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CHEMISTRY

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(Federal Board)

Class

9th

According to SLO Based
Exam System of New Curriculum

CHEMISTRY

According to NEW NATIONAL CURRICULUM
for Session 2025-26

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Chairman's Message

Since its inception, Unique Group of Institutions has been steadfast in its mission to empower students by providing exceptional opportunities that help turn their aspirations into reality. Driven by an unwavering commitment to nurture young minds, we passionately strive to lay the foundation for successful and meaningful careers. Our guiding philosophy, "Where Career Meets Success," epitomizes our dedication to bridging the gap between ambition and achievement.

Our indefatigable pursuit of educational excellence has inspired us to extend our services into the realm of Unique Publications, a visionary initiative aimed at transforming the lives of students across Pakistan. Recognizing the vital need for high-quality, student-centric academic resources, Unique Notes have been meticulously crafted by a team of highly skilled, experienced, and devoted educators who possess both subject mastery and a deep understanding of student needs.

At Unique Group of Institutions, we believe that every student deserves comprehensive guidance and unwavering support during the formative stages of their academic and professional journey. We walk beside them as mentors and motivators, ensuring they are equipped to excel and secure a future brimming with opportunities, confidence, and success.

Unique Publications is more than just an initiative; it is our pledge to reach every corner of the country, connecting students from bustling cities to the remotest towns with cutting-edge educational material. Through this project, we aspire to democratize education, making world-class learning accessible and inclusive, thus paving the way for a brighter, more empowered Pakistan.

Our vision is clear and resolute: to inspire excellence, foster innovation, and cultivate a generation of well-rounded individuals who will not only achieve personal success but also contribute meaningfully to the nation's progress.

Together, we work toward the ideal of "Better Education, Better Pakistan" — a mission that defines us, drives us, and keeps us striving for greater heights.

Abdul Manan Khurram
Chairman UGI





A Word of Thanks

It is a moment of immense pride and satisfaction for me to declare that this book is not merely a helping guide but a testament to the Unique Group of Institutions' (UGI) zealous commitment to empowering students to perform at their very best. This edition stands as a reflection of the tireless efforts and unparalleled dedication of our esteemed teachers, whose professional expertise, subject mastery, and student-centered approach have truly brought this work to life.

The exceptional dexterity demonstrated by our educators in curating this edition reflects both their individual passion and professional commitment to their respective disciplines. Every effort has been made to ensure that the content is accessible, comprehensive, and aligned with the desired learning objectives, keeping in view the individual learning needs of students. Equal emphasis has been placed on formative and summative evaluations, ensuring that assessment and learning outcomes are both measurable and achievable.

This book has been meticulously designed with a focus on clarity, brevity, and precision, while its carefully curated content serves as a true "knowledge booster" for students. Undoubtedly, Unique Notes are a proven key to success, empowering students to excel academically and achieve their dreams. I deeply appreciate the untiring efforts and profound commitment of our distinguished teachers who have worked diligently to make this edition possible. Their contributions reflect the very essence of excellence, innovation, and purpose-driven education that UGI stands for.

Prof. Amjad Ali Khan
Rector UGI



Foreword

Unique Notes have been meticulously prepared in alignment with the recommendations of the National Education Policy and modern pedagogical requirements, ensuring that they meet the highest standards of contemporary education. The exercises included within this material are carefully designed to foster not only academic excellence but also the mental, personal, and intellectual development of students. Each section has been curated to ignite critical thinking, enhance problem-solving skills, and cultivate a deep understanding of the subjects.

We firmly believe that achieving the dream of educational advancement demands continuous effort, innovation, and an unwavering commitment to excellence. With this realization, we are indefatigably striving to create resources that empower learners and inspire educators. In this pursuit, we warmly invite valuable opinions and constructive suggestions from scholars, esteemed educators, students, parents, and all stakeholders in society. Your feedback is a cornerstone of our progress and will enable us to continually improve and evolve in our mission to deliver the finest educational resources.

Together, let us join our hands and unite our efforts to envision and create a stronger, smarter, and more enlightened future for our students and our nation—a future that shines as a beacon of progress, knowledge, excellence, and inspiration for generations to come.

