or dilute sulphuric acid is added to it ?

(iv) Which solution becomes a deep or inky blue colour when excess of ammonium hydroxide is added to it ?

(v) Which solution gives a white precipitate with excess ammonium hydroxide solution ?

Ans. (i) B and E (Iron II sulphate and magnesium sulphate).

(ii) C and F (Iron III chloride and zinc chloride) (iii) D (lead nitrate)

(iv) A (copper nitrate) (v) F (Zinc chloride)

Q. 7. What do you observe when caustic soda solution is added to the following solutions first a little and then in excess :

(i) $FeCl_3$ (ii) $Al_2(SO_4)_3$ (iii) $ZnSO_4$ (iv) $Pb(NO_3)_2$ (v) $CuSO_4$

Also give balanced chemical equations.

Ans. (i) A reddish brown ppt. of ferric hydroxide is obtained which is insoluble in excess of caustic soda solution.

$$FeCl_3 + 3NaOH \longrightarrow \underset{\text{Ferric hydroxide (Reddish brown ppt.)}}{Fe(OH)_3\uparrow} + 3NaCl$$

(ii) A gelatinous white ppt. of aluminium hydroxide is obtained which is soluble in excess of caustic soda solution.

$$Al_2(SO_4)_3 + 6NaOH \longrightarrow \underset{\text{Aluminium hydroxide (White, gelatinous ppt.)}}{2Al(OH)_3\downarrow} + 3Na_2SO_4$$

$$Al(OH)_3 + \underset{\text{(Excess)}}{NaOH} \longrightarrow \underset{\text{Sodium meta-aluminate (Soluble)}}{NaAlO_2} + 3Na_2SO_4$$

(iii) A gelatinous white ppt. of zinc hydroxide is obtained which is soluble in excess of caustic soda solution.

$$ZnSO_4 + 2NaOH \longrightarrow \underset{\text{Zinc hydroxide (White gelatinous ppt.)}}{Zn(OH)_2\downarrow} + Na_2SO_4$$

$$Zn(OH)_2 + \underset{\text{(Excess)}}{2NaOH} \longrightarrow \underset{\text{Soluble (Colourless)}}{NaZnO_2} + 2H_2O$$

(iv) A white ppt. of lead(II) hydroxide is obtained which is soluble in excess of caustic soda solution.

$$Pb(NO_3)_2 + 2NaOH \longrightarrow \underset{\text{Lead hydroxide (White ppt.)}}{Pb(OH)_2\downarrow} + 2NaNO_3$$

$$Pb(OH)_2 + \underset{\text{(Excess)}}{2NaOH} \longrightarrow \underset{\text{Sodium plumbite (Colourless) (Soluble)}}{Na_2PbO_2} + 2H_2O$$

(v) A pale blue ppt. of copper(II) hydroxide is obtained which is insoluble in excess of caustic soda solution.

$$CuSO_4 + 2NaOH \longrightarrow \underset{\substack{\text{Copper(II)}\\\text{(hydroxide)}\\\text{(Pale blue ppt.)}}}{Cu(OH)_2\downarrow} + Na_2SO_4$$

Q. 8. (i) What are amphoteric metals ? Describe their reactions with hot caustic alkali.

(ii) What are amphoteric oxides ? Why these oxides react with NaOH ?

Ans. (i) Those metals which react with both alkalies as well as acids are called amphoteric metals *e.g.*, Zn, Sn, Al etc. They react with caustic alkalies like NaOH, KOH on heating and liberates H_2 gas. *e.g.*,

$$\underset{\text{Zinc}}{Zn} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2\uparrow$$

$$\underset{\text{Zinc}}{Zn} + \underset{\text{(Conc.)}}{2KOH\,(aq.)} \longrightarrow \underset{\text{Potassium zincate}}{K_2ZnO_2} + H_2\uparrow$$

$$\underset{\text{Tin}}{Sn} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} + H_2O \longrightarrow \underset{\text{Sodium stannate}}{Na_2SnO_3} + 2H_2\uparrow$$

$$\underset{\text{Tin}}{Sn} + \underset{\text{(Conc.)}}{2KOH\,(aq.)} + H_2O \longrightarrow \underset{\text{Potassium stannate}}{K_2SnO_3} + 2H_2\uparrow$$

$$\underset{\text{Aluminium}}{2Al} + 2NaOH + 2H_2O \longrightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + 3H_2\uparrow$$

$$\underset{\text{Aluminium}}{2Al} + 2KOH + 2H_2O \longrightarrow \underset{\text{Potassium aluminate}}{2KAlO_2} + 3H_2\uparrow$$

(ii) Those oxides which react with both acids as well as bases are called amphoteric oxides. Oxides of amphoteric metals like Zn, Sn, Al, etc., react with strong alkalies like NaOH to form complex salt and water, *e.g.*

$$\underset{\text{Zinc oxide}}{ZnO} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium zincate}}{Na_2ZnO_2} + H_2O$$

$$\underset{\text{Tin oxide}}{SnO_2} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium stannate}}{Na_2SnO_3} + H_2O$$

$$\underset{\text{Aluminium oxide}}{Al_2O_3} + \underset{\text{(Conc.)}}{2NaOH\,(aq.)} \longrightarrow \underset{\text{Sodium aluminate}}{2NaAlO_2} + H_2O$$

Chapter 5. Mole Concept and Stoichiometry

Q. 1. State Gay-Lussac's law of combining volumes.

Ans. The law states That : Under same conditions of temperature and pressure, the volume of gases taking part in a chemical reaction show simple whole number ratio to one another and to those of products if gaseous.

Q. 2. (i) When gases react together, their reaction volume bears a simple ratio to each other, under the same conditions of temperature and pressure. Who proposed this gas law ?

(ii) What is the volume (measured in dm^3 or litres occupied by one mole of gas at S.T.P. ?

Ans. (i) This law was proposed by 'Gay Lussac'.

(ii) One mole of gas occupies 22·4 litre at S.T.P.

Q. 3. Under the same conditions of temperature and pressure, one collects 2·2 litre of CO_2, 3·3 litres of Cl_2, 5·5 litres of hydrogen, 4·4 litres of nitrogen and 1·1 litres of SO_2. In which gas sample their will be :

(i) Greatest number of molecules. (ii) The least number of molecules.

Ans. We know that 22·4 litres of any gas at S.T.P. has $6{\cdot}023 \times 10^{23}$ molecules. If the volume of gas at S.T.P. is more than 22·4 litres, then the number of molecules will be greater and vice-versa.

(i) 5·5 litres of hydrogen will contain greatest number of molecules.

(ii) 1·1 litres of sulphur dioxide will contain least number of molecules.

Q. 4. Under the same conditions of temperature and pressure, you collect 2 litres of carbon dioxide, 3 litres of chlorine, 5 litres of hydrogen, 4 litres of nitrogen and 1 litre of sulphur dioxide. In which gas will there be sample ?

(i) The greatest number of molecules (ii) The least number of molecules. Justify your answer.

Ans. The greatest number of molecules will be in 5 litres of hydrogen and the least number of molecules in 1 litre of sulphur dioxide. The justification is based on Avogadro's law, which states that equal volumes of all gases, under conditions of same temperature and pressure, contain same number of molecules. So greater the volume, greater will be the number of molecules.

Q. 5. How does Avogadro's law explain Gay-Lussac's law of gaseous volumes ?

Ans. Avogadro's law states that equal volumes of all gases contain equal number of molecules under similar conditions of temperature and pressure. Since, when gases react chemically, they do so in volumes which bear a simple whole number ratio to each other and to the volume of products, provided the products are also in gasesous state under similar conditions of temperature and pressure. This is what Gay-Lussac's law states. For example, in the reaction of carbon monoxide with oxygen, two volumes of carbon monoxide react with one volume of oxygen to give two volumes of carbon dioxide under similar conditions of temperature and pressure.

$$\begin{array}{ccccc} 2CO & + & O_2 & \rightarrow & 2CO_2 \\ 2 \text{ vol.} & & 1 \text{ vol.} & & 2 \text{ vol.} \end{array}$$

The volume ratio of carbon monoxide, oxygen and carbon dioxide is 2 : 1 : 2.

Q. 6. What is the relationship between gram molecular weight and gram molecular volume at S.T.P. ?

Ans. Density of gas is defined as mass per unit volume. Volume is usually taken as 1 dm^3 at S.T.P.

$$\therefore \quad \text{Density of gas} = \frac{\text{Mass of gas}}{1 \text{ dm}^3 \text{ of gas at S.T.P.}}$$

Molar volume of hydrogen :

$$\text{Density of hydrogen} = 0{\cdot}09 \text{ g/dm}^3 \text{ at S.T.P.}$$

$$\text{Gram molecular weight of hydrogen} = 2{\cdot}016 \text{ g}$$

$$0{\cdot}09 \text{ g of hydrogen occupies volume} = 1 \text{ dm}^3 \text{ at S.T.P.}$$

$$\therefore \quad 2{\cdot}016 \text{ g of hydrogen occupies volume} = \frac{2{\cdot}016}{0{\cdot}09} \text{ dm}^3 \text{ at S.T.P.}$$

$$= 22{\cdot}4 \text{ dm}^3 \text{ at S.T.P.}$$

$$\text{As } 2{\cdot}016 \text{ g of hydrogen} = 1 \text{ gram molecular weight}$$

$\therefore$ 1 gram molecular weight of hydrogen occupies 22·4 dm^3 at S.T.P.

Q. 7. (i) What is 'mole scale' of a compound ?

(ii) What is the relation between atomic mass and equivalent mass ?

Ans. (i) The molecular weight of a compound expressed in gram is known as 'a mole' of a compound. The multiples of the fractions of a mole give different mole values of a compound. The molecular weight of carbon dioxide is 44, hence 44 g is one mole of carbon dioxide. 88 g and 176 g of carbon dioxide represent 2 moles and 4 moles respectively.

In general,

$$\text{Number of moles of a compound} = \frac{\text{Mass of the compound in g}}{\text{Molecular weight of the compound}}$$

(ii) Atomic mass = Equivalent mass × Valency.

Q. 8. Explain the following :

(i) Is it possible to change the temperature and pressure of a fixed mass of gas without changing its volume ?

(ii) One mole of hydrogen contains $2 \times 6{\cdot}023 \times 10^{23}$ atoms of hydrogen where as one mole of helium contains $6{\cdot}023 \times 10^{23}$ atoms of helium.

Ans. (i) Yes, an increase in temperature produce an increase in volume which can be reduced (changed) to original volume by the increase in pressure.

(ii) Hydrogen is a diatomic gas.

So one molecule of hydrogen = 2 atoms

$\therefore$ 1 mole or $6{\cdot}023 \times 10^{23}$ molecules of H_2 = $2 \times 6{\cdot}023 \times 10^{23}$ atoms

On the other hand, helium is monoatomic gas,

$\therefore$ One molecule of helium = 1 atom of He

or $6{\cdot}023 \times 10^{23}$ molecules of He = $6{\cdot}023 \times 10^{23}$ atoms of He.

Q. 9. How will you differentiate between atomic weight and actual weight of an element ?

Ans.

	Atomic weight	Actual weight
(i)	It is the number of times an atom of an element is heavier than a carbon atom (C^{12}).	It is the weight of an atom as compared to a standard weight of 1g.
(ii)	Its numerical value is quite large and is conveniently used for comparing the weights of various atoms and making calculations.	Its numerical value is quite small and is inconvenient to use in comparing the weights of various atoms and making calculations.
(iii)	It represents the mass of $6{\cdot}023 \times 10^{23}$ atoms.	It represents the mass of one atom.
(iv)	It is simply a number as it expresses the ratio between two weights.	It is the absolute weight of an atom and is generally expressed in grams.

Q. 10. What do you understand by the statement, "The vapour density of CO_2 is 22" ?

Ans. The molecular weight of the gas is twice its vapour density.

Molecular weight = 2 × Molecular weight of carbon dioxide

$$CO_2 = 12 + 2\,(16) = 12 + 32 = 44 \text{ gram.}$$

The vapour density of carbon dioxide

$$\text{V.D. } (CO_2) = \frac{\text{Molecular weight of } CO_2}{2}$$

$$\text{V.D. } (CO_2) = \frac{44}{2}$$

$\therefore$ $$\text{V.D. } (CO_2) = 22$$

The vapour density of CO_2 is 22 indicates that the mass of x litres of hydrogen gas or the molecular mass of CO_2 is 44 g.

Thus, the vapour density of carbon dioxide (CO_2) is 22.

Q. 11. What are the applications of Avogadro's law ?

Ans. (i) It determines the molecules formula of a gas.

(ii) It determines atomicity of gases.

(iii) It explains Gay-Lussac's law of combining volumes.

(iv) It establishes the relation between molecular weight and vapour density of a gas.

(v) It establishes relation between gram molecular weight and gram molecular volume of a gas.

(vi) Avogadro's hypothesis modifies Dalton's atomic theory.

Q. 12. A compound is formed by 24 grams of X and 64 grams of oxygen, if X = 12 and O = 16. Find the simplest formula of the compound.

Ans.

Relative number of atoms	Simplest ratio
$X = \frac{24}{12} = 2$	$X = \frac{2}{2} = 1$
$O = \frac{64}{16} = 4$	$O = \frac{4}{2} = 2$

Therefore, simplest ratio between X and O is X : O = 1 : 2

Thus, empirical formula of the compound is XO_2.

Q. 13. What is the important information given by a balanced chemical equation of decomposition of hydrogen peroxide ?

Ans. The decomposition of hydrogen peroxide is given by the equation :

$$2H_2O_2 \longrightarrow 2H_2O + O_2$$

The equation gives the following important informations :

(i) Hydrogen peroxide decomposes to form water and oxygen.

(ii) Two molecules of hydrogen peroxide when decomposed, form two molecules of water and one molecule of oxygen.

(iii) 68 g of hydrogen peroxide when decomposed, yield 36 g of water and 32 g of oxygen.

Q. 14. What are the limitations of a chemical equation ?

Ans. Following are the limitations of a chemical equation :

(i) A chemical equation does not tell us the physical state of the reactants and the products in the reaction.

(ii) It does not tell us the actual concentration or dilution of the reactants used in the reaction.

(iii) It does not tell whether the reaction starts at its own or some heat is required to start the reaction.

(iv) It does not tell whether the reaction is violent in nature or not.

(v) The time taken by the reaction to complete itself is also not known.

Chapter 6. Electrolysis

Q. 1. Classify following substances under three headings :

Strong electrolytes, Weak electrolytes, Non-electrolytes.

Acetic acid, ammonium chloride, ammonium hydroxide, carbon tetrachloride, dilute hydrochloric acid, sodium acetate, dilute sulphuric acid.

Ans. Strong electrolytes —Ammonium chloride, dilute hydrochloric acid, dilute sulphuric acid.

Weak electrolytes — Ammonium hydroxide, acetic acid, sodium acetates.

Non-electrolyte — Carbon tetra chloride.

Q. 2. How will you distinguish between metallic conduction and electrical conduction ?

Ans.

Metallic Conduction	Electrical Conduction
(i) By the Movement of electrons.	By the Movement of ions.
(ii) Does not involve the transfer of matter.	It involves the transfer of matter as ions.
(iii) No change in chemical properties of the conductor.	It involve the decomposition of electrolyte as a result of chemical reactions.
(iv) Increase in resistance with the rise of temperature.	Decrease in resistance with the rise of temperature.

Q. 3. Differentiate between an electrolytic cell and electrochemical cell.

Ans.

Electrolytic cell	Electrochemical cell
It is a device (vessel) in which chemical changes are brought about with the help of electric energy.	It is a device in which electric energy is generated as a result of chemical change.

Q. 4. Differentiate between electrical conductivity of copper sulphate solution and copper metal.

Ans. Differences between electrical conductivity of copper sulphate solution and copper metal :

	Copper sulphate solution	Copper metal
(i)	Electric current is by flow of ions.	Electric current is by flow of electrons.
(ii)	It is aqueous solution of ionic compound.	It is a metal in solid state.
(iii)	Copper sulphate undergoes a chemical change.	Copper metal remains unchanged chemically.

Q. 5. Choose A, B, C or D to match the descriptions (i) to (v) below. Some alphabets may be repeated.

(A) Non-electrolyte (B) Strong electrolyte

(C) Weak electrolyte (D) Metallic conductor

(i) Molten ionic compound

(ii) Carbon tetrachloride

(iii) An aluminium wire

(iv) A solution containing solvent molcules, solute molecules and ions formed by the dissociation of solute molecules.

(v) A sugar solution with sugar molecules and water molecules.

Ans. (i) B (ii) A (iii) D (iv) C (v) A

Q. 6. Give three differences between sodium atom and sodium ion.

Ans. (i) Sodium atom is neutral in nature, while sodium ion is a positively charged particle.

(ii) Sodium atom vigorously reacts with water to liberate hydrogen gas, while sodium ion does not react with water.

(iii) Sodium atom tends to lose an electron to form sodium ion with a complete octet in the outermost shell.

Q. 7. Explain how electrolysis is an example of redox reaction.

Ans. Redox reactions are called simultaneous oxidation-reduction reactions. In electrode reactions, the positively charged ions (cations) accept electrons from cathode to form neutral atoms, *i.e.*, at cathode reduction takes place. At anode, the negatively charged ions (anions) lose electrons to form neutral atoms, *i.e.*, at anode oxidation takes place. So, electrode reactions also signify oxidation-reduction reactions. Hence, they are also called redox reactions.

Q. 8. (i) Write equations to show the electrolytic dissociation of :

(a) Two acids (b) Two bases

(ii) When fused sodium chloride is electrolysed, explain exactly what happens at the electrodes and explain how the electricity is conducted ?

Ans. (i) (a) Acids : $H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-}$

$HNO_3 \rightleftharpoons H^+ + NO_3^-$

(b) Bases : $NaOH \rightleftharpoons Na^+ + OH^-$

$KOH \rightleftharpoons K^+ + OH^-$

(ii) When electricity is passed through fused sodium chloride, the electrolysis starts as follows :

$$NaCl \rightleftharpoons Na^+ + Cl^-$$
$$Na^+ + e^- \longrightarrow Na \text{ (At cathode)}$$
$$Cl^- - e^- \longrightarrow Cl$$
$$Cl + Cl \longrightarrow Cl_2 \text{ (At anode)}$$

Sodium metal is deposited at cathode, while chlorine gas is liberated at anode. Electricity is conducted with the help of free sodium and chloride ions, which are present in fused sodium chloride.

Q. 9. How is it possible to discharge Na^+ ions in preference to H^+ ions in electrolysis of NaCl solution ?

Ans. By using cathode made of moving mercury, Na^+ ions are discharged in preference to H^+ ions because of the nature of electrode. Mercury has strong tendency to form an amalgam with sodium :

$$Na^+ + e^- \longrightarrow Na$$
$$Na + Hg \longrightarrow Na/Hg$$

When the sodium amalgam dissolves in water, the reaction is :

$$2Na/Hg + 2H_2O \longrightarrow 2NaOH + H_2 + Hg$$

Q. 10. A certain metal, say M, does not liberate hydrogen from dilute sulphuric acid, but displaces copper from aqueous copper(II) sulphate. State the most likely place for the metal in electro-chemical series.

Ans. The activity series is obtained, when we examine replacement of one metal ion from its solution by another metal. The metal (M) which displaces copper from aqueous copper(II) sulphate is placed at higher position as compared to copper in activity series.

Q. 11. M is a metal above hydrogen in the activity series and its oxide has the formula M_2O. This oxide when dissolved in water forms the corresponding hydroxide which is a good conductor of electricity. In the above context answer the following :

(i) What kind of combination exists between M and O ?

(ii) How many electrons are there in the outermost shell of M ?

(iii) Name the group to which M belongs.

(iv) State the reaction taking place at the cathode.

(v) Name the product at the anode.

Ans. (i) Electrovalent bond exists between M and O.

(ii) One electron is there in the outermost shell.

(iii) M belongs to First group.

(iv) $M^+ + e^- \longrightarrow M$ (at cathode).

$M + M \longrightarrow M_2$

(v) Oxygen gas is liberated at anode.

Q. 12. How will you electrolyse the molten solution of lead bromide ?

Ans. Molten lead bromide ($PbBr_2$) forms Pb^{2+} and Br^- ions. The positive lead ions (Pb^{2+}) move to the cathode, and gain two electrons and change into lead atom.

$$Pb^{2+} + 2e^- \longrightarrow \underset{\text{(Lead)}}{Pb}$$

Lead is deposited at the cathode. The negative bromide ion migrates to the anode. It loses an electron and becomes a bromide atom. The two bromine atoms join bromine molecule. It is liberated as bromine gas :

$$Br^- - e^- \longrightarrow Br$$

$$Br + Br \longrightarrow Br_2$$

Q. 13. (i) What are the particles present in a non-electrolyte ?

(ii) What is conductivity of metals due to ?

(iii) What should be the physical state of lead bromide, if it is to conduct electricity ?

(iv) What particles are present in pure lead bromide ?

Ans. (i) Molecules are present in a non-electrolyte.

(ii) The conductivity of metals is due to movement of electrons.

(iii) Lead bromide should be in molten state, if it is to conduct electricity.

(iv) Lead ions and bromide ions are present in pure lead bromide in molten state.

Q. 14. (i) When the electrolysis of acidified water is carried out :

(a) What is the ratio of the volume of hydrogen produced to the volume of oxygen ?

(b) Give the equation for the discharge of ions at the cathode.

(ii) To carry out the so-called 'electrolysis of water', sulphuric acid is added to water. How does the addition of sulphuric acid produce a conducting solution ?

Ans. (i) (a) The ratio is 2 : 1

(b) $H^+ + e^- \rightarrow H$; $2H + 2H \longrightarrow 2H_2$

(ii) Addition of sulphuric acid causes dissociation of water molecules into $[H^+]$ and $[OH^-]$ ions.

Q. 15. What would happen if in the electrolysis of acidified water, copper electrodes were used instead of platinum ones ?

Ans. **At anode :** OH^- and SO_3^{2-} would migrate to anode but neither would be discharged, instead copper atoms would get oxidised to Cu^{2+} and enter solution

$$Cu \longrightarrow Cu^{2+} + 2e^-$$

The electrolytic solution would become blue in colour. Anode would dissolve.

At cathode : H^+ ions would migrate to the cathode and get reduced. Thus, H_2 gas would be discharged at cathode

$$2H^+ + 2e^- \longrightarrow 2H \longrightarrow H_2$$

Later, as the solution turns blue due to formation of Cu^{2+} ions, the Cu^{2+} ions will get discharged to $2H^+$ ions as they are less electropositive

$$Cu^{2+} + 2e^- \longrightarrow Cu\downarrow$$

Q. 16. During the electrolysis of aqueous copper sulphate, between copper electrodes, the sulphate and hydroxyl ions remain as spectator ions.

Ans. During electrolysis of aqueous copper sulphate using copper electrodes, the two anions OH^- and SO_4^{2-} migrate to the anode, but none of them get discharged because the copper of the anode dissolves in the solution producing copper ions and electrons. Hence, OH^- and SO_4^{2-} ions remain as spectator ions.

Q. 17. The following questions refer to the electrolysis of copper sulphate solution with copper electrodes.

(i) Compare the change in mass of the cathode with the change in mass of the anode.

(ii) What happens, when electrolysis of aqueous copper sulphate between platinum electrode, occurs.

(iii) What is the practical application of the electrolysis of copper sulphate solution ? Briefly describe one such application.

Ans. (i) Mass of Cathode increases where as that of anode decreases due to deposition of pure copper on cathode.

(ii) The blue colour of copper sulphate is due to the presence of cupric ions (Cu^{2+}). Cu^{2+} ions are discharged at the cathode and deposited as Pinkish copper metal, but OH^- ions are discharged at anode. The electrolyte consists of hydrogen and sulphate ions which associate to form colourless sulphuric acid.

(iii) The electrolysis of copper sulphate solution is used in the purification of copper using pure copper plate as cathode and impure copper plate as anode.

Q. 18. During the electrolysis of copper(II) sulphate solution using platinum as cathode and carbon as anode :

(i) What do you observe at the cathode and at the anode ?

(ii) What change is noticed in the electrolyte ?

(iii) Write the reactions at the cathode and at the anode.

Ans. (i) At cathode red shiny metal deposits.

At anode bubbles of a colourless odourless gas are seen coming out.

(ii) Colour of electrolyte gradually fades from blue to colourless.

(iii) Reaction at cathode

$$Cu^{2+} + 2e^- \rightarrow Cu$$

Reaction at anode

$$OH^- - e^- \rightarrow OH$$

$$4OH \rightarrow 2H_2O + O_2\uparrow$$

Q. 19. Explain, how the blue colour of electrolyte fades during electrolysis of $CuSO_4$ solution ?

Ans. The blue colour of electrolyte is due to the presence of copper ions in it. As the electrolysis is carried out, the copper ions discharge at the cathode.

$$Cu^{2+} + 2e^- \longrightarrow Cu$$

However, no copper ions enters in the electrolyte from anode. Thus concentration of copper ions goes on decreasing. This result in fading of blue colour. When copper ions completely finish the electrolyte becomes colourless.

Reaction of cathode :

$$H^+ + 1e^- \longrightarrow H$$
$$H + H \longrightarrow H_{2(g)}$$

Reaction of anode :

$$OH^- - 1e^- \longrightarrow OH$$
$$4OH \longrightarrow 2H_2O + O_{2(g)}$$

Q. 20. Explain, how blue colour of electrolyte remains unchanged during electrolysis of aqueous copper sulphate ?

Ans. The decrease in the weight of copper anode is equal to the increase in weight of copper cathode.

$$CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^{2-} \quad \text{(Dissociation of } CuSO_4\text{)}$$
$$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-} \quad \text{(Dissociation of } H_2SO_4\text{)}$$
$$H_2O \rightleftharpoons H^+ + OH^- \quad \text{(Dissociation of } H_2O\text{)}$$
$$Cu + 2e^- \longrightarrow Cu \quad \text{(at Cathode)}$$
$$Cu - 2e^- \longrightarrow Cu^{2+} \quad \text{(at Anode)}$$

From the above equations it can be deduced that for every Cu^{2+} discharging at cathode a copper atom ionises from anode to form Cu^{2+} ion.

Thus concentration of copper ions in electrolyte remain unchanged. As the blue colour of electrolyte is due to the presence of Cu^{2+} ions, therefore it does not change.

$$CuSO_4 \rightleftharpoons Cu^{2+} + SO_4^{2-} \quad \text{(Ionisation of } CuSO_4\text{)}$$
$$H_2SO_4 \rightleftharpoons 2H^+ + SO_4^{2-} \quad \text{(Dissociation of } H_2SO_4\text{)}$$
$$H_2O \rightleftharpoons H^+ + OH^- \quad \text{(Dissociation of } H_2O\text{)}$$

Q. 21. Mention the type of ions present, the products obtained and the electrode reactions that occur, when the following are electrolysed :

(i) Molten lead bromide between steel cathode and graphite anode.

(ii) Water acidified with sulphuric acid between platinum electrodes.

(iii) Aqueous copper sulphate between copper electrodes.

(iv) Aqueous copper sulphate between copper cathode and platinum anode.

Ans.

		Cathode	Anode
(i)	Electrode used	Steel	Graphite
	Ions present	Pb^{2+}	Br^-
	Products	Lead	Bromine
	Reaction	$Pb^{2+} + 2e^- \longrightarrow Pb$	$2Br^- - 2e^- \longrightarrow 2Br$
(ii)	Electrode used	Platinum	Platinum
	Ions present	H^+	OH^- and SO_4^{2-}
	Products	Hydrogen	Oxygen
	Reaction	$4H^+ + 4e^- \longrightarrow 2H_2$	$4OH^- - 4e^- \longrightarrow 2H_2O + O_2$
(iii)	Electrode used	Copper	Copper
	Ions present	Cu^{2+} and H^+	OH^- and SO_4^{2-}
	Products	Copper atom	Copper ions
	Reaction	Cu^{2+} (aq) + $2e^- \longrightarrow$ Cu (s)	Cu (s) – $2e^- \longrightarrow Cu^{2+}$ (aq)
(iv)	Electrode used	Copper	Platinum
	Ions present	Cu^{2+} and H^+	OH^- and SO_4^{2-}
	Products	Copper atom	Oxygen
	Reaction	$Cu^{2+} + 2e^- \longrightarrow$ Cu (s)	$4OH^- - 4e^- \longrightarrow 2H_2O + O_2$

Q. 22. With reference to electroplating answer the following :

(i) Why are articles electroplated ?

(ii) Why a small current passed for a longer period is preferred over high current for a shorter period ?

(iii) Why the article to be electroplated is made a cathode ?

(iv) Why a direct current is used ?

Ans. (i) Articles are electroplated for the following reasons :

(a) To prevent it from corrosion.

(b) To improve the appearance of the metal articles.

(ii) To get a uniform and smooth coating of superior metal, a small current should be used for a longer time.

(iii) The article to be electroplated is always placed at cathode because the metal is always deposited at cathode.

(iv) Direct current is used to get smooth coating and the phase of the current is same at all instance of time.

Q. 23. How a spoon is electroplated with silver ?

Ans. Silver nitrate solution is taken in a beaker. Silver wire and a spoon, which is to be plated with silver, are dipped in the solution. Silver wire is connected with the positive terminal of the battery which acts as anode and spoon is connected with the negative terminal of the battery which acts as cathode.

When electric current is passed through silver nitrate solution, electrolysis takes place and silver is deposited as a fine thin film at the surface of spoon. The spoon is coated with silver and looks as a silver spoon.

Q. 24. Element X is a metal with a valency 2.

Element Y is a non-metal with a valency 3.

(i) Write equations to show how X and Y form ions.

(ii) If Y is a diatomic gas, write the equation for the direct combination of X and Y to form a compound.

(iii) Write two applications of electrolysis in which the anode diminishes in mass.

(iv) If the compound formed between X and Y is melted and an electric current passed through the molten compound, the element X will be obtained at the … and Y at the … of the electrolytic cell.

(Provide the missing words.)

Ans. (i) $X - 2e^- \longrightarrow X^{2+}$

$Y + 3e^- \longrightarrow Y^{3-}$

(ii) $3X^{+2} + 2Y^{-3} \longrightarrow X_3Y_2$

(iii) (a) Electroplating of metals.

(b) Electrorefining of metals.

(iv) If the compound formed between X and Y is melted and an electric current passed through the molten compound, the element X will be obtained at the cathode and Y at the anode of the electrolytic cell.

Q. 25. Mr. Ramu wants to electroplate his key chain with nickel to prevent rusting. For this electroplating :

(i) Name the electrolyte

(ii) Name the cathode

(iii) Name the anode

(iv) Give the reaction at the cathode

(v) Give the reaction at the anode.

Ans. (i) Nickel sulphate

(ii) Key chain

(iii) Pure nickel plate

(iv) $Ni^{2+} + 2e^- \longrightarrow Ni$

(v) $Ni - 2e^- \longrightarrow Ni^{2+}$

Q. 26. Three different electrolytic cells A, B and C are connected in separate circuits. Electrolytic cell A contains sodium chloride solution. When the circuit is completed a bulb in the circuit glows brightly. Electrolytic cell B contains acetic acid solution and in this case the bulb in the circuit glows dimly. The electrolytic cell C contains sugar solution and the bulb does not glow. Give a reason for each of these observations.

Ans. **In Cell A :** Sodium chloride being strong electrolyte dissociates completely and therefore, current flows better.

In Cell B : Acetic acid being weak electrolyte ionises only partially and therefore, only a weak current flows.

In Cell C : Sugar being a covalent compound does not ionise at all and therefore, no current flows.

Chapter 7. Metallurgy

Q. 1. (i) Arrange Cu, Ca, Al, Fe, Mg, Pb, Na and Zn in the decreasing order, in which they appear in the activity series; putting down the most reactive metal first and least reactive in the last.

(ii) (a) Among the above metals, write the names of metals which will displace hydrogen from water or steam.

(b) Give two evidences to show that magnesium is more reactive than iron.

Ans. (i) The given metals are arranged in the activity series of metals as follows : Na, Ca, Mg, Al, Zn, Fe, Pb (most reactive) and Cu (least reactive).

(ii) (a) (1) Sodium and calcium displace hydrogen from cold water.

$$2Na + 2H_2O \longrightarrow 2NaOH + H_2\uparrow$$

$$Ca + 2H_2O \longrightarrow Ca(OH)_2 + H_2\uparrow$$

(2) Magnesium and zinc metals are less reactive as they react with boiling water to liberate hydrogen gas.

$$Mg + 2H_2O \longrightarrow Mg(OH)_2 + H_2\uparrow$$

$$Zn + 2H_2O \longrightarrow Zn(OH)_2 + H_2\uparrow$$

(3) Iron which is less reactive, reacts in red hot conditions with steam to liberate hydrogen gas.

$$3Fe + 4H_2O \longrightarrow Fe_3O_4 + 4H_2\uparrow$$

(4) Lead and copper almost fail to liberate hydrogen gas in any conditions, because they are not so reactive. They lie just above and below hydrogen in activity series of metals.

(b) (1) Magnesium reacts with boiling water to liberate hydrogen gas, while iron can do so with steam in red hot condition only.

(2) Magnesium can displace hydrogen from acids vigorously in cold but iron displaces hydrogen slowly.

Q. 2. (i) Na, Ca, Mg, Al, Zn, Fe, Pb and Cu, are well known metals.

(a) X, Y and Z are coded letters for three of the metals in the activity series of metals as given above.

Metal X, reacts violently with cold water and its hydroxide is not decomposed by heat.

Metal Y, has no reaction with water but its hydroxide decomposes, with slight warming, giving a black powder.

Metal Z, reacts vigorously with dilute hydrochloric acid but hardly at all with cold water. If it is heated in steam, a white solid A is formed and a colourless gas B is set free.

(1) which of the metals in the list is X ?

(2) which of the metals in the list is Y ?

(3) which of the metals in the list is Z ?

(4) write the name of the solid A and gas B.

(b) State whether the following are soluble or insoluble in water.

(1) The carbonate of X.

(2) The carbonate of Y.

(3) The hydroxide of Z.

(ii) A certain metal does not liberate hydrogen from dilute sulphuric acid but it displaces silver from aqueous silver nitrate solution. State the most likely place for the metal in the activity series.

(iii) What would you expect to happen, if aluminium metal is heated with iron(III) oxide ? Also write the equation.

Ans. (i) (a) (1) The metal X is sodium.

(2) The metal Y is copper.

(3) The metal Z is magnesium.

(4) The name of the solid A is magnesium hydroxide, while the gas B is hydrogen.

(b) (1) Soluble as sodium carbonate is soluble in water.

(2) Insoluble, as copper carbonate is insoluble in water.

(3) Soluble, as magnesium hydroxide is soluble in water.

(ii) The metal lies below hydrogen and above silver in the activity series of metals.

(iii) When aluminium metal is heated with iron(III) oxide with metallic iron, an enormous amount of heat is produced due to the exothermic nature of the reaction. Molten iron is thus produced, which can be used in welding.

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe + Q.$$

Q. 3. (i) Arrange Ca, Pb, Fe, Na, Zn, Cu, and Al in the decreasing order of their reactivity.

(ii) Answer the following question related to above (i) sequence :

(a) Which of these is most likely to tarnish readily when exposed to the air ?

(b) Which of these is most likely to be found in free state in nature ?

(c) Which of these is most likely to react with cold water ?

Ans. (i) The decreasing order of the given metals is as follows :

[Most reactive] Na, Ca, Al, Zn, Fe, Pb, and Cu [Least reactive]

(ii) (a) Sodium [Na] (b) Copper [Cu]

(c) Sodium [Na] and calcium [Ca]

Q. 4. (i) From the metals copper, zinc, magnesium, sodium and iron, select the metal in each case which :

(a) Does not react with dil. hydrochloric acid.

(b) Has a hydroxide that reacts with both acids and alkalies.

(c) Does not react with cold water but reacts with steam when heated.

(d) Can form +2 and +3 ions.

(ii) Arrange the metals in decreasing order of reactivity.

Ans. (i) (a) Copper (b) Zinc

(c) Magnesium (d) Iron

(ii) Sodium > Magnesium > Iron > Zinc > Copper.

Q. 5. (i) Differentiate between :

(a) Slag and Flux. (b) Calcination and Roasting.

(ii) Compare the properties of a typical metal and a non-metal on the basis of the following :

(a) Electronic configuration (b) Nature of the oxides

(c) Oxidising or reducing action (d) Conductivity of heat and electricity.

(iii) What are the differences between a mineral and an ore ?

Ans. (i) (a)

Slag	Flux
It is the product obtained by the combination of the flux with gangue in metallurgy.	It is a substance which is added along with charge to separate the gangue in metallurgy.

(b)

Calcination	Roasting
1. It is the process of heating concentrated ore in a limited supply of air to a temperature insufficient to melt the ore.	It is the process of heating concentrated ore in a free supply of air to a temperature insufficient to melt the ore.
2. During calcination, no other chemical change occurs except decomposition.	During roasting, chemical changes like oxidation or reduction take place.

(ii) (a) Metals complete their octet by the loss of electrons whereas non-metals complete their octet by the gain of electrons.

Metals generally contain 1 to 3 valence electrons in their outermost shell whereas non-metals contain 4 to 7 valence electrons in their outermost shell.

(b) Metals form basic oxides whereas non-metals form acidic oxides.

(c) Metals are reducing agents whereas non-metals act as oxidising agents.

(d) Metals are generally good conductors of heat and electricity whereas non-metals are bad conductors of heat and electricity.

(iii) (a) The minerals contain a low percentage of metal, while the ores contain a large percentage of the metal.

(b) The metal cannot be extracted from mineral, on the other hand ores can be used for the extraction of metal.

(c) All minerals are not ores, but all ores are minerals.

Q. 6. (i) The ore zinc blende, is an important source of the metal zinc. What is the name of the zinc compound in zinc blende ?

(ii) What is the zinc compound obtained by roasting zinc blende ?

(iii) What is the type of chemical reaction carried out in order to obtain zinc ?