Prof. Muhammad Abdullah
Additional Director UGI



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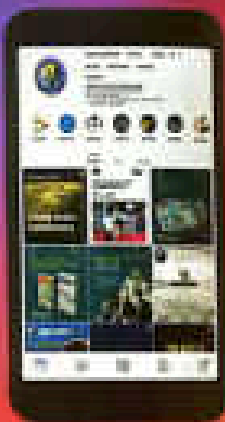
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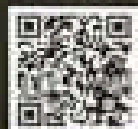
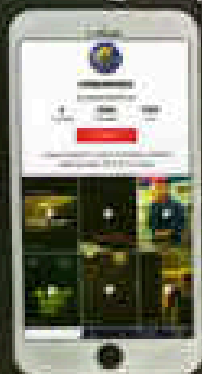


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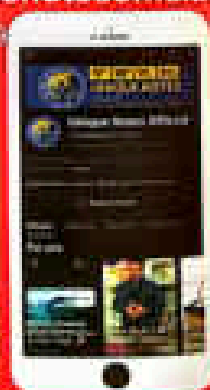
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Mapping Grid Based on National Curriculum (2022-23)

Chapter	Student learning Outcomes	Page no.
Chapter:1	NATURE OF SCIENCE IN CHEMISTRY After completing this lesson, the student will be able to: - Define chemistry as the study of matter, its properties, composition, and its interactions with other matter and energy. - Explain with examples that chemistry has many sub-fields and interdisciplinary fields. - Formulate examples of essential questions that are important for the branch of chemistry. - Differentiate between 'science' 'technology' and 'engineering' by referring to examples from the physical sciences.	01 02 09 02
Chapter:2	MATTER After completing this lesson, the student will be able to: - Define matter as a substance having mass and occupying space. State the distinguishing macroscopic properties of commonly observed states of solids, liquids, and gases in particular: density, compressibility and fluidity. Identify that state is a distinct form of matter (examples could include familiarity with plasma, intermediate states and exotic states e.g. BEC or liquid crystals). - Explain the allotropic forms of solids (some examples may include diamond, graphite, and fullerenes). - Explain the differences between elements, compounds, and mixtures. - Identify solutions, colloids and suspensions as mixtures and give an example of each. - Explain the effect of temperature on solubility and formation of unsaturated and saturated solutions.	17 16 16 17 26
Chapter:3	ATOMIC STRUCTURE After completing this lesson, the student will be able to: - Explain the structure of the atom as the central nucleus containing neutrons and protons surrounded by electrons in shells. State that, orbits/shells are energy levels of electrons and a larger shell implies higher energy and greater average distance from nucleus. - State the electrons are quantum particles with probabilistic paths whose exact paths and location cannot be mapped (with reference to uncertainty principle). - Explain that nucleus is made up of protons and neutrons held together by strong nuclear force. - Explain that an atomic model is an aid to understand the structure of an atom. State the relative charge and relative masses of a subatomic particles (an electron, proton, and neutron). - Interpret the relationship between a subatomic particle, their mass, and charge.	41 41 41 41 41

	- Illustrate the path that positively and negatively charged particles would take under the influence of a uniform electric field. 42 - Define proton number/atomic number as the number of protons in the nucleus of an atom. 42 - Explain that the proton number is unique to each element and use to arrange elements in periodic table. 42 - State that radioactivity can change the proton number and alter an atom's identity. Define nucleon number/atomic mass as sum of protons and neutrons in the nucleus of an atom. 43 - Define isotopes as different atoms of the same element that have same number of protons but different neutrons. 43 - State that isotopes can affect molecular mass but not chemical properties of an atom. 44 - Determine the number of protons and neutrons of different isotopes. 43 - Define relative atomic mass as the average mass of isotopes of an element compared to 1/12th of the mass of carbon-12. 44 - State that isotopes can exhibit radioactivity. 43 - Discuss the importance of isotopes using carbon dating and medical imaging as examples. 46 - Describe the formation of positive (cation) and negative(anion) ions from atoms. 44 - Interpret and use the symbols for atoms and ions. 44 - Calculate the relative mass of an isotope given relative atomic mass and abundance of all stable isotopes. 43	
Chapter:4	PERIODIC TABLE AND PERIODICITY OF PROPERTIES	
	After completing this lesson, the student will be able to:	
	- Define the periodic table as an arrangement element in periods and group, in order of increasing proton number/atomic number. 62 - Identify the group or period or block of an element using its electronic configuration (only the idea of subshells related to the blocks can be introduced). 46 - Explain the relationship between group number and the charge of ions formed from elements in the group in terms of their outermost shells. 46 - Explain similarities in the chemical properties of elements in the same group in terms of their electronic configuration. 45 - Identify trends in groups and periods, given information about the elements, including trends for atomic radius, electron affinity, electronegativity, ionization energy, metallic character, reactivity, and density. 64 - Use terms like alkali metals, alkaline earth metals, halogens, noble gases, transition metals, lanthanides, and actinides in reference to the periodic table. 66 - Predict the characteristic properties of an element in a given group by using knowledge of chemical periodicity. 49	