(iv) Are liquid zinc and liquid lead miscible or immiscible ?

(v) What is the name of the alloy formed between zinc and copper ?

Ans. (i) Zinc sulphide (ZnS).

(ii) Zinc blende is oxidized to zinc oxide by roasting in presence of excess air.

(iii) Reduction of zinc oxide.

(iv) Immiscible.

(v) Brass [7% of Cu, 30% of Zn].

Q. 7. The following questions refer to the extraction of aluminium and iron from their ores :

(i) Name the principal ore from which; (a) iron and (b) aluminium are extracted.

(ii) What is the most important chemical process in the extraction of any metal ? State how this essential step is carried out in the extraction of; (a) iron, (b) aluminium.

(iii) Iron and aluminium ores both, contain impurities. Explain briefly how these impurities are removed in each case.

(iv) What is the major impurity present in iron when it is removed from the blast furnace ?

Ans. (i) (a) Haematite (Fe_2O_3). (b) Bauxite (Al_2O_3).

(ii) Reduction of the oxide is an important step in extraction of metal.

In case of iron, $Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$

Al_2O_3 cannot be easily reduced, hence it is subjected to electrolysis. Aluminium is collected at the cathode.

(iii) Iron ore contains impurities of silica and sand. These are removed by magnetic separation. Bauxite and aluminium ore contains impurities of FeO and SiO_2.

Bauxite containing FeO is calcinated at high temperature when FeO is oxidised to Fe_2O_3. Calcinated ore is then treated with NaOH when Al_2O_3 is converted into soluble $NaAlO_2.Fe_2O_3$ can thus be filtered off. Bauxite containing SiO_2 is mixed with coke and heated to 1000°C in an atmosphere of N_2. Silica is reduced to Si which volatilises at the temperature of reaction. Aluminium oxide is converted into AIN which is hydrolysed with water to obtain $Al(OH)_3$.

(iv) Carbon is major impurity present in iron.

Q. 8. (i) What is bauxite ? Which metal is extracted from it ?

(ii) In the electrolysis of molten alumina, the carbon anode is gradually burnt away. Why ?

(iii) Describe modern method of aluminium extraction.

Ans. (i) Bauxite is hydrated aluminium oxide [$Al_2O_3.2H_2O$] and aluminium metal is extracted from bauxite.

(ii) In the electrolysis of molten aluminium oxide, oxygen gas is liberated which gradually burns away carbon anode at a higher temperature to form carbon dioxide.

$$C + O_2 \longrightarrow CO_2$$

(iii) In the modern method, pure alumina is dissolved in cryolite [$Na_3.AlF_6$], which makes it good conductor of electricity.

When an electric current is passed through electrolyte, the heat is also produced which keeps the mass in molten state and alumina gets reduced to free aluminium metal according to the following reactions :

$$Na_3AlF_6 \longrightarrow 3NaF + AlF_3$$

$$2AlF_3 \rightleftharpoons 2Al^{3+} + 6F^-$$

$$6F^- + Al_2O_3 \longrightarrow 2AlF_3 + 3O^{2-}$$

At cathode : $2Al^{3+} + 6e^- \longrightarrow 2Al$

At anode : $3O^{2-} - 6e^- \longrightarrow 3O$

$$3O + 3O \longrightarrow 3O_2$$

Q. 9. The following questions are relevant to the extraction of aluminium :

(i) State the reason for addition of caustic alkali to bauxite ore during purification of bauxite.

(ii) Give a balanced chemical equation for the above reaction.

(iii) Alongwith cryolite and alumina, another substance is added to the electrolyte mixture. Name the substance and give one reason for the addition.

Ans. (i) Caustic alkali dissolves aluminium oxide forming soluble sodium aluminate while impurities remains insoluble and ppt. as red mud.

(ii) $Al_2O_3 \cdot 2H_2O + NaOH \longrightarrow 2NaAlO_2 + 3H_2O$

(iii) The name of substance is Fluorspar (CaF_2) and it increases conductivity of the electrolyte.

Q. 10. 'Alumina (aluminium oxide) has a very high melting point of over 2,000°C so that it cannot readily be liquiefied. However, conversion of alumina to aluminium and oxygen, by electrolysis, can occur when it is dissolved in some other substance.'

(i) Which solution is used to react with bauxite as a first step in obtaining pure aluminium oxide ?

(ii) The aluminium oxide for the electrolytic extraction of aluminium is obtained by heating aluminium hydroxide. Write the equation for this reaction.

(iii) Name the element which serves both as the anode and the cathode in the extraction of aluminium.

(iv) Write the equation for the reaction that occurs at the cathode during the extraction of aluminium by electrolysis.

(v) Give the equation for the reaction which occurs at the anode when aluminium is purified by electrolysis.

Ans. (i) Sodium hydroxide

(ii) $2Al(OH)_3 \xrightarrow{\Delta} Al_2O_3 + 3H_2O$

(iii) Carbon

(iv) $[Al^{3+} + 3e^- \longrightarrow Al] \times 2$

(v) $[O^{2-} - 2e^- \longrightarrow O] \times 3$

Q. 11. (i) Give the name and formula of the ore of zinc containing its sulphide.

(ii) Write equations for the following steps in the extraction of zinc.

(a) Roasting of the ore.

(b) Reduction of the zinc compound which is the product of the above reaction.

OR

In the process of extracting zinc, the above named ore is roasted. Write the equation for the reaction which takes place when the sulphide ore is roasted.

(iii) What in addition to a zinc compound, is put into the blast furnace ?

(iv) State one large scale use of zinc.

(v) "Iron is removed from a blast furnace as a liquid". State how zinc leaves a furnace.

Ans. (i) Zinc blende (ZnS)

(ii) (a) $2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2$

(b) $ZnO + C \longrightarrow Zn + CO$

(iii) Powdered coke.

(iv) For galvanising iron sheets to prevent rusting.

(v) Iron is removed from a blast furnace as a liquid because of the maximum liberated heat coke reduces zinc oxide to zinc vapours to volatize a brilliant glow. These received in a condenser to liquifies, called spelter.

Q. 12. (i) (a) What is the function of adding the lime stone in the "Blast Furnace"?

(b) Give two uses of slag.

(ii) How is zinc extracted from zinc blende [ZnS] ?

Ans. (i) (a) Lime stone decomposes at a higher temperature of blast furnace, to form calcium oxide and carbon dioxide.

$$CaCO_3 \longrightarrow \underset{\text{Carbon dioxide}}{CaO + CO_2 \uparrow}$$

Calcium oxide combines with sand, present as impurities, to form calcium silicate known as the slag.

$$CaO + SiO_2 \longrightarrow \underset{\text{Calcium Silicate [Slag]}}{CaSiO_3}$$

The slag, is formed at the surface of blast furnace from where, it is removed from time to time. Thus, lime stone is used to remove the impurities of silicon dioxide present in ore.

(b) (1) It is used in the manufacture of cement.

(2) It is used as a fertilizer.

(ii) Zinc blende is strongly heated in the presence of air in a 'reverberatory furnace', where it is oxidized to zinc oxide and sulphur dioxide gas is liberated.

$$2ZnS + 3O_2 \longrightarrow \underset{\text{Zinc oxide}}{2ZnO} + 2SO_2\uparrow$$

Zinc oxide so obtained is mixed with carbon and is strongly heated, where it is reduced to metallic zinc and carbon monoxide are formed.

$$\underset{\text{Zinc oxide}}{ZnO} + C \longrightarrow Zn + CO\uparrow$$

$$ZnO + CO \longrightarrow Zn + CO_2\uparrow$$

$$CO_2 + C \longrightarrow \underset{\text{Carbon monoxide}}{2CO}$$

Carbon mono-oxide is regenerated.

Q. 13. (i) The following is a list of metals : Na, Mg, Al, Zn, Fe, Pb, Cu and Au.

Name an ore of one of the above metals and state, how the metal is produced from it commercially by the process of :

(a) Electrolysis of the molten ore (b) Reduction by coke

(c) Roasting followed by reduction (d) Metal found in native state

(ii) How would you prove that the alloy solder contains lead ?

Ans. (i) (a) Aluminium–Bauxite (b) Iron–Hematite

(c) Lead–Galena (d) Gold

(ii) Take the given sample of solder and dissolve it in concentrated nitric acid. Dilute the solution with water and add dilute hydrochloric acid. A white precipitate of lead chloride is obtained, which is soluble in hot water. To this solution add potassium chromate solution, a golden yellow precipitate, confirms the presence of lead.

$$Pb + 4HNO_3 \longrightarrow Pb(NO_3)_2 + 2H_2O + 2NO_2$$

Lead present in solder is confirmed as below :

$$Pb(NO_3)_2 \longrightarrow 2HCl \longrightarrow \underset{\text{White ppt.}}{PbCl_2\downarrow} + 2HNO_3$$

$$PbCl_2 + K_2CrO_4 \longrightarrow \underset{\substack{\text{Lead chromate}\\ \text{(Golden yellow ppt.)}}}{PbCrO_4\downarrow} + 2KCl$$

Q. 14. (i) The basic materials needed for production of iron in the blast furnace are lime stone, coke and air in addition to the iron ore.

(a) Name one iron ore and write its formula.

(b) Hot air is blown in, at the base of the furnace; where it reacts with coke. Give the equation for the reaction that takes place.

(c) Higher up in the furnace, the iron ore is reduced to iron by one of the gases produced in the furnace. Give the chemical equation for the reaction, by which this gas is produced and give a balanced equation to show, how the ore is reduced to iron.

(ii) (a) Which compound produced from the limestone takes part in forming the slag ? Give the formula of the slag.

(b) What is the principal use of slag ?

(iii) (a) Iron forms two series of slags ferrous and ferric. Using caustic soda solution, how would you distinguish between these two salts ?

(b) How zinc is extracted from calamine ore ?

Ans. (i) (a) Haematite (Ferric oxide) Fe_2O_3.

(b) $$C + O_2 \longrightarrow \underset{\text{Coke}}{CO_2}$$

(c) $$CO_2 + C \longrightarrow 2CO$$

$$\underset{\text{Haematite}}{Fe_2O_3} + 3CO \longrightarrow \underset{\text{Iron}}{2Fe} + 3CO_2$$

(ii) (a) The limestone decomposes at 1000°C, to form lime and carbon dioxide. Lime is the compound which takes part in the formation of slag.

$$CaCO_3 \xrightarrow{1000°C} \underset{\text{Lime}}{CaO} + CO_2$$

$$CaO + SiO_2 \longrightarrow \underset{\text{Slag}}{CaSiO_3}$$

Slag is calcium silicate with the formula $CaSiO_3$.

(b) The slag is used in the manufacture of cement.

(iii) (a) When caustic soda solution is added to a ferrous salt, a dirty green precipitate of ferrous hydroxide is obtained.

$$FeSO_4 + 2NaOH \longrightarrow \underset{\text{Dirty green ppt.}}{Fe(OH)_2\downarrow} + Na_2SO_4$$

On the other hand, ferric salts give a reddish brown precipitate of ferric hydroxide with caustic soda.

$$FeCl_3 + 3NaOH \longrightarrow \underset{\text{Reddish brown}}{Fe(OH)_3\downarrow} + 3NaCl.$$

(b) Calamine ore is chemically zinc carbonate [$ZnCO_3$]. Purified ore is roasted in a reverberatory furnace, where it is decomposed to form zinc oxide and carbon dioxide gas is liberated.

$$ZnCO_3 \longrightarrow ZnO + CO_2$$

Zinc oxide so obtained is mixed with carbon and heated in a specially designed clay retorts, placed in a furnace, where it is reduced to zinc metal and carbon monoxide is formed, which is further used to reduce the ore.

$$ZnO + C \longrightarrow Zn + CO$$

$$ZnO + CO \longrightarrow Zn + CO_2$$

Q. 15. (i) (a) Give the common name of an ore, from which aluminium is extracted.

(b) Name the process of its extraction and describe it.

(c) Name another metal, which is extracted by this process.

(ii) (a) Give a reason, why aluminium cannot be obtained from aluminium oxide; by the ''Blast Furnace Process'' or "Carbon Reduction Process."

(b) Name the properties for which aluminium is used in :

(i) Cooking utensils, (ii) Overhead electric transmission wire.

(c) Aluminium is more active than iron and yet there is less corrosion of the aluminium, when both are exposed to air. Explain this fact.

(iii) (a) What is pig-iron ?

(b) What is the main difference in chemical composition of cast iron and steel ?

Ans. (i) (a) Aluminium metal is extracted from Bauxite ore [$Al_2O_3.2H_2O$].

(b) Aluminium metal is extracted by electrolytic reduction process, in which electric current is passed through fused aluminium oxide, the purified Bauxite. Aluminium metal is collected at cathode, while oxygen gas is liberated at anode according to the following reactions.

$$Al_2O_3 \rightleftharpoons 2Al^{3+} + 3O^{2-}$$

At cathode : $2Al^{3+} + 6e^- \longrightarrow 2Al$

At anode : $3O^{2-} - 6e^- \longrightarrow 3O$

$$3O + 3O \longrightarrow 3O_2$$

(c) Calcium metal is also extracted by electrolytic reduction process.

(ii) (a) Aluminium metal is more electropositive than iron. It has the characteristic property of all the oxides of metals that are highly electropositive oxides of metals cannot be reduced by heating with carbon to form free metal. Hence aluminium is not extracted by the ''Blast Furnace Process''.

(b) (i) Aluminium is a good conductor of heat, light in weight, strong and can be made passive by nitric acid.

(ii) Aluminium is a good conductor of electricity, light in weight, tough and possess high tensile strength and is resistant to corrosion. It is a cheaper metal than copper.

(c) Aluminium metal is protected by a thin film of aluminium oxide, which sticks firmly with the metal and prevents further corrosion.

(iii) (a) The iron, which is obtained directly from the blast furnace is known as pig iron. Besides iron, it contains about 4% of carbon and small quantities of silicon,

phosphorus, manganese and sulphur. When pig iron is heated to melting and is casted into desired moulds, then it is known as cast iron.

(b) Cast iron contains 2·5% to 4% of carbon, while steel contains 0·5% to 1·5% of carbon. Due to the higher percentage of carbon in cast iron, it resists corrosion.

Q. 16. (i) What is froath floatation process and for, what purpose it is used ?

(ii) How is the metal sodium extracted ? Write the equations for the reactions involved.

(iii) Name two other metals, which can be extracted by electrolytic reduction method.

Ans. (i) In this process, the heavy material containing metal, is floated upward with froath to separate it from waste material present in ore or mineral. Hence it is called froath floatation process.

(ii) Sodium metal is extracted by the electrolysis of fused sodium chloride. Sodium is collected at cathode, while chlorine gas is liberated at anode; as an important by product.

$$NaCl \rightleftharpoons Na^+ + Cl^-$$

At Cathode : $Na^+ + e^- \longrightarrow Na$

At anode : $Cl^- - e^- \longrightarrow Cl$

$$Cl + Cl \longrightarrow Cl_2$$

(iii) Calcium, and magnesium are other two metals, which can be extracted by electrolytic reduction method.

Q. 17. (i) Give the reactions taking place in the blast furnace, when haematite, coke and lime stone are added to it.

(ii) What is the purpose of adding lime stone in the extraction of iron from haematite ?

(iii) What is the use of galvanized iron ?

(iv) Which two products are taken out from the blast furnace during the extraction of iron ?

Ans. (i) (a) Carbon burns in the presence of oxygen of air to form carbon dioxide which is reduced to carbon monoxide in the presence of coke.

$$C + O_2 \longrightarrow CO_2$$

$$CO_2 + C \longrightarrow 2CO$$

(b) Carbon monoxide so produced, reduces haematite ore [Ferric oxide] to metallic iron.

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2\uparrow$$

(c) Lime stone, at a higher temperature of blast furnace decomposes into calcium oxide and carbon dioxide.

$$CaCO_3 \longrightarrow CaO + CO_2\uparrow$$

(d) Calcium oxide so formed reacts with sand [silicon dioxide] to form calcium silicate, the slag and thus the impurity of sand is removed.

$$CaO + SiO_2 \longrightarrow CaSiO_3$$

(ii) Lime stone is added to ''blast furnace'' in the extraction of iron to remove the impurities of silicon dioxide, *i.e.,* the sand.

(iii) Galvanized iron is used in making different varieties of tools for industries, scientific apparatus, and household fittings.

(iv) Pig iron and slag are the two products, which are taken out from the blast furnace during the extraction of iron.

Q. 18. (i) The following represents a summary of the reaction which occur in the ''Blast furnace'', leading to the production of molten iron.

$$\text{Coke} + O_2 \longrightarrow \text{Gas Y}$$

$$\text{Gas Y} + \text{Coke} \longrightarrow \text{Gas Z}$$

$$\text{Gas Z} + \text{Iron oxide} \longrightarrow \text{Gas Y} + \text{Iron}$$

Identify the gases, Y and Z. Explain why gas Z is said to act as a reducing agent in the last step in the above equations.

(ii) Calcium, Copper, Lead, Aluminium, Zinc, Chromium, Magnesium, Iron,

Choose the major metals from the list given above to make the following alloys :

(a) Stainless steel (b) Brass

Ans. (i) The gas Y, carbon dioxide and the gas Z, is carbon monoxide. The gas Z is a reducing agent because it removes oxygen from iron oxide and converts it into metallic iron and itself gets oxidized to carbon dioxide.

(ii) (a) Iron, Chromium (b) Zinc

Q. 19. (i) (a) Name two ores of iron.

(b) Name three raw materials used in the extraction of iron.

(c) Write equations that occur in the ''Blast Furnace''.

(ii) What are the main constituents of steel ?

(iii) What is tempering of steel ?

Ans. (i) (a) Two main ores of iron are : Haematite [Fe_2O_3] and Magnetite [Fe_3O_4].

(b) Iron ore, lime stone, and coke are used in the extraction of iron.

(c) Following are the reactions, which take place in the ''Blast Furnace'', during the extraction of iron.

$$C + O_2 \longrightarrow CO_2$$

$$CO_2 + C \longrightarrow 2CO$$

$$Fe_2O_3 + 3CO \longrightarrow 2Fe + 3CO_2$$

$$Fe_3O_4 + 4CO \longrightarrow 3Fe + 4CO_2$$

$$CaCO_3 \longrightarrow CaO + CO_2$$

$$CaO + SiO_2 \longrightarrow \underset{\text{Calcium Silicate [Slag]}}{CaSiO_3}$$

(ii) Steel is an alloy of iron and carbon containing very small amounts of impurities, that are present in the cast iron. The carbon content varies from 0·5 to 1·5%. The variety containing lower percentage of carbon is called "mild steel" and the variety which contains higher percentage of carbon is known as "hard steel".

(iii) The hardened steel is brittle in nature and when it is heated upto a definite temperature and for certain time and then allowed to be cooled down slowly, then it loses its brittleness. This process is known as tempering of steel and is employed for bringing the steel into a suitable state of hardness and elasticity. The temperature required is generally judged from the colour of a thin film of oxide which is formed on the surface and varies from yellow to brown to blue as the temperature rises from 200°C to 300°C.

Q. 20. (i) Most of pig iron obtained from blast furnace is converted into steel. Suggest a reason for this.

(ii) The element X, has the electronic configuration 2, 8, 8, 1. Describe the symbol for an ion of X. Give a reason for your answer and deduce whether the element X would be expected to have oxidizing or reducing properties.

(iii) How is the metal X, extracted from its given salt ?

Ans. (i) Pig-iron does not possess a high tensile strength, hence it cannot withstand with high stress and strain. Pig-iron is brittle in nature and cannot be welded. Due to these disadvantages, pig-iron cannot be put in different varieties of uses hence it is converted into steel.

(ii) The element X, contains one electron in the outermost orbit of its atom, which can be easily donated and one unit of positive charge is gained on its ion.

$$X - e^- \longrightarrow X^+$$

The symbol of X ion is X^+. The atom of element X is a donor of electron hence X is expected to have reducing properties.

(iii) It is clear from the properties of X, that the metal X is supposed to be highly positive in nature, hence it is extracted by electrolytic reduction method.

$$XCl \rightleftharpoons X^+ + Cl^-$$

At cathode : $X^+ + e^- \longrightarrow X$

At anode : $Cl^- - e^- \longrightarrow Cl$

$$Cl + Cl \longrightarrow Cl_2$$

Q. 21. A to F below relate to the source and extraction of either Zinc or Aluminium.

(A) Bauxite (B) Coke

(C) Cryolite (D) Froth floatation

(E) Sodium hydroxide solution. (F) Zinc blende.

(i) Write down the three letters each from the above list which are relevant to :

(1) Zinc (2) Aluminium.

(ii) (1) Metals are generally solid at room temperature. Name the metal which is liquid at room temperature [say 25°C].

(2) Which allotrope of the non-metal conducts electricity ?

(iii) How many valence electrons are present in : (a) Metals, (b) Non-metals.

Ans. (i) (1) B, D, F (2) A, C, E

(ii) (1) Mercury metal exists in liquid state at room temperature.

(2) Graphite, an allotrope of carbon is a good conductor of electric current.

(iii) Atom of metals contain 1, 2 and 3 valence electrons, while the atom of non-metals contain 4, 5, 6 and 7 valence electrons.

Q. 22. The following substances are put into the blast furnace while manufacturing iron :

Iron ore, coke, limestone and hot air. In this context—

(i) What is the name of the most common ore of iron and what is its chemical formula ?

(ii) What is the purpose of using :

(a) The coke (b) The limestone

(iii) Write the equation for the reduction reaction which produces iron.

(iv) Name the substance which is collected along with cast iron at the bottom of the furnace.

(v) Write the chemical equation for the formation of the substance named in (iv) above.

Ans. (i) Haematite – Fe_2O_3.

(ii) (a) Coke acts as a reducing agent. (b) Limestone acts as a flux.

(iii) $Fe_2O_3 + 3CO \longrightarrow \underset{\text{Spongy iron}}{2Fe} + 3CO_2$

(iv) Fusible slag (calcium silicate)

(v) $CaO + SiO_2 \longrightarrow CaSiO_3$

Q. 23. (i) Name an alloy used in aircraft construction and give a reason for its use.

(ii) What is rusting of iron ?

(iii) (a) How are the following protected from rust ?
(1) A car bumper and (2) A food can.

(b) How can iron or steel be prevented from rusting, when used for ?

(c) What is galvanized iron and for what purposes it is used ?

(d) To protect iron from rusting it is coated with a thin layer of zinc. Name this process.

Ans. (i) Duralumin, an alloy of aluminium, is used in the construction of aircraft; because it is light, resistant to corrosion and has great tensile strength.

(ii) The rusting of iron is a process of atmospheric corrosion, *i.e.*, slow destruction of iron by moisture and atmospheric oxygen. Rust is a reddish-brown powdery deposit and consists of a mixture of ferric hydroxide and hydrated ferric oxide.

(iii) (a) (1) Nickel Plating and (2) Galvanizing.

(b) By painting and by coating with nickel.

(c) Iron coated with zinc is called galvanized iron. Galvanization is a process of depositing a thin layer of zinc, over the surface of iron to protect iron from rusting. Zinc is more electropositive and would be attacked first and thus iron is protected from any corrosion. Galvanized iron is used in making different varieties of tools for industries, scientific apparatus and household fittings.

(d) Galvanisation.

Q. 24. (i) The ore zinc blende, is an important source of the metal zinc. What is the name of the zinc compound in zinc blende ?

(ii) Which is the zinc compound obtained by roasting zinc blende ?

(iii) What is the type of chemical reaction carried out after roasting in order to obtain zinc ?

(iv) Are liquid zinc and liquid lead miscible or immiscible ?

(v) What is the name of the alloy formed between zinc and copper ?

Ans. (i) Zinc sulphide [ZnS].

(ii) Zinc blende is oxidised to zinc oxide by roasting in presence of excess air on reverberatory furance.

(iii) Reduction of zinc oxide.

(iv) Immiscible.

(v) Brass.

Q. 25. (i) (a) With reference to the reduction of copper oxide, iron (II) oxide, lead (II) oxide and magnesium oxide by hydrogen; place the oxides in increasing order of reduction, *i.e.*, first the oxide that is most difficult to reduce; and at last, the oxide that is most easy to reduced.

(b) (1) What is the type of bonding expected in metallic chloride ?

(2) If fused metallic chloride is electrolysed, at which electrode the metal will be obtained.

(3) What metallic property is shown by the non-metal graphite ?

(c) (1) Cast iron contains about 4% of carbon. By which chemical process is the amount of carbon decreased to make steel ?

(2) Which metal is added to steel to make stainless steel ?

(ii) (a) For each substance listed below, explain its significance in the extraction of Aluminium :

(1) Bauxite (2) Cryolite

(3) Graphite (4) Sodium hydroxide

(b) The following questions relate to the extraction of aluminium by electrolysis :

(1) Give the equation for the reaction that takes place at the cathode.

(2) Explain why it is necessary to renew the anode from time to time.

Ans. (i) (a) The increasing order of oxides is :

Magnesium oxide > iron (II) oxide > lead (II) oxide > copper oxide.

The magnesium oxide is highly stable. It cannot be reduced by hydrogen, while the last three members are reduced by hydrogen to their metals according to reactivity series.

(b) (1) Electrovalent or ionic bond.

(2) Cathode.

(3) Non-metal graphite is good conductor of heat and electricity.

(c) (1) In the Bessemer process it takes only a few minutes to convert cast iron into steel.

(2) Stainless steel is an alloy which contains about 18% of Cr, 8% Ni and 1% C.

(ii) (a) (1) **Bauxite :** It is the main ore of aluminium from which aluminium metal can easily be extracted.

(2) **Cryolite :** It is added to lower the fusion temperature of the electrolytic bath. The mixture melts at 950°C instead of 2050°C thereby saving electrical energy. It also increases conductivity alongwith fluorspar.

(3) Graphite acts as an anode. Here the anode gets oxidised to carbon dioxide, *i.e.*

$$C + O_2 \longrightarrow CO_2$$

or $$2O^{2-} - 4e^- \longrightarrow O_2$$

Thus, electrodes are made of graphite.

(4) Sodium hydroxide when added to powdered bauxite and the mixture when heated under pressure for 2-3 hours, bauxite is converted to soluble sodium aluminate ($NaAlO_2$).

$$Al_2O_3.\,2H_2O + 2NaOH \xrightarrow{150 \text{ to } 200°C} 2NaAlO_2 + 3H_2O$$

This solution is used to obtain pure aluminium.

(b) (1) The following reaction (reduction) takes place at the cathode during the extraction of aluminium.

$$Al^{3+} + 3e^- \longrightarrow Al$$

(2) Oxygen gas is produced at the graphite anode, which combines with carbon to form carbon dioxide gas at high temperature and thus anode destroys away. Thus, it is necessary to renew the anode to continue the process of extraction of aluminium.

Q. 26. (i) How are the alloys classified ?

(ii) What are ferrous alloys ? Give one example.

(iii) What are non-ferrous alloys ? Give one example.

(iv) An alloy usually has some property which makes it particularly useful. What is the special property of : (a) Type metal, (b) Duralumin ?

Ans. (i) Alloys are classified on the basis of their constituents. They are classified as follows :

(a) Ferrous alloys (b) Amalgams (c) Non-ferrous alloys

(ii) **Ferrous alloys :** It is an alloy having iron as one of the constituent, *e.g.*, nickel, steel.

(iii) **Non-ferrous alloys :** An alloy that does not contain iron as one of its constituents, is called a non-ferrous alloy, *e.g.*, brass.

(iv) (a) Type metal is hard and expands on cooling and is therefore used for making types.

(b) Duralumin is light and strong therefore it is used in the construction of air-craft.

Q. 27. State the main components of the following alloys :

(i) Brass (ii) Duralumin

(iii) Bronze (iv) Stainless steel

Ans. (i) Copper and zinc (ii) Aluminium and magnesium

(iii) Copper and Tin (iv) Iron

Q. 28. Give the composition and uses of the following alloys :

(i) Brass (ii) Bronze (iii) German silver

(iv) Type metal (v) Magnalium (vi) Duralumin

Ans. (i) It is an alloy of copper and zinc and is used for making utensils, condenser tubes, statues, and for making decoration pieces.

(ii) It is an alloy of copper, zinc and tin and is used for making statues, utensils and coins.

(iii) It is an alloy of copper, zinc and nickel and is used for making ornaments and utensils and also used for decoration.

(iv) It is an alloy of lead, antimony and tin and is used for making printing type.

(v) It is an alloy of aluminum and magnesium and is used for making light instruments, parts of machines and balance beams.

(vi) It is an alloy of aluminium, copper, magnesium and manganese and is used for making aeroplanes, space crafts, sea ship and pressure cookers.

Q. 29. (i) Write a note on thermite welding.

(ii) What is meant by electrochemical series of metal ?

Ans. (i) Thermite is a mixture of 3 parts of ferric oxide and one part of aluminium powder. On the top of the thermite mixture, an ignition mixture of potassium chlorate and magnesium powder is placed. A burning Mg ribbon is inserted into the ignition mixture, which catches the fire and ignite the thermite. During this reaction ferric oxide is

converted into iron and a large amount of heat is evolved and about 3000°C temperature is achieved.

$$Fe_2O_3 + 2Al \longrightarrow 2Al_2O_3 + 2Fe + Heat$$

The formed liquid iron is allowed to drop over the gap between the broken piece and thus they join together. This process is termed as **boldschmidts aluminothermic process.**

(ii) The arrangement of metals in the order of their decreasing activity, in which the most reactive at the top and the least reactive at the bottom are placed in the series. This arrangement of metals in a series is called electrochemical or metal activity series.

Q. 30. (i) (a) How will you show that sodium is a metal ?

(b) How will you show that sulphur is a non-metal ?

(ii) (a) Which gas is liberated when aluminium metal reacts with a solution of sodium hydroxide ?

(b) Which gas is generally liberated when metals react with dilute acid ?

Ans. (i) (a) Sodium metal can form positive ions by the loss of one electron, this metal is electropositive.

$$Na + e^- \longrightarrow Na^+$$

Sodium has high density and is less dense then water.

(b) Sulphur is non metal because, it gives negative sulphur ions by gaining of two electrons. It dissolves in many liquid solvents, but it is non-conductor of electricity and heat.

$$S + 2e^- \longrightarrow S^{2-}$$

(ii) (a) When aluminium metal reacts with sodium hydroxide solution, hydrogen gas is liberated.

(b) Hydrogen gas is generally liberated when metals react with dilute acid.

Q. 31. (i) For each of the substance listed below, described the role played in the extraction of aluminium.

(1) Cryolite (2) Sodium hydroxide (3) Graphite

(ii) Explain why :

(1) In the electrolysis of alumina using the Hall Heroult's Process the electrolyte is covered with powdered coke.

(2) Iron sheets are coated with zinc during galvanization.

Ans. (i) (1) Cryolite acts as a solvent for the electrolytic mixture as it lowers the fusion temperature from 2050°C to 950°C and enhances conductivity.

(2) Sodium hydroxide is used to remove insoluble impurities from the ore. When bauxite ore is treated with sodium hydroxide, it dissolves and forms sodium aluminate leaving behind insoluble impurities called red mud (consists of ferric oxide, sand etc.)

(3) Graphite is used as an electrode in the extraction of aluminium because it has a very high melting point and is a good conductor of electricity.

(ii) (1) To reduce the heat loss by radiation and to prevent burning of anode.

(2) Iron sheets are coated with zinc during galvanization to prevent them from rusting.

Chapter 8. (a) Study of Compounds : Hydrogen Chloride

Q. 1. (i) State one condition under which chlorine and hydrogen react to form hydrogen chloride gas.

(ii) Give balanced chemical equation for the above reaction.

(iii) Name the gas which is a covalent compound but becomes electrovalent when dissolved in water ?

(iv) For which gas, ammonia fountain experiment can be used ?

Ans. (i) Presence of diffused sunlight.

(ii) $H_2 + Cl_2 \longrightarrow 2HCl$

(iii) Hydrogen chloride (HCl) gas.
(iv) Hydrogen chloride gas.

Q. 2. A colourless gas G fumes strongly in the air. The gas gives dense white fumes when a glass rod dipped in ammonia solution is held near the gas.

Answer the following questions :

(i) Name the gas G.
(ii) Name two chemicals used in the preparation of the gas G.
(iii) Write the chemical equations for the reaction of the chemicals named in (ii) when :
(a) The reaction mixture is not heated.
(b) The reaction mixture is heated above 100°C.
(iv) Why does the gas G fume strongly in air ?
(v) Why does the gas G form dense white fumes with ammonium hydroxide ?

Ans. (i) The gas G is hydrogen chlorine gas.
(ii) The chemicals are (i) sodium chloride, (ii) concentrate sulphuric acid.
(iii) (a) $NaCl + H_2SO_4$ (conc.) $\longrightarrow NaHSO_4 + HCl\,(g)$

(b) $NaCl + NaHSO_4 \xrightarrow{Heat} Na_2SO_4 + HCl\,(g)$

(iv) It is because the HCl gas is extremely soluble in water. Thus, the gas dissolves in water vapour present in the air to form tiny droplets of hydrochloric acid, which appear in the form of fumes.
(v) The HCl gas reacts with vapours of ammonium hydroxide to form very fine solid particles of ammonium hydroxide which are white in colour. These white particles of solid ammonium hydroxide appear in the form of white fumes.

Q. 3. (i) How will you dry HCl acid gas.
(ii) Give three tests of hydrogen chloride.
(iii) Which two colourless gases combine to form a white solid.

Ans. (i) HCl gas can be dried by passing it over conc. H_2SO_4, which acts as a powerful dehydrating agent.
(ii) Tests for hydrogen chloride.
(1) It gives dense white fumes with a rod dipped in NH_4OH solution.
(2) It produces white ppt. with $AgNO_3$ solution.

$$AgNO_3 + HCl \longrightarrow \underset{\text{White ppt.}}{AgCl\downarrow} + HNO_3$$

(3) It turns moist blue litmus red.
(iii) NH_3 and HCl gases combine to form a white solid NH_4Cl

$$\underset{\text{Gas}}{NH_3} + \underset{\text{Gas}}{HCl} \longrightarrow \underset{\text{Solid}}{NH_4Cl}$$

Q. 4. (i) (a) What must be added to sodium chloride to obtain hydrogen chloride ?
(b) Write the equation for the reaction which takes place in (a) (i) above.
(c) What would you see when hydrogen chloride is mixed with ammonia ?
(ii) Hydrogen chloride dissolve in water forming an acidic solution :
(a) Name the experiment which demonstrates that hydrogen chloride is very soluble in water.
(b) Give three distinct tests (apart from using an indicator) you would carry out with this solution to illustrate the typical properties of an acid.

Ans. (i) (a) Concentrated sulphuric acid.

(b) $$NaCl + H_2SO_4 \xrightarrow{< 200^\circ C} NaHSO_4 + HCl\,(g)$$
$$NaHSO_4 + NaCl \xrightarrow{> 200^\circ C} Na_2SO_4 + HCl\,(g)\uparrow$$

(c) When aqueous solution of ammonia is taken in the jar of hydrogen chloride, it forms dense white fumes of ammonium chloride.

$$NH_3 + HCl \longrightarrow NH_4Cl$$

(ii) (a) Fountain experiment.
(b) An acid reacts with :
(1) Metal carbonates and bicarbonates with effervescence to liberate CO_2.
(2) Acids react with metal sulphides to liberate H_2S gas which has smell of rotten eggs.
(3) Acids react with metal sulphites to liberate SO_2 gas.

Q. 5. (i) (a) Name the oxidising agent in the reaction between Manganese dioxide and conc. hydrochloric acid.
(b) State your observation when a rod dipped in ammonium hydroxide solution is brought near a gas jar containing hydrogen chloride gas.
(ii) Manganese (IV) oxide, lead (IV) oxide and red lead (Pb_3O_4) react with concentrated hydrochloric acid liberating chlorine.
(a) What is the common property being shown by these metal oxides ?
(b) Write the equation for the reaction of concentrated hydrochloric acid with Pb_3O_4.
(c) What kind of compound can be added to bleaching powder to obtain chlorine ?

Ans. (i) (a) Manganese dioxide acts as an oxidising agent.
(b) Dense white fumes appear in the jar on account of formation of fine particles of ammonium chloride which get suspended in the gas.
(ii) (a) Oxidizing agents
(b) $Pb_3O_4 + 8HCl \longrightarrow 3PbCl_2 + 4H_2O + Cl_2$
(c) Dilute acid (Hydrochloric acid)

Q. 6. Answer the following questions, stating your answer only to compounds in the following list :
Silver nitrate, hydrochloric acid, chlorine, ammonia, bleaching powder.
(i) What is water sterilizer ?
(ii) Which compound forms curdy white precipitate with hydrogen chloride ?
(iii) Name the gas which produces dense white fumes with ammonia, write the balanced chemical equation.

Ans. (i) Chlorine is water sterilizer.
(ii) Silver nitrate and hydrochloric acid forms white ppt.

$$AgNO_3 + HCl \longrightarrow \underset{\text{White ppt.}}{AgCl} + HNO_3$$

(iii) Hydrogen chloride (HCl)

$$NH_3 + HCl \longrightarrow NH_4Cl \text{ (Dense white fumes)}$$

Q. 7. (i) When moist chlorine reacts with hydrogen sulphide, two products are formed :
(a) A gas which fumes in moist air
(b) A yellow solid
Name these products.
(ii) What type of reaction is taking place when chlorine acts as a bleaching agent ?

Ans. (i) (a) Hydrogen chloride gas (b) Sulphur
(ii) Oxidation reaction.

Q. 8. From the gases–ammonia, hydrogen chloride, hydrogen sulphide, sulphur dioxide. Select the following :
(i) The gas which gives a white precipitate when reacted with silver nitrate solution acidified with dilute nitric acid.
(ii) A solution of hydrogen chloride in water is prepared. The following substances are added to separate portions of the solution.

Substances Added	Gas evolved	Odour
Calcium carbonate	—	—
Magnesium ribbon	—	—
Manganese (IV) oxide with heating	—	—
Sodium sulphide	—	—

Complete the table by writing the gas evolved in each case and its odour.