	- Deduce the name, possible position in the Periodic Table and the identity of unknown elements from given information about their physical and chemical properties. 50 - Define Group 1 Alkali metals as relatively soft metals with general trends down the group limited to decreasing melting point, increasing density and increasing reactivity. 50 - Predict properties of other elements in Group 1, given information about the elements. 50 - Predict properties of elements in Group 1 in order of reactivity given relevant information. 50 - Define Group VII halogens as diatomic non-metals with general trends limited to increasing density and decreasing reactivity. 67 - Identify the appearance of halogens at RTP as fluorine as pale yellow gas, chlorine as yellow-green gas, bromine as red-brown liquid, iodine as grey-black solid. 67 - Explain the displacement reactions of halogens with other halide ions and also as reducing agents. 54 - Predict the properties of elements in group VII, given information about the elements. 67 - Analyze the relative thermal stabilities of the hydrogen halides and explain these in terms of bond strengths. 66 - Describe the transition elements as metals that: have high densities, high melting points, variable oxidation numbers, form coloured compounds and act as catalysts for industrial purposes. (some example include catalysts being used are the Haber process, catalytic converters, Contact process and manufacturing of margarine). 66 - Define the Group 18 noble gases as un-reactive mono-atomic gases. 67 - Explain this in terms of electronic configuration. 67 - Compare the general physical properties of metals and non-metals, (specifically in terms of: a. Thermal conductivity b. Electrical conductivity c. Malleability and ductility d. Melting points and boiling points	
Chapter:5	CHEMICAL BONDING	
	After completing this lesson, the student will be able to:	
	- Describe noble gas electronic configuration, octet and duplet rules help predict chemical properties of main group elements. 68 - Compare between the formation of cations and anions. 77 - Account for the electropositive and electronegative nature of metals. 88 - Define ionic, covalent, coordinate covalent and metallic bonds. 89 - Differentiate between ionic compounds and covalent compounds. (the following points to be included in the respective definitions: a. Ionic bond as strong electrostatic attraction between oppositely charged ions. b. Covalent bond as strong electrostatic attraction between	99

	shared electrons and two nuclei. C. Metallic bonds as strong electrostatic attraction between cloud/sea of delocalized electrons and positively charged cations.	
	• Explain the properties of compounds in terms of bonding and structure.	92
	• Compare properties and use of materials such as strength and conductivity as determined by the type of chemical bond present between their atoms.	68
	• Interpret the strength of forces of attraction and their impact on melting and boiling points of ionic and covalent compounds.	92
	• Justify the availability of free charged particles (electrons or ions) for conduction of electricity in ionic compounds (solid and molten) covalent compounds and metallic bonds.	92
	• Recognize some substances can ionize when dissolved in water (e.g. acids dissolve in water and conduct electricity).	92
	• Justify the suitability of usage of graphite, diamond and metals for industrial purposes (some example may include; a. graphite as lubricant or as electrode, b. diamond in cutting tools, c. metals for wires, and sheets).	92
	• Draw the structure of ionic and covalent compounds along with their formation. (some examples may include; a. Ionic bonds in binary compounds such as NaBr, NaF, CaCl ₂ , using dot-and-cross diagrams and Lewis dot-structures, b. simple molecules including H ₂ , Cl ₂ , O ₂ , N ₂ , H ₂ O, CH ₄ , NH ₃ , HCl, CH ₃ OH, C ₂ H ₆ , CO ₂ , HCN, and similar molecules using dot-and-cross diagrams and Lewis structures.	78
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	After completing this lesson, the student will be able to:	
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	• Define empirical formula of a compound as the simplest whole number ratio of different atoms in a molecule.	110
	• Deduce the formula and name of a binary compound from ions given relevant information.	98
	• Deduce the formula of a molecular substance from a given structure of molecules.	183
	• Use the relationship amount of substance = mass/molar mass to calculate number of moles, mass, molar mass, relative mass (atomic/molecular/formula) and number of particles.	110
	• Define mole as amount of substance containing Avogadro's number (6.022×10^{23}) of particles.	110
	• Explain the relationship between a mole and Avogadro's constant.	96
	• Construct chemical equations and ionic equations to show reactants forming products, including state symbols.	117