Ans. (i) Hydrogen chloride

(ii)

Substances Added	Gas evolved	Odour
Calcium carbonate	Carbon dioxide	Odourless
Magnesium ribbon	Hydrogen	Odourless
Manganese(IV) oxide with heating	Chlorine	Pungent irritating
Sodium sulphide	Hydrogen sulphide	Rotten eggs

Q. 9. What is aqua regia ? How does it help in dissolving gold or platinum.

Ans. A mixture of 1 part of conc. nitric acid and 3 parts of conc. hydrochloric acid by weight is called aqua regia.

The conc. HCl and conc. HNO_3 reacts to form nascent chlorine which reacts with gold or platinum to form their respective soluble chlorides.

$$HNO_3 + \underset{(Conc.)}{3HCl} \longrightarrow 2H_2O + NOCl + 2\,(Cl)$$

$$Au + 3[Cl] \longrightarrow \underset{\text{Gold(II) chloride}}{AuCl_3}$$

$$Pt + 4\,[Cl] \longrightarrow \underset{\text{Platinium(IV) chloride}}{PtCl_4}$$

Q. 10. State three uses of hydrochloric acid.

Ans. (i) It is used in the manufacture of silver chloride, which is used widely in photography.

(ii) It is used in the manufacture of dyes, drugs and paints.

(iii) It is used for cleaning metal surface before painting, electroplating, galvanising, soldering etc.

Q. 11. The following questions are pertaining to the laboratory preparation of hydrogen chloride gas :

(i) Write the equation for its preparation mentioning the condition required.

(ii) Name the drying agent used and justify your choice.

(iii) State a safety precaution you would take during the preparation of hydrochloric acid.

Ans. (i)

$$\underset{\text{Sodium chloride}}{NaCl} + \underset{\text{Sulphuric acid (Conc.)}}{H_2SO_4} \xrightarrow{< 200°C} \underset{\text{Sodium hydrogen Sulphate}}{NaHSO_4} + \underset{\text{Hydrogen chloride}}{HCl\uparrow}$$

(ii) It is dried by passing through conc. sulphuric acid because it does not react with hydrogen chloride gas.

(iii) To prepare hydrochloric acid, HCl gas is dissolved in water by inverted.

Chapter 8. (b) Study of Compounds : Ammonia and Nitric Acid

Q. 1. How liquor ammonia is different from liquid ammonia ?

Ans. A very strong solution of ammonia in water is called liquor ammonia. Ammonia can be obtained from it by boiling. When ammonical liquor is boiled with milk of lime, the ammonia formed is passed into ice or cold water to form liquor ammonia.

When cooled under pressure, ammonia condenses to a colourless liquid which boils at – 33·4°C. This is liquid ammonia which when further cooled freezes to a white crystalline snow like solid, which melts at – 77·7°C. Liquid ammonia is used as a refrigerant because its heat of vaporisation is 5700 calories per gram molecule. Liquid ammonia is liquified ammonia and is available in cylinders. Laboratory bench reagent is a diluted solution of liquor ammonia.

Q. 2. The questions below are related to the manufacture of ammonia.

(i) Name the process.

(ii) In what ratio must the reactants be taken ?

(iii) Name the catalyst used.

(iv) Give the equation for the manufacture of ammonia.

(v) Ammonia can act as a reducing agent — write a relevant equation for such a reaction.

Ans. (i) Haber's process.

(ii) Nitrogen one part, hydrogen three parts.

(iii) Iron powder.

(iv) $N_2 + 3H_2 \longrightarrow 2NH_3$

(v) $2NH_3 + 3\underset{\text{oxide}}{\underset{\text{Copper}}{CuO}} \longrightarrow 3\underset{\text{Copper}}{Cu} + 3H_2O + N_2$

Q. 3. The following questions are based on the preparation of ammonia gas in the laboratory :

(i) Explain why ammonium nitrate is not used in the preparation of ammonia.

(ii) Name the compound normally used as a drying agent during the process.

(iii) How is ammonia gas collected ?

(iv) Explain why it is not collected over water.

(v) Give the name of a hydride of nitrogen.

(vi) Which reactants are used in laboratory preparation of ammonia ?

(vii) What is the vapour density and nature of ammonia ?

(viii) Which feature of the Ammonia molecules leads to the formation of the ammonium ion when ammonia dissolves in water. Name the other ion formed when ammonia dissolves in water.

Ans. (i) Ammonium nitrate is not used in the preparation of ammonia because ammonium nitrate is explosive in nature and dissociate into nitrous oxide and water on heating.

(ii) Quick lime.

(iii) By downward displacement of air.

(iv) It is highly soluble in water.

(v) Ammonia.

(vi) Ammonium chloride and slaked lime [$Ca(OH)_2$].

(vii) Vapour density of ammonia is 8·5, and it is alkaline in nature.

(viii) In ammonia molecule there is one lone pair of electrons available on nitrogen atom. This lone pair of electron leads to the formation of ammonium ion. Hydroxide ion (OH^-), is formed when ammonia dissolves in water.

Q. 4. What are the necessary conditions for getting maximum yield of ammonia ?

Ans. The necessary conditions for getting maximum yield of ammonia are as follows :

(i) **Low Temperature :** As the reaction is exothermic in nature, so the temperature should be low. When temperature is lowered, the rate of the reaction slows down and the yield is maximum. It is found for maximum yield, temperature should be between 450° to 500°C (optimum temperature).

(ii) **Catalyst :** A catalyst is used to accelerate the reaction at optimum temperature. Following are the catalysts used :

(a) Finely divided iron, mixed with molybdenum as promoter.

(b) A better catalyst is ferric oxide (Fe_2O_3) containing 1% of potassium oxide (K_2O) and 3% of aluminium oxide (Al_2O_3) which acts as promoters.

(iii) **High Pressure :** When 4 volumes of a mixture of nitrogen and hydrogen are reduced to 2 volumes of ammonia, the pressure drops. In order to have maximum yield the pressure should be very high. The optimum pressure should be between 200 atmospheres to 900 atmospheres.

Pressure (in atm.)	Temperature (in °C)	Yield (in %)
200 atms.	400°C	36·3%
1000 atms.	400°C	79·8%

(iv) **Purity of Gases :** Any kind of impurity tends to slow down the reaction or poisons catalyst. So, the gases that are to be used should be pure and dry.

Q. 5. (i) What are the products formed when ammonia is oxidised with copper oxide ?

(ii) What is the difference between chemical nature of an aqueous solution of hydrogen chloride and an aqueous solution of ammonia.

Ans. (i) Nitrogen, copper and water.

(ii) Aqueous solution of HCl is acidic while aqueous solution of ammonia is basic.

Q. 6. How would you prepare :

(i) Nitrogen from ammonia. (ii) Ammonia from nitrogen.

(iii) Nitric oxide gas and nitrous oxide gas.

Ans. (i) Ammonia gas burns in the presence of oxygen in a glass jar with a greenish yellow flame to form nitrogen and steam.

$$4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$$

(ii) Nitrogen combines with heated metals; for example, aluminium to form aluminium nitride, which is readily decomposed by water to form ammonia gas which has a characteristic pungent odour and aluminium hydroxide is also formed.

$$2Al + N_2 \longrightarrow \underset{\text{Aluminium nitride}}{2AlN}$$

$$AlN + 3H_2O \longrightarrow \underset{\substack{\text{Aluminium}\\ \text{hydroxide}}}{Al(OH)_3} + NH_3$$

(iii) Introduce the given gas in the atmosphere of oxygen and if reddish brown fumes are produced, then the given sample of gas is nitric oxide and if no brown fumes are produced and the mixture remains colourless, then the gas is nitrous oxide.

Q. 7. Outline the conditions of the synthetic process for producing ammonia gas. Mention the catalyst used.

Ans. A mixture of nitrogen and hydrogen in the ratio of 1 : 3 by volume is passed over heated iron at 450°C in the presence of molybdenum, which acts as catalyst (promoter) under 200 atmospheric pressure. The reaction of nitrogen and hydrogen is a reversible reaction hence ammonia is removed from the reaction vessel from time to time by liquefaction under high pressure, so that the reaction proceeds in the forward direction.

$$N_2 + 3H_2 \rightleftharpoons \underset{\text{Ammonia}}{2NH_3} + 22\text{ k cal.}$$

Q. 8. Name one element in each case, to which the following description would apply.

(i) The burning metal which combines directly with nitrogen.

(ii) Define fixation of nitrogen and state two ways in which fixation of nitrogen occurs, naturally.

(iii) Give two reasons to show that the solution of ammonia in water contains hydroxide ions.

Ans. (i) Magnesium, calcium and aluminium.

(ii) Conversion of atmospheric nitrogen into soluble nitrogenous compounds which can be easily absorbed by the roots of the plants.

(a) During thunder and lightning

(b) By symbiotic bacteria

(iii) (a) It turns red litmus solution to blue.

(b) It reacts with acids to form salt and water.

Q. 9. (i) Of the two gases, ammonia and hydrogen chloride, which is more dense ? Name the method of collection of this gas.

(ii) Give one example of a reaction between the above two gases which produces a solid compound.

Ans. (i) HCl collected by upward displacement of air.

(ii) $NH_3 + HCl \longrightarrow NH_4Cl$

Q. 10. (i) Does ammonia burn in oxygen ? If yes, give equation.

(ii) What is catalytic oxidation of ammonia ?

(iii) What is the special feature of the apparatus that is used in the laboratory preparation of nitric acid ?

(iv) Why should the temperature of the reaction mixture of nitric acid not be allowed to rise above 200°C ?

Ans. (i) Yes. Ammonia burns in oxygen with a greenish yellow flame producing water vapour and nitrogen.

$$4NH_3 + 3O_2 \longrightarrow 2N_2 + 6H_2O$$

(ii) Ammonia, when reacts with oxygen in presence of platinum (as catalyst) at 800°C, ammonia is oxidised to nitric oxide (NO). This is called catalytic oxidation of ammonia.

(iii) It is an all glass retort.

(iv) Because above 200°C nitric acid will decompose.

Q. 11. Oxidation of ammonia under certain conditions is represented by the following equation.

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

(i) Give the conditions required for this reaction.

(ii) Briefly describe the importance of this reaction in industry.

Ans. (i) Pure and dry ammonia gas mixed with air in the ratio of 1 : 8 by volume is first compressed and then passed over heated platinum gauze at 800°C.

(ii) Nitric oxide is obtained by the oxidation of ammonia, which is further oxidised to form nitrogen dioxide. Nitrogen dioxide is dissolved in water, in the presence of oxygen, to form nitric acid. Thus, nitric acid can be prepared by the catalytic oxidation of ammonia.

$$4NH_3 + 5O_2 \xrightarrow[800°C]{\text{Platinum}} \underset{\text{Nitric Oxide}}{4NO} + 6H_2O$$

$$2NO + O_2 \longrightarrow \underset{\text{Nitrogen dioxide}}{2NO_2}$$

$$4NO_2 + 2H_2O + O_2 \longrightarrow \underset{\text{Nitric acid}}{4HNO_3}$$

Q. 12. (i) What would you see during burning of ammonia in oxygen.

(ii) Name the catalyst used in the catalytic oxidation of ammonia.

(iii) In the reaction of the catalytic oxidation of ammonia the catalyst glows red hot, Why ?

(iv) What is the name of the industrial process, which starts with the reaction of catalytic oxidation of ammonia.

(v) How is the temperature maintained in the Ostwald's process ?

Ans. (i) The burning of ammonia in oxygen produces a bluish green flame. The reaction is irreversible and highly exothermic.

(ii) Platinum.

(iii) The catalyst glows red hot without external heating because much heat is liberated during the reaction.

(iv) Ostwald's process.

(v) In the Ostwald's process, the catalytic oxidation of ammonia to nitric oxide is an exothermic reaction. Once the reaction starts, the heat released maintains the temperature of the catalyst.

Q. 13. (i) How would you obtain the compound magnesium nitride ?

(ii) What property of ammonia is illustrated by the reaction between ammonia and copper oxide.

(iii) What important industrial process starts with reaction between ammonia and oxygen. Name the catalyst uses.

(iv) During laboratory preparation how is ammonia dried and collected ?

Ans. (i) By burning magnesium in the atmosphere of nitrogen by direct combination of elements.

$$3Mg + N_2 \longrightarrow Mg_3N_2$$

(ii) Reducing property of ammonia, as it reduces CuO to Cu in reaction.

(iii) Ostwald process for the manufacture of nitric acid and the catalyst used is platinum gauze.

(iv) Ammonia is dried by passing it through quick lime (CaO) and is collected by downward displacement of air.

Q. 14. (i) Give the balanced equations for laboratory preparation of nitric acid and describe the reaction.

(ii) In laboratory preparation of nitric acid, the mixture of potassium nitrate and concentrated sulphuric acid should not be heated above 200°C. Explain ?

Ans. (i) In laboratory, nitric acid is prepared by heating potassium nitrate with concentrated sulphuric acid at low temperature, potassium hydrogen sulphate and nitric acid are formed, and at a higher temperature, potassium sulphate and nitric acid are formed.

$$KNO_3 + H_2SO_4 \xrightarrow{\text{Low temp.}} KHSO_4 + HNO_3$$

$$2KNO_3 + H_2SO_4 \xrightarrow{\text{High temp.}} K_2SO_4 + \underset{\text{Nitric acid}}{2HNO_3}$$

(ii) In laboratory preparation of nitric acid, the mixture of potassium nitrate and concentrated sulphuric acid should not be heated above 200°C because at a higher temperature, potassium sulphate is formed. Potassium sulphate is deposited as a hard, solid mass in the retort, which is difficult to remove. Moreover, most of the nitric acid decomposes at a higher temperature to form reddish brown fumes of nitrogen dioxide and the acid acquire a yellow colouration.

Q. 15. (i) (a) What compounds are required for the laboratory preparation of nitric acid ?

(b) The first step in the manufacture of nitric acid is the catalytic oxidation of ammonia. What is the name of the catalyst ?

(ii) (a) How soluble is ammonia in water ?

(b) Give two reasons to show that the solution of ammonia in water contains hydroxide ions.

(c) Name a simple method you would employ to prepare ammonium salts in your laboratory.

Ans. (i) (a) Nitre (Potassium Nitrate) and conc. sulphuric acid.

(b) Platinum.

(ii) (a) Extremely soluble.

(b) Ammonia solution in water turns red litmus blue and phenolphthalein pink. Ferric chloride, aluminium chloride solutions treated with ammonia solution give precipitates of $Fe(OH)_3$ and $Al(OH)_3$ respectively.

$$FeCl_3 + 3NH_4OH \longrightarrow Fe(OH)_3\downarrow + 3NH_4Cl$$

$$AlCl_3 + 3NH_4OH \longrightarrow Al(OH)_3\downarrow + 3NH_4Cl$$

(c) By titration or neutralisation.

Q. 16. (i) Among the elements chlorine, nitrogen and sulphur select :

(a) The least reactive (b) Obtained from the atmosphere

(ii) Why commercial nitric acid is brown ?

(iii) How can you get 'liquid air' ?

Ans. (i) (a) Nitrogen (b) Nitrogen

(ii) Commercial nitric acid is brown in colour because it contains dissolved nitrogen dioxide.

(iii) CO_2 and moisture-free air is passed through a condenser. Finally, this air is compressed, cooled and suddenly allowed to expand. By repeating this process, the air can be liquified.

Q. 17. Give two reactions to show that nitric acid is :

(i) An acid (ii) An oxidizing agent

Ans. (i) (a) Dilute nitric acid reacts with magnesium metal to liberate hydrogen gas and magnesium nitrate is formed.

$$Mg + 2NHO_3 \longrightarrow Mg(NO_3)_2 + H_2\uparrow$$

(b) Dilute nitric acid reacts with marble pieces to liberate carbon dioxide gas and calcium nitrate is formed.

$$CaCO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + CO_2\uparrow$$

(ii) (a) When carbon is heated with concentrated nitric acid, it is oxidized to carbonic acid and the acid is reduced to nitrogen dioxide and water.

$$C + 4HNO_3 \longrightarrow H_2CO_3 + 4NO_2 + H_2O$$

(b) When sulphur is heated with concentrated nitric acid, it is oxidized to sulphuric acid and the nitric acid is reduced to nitrogen dioxide and water. Carbonic acid further decomposes to carbon dioxide.

$$S + \underset{\text{(Conc.)}}{6HNO_3} \longrightarrow H_2SO_4 + 6NO_2 + 2H_2O$$

Q. 18. In what way does the action of dilute nitric acid on a metal like zinc differ from the action of dil. sulphuric acid.

OR

Dilute nitric acid is generally considered a typical acid except for its reaction with metals. In what way is dilute nitric acid different from other acids when it reacts with metals ?

Ans. Nitric acid is a strong oxidising agent and oxidises the liberated hydrogen to water and is itself reduced to nitrogen dioxide. On the other hand dilute sulphuric acid can not oxidise the liberated hydrogen to water.

Q. 19. The reaction of nitric acid with metals depends upon the concentration of the acid. Give examples, alongwith equations to illustrate the reaction of the acid.

Ans. Copper reacts differently with nitric acid at different concentrations and temperature.

(i) Copper reacts with cold and dilute nitric acid to form copper nitrate, water and nitric oxide gas is liberated.

$$3Cu + 8HNO_3 \longrightarrow Cu(NO_3)_2 + 4H_2O + \underset{\text{Nitric oxide}}{2NO}$$

(ii) Copper reacts with hot and concentrated nitric acid to form copper nitrate, water and nitrogen dioxide gas, which has reddish brown fumes and a pungent smell is liberated.

$$Cu + 4HNO_3 \longrightarrow \underset{\text{Copper nitrate}}{Cu(NO_3)_2} + 2H_2O + \underset{\text{Nitrogen dioxide}}{2NO_2}$$

Q. 20. Answer the questions given below, relating your answer only to compounds given in the following list :

Tetrammine copper(II) sulphate, Iron(III) chloride, conc. nitric acid, Ammonium hydroxide.

(i) Write name of the colours and action when concentrated nitric acid is heated with copper turnings ?

(ii) A compound X is dissolved in the ammonia solution to give a deep blue coloured solution, write the name of the compound having deep blue colours ?

(iii) The concentrated nitric acid produces yellow stains and blisters on skin. Give the reason.

Ans. (i) Brown fumes of nitrogen dioxide are evolved.

(ii) Tetrammine copper(II) sulphate.

(iii) This is due to the chemical reaction that occurs between nitric acid and proteins of skin and flesh. In this reaction, a complex compound xanthoprotic acid is formed.

Q. 21. The action of heat on the blue crystalline solid L gives a reddish brown gas M, a gas which relights a glowing splint and leaves a black residue. When as N, which has a rotten egg smell, is passed through a solution of L a black precipitate is formed.

(i) Identify L, M and N (Name or formula).

(ii) Write the equation for the action of heat on L.

(iii) Write the equation for the reaction between the solution of L and the gas N.

Ans. (i) L is copper nitrate.

M is nitrogen dioxide gas.

N is hydrogen sulphide gas.

(ii) $2\,Cu\,(NO_3)_2 \longrightarrow 2CuO + 4NO_2 + O_2$

(iii) $Cu\,(NO_3)_2 + H_2S \longrightarrow CuS + 2HNO_3$.

Q. 22. How will you show that nitric acid contains :

(i) Hydrogen (ii) Nitrogen (iii) Oxygen

Ans. (i) Dilute nitric acid reacts with magnesium metal to liberate hydrogen gas which burns with a pale blue flame and a pop sound and magnesium nitrate is formed.

$$Mg + \underset{(Dil.)}{2HNO_3} \longrightarrow Mg(NO_3)_2 + H_2\uparrow$$

(ii) Nitric acid when heated with copper turnings, produces brown fumes of nitrogen dioxide, which are passed over red hot iron filings. The residual gas collected over water is nitrogen.

$$Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$$
$$6NO_2 + 8Fe \longrightarrow 4Fe_2O_3 + 3N_2\uparrow$$

(iii) Nitric acid, when heated alone, is decomposed into a reddish brown coloured gas nitrogen dioxide, steam and a colourless, odourless gas oxygen, which rekindles a glowing splinter.

$$4HNO_3 \longrightarrow 4NO_2 + 2H_2O + O_2$$

Q. 23. What is the ring test for nitric acid ? Briefly describe this test.

Ans. To the nitrate solution, add freshly prepared iron(II) sulphate solution. Filter off the precipitate if formed. Now carefully add conc. H_2SO_4 along the sides of the test tube. A dark brown ring is formed at junctions of two liquids. Brown ring is due to the formation of nitrosonium pentaqua iron(I) sulphate $[Fe^{+} (NO^{+}) (H_2O)_5] SO_4$, which is an octahedral complex compound.

Q. 24. Gas B turns moist red litmus paper blue.

(i) What is the name of gas B ?

(ii) Write the equation for the reaction that takes place when gas B is passed over heated copper oxide.

Ans. (i) Gas B is ammonia.

(ii) $3CuO + 2NH_3 \longrightarrow 3Cu + 3H_2O + N_2\uparrow$

Q. 25. (i) Sodium hydroxide solution is added to solution A, a white precipitate is formed which is soluble in excess of sodium hydroxide. What metal ion is present in A ?

(ii) Ammonium hydroxide solution is added to solution B, when a pale blue precipitate is formed. This pale blue precipitate dissolves in excess of ammonium hydroxide to give inky blue colouration. Name the cation present in B. Name the probable colour of solution B.

(iii) When an ammonium salt is warmed with sodium hydroxide solution, ammonia gas is evolved. State three ways in which you can identify the gas.

Ans. (i) Ammonium ion is present in A.

(ii) The cation present in B is copper. Solution B is blue in colour.

(iii) The three ways in which the gas can be identified are as follows :

(a) It gives dense white fumes when a rod dipped in HCl is held in it.

(b) It turns moist red litmus paper blue.

(c) It turns phenolphthalein solution pink.

Q. 26. Explain the following :

(i) Dilute nitric acid is generally considered a typical acid but not so in its reaction with metals.

(ii) Concentrated nitric acid appears yellow when it is left standing in a glass bottle.

(iii) An all glass apparatus is used in the laboratory preparation of nitric acid.

Ans. (i) Because it does not liberate hydrogen. It is a powerful oxidising agent and the nascent oxygen formed oxidises the hydrogen to water.

(ii) Because when nitric acid is left standing in a glass bottle, it decompases to give reddish brown NO_2 gas which dissolves in undecomposed nitric acid to give a yellow colour.

(iii) Because nitric acid vapours are corrosive and may attack rubber, cork or metal.

Chapter 8. (c) Study of Compounds : Sulphuric Acid

Q. 1. Sulphuric acid is said to be dibasic acid. What is meant by the term 'dibasic' ?

Ans. Basicity of an acid is the number of H^+ ions that one formula unit of an acid liberates, *e.g.,*

Monobasic = HCl, HNO_3 etc.

Dibasic = H_2SO_4, H_2SO_3 etc.

Each acid can form as many kinds of salts, as it has hydrogen ions. Sulphuric acid can form two kinds of salts, *i.e.,* SO_4^{2-} and HSO_4^-. It ionizes in water to form two hydrogen ions. Hence, it is said to be dibasic.

$$H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$$
$$HSO_4^- \rightleftharpoons H^+ + SO_4^{2-}$$

These acids can yield two kinds of salts, *i.e.,* the normal salt and the acid salt.

Q. 2. Some bacteria obtain their energy by oxidizing sulphur, producing sulphuric acid as a byproduct. In the laboratory, or industrially, the first step in the conversion of sulphur to sulphuric acid is to produce sulphur dioxide. Then sulphur dioxide is converted to sulphur trioxide which reacts with water, producing sulphuric acid.

(i) Name one catalyst used industrially which speeds up the conversion of sulphur dioxide to sulphur trioxide.

(ii) Write the equation for the conversion of sulphur dioxide to sulphur trioxide. Why does this reaction supply energy ?

(iii) What is the name of the compound formed between sulphur trioxide and sulphuric acid

Ans. (i) Platinum and Vanadium pentaoxide.

(ii) When conversion of SO_2 to SO_3 takes place according to the following reaction.

$$SO_2 + O_2 \longrightarrow 2SO_3 + 45 \text{ k cal}$$

The 45 k cal energy supplied by above reaction.

(iii) Oleum ($H_2S_2O_7$).

Q. 3. (i) Write balanced equations for the three chemical reactions that take place during the conversion of sulphur dioxide to sulphuric acid in the contact process.

(ii) Name the catalyst used in the contact process.

(iii) Name another ore which on roasting gives sulphur dioxide.

Ans. (i) The chemical reactions are summarised as below :

$$S + O_2 \longrightarrow SO_2$$
$$2SO_2 + O_2 \longrightarrow 2SO_3$$
$$SO_3 + H_2SO_4 \longrightarrow \underset{\text{(Oleum)}}{H_2S_2O_7}$$
$$H_2S_2O_7 + H_2O \longrightarrow 2H_2SO_4$$

(ii) Platinized asbestos or V_2O_5.

(iii) Zinc blende or ZnS :

$$2ZnS + 3O_2 \longrightarrow 2ZnO + 2SO_2\uparrow$$

Q. 4. (i) With the help of equations, give an outline for the manufacture of sulphuric acid by the contact process.

(ii) What property of sulphuric acid is shown by the reaction of concentrated sulphuric acid when heated with

(a) potassium nitrate (b) carbon ?

Ans. (i) Contact Tower :

$$\underset{\text{Sulphur dioxide}}{2SO_2} + O_2 \xrightarrow[450^\circ C]{V_2O_5} \underset{\text{Sulphur trioxide}}{2SO_3}$$

Absorption Tower :

$$SO_3 + \underset{\text{Conc.}}{H_2SO_4} \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$$

Dilution Tower :

$$H_2S_2O_7 + H_2O \longrightarrow \underset{\text{Sulphuric acid}}{2H_2SO_4}$$

(ii) (a) Non-volatile nature.
(b) Oxidising property.

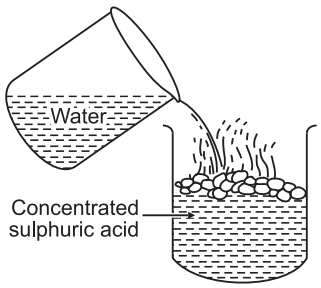
Q. 5. (i) Which two gases are combined during contact process ?
(ii) Write the equation for the reaction between zinc and the final product of the contact process ?
(iii) What happens when sulphur trioxide gas is passed into concentrated sulphuric acid.

Ans. (i) SO_2 and O_2 (sulphur dioxide and oxygen)
(ii) $$Zn + \underset{\text{(Conc.)}}{2H_2SO_4} \longrightarrow ZnSO_4 + 2H_2O + SO_2$$
(iii) Sulphur trioxide gas dissolves in concentrated sulphuric acid to form fuming sulphuric acid, commonly known as oleum.

$$SO_3 + H_2SO_4 \longrightarrow \underset{\text{Oleum}}{H_2S_2O_7}$$

Q. 6. While diluting concentrated sulphuric acid, the acid should be added to water and not water to the acid. Explain ?

Ans. When equal volumes of the acid and water are mixed at room temperature, the temperature may reach up to 120°C. Therefore, dilution of the acid should be done by adding small quantity of acid into water.



If water is added to concentrated sulphuric acid, the molecules of the acid try to grasp the molecules of water resulting in molecular tension, liberating heat and due to sudden rise in temperature, the acid starts splashing.

If a drop of concentrated acid is added to water, the molecules of acid go in different directions to pick up water which is available in plenty. Although the same amount of heat is formed but since the molecules are spread out, no splashing occurs.

Q. 7. (i) Which property of sulphuric acid is used to prepare the hydrochloric and nitric acid respectively.
(ii) What is the catalyst used in catalytic chamber and what is the temperature used ?

Ans. (i) Non-volatile nature of sulphuric acid is responsible to prepare HCl and HNO_3 by using H_2SO_4.
(ii) The catalyst used is platinized asbestos or vanadium pentaoxide and the temperature used is about 450°C.

Q. 8. (i) (a) Name the acid formed when sulphur dioxide dissolves in water.
(b) What are the two necessary conditions for the direct combination of sulphur dioxide and chlorine forming sulphuryl chloride ?
(c) State the property of sulphur dioxide which causes potassium permanganate to change its colour from purple to colourless.
(ii) Answer the following questions related to dilute and concentrated sulphuric acid.
(a) Which acid does not react with metals that are placed below hydrogen in activity series ?
(b) Which acid will give white precipitates with barium sulphate.

Ans. (i) (a) Sulphurous acid.
(b) Sunlight and absence of moisture.
(c) Reducing.

(ii) (a) Dilute sulphuric acid.

(b) Dilute sulphuric acid.

Q. 9. Give one reaction in each case to illustrate the following properties of sulphuric acid :

(i) As an acid. (ii) As an oxidising agent.

(iii) As a dehydrating agent. (iv) As a less volatile acid.

Ans. (i) Dilute sulphuric acid reacts with metals above hydrogen in the activity series, for example, magnesium to liberate hydrogen gas and magnesium sulphate.

$$Mg + H_2SO_4 \longrightarrow MgSO_4 + H_2 \uparrow$$

(ii) When sulphur is heated with concentrated sulphuric acid, it is oxidised to sulphur dioxide.

$$S + 2H_2SO_4 \longrightarrow \underset{\text{Sulphur dioxide}}{3SO_2} + 2H_2O$$

(iii) Add few drops of concentrated sulphuric acid to blue coloured crystals of copper(II) sulphate. After sometime, white anhydrous copper(II) sulphate is left, due to loss of water of crystallization.

$$\underset{\text{Hydrated copper sulphate (Blue)}}{CuSO_4.5H_2O} + [H_2SO_4] \longrightarrow \underset{\text{Anhydrous copper sulphate (White)}}{CuSO_4} + [H_2SO_4.5H_2O]$$

(iv) Concentrated sulphuric acid, when heated with sodium chloride, produces volatile hydrochloric acid.

$$NaCl + \underset{\text{(Conc.)}}{H_2SO_4} \xrightarrow{\text{Heat}} NaHSO_4 + HCl$$

Q. 10. What happens when conc. sulphuric acid reacts with :

(i) Potassium chloride

(ii) Zinc nitrate.

Ans. (i) Conc. sulphuric acid reacts with potassium chloride and forms hydrogen chloride and potassium hydrogen sulphate.

$$KCl + H_2SO_4 \longrightarrow KHSO_4 + HCl$$

(ii) Conc. sulphuric acid reacts with zinc nitrate to form zinc sulphate and nitric acid.

$$Zn(NO_3)_2 + H_2SO_4 \longrightarrow ZnSO_4 + 2HNO_3$$

Q. 11. State how you can obtain :

(i) Sulphur dioxide from sulphur

(ii) Hydrogen sulphide from iron(II) sulphide

(iii) Oxalic acid

(iv) Sodium hydroxide

(v) Hydrogen sulphide gas

Ans. (i) When sulphur is burnt in a deflagerating spoon, it melts to form a reddish brown liquid which catches fire. It burns with a blue flame forming an extremely pungent gas sulphur dioxide.

$$S + O_2 \longrightarrow SO_2$$

(ii) In the laboratory, hydrogen sulphide gas is prepared by the action of dilute sulphuric acid on ferrous sulphide.

$$FeS + H_2SO_4 \longrightarrow FeSO_4 + H_2S$$

(iii) Concentrated sulphuric acid, when heated with oxalic acid crystals, it absorbs water from oxalic acid and mixtures of carbon monoxide and carbon dioxide is formed.

$$\underset{\text{Oxalic acid}}{\begin{matrix}COOH\\|\\COOH\end{matrix}} + H_2SO_4 \longrightarrow CO\uparrow + CO_2\uparrow + [H_2SO_4.H_2O]$$

In this reaction sulphuric acid acts as a dehydrating agent.

(iv) Sodium hydroxide solution reacts with dilute sulphuric acid to form sodium sulphate and water.

$$2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$$

In this reaction sulphuric acid acts as an acid as it neutralizes sodium hydroxide to form salt and water only.

(v) When hydrogen sulphide gas is passed through concentrated sulphuric acid, it is oxidized to free sulphur. Sulphur dioxide and water are also formed.

$$2H_2S + H_2SO_4 \longrightarrow 2H_2O + SO_2\uparrow + \underset{\text{Sulphur}}{2S\downarrow}$$

In this reaction sulphuric acid acts as an oxidizing agent.

Q. 12. Which property of sulphuric acid is used in the following :

(i) As a source of hydrogen when treated in dilute form with metals like Zn, Mg, Fe, etc.
(ii) Production of hydrogen chloride on treating concentrated acid with sodium chloride.
(iii) Production of sulphur dioxide on heating in concentrated form with copper turnings.
(iv) Liberation of sulphur from H_2S with concentrated form.
(v) Charring of sugar with hot concentrated acid.
(vi) Liberation of ethylene gas with hot concentrated acid.
(vii) Liberation of carbon monoxide with hot concentrated acid.

Ans. (i) Acidic property (ii) Non volatile nature
(iii) Oxidising nature (iv) Oxidising property
(v) Dehydrating nature (vi) Dehydrating nature
(vii) Dehydrating nature

Q. 13. Some properties of sulphuric acid are listed below. Choose the property A, B, C or D which is responsible for the reactions (i) to (v). Some properties may be repeated :

(A) Acid (B) Dehydrating agent
(C) Non-volatile acid (D) Oxidizing agent

(i) $C_{12}H_{22}O_{11} + nH_2SO_4 \longrightarrow 12C + 11H_2O + nH_2SO_4$
(ii) $S + 2H_2SO_4 \longrightarrow 3SO_2 + 2H_2O$
(iii) $NaCl + H_2SO_4 \longrightarrow NaHSO_4 + HCl$
(iv) $CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$
(v) $Na_2CO_3 + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O + CO_2$
(vi) $CuSO_4 \cdot 5H_2O \xrightarrow{\text{conc. } H_2SO_4} CuSO_4 + 5H_2O$
(vii) $NaNO_3 + H_2SO_4 \text{ (conc.)} \xrightarrow{< 200^\circ C} NaHSO_4 + HCl$
(viii) $MgO + H_2SO_4 \longrightarrow MgSO_4 + H_2O$
(ix) $Zn + 2H_2SO_4 \text{ (conc.)} \longrightarrow ZnSO_4 + SO_2 + 2H_2O$

Ans. (i) B (ii) D (iii) C (iv) A (v) A
(vi) B (vii) C (viii) A (ix) D

Q. 14. A, B, C and D summarize the properties of sulphuric acid depending on whether it is dilute or concentrated. Choose the property (A, B, C or D), depending on which is relevant to each of the preparations (i) to (iii) :

(A) Dilute acid (typical acid properties)
(B) Non-volatile acid.
(C) Oxidizing agent.
(D) Dehydrating agent
(i) Preparation of hydrogen chloride.
(ii) Preparation of ethene from ethanol.
(iii) Preparation of copper sulphate from copper oxide.

Ans. (i) B (non-volatile acid).
(ii) D (dehydrating agent).
(iii) A (dilute acid).

Q. 15. Name from the list of substances given below, the substances which you would use to prepare each of the following salts, named in parts (i) to (iv) :

The substances are :

Copper, Lead, Sodium, Zinc, Copper oxide, Lead carbonate, Sodium carbonate solution, Dilute hydrochloric acid, Dilute nitric acid and Dilute sulphuric acid :

(i) Zinc sulphate; (ii) Copper sulphate; (iii) Sodium sulphate; (iv) Lead sulphate.

Ans. (a) For zinc sulphate — Zinc and dilute sulphuric acid.

(b) For copper sulphate — Copper oxide and dilute sulphuric acid.

(c) For sodium sulphate — Sodium carbonate and dilute sulphuric acid.

(d) For lead sulphate — Lead carbonate and add dil. nitric acid and then dil. sulphuric acid.

Q. 16. Give examples of the use of sulphuric acid as :

(i) An electrolyte in everyday use. (ii) A non-volatile acid.

(iii) An oxidizing agent.

Ans. (i) In lead accumulators or in storage batteries.

(ii) In the manufacture of other acids like nitric acid, hydrochloric acid and phosphoric acid.

(iii) For cleaning metals before enameling, electroplating and galvanizing, as a pickling agent.

Q. 17. Some of the properties of six pure substances represented by A, B, C, D, E and F are given below :

A–when heated with concentrated sulphuric acid, it gives off a choking gas which dissolves in water giving an acid.

B–is a greenish-yellow gas which dissolves in water and when this aqueous solution is exposed to sunlight, bubbles of a gas are evolved, which rekindles a glowing splinter.

C– is a metal which when treated with concentrated nitric acid, gives off a brown gas and a blue solution is obtained.

D– is a white solid, which when heated, gives off a sweet smelling gas which rekindles a glowing splinter.

E– is a heavy oily liquid which when added to moist sugar, chars it into a black porous mass.

F– is a gas which turns moist red litmus to blue. When the gas is passed over heated copper oxide, an inactive gas is obtained.

(i) Name the substances A, B, C, D, E and F.

(ii) Write equations for the following reactions involving A, B, C, D, E and F.

(a) A is heated with concentrated sulphuric acid.

(b) An aqueous solution of B is exposed to bright sunlight.

(c) Concentrated nitric acid and the metal C are heated.

(d) The action of heat on D.

(e) Oily liquid E is added to sugar.

(f) The action of F on heated copper(II) oxide.

Ans. (i) A is sodium chloride, B is chlorine gas, C is copper, D is ammonium nitrate, E is concentrated sulphuric acid and F is ammonia gas respectively.