	• Deduce the symbol equation with state symbols for a chemical reaction given relevant information.	117
Chapter:7	ELECTROCHEMISTRY	
	After completing this lesson, the student will be able to:	
	• Define redox reactions as simultaneous oxidation and reduction in terms of transfer of oxygen, hydrogen, electrons, and changes in oxidation state.	128
	• Use roman numerals to indicate oxidation number of an element in a compound.	132
	• Identify oxidizing and reducing agents in redox reactions. Recognize that the oxidation number of elements in their free state is zero.	133
	• Derive the formula of ionic compounds from ionic charges and oxidation numbers.	132
	• Identify the oxidation number of a monatomic ion is the same as the charge on the ion.	119
	• Explain that the sum of the oxidation numbers in a neutral compound is zero.	119
	• Explain that the sum of the oxidation numbers in an ion is equal to the charge on the ion.	119
	• Identify the redox reaction by the colour changes involved when using acidified aqueous potassium manganate (VII) to (II) or aqueous potassium iodide.	135
	• Define corrosion and discuss methods to prevent it. (Some examples may include barrier method such using paint, galvanizing, electroplating, sacrificial protection such as using magnesium blocks in ships.	134
Chapter:8	ENERGETICS	
	After completing this lesson, the student will be able to:	
	• Differentiate between exothermic and endothermic reactions giving examples.	136
	• Explain the idea of a chemical system and its connections with its surroundings influences energy transfer during a chemical reaction.	141
	• State that thermal energy is called enthalpy change and recognize its sign as negative for exothermic and positive for endothermic reactions.	140
	• Define activation energy as minimum energy that colliding molecules must have for a successful collision.	140
	• Explain that activation energy depends on reaction pathway which can be changed using catalyst or enzyme (detailed pathways not required).	137
	• Draw, label and interpret reaction pathway diagram for exothermic and endothermic reaction which includes enthalpy change, activation energy (uncatalyzed and catalyzed), reactants and products.	137
	• Recognize that bond breaking is endothermic and bond making is exothermic processes.	141

	- Explain that enthalpy change is sum of energies absorbed and released in bond breaking and bond forming. - Calculate enthalpy change of a reaction from given bond energy values. - Explain how respiration/aerobic and anaerobic, an exothermic process, provides energy for biological systems and lipids as reserve stores of energy.	136
Chapter:9	CHEMICAL EQUILIBRIUM	
	After completing this lesson, the student will be able to:	
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	Describe how changing the physical conditions of a chemical equilibrium system can redirect reversible reactions (a) effect of heat on hydrated compounds (b) addition of water to anhydrous substances in particular copper (II) sulphate and cobalt (II) chloride.	141
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Chapter:10	ACIDS, BASES AND SALTS	
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	Define a strong acid and a base as an acid or base that completely dissociates in aqueous solution and weak acids and bases that partially dissociates in aqueous solution. (some example include: Students writing symbol equations to show these for hydrochloric acid, sulphuric acid, nitric acid, and ethanoic acid).	153
	Formulate dissociation equations for an acid or base in aqueous solution.	152
	Recognize that bases are oxides or hydroxides of metals and that alkalis are water-soluble bases. Describe the characteristic properties of acids in terms of their reactions with metals, bases, and	154
	Identify the characteristic properties of bases in terms of their	152
	Define acid rain, carbonates, reactions with acids and ammonium salts.	
	Discuss effects of acid rain and relate them with the properties of acids.	154
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	After completing this lesson, the student will be able to:	
	State that composition of clean, dry air is approximately 78% nitrogen, 21% oxygen, remainder as a mixture of noble gases and carbon dioxide.	165
	State the major sources of air pollutants. Some examples include (a) carbon dioxide from the complete combustion of carbon-containing fuels (b) carbon mono-oxide and particulates from the incomplete combustion of carbon-containing fuels. (c) methane from the decomposition of vegetation and waste gases from digestion in	159