(ii) (a) When sodium chloride is heated with concentrated sulphuric acid, hydrogen chloride gas is liberated and sodium sulphate is also formed.

$$2NaCl + \underset{(Conc.)}{H_2SO_4} \xrightarrow{Heat} Na_2SO_4 + 2HCl.$$

(b) Chlorine gas reacts with water in the presence of sunlight to liberate oxygen gas and hydrochloric acid is formed.

$$2Cl_2 + 2H_2O \xrightarrow{Sunlight} 4HCl + \underset{Oxygen}{O_2\uparrow}$$

(c) Copper and concentrated nitric acid when heated, a brown gas, nitrogen dioxide is evolved and a blue coloured copper nitrate is formed.

$$\underset{\text{(Conc.)}}{Cu + 2HNO_3} \xrightarrow{\text{Heat}} \underset{\substack{\text{Copper nitrate}\\ \text{Blue}}}{Cu(NO_3)_2} + 2H_2O + \underset{\substack{\text{Nigrogen dioxide}\\ \text{Brown gas}}}{2NO_2\uparrow}$$

(d) Ammonium nitrate on heating gives off a sweet smelling gas nitrous oxide, commonly known as laughing gas and water is formed.

$$NH_4NO_3 \xrightarrow{\text{Heat}} \underset{\substack{\text{Nitrous oxide}\\ \text{(laughing gas)}}}{N_2O\uparrow} + 2H_2O$$

(e) Sulphuric acid acts as dehydrating agent and chars the sugar to black porous mass, *i.e.,* carbon.

$$\underset{\text{Sugar}}{C_{12}H_{22}O_{11}} + H_2SO_4 \longrightarrow 12C + \underset{\text{Hydrate}}{[H_2SO_4 + 11H_2O]}$$

(f) When ammonia is passed over heated copper (II) oxide, it is oxidized to form nitrogen and water. Copper(II) oxide itself reduces to metallic copper.

$$2NH_3 + 3CuO \longrightarrow 3Cu + 3H_2O + \underset{\text{Nitrogen gas}}{N_2\uparrow}$$

Q. 18. A, B, C and D summarize the properties of sulphuric acid depending on whether it is dilute or concentrated.

A = Typical acid property.

B = Non-volatile acid

C = Oxidizing agent

D = Dehydrating agent

Choose the property (A, B, C or D) depending on which is relevant to each of the following :

(i) Preparation of Hydrogen chloride gas.

(ii) Preparation of Copper sulphate from copper oxide.

(iii) Action of conc. Sulphuric acid on sulphur.

Ans. (i) B = Non-volatile acid.

(ii) A = Typical acid property.

(iii) C = Oxidizing agent.

Chapter 9. Organic Chemistry

Q. 1. The list of some organic compound is given below :

Ethanol, ethane, methanol, methane, ethyne, and ethene.

From the list above, name a compound :

(i) Formed by the dehydration of ethanol by concentrated sulphuric acid.

(ii) Which will give red precipitate with ammonical cuprous chloride solution.

(iii) Which forms methanoic acid on oxidation in the presence of copper at 200°C.

(iv) Which has vapour density 14 and turns alkaline potassium permanganate green.

(v) Which forms chloroform on halogenation in the presence of sunlight.

(vi) Which decolourises bromine solution in carbon tetrachloride.

Ans. (i) Ethene (ii) Ethyne

(iii) Methane (iv) Ethene

(v) Methane (vi) Ethene

Q. 2. Name the functional group of each of CH_3OH, CH_3COOH, CH_3CHO.

Ans. Alcoholic – OH group present in CH_3OH.

Carboxylic – COOH group present in CH_3COOH.

Aldehydic – CHO group present in CH_3CHO.

Q. 3. The melting point of three members X, Y, and Z of a homologous series of hydrocarbons are –180°C, –140°C and –30°C respectively.

(i) Which one of the three would have the lowest number of carbon atoms in its molecule ? Justify your answer.

(ii) Which one of the three have the maximum number of carbon atoms in its molecule ? Justify your answer.

Ans. (i) The homologue with lower number of C-atoms in its molecule has lower melting point. Therefore, compound X has the lowest number of carbon atoms in its molecule. It is clear from the given values of melting points in which – 180°C is lowest.

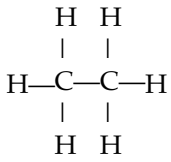
(ii) The homologue with maximum number of carbon atoms in its molecule has the highest melting point. Therefore, compound Z has the maximum number of carbon atoms in its molecules. It is clear from the given values of melting point in which 30°C is the highest of the three.

Q. 4. (i) Alkanes are called saturated hydrocarbons. Give a brief explanation, by taking the example of C_2H_6.

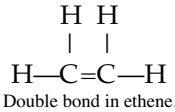
(ii) 'Alkenes are unsaturated hydrocarbons'. Illustrate it, by taking the example of ethene (C_2H_4).

(iii) A compound has number of H atoms just double that of C atoms. What types of hydrocarbon is it ?

Ans. (i) Alkane are called saturated hydrocarbons because tetra-valency of each carbon atom is satisfied by single covalent bond.



(ii) Ethene (C_2H_4) is an unsaturated hydrocarbon, commonly known as alkene. Ethene molecule contains two carbon atoms bonded by double bond.



Double bond in ethene.

(iii) The compound is an unsaturarted hydrocarbon having general formula C_nH_{2n}. So, this compound is an alkene.

Q. 5. (i) In the general formula C_nH_{2n+2}, write the meaning of n and $2n + 2$.

(ii) Write the formulae and names of the first four members of the alkane family.

(iii) Write the molecular formula of an alkane, which is composed of 16H atoms.

(iv) In a molecule of saturated hydrocarbon the number of C-atoms is 5, what is the number of H-atoms ?

Ans. (i) The number of alkane family represents the general formula C_nH_{2n+2}. In this formula :

n = number of carbon atoms in the same molecule of alkane.

$2n + 2$ = number of H-atoms in a molecule of alkane.

(ii) CH_4 (methane), C_2H_6 (ethane), C_3H_8 (propane), C_4H_{10} (butane).

(iii) C_7H_{16} (Heptane). [$\because 2n + 2 = 16$, $2n = 16 - 2$, $2n = 14$, $n = 14/2 = 7$].

(iv) According to general formula C_4H_{2n+2} when $n = 5$, $C_5H_{2\times5+2}$ or C_5H_{10+2} or C_5H_{12}. Thus, the number of hydrogen atom is 12.

Q. 6. The molecules of alkene family are represented by a general formula C_nH_{2n}. Now answer the following :

(i) What do n and $2n$ signify ?

(ii) What is the lowest value which can be assigned to n ?

(iii) What is the molecular formula of alkene, when $n = 4$?

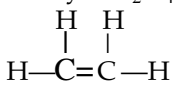
(iv) What is the structural formula of the first member of the alkene family ?

Ans. (i) n = Number of C-atoms in a molecule of alkene.
$2n$ = Number of H-atoms in a molecule of alkene.

(ii) The lowest value of n is 2.

(iii) Butene (C_4H_8).

(iv) The first member of alkene family is C_2H_4. It is called ethene, the structural formula is :



Q. 7. (i) Which compound should be heated with sodalime to obtain ethane gas in the laboratory ?

(ii) Write the equation for the reaction in (i) above.

(iii) Write a balanced equation for the complete combustion of ethane.

(iv) Name a solid which can be used instead of concentrated sulphuric acid to prepare ethylene by the dehydration of ethanol.

(v) Ethylene forms an addition product with chlorine. Name this addition product and write its structural formula.

Ans. (i) Sodium propionate.

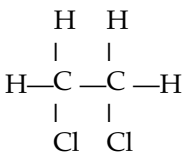
(ii) $\underset{\text{Sodium propionate}}{C_2H_5COONa} + \underset{\text{Sodium hydroxide}}{NaOH} \xrightarrow[CaO]{\Delta} \underset{\text{Ethane}}{C_2H_6} + Na_2CO_3$

(iii) $\underset{\text{Ethane}}{2C_2H_6} + 7O_2 \longrightarrow 4CO_2 + 6H_2O$

(iv) Alumina (Al_2O_3).

$$C_2H_5OH \xrightarrow[\Delta]{Al_2O_3} C_2H_4 + H_2O$$

(v) $\underset{\text{Ethylene}}{CH_2{=}CH_2} + Cl_2 \longrightarrow \underset{\text{Ethene dichloride}}{CH_2Cl{-}CH_2Cl}$



1, 2, dichloroethane

Q. 8. (i) Write the equation, for the preparation of ethylene from ethyl alcohol.

(ii) Write the general formula of a saturated hydrocarbon and give one example of a saturated hydrocarbon with its structural formula.

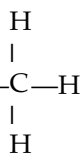
(iii) Name a compound, which will give acetylene gas, when treated with water.

Ans. (i) $C_2H_5OH(l) \xrightarrow[160\text{–}170°C]{\text{conc. } H_2SO_4} C_2H_4(g) + H_2O(l)$

(ii) General formula C_nH_{2n+2}.

Example : Methane–CH_4

Structural formula



(iii) Calcium carbide.

Q. 9. (i) Ethane and chlorine react together to form monochloroethane [ethyl chloride].

(a) Write down the structural formula of ethane.

(b) What type of reaction has taken place between ethane and chlorine ?

(ii) The type of reaction between ethene and chlorine is different from that between ethane and chlorine.

(a) What is the type of reaction between ethene and chlorine.

(b) What feature of the ethene structure makes such reaction possible ?

(c) Name the product of the reaction between ethene and chlorine.

(iii) Ethane burns completely in air or oxygen to give carbon dioxide and water vapours. With a limited supply of air or oxygen, carbon monoxide is formed. The same gases are found in automobile exhaust gases. Both gases can be considered as atmospheric pollutants.

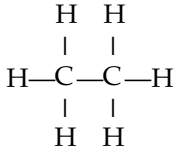
(a) Write the equation for the complete combustion of ethane.

(b) What danger is associated with carbon monoxide ?

(c) What effect is associated with too much carbon dioxide in the atmosphere ?

(d) Burning of acetylene [Ethyne] in oxygen, under appropriate conditions, produces a very hot flame. What is this hot flame used for ?

Ans. (i) (a) The structural formula of ethane is given by :



(b) Substitution reaction takes place in between ethane and chlorine.

$$\underset{\text{Ethane}}{C_2H_6} + Cl_2 \longrightarrow \underset{\text{Ethyl chloride}}{C_2H_5Cl} + HCl$$

(ii) (a) Addition reaction takes place in between ethene and chlorine.

$$\underset{\text{Ethene}}{CH_2 \!\!=\!\!\!= CH_2} + Cl_2 \longrightarrow \underset{\text{Dichloroethene}}{CH_2Cl\text{–}CH_2Cl}$$

(b) Ethene is an unsaturated hydrocarbon [Alkene], containing double covalent bonds, which respond to the addition reaction.

(c) Ethene combines with chlorine to form 1 : 2 dichloroethane [Ethylene dichloride].

(iii) (a) Ethane burns in atmospheric oxygen to form carbon dioxide and steam [water].

$$2C_2H_6 + 7O_2 \longrightarrow 4CO_2\uparrow + 6H_2O$$

(b) Carbon monoxide is a highly poisonous gas. It readily combines with haemoglobin of blood to form carboxy haemoglobin. Carboxy haemoglobin is a stable compound and is incapable of taking up the oxygen from the inhaled air and as a result, people die due to suffocation.

(c) Greenhouse effect or global warming is associated with too much carbon dioxide in the atmosphere.

(d) This hot flame is used for welding and cutting of steel.

Q. 10. Indicate the type of reaction that occurs when :

(i) Ethane reacts with chlorine.

(ii) Ethene reacts with chlorine.

(iii) What type of reaction is common in C_2H_4 and C_2H_2 ?

(iv) What is formed when ethene reacts with steam at 300°C in the presence of phosphoric acid as catalyst ?

(v) Name a solid which on reaction with water forms :

(a) methane (b) ethyne (acetylene)

(vi) Give the names of each of the following compounds :

(a) $CH_3CH_2CH_2CH_3$

(b) $CH_2 = CH_2$

(c) $CH \equiv CH$

Ans. (i) Substitution reaction (ii) Addition reaction

(iii) Addition reaction (iv) Ethanol

(v) (a) Aluminium carbide, (b) Calcium carbide.

(vi) (a) Butane, (b) Ethylene (Ethene), (c) Acetylene (Ethyne).

Q. 11. (i) Experimentally, how can polychlorination of methane be minimized ?

(ii) What are the conditions required for the addition of hydrogen to ethene ?

(iii) Which catalyst is used for the addition of hydrogen to ethene at room temperature ?

(iv) Write the names of all the possible organic products in the reaction of methane with chlorine.

Ans. (i) If excess of methane over chlorine is used, the chance of chlorine reacting with methane is greatest than with any other of the formed chloromethane.

(ii) Addition of hydrogen to ethene occurs at 300°C in the presence of nickel (Ni) catalyst.

(iii) Palladium (Pd) or Platinum (Pt) are used as catalyst at room temperature for the addition of hydrogen.

(iv) The main products is methyl chloride (CH_3Cl), (CH_2Cl_2) dichloro methane; ($CHCl_3$) trichloro methane, (CCl_4) and tetra chloromethane.

Q. 12. How does ethene gas react with the following ?

(i) Hydrogen, (ii) Halogen acid, (iii) Sulphuric acid, (iv) Bromine, (v) Alkaline potassium per manganate, (vi) HCl gas.

Ans. (i) When a mixture of ethene and hydrogen are passed over heated catalyst (Ni, Pd or Pt), an addition reaction takes place with the formation of ethane, a saturated hydrocarbon.

$$\begin{matrix} CH_2 \\ | \\ CH_2 \end{matrix} + H_2 \xrightarrow{Ni - 300°C} \begin{matrix} CH_3 \\ | \\ CH_3 \end{matrix}$$

Ethane

(ii) When vapours of ethene and hydrobromic acid are mixed at room temperature, they react to form addition product, bromoethane.

$$\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix} + \begin{matrix} H \\ | \\ Br \end{matrix} \longrightarrow \begin{matrix} CH_3 \\ | \\ CH_2Br \end{matrix}$$

(iii) When ethene is passed through conc. sulphuric acid, an addition reaction takes place at room temperature with the formation of ethyl hydrogen sulphate.

$$\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix} + \begin{matrix} H \\ | \\ HSO_4 \end{matrix} \longrightarrow \begin{matrix} CH_3 \\ | \\ CH_2HSO_4 \end{matrix}$$

Ethyl hydrogen sulphate

(iv) When bromine is passed through the inert solution of ethene, an addition reaction takes place with the formation of 1, 2, dibromoethane.

$$\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix} + \begin{matrix} Br \\ | \\ Br \end{matrix} \xrightarrow[\text{inert solvent}]{CCl_4} \begin{matrix} CH_2Br \\ | \\ CH_2Br \end{matrix}$$

1, 2-dibromoethane

(v) Ethene reacts with alkaline potassium permanganate solution to form glycol.

$$\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix} + 2\,KMnO_4 + 4H_2O \longrightarrow \begin{matrix} CH_2OH \\ | \\ CH_2OH \end{matrix} + 2MnO_2 + 2KOH$$

Glycol

(vi) Ethene reacts with HCl to form ethane glycol monochloride.

$$\begin{matrix} CH_2 \\ \| \\ CH_2 \end{matrix} + \begin{matrix} H \\ | \\ Cl \end{matrix} \longrightarrow \begin{matrix} CH_3 \\ | \\ CH_2Cl \end{matrix}$$

Ethane monochloride

Q. 13. Illustrate the following :

(i) Thermal cracking (ii) Catalytic cracking (iii) Substitution reactions.

Ans. (i) **Thermal Cracking :** Breaking of higher hydrocarbons into smaller hydrocarbons on heating in absence of air, is called thermal cracking.

$$C_{12}H_{26} \xrightarrow{273\ K} \underset{\text{Heptane}}{C_7H_{16}} + \underset{\text{Pentane}}{C_5H_{10}}$$

(ii) **Catalytic Cracking :** The breaking of higher hydrocarbons into smaller hydrocarbons, by heating under pressure, in the presence of suitable catalysts, is called catalytic cracking :

$$CH_3CH_2CH_2CH_3 \xrightarrow[450\ K]{Cr_2O_3 + SiO_2} \underset{\text{Propylene}}{CH_3CH=CH_2} + \underset{\text{Methane}}{CH_4}$$

$$CH_3CH_2CH_2CH_3 \xrightarrow[450\ K]{Cr_2O_3 + SiO_2} \underset{\text{Ethylene}}{CH_2=CH_2} + \underset{\text{Ethane}}{C_2H_6}$$

(iii) In the presence of diffused light or ultraviolet rays, an atom of hydrogen from the hydrocarbon is substituted by an atom of halogen (Cl, Br, I). These are called substitution reactions.

e.g. : When ethane reacts with chlorine, all the hydrogen atoms are replaced by chlorine atom and substitution products are obtained.

$$\textit{e.g.} : \underset{\text{Ethane}}{C_2H_6} \xrightarrow[-HCl]{Cl_2} \underset{\text{Ethylchloride}}{C_2H_5Cl} \xrightarrow[-HCl]{+Cl_2} \underset{\text{Dichloro ethane}}{C_2H_4Cl_2} \xrightarrow[-HCl]{+Cl_2} \underset{\text{Trichloro ethane}}{C_2H_3Cl_3} \xrightarrow[-HCl]{+Cl_2} \underset{\text{Tetrachloro ethane}}{C_2H_2Cl_2} \xrightarrow[-HCl]{+Cl_2} \underset{\text{Penta chloroethane}}{C_2HCl_5}$$

$$\xrightarrow[-HCl]{+Cl_2} \underset{\text{Hexachloroethane}}{C_2Cl_6}$$

Q. 14. (i) The alkenes having how many carbon atoms are in liquid state at normal temperature ?

(ii) The alkenes having how many carbon atoms are in solid state at normal temperature ?

Ans. (i) The alkenes having six to seventeen carbon atoms are in liquid state at normal temperature.

(ii) The alkenes having eighteen or more carbon atoms are in solid state at normal temperature.

Q. 15. (i) What is the type of reaction taking place between ethane and chlorine to form monochlorethane ?

(ii) The reaction between ethene and chlorine forms only one product. Name the type of this reaction.

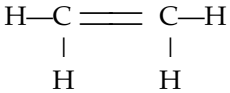
(iii) (1) Draw the structural formula of ethene.

(2) What is the feature of the ethene structure, which allows ethene to react with chlorine in the way it does ?

Ans. (i) Substitution Reaction.

(ii) Addition Reaction.

(iii) (1)



(2) Unsaturated hydrocarbon with double bond.

Q. 16. Compound A is bubbled through bromine dissolved in carbon tetrachloride and the product is $CH_2Br - CH_2Br$.

$$A \xrightarrow{Br_2/CCl_4} CH_2Br{-}CH_2Br$$

(i) Draw the structural formula of A.

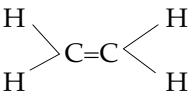
(ii) What type of reaction has A undergone ?

(iii) What is your observation ?

(iv) Name (not formula) the compound formed when steam reacts with A in the presence of phosphoric acid.

(v) What is the procedure for converting the product of (b)(iv) back to A ?

Ans. (i)



(ii) Addition reaction.

(iii) Bromine solution gets decolourised.

(iv) Ethanol

(v) By heating it (ethanol) with concentrated sulphuric acid at 170°C.

Q. 17. (i) Give the names and structural formulae of :

(a) An alkane with a carbon to carbon single bond.

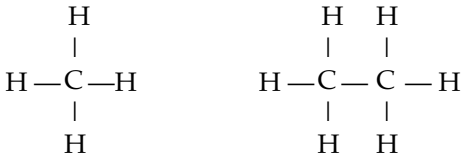
(b) An unsaturated hydrocarbon with a double bond.

(ii) (a) Write the equation, for the laboratory preparation of ethyne (acetylene) from calcium carbide.

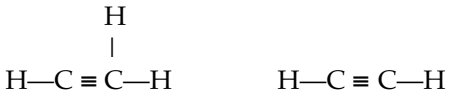
(b) What is the special feature of the structure of ethyne ?

(iiii) Name the addition product formed between ethene and water.

Ans. (i) (a) Saturated hydrocarbon – methane and ethane.



(b) Unsaturated hydrocarbon – ethene, ethyne.



(ii) (a) $CaC_2 + 2H_2O \longrightarrow Ca(OH)_2 + \underset{\text{Acetylene}}{C_2H_2} \uparrow$

(b) Ethyne is highly reactive because of presence of one triple bond between two carbon atoms.

(iii) Ethylene glycol.

Q. 18. (i) A compound 'X' reacts with compound 'Y' in presence of lime to form a 'Z'. It is insoluble in water.

(a) Name the compound X and Y. (b) Name the gas Z.

(c) Write only balanced chemical equation.

(ii) (a) Name the product of the reaction between ethene and chlorine.

(b) Burning acetylene in oxygen, under appropriate conditions, produces a very hot flame. For what purpose, this hot flame is used ?

Ans. (i) (a) X – Sodium ethanoate.

Y – Sodium hydroxide.

(b) Z – Methane (CH_4).

(c) $CH_3\,COONa + NaOH \xrightarrow{CaO} CH_4 + Na_2CO_3$.

(ii) (a) Ethene dichloride.

(b) For welding.

Q. 19. (i) What word is used to describe these three compounds taken together ?

(ii) What is the special feature of the structure of :

(a) C_2H_4 (b) C_2H_2

(iii) What type of reaction is common in both of these compounds ?

(iv) How is acetylene filled in commercial gas cylinders ?

Ans. (i) Organic compounds .

(ii) (a) C_2H_4 contains a double bond between two carbon atoms.

(b) C_2H_2 contains a triple bond between two carbon atoms.

(iii) Addition reaction.

(iv) The commercial gas cylinders of acetylene contain a solution of acetylene in acetone. The cylinder contains a porous material into which the acetone and acetylene are absorbed. The pressure in a freshly filled cylinder of acetylene is about 15 atmosphere.

Q. 20. Acetylene can be converted to benzene by suitable temperature and catalyst.

(i) State the temperature and catalyst.

(ii) What type of reaction has taken place ?

(iii) Write down the equation involved.

Ans. (i) 600° C in presence of copper tube.

(ii) Polymerisation reaction.

(iii) $3C_2H_2 \xrightarrow[Cu]{\text{At } 600°C} C_6H_6$ (Benzene)

Q. 21. (i) (a) A compound has triple bond in its molecule and has only two carbon atoms with two hydrogen atoms. Name the compound.

(b) What is hydrogenation ?

(c) What is halogenation ?

(d) What 'substitution reaction' and 'substitution product'.

(e) What is 'pyrolysis' ? What is the other term signifying the same ?

(ii) State the conditions required for the following reactions to take place :

(a) Catalytic hydrogenation of ethyne.

(b) Preparation of ethyne from ethylene dibromide.

Ans. (i) (a) Acetylene $H - C \equiv C - H$.

(b) Addition of hydrogen to some unsaturated hydrocarbons is called hydrogenation.

(c) Addition of halogens (Cl, Br, I) to some unsaturated hydrocarbons is called halogenation.

(d) A substitution reaction is one in which one atom in a molecule is replaced by another atom (or a group of atoms). The product of a substitution reaction is known as a substitution product.

(e) Decomposition of alkanes by heat is called pyrolysis. Another term signifying the same is cracking.

(ii) (a) In presence of catalyst like finely divided nickel, platinum, heating upto 473 K.

(b) Hot and concentrated alcoholic solution of potassium hydroxide.

Q. 22. A hydrocarbon decolourises $KMnO_4$ solution but does not form any precipitate with ammonical $AgNO_3$. Now answer the following questions :

(i) Is the hydrocarbon saturated or unsaturated ?

(ii) What is the type of bonds between two carbon atoms ?

(iii) Does the hydrocarbon belong to alkane, alkene or alkyne family ?

(iv) What will be the change on adding a few drops of bromine solution in a test tube filled with this hydrocarbon ?

Ans. (i) Unsaturated.

(ii) Double bond between two carbon atoms.

(iii) Alkene family.

(iv) Ethene decolourises the solution of bromine in carbon tetrachloride and dibromo-ethane is formed

$$\underset{\text{Brownish red}}{C_2H_4 + Br_2} \longrightarrow \underset{\substack{\text{Dibromo ethane}\\ \text{(Colourless)}}}{CH_2Br.\,CH_2Br}$$

Q. 23. State two uses of ethane and methane.

Ans. Uses of ethane :

(i) Liquified ethane is used as a fuel in automobiles.

(ii) It is used in the manufacture of organic compounds such as acetic acid, ethyl alcohol etc.

Uses of Methane :

(i) It is used on industrial scale for the preparation of hydrogen by the process of pyrolysis.

(ii) It is used in the manufacture of industrial compounds such as carbon tetrachloride, chloroform, formic acid etc.

Q. 24. State two uses of ethylene and acetylene.

Ans. Uses of ethylene :

(i) It is used in the manufacture of polyethylene which is a valuable plastic.

(ii) It is used in the artificial ripening of fruits.

Uses of acetylene :

(i) It is used in oxyacetylene flame which is used for cutting and welding of metals.

(ii) It is used in the manufacture of acetaldehyde, acetic acid etc.

Chapter 10. Practical Chemistry

Q. 1. Name the three ions which can be identified by $K_4[Fe(CN)_6]$ solution.

Ans. Fe^{3+}, Z^{2+}, Cu^{2+}

Q. 2. State the colour of the following :

(i) Lead monoxide (ii) Hat zinc oxide

(iii) Copper carbonate (iv) Copper nitrate crystals

Ans. (i) Lime yellow (ii) Yellow

(iii) Emerald green (iv) Deep blue

Q. 3. Mention the colour changes observed when the following indicators are added to acids :

(i) Alkaline phenolphthalein solution (ii) Methyl orange solution

(iii) Neutral litmus solution

Ans. (i) From pink to colourless (ii) From orange to pink (red)

(iii) From colourless to red

Q. 4. Identify the anion present in the following compounds :

(i) Compound X on heating with copper turnings and concentrated sulphuric acid liberates a reddish brown gas.

(ii) When a solution of compound Y is treated with silver nitrate solution a white precipitate is obtained which is soluble in excess of ammonium hydroxide solution.

(iii) Compound Z which on reacting with dilute sulphuric acid liberates a gas which turns lime water milky, but the gas has no effect on acidified potassium dichromate solution.

(iv) Compound L on reacting with barium chloride solution gives a white precipitate insoluble in dilute hydrochloric acid or dilute nitric acid.

Ans. (i) Nitrate ion, NO_3^- (ii) Chloride ion, Cl^-

(iii) Carbonate ion, CO_3^{2-} (iv) Sulphate ion, SO_4^{2-}

Q. 5. Identify the substances P, Q, R, S and T in each case based on the information given below :

(i) The deliquescent salt P, turns yellow on dissolving in water, and gives a reddish brown precipitate with sodium hydroxide solution.

(ii) The white crystalline solid Q is soluble in water. It liberates a pungent smelling gas when heated with sodium hydroxide solution.

(iii) The pale green solid R turns reddish brown on heating. Its aqueous solution gives a white precipitate with barium chloride solution. The precipitate is insoluble in mineral acids.

(iv) The reddish brown liquid S is dissolved in water. When ethyne gas is passed through it, turns colourless.

Ans. (i) Hydrogen chloride gas (ii) Nitric oxide
(iii) Oxygen (iv) Ammonia

Q. 6. Select from the list given (A to E) one substance in each case which matches the description given in parts (i) to (v). (Note : Each substance is used only once in the answer.)

(A) Nitroso Iron(II) sulphate, (B) Iron(III) chloride, (C) Chromium sulphate, (D) Lead(II) chloride, (E) Sodium chloride.

(i) A compound which is deliquescent.
(ii) A compound which is insoluble in cold water, but soluble in hot water.
(iii) The compound responsible for the brown ring during the brown ring test of nitrate ion.
(iv) A compound whose aqueous solution is neutral in nature.
(v) The compound which is responsible for the green colouration when sulphur dioxide is passed through acidified potassium dichromate solution.

Ans. (i) B, Iron (III) chloride (ii) D, Lead (II) chloride
(iii) A, Nitroso Iron (II) sulphate (iv) E, Sodium chloride
(v) C, Chromium sulphate

Q. 7. The questions (i) to (v) refer to the following salt solutions listed A to F :

(A) Copper nitrate (B) Iron(II) sulphate.
(C) Iron(III) chloride (D) Lead nitrate
(E) Magnesium sulphate (F) Zinc chloride.

(i) Which two solutions will give a white precipitate when treated with dilute hydrochloric acid followed by barium chloride solution ?
(ii) Which two solutions will give a white precipitate when treated with dilute nitric acid followed by silver nitrate solution ?
(iii) Which solution will give a white precipitate when either dilute hydrochloric acid or dilute sulphuric acid is added to it ?
(iv) Which solution becomes a deep or inky blue colour when excess of ammonium hydroxide is added to it ?
(v) Which solution gives a white precipitate with excess ammonium hydroxide solution ?

Ans. (i) B and E (IronII sulphate and magnesium sulphate)
(ii) C and F (IronIII chloride and zinc chloride)
(iii) D (lead nitrate)
(iv) A (copper nitrate)
(v) F (zinc chloride)

Q. 8. A white crystalline solid A on dissolving in water forms a neutral solution. When solid A is heated with calcium hydroxide, it gives off colourless gas B having a sharp biting smell. The gas fumes very strongly in air and turns red litmus blue. The aqueous solution of A on treating with lead acetate solution forms a white precipitate C. The precipitate is insoluble in all acids.

(i) Name the cation present in solid A.
(ii) Name the anion present in solid A.
(iii) Name the solid A and write its chemical formula.
(iv) Name the colourless gas B.
(v) Write one more chemical test for the identification of gas B.
(vi) Name the white precipitate C.
(vii) Write fully balanced chemical equations for :
(a) Solid A and calcium hydroxide.
(b) Solution of solid A and lead acetate solution.

Ans. (i) Cation in A is ammonium $\left(NH_4^+\right)$

(ii) Anion in A is sulphate $\left(SO_4^{2-}\right)$

(iii) Solid A is ammonium sulphate $[(NH_4)_2SO_4]_2$

(iv) The colourless gas B is ammonia gas.

(v) Bring a rod dipped in HCl sol. near the gas. The dense white fumes of ammonium chloride are formed.

(vi) White precipitate C is lead sulphate.

(vii) (a) $(NH_4)_2SO_4 + Ca(OH)_2 \longrightarrow CaSO_4 + 2NH_3 + 2H_2O$

(b) $(NH_4)_2SO_4 + (CH_3COO)_2Pb \longrightarrow PbSO_4 + 2CH_3COONH_4$

Q. 9. Identify the following solids.

(i) A silvery white solid which floats on the surface of water and reacts violently to give tiny bubbles of a colourless gas. The gas burns in air with a pop sound. The chloride of solid gives a non-persistent lilac colour to non-luminous bunsen flame.

(ii) A pale yellow compound gives a persistent golden yellow colour in non-luminous bunsen burner flame. When treated with water, it liberates a colourless gas, which burns with a pop sound.

(iii) A white solid on treating with water gives off a colourless gas which has a sharp biting smell and turns red litmus blue. The white solid formed after the reaction is soluble in conc. sodium hydroxide solution.

Ans. (i) The solid is potassium metal (ii) The solid is sodium hydride

(iii) The solid is aluminium nitride

Q. 10. Identify the cations and anions in each case and write relevant equations wherever necessary.

(i) A white crystalline solid on heating swells and gives off colourless vapours, which condense to form a colourless liquid X. The X turns anhydrous copper sulphate solution blue. The flame test shows the flame as persistent golden yellow. When the solution of solid is treated with HCl, it gives off a colourless gas Y which turns lime water milky.

(ii) A blue solid gives a non-persistent green flame during the flame test. When the solid is heated strongly, it leaves behind a white residue. The residue on treating with few drops of water changes to blue colour.

(iii) A white solid gives a non-persistent brick red flame. On treating with dilute sulphuric acid, it gives off a colourless gas which turns acidified potassium dichromate solution green.

(iv) A white solid gives a non-persistent lilack colour. On treating with dilute sulphuric acid, it gives off a highly offensive smell. The gas turns lead acetate paper black.

Ans. (i) Cation ⇒ Sodium (Na^+);

Anion ⇒ Carbonate $\left(CO_3^{2-}\right)$

X is water of crystallisation.

$Na_2CO_3 \cdot 10H_2O \overset{\text{Heat}}{\rightleftharpoons} Na_2CO_3 + 10H_2O$ (Steam)

Y is carbon dioxide gas.

(ii) Cation ⇒ Copper (Cu^{2+});

Anion ⇒ Sulphate $\left(SO_4^{2-}\right)$ Salt is $CuSO_4 \cdot 5H_2O$

$CuSO_4 \cdot 5H_2O \xrightarrow{\text{Heat}} CuSO_4 \cdot 5H_2O$

$CuSO_4 + 5H_2O \longrightarrow CuSO_4 \cdot 5H_2O$

(iii) Cation ⇒ Calcium (Ca^{2+});

Anion ⇒ Sulphite $\left(SO_3^{2-}\right)$ Salt is $CaSO_3$.

$CaSO_3 + H_2SO_4$ (dil.) $\longrightarrow CaSO_4 + H_2O + SO_2$

(iv) Cation ⇒ Potassium (K^+);

Anion ⇒ Sulphide (S^{2-})

Salt is potassium sulphide.

$K_2S + H_2SO_4$ (dil.) $\longrightarrow K_2SO_4 + H_2S$

❐

Question Set 13

Numericals

Chapter 5. Mole Concept and Stoichiometry

Q. 1. Calculate the volume occupied by 3.4 g of ammonia at S.T.P.

Sol. Gram molecules of NH_3 = $(1 \times 14) + (3 \times 1)$

= $14 + 3 = 17$ g

Mass of one mole of ammonia = 17 g

Molar volume = 22.4 litre

Thus, 17 grams of NH_3 occupied 22.4 litre

$\therefore$ 3.4 gram = $\frac{3.4 \times 22.4}{17} = 4.48$ litre

Volume occupied by 3.4 g of NH_3 at S.T.P. is 4.48 litre.

Q. 2. A cylinder contains 68 g of ammonia gas at S.T.P.

(i) What is the volume occupied by this gas ?

(ii) How many moles of ammonia are present in the cylinder ?

(iii) How many molecules of ammonia are present in the cylinder ?

[N–14, H–1]

Sol. Molecular weight of $NH_3 = (14 + 3 \times 1) = 17$

Number of moles of NH_3 in 68 g $= \frac{\text{Wt.}}{\text{Mol. wt.}} = \frac{68}{17} = 4$ moles

At S.T.P. one mole of NH_3 occupies 22.4 lit.

(i) $\therefore$ Volume occupied by 4 moles of the gas

= 4×22.4 lit. = 89.6 lit. at S.T.P.

(ii) 4 moles of ammonia are present in the cylinder.

(iii) Number of molecules = No. of moles $\times N_A$

= $4 \times 6.023 \times 10^{23}$

= 24.092×10^{23}.

Q. 3. What weight of zinc is needed to produce 100 ml of dry hydrogen at S.T.P. from dilute sulphuric acid solution ?

Sol. The chemical equation representing the reaction is

$$\underset{(65\text{ g})}{Zn} + H_2SO_4 \longrightarrow ZnSO_4 + \underset{(22400\text{ ml})}{H_2}$$

$\because$ 22400 ml of hydrogen is liberated at S.T.P. from 65 g of zinc

$\therefore$ 100 ml of hydrogen is liberated at S.T.P. from

= $\frac{65}{22400} \times 100 = 0.29$ g of zinc.

Q. 4. What weight and volume of oxygen at S.T.P. will be given, when 18 g of water is electrolysed ?

Sol. The decomposition of water can be represented as :

$$\underset{(36\text{ g})}{2H_2O} \longrightarrow \underset{(4\text{ g})}{2H_2} + \underset{(32\text{ g})}{O_2}$$

$\because$ 36 g of water yields = 32 g of oxygen.

$\therefore$ 18 g of water will yield = $\frac{32}{36} \times 18 = 16$ g oxygen.

Again, 32 g oxygen occupies 22.4 litre volume at S.T.P.

$\therefore$ 16 g oxygen will occupy = $\frac{22.4}{32} \times 16 = 11.2$ litre.

Q. 5. Calculate the volume of propane burnt for every 200 cm^3 of oxygen used in the reaction.

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O$$

Sol. From the above reaction it is clear that for every 5 volumes of oxygen, 1 volume of propane is burnt.

Hence, volume of propane burnt for every 200 cm^3 of oxygen $= \frac{1}{5} \times 200$

$= 40\ cm^3$.

Q. 6. Calculate the volume of methane gas that must be burnt completely to produce 100 lit of CO_2 at S.T.P.

Sol. Let x be the volume of methane to be burnt to produce 100 lit CO_2

$$\underset{1\text{ mol}\ 22.4\text{ lit}}{CH_4(g)} + 2\underset{}{O_2(g)} \rightarrow \underset{1\text{ mol}\ 22.4\text{ lit}}{CO_2(g)} + 2H_2O(l)$$

(x lit CH_4 ; 100 lit CO_2)

$$\text{Ratio proportion} = \frac{x\ CH_4}{22.4\text{ lit } CH_4} = \frac{100\text{ lit } CO_2}{22.4\text{ lit } CO_2}$$

$$\therefore \quad x = \frac{100\text{ lit}}{22.4\text{ lit}} \times 22.4\text{ l} = 100\text{ lit}$$

Volume of methane to be burnt is 100 lit.

Q. 7. Calculate the volume of carbon dioxide formed when 8 g of methane gas burns completely as represented by the equation :

$$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(l)$$

Sol. Let x be the volume of CO_2 produced when 8 g CH_4 is burnt.

$$\underset{1\text{ mole}\ 16\text{ g}}{CH_4(g)} + 2O_2(g) \rightarrow \underset{1\text{ mole}\ 44\text{ g} = 22.4\text{ litre.}}{CO_2(g)} + 2H_2O(l)$$

(8 g CH_4 ; x lit CO_2)

$$\text{Ratio proportion} = \frac{8\text{ g } CH_4}{16\text{ g } CH_4} = \frac{x\text{ lit } CO_2}{22.4\text{ lit } CO_2}$$

$$x = \frac{8\text{ g}}{16\text{ g}} \times 22.4\text{ lit} = 11.2\text{ lit is the volume of } CO_2 \text{ produced at S.T.P.}$$

Q. 8. What volume of oxygen would be required for the complete combustion of 100 litre of ethane according to the following equation ?

$$2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$$

Sol.

$$2C_2H_6 + 7O_2 \longrightarrow 4CO_2 + 6H_2O$$

2 volume of ethane = 7 volume of oxygen

2 volume of ethane = 100 litre

$\therefore$ 1 volume of ethane = 50 litre

7 volume of O_2 = 50 × 7 = 350 litre

$\therefore$ 100 litre of ethane require = 350 litre of oxygen.