	animals (d) oxides of nitrogen from car engines (f) ground level ozone from reactions of oxides of nitrogen, from car engines, and volatile organic compounds, in presence of light.	
	State the adverse effects of air pollutants. Some examples include (a) carbon dioxide: higher levels of carbon dioxide leading to increased global warming, which leads to climate change. (b) carbon mono-oxide as toxic gas (c) particulates: increased risk of respiratory problems and cancer (d) methane: higher levels of methane leading to increased global warming, which leads to climate change. (e) oxides of nitrogen: acid rain, photochemical smog, and respiratory problems (f) sulphur dioxide: acid rain and haze.	160
	Explain how the greenhouse gases carbon dioxide and methane cause global warming, some example include: (a) the absorption, reflection, and emission of thermal energy. (b) reducing thermal energy loss to space.	156
	Describe the role of sulphur in the formation of acid rain and its impact on the environment.	155
	Describe the strategies to reduce the effect of environmental issues. Some examples include (a) climate change: planting trees, reduction in livestock farming, decreasing use of fossil fuels, increasing use of hydrogen, and renewable energy, e.g., wind, solar (b) acid rain: use of catalytic converters in vehicles, reducing emissions of sulphur dioxide by using low sulphur fuels and flue gas desulphurization with calcium oxide.	158
	Describe the role of NO and NO_2 in the formation of acid rain, both directly and through their catalytic role in the oxidation of atmospheric sulphur dioxide.	167
	Explain how oxides of nitrogen form in car engines and describe their removal by catalytic converters, e.g. $CO + 2NO_2 \rightarrow CO_2 + N_2$.	164
	Define photosynthesis as the reaction between carbon dioxide and water to produce glucose and oxygen in the presence of chlorophyll and using energy from sun.	167
	Analyse how to use tools to reduce personal exposure to harmful pollutants (some examples include the usage of masks, air quality indices and CO detectors).	167
	Identify high risk situations in life including those where long-term exposure to these pollutants can lead to respiratory issues and reduction in quality and longevity of life.	168
Chapter:12	Environmental Chemistry - Water	
	After completing this lesson, the student will be able to:	
	Investigate chemical tests for the presence of water using anhydrous copper (II) sulphate.	
	Explain how to test the purity of water using melting point and boiling point. Distinguish between distilled water and tap water with their applications in practical chemistry.	169

	- State that water from natural sources may contain useful and harmful substances. (Some examples include: (a) Dissolved oxygen (b) Metal compounds (c) Plastics (d) Sewage (Nitrates from fertilizers (g) Phosphates from fertilizers and detergents) - Recognize that some naturally occurring substances in water are beneficial. (some examples include: Dissolved oxygen for aquatic life (b) Some metal compounds provide essential minerals for life) - Recognise that some naturally occurring substances in water are potentially harmful (some example include: Some metal compounds that are toxic (b) Some plastics that harm aquatic life (c) Sewage that contains harmful microbes which cause disease (d) Nitrates and phosphates that lead to de- oxygenation of water and damage to aquatic life. Details of the eutrophication process are not required) - Explain the treatment of domestic water supply (some examples include: Sedimentation and filtration to remove solids (b) Use of carbon to remove tastes and odours Chlorination to kill microbes. - Describe various water-borne diseases and the steps that can be taken to avoid them. - Identify the negative effects of water pollutants on life and the ways to avoid them. - Explain water scarcity as an important issue faced by Pakistan and the ways in which can be resolved. Fertilizers: State that urea, ammonium salts, and nitrates are used as fertilizers. - Explain the use of NPK fertilizers to provide the elements nitrogen, phosphorus, and potassium for improved plant growth.	169 177 177 178 169 170 170 171
Chapter:13	ORGANIC CHEMISTRY	
	After completing this lesson, the student will be able to:	
	- Describe organic molecules as either straight-chained, branched chained or cyclic. - State that structural formula is an unambiguous description of the way the atoms in a molecule are arranged, including $\text{CH}_2=\text{CH}_2$, $\text{CH}_3\text{CH}_2\text{OH}$, $\text{CH}_3\text{COOCH}_3$. - Identify and draw structural formulae for molecules. Interpret general formulae of compounds in the same homologous series including alkanes, alkenes, alkynes, alcohols and carboxylic acids. - Define structural isomers as formula, but different structural formulae, including C_4H_{10} as $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_3$ and C_4H_6 as $\text{CH}_2=\text{CH}-\text{CH}=\text{CH}_2$ and $\text{CH}_3\text{CH}=\text{CHCH}_3$. - Identify a functional group as are atom or group of atoms that determines the chemical properties of a homologous series including that for alcohols, aldehydes, ketones, phenols, carboxylic acids, amines, esters and amide.	192 191 191 190 181

	- Describe the general characteristics of a homologous series. These can include: (a) having the same functional group (b) having the same general formula (c) differing from one member to the next by a CH_2-unit(d) displaying a trend in physical properties(e) sharing similar chemical properties. - State that a saturated compound has molecules in which all carbon-carbon are single bonds. State that an unsaturated compound has molecules in which one or more carbon-carbon are not single bond.	191 192
Chapter:14	HYDROCARBONS	
	After completing this lesson, the student will be able to:	
	- State that bonding in alkanes is single covalent and that alkanes are saturated hydrocarbons. - Describe the properties of alkanes as being generally unreactive, except in terms of combustion and substitution by chlorine. - State that in a substitution reaction one atom or group of atoms is replaced by another atom or group of atoms. - Describe the substitution reaction of alkanes with chlorine as a photochemical reaction, and draw the structural or displayed formulae of the products, limited to mono-substitution. - Describe, using symbol equations, preparation of alkanes from cracking of larger hydrocarbons, hydrogenation of alkenes and alkynes, and reduction of alkyl halides.	199 200 200 200 194
Chapter:15	BIOCHEMISTRY	
	After completing this lesson, the student will be able to:	
	- Explain the importance and basics of nutrition and healthy eating. - Recognize the main biomolecules, carbohydrates, proteins, lipids, and nucleic acids, their sources along with the required daily intake for young adults. - Identify carbohydrates as a source of energy.	208 210 207
Chapter:16	EMPIRICAL DATA COLLECTION AND ANALYSIS	
	After completing this lesson, the student will be able to:	
	- Explain that units are standardized for better communication and collaboration. - Identify SI for abstract and physical quantities - Apply the concept that units can be combined with terms for magnitudes, especially for kilo, Deci, and Milli. - Justify why chemists use cm^3, g, and s as more practical units when working with small amounts in the lab. - Explain with examples how different tools and techniques can be used to manage accuracy and precision for inherent errors that arise during measurement.	216 216 217 216 212
Chapter:17	SEPARATION TECHNIQUES	
	After completing this lesson, the student will be able to:	