Q. 9. Ammonia may be oxidised to nitrogen monoxide in the presence of a catalyst according to the following equation.

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

If 27 litre of reactants are consumed, what volume of nitrogen monoxide is produced at the same temperature and pressure ?

Sol. According to equation,

$$\underset{5\text{ vol.}}{4NH_3 + 5O_2} \longrightarrow \underset{4\text{ vol.}}{4NO + 6H_2O}$$

$\because$ 5 volumes of reactants are consumed to give 4 volumes of nitrogen monoxide.

$\therefore$ 27 litre of reactants are consumed to give

$$= \frac{27 \times 4}{5} = \frac{108}{5}$$

$$= 21.6\text{ litre.}$$

Q. 10. Hydrogen sulphide gas burns in oxygen to yield 12.8 g of sulphur dioxide according to the equation :

$$2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2$$

Calculate the volume of hydrogen sulphide at S.T.P. Also calculate the volume of oxygen required at S.T.P., which will complete the combustion of hydrogen sulphide.

[S = 32; O = 16; H = 1]

Sol. According to equation,

$$\underset{\substack{2 \times 22.4 \\ = 44.8\ cm^3 \text{ at S.T.P.}}}{2H_2S} + \underset{\substack{3 \times 22.4 \\ = 67.2\ dm^3 \text{ at S.T.P.}}}{3O_2} \longrightarrow 2H_2O + \underset{\substack{2\,[32+32] \\ = 128\ g}}{2SO_2}$$

$$128 \text{ g of } SO_2 \text{ is produced from } H_2S = 44.8 \text{ dm}^3$$

$$\therefore \quad 12.8 \text{ g of } SO_2 \text{ is produced from } H_2S = \frac{44.8 \times 12.8}{128}$$

$$= 4.48 \text{ dm}^3$$

$$128 \text{ g of } SO_2 \text{ is produced from } O_2 = 67.2 \text{ dm}^3$$

$$\therefore \quad 12.8 \text{ g of } SO_2 \text{ is produced from } O_2 = \frac{67.2 \times 12.8}{128}$$

$$= 6.72 \text{ dm}^3$$

Q. 11. Ammonia burns in oxygen and the combustion, in the presence of a catalyst; may be represented as :

$$2NH_3 + 2\frac{1}{2}O_2 \longrightarrow 2NO + 3H_2O$$

(i) What mass of steam is produced when 1.5 g of nitrogen monoxide is formed ?

(ii) What volume of oxygen at S.T.P. is required to form 10 moles of products ?

Sol. (i) $2NH_3 + 2\frac{1}{2}O_2 \longrightarrow 2NO + 3H_2O$

$$\text{Wt. of } 2NO = 2[14 + 16]$$

$$= 60 \text{ g}$$

and $$\text{Wt. of } 3H_2O = 3[2\,(1) + 16]$$

$$= 54 \text{ g}$$

When 60 g of NO is formed, mass of steam produced = 54 g

$$\therefore \quad \text{For 1.5 g of NO mass of steam produced} = \frac{54 \times 1.5}{60} = 1.35 \text{ g}$$

(ii) For 5 moles of products, oxygen required = 2.5 × 22.4 litre

$$\therefore \quad \text{For 10 moles of products, oxygen required} = \frac{2.5 \times 22.4 \times 10}{5}$$

$$= 112 \text{ litre.}$$

Q. 12. $3Cu + 8HNO_3 \rightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$

(H = 1, N = 14, O = 16, Cu = 64)

Calculate from the equation :

(i) The mass of copper needed to react with 63 g of HNO_3.

(ii) The volume of nitric oxide that can be collected at S.T.P. (the gram molecular volume of a gas at STP = 22.4 litre).

Sol. (i)

$$\underset{\substack{3 \times 64 \\ = 192\ g}}{3Cu} + \underset{\substack{8(1 \times 14 + 48) \\ = 504\ g}}{8HNO_3} \longrightarrow 3Cu(NO_3)_2 + 4H_2O + 2NO$$

$\because$ 504 g of HNO_3 reacts with 192 g of Cu.

$$\therefore \quad 1 \text{ g of } HNO_3 \text{ reacts with} = \frac{192}{504} \text{ g of Cu.}$$

$$63 \text{ g of } HNO_3 \text{ reacts with} = \frac{192}{504} \times 63 = 24 \text{ g copper.}$$

(ii) 192 g of Cu with HNO_3 gives out $= 2 \times 22.4$ litre of NO at S.T.P.

$\therefore$ 24 g of Cu with $HNO_3 = \frac{2 \times 22.4}{192} \times 24$

$= 5.6$ litre of NO.

Q. 13. From the equation :

(i) $(NH_4)_2Cr_2O_7 \rightarrow Cr_2O_3 + 4H_2O + N_2$

Calculate :

(a) The volume of nitrogen at S.T.P. evolved when 63 g of ammonium dichromate is heated.

(b) The mass of chromium(II) oxide (Cr_2O_3) formed at the same time.

(N = 14; H = 1; Cr = 52; O = 16)

(ii) The reaction $4N_2O + CH_4 \rightarrow CO_2 + 2H_2O + 4N_2$ takes place in the gaseous state. If all volumes are measured at the same temperature and pressure, calculate the volume of dinitrogen oxide (N_2O) required to give 150 cm^3 of steam.

(N = 14; O = 16; C = 12; H = 1)

Sol. (i) The reaction is represented as :

$$\underset{252\text{ g}}{(NH_4)_2Cr_2O_7} \longrightarrow Cr_2O_3 + 4H_2O + \underset{22.4\text{ litre at S.T.P.}}{N_2}$$

(a) $\therefore$ 63 g $= \frac{22.4 \times 63}{252}$

$= 5.6$ litre at S.T.P.

(b) 252 g $(NH_4)_2Cr_2O_7$ gives 152 g of Cr_2O_3

$\therefore$ 63 g $(NH_4)_2Cr_2O_7$ gives $= \frac{152 \times 63}{254} = 37.70$ g

(ii) $$\underset{\substack{4\text{ vol.}\\300\text{ cm}^3}}{4N_2O} + CH_4 \longrightarrow CO_2 + \underset{\substack{2\text{ vol.}\\150\text{ cm}^3}}{2H_2O} + 4N_2$$

300 cm^3 of N_2O will be required to yield 150 cm^3 of steam.

Q. 14. (i) Rewrite the following equation in terms of moles of reactants and products :

$$2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3$$

(ii) Use the given equation to calculate the weight of calcium hydroxide needed to decompose 2.14 g NH_4Cl.

(iii) Find out the volume of ammonia at S.T.P. obtained from 4.28 g of NH_4Cl.

Sol. (i) In term of moles, the equation is as follows :

$2NH_4Cl$	+	$Ca(OH)_2$	$\longrightarrow$	$CaCl_2$	+	$2H_2O$	+	$2NH_3$
2 moles		1 moles		1 mole		2 moles		2 moles
2 (14 + 4 + 35.5)		40 + 32 + 2		40 + 71		2 (2 + 16)		2 (14 + 3)
= 107 g		= 74 g		= 111 g		= 36 g		= 34 g

So, 2 moles of ammonium chloride combines with 1 mole of calcium hydroxide to form 1 mole of calcium chloride, 2 moles of water and 2 moles of ammonia gas.

(ii) 107 g of NH_4Cl needed to react with 74 g of $Ca(OH)_2$

$\therefore$ 2.14 g of NH_4Cl needed $= \frac{74 \times 2.14}{107}$ g of $Ca(OH)_2$

$= 1.48$ gm.

(iii) 107 g of NH_4Cl will liberate with slaked lime

$= 2 \times 22.4$ litre of NH_3.

$\therefore$ 4.28 g of NH_4Cl liberates with slaked lime

$= \frac{2 \times 22.4 \times 4.28}{107}$

$= 1.792$ litre.

Q. 15. Solve the following :

(i) What volume of oxygen is required to burn completely 90 dm^3 of butane under similar conditions of temperature and pressure ?

$$2C_4H_{10} + 13O_2 \longrightarrow 8CO_2 + 10H_2O$$

(ii) The vapour density of a gas is 8. What would be the volume occupied by 24.0 g of the gas at STP ?

(iii) A vessel contains X number of molecules of hydrogen gas at a certain temperature and pressure. How many molecules of nitrogen gas would be present in the same vessel under the same conditions of temperature and pressure ?

Sol. (i) $$\underset{2 \text{ vol.}}{2C_4H_{10}} + \underset{13 \text{ vol.}}{13O_2} \longrightarrow 8CO_2 + 10H_2O$$

$\because$ 2 vol. of butane require 13 vol. of oxygen (according to Gay-Lussac's law)

$\therefore$ 90 dm^3 of butane require $= \frac{13 \times 90}{2} = 585 \text{ dm}^3$

Ans. 585 dm^3 of oxygen is required.

(ii) Given : Vapour Density (VD) = 8

$\therefore$ Mol. wt = $2 \times VD = 2 \times 8 = 16$

No. of moles in 24.0 g of gas = $\frac{\text{Wt.}}{\text{mol. wt.}} = \frac{24}{16}$

= 1.5 moles

At S.T.P. 1 mole of a gas occupies 22.4 l.

$\therefore$ 1.5 moles (or 24.0 g) of the gas will occupy $= \frac{22.4 \times 1.5}{1} = 33.6$ l.

(iii) 'X' number of molecules.

Q. 16. O_2 is evolved by heating $KClO_3$ using MnO_2 as a catalyst

$$2KClO_3 \xrightarrow{MnO_2} 2KCl + 3O_2$$

(i) Calculate the mass of $KClO_3$ required to produce 6.72 litre of O_2 at S.T.P. [atomic masses of K = 39, Cl = 35.5, O = 16]

(ii) Calculate the number of moles of oxygen present in the above volume and also the number of molecules.

(iii) Calculate the volume occupied by 0.01 mole of CO_2 at S.T.P.

Sol. (i) Molecular wt. of $KClO_3 = 39 + 35.5 + 16 \times 3$

$= 122.5$

$$\underset{2 \text{ moles}}{2\,KClO_3} \longrightarrow \underset{3 \text{ moles}}{2\,KCl + 3O_2}$$

2×122.5 g. $\quad$ 3×22.4 lit at S.T.P.

$\because$ 3×22.4 lit of oxygen is produced from 2×122.5 g of $KClO_3$

$\therefore$ 6.72 lit of oxygen is produced from $\frac{2 \times 122.5 \times 6.72}{3 \times 22.4} = 24.5$ g

Ans. 24.5 g of $KClO_3$ is required to produce 6.72 lit of O_2 at S.T.P.

(ii) At S.T.P. 22.4 lit of a gas = 1 mole

$\therefore$ 6.72 lit = $\frac{1 \times 6.72}{22.4} = 0.3$ moles

One mole contains = 6×10^{23} molecules

$\therefore$ 0.3 mole contains = $6 \times 10^{23} \times 0.3$

= 1.8×10^{23} molecules.

Ans. 6.72 l of oxygen contains 0.3 moles and hence 1.8×10^{23} molecules.

(iii) At STP one mole of CO_2 occupies 22.4 lit

$\therefore$ 0.01 mole of CO_2 occupies $= 22.4 \times 0.01$

$= 0.224$ lit

Ans. 0.01 mole of CO_2 will occupy 0.224 l at S.T.P.

Q. 17. 4.5 moles of calcium carbonate are reacted with dilute hydrochloric acid.

(i) Write the equation for the reaction.

(ii) What is the mass of 4.5 moles of calcium carbonate ? (Relative molecular mass of calcium carbonate is 100).

(iii) What is the volume of carbon dioxide liberated at S.T.P. ?

(iv) What mass of calcium chloride is formed ? (Relative molecular mass of calcium chloride is 111).

(v) How many moles of HCl are used in this reaction ?

Sol. (i) $CaCO_3 + 2HCl \longrightarrow \underset{\text{calcium chloride}}{CaCl_2} + H_2O + CO_2$

(ii) 4.5 moles of $CaCO_3 = 4.5 \times 100 = 450$ g

(iii) $\because$ 1 mole $CaCO_3$ liberates 1 mole of CO_2

$\therefore$ 4.5 moles of $CaCO_3$ liberates 4.5 moles of CO_2

$\therefore$ Volume of CO_2 liberated at STP $= 22.4 \times 4.5 = 100.8$ lit

(iv) $\because$ 1 mole of $CaCO_3$ gives 1 mole of $CaCl_2$.

$\therefore$ 4.5 moles of $CaCO_3$ gives 4.5 moles of $CaCl_2 = 4.5 \times 111 = 499.5$ g

(v) $\because$ 1 mole of $CaCO_3$ requires 2 moles of HCl

$\therefore$ 4.5 moles of $CaCO_3$ requires $= 2 \times 4.5 = 9$ moles of HCl

Q. 18. (i) Oxygen oxidises ethyne to carbon dioxide and water as shown by the equation :

$$2C_2H_2 + 5O_2 \rightarrow 4CO_2 + 2H_2O$$

What volume of ethyne gas at S.T.P. is required to produce 8.4 dm^3 of carbon dioxide at S.T.P. ?

[H = 1, C = 12, O = 16]

(ii) A compound made up of two element X and Y has an empirical formula X_2Y. If the atomic weight of X is 10 and that of Y is 5 and the compound has a vapour density 25, find its molecular formula.

Sol. (i) Given :

$$\underset{\text{2vol.}}{2C_2H_2} + 5O_2 \longrightarrow \underset{\text{4 vol.}}{4CO_2} + 2H_2O$$

$\therefore$ 1 vol. 2 vol.

According to Gay-Lussac's law :

2 volume of CO_2 is produced from 1 vol. of C_2H_2

$\therefore$ 8.4 dm^3 of CO_2 at S.T.P. produced from

$$= \frac{1 \times 8.4}{2}$$

$= 4.2$ dm^3 of C_2H_2

Ans. At S.T.P. 4.2 dm^3 of ethyne is required.

(ii) Molecular formula $=$ $(\text{Empirical formula})_n$

$$n = \frac{\text{Molecular formula weight}}{\text{Empirical formula weight}}$$

$$= \frac{2 \times \text{V.D.}}{(2 \times 10 + 5)} \quad (\text{V.D. = Vapour Density})$$

$$= \frac{2 \times 25}{25} = 2$$

$\therefore$ Molecular formula $= (X_2Y)_2$

$= X_4Y_2$

Q. 19. (i) Calculate the volume of 320 g of SO_2 at S.T.P. (Atomic mass : S = 32 and O = 16).

(ii) Calculate the volume of oxygen required for the complete combustion of 8.8 g of propane (C_3H_8). (Atomic mass : C = 14, O = 16, H = 1, Molar volume = 22.4 dm^3 at S.T.P.)

Sol. (i) Gram molar mass of SO_2 = $32 + (2 \times 16) = 64$ g.

$\therefore$ No. of moles in 320 g of $SO_2 = \frac{320}{64} = 5$ moles.

At S.T.P. 1 mole of SO_2 occupies 22.4 dm^3.

$\therefore$ 5 moles of SO_2 will occupy $5 \times 22.4 = 112$ dm^3

(ii) Chemical equation for the complete combustion of propane is :

$$\underset{\substack{1 \text{ mole} \\ (12 \times 3) + (1 \times 8) = 44 \text{ g}}}{C_3H_8} + \underset{\substack{5 \text{ mole} \\ 5 \times 22.4 \text{ lit at S.T.P.}}}{5O_2} \rightarrow 3CO_2 + 4H_2O$$

$$44\text{g} \equiv 5 \times 22.4 \text{ lit S.T.P.}$$

$\therefore$ 8.8 g of propane would require $\frac{5 \times 22.4 \times 8.8}{44} = 22.4$ lit of oxygen at S.T.P.

Q. 20. (i) How many grams of sulphuric acid will be required to completely neutralise 16.0 g of caustic soda ?

(ii) What volume of H_2 be evolved at S.T.P. ?

Sol. (i) The complete reaction between H_2SO_4 and NaOH is represented by :

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2$$

$\therefore$ 2 [23 + 16 + 1] g of NaOH react with $[2 \times 1 + 32 + 4 \times 16]$ g of H_2SO_4

or 80 g of NaOH react with 98 g of H_2SO_4

$\therefore$ 16 g of NaOH react with $\frac{98 \times 16}{80} = 19.6$ g of H_2SO_4.

(ii) 80 g of NaOH formed at S.T.P. = 2×22.4 litre of H_2

$\therefore$ 16 g of NaOH formed at S.T.P. = $\frac{2 \times 22.4 \times 16}{80}$

= 8.96 litre of H_2.

Q. 21. (i) How many molecules are present in (the numerical value of Avogadro's number can be used as 6×10^{23}) ?

(a) 2.2 grams of carbon dioxide

(b) 16 grams of sulphur dioxide

(c) 2 grams of oxygen

(d) 58.5 grams of sodium chloride

(C = 12, O = 16, Na = 23, S = 32, Cl = 35.5)

(ii) How many moles are present in ?

(a) 100 g of calcium carbonate, (b) 2.3 g of sodium

(c) 80 g of sodium hydroxide.

Sol. (i) (a) 44 g of CO_2 contain 6×10^{23} molecules at S.T.P.

$\therefore$ 2.2 g of $CO_2 = \frac{6 \times 10^{23}}{44} \times 2.2$

$= 3 \times 10^{23}$ molecules

(b) 64 g of SO_2 contain 6×10^{23} molecules at S.T.P.

$\therefore$ 16 g of S.T.P. $= \frac{6 \times 10^{23}}{64} \times 16$

$= 1.5 \times 10^{23}$ molecules

(c) 32 g of O_2 contain 6×10^{23} molecules at S.T.P.

$\therefore$ 2 g of $O_2 = \frac{6 \times 10^{23}}{32} \times 2$

$= 3.75 \times 10^{23}$ molecules

(d) 58.5 g of NaCl contain 6×10^{23} molecules at S.T.P.

$$\therefore \quad 58.5 \text{ g of NaCl} = \frac{6 \times 10^{23}}{58.5} \times 8.5$$

$$= 0.871 \times 10^{23} \text{ molecules}$$

(ii) (a) $$\text{Number of moles} = \frac{\text{Weight of the substance (W)}}{\text{Molecular weight (M)}}$$

$$\text{Molecular weight of } CaCO_3 = 40 + 12 + 48 = 100$$

$$\text{No. of moles} = \frac{100}{100} = 1 \text{ mole}$$

(b) $$\text{No. of moles of sodium} = \frac{2.3}{23} = \text{molecular wt. of sodium} = 23$$

$$= 0.1 \text{ mole}$$

(c) $$\text{No. of moles of NaOH} = \frac{80}{40} = 2$$

$$\text{Molecular wt. of NaOH} = 23 + 16 + 1 = 40 = 2 \text{ moles}$$

Q. 22. The gases chlorine, nitrogen, ammonia and sulphur dioxide are collected under the same conditions of temperature and pressure. Copy the following table which gives the volumes of gases collected and the number of molecules (X) in 20 litre of nitrogen. You have to complete the table giving the number of molecules in the other gases in terms of X.

Gas	Volume (litres)	Number of Molecules
Chlorine	10	
Nitrogen	20	X
Ammonia	20	
Sulphur dioxide	5	

Sol. In accordance with Avogadro's law which states that, under similar conditions of temperature and pressure, equal volumes of all the gases contain the same number of molecules.

Hence, the table can be represented as :

Gas	Volume (litres)	Number of Molecules
Chlorine	10	$\frac{10}{20}X = X/2$
Nitrogen	20	$\frac{20}{20}X = X$
Ammonia	20	$\frac{20}{20}X = X$
Sulphur dioxide	5	$\frac{5}{20}X = X/4$

Q. 23. A sample of ammonium nitrate when heated yields 8.96 litres of steam (measured at S.T.P.).

$$NH_4NO_3 \longrightarrow N_2O + 2H_2O$$

(i) What volume of dinitrogen oxide is produced at the same time as 8.96 litres of steam ?

(ii) What mass of ammonium nitrate should be heated to produe 8.96 litres of steam ? (Relative molecular mass of ammonium nitreate is 80)

(iii) Determine the precentage of oxygen in ammonium nitrate (O = 16).

Sol. (i) $$44.8 \text{ L of } H_2O \equiv 22.4 \text{ L of } N_2O \text{ at S.T.P.}$$

$$8.96 \text{ L of } H_2O \equiv \frac{22.4 \text{ L} \times 8.96 \text{ L}}{44.8 \text{ L}} \text{ at S.T.P.}$$

$$= 4.48 \text{ L of } N_2O \text{ at S.T.P.}$$

(ii) 44.8 L steam is liberated by 80 g NH_4NO_3

$\therefore$ 8.96 L steam will be liberated by $\frac{80 \times 8.96}{44.8} = 16$ L

(iii) 80 g NH_4NO_3 contains 48 g O_2

Percentage of oxygen $= \frac{48}{80} \times 100 = 60\%$

Q. 24. (i) What volume of hydrogen sulphide at S.T.P. will burn in oxygen to yield 12.8 g of sulphur dioxide according to the equation ?

$$2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2 \quad (H = 1, O = 16, S = 32)$$

(ii) For the volume of hydrogen sulphide determined in (i) above, what volume of oxygen would be required for complete combustion ?

$$\underset{\substack{2 \times 22.4 \\ \text{litres at S.T.P.}}}{2H_2S} + \underset{\substack{3 \times 22.4 \\ \text{litres at S.T.P.}}}{3O_2} \longrightarrow 2H_2O + \underset{\substack{2(32 + 2 \times 16) \\ = 128 \text{ g}}}{2SO_2}$$

Sol. (i) Volume of H_2S at S.T.P. required to form 128 g of $SO_2 = 2 \times 22.4$ litres

$\therefore$ Volume of H_2S at S.T.P. required to form 1.28 g of $SO_2 = \frac{2 \times 22.4}{128} \times 12.8$ litres

$= 44.8$ litres

(ii) Volume of O_2 required for complete combustion of 2×22.4 litres of H_2S

$= 3 \times 22.4$ litres at S.T.P.

$\therefore$ Volume of O_2 required for combustion of 4.48 litres of H_2S

$= \frac{3 \times 22.4}{2 \times 22.4} \times 4.48 = 6.72$ litres

Q. 25. Iron pyrites has formula FeS_2. What mass of sulphur is contained in 30 g iron pyrites. When roasted, iron pyrites gives sulphur dioxide according to the equation ?

$$4FeS_2 + 11O_2 \longrightarrow 2Fe_2O_3 + 8SO_2$$

What volume of SO_2 at S.T.P. would be liberated by roasting 30 g of iron pyrites [S = 32, Fe = 56, Molar volume of gas is 22.4 litre at S.T.P.]

Sol. (i) Mass of sulphur in iron pyrites.

Gram molecular mass of $FeS_2 = 56 + 2 \times 32 = 120$ g

Mass of sulphur $= 2 \times 32 = 64$ g

Sulphur contained in 120 g of $FeS_2 = 64$ g

$\therefore$ Sulphur contained in 30 g of $FeS_2 = \frac{64}{120} \times 30 = 16$ g.

(ii) Volume of SO_2.

$$4FeS_2 + H_2O \longrightarrow 2Fe_2O_3 + 8SO_2$$

Now 4 moles of FeS_2 give 8 moles of SO_2 or 1 mole of FeS_2 gives 2 moles of SO_2.

[Molecular mass of $FeS_2 = 56 + 32 \times 2 = 120$]

Thus, 120 g of FeS_2 gives 2×22.4 litres of SO_2 at S.T.P.

$\therefore$ Volume of SO_2 obtained from 120 g of $FeS_2 = 2 \times 22.4$ litres at S.T.P.

$\therefore$ Volume of SO_2 obtained from 30 g of $FeS_2 = \frac{2 \times 22.4}{120} \times 30 = 11.2$ litres at S.T.P.

Q. 26. 40 g of sulphur is taken in an enclosed vessel containing 22.4 litre of oxygen, and ignited. Calculate the volume of sulphur dioxide formed and the mass of uncombined sulphur.

(1 mol. of S = 32 g; molar volume = 22.4 litre)

Sol.

$$\underset{32 \text{ g}}{S} + \underset{1 \text{ vol.}}{O_2} \longrightarrow \underset{1 \text{ vol.}}{SO_2}$$

Oxygen	:	Sulphur dioxide
1	:	1
22.4	:	x

Volume of SO_2 produced = 22.4 litres (Equal to the volume of O_2)

Sulphur : Oxygen

32 gm : 1 vol.

$\therefore$ x = 22.4 lit

x = 32 g

$\therefore$ Mass of uncombined sulphur = 40 – 32 = 8 g.

Q. 27. Solid ammonium dichromate (Relative molecular mass 252) decomposes according to the following equation :

$$(NH_4)\,Cr_2O_7 \longrightarrow N_2 + Cr_2O_3 + 4H_2O$$

(i) What volume of nitrogen at S.T.P., will be evolved when 63 g of ammonium dichromate is decomposed ? (H = 1, N = 14, O = 16, Cr = 52)

(ii) If 63 g of ammonium dichromate is heated above 1000°C, what will be the loss of mass ?

Sol. (i) 252 g of ammonium dichromate evolves 22.4 litre N_2 at S.T.P.

$\therefore$ 1 g of ammonium dichromate evolves = $\frac{22.4}{252}$ litre N_2

$\therefore$ 63 g of ammonium dichromate evolves = $\frac{22.4 \times 63}{252}$ litre N_2

= 5.6 litre of N_2.

(ii) Loss of mass due to evolution of nitrogen according to the reaction.

$\because$ 252 g of ammonium dichromate loses 28 g of N_2 gas on heating

$\therefore$ 63 g of ammonium dichromate loses = $\frac{28 \times 63}{252}$

= 7 g of N_2 gas

Loss due to water vapours :

$\because$ 252 g of ammonium dichromate loses 72 g of H_2O

$\therefore$ 63 g of ammonium dichromate loses = $\frac{72 \times 63}{252}$

= 18 g of H_2O

$\therefore$ Total loss of mass = Loss of N_2 + Loss of water vapours

= 7 g + 18 g

= 25 g

Q. 28. Solid ammonium dichromate (relative molecular mass = 252) on heating decomposes as follows :

$$(NH_4)_2\,Cr_2O_7 \xrightarrow{\text{Heat}} N_2 + Cr_2O_7 + 4H_2O$$

(i) Calculate the volume of nitrogen at S.T.P., that will be evolved when 31.5 g of ammonium dichromate is heated and

(ii) The mass of chromium(III) oxide formed at the same time

(H = 1; N = 14; O = 16; Cr = 52)

$$\underset{2(14+4)+(52\times2)+7\times16=252\text{ g}}{(NH_4)_2\,Cr_2O_7} \longrightarrow \underset{\substack{22.4\text{ litres}\\ \text{at S.T.P.}}}{N_2} + \underset{\substack{(52\times2)+(7\times16)\\ =216\text{ g}}}{Cr_2O_7} + 4H_2$$

Sol. (i) Volume of N_2 evolved at S.T.P. when 31.5 g of $(NH_4)_2Cr_2O_7$ is decomposed

= $\frac{22.4 \text{ litre}}{252 \text{ g}} \times 31.5$ gm

= 2.80 litre

(ii) Amount of Cr_2O_3 formed = $\frac{216 \text{ g}}{252 \text{ g}} \times 31.5$ g

= 27.0 g

Q. 29. (i) From the balanced chemical equation $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$.
Compute the mass of oxygen gas that will combine with 8 g of methane.
(Relative atomic mass : H = 1; O = 16; C = 12)

(ii) (a) Iron pyrites has the formula FeS_2. What mass of sulphur is contained in 30 g of pyrites ?

(b) When roasted, iron pyrite gives sulphur dioxide according to the following equation :

$$4FeS_2 + 11O_2 \longrightarrow 2Fe_2O_3 + 8SO_2$$

What volume of sulphur dioxide (at S.T.P.) would be liberated by roasting 30 g of pyrites ?
(S = 32; Fe 56; molar volume of a gas is 22.4 litres at S.T.P.)

Sol. (i) Let x be the mass of oxygen that will combine with 8 g of methane.

$$\underset{\substack{1\text{ mol}\\ 1\text{ molar mass}\\ 12+4\times1\\ =16\text{ g}}}{CH_4} + \underset{\substack{2\text{ mol}\\ 2\text{ molar mass}\\ 2\times(2\times16)\\ =64\text{ g}}}{2O_2} \longrightarrow CO_2 + 2H_2O$$

(From atomic masses)
(Mass)

$$\text{Ratio proportion} = \frac{8\text{ g } CH_4}{16\text{ g } CH_4} = \frac{x\text{ g } O_2}{64\text{ g } O_2}$$

$$\therefore \quad x = \frac{8\text{ g}}{16\text{ g}} \times 64\text{ g} = 32\text{ g}$$

Mass of oxygen gas that will combine with 8 g of methane is 32 g.

(ii) (a) $FeS_2 = 2S$

$(56 + 64 = 120) = 64$

120 g pyrites contain = 64 g S

$$30\text{ g pyrites contain} = \frac{64}{120} \times 30 = 16\text{ g}$$

(b) $4FeS_2 + 11O_2 = 2Fe_2O_3 + 8SO_2$

$4 \times 120 = 480\text{ g} = 8 \times 22.4$ litres of SO_2

480 g pyrites liberate = 8×22.4 litres of SO_2

$$30\text{ g pyrites liberate} = \frac{8 \times 22.4}{480} \times 30 = 11.2\text{ litres}$$

Q. 30. Water can be split into hydrogen and oxygen under suitable conditions. The equation representing the change is :

$$2H_2O(l) \longrightarrow 2H_2(g) + O_2(g)$$

(i) In a given experiment if 2500 cm^3 of hydrogen is being produced, what volume of oxygen is liberated at the same time, under the same conditions of temperature and pressure ?

(ii) The 2500 cm^3 of hydrogen is subjected to $2\frac{1}{2}$ times increase in pressure (temperature remaining constant). What volume will the hydrogen now occupy ?

(iii) Taking the volume of hydrogen calculated in (ii), what change must be made in the Kelvin temperature to return the volume to 2500 cm^3 (P remaining constant) ?

Sol. (i) The reaction is represented as :

$$2H_2O(l) \longrightarrow 2H_2(g) + O_2(g)$$

From the above reaction, it is clear that the volume of O_2 evolved is half that of hydrogen.

Hence, $$\text{Volume of } O_2 \text{ evolved} = \frac{2500\text{ cm}^3}{2} = 1250\text{ cm}^3$$

(ii) Let initial pressure of $H_2 = P_i$

Final pressure = 2.5 P

$P_i V_i = P_f V_f$

$P \times 2500 = 2.5\ P \times V_f$

$$V_f = \frac{P \times 2500}{2.5\ P} = 1000\text{ cm}^3.$$

(iii) Let initial temperature $= T_i$

and Final temperature $= T_f$

According to Charles law, $\frac{V_i}{T_i} = \frac{V_f}{T_f}$

or $T_f = \frac{V_f}{V_i} \times T_i$

$\therefore = \frac{2500 \times T_i}{1000} = 2.5\ T_i$

Thus, the Kelvin temperature must increase by 2.5 times.

Q. 31. Ammonia and oxygen combine to produce water vapour and nitric oxide as per chemical equation : $4NH_3(g) + 5O_2(g) \rightarrow 6H_2O + 4NO$.

(i) Write the chemical equation in terms of Gay-Lussac's law of combining volumes and the Avogadro's law.

(ii) How many moles of oxygen are required to burn 85 g of ammonia ?

(iii) How many moles of nitric oxide will be produced in reaction (i) ?

(iv) What is the volume of NH_3 at S.T.P. that will combine with oxygen in reaction (ii) ?

Sol. (i) The chemical equation can be written as below :

$$\underset{\substack{4\text{ volumes}\\4\text{ mol}}}{4NH_3(g)} + \underset{\substack{5\text{ volumes}\\5\text{ mol}}}{5O_2(g)} \rightarrow \underset{\substack{6\text{ volumes}\\6\text{ mol}}}{6H_2O} + \underset{\substack{4\text{ volumes}\\4\text{ mol}}}{4NO(g)}$$

(In terms of Gay-Lussac's law)
(In terms of Avogadro's law)

(ii) Molar mass of ammonia $= \frac{\text{Mol. wt.}}{\text{No. of moles}}$

Moles wt. $= 4\ (14 + 3 \times 1) = 68$ g

No. of moles $= 4$

$\therefore$ Molar mass of ammonia $= \frac{68}{4} = 17$ g/mol.

Moles of ammonia $= \frac{\text{Mass of ammonia}}{\text{Molar mass of ammonia}}$

$= \frac{85\text{ g}}{17\text{ g/mol}} = 5$ mol

Let x be the moles of O_2 required to combine with 5 moles of NH_3

$$\underset{4\text{ mol}}{4NH_3(g)} + \underset{5\text{mol}}{5O_2(g)} \rightarrow 6H_2O + 4NO(g)$$

$$\text{Ratio proportion} = \frac{5\text{ mol } NH_3}{4\text{ mol } NH_3} = \frac{x\text{ mol } O_2}{5\text{ mol } O_2}$$

$$x = \frac{5\text{ mol} \times 5\text{ mol}}{4\text{ mol}} = 6.25\text{ mol } O_2.$$

(iii) Let y be the moles of nitric oxide formed when 5 moles of ammonia are completely burnt in oxygen.

$$\underset{4\text{ mol}}{\overset{5\text{ mol}}{4NH_3(g)}} + 5O_2(g) \rightarrow 6H_2O + \underset{4\text{ mol}}{\overset{y\text{ mol}}{4NO(g)}}$$

$$\text{Ratio proportion} = \frac{5\text{ mole } NH_3}{4\text{ mole } NH_3} = \frac{y\text{ mole NO}}{4\text{ mole NO}}$$

$$y = \frac{5\text{ mole } NH_3}{4\text{ mole } NH_3} \times 4\text{ mole NO}$$

On burning ammonia completely = 5 mole NO will be produced.

(iv) $\because$ 1 mole NH_3 occupies 22.4 litre at S.T.P.

$\therefore$ 5 mole NH_3 will occupy $5 \times 22.4 = 112$ litre.

Volume of ammonia at S.T.P. is 112 litre.

Q. 32. The equations given below relate to the manufacture of sodium carbonate (Molecular weight of $Na_2CO_3 = 106$).

$$NaCl + NH_3 + CO_2 + H_2O \longrightarrow NaHCO_3 + NH_4Cl$$
$$2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$$

Questions (i) and (ii) are based on the production of 21.2 g of sodium carbonate.

(i) What mass of sodium hydrogen carbonate must be heated to give 21.2 g of Sodium carbonate (Molecular weight of $NaHCO_3 = 84$) ?

(ii) To produce the mass of sodium hydrogen carbonate calculated in (a), what volume of carbon dioxide, measured at S. T. P., would be required ?

Sol. (i) $2NaHCO_3 \longrightarrow Na_2CO_3 + H_2O + CO_2$

$2(23 + 1 + 12 + 48) = 2 \times 84 = 168$ g; $(23 \times 2 + 12 + 48) = 106 = 106$ g

$\because$ 106 g of Na_2CO_3 is obtained from 168 g of $NaHCO_3$

$\therefore$ 21.2 g of Na_2CO_3 is obtained from $= \dfrac{168 \times 21.2}{106}$

$= 33.6$ g $NaHCO_3$.

(ii) $NaCl + NH_3 + CO_2 + H_2O \longrightarrow NaHCO_3 + NH_4Cl$

1 mole. 22.4 lit at S.T.P. ; 1 mole 84 g

$\because$ 84 g of $NaHCO_3$ requires 22.4 lit of CO_2

$\therefore$ 33.6 g of $NaHCO_3$ requires $= \dfrac{22.4 \times 33.6}{84}$

$= 8.96$ lit of CO_2.

Q. 33. (i) Concentrated nitric acid oxidizes phosphorus to phosphoric acid according to the following equation :

$$P + 5HNO_3 \longrightarrow H_3PO_4 + H_2O + 5NO_2$$

(a) What mass of phosphoric acid can be prepared from 6.2 g of phosphorus ?

(b) What mass of nitric acid will be consumed at the same time ?

(c) What will be the volume of steam at the same time if measured as 760 mm Hg pressure and 273°C ?

[H = 1; N = 14; O = 16; P = 31]

(ii) Ammonia may be oxidised to nitrogen monoxide in the presence of a catalyst according to the following equation :

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

If 27 litres of reactants are consumed, what volume of nitrogen monoxide is produced at the same temperature and pressure ?

Sol. (i) $\underset{(31\text{ g})}{P} + \underset{(315\text{ g})}{5\,HNO_3} \longrightarrow \underset{(98\text{ g})}{H_3PO_4} + H_2O + \underset{(22.4\text{ lit at S.T.P.})}{5NO_2}$

(a) 31 g of phosphorus produces 98 phosphoric acid

($H_3PO_4 = 3 \times 1 + 31 + 4 \times 16 = 98$ g)

6.2 g phosphorus produces $= \dfrac{98}{31} \times 62 = 196$ g

(b) 31 g of P consumes 5×63 gm of HNO_3

Mass of HNO_3 consumed by 6.2 g of phosphorus $= \dfrac{5 \times 63}{31} \times 6.2 = 63$ g

(c) 31 g of phosphorus at S.T.P. produces = 22.4 litres of steam.

Vol. of steam S.T.P. formed by 6.2 g of phosphorus

$= \dfrac{22.4}{31} \times 6.2$

$= 4.48$ litres

As we know, $\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$

At S.T.P. $P_1 = 760$ mm; $V_1 = 4.48$ lit; $T_1 = 273$ K

$P_2 = 760$ mm; $T_2 = 273°C + 273 = 546$ K; $V_2 = ?$

$$V_2 = \frac{760 \times 4.48 \times 546}{760 \times 273} = 8.96 \text{ litres}$$

(ii) The balanced equation for the oxidation of ammonia is

$$\underset{\text{4 vols.}}{4NH_3(g)} + \underset{\text{5 vols.}}{5O_2(g)} \longrightarrow \underset{\text{4 vols.}}{4NO(g)} + 6H_2O(l)$$

Total volume of reactant consumed = 27 litres

Ratio by volume of $NH_3 : O_2$ is 4 : 5

$\therefore$ Volume of $NH_3 = \frac{27 \times 4}{9} = 12$ litres

Volume of $O_2 = \frac{27 \times 5}{9} = 15$ litres

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

9 litres of reactants give 4 litres of NO

$\therefore$ 27 litres would give $\frac{27 \times 4}{9} = 12$ litres

12 litres, of NH_3 produces 4 litres, of NO

$\therefore$ 12 litres of NH_3 produces of 12 litres, of NO

$\therefore$ Volume of NO produced = 12 litres

Q. 34. What is the mass of Nitrogen in 1000 kg of Urea $[CO(NH_2)_2]$? (Answer correct to the nearest kg) [H = 1; C = 12; N = 14; O = 16]

Sol. Molecular formula of urea is NH_2CONH_2.

Molecular mass of Urea $[CO(NH_2)]_2 = 12 + 16 + 2\,(14 + 1 \times 2)$

$= 28 + 32$

$= 60$ g

60 g of urea contains Nitrogen $= 2 \times 14$

$= 28$ g

$\therefore$ 1000 kg of urea contains Nitrogen $= \frac{28}{60} \times 1000$

$= 467$ kg.

Q. 35. Calculate the atomicity of oxygen molecule from the following information :

Vapour density of oxygen = 16

Relative atomic mass of oxygen = 16

Show all the calculations.

Sol. Vapour density of oxygen = 16

$\therefore$ Molecular weight of oxygen $= 2 \times$ V.D.

$= 2 \times 16 = 32$

Relative atomic mass of oxygen = 16

$\therefore$ No. of atoms in one molecule of oxygen $= \frac{\text{Molecular wt.}}{\text{Atomic wt.}}$

$= \frac{32}{16} = 2$

$\therefore$ Atomicity of Oxygen = 2

Q. 36. (i) 67.2 litres of hydrogen combines with 44.8 litres of nitrogen of form ammonia under specific conditions as :

$$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$$

Calculate the volume of ammonia produced. What is the other substance, if any, that remains in the resultant mixture ?

(ii) The mass of 5.6 dm^3 of a certain gas at S.T.P. is 12.0 g. Calculate the relative molecular mass of the gas.

(iii) Find the total percentage of Magnesium in magnesium nitrate crystals, $Mg(NO_3)_2.6H_2O$.
[Mg = 24, N = 14; O = 16 and H = 1]

Sol. (i)

N_2	+	$3H_2$	⟶	$2NH_3$
1 vol.		3 vol.		2 vol.
22.4 lit		67.2 lit		44.8 lit

According to Gay-Lussac's law :

3 volumes of H_2 will give 2 vol. of NH_3.

$\therefore$ 67.2 lit of H_2 will give $= \frac{2 \times 67.2}{3} = 44.8$ lit of NH_3

At the same time

3 vol. of H_2 will react with 1 vol. of N_2

$\therefore$ 67.2 lit of H_2 will react with $= \frac{1}{3} \times 67.2 = 22.4$ lit of N_2

$\therefore$ (44.8 – 22.4) = 22.4 lit of N_2 will be left unreacted in the mixture.

(ii) According to molar volume concept weight of 22.4 lit of a gas at S.T.P. is equal to molecular mass of the gas. Now,

$\because$ 5.6 lit of gas at S.T.P. weighs 12.0 g

$\therefore$ 22.4 lit of gas at S.T.P. weighs $= \frac{12 \times 22.4}{5.6} = 48$ g

Hence, molecular mass of the gas is 48 g.

(iii) Relative molecular mass of $Mg(NO_3)_2.6H_2O$

$= (24) + (14 \times 2) + (16 \times 6) + (12 \times 1) + (6 \times 16)$

$= 24 + 28 + 96 + 12 + 96 = 256$ g

Amount of Mg in 256 g of magnesium nitrate = 24 g

$\therefore$ % of Mg in $Mg(NO_3)_2.6H_2O = \frac{24}{256} \times 100 = 9.37\%$

Q. 37. (i) What is the volume (measured in dm^3 or litres) occupied by one mole of a gas at S.T.P. ?

(ii) 112 cm^3 (at S.T.P.) of a gaseous fluoride of phosphorus has a mass of 0.63 g. Calculate the relative molecular mass of the fluoride. If the molecule of the fluoride contains only one atom of phosphorus, then determine the formula of the phosphorus fluoride. (F = 19; P = 31)

(iii) 2.24 litres of a gas weighs 4.4 g at S.T.P. Calculate the vapour density of the gas.

Sol. (i) The volume occupied by one mole of a gas at S.T.P. is 22.4 litre.

(ii) Mass of 112 cm^3 of phosphorus fluoride = 0.63 g

Mass of 22,400 cm^3 of phosphorus fluoride $= \frac{0.63}{112} \times 22400$

$= 126$ g

Relative molecular mass of fluoride = 126 g

Mass of fluoride in phosphorus fluoride = 126 – 31 = 95 g.

Hence, Number of fluorine in phosphorus fluoride

$= \frac{95}{19} = 5$

Thus, The formula of phosphorus fluoride = PF_5

(iii) ∵ 2.24 litres of gas weighs 4.4 g at S.T.P.

$$\therefore \quad 22.4 \text{ litres of gas weighs} = \frac{4.4 \times 22.4}{2.24} = 44 \text{ g}$$

$$\therefore \quad \text{Vapour density} = \frac{\text{Molecular wt.}}{2} = \frac{44}{2} = 22$$

Q. 38. Vapour density of a gas Z is 23. Calculate : (i) number of moles, (ii) weight in grams and (iii) number of molecules in 6.72 dm^3 of gas at S.T.P.

Sol. Molecular weight of gas Z = 2 × V.D.
= 2 × 23 = 46 a.m.u.

∴ 1 mole of gas = 46 g

(i) 22.4 dm^3 of gas Z at S.T.P. = 1 mole

∴ 6.72 dm^3 of gas Z at S.T.P. $= \frac{6.72}{22.4} = 0.3$ moles.

(ii) 1 mole of gas Z at S.T.P. weighs = 46 g

∴ 0.3 mole of gas Z at S.T.P. weighs = 46 × 0.3 = 13.8 g

(iii) 1 mole of gas Z at S.T.P. contains = 6×10^{23} molecules

∴ 0.3 mole of gas Z at S.T.P. contains = $6 \times 10^{23} \times 0.3$
= 1.8×10^{23} molecules.

Q. 39. The atomic weight of oxygen is 16.0 and the formula of oxygen molecule is O_2. Calculate the weight of :

(i) 1 atom of oxygen, (ii) One molecule of oxygen.

Sol. (i) Molecular weight of oxygen = 16 × 2 = 32 g

∴ 32 g of oxygen = $2 \times 6.023 \times 10^{23}$ atoms of oxygen

or $2 \times 6.023 \times 10^{23}$ atoms weighs = 32 g

$$\therefore \quad \text{Weight of one oxygen atom} = \frac{32}{2 \times 6.023 \times 10^{23}} = 2.656 \times 10^{-23} \text{ g}$$

(ii) Similarly 32 g of oxygen contains = 6.023×10^{23} molecules of oxygen

$$\therefore \quad \text{1 molecule of oxygen will weighs} = \frac{32}{6.023 \times 10^{23}}$$
$$= 5.312 \times 10^{-23} \text{ g}.$$

Q. 40. Calculate the relative molecular masses (or molecular weights) of the following compounds :

(i) Copper sulphate crystals, $CuSO_4.5H_2O$. (ii) Ammonium sulphate, $(NH_4)_2SO_4$.

(iii) Cane sugar, $C_{12}H_{22}O_{11}$.

(Given atomic masses Cu = 63.5, S = 32, O = 16, N = 14, C = 12)

Sol. (i) $CuSO_4.5H_2O = 63.5 + 32 + (16 \times 4) + 5 \times (2 + 16)$
= 159.5 + 90 = 249.5 a.m.u.

(ii) $(NH_4)_2SO_4 = N_2H_8SO_4$
= 14 × 2 + 1 × 8 + 32 + 16 × 4
= 28 + 8 + 32 + 64 = 132 a.m.u.

(iii) $C_{12}H_{22}O_{11} = 12 \times 12 + 22 \times 1 + 11 \times 16$
= 144 + 22 + 176 = 342 a.m.u.

Q. 41. (i) An organic compound with vapour density = 94 contains.
C = 12.67%, H = 2.13%, and Br = 85.11%. Find the molecular formula.
[Atomic mass : C = 12, H = 1, Br = 80]

(ii) Calculate the mass of
(a) 10^{22} atoms of sulphur.
(b) 0.1 mole of carbon dioxide.
[Atomic mass : S = 32, C = 12 and O = 16 and Avogadro's Number = 6×10^{23}]

Sol. (i)

Elements	% Ratio	Atomic mass	Relative no. of atoms	Simplest ratio
C	12.67	12	12.67/12 = 1.055	1.055/1.055 = 1
H	2.13	1	2.13/1 = 2.13	2.13/1.055 = 2
Br	85.11	80	85.11/80 = 1.063	1.063/1.055 = 1

$\therefore$ Empirical formula of the compound is CH_2Br

$$\text{Molecular formula} = (\text{Empirical formula})_n$$

$$n = \frac{\text{M.W.}}{\text{Empirical formula weight}}$$

$$= \frac{2 \times \text{V.D.}}{\text{Empirical formula weight}}$$

$$= \frac{2 \times 94}{(12 + 2 + 80)} = \frac{2 \times 94}{94} = 2$$

$\therefore$ Molecular formula $= (CH_2Br)_2 = C_2H_4Br_2$

(ii) (a) 1 mole of sulphur $= 6 \times 10^{23}$ atoms = 32 g of sulphur

$\therefore$ 10^{22} atoms $= \frac{32 \times 10^{22}}{6 \times 10^{23}} = \frac{32}{60} = 0.533$ g

(b) 1 mole of carbon dioxide (CO_2)

$= 12 + (2 \times 16) = 44$ g

$\therefore$ 0.1 mole of carbondioxide $= 0.1 \times 44 = 4.4$ g

Q. 42. Half-litre of carbon dioxide is passed over red hot carbon. The volume becomes 700 ml. Find the composition of the product, assuming that all the volumes of gases are measured at S.T.P.

Sol. The chemical equation representing the reaction is

$$\underset{\text{1 vol.}}{CO_2} + C \longrightarrow \underset{\text{2 vol.}}{2CO}$$

Let, x ml of CO_2 react with red hot carbon to form $2x$ ml of CO. Initial volume of carbon dioxide = 500 ml.

Final volume of the reaction mixture = 700 ml.

Thus, we have $(500 - x) = (700 - 2x)$

or $2x - x = 700 - 500$

$x = 200$

Volume of carbon monoxide formed $= 2 \times 200 = 400$ ml

Volume of carbon dioxide remains after the reaction

$= (500 - 200) = 300$ ml.

Q. 43. Iron forms three different forms of oxides :

(i) Ferrous oxide [FeO], (ii) Ferric oxide [Fe_2O_3],

(iii) Tri-ferric tetraoxide [Fe_3O_4].

Calculate the percentage of iron in each of the above oxides.

Sol. (i) Molecular formula of ferrous oxide is FeO.

$\because$ Molecular weight of ferrous oxide $= 56 + 16 = 72$ g

$\therefore$ % of Iron in ferrous oxide (FeO) $= \frac{56}{72} \times 100 = \frac{700}{9} = 77.78\%$.

(ii) Molecular formula of ferric oxide is Fe_2O_3.

$\because$ Molecular weight of ferric oxide $= (2 \times 56) + (3 \times 16)$

$= 112 + 48 = 160$ g

$\therefore$ % of Iron in ferric oxide (Fe_2O_3) $= \frac{112}{160} \times 100 = 70\%$.

(iii) Molecular formula of tri-ferric tetraoxide is Fe_3O_4.

Molecular weight of tri-ferric tetraoxide $= (3 \times 56) + (4 \times 16)$

$= 168 + 64 = 232$ g

$\therefore$ % of Iron in tri-ferric tetraoxide (Fe_3O_4) $= \frac{168}{232} \times 100$

$= \frac{2100}{29} = 72.41\%$.

Q. 44. (i) If 16.4 gram of calcium nitrate is heated :

(a) Calculate the volume of nitrogen dioxide obtained at S.T.P.

(b) The weight of calcium oxide obtained.

(ii) Paddy crop removes 20 kg of nitrogen from soil per hectare. Calculate the amount of calcium nitrate [$Ca(NO_3)_2$] which should be added to the soil to provide nitrogen to a farm of 10 hectares ? State your answer in kg (approx.). [Ca = 40, N = 14, O = 16]

Sol. (i) The reaction is :

$$\underset{2[40 + 2\,(14 + 48)] = 328\text{ g}}{2Ca(NO_3)_2} \longrightarrow \underset{112\text{ g}}{2CaO} + \underset{4\text{ moles}}{4NO_2} + O_2$$

(a) 328 g of $Ca(NO_3)_2$ liberate 4×22.4 NO_2

$\therefore$ 16.4 g will liberate $= \frac{4 \times 22.4}{328} \times 16.4$

$= 4.48$ litre NO_2 at S.T.P.

(b) 328 g of $Ca(NO_3)_2$ yields 112 g CaO

$\therefore$ 16.4 g will yields $= \frac{112}{328} \times 16.4 = 5.6$ g CaO

(ii) Total amount of nitrogen required for 10 hectare farm $= 10 \times 20 = 200$ kg

Gram molecular wt. of $Ca(NO_3)_2 = 1(Ca) + 2(N) + 6(O)$

$= 1 \times (40) + 2 \times (14) + 6 \times (16)$

$= 40 + 28 + 96$

$= 164$ kg.

28 kg of nitrogen can be obtained from

$Ca(NO_3)_2 = 164$ kg.

$\therefore$ 200 kg of nitrogen can be obtained from $Ca(NO_3)_2$

$= \frac{164 \times 200}{28}$

$= 1171.42$ kg.

Q. 45. When heated, potassium permanganate decomposes according to the following equation :

$$2KMnO_4 \longrightarrow \underset{\text{Solid residue}}{K_2MnO_4 + MnO_2} + O_2$$

(i) Some potassium permanganate was heated in a test tube. After collecting one litre of oxygen at room temperature, it was found that the test tube had undergone a loss in mass of 1.32 g. If one litre of hydrogen under the same conditions of temperature and pressure has a mass of 0.0825 g, calculate the relative molecular mass of oxygen.

(ii) Given that the molecular mass of potassium permanganate is 158, what volume of oxygen (measured at room temperature) would be obtained by the complete decomposition of 15.8 of potassium permanganate (molar volume at room temperature is 24 litres) ?

Sol. (i) Mass of one litre of oxygen $= 1.32$ g

Mass of one litre of hydrogen under the same condition $= 0.0825$ g

$$\text{V.D. of oxygen} = \frac{\text{Mass of one litre of oxygen}}{\text{Mass of one litre of hydrogen}}$$

$$= \frac{1.32\text{ g}}{0.0825\text{ g}} = 16$$

Relative molecular mass of oxygen = 2 × V.D.

= 2 × 16 = 32

(ii) $\underset{(2 \times 158\ g)}{2KMnO_4} \longrightarrow K_2MnO_4 + MnO_2 + \underset{1\ mol\ (24\ lit)}{O_2}$

(2 × 158) g $KMnO_4$ on heating liberates 24 litre O_2 at room temperature

15.8 g $KMnO_4$ on heating liberates $\frac{24 \text{ litre}}{(2 \times 158)\ g} \times 15.8\ g = 1.2$ litre O_2

Volume of O_2 liberated at room temperature by heating 15.8 g potassium permanganate = 1.2 litres.

Q. 46. (i) The compound A has the following percentage composition by mass.

Carbon = 26.7%, oxygen = 71.1%, hydrogen = 2.2%. Determine the Empirical formula of compound A [work to one decimal place] [H = 1, C = 12, O = 16].

(ii) If the relative molecular mass of A is 90, what is the molecular formula of A ?

(iii) The compound A is weak acid. What is meant by this statement ?

Sol. (i) Relative number of atoms,

$C = \frac{26.7}{12} = 2.2$ $O = \frac{71.1}{16} = 4.4$ $H = \frac{2.2}{1} = 2.2$

Simplest ratio,

$C = \frac{2.2}{2.2} = 1$ $O = \frac{4.4}{2.2} = 2$ $H = \frac{2.2}{2.2} = 1$

Empirical formula of the compound A is CO_2H.

(ii) The empirical formula weight = [12 + 32 + 1] = 45

$n = \frac{\text{Molecular weight}}{\text{Empirical weight}} = \frac{90}{45}$

$n = 2$

∴ Molecular formula of the compound A is $[CO_2H]_2$

$= C_2O_4H_2$

$= \begin{matrix} COOH \\ | \\ COOH \end{matrix}$ (Oxalic acid)

(iii) It does not completely ionise into $C_2O_4^{2-}$ and H^+ ions.

Q. 47. (i) Find the total percentage of oxygen in magnesium nitrate crystals.

$(MgNO_3)_2.6H_2O$ [H = 1, N = 14, O = 16, Mg = 24].

(ii) Calculate the percentage of nitrogen in aluminium nitride.

(Al = 27, N = 14)

(iii) Find out the percentage, by weight of phosphorus present in calcium phosphate.

Sol. (i) $Mg(NO_3)_2.6H_2O$

The molecular mass = 24 + (2 × 62) + 6 × 18

= 24 + 124 + 108 = 256 g

Mass due to oxygen = (2 × 48) + (6 × 16) = 96 + 96 = 192 g

∴ % of oxygen $= \frac{192}{256} \times 100 = 75\%$.

(ii) Molecular weight of AlN = 27 + 14 = 41 g

$\%$ of Nitrogen $= \frac{14 \times 100}{41} = 34.14\%$

(iii) Molecular formula of calcium phosphate is $Ca_3(PO_4)_2$.

Molecular weight of calcium phosphate

= 3 × 40 + 2 × [31 + (4 × 16)]

= 120 + 2 × (31 + 64)

= 310 g

and molecular weight of phosphorus = 62 g

$\therefore$ % of phosphorus in calcium phosphate $= \frac{62}{310} \times 100 = 20\%$.

Q. 48. (i) If 112 cm^3 of hydrogen sulphide is mixed with 120 cm^3 of chlorine at S.T.P., what mass of sulphur is formed ?

$$H_2S + Cl_2 \longrightarrow 2HCl + S$$

(ii) Washing soda has the formula $Na_2CO_3.10H_2O$. What mass of anhydrous sodium carbonate is left when all the water of crystallization is expelled by heating 57.2 g of washing soda ?

(iii) When excess lead nitrate solution was added to a solution of sodium sulphate, 15.15 g of lead sulphate was precipitated. What mass of sodium sulphate was present in the original solution ?

$$Na_2SO_4 + Pb(NO_3)_2 \rightarrow PbSO_4 + 2NaNO_3$$

(H = 1; C = 12; O = 16; Na = 23; S = 32; Pb = 207)

Sol. (i) $\underset{1 \text{ vol.}}{H_2S} + \underset{1 \text{ vol.}}{Cl_2} \longrightarrow 2HCl + S$

From the above equation, it is clear that 1 vol. of H_2S reacts with 1 vol. of Cl_2. Thus, when 112 cm^3 of H_2S is mixed with 120 cm^3 of Cl_2 at S.T.P. only 112 cm^3 of Cl_2 will react.

Amount of gas in 22,400 cm^3 at S.T.P. = 1 mole

Amount of gas in 112 cm^3 at S.T.P. $= \frac{112}{22400}$

$= 0.005$ mole

112 cm^3 of H_2S at S.T.P. = 0.005 mole H_2S

112 cm^3 of Cl_2 at S.T.P. = 0.005 mole Cl_2

$$\underset{0.005}{H_2S} + \underset{0.005}{Cl_2} \longrightarrow 2HCl + \underset{0.005 \text{ mol.}}{S}$$

Amount of sulphur formed $= (0.005 \times 32)$

$= 0.16$ g

(ii) $\underset{286 \text{ g}}{Na_2CO_3.10H_2O} \longrightarrow \underset{106 \text{ g}}{Na_2CO_3} + 10H_2O$

$\because$ 286 g washing soda on heating, produce 106 g anhydrous sodium carbonate.

$\therefore$ 57.2 g washing soda produce $= \frac{57.2 \times 106}{286}$

$= 21.20$ g.

(iii) $\underset{\substack{2 \times 23 + 32 + 16 \times 4 \\ = 142 \text{ g}}}{Na_2SO_4} + Pb(NO_3)_2 \longrightarrow \underset{\substack{207 + 32 + 64 \\ = 303 \text{ g}}}{PbSO_4} + 2NaNO_3$

$\therefore$ 303 g $PbSO_4$ is precipitated by 142 g Na_2SO_4

$\therefore$ 15.15 g $PbSO_4$ will be precipitated by $= \frac{15.15 \times 142}{303}$

$= 7.1$ g Na_2SO_4

Q. 49. Concentrated nitric acid oxidizes phosphorus to phosphoric acid according to the following equation :

$$P + 5HNO_3 \longrightarrow H_3PO_4 + H_2O + 5NO_2$$

(i) What mass of phosphoric acid can be prepared from 6.2 g of phosphorus ?

(ii) What mass of nitric acid will be consumed at the same time ?

[H = 1; N = 14; O = 16; P = 31]

Sol. $\underset{31 \text{ g}}{P} + \underset{\substack{5[1 + 14 + 48] \\ 5 \times 63 = 315 \text{ g}}}{5\,HNO_3} \longrightarrow \underset{\substack{(3) + (31) + (64) \\ = 98 \text{ g}}}{H_3PO_4} + 5NO_2 + \underset{\substack{22.4 \text{ dm}^3 \\ \text{at S.T.P.}}}{H_2O}$

(i) $\because$ 31 g of phosphorus can produce phosphoric acid = 98 g

$\therefore$ 6.2 g of phosphorus can produce phosphoric acid $= \frac{98 \times 6.2}{31} = 19.6$ g

(ii) ∵ 31 g of phosphorus requires nitric acid = 315 g

∴ 6.2 g of phosphorus requires nitric acid $= \frac{6.2 \times 315}{31}$

$= 63.0$ g.

Q. 50. Following chemical equation is given :

$$2NH_4Cl + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + 2NH_3 .$$

(i) Calculate the mass of ammonia obtained from 321 g of ammonium chloride.

(ii) Find the mass of ammonium chloride required to obtain 6 moles of H_2O.

(iii) Find the mass of ammonium chloride required to obtain 4 moles of NH_3.

Sol. The chemical equation is :

$$\underset{\substack{2\,(14+4\,(1)+35.5)\\=107\text{ g}}}{2NH_4Cl} + Ca(OH)_2 \longrightarrow CaCl_2 + 2H_2O + \underset{\substack{2\text{ moles or }2\,[14+(1\times 3)]\\=2\,(17)=34\text{ g}}}{2NH_3}$$

(i) ∵ 107 g of NH_4Cl gives 34 g of ammonia

∴ 1 g of NH_4Cl gives $= \frac{34}{107}$ g of ammonia

∴ 321 g of NH_4Cl gives $= \frac{34 \times 321}{107}$ g = 102 g of ammonia.

(ii) ∵ 2 moles of H_2O is obtained from 107 g NH_4Cl

∴ 6 moles of H_2O will be obtained from

$$= \frac{107 \times 6}{2} = 321 \text{ g } NH_4Cl.$$

(iii) ∵ 2 moles of NH_3 is obtained from 107 g of NH_4Cl

∴ 1 mole of NH_3 is obtained from $= \frac{107}{2}$ g of NH_4Cl

∴ 4 moles of NH_3 is obtained from $= \frac{107 \times 4}{2}$ g = 214 g of NH_4Cl.

Q. 51. 10 g of a mixture of sodium chloride and anhydrous sodium sulphate is dissolved in water. An excess of barium chloride solution is added and 6.99 g of barium sulphate is precipitated according to the equation given below :

$$Na_2SO_4 + BaCl_2 \longrightarrow BaSO_4 + 2NaCl$$

Calculate the percentage of sodium sulphate in the original mixture.

(O = 16, Na = 23, S = 32, Ba = 137)

Sol.

$$\underset{\substack{2\times 23+32+4\times 16\\=142\text{ g}}}{Na_2SO_4} + BaCl_2 \longrightarrow \underset{\substack{137+32+4\times 16\\=233\text{ g}}}{BaSO_4} + 2NaCl$$

From the above equation, it is clear that 233 g barium sulphate is precipitated from 142 g sodium sulphate.

∴ 6.99 g barium sulphate is precipitated from $= \frac{142 \text{ g}}{233 \text{ g}} \times 6.99 = 4.26$ g sodium sulphate

Amount of sodium sulphate in 10 g mixture = 4.26 g

Percentage of sodium sulphate in original mixture

$$= \frac{4.26 \text{ g}}{10 \text{ g}} \times 100 = 42.6\%$$

Q. 52. (i) The reaction of potassium permanganate(VII) with acidified iron(II) sulphate is given below :

$$2KMnO_4 + 10FeSO_4 + 8H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$$

If 15.8 g of potassium permanganate was used in the reaction, calculate the mass of iron(II) sulphate used in the above reaction.

(K = 39, Mn = 55, Fe = 56, S = 32, O = 16)

(ii) 20% nitric acid reacts with 4.11 g of lead carbonate of 65% purity. Calculate the weight of nitric acid to complete the reaction. [Pb = 207; C = 12; O = 16; N = 14]

Sol. (i) $\underset{2 \times 158\ g}{2KMnO_4} + \underset{10 \times 152\ g}{10FeSO_4} + 8H_2SO_4 \longrightarrow K_2SO_4 + 2MnSO_4 + 5Fe_2(SO_4)_3 + 8H_2O$

(2×158) g $KMnO_4$ uses (10×152) g $FeSO_4$

15.8 g $KMnO_4$ uses $\frac{(10 \times 152)\ g}{(2 \times 158)\ g} \times 15.8\ g = 76\ g\ FeSO_4$

Amount of $FeSO_4$ used by 15.8 g $KMnO_4$ = 76 g

(ii) Weight of impure lead carbonate = 4.11 g

$\therefore$ Weight of pure lead carbonate $= \frac{4.11 \times 65}{100} = 2.6715$ g

Writing gram-molecular weights

$$\underset{[207 + 12 + 3\ (16)] = 267\ g}{PbCO_3} + \underset{2\ [1 + 14 + 3\ (16)] = 126\ g}{2HNO_3} \longrightarrow Pb(NO_3)_2 + H_2O + CO_2$$

When pure $PbCO_3$ is 267 g pure nitric acid required

$= 126$ g

When pure $PbCO_3$ is 2.6715 g pure nitric acid required

$= \frac{126 \times 2.6715}{267}$ g

$= 1.260$ g.

$\therefore$ Wt. of pure nitric acid required = 1.260 g

$\therefore$ Wt. of 20% nitric acid required $= \frac{1.26 \times 100}{20} = 6.30$ g.

Q. 53. (i) Determine the empirical formula of the compound whose composition by mass is : 42% nitrogen, 48% oxygen and 9% hydrogen. [H = 1; N = 14; O = 16]

(ii) Determine the empirical formula of a compound containing 47.9% potassium, 5.5% beryllium and 46.6% fluorine by mass.

(Atomic weight of Be = 9; F = 19; K = 39) Work to one decimal place.

Sol. (i)

Element	Rel. At. Mass	% age comp.	Relative No. of atoms	Simple Ratio
N	14	42	$\frac{42}{14} = 3$	$\frac{3}{3} = 1$
O	16	48	$\frac{48}{16} = 3$	$\frac{3}{3} = 1$
H	1	9	$\frac{9}{1} = 9$	$\frac{9}{3} = 3$

Empirical formula = NOH_3

(ii)

	%	Atomic mass	Relative no. of atoms	Simplest Ratio
K	47.9	39	$\frac{47.9}{39} = 1.2$	$\frac{1.2}{0.6} = 2$
Be	5.5	9	$\frac{5.5}{9} = 0.6$	$\frac{0.6}{0.6} = 1$
F	46.6	19	$\frac{46.6}{19} = 2.4$	$\frac{2.4}{0.6} = 4$

Empirical formula = K_2BeF_4.

Q. 54. (i) Calculate the Empirical formula of the compound having 37.6% of sodium, 23.1% of silicon and 39.3% of oxygen. [O = 16, N = 23, Si = 28]

(ii) The Empirical formula of a compound is C_2H_5. It has a vapour density of 29. Determine the relative molecular formula mass of the compound and hence its molecular formula.

Sol. (i)

Element	Atomic Mass	% Comp.	Rel. No. of moles	Simple ratio
Na	23	37.6	$\frac{37.6}{23} = 1.63$	$\frac{1.63}{0.82} = 1.98 = 2$
Si	28	23.4	$\frac{23.1}{28} = 0.82$	$\frac{0.82}{0.82} = 1$
O	16	39.3	$\frac{39.3}{16} = 2.45$	$\frac{2.45}{0.82} = 2.98 = 3$

The Empirical formula is Na_2SiO_3.

(ii) $\because$ The Empirical formula $= C_2H_5$

$\therefore$ Empirical formula wt. $= 2\,(C) + 5\,(H)$

$= 2\,(12) + 5\,(1)$

$= 24 + 5 = 29$

The vapour density of C_2H_5 is 29,

$\therefore$ Molecular weight $= 2 \times$ V.D.

$= 2 \times 29$

$= 58$

No. of Molecules $n = \frac{\text{M.F.W.}}{\text{E.F.W.}}$

$n = \frac{58}{29}$

$n = 2$

Molecular formula $= n \times$ [Empirical formula]

$= 2\,[C_2H_5]$

$= C_4H_{10}$

The molecular formula $= C_4H_{10}$

The relative molecular formula mass of $C_4H_{10} = 4\,(C) + 10\,(H)$

$= 4\,(12) + 10\,(1)$

$= 48 + 10$

$= 58$ g

Q. 55. (i) Calculate the percentage of platinum in ammonium chloroplatinate $(NH_4)_2PtCl_6$ (Give your answer correct to the nearest whole number).

(ii) The percentage composition of sodium phosphate as determined by analysis, is 42.1% sodium, 18.9% phosphorus and 39% oxygen. Find the empirical formula of the compound (work to two decimal places).

(H = 1, N = 14, O = 16, Na = 23, P = 31, Cl = 35.5, Pt = 195)

Sol. (i) Mol. wt. of $(NH_4)_2\,PtCl_6 = [14 + 4 \times 1] \times 2 + 195 + 6 \times 35.5$

$= 18 \times 2 + 195 + 213$

$= 444$

% of platinum $= \frac{195}{444} \times 100 = 43.9\%$

(ii)

Element	Percentage	At. wt.	% / At. wt	Simple ratio
Na	42.1%	23	$\frac{42.1}{23} = 1.8$	$\frac{1.8}{0.6} = 3$
P	18.9	31	$\frac{18.9}{31} = 0.6$	$\frac{0.6}{0.6} = 1$
O	39%	16	$\frac{39}{16} = 2.4$	$\frac{2.4}{0.6} = 4$

Empirical formula = Na_3PO_4

Q. 56. A compound contains 87.5% by mass of nitrogen and 12.5% by mass of hydrogen. Determine the empirical formula of this compound.

Sol.

Element	Percentage	Relative No. of Atoms	Simple Ratio
N	87.5	$\frac{87.5}{14} = 6.25$	1
H	12.5	$\frac{12.5}{1} = 12.5$	2

Hence, empirical formula = NH_2.

Q. 57. A compound X consists of 4.8% carbon and 95.2% bromine by mass.

(i) Determine the empirical formula of this compound working correct to one decimal place (C = 12; Br = 80).

(ii) If the vapour density of the compound is 252, what is the molecular formula of the compound ?

(iii) Name the type of chemical reaction by which X can be prepared from ethane.

Sol. (i) Empirical formula :

Elements	% composition	At. mass	Relative number of atoms	Simplest Ratio
Carbon	4.8	12	$\frac{4.8}{12} = 0.4$	$\frac{0.4}{0.4} = 1$
Bromine	95.2	80	$\frac{95.2}{80} = 1.19$	$\frac{1.19}{0.4} = 2.975$

Empirical fromula of substance is CBr_3

$$\text{Empirical mass} = 12 + 80 \times 252$$

$$\text{Molecular mass} = 2 \times \text{V.D} = 2 \times 252 = 504$$

$$\therefore \quad n = \frac{\text{Molecular mass}}{\text{Empirical formula mass}} = \frac{504}{252} = 2$$

or $$\text{Molecular formula} = n \times \text{Empirical formula}$$

$$2 \times CBr_3 = C_2Br_6$$

(iii) This substance can be prepared by substitution method.

Q. 58. A gaseous organic compound contains 3.6 g of carbon and 0.8 g of hydrogen. The vapour density of this compound is 22.

(i) Calculate the Empirical formula.

(ii) Calculate the molecular formula of the compound.

(iii) If 4.4 g of the above compound are completely burnt in oxygen, calculate the volume of carbon dioxide formed at S.T.P. [C = 12; H = 1; O = 16]

Sol. (i)

Element	Wt. of atoms	At. wt	Relative No. of atoms	Simple Ratio
C	3.6	12	$\frac{3.6}{12} = 0.3$	3
H	0.8	1	$\frac{0.8}{1} = 0.8$	8

$$\text{Empirical formula of the compound} = C_3H_8$$

(ii) $$\text{V.D. of the compound} = 22$$

$$\text{Empirical formula wt.} = 36 + 8 = 44$$

$$\text{Molecular wt. of compound} = 2 \times \text{V.D.}$$

$$= 2 \times 22 = 44$$

$$\text{No. of Molecules} = \frac{\text{Molecular wt.}}{\text{Empirical wt.}} = \frac{44}{44} = 1$$

$$\text{Molecular formula} = n \times \text{Empirical formula}$$

$$= 1 \times C_3H_8$$

$$= C_3H_8$$

(iii) $\underset{44\text{ g}}{C_3H_8} + 5O_2 \longrightarrow \underset{\substack{3 \times 22.4\ dm^3 \text{ at S.T.P.} \\ = 67.2\ dm^3 \text{ at S.T.P.}}}{3CO_2} + 4H_2O$

44 g of C_3H_8 yields carbon dioxide at S.T.P.

$= 67.2\ dm^3$

$\therefore$ 4.4 g of C_3H_8 will produce carbon dioxide at S.T.P.

$$= \frac{67.2 \times 4.4}{44} = 6.72\ dm^3 \text{ at S.T.P.}$$

Q. 59. (i) A solid organic compound contained 2.15% of hydrogen, 26.8% of carbon, and the rest of oxygen. Take the molecular weight of the compound as 90. Find the empirical and molecular formula of the compound.

(ii) A metal M forms a volatile chloride containing 65.5% chlorine. If the density of the chloride relative to hydrogen is 162.5, find the molecular formula of the chloride.

(M = 56; Cl = 35.5).

Sol. (i) Percentage of oxygen (by difference) = 100 – (26.8 + 2.15)

= 100 – 28.95 = 71.05%

Relative number of atoms	Simplest ratio
$C = \frac{26.8}{12} = 2.23$	$C = \frac{2.23}{2.15} = 1$
$H = \frac{2.15}{1} = 2.15$	$H = \frac{2.15}{2.15} = 1$
$O = \frac{71.05}{16} = 4.44$	$O = \frac{4.44}{2.15} = 2$

Empirical formula of the compound is CHO_2

Empirical formula weight = 12 + 1 + 2 × 16

= 12 + 1 + 32 = 45

Given, that the molecular weight = 90

$\therefore$ $n = \frac{\text{Relative molecular weight}}{\text{Empirical formula weight}} = \frac{90}{45} = 2$

Molecular formula = $(CHO_2) \times 2$

Therefore, molecular formula of the compound is $C_2H_2O_4$.

(ii) % of Metal = 100 – 65.5 = 34.5

Chlorine % = 65.5

Relative number of atoms	Simplest ratio
$\text{Metal} = \frac{34.5}{56} = 0.616$	$\frac{0.616}{0.616} = 1$
$\text{Chlorine} = \frac{65.5}{35.5} = 1.85$	$\frac{1.85}{0.616} = 3$

$\therefore$ Empirical formula = MCl_3

Molecular mass = 2 × V.D.

= 2 × 162.5 = 325.0

$n = \frac{\text{Molecular mass}}{\text{Empirical formula weight}} = \frac{325}{162.5} = 2$

$\therefore$ Molecular formula = $(\text{Empirical formula})_n$

= $(MCl_3)_2 = M_2Cl_6$

Q. 60. (a) (i) Propane burns in air according to the following equation :

$$C_3H_8 + 5O_2 \longrightarrow 3CO_2 + 4H_2O.$$

What volume of propane is consumed on using 1000 cm^3 of air, considering only 20% of air contains oxygen ?

(ii) The mass of 11.2 litres of a certain gas at S.T.P. is 24 g. Find the gram molecular mass of the gas.

(b) A gas cylinder can hold 1 kg of hydrogen at room temperature and pressure :
(i) Find the number of moles of hydrogen present.
(ii) What weight of CO_2 can the cylinder hold under similar conditions of temperature and pressure ? (H = 1, C = 12, O = 16)
(iii) If the number of molecules of hydrogen in the cylinder is X, calculate the number of CO_2 molecules in the cylinder under the same conditions of temperature and pressure.
(iv) State the law that helped you to arrive at the above result.