	- Define important terms associated with creating chemical solutions. (some example include: a) substance that dissolves a solute, b) solute as a substance that is dissolved in a solvent a mixture of one or more solutes dissolved in a solvent, d) saturated solution as a solution maximum concentration of a solute dissolved in the solvent at a specific temperature substance that remains after evaporation, distillation, filtration, or any similar process, liquid or solution that has passed through a filter. - Explain methods of separation and purification(some example include: a) using a suitable solvent, b) filtration, c) crystallization d) simple distillation e) fractional distillation. - Suggest suitable separation and purification techniques, given information about the substances involved, and their usage in daily life. - Identify substances and assess their purity using melting point and boiling point information.	224
Chapter:18	QUALITATIVE ANALYSIS After completing this lesson, the student will be able to:	
	- Describe tests to identify important gases (Some examples include: a) ammonia, NH_3, using damp red litmus paper b) carbon dioxide, CO_2, using lime water c) chlorine, Cl_2, damp litmus paper d) hydrogen, H_2, using a lighted splint) oxygen, O_2, using a glowing splint e) sulphur dioxide, SO_2, using acidified aqueous potassium manganate(VII) - Explain the use of a flame test to identify important cations: (Some examples include: a) lithium, Li^+, b) sodium, Na^+, c) potassium, K^+, d) calcium, Ca^{2+}, e) copper, Cu^{2+}, f) barium, Ba^{2+}	231
Chapter:19	CHROMATOGRAPHY After completing this lesson, the student will be able to:	
	- Describe how paper chromatography is used to separate mixtures of soluble substances, using a suitable solvent. - Describe the use of locating agents when separating mixtures containing colourless substances. (If or context, knowledge of specific locating agents is not required) - Interpret simple chromatograms (for context, students should identify: a) unknown substance with known substances b) pure and impure substances. - State and use the equation for R_f.	234
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UNIT
01

Nature of Science in Chemistry

Q.1. Define chemistry and its interactions with other matter and energy.

Answer

Ans. Chemistry is defined as the science that investigates the materials of the universe and the changes that these materials undergo. Chemistry deals with the composition, structure, properties, behavior, and changes of matter and energy.

1. Insight Matter and the Natural World

Chemistry helps to develop a deep understanding of how our world works. Everything that has matter breaks down into chemical building blocks. Chemistry helps us to know why leaves change color in the fall and how food is made and preserved.

2. Scientific Method and Critical Thinking

Chemistry is based on the approach a critical thinking. Chemistry helps us to understand the scientific method, which involves observation, experimentation, and analysis.

3. Predicting and Controlling Reactions

Chemistry investigates predicting and controlling chemical reactions. Predicting reactions promotes the development of critical thinking skills. Pharmacists consistently work on reaction predictions to produce new medicines.

4. Constructing New Materials

Chemistry research has led to breakthrough and expansion of new and improved medicines, plastics, fertilizers, cleaners and batteries.

5. Energy Production and Storage

Chemistry is important in the development of energy-making and storage devices like smartphones, watches, computers, flashlights and batteries.

6. Health and Medicine

The knowledge of chemistry helps a doctor to know about the chemical nature and chemical composition of medicine. It helps us know the relations between medicines and biological targets.

7. Environmental Effect

Chemistry helps us to recognize, observe, defend and improve the environment around us. Chemistry helps us to gauge the behavior of pollutants and develop techniques for pollution control.

8. Agriculture and Food Science

The knowledge of chemistry is vital in agriculture and food science. It helps us to understand the chemical composition of soils, fertilizers and pesticides, indicating enhanced crop yields and sustainable farming methods.

9. Technological Advancements

Technological advancement is the innovation of knowledge that upgrades the understanding of science or technology. Technological advancement enables us to experiment with innovative ideas and test new concepts. It helps us understand how to utilize new technology in the development of new materials, electronics, renewable energy, and wastewater treatment methods.

Q.2. Describe the applications of inorganic chemistry and its importance in our daily lives?

Answer

Ans. Inorganic chemistry is the branch of chemistry that deals with elements and their compounds except organic compounds.



Applications of Inorganic Chemistry in our Daily Life

Lithium-ion (Li-ion) batteries are used as rechargeable batteries for electronics, toys, wireless headphones, handheld power tools, small and large appliances, electrical storage devices and electric vehicles.

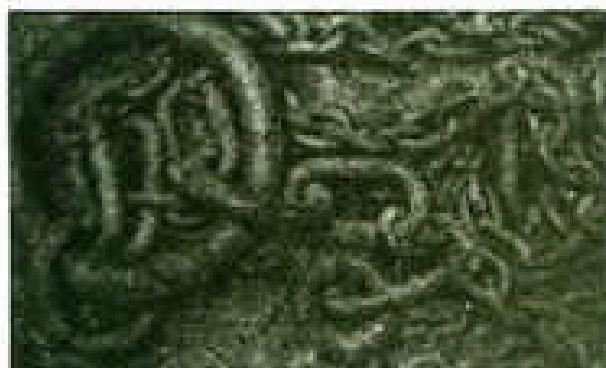
- Q.3. With the help of few examples highlight the relation between science, technology and engineering.**