Sol. (a) (i) For every 5 moles of O_2, 1 mole of propane is burnt.
20% of 1000 = 20 × 1000/100 = 200 cm^3 of O_2.
Thus, volume of propane = 40 cm^3

(ii) Mass of gas = 24 g
Volume of gas = 11.6 litres
22.4 L of gas at S.T.P. = 1 mole
11.2 L of gas at S.T.P. = 11.2 / 22.4 = 0.5 moles
Mass of 0.5 moles of gas = 24 g
Mass of 1 mole of gas or molar mass = 24/0.5 = 48 g

(b) (i) 1 kg = 1000 grams
2 g of hydrogen molecules = 1 mole
1 g of hydrogen molecules = 1/2 mole
1000 g of hydrogen molecules = 1/2 × 1000 = 500 moles

(ii) Molecular weight of carbon dioxide = 44 g

$$\text{Vapour density} = \frac{44}{2} = 22$$

Now,
$$\text{Vapour density} = \frac{\text{Weight of carbon dioxide at certain temperature}}{\text{Weight of same volume of hydrogen at same temperature and pressure}}$$

22 = Weight of carbon dioxide / 1 kg
Weight of carbon dioxide = 22 kg.

(iii) If the number of molecules of hydrogen is X, then number of molecules of carbon dioxide will also be X.

(iv) This is according to the **Avogadro's law** which states that, "Equal volumes of all gases under similar conditions of temperature and pressure contain equal number of molecules".

Q. 61. (a) A gas cylinder contains 12×10^{24} molecules of oxygen gas.
If Avogadro's number is 6×10^{23}. Calculate :
(i) The mass of oxygen present in the cylinder.
(ii) The volume of oxygen at S.T.P. present in the cylinder. [O = 16]

(b) A gaseous hydrocarbon contains 82.76% of carbon. Given that its vapour density is 29, find its molecular formula. [C = 12, H = 1]

(c) The equation $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$, represents the catalytic oxidation of ammonia. If 100 cm^3 of ammonia is used calculate the volume of oxygen required to oxidise the ammonia completely.

Sol. (a) (i) 12×10^{24} molecules of O_2

$$\text{Number of mole} = \frac{12 \times 10^{24}}{6 \times 10^{23}} = 20 \text{ mole}$$

∵ 1 mole of oxygen has the atomic weight ⟶ 32 g
∴ 20 moles of oxygen have the atomic weight = 32 × 20 = 640 g

(ii) The volume of one mole gas at S.T.P. = 22.4 lit
∴ 20 mole of gas at S.T.P. will have the volume of oxygen
= 20 × 22.4 lit
= 448 lit

(b)

Element	Percentage	Molecules	Simple ratio	Simple whole ratio
C	82.76	$\frac{82.76}{12} = 6.89$	1	2
H	17.24	$\frac{17.24}{1} = 17.24$	2.5	5

$\therefore$ Empirical formula $= C_2H_5$

Empirical formula mass $= (12 \times 2) + (1 \times 5)$

$= 24 + 5 = 29$

Vapour density $= 29$ (Given)

Molecular mass = V.D. $\times 2 = 29 \times 2$

$= 58$ gm

Molecular formula mass $= n \times$ Empirical formula mass

$\Rightarrow \quad n = \frac{\text{Molecular formula mass}}{\text{Empirical formula mass}}$

$= \frac{58}{29} = 2$

Molecular formula $= n \times$ Empirical formula

$= 2 \times C_2H_5$

$= C_4H_{10}$

(c) $4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$

Given : Ammonia used in the reaction = 100 cm^3

From the equation, 4 vol. of NH_3 requires 5 vol. of O_2 for its oxidation.

$\therefore$ 1 vol. will require $= \frac{5}{4}$

Thus 100 cm^3 of ammonia will require $= \frac{5}{4} \times 100$

$= 125$ cm^3 of oxygen

Q. 62. Consider the following reaction and based on the reaction answer the questions that follow :

$$(NH_4)\,Cr_2O_7 \xrightarrow{\text{Heat}} N_2(g) + 4H_2O(g) + Cr_2O_3$$

Calculate :

(i) The quantity in moles of $(NH_4)_2Cr_2O_7$ if 63 g of $(NH_4)_2Cr_2O_7$ is heated.

(ii) The quantity in moles of nitrogen formed.

(iii) The volume in litres or dm^3 of N_2 evolved at S.T.P.

(iv) The mass in grams of Cr_2O_3 formed at the same time.

[Atomic masses : H = 1, Cr = 52, N = 14]

Sol.

$$\underset{\substack{2(14+4)+(52\times2)+(16\times7)\\=36+104+112=252\text{ g}}}{(NH_4)Cr_2O_7} \xrightarrow{\text{heat}} \underset{\substack{(2\times52)+(16\times3)\\=104+48=152}}{N_2(g) + 4H_2O(g) + Cr_2O_3}$$

(i) 252 g $(NH_4)_2Cr_2O_7$ = 1 mole

$\therefore$ 63 g $(NH_4)_2Cr_2O_7 = \frac{63}{252} = 0.25$ mole

Hence, 0.25 mole of $(NH_4)_2Cr_2O_7$ is heated.

(ii) From the chemical equation

1 mole of $(NH_4)_2Cr_2O_7$ liberates 1 mole of N_2

$\therefore$ 0.25 mole of $(NH_4)_2Cr_2O_7$ liberates 0.25 moles of N_2.

(iii) Volume of 1 mole of N_2 at S.T.P. is 22.4 l.

$\therefore$ 0.25 mole of N_2 at S.T.P. has volume = $22.4 \times 0.25 = 5.6$ lit

(iv) 252 g $(NH_4)_2Cr_2O_7$ gives 152 g Cr_2O_3

$\therefore$ 63 g $(NH_4)_2Cr_2O_7$ gives $= \frac{152 \times 63}{252}$ g $Cr_2O_3 = 38$ g Cr_2O_3

Hence, the mass of Cr_2O_3 formed is 38 g.

❐

Question Set 14

Figure/Table Based Questions

Chapter 1. Periodic Properties and Variations of Properties

Q. 1. Consider the section of the periodic table given below :

Group Numbers	I A 1	II A 2	IIIA 13	IV A 14	V A 15	VI A 16	VII A 17	O 18
	Li		D			O	J	Ne
	A	Mg	E	Si		H	K	
	B	C		F	G			L

In this table
B does not represent Boron
C does not represent Carbon
F does not represent Fluorine
H does not represent Hydrogen
K does not represent Potassium

You must see the position of the element in the periodic table. Some elements are given in their own symbol and position in the periodic table. While others are shown with a letter. With reference to the table :

(i) Which is the most electronegative ?

(ii) How many valence electrons are present in G ?

(iii) Write the formula of the compound between B and H.

Ans. (i) J (ii) 5 (iii) B_2H

Q. 2. Given below is the part of Periodic Table :

Li	Be	B	C	N	O	F
Na	Mg	Al	Si	P	S	Cl

(i) How does metallic character of an element change as one moves from
(a) Left to right in period ? (b) Top to bottom in group ?

(ii) How does the valency of elements change with respect to hydrogen as one moves from left to right in period ?

(iii) (a) What is the valency of element silicon ?
(b) Will it form a covalent or electrovalent bond with hydrogen ?

(iv) Which are the most metallic and the most non-metallic elements in above table ?

Ans. (i) (a) As one moves from left to right in period, the metallic character of an element decreases and then it changes to non-metallic character.

(b) As one moves from top to bottom in period, the metallic character of the elements increases.

(ii) The valency of elements with respect to hydrogen is stated as under :

I group +1 II group +2
III group +3 IV group −4
V group −3 VI group −2
VII group −1

(iii) (a) The valency of element silicon is −4.
(b) Silicon will form a covalent compound with hydrogen.

(iv) Sodium is the most metallic and chlorine is most non-metallic element.

Q. 3. The diagram given below is a part of Periodic Table. Study the table and answer the questions given below the table :

1																	2 He
3	4 Be											5	6	7	8	9	10
11	12											13	14 Si	15	16 S	17	18
19	20 Ca	21	22	23	24 Cr	25	26	27	28	29	30	31	32	33	34	35	36 Kr

(i) Name two elements in same group of Periodic Table.

(ii) Name the transition metal.

(iii) Name one elements, whose oxide has a very low melting point.

(iv) Name the element, whose oxide is basic.

(v) Name an element, which reacts vigorously with water.

(vi) Name an element, which form basic oxide.

(vii) Which element shows variable oxidation state ?

(viii) Which element is used in semiconductors ?

(ix) Which elements posses complete valence shell ?

(x) Which element forms very corrosive acid ?

Ans. (i) Oxygen and sulphur (ii) Chromium

(iii) Calcium (iv) Sulphur

(v) Calcium (vi) Calcium

(vii) Chromium (viii) Silicon

(ix) Helium and Krypton (x) Chromic acid produced by chromium

Q. 4. In the portion of the Periodic Table given below, the letters A, B, ... represent the elements in periods 2 and 3 and groups 1, 2, 13, 14, 15, 16, 17 and 18 which are not the usual symbols of the elements.

	1	2	13	14	15	16	17	18
Period 2	A	B	C	D	E	F	G	H
Period 3	I	J	K	L	M	N	O	P
	Q	R	S	T	U			

Study the table and answer the following questions :

(i) Which is the most electropositive element ?

(ii) Which is the most electronegative element ?

(iii) Which elements have properties that are similar to those of the element O ?

(iv) Which elements are the noble gases ?

(v) Which elements have a valency of 4 ?

(vi) Which is more metallic, Q or R ?

(vii) Which is more non-metallic, E or M ?

(viii) What is the collective name for the elements G, O and S ?

(ix) Which elements are represented by the letters I, J, N and O ?

Ans. (i) T, (ii) G, (iii) G and S, (iv) H and P, (v) D and L, (vi) Q, (vii) E, (viii) The halogens, (ix) I : Sodium, J : Magnesium; N : Phosphorus; O : Chlorine.

Q. 5. The electronegativities (according to pauling) of the elements in period 3 of the portion of Periodic Table are as follows when the elements arranged in alphabetical order :

Al	Cl	Mg	Na	P	S	Si
1·5	3·0	1·2	0·9	2·1	2·5	1·8

(i) Arrange the elements in the order in which they occur in the Periodic Table from left to right.

(The group 1 element first, followed by the group 2 element and so on, up to group 7)

(ii) The element below sodium in the same group would be expected to have a ..... (lower/higher) electronegativity than sodium and the element above chlorine would be expected to have a ..... (lower/higher) ionization potential than chlorine.

Ans. (i) Arrangement of elements in the IIIrd group of Periodic Table is given below :

Na, Mg, Al, Si, P, S, Cl.

(ii) Lower, Higher.

Q. 6. The questions refers to the elements of the Periodic Table with atomic numbers from 3 to 18. Some of the elements are shown by letters, but letters are not usual symbols of the elements.

3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P

Which of these :

(i) Is a noble gas ? (ii) Is a halogen ?

(iii) Is an alkali metal ? (iv) Is an element with valency ?

Ans. (i) P is a noble gas with atomic number 18, *i.e.*, 2, 8, 8.

H is a also a noble gas with atomic number 10, *i.e.*, 2, 8.

(ii) G is halogen with atomic number 9, *i.e.*, 2, 7.

O is also a halogen with atomic number 17, *i.e.*, 2, 8, 7.

(iii) A and I are alkali metals.

(iv) D and L are elements with valency 4.

Q. 7.

Group number	IA 1	IIA 2	IIIA 13	IVA 14	VA 15	VIA 16	VIIA 17	0 18
2^{nd} period	Li		D			O	J	Ne
	A	Mg	E	Si		H	M	
	R	T	I		Q	u		y

- In this table H does not represent hydrogen.
- Some elements are given in their own symbol and position in the periodic table.
- While others are shown with a letter.

With reference to the table answer the following questions :

(i) Identify the most electronegative element.

(ii) Identify the most reactive element of group 1.

(iii) Identify the element from period 3 with least atomic size.

(iv) How many valence electrons are present in Q ?

(v) Which element from group 2 would have the least ionization energy ?

(vi) Identify the noble gas of the fourth period.

(vii) In the compound between A and H what type of bond would be formed and give the molecular formula for the same ?

Ans. (i) J (ii) R (iii) M

(iv) 5 (v) T (vi) *y*-Krypton

(vii) Ionic bond. Molecular formula → A_2H

Q. 8.

Elements	A	B	C
Mass number	23	20	35
Number of neutrons	12	10	18

Study the table above and answer the following questions carefully :

(i) Write the atomic number and electronic configuration of elements A, B and C.

(ii) To which groups do A, B and C belong ?

(iii) To which periods do A, B and C belong ?

(iv) Which amongst A, B and C is (i) an alkali metal, (ii) noble gas, (iii) halogen ?

Ans. (i) Atomic number of A = (Mass number – No. of neutrons

$= 23 - 12$

$= 11 \Rightarrow \begin{pmatrix} 2 & 8 & 1 \\ K, & L, & M \end{pmatrix}$

Atomic number of B = (Mass number – No. of neutrons)

$= 20 - 10$

$= 10 \Rightarrow \begin{pmatrix} 2 & 8 \\ K, & L \end{pmatrix}$

Atomic number of C = (Mass number – No. of neutrons)

$= 35 - 18$

$= 17 \Rightarrow \begin{pmatrix} 2 & 8 & 7 \\ K, & L, & M \end{pmatrix}$

(ii) A belong to IA group — B belong to zero group

C belongs to VII A group — **Criterion :** No. of valence electrons

(iii) A belongs to 3rd period — B belongs to 2nd period

C belongs to 3rd period — **Criterion :** No. of shells

(iv) A is an alkali metal — B is a noble gas

C is a halogen

Q. 9. (a) Use the letters only written in the Periodic Table given below to answer the questions that follow :

PERIODS	I	II	GROUPS								III	IV	V	VI	VII	0
1																L
2	Q										E	G	J	Z	M	
3	R															
4	T															
5																

(i) State the number of valence electrons in atom J.

(ii) Which element shown forms ions with a single negative charge ?

(iii) Which metallic element is more reactive than R ?

(iv) Which element has its electrons arranged in four shells ?

(b) The following tables shows the electronic configuration of the elements W, X, Y, Z :

Elements	W	X	Y	Z
Electronic configurations	2, 8, 1	2, 8, 7	2, 5	1

Answer the following questions based on the table above :

(i) What type of bond is formed between :

(1) W and X (2) Y and Z

(ii) What is the formula of the compound formed between :

(1) X and Z (2) W and X

Ans. (a) (i) Five valence electrons (ii) M

(iii) T (iv) T

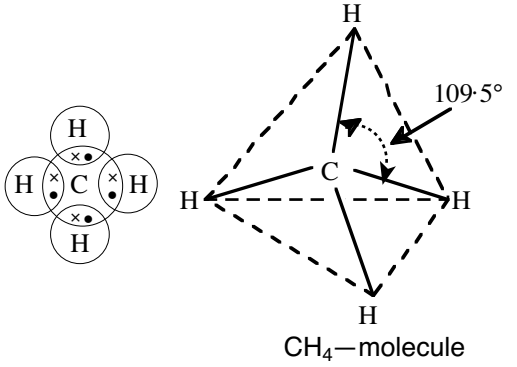
(b) (i) (1) Ionic bond (2) Covalent bond

(ii) (1) ZX (2) WX

Chapter 2. Chemical Bonding

Q. 1. With the help of the figure, explain that methane molecule is a non-polar covalent compound.

Ans. A covalent bond formed between two atoms is non-polar if the electrons involved in bond formation are equally shared between two atoms having similar electronegativities. For example, in case of methane molecule, the four electron pairs shared between one carbon atom and four hydrogen atoms lie exactly in between one carbon atom and four hydrogen atoms and hence forms non-polar bonds. The three-dimensional structure of methane molecule has the carbon atom at the centre of the tetrahedron and four hydrogen atoms are located at the corners of the tetrahedron. In such a configuration, none of the participating atoms is more electrically charged. So, methane is a non-polar covalent compound.

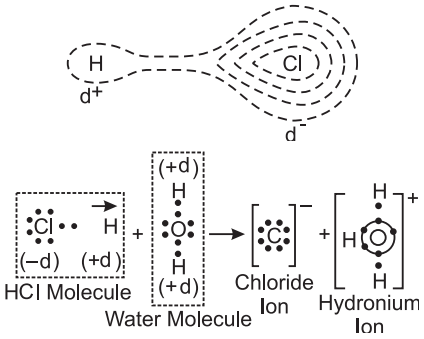


Electronegativity of carbon = 2.5

Electronegativity of hydrogen = 2.1

Q. 2. With the help of the figure show HCl is a polar molecule.

Ans. In HCl molecule the strong nuclear charge of chlorine atom attracts the electron of hydrogen far away from its nucleus, with the result the hydrogen atom develops a slight positive charge (d^+) and chlorine atom develops a slight negative charge (d^-)



Q. 3. Explain how polar covalent compound HCl which is a bad conductor in pure and liquid state, ionises in water.

Ans. A molecule of HCl is a polar covalent, *i.e.*, the electron pair shared between hydrogen and chlorine is far away from hydrogen than chlorine, with the result that hydrogen atom has a slight positive charge on it and the atom of chlorine has slight negative charge on it as :

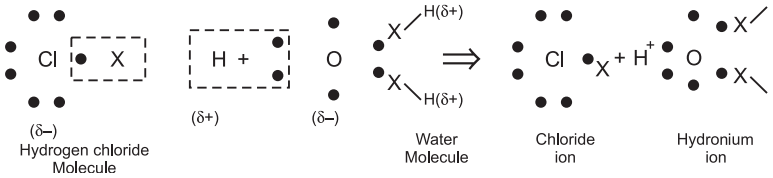
$$:\ddot{\underset{\ddot{}}{Cl}}\cdot \text{ —— } H$$

(δ^-) (δ^+)

Hydrogen chloride molecule

When hydrogen chloride is added to water, then water molecules bombard it from all directions. If the alignment of a water molecule is such that slightly negative oxygen atom faces the slightly positive hydrogen atom of HCl then, the slightly positive hydrogen atom is swallowed by water molecule in the form of single proton to form hydronium ion (H_3O^+). The residual chlorine atom

takes away the electron of hydrogen atom along with it so as to form chloride ion as illustrated below :

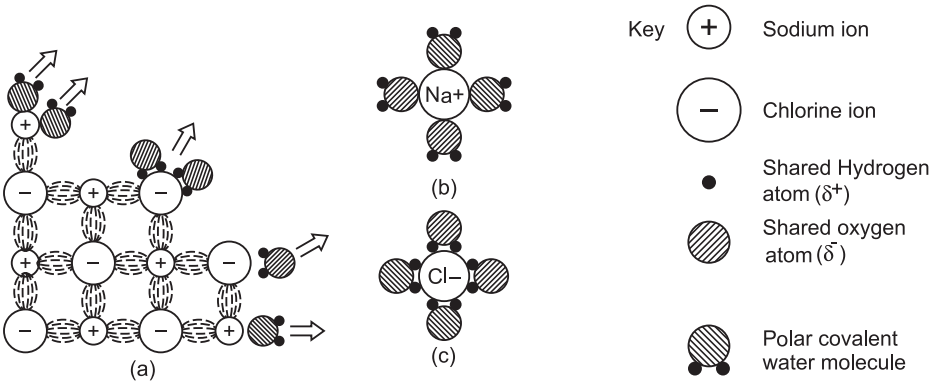


$$HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$$

Q. 4. How does common salt solution ionises in water which is a polar covalent compound ?

Ans. When the sodium chloride crystals come in contact with water, they are bombarded by water molecules from all possible directions.

When the molecules of water bombard the sodium ion, such that the slightly negatively charged oxygen atom face sodium ion, then they exert an electrostatic pull on it. If sufficient number of water molecules strike a particular sodium ion in same fashion, then it can be pulled out of the crystal of sodium chloride to form free sodium ion.



Similarly, if the molecules of water bombards the chloride ion, such that the slightly positively charged hydrogen atoms face chloride ion then they exert an electrostatic pull on it. If sufficient number of water molecules strike a particular chloride ion in same fashion, then it can be pulled out of the crystal of sodium chloride to form free chloride ion.

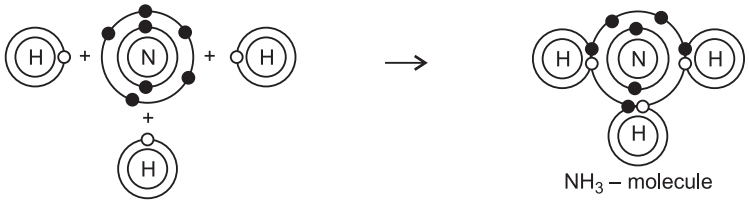
Figures (b) and (c) show a sodium ion and a chloride ion has been pulled out of crystalline structure by water molecules. However, it is not actually known that how many molecules of water are necessary to pull out a particular ion from its crystal.

Q. 5. Draw dot diagrams to illustrate the structure of the molecules of :

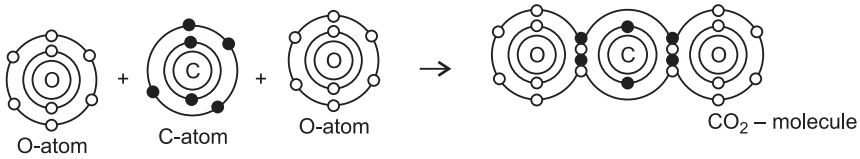
(i) Ammonia (ii) Carbon dioxide

(iii) Methane (iv) Water

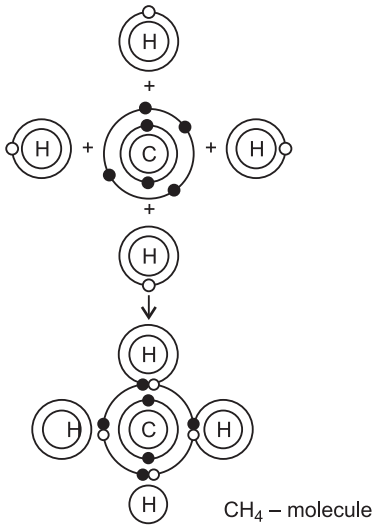
Ans. (i) Ammonia molecule



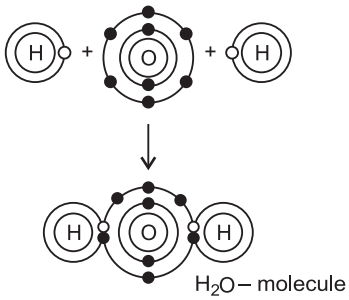
(ii) Carbon dioxide molecule



(iii) Methane molecule



(iv) Water molecule



Q. 6. Give the electron dot structures of :

(i) NaCl (ii) $MgCl_2$
(iii) CaO (iv) Cl_2
(v) H_2O (iv) NH_3

Ans. (i) NaCl

$$Na + \cdot\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}: \longrightarrow Na^+ [:\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:]^- \text{ or } Na^+Cl^-$$

2, 8, 1 2, 8, 7 2, 8 2, 8, 8

(ii) $MgCl_2$

$$Mg: + 2\cdot\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}: \longrightarrow Mg^{2+} 2[:\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}:] \text{ or } MgCl_2$$

(iii) CaO

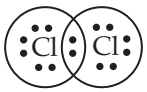
$$Ca: + \underset{\cdot\cdot}{\overset{\cdot\cdot}{O}}: \longrightarrow Ca^{2+} [:\underset{\cdot\cdot}{\overset{\cdot\cdot}{O}}:]^- \text{ or } CaO$$

2, 8, 8, 2 2, 6 2, 8, 8 2, 8

(iv) Cl_2

$$:\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}\cdot + \cdot\underset{\cdot\cdot}{\overset{\cdot\cdot}{Cl}}: \longrightarrow$$

2, 8, 7 2, 8, 7

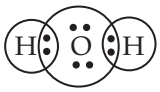


or
Cl – Cl

(v) H_2O

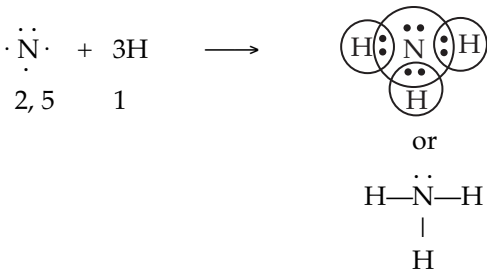
$$H\cdot + :\underset{\cdot\cdot}{\overset{\cdot\cdot}{O}} + \cdot H \longrightarrow$$

1 2, 6 1



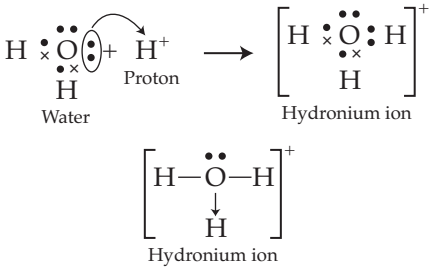
or
H–O–H

(vi) NH_3



Q. 7. Draw an electron dot diagram to show the structure of hydronium ion. State the type of bonding present in it.

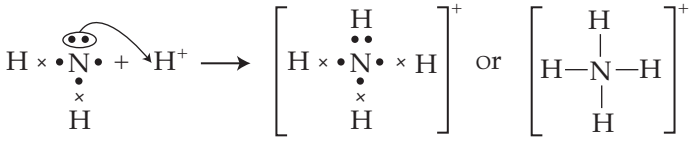
Ans. Formation of hydronium ion :



The type of bonding present in hydronium ion is coordinate bonding.

Q. 8. By drawing an electron dot diagram, show the lone pair effect leading to the formation of ammonium ion from ammonia gas and hydrogen ion.

Ans.



NH_3 has one lone pair of electrons which it donates to hydrogen atom forming a coordinate bond. The arrow represents a coordinate bond. The arrow points from donor to acceptor atom.

Chapter 3. Study of Acids, Bases and Salts

Q. 1. Draw the structure of the stable positive ion formed when an acid dissolves in water.

Ans. $H-\underset{\displaystyle H}{\overset{\displaystyle H}{\underset{\displaystyle \cdot\cdot}{O}}}: \rightarrow H^+$

(H_3O^+) Hydronium ion.

Q. 2. Some methods used for the laboratory preparation of salts are :

A : metal + acid B : carbonate + acid

C : precipitation (double decomposition) D : direct combination

E : titration

Copy and complete the following table :

Salt	Method of Preparation
Ammonium sulphate	
Calcium carbonate	
Iron(III) chloride	
Lead nitrate	
Zinc sulphate	

Ans.

Salt	Method of Preparation
Ammonium sulphate	E : Titration
Calcium carbonate	C : Precipitation
Iron(III) chloride	D : Direct combination
Lead nitrate	B : Carbonate + acid
Zinc sulphate	A : Metal + acid

Chapter 4. Analytical Chemistry

Q. 1. Sodium hydroxide solution is added first in a small quantity, then in excess to the aqueous salt solution of copper(II) sulphate, zinc nitrate, lead nitrate, calcium chloride and iron(III) sulphate. Copy the following table and write the colour of the precipitate in (i) to (v) and the nature of the precipitate (soluble or insoluble) in (vi) to (x).

Aqueous salt solution	Colour of ppt. when NaOH is added in a small quantity	Nature of ppt. (soluble or insoluble) when NaOH is added in excess
Copper(II) sulphate	(i)	(vi)
Zinc nitrate	(ii)	(vii)
Lead nitrate	(iii)	(viii)
Calcium chloride	(iv)	(ix)
Iron(III) sulphate	(v)	(x)

Ans.

Aqueous salt solution	Colour of ppt. when NaOH is added in a small quantity	Nature of ppt. (soluble or insoluble) when NaOH is added in excess
Copper(II) sulphate	Blue	Insoluble
Zinc nitrate	White	Soluble
Lead nitrate	White	Soluble
Calcium chloride	White	Insoluble
Iron(III) sulphate	Reddish Brown	Insoluble

Q. 2. Three test tubes contain calcium nitrate solution, zinc nitrate solution and lead nitrate solution respectively. Each solution is divided into two portions. Describe the effect of :

(i) Adding sodium hydroxide solution to each portion in turn till it is in excess.

(ii) Adding ammonium hydroxide to each portion till it is in excess.

Ans.

Solution	Effect of adding sodium hydroxide solution		Effect of adding ammonium hydroxide solution	
	Small amount	In excess	Small amount	In excess
Calcium nitrate	A white precipitate.	No change.	No precipitate.	No change.
Zinc nitrate	A white ppt.	White ppt. dissolves, gives a colourless solution.	A white ppt.	A white ppt. dissolves to give a colourless solution.
Lead nitrate	A white ppt.	White ppt. dissolves to give a colourless solution.	A white ppt.	No change.

Q. 3. The following table shows the tests a student performed on four aqueous solutions A, B, C and D. Write down on your answer sheet the observations (i) to (iv) that were made.

Test	Observations	Conclusions
(i) To solution A, calcium nitrate solution and sodium hydroxide solution were added.	(i)	A contains Ca^{2+} ions
(ii) To solution B sodium hydroxide solution was added.	(ii)	B contains Fe^{3+} ions
(iii) To solution C ammonium hydroxide was added slowly till in excess.	(iii)	C contains Cu^{2+} ions
(iv) To solution D lead nitrate solution and sodium hydroxide solution were added.	(iv)	D contains Pb^{2+} ions

Ans. Observations :

(i) White ppt. of calcium hydroxide is formed.

(ii) Reddish brown ppt. of $Fe(OH)_3$ is formed.

(iii) Pale blue ppt. is formed which gives deep blue solution with excess of ammonium hydroxide.

(iv) A white ppt. of lead hydroxide AgCl is formed.

Q. 4. Sodium hydroxide solution is added to the solutions containing the ions mentioned in list X. Y gives the details of the precipitate. Match the ions with their coloured precipitates.

List X		List Y	List X	List Y
(i)	Pb^{2+}	A. Reddish brown	(iv) Fe^{3+}	D. White soluble in excess
(ii)	Fe^{2+}	B. White insoluble in excess	(v) Cu^{2+}	E. White soluble in excess
(iii)	Zn^{2+}	C. Dirty green	(iv) Ca^{2+}	F. Blue

Ans. (i) $Pb^{2+} \rightarrow$ White soluble in excess (ii) $Fe^{2+} \rightarrow$ Dirty green

(iii) $Zn^{2+} \rightarrow$ White soluble in excess (iv) $Fe^{3+} \rightarrow$ Reddish brown

(v) $Cu^{2+} \rightarrow$ Blue (vi) $Ca^{2+} \rightarrow$ White insoluble in excess.

Q. 5. Certain blank spaces are left in the following table and these are labelled as A, B, C, D and E. Identify each of them.

	Lab preparation of	Reactants used	Products formed	Drying agent	Method of collection
(i)	HCl gas	$NaCl + H_2SO_4$	A _____	conc. H_2SO_4	B _____
(ii)	NH_3 gas	C _____	$Mg(OH)_2$ NH_3	D _____	E _____

Ans. (i) (A) $NaHSO_4 + HCl$ (B) Upward displacement of air

(ii) (C) $Mg_3N_2 + H_2O$ (D) CaO

(E) Downward displacement of air

Chapter 6. Electrolysis

Q. 1.

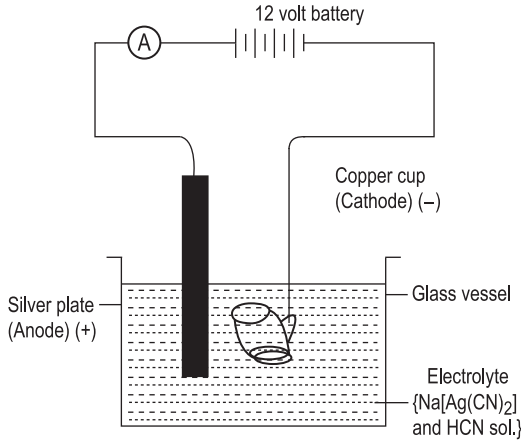


Fig. Silver electroplating

(i) Name the cathode and anode used during electroplating of silver.

(ii) Name the electrolyte used in this processes.

(iii) Give the dissociation reactions taking place.

(iv) Give the reactions occuring at cathode and anode.

(v) The overall strength of silver ions remain constant in the reaction. Why ?

Ans. (i) **Cathode :** Highly cleaned article such as copper cup.

Anode : A plate or rod of silver.

(ii) Sodium argento cyanide ($Na[Ag(CN)_2]$)
and hydrocyanic acid (HCN).

(iii) $$Na[Ag(CN)_2] \rightleftharpoons Na^+ + Ag^+ + 2CN^-$$
$$HCN \rightleftharpoons H^+ + CN^-$$
$$H_2O \rightleftharpoons H^+ + OH^-$$

(iv) **At cathode :**

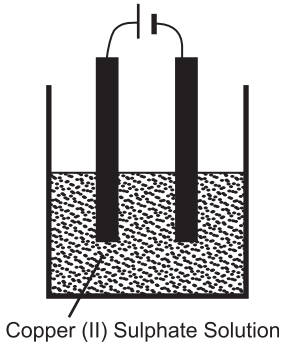
$$Ag^+ + e^- \longrightarrow Ag^-$$

At anode :

$$Ag - e^- \longrightarrow Ag^+$$

(v) Overall strength of silver ions does not change in the electrolyte as the number of Ag^+ ions entering the electrolyte is equal to the number of Ag^+ ions discharged at cathode.

Q. 2. Copper sulphate solution is electrolysed using copper electrodes. Study the diagram given below and answer the question that follows :



(i) Which electrode to your left or right is known as the oxidising electrode and why ?

(ii) Write the equation representing the reaction that occurs.

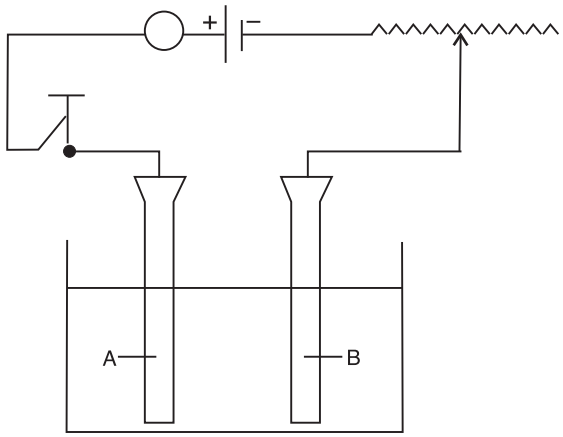
(iii) State two appropriate observations for the above electrolysis reaction.

Ans. (i) Electrode on the left side is the oxidising electrode because copper atoms lose electrons at this electrode.

(ii) $Cu - 2e^- \longrightarrow Cu^{2+}$

(iii) Reddish brown copper metal is deposited at cathode and blue colour of aqueous copper(II) sulphate solution remains unchanged.

Q. 3. (i) Study the diagram given below and answer the questions that follows :



(a) Give the names of the electrodes A and B.

(b) Which electrode is the oxidizing electrode ?

(ii) A strip of copper is placed in four different colourless salt solutions. They are KNO_3, $AgNO_3$, $Zn(NO_3)_2$, $Ca(NO_3)_2$. Which one of the solutions will finally turn blue ?

(iii) Write the equations of the reactions which take place at the cathode and anode when acidified water is electrolysed.

Ans. (i) (a) A—Anode
B—Cathode

(b) A

(ii) $AgNO_3$ solution

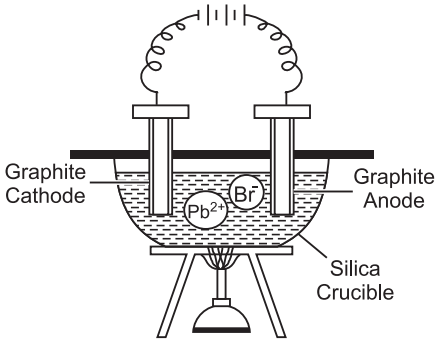
(iii) **Cathode reaction**

$$2H^+ + 2e^- \longrightarrow 2H \longrightarrow H_2$$

Anode reaction

$$2OH^- - 2e^- \longrightarrow 2OH \longrightarrow H_2O + O$$
$$O + O \longrightarrow O_2$$

Q. 4. Study the given figure and answer the question that follow :



(i) Why silica crucible is used in this type of electrolysis ?

(ii) Which anode is preferred and why ?

(iii) Why crucible is heated from outside ?

(iv) Write the equations of the reaction which take place at the cathode and anode.

Ans. (i) Silica is non-reactive. It can withstand at high temperature and is almost a non-conductor of electricity.

(ii) The graphite anode is preferred because it is unaffected by the reactive bromine vapours.

(iii) The crucible is heated from outside to keep lead bromide in the molten state. So that the ions become free.

(iv) At the cathode : $Pb^{2+} + 2e^- \longrightarrow Pb$

At the cathode : $Br^- - e^- \longrightarrow Br$

$Br + Br \longrightarrow Br_2$

Q. 5. An electrolytic cell is set up using two platinum electrodes and an aqueous solution of copper(II) sulphate.

(i) Draw a labelled diagram of the electrolytic cell.

(ii) Name the ions present in the cell.

(iii) Name the ions migrating towards the anode.

(iv) Name the ions migrating towards the cathode.

(v) Name the ions which will not be discharged at electrodes during electrolysis.

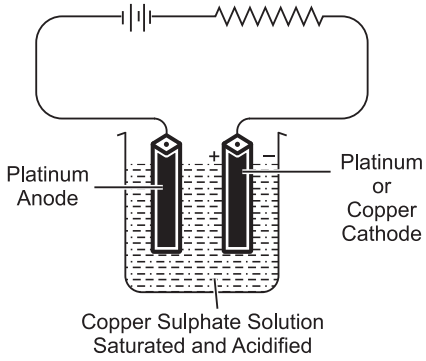
(vi) Write the reaction at the cathode.

(vii) Write the reaction at the anode.

(viii) Name the spectator ions in the solution.

(ix) Why the electrolytic solution acidified.

Ans. (i)



(ii) The ions present in the cell are Cu^{2+}, H^+, SO_4^{2-} and OH^-.

(iii) The ions migrating towards the anode are SO_4^{2-} and OH^-.

(iv) The ions migrating towards the cathode is Cu^{2+}.

(v) The ions that will not be discharged at electrode during electrolysis are H^+ and OH^-.

(vi) Reaction at cathode :

$$Cu^{2+} - 2e^- \longrightarrow Cu$$

(vii) Reaction at anode :

$$4OH^- - 4e^- \longrightarrow 4OH$$

$$2OH + 2OH \longrightarrow 2H_2O + O_2$$

(viii) The spectator ions present in the solution are SO_4^{2-} and OH^-.

(ix) Electrolytic solution is acidified to increase the electrical conductivity of electrolyte.

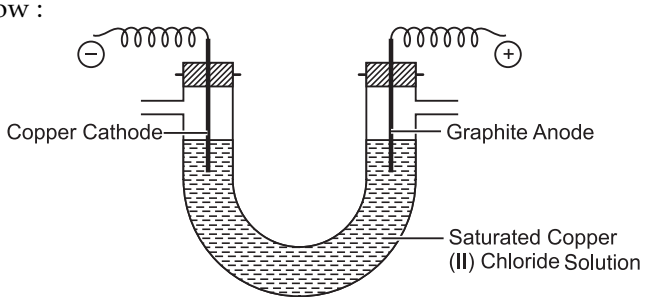
Q. 6. A saturated aqueous copper(II) chloride is electrolysed using graphite anode and copper cathode as illustrated in diagram given below :

(i) Name the ions which will migrate to cathode.

(ii) Name the ions which will migrate to anode.

(iii) Which ion is likely to discharge at cathode and why ?

(iv) Write ionic equation for reaction taking place at cathode.

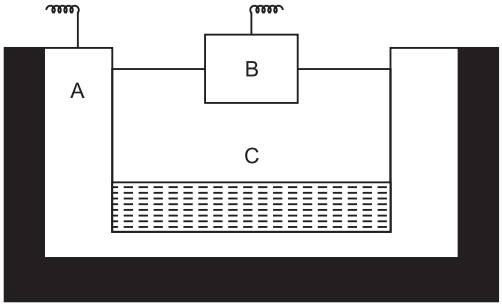


(v) Which ion is likely to discharge at anode and why ?
(vi) Write ionic equation for reaction taking place at anode.
(vii) If electric current is passed for a very long time, state colour change taking place in electrolyte. State one reason for the change.
(viii) Give one reason for using graphite anode, rather than copper anode.
(ix) Name the gas liberated at cathode after the colour changes in electrolyte.

Ans. (i) Copper ions (Cu^{2+}) and hydrogen ions H^+ migrate to cathode.
(ii) Chloride ions (Cl^-) and hydroxyl ions OH^- migrate to anode.
(iii) Copper ions (Cu^{2+}) are likely to discharge at cathode, because their position is lower than hydrogen ions H^+ in electrochemical series.
(iv) $Cu^{2+} + 2e^- \longrightarrow Cu$
(v) Hydroxyl ions (OH^-) are likely to discharge at anode, because their position is lower than chloride ion (Cl^-) in electrochemical series.
(vi) $4OH^- - 4e^- \longrightarrow 2H_2O + O_2(g)$
(vii) The electrolyte gets decolourised. It is because, the blue colour of electrolyte is due to the presence of Cu^{2+} ions. As Cu^{2+} ions discharge at cathode, therefore, their concentration in electrolyte decreases. Thus, gradually blue colour fades away.
(viii) In such a situation the copper atoms on copper anode ionise and enter into electrolyte. Thus, size of copper anode gradually decreases. This is not possible in case of graphite anode.
(ix) Hydrogen gas is liberated at cathode.

Chapter 7. Metallurgy

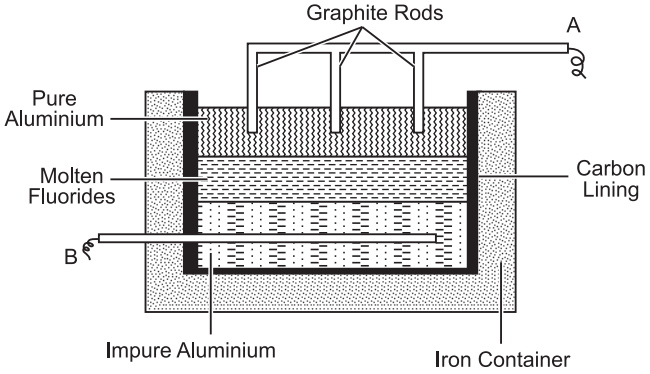
Q. 1. The given sketch of an electrolytic cell used in the extraction of aluminium :



(i) What is the substance of which the electrode A and B are made ?
(ii) At which electrode (A or B) is the aluminium formed ?
(iii) What are the two aluminium compound in the electrolyte C ?
(iv) Why is it necessary for electrode B to be continuously replaced ?

Ans. (i) Carbon (Graphite)
(ii) A
(iii) Aluminium oxide, Alumina or cryolite (sodium aluminium fluoride).
(iv) It is necessary for electrode B to be continuously replaced because it burns away in the presence of oxygen produced or consumed.

Q. 2. The given figure illustrates the refining of aluminium by Hoope's process.



(i) Which of A and B is the cathode and which one is the anode ?

(ii) What is the electrolyte in the tank ?

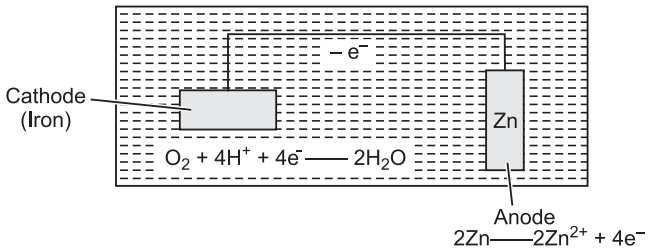
(iii) What material is used for the cathode ?

Ans. (i) A—Cathode, B—Anode.

(ii) Mixture of fluorides.

(iii) Graphite

Q. 3. Study the given figure and answer the following questions :



(i) What are the elements (any two) of which the electrodes are made ?

(ii) Name the process shown.

(iii) Explain the process and write the reactions which takes place at the anode and cathode.

(iv) Where this method is used ?

Ans. (i) A is cathode made up of iron and B is anode made up of zinc or magnesium.

(ii) The process shown is cathode protection.

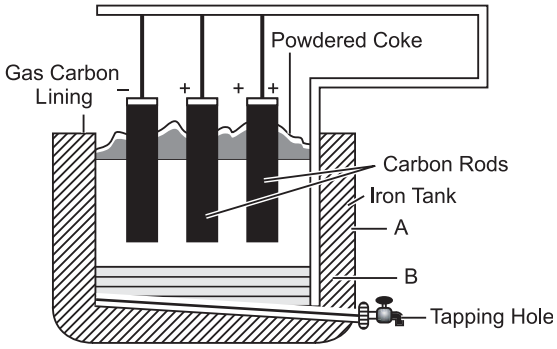
(iii) The iron cathode is to saved by connecting it, to a piece fo more electropositive metal (anode). The electrons from anode get oxidised and move towards the cathode, to cover it.

At anode : $2Zn \longrightarrow 2Zn^{2+} + 4e^-$

At cathode : $O_2 + 4H^+ + 4e^- \longrightarrow 2H_2O$

(iv) This method is used for protecting iron from rusting. *e.g.,* underground sewer pipes and storage tanks.

Q. 4. (i) Name the process and the element extracted by the above process as shown in the figure.



(ii) Give the function of three components of electrolyte.

(iii) Why is electrolyte covered with coke ?

(iv) Write the electrolytic reaction taking place at cathode ?

Ans. (i) Aluminium, Hall and Herault's process.

(ii) (a) Alumina (Al_2O_3) is the main aluminium yielding compound.

(b) Cryolite [Na_3AlF_6] acts as a solvent and lowers the fusion temperature from 2050°C to 950°C.

(c) Fluorspar (CaF_2) acts as a solvent and increases the conductivity of electrolytic mixture.

(iii) A layer of powdered coke is sprinkled over the surface of the electrolyte mixture because it reduces the heat loss by radiation and prevents carbon anode from burning in air.

(iv) At cathode $Al^{3+} + 3e^- \longrightarrow \underset{\text{Aluminium}}{Al}$

Aluminium formed sinks to the bottom of the tank and is periodically tapped off.

Q. 5. List 1 contains the metals or alloys, (i), (ii), (iii), (iv), (v) and list 2 contains their uses A, B, C, D, E.

(i) Aluminium	A. Steel making
(ii) Lead	B. Aeroplane wings
(iii) Brass	C. Galvanizing
(iv) Iron	D. Radiation shield
(v) Zinc	E. Electrical fittings

Copy and complete the following table writing down the letter for the correct use of each metal. An answer may be used only once. The first has been done for you.

Metal	(i)	(ii)	(iii)	(iv)	(v)
Use	B				

Ans.

Metal	(i)	(ii)	(iii)	(iv)	(v)
Use	B	D	E	A	C

Q. 6. The table below compare some properties of metals and non-metals. Write down the missing statements (i) to (iv).

Metal	Non-Metal
(i)	Poor conductor of heat
(ii) Malleable	.....
(iii) Forms positive ions	.....
(iv)	Form acidic oxide.

Ans. (i) Metals are good conductor of heat.

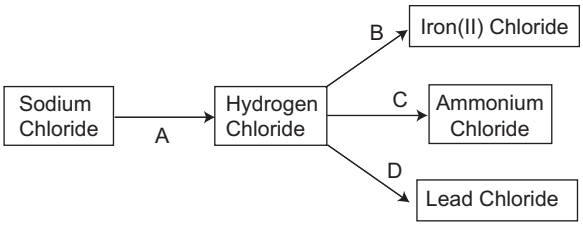
(ii) Non-metals are non-malleable [Brittle].

(iii) Non-metals form negative ions [Anions].

(iv) Metals form basic oxides.

Chapter 8. (a) Study of Compounds : Hydrogen Chloride

Q. 1. Refer to the flow chart diagram below and give balanced equations with conditions, if any, for the following conversions A to D.



Ans.

A. $NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow{\Delta < 200^\circ C} NaHSO_4 + \underset{\text{Hydrogen chloride}}{HCl\uparrow}$

B. $2HCl + Fe \longrightarrow \underset{\text{Iron(II) chloride}}{FeCl_2} + H_2$

C. $HCl_{(g)} + NH_{3(g)} \longrightarrow \underset{\text{Ammonium chloride}}{NH_4Cl}$

D. $\underset{\text{(dil.)}}{2HCl} + Pb(NO_3)_{2(aq)} \longrightarrow \underset{\text{Lead chloride}}{PbCl_2\downarrow} + 2HNO_3$

Q. 2. In the laboratory preparation of hydrochloric acid, HCl gas is dissolved in water.

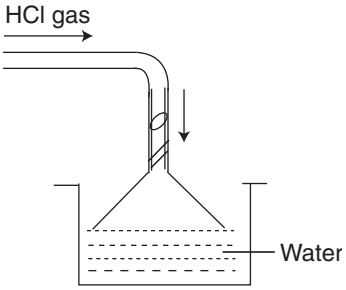
(i) Draw a diagram to show the arrangement used for the absorption of HCl in water.

(ii) Why is such an arrangement necessary ? Give two reasons.

(iii) Write the chemical equations for the laboratory preparation of HCl gas when the reactants are :

(A) below 200°C (B) above 200°C

Ans. (i)



Inverted funnel arrangement.

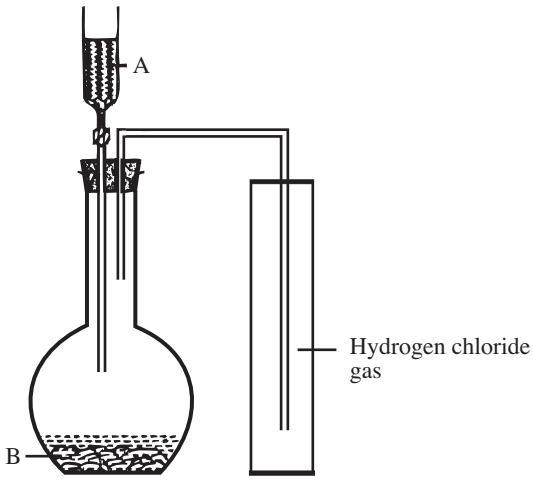
(ii) (a) To check back suction.

(b) To check its escape in the air.

(iii) (A) $NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow[\text{Below } 200^\circ C]{\text{Heated}} NaHSO_4 + HCl\uparrow$

(B) $2NaCl + \underset{\text{conc.}}{H_2SO_4} \xrightarrow[\text{Above } 200^\circ C]{\text{Heated}} Na_2SO_4 + 2HCl\uparrow$

Q. 3. The diagram shows an apparatus for the laboratory preparation of hydrogen chloride.



(i) Identify A and B.

(ii) Write the equation for the reaction.

(iii) How would you check whether or not the gas jar is filled with hydrogen chloride ?

(iv) What does the method of collection tell you about the density of hydrogen chloride ?

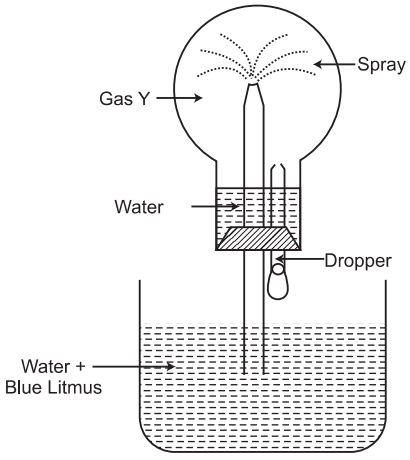
Ans. (i) A → Conc. H_2SO_4, B → NaCl

(ii) $NaCl + H_2SO_4 \rightarrow \underset{\text{sodium hydrogen sulphate}}{NaHSO_4} + HCl$

(iii) If a moist blue litmus paper is brought near the mouth of gas jar it turns red, then the gas jar is filled with HCl.

(iv) Hydrogen chloride is denser than air.

Q. 4 Study the figure given below and answer the questions that follow :



(i) Identify the gas Y.

(ii) What property of gas Y does this experiment demonstrate ?

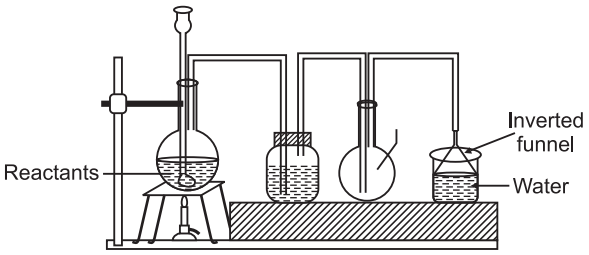
(iii) Name another gas which has the same property and can be demonstrated through this experiment.

Ans. (i) Y is Hydrochloride (HCl) gas.

(ii) Gas Y is highly soluble in water.

(iii) Ammonia gas.

Q. 5. The given figure shown is for the preparation of an acid.



(i) Name the acid prepared by this method.

(ii) Name the reactants used.

(iii) Why an empty flask is used ?

(iv) What is the drying agent used ? Why is this drying agent chosen ?

(v) What is the role of inverted funnel in the arrangement ?

Ans. (i) Hydrochloric acid.

(ii) Sodium chloride and conc. sulphuric acid.

(iii) An empty flask is used to prevent back suction. If back suction occurs, the water will collect in it and will not reach the generating flask.

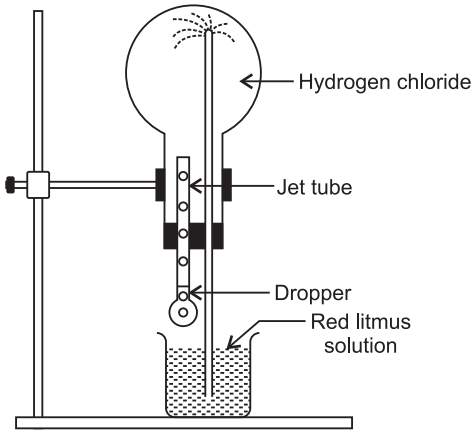
(iv) The drying agent used is concentrated sulphuric acid. It is used because it does not react with hydrogen chloride.

(v) The role of inverted funnel in the arrangement is :

(a) It prevents back-suction of water.

(b) It provides a large surface area for absorption of HCl gas.

Q. 6. (i) Name the experiment illustrated in the diagram.



(ii) Which property of hydrogen chloride is demonstrated by this experiment.

(iii) State the colour of the water that has entered the round bottomed flask.

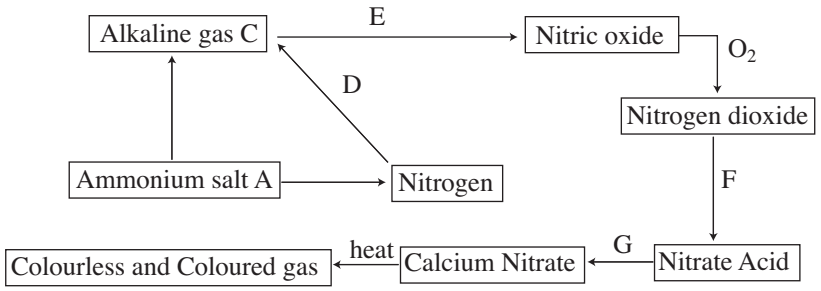
Ans. (i) Fountain experiment.

(ii) Hydrogen chloride (HCl) is highly soluble in water.

(iii) The colour of water that has entered the round bottomed flask is red.

Chapter 8. (b) Study of Compounds : Ammonia and Nitric Acid

Q. 1.



(i) Name (a) the ammonium salt A, (b) alkaline gas C.

(ii) How the conversion D is carried out ? State all the conditions like temperature, pressure and catalyst.

(iii) (a) How is C converted to nitric oxide ? Write the equation.

(b) What is the name of the process ?

(c) How is temperature maintained in above process ?

(d) Write the equation for conversion of F and G.

(iv) Name the coloured gas and the colourless gas.

Ans. (i) (a) Ammonium nitrate, NH_4NO_3

(b) Ammonia.

(ii) D is mixed with hydrogen in the ratio of 1 : 3, compressed to a pressure of 200 to 500 atmosphere and passes over a catalyst (iron) heated to 450 to 500°C.

(iii) (a) By passing the gas with excess of air over platinum gauze heated to 800°C.

$$4NH_3 + 5O_2 \longrightarrow 4NO + 6H_2O$$

(b) Ostwald process.

(c) The oxidation of ammonia to nitric oxide is exothermic reaction and once the reaction is started it maintains the temperature of the platinum gauze.

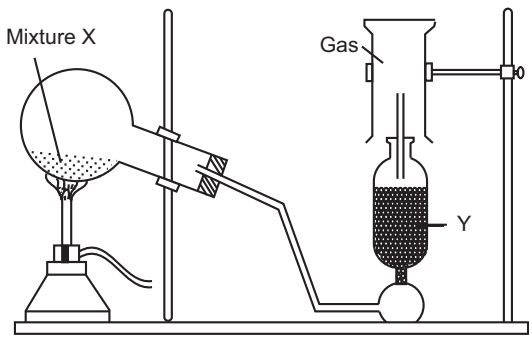
(d) $$2N_2O + 2H_2O + O_2 \longrightarrow 4HNO_3$$

$$Ca(OH)_2 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + 2H_2O$$

(iv) **Coloured gas :** Nitrogen dioxide and

Colourless gas : Oxygen

Q. 2. The diagram shows an experimental set up for the laboratory preparation of a pungent smelling gas. The gas is alkaline in nature.



(i) Name the gas collected in the jar.

(ii) Write the balanced equation for the above preparation.

(iii) How is the gas being collected ?

(iv) Name the drying agent used.

(v) How will you find that the jar is full of gas ?

Ans. (i) Ammonia.

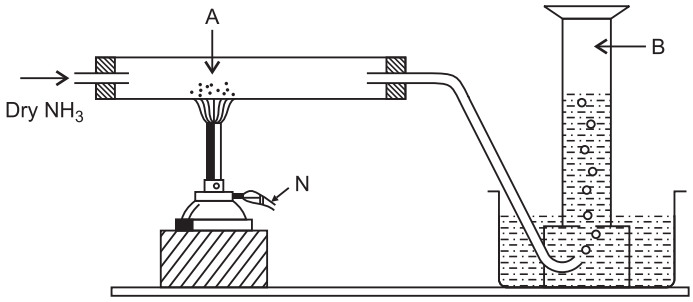
(ii) $\underset{\text{Calcium oxide}}{Ca(OH)_2} + \underset{\text{Ammonium chloride}}{2NH_4Cl} \xrightarrow{\Delta} \underset{\text{Calcium chloride}}{CaCl_2} + 2H_2O + 2NH_3\uparrow.$

(iii) By downward displacement of air.

(iv) Quick lime (CaO).

(v) By bringing a wet red litmus paper near the brim (mouth) of the gas jar. When jar is full of gas litmus will turn blue.

Q. 3. Dry ammonia gas is passed over black substance as shown in figure below :



(i) Name the black substance A.

(ii) Name the gas evolved B.

(iii) Write a balanced equation for the reaction of ammonia with A.

(iv) What do you observe when ammonia is passed over copper oxide ?

(v) State the property illustrated in the above reaction (iii).

Ans. (i) CopperII oxide

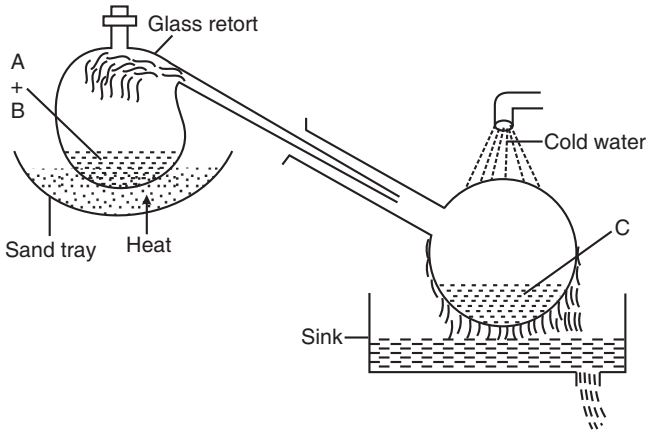
(ii) Nitrogen gas

(iii) $3CuO + 2NH_3 \xrightarrow{\Delta} 3Cu + 3H_2O + N_2$

(iv) The black mass changes to reddish powdery mass.

(v) Ammonia is a reducing agent.

Q. 4. The figure given below illustrates the apparatus used in the laboratory preparation of nitric acid.



(i) Name A (a liquid), B (a solid) and C (a liquid). (Do not give the formulae)

(ii) Write an equation to show how nitric acid undergoes decomposition.

(iii) Write the equation for the reaction in which copper is oxidized by concentrated nitric acid.

Ans. (i) A—Conc. Sulphuric acid, B—Potassium nitrate or Sodium nitrate, C—Nitric acid

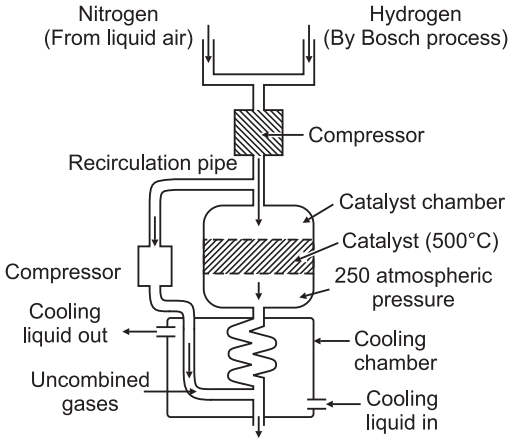
(ii) $4HNO_3 \longrightarrow 2H_2O + 2NO_2 + O_2$

(iii) $Cu + 4HNO_3 \longrightarrow Cu(NO_3)_2 + 2H_2O + 2NO_2$

Q. 5. (i) Draw a neat sketch for the manufacture of ammonia by Haber's process.

(ii) Discuss the principles involved in Haber's process.

Ans. (i)



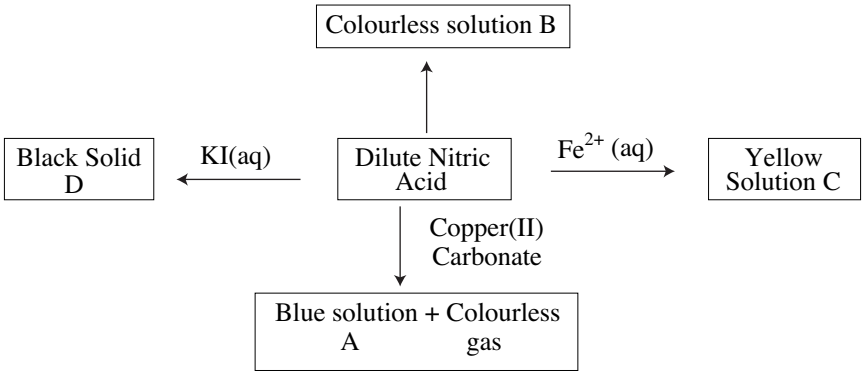
(ii) The principles involved in Haber's process are :

In this process, a mixture of pure, dry nitrogen and hydrogen in the ratio of 1 : 3 is compressed to a pressure of 200 to 900 atmospheres. The compressed gases are passed over heated catalyst (finally divided molybdenum, *i.e.*, Fe/Mo) at 450° to 500°C.

$$\underset{1\text{ vol.}}{N_2} + \underset{3\text{ vols.}}{3H_2} \rightleftharpoons \underset{2\text{ vols.}}{2NH_3};\ \Delta H = -92{\cdot}38\text{ kJ}$$

The above reaction is exothermic and reversible. It is accompanied by decrease in volume. Ammonia formed is immediately removed from the catalytic chamber and allowed to condense to form liquid ammonia.

Q. 6. Study the scheme for dilute nitric acid.



(i) Give the name or formula of

(a) Solution A

(b) Solution B

(c) A cation in solution C

(d) Solid D

(ii) Which property of nitric acid is shown by its reaction with iron(II) ions and aqueous potassium iodide solution ?

(iii) Describe one other reaction of dilute nitric acid not shown in the reaction scheme, that is typical of a strong acid.

Ans. (i) (a) Copper(II) nitrate [$Cu(NO_3)_2$]

(b) Ammonium nitrate

(c) Fe^{3+}

(d) Iodine

(ii) Oxidising property of nitric acid.

(iii) It is a characteristic of strong acids that when dilute, they react with the more electropositive metals, liberating hydrogen gas.

$$Zn + 2H^+ \longrightarrow Zn^{2+} + H_2$$

This reaction can not occur with nitric acid as it is a powerful oxidising agent. Any hydrogen initially produced is at once oxidised by more of the acid to water. If however very dilute nitric acid is used (about 1%) with magnesium or manganese, some hydrogen will be produced, escaping oxidation because of the very dilute condition of the acid.

$$Mg + \underset{\text{Very dil.}}{2HNO_3} \longrightarrow Mg(NO_3)_2 + H_2$$

Q. 7. Copy and complete the following table relating to the important industrial process. Output refers to the product of the process and not the intermediate steps.

Name of process	Inputs	Catalyst	Equation for catalyst reaction	Output
	Ammonia + air			Nitric acid

Ans.

Name of process	Inputs	Catalyst	Equation for catalyst reaction	Output
Ostwald's process	Ammonia + air	Platinum	$4NH_3 + 5O_2 \xrightarrow[800°C]{Pt.} 4NO + 6H_2O + heat$	Nitric acid

Q. 8. Copy and complete the following table relating to important industrial process :

Name of the process	Temperature	Catalyst	Equation for the catalyzed reaction
Haber's process			

Ans.

Name of process	Temperature	Catalyst	Equation for the catalysed reaction
Haber's	450° – 500 °C	Finely divided iron	$N_2 + 3H_2 \rightarrow 2NH_3 + Heat$

Chapter 8. (c) Study of Compounds : Sulphuric Acid

Q. 1. (i) Copy and complete the following table : Column 3 has the names of gases to be prepared using the substance you enter in column 1 alongwith dilute or concentrated sulphuric acid as indicated by you in column 2.

Column 1	Column 2	Column 3
Substance reacted with acid	Dilute or concentrated sulphuric acid (H_2SO_4)	Gas
(a)		Hydrogen
(b)		Carbon dioxide
(c)		Only chlorine

(ii) Write the equations for the laboratory preparation of :

(a) Sodium sulphate using dilute sulphuric acid.

(b) Lead sulphate using dilute sulphuric acid.

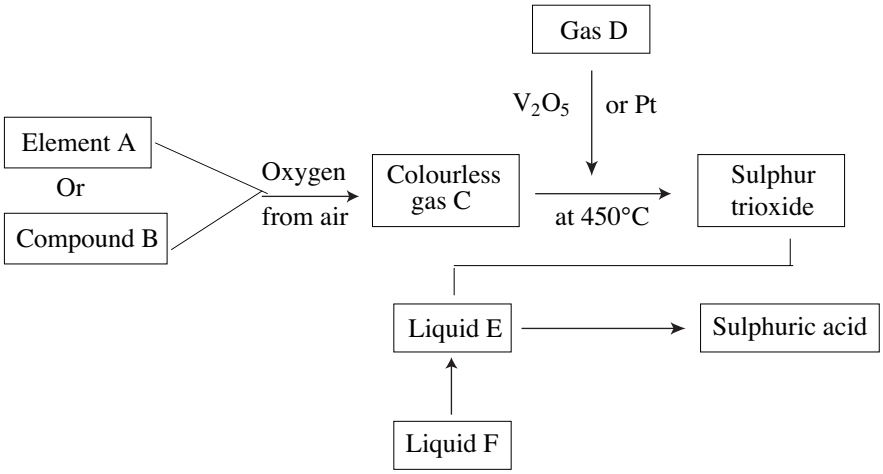
Ans. (i)

Column 1	Column 2	Column 3
Substance reacted with acid	Dilute or concentrated sulphuric acid (H_2SO_4)	Gas
(a) Zinc	Dilute H_2SO_4	Hydrogen gas
(b) Copper carbonate	Dilute H_2SO_4	Carbon dioxide gas
(c) Sodium chloride + Manganese oxide	Concentrated H_2SO_4	Only chlorine gas.

(ii) (a) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(b) $Pb(OH)_2 + H_2SO_4 \longrightarrow PbSO_4 + 2H_2O$

Q. 2. Study the diagram given below, which illustrates the manufacture of sulphuric acid.



(i) Write the names of the substances A to F.

(ii) Describe how gas C could be identified.

(iii) Explain the purpose of V_2O_5 or Pt.

Ans. (i) A—Sulphur B—Iron pyrites
C—Sulphur D—Oxygen
E—Concentrated sulphuric acid F—Water

(ii) The gas C will turn acidified potassium dichromate paper green.

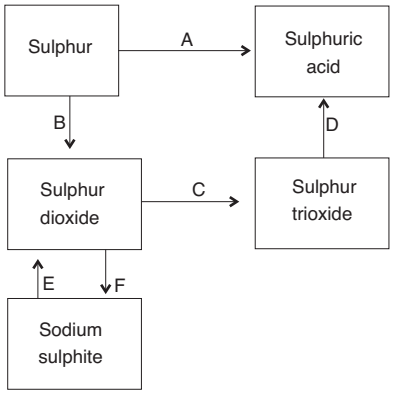
(iii) V_2O_5 or Pt acts as a catalyst and increases the rate of formation of sulphur trioxide from sulphur dioxide and oxygen.

Q. 3. (i) Name the catalyst which helps in the conversion of sulphur dioxide to sulphur trioxide in step C.

(ii) In the contact process for the manufacture of sulphuric acid, sulphur trioxide is not converted to sulphuric acid by reacting it with water. Instead a two step procedure is used. Write the equations for the two steps involved in D.

(iii) What type of substance will liberate sulphur dioxide from sodium sulphite in step E ?

(iv) Write the equation for the reaction by which sulphur dioxide is converted to sodium sulphite in step F.



Ans. (i) Platinum (Pt)

(ii) $SO_3 + H_2SO_4 \longrightarrow \underset{\text{(Oleum)}}{H_2S_2O_7}$

$H_2S_2O_7 + H_2O \longrightarrow \underset{\text{(Sulphuric acid)}}{2H_2SO_4}$

(iii) Any mineral acid HCl, H_2SO_4 or HNO_3

$$CaSO_3 + 2HCl \longrightarrow CaCl_2 + H_2O + SO_2$$

$$CaSO_3 + H_2SO_4 \longrightarrow CaSO_4 + H_2O + SO_2$$

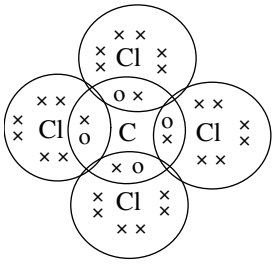
$$CaSO_3 + 2HNO_3 \longrightarrow Ca(NO_3)_2 + H_2O + SO_2$$

(iv) $$2NaOH + SO_2 \longrightarrow Na_2SO_3 + H_2O$$

Chapter 9. Organic Chemistry

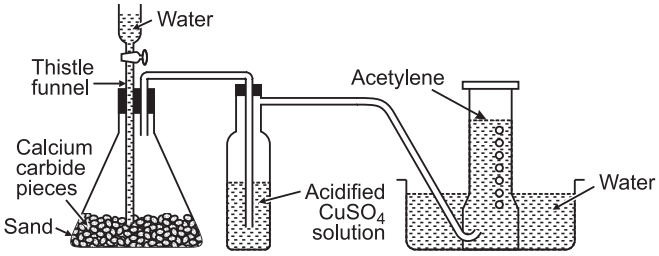
Q . 1. Methane is the first member of alkane, when it is treated with excess of chlorine in the presence of diffused sunlight forms carbon tetrachloride. Draw the appropriate structural formula of carbon tetrachloride and state the type of bond present in it.

Ans.



Structural formula of carbon tetrachloride CCl_4. The type of bond present in CCl_4 is covalent bond.

Q. 2. The figure given below is showing the laboratory preparation of acetylene gas.



(i) How it is prepared in the laboratory ?

(ii) What is the function of acidified copper sulphate solution ?

(iii) Give a reaction in which acetylene gas is prepared by synthesis reaction.

(iv) What happens when acetylene is heated in a copper tube at 600°C ?

Ans. (i) Laboratory preparation of acetylene gas (ethyne gas) : When calcium carbide is treated with water, it forms calcium hydroxide, with the liberation of acetylene.

$$\underset{\text{Calcium carbide}}{CaC_2} + 2H_2O \longrightarrow \underset{\text{Calcium hydroxide}}{Ca(OH)_2} + \underset{\text{Acetylene}}{C_2H_2}\uparrow$$

(ii) Acidified $CuSO_4$ solution is used to absorb impurities of phosphene hydrogen sulphide, ammonia etc.

(iii) $$2C + H_2 \xrightarrow{\Delta} \underset{\text{Acetylene}}{CH \equiv CH}$$

(iv) Acetylene will polymerise in the copper tube to form benzene.

$$\underset{\text{Acetylene}}{3C_2H_2} \xrightarrow[600°C]{\text{Cu tube}} \underset{\text{Benzene}}{C_6H_6}$$

Q . 3. Copy and complete the following table which relates to three homologous series of Hydrocarbons :

General Formula	C_nH_{2n}	C_nH_{2n-2}	C_nH_{2n+2}
IUPAC name of the homologous series			
Characteristic bond type			Single bonds
IUPAC name of the first member of the series			
Type of reaction with chlorine.		Addition	

Ans.

General Formula	C_nH_{2n}	C_nH_{2n-2}	C_nH_{2n+2}
IUPAC name of the homologous series	Alkynes	Alkenes	Alkanes
Characteristic bond type	Triple bond	Double bond	Single bonds
IUPAC name of the first member of the series	Ethyne	Ethene	Methane
Type of reaction with chlorine.	Addition	Addition	Substitution

Chapter 10. Practical Chemistry

Q. 1. Salts A, B, C, D and E undergo reactions (i) to (v) respectively. Identify the anion present in these salts on the basis of these reactions. Tabulate your answers in the format given below :

(i) When silver nitrate solution is added to a solution of A, a white precipitate, insoluble in dilute nitric acid, is formed.

(ii) Addition of dilute hydrochloric acid to B produces a gas which turns lead acetate paper black.

(iii) When a freshly prepared solution of ferrous sulphate is added to a solution of C and concentrated sulphuric acid is gently poured from the side of the test-tube, a brown ring is formed.

(iv) When dilute sulphuric acid is added to D, a gas is produced which turns acidified potassium dichromate solution from orange to green.

(v) Addition of dilute hydrochloric acid to E produces an effervescence. The gas produced turns lime water milky but does not affect acidified potassium dichromate solution.

Salt	Anion
A	
B	
C	
D	
E	

Ans. (i) A—Chloride

(ii) B—Sulphide

(iii) C—Nitrate

(iv) D—Sulphite

(v) E—Carbonate

Q. 2. Sodium hydroxide solution is added first in a small quantity, then in excess to the aqueous salt solutions of copper(II) sulphate, zinc nitrate, lead nitrate, calcium chloride and iron(III) sulphate. Copy the following table and write the colour of the precipitate in (i) to (v) and the nature of the precipitate (soluble or insoluble) in (vi) to (x).

Aqueous salt solution	**Colour of precipitate when NaOH is added in a small quantity**	**Nature of precipitate (soluble or insoluble) when NaOH is added in excess**
Copper(II) sulphate	(i)	(vi)
Zinc nitrate	(ii)	(vii)
Lead nitrate	(iii)	(viii)
Calcium chloride	(iv)	(ix)
Iron(III) sulphate	(v)	(x)

Ans.

Aqueous salt solution	**Colour of precipitate when NaOH is added in a small quantity**	**Nature of precipitate (soluble or insoluble) when NaOH is added in excess**
Copper(II) sulphate	Blue	Insoluble
Zinc nitrate	White	Soluble
Lead nitrate	White	Soluble
Calcium chloride	White	Insoluble
Iron(III) sulphate	Reddish Brown	Insoluble

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Also Available at : amazon Flipkart snapdeal

ISBN 97893876 6-0