ANSWER

Ans. Let's take a look at how science, technology and engineering work together to solve problems in real-world situations. For example:

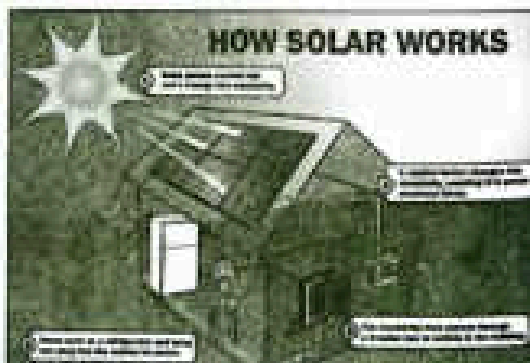
- i) **Investigating Rusting of Iron**

Imagine trying to figure out why a bike or car will rust over time. Scientists could investigate the chemical reactions that occur between iron, water and oxygen that cause rust to form. Experiments could be conducted to understand the factors that influence this process and help develop strategies to prevent rust.



- ii) **Harvesting Solar Energy**

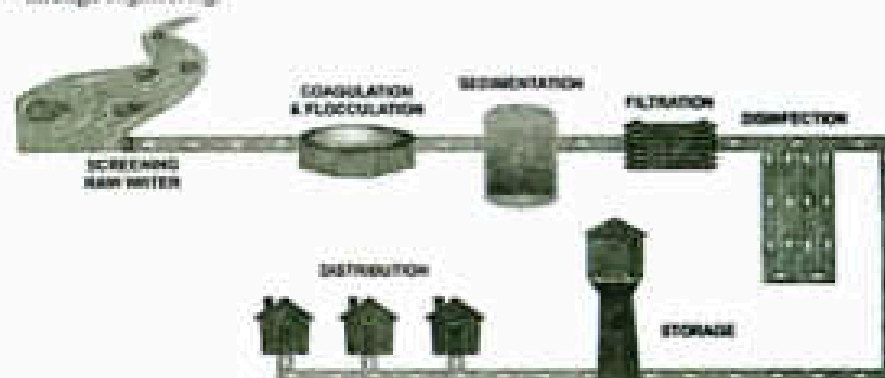
Scientists may study the principles of photovoltaic cells to understand how sunlight can be converted into electricity. Technologists can develop solar panels based on the scientific principles discovered. Engineers play their role in designing and implementing large-scale renewable energy systems. For instance, an electrical engineer might design the wiring and connections of a solar power plant, a civil engineer could be involved in designing the infrastructure. In this example, science helps us understand the underlying principles of converting sunlight into electricity. Technology transforms this knowledge into practical applications, such as solar panels and energy storage systems. Engineering takes these



technologies and implements them on a larger scale. Together, science, technology, and engineering contribute to the development and utilization of sustainable energy sources.

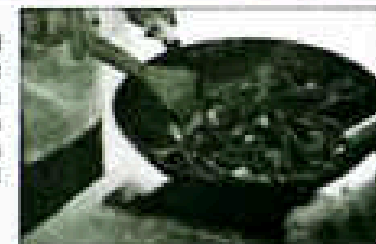
- iii) **Designing a Water Filtration System**

Let's look at how engineers design water filtration systems. Chemical engineers can help develop processes to remove contaminants from water while mechanical engineers design physical components. Together, they create a solution to clean drinking water for a community. From understanding chemical reactions to using technological devices to solving practical problems through engineering.



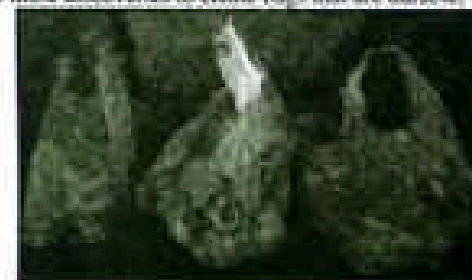
- iv) **Organic Chemistry in Action**

How do you make food? The oil used to cook food contains carbohydrates, which are organic molecules. Scientists study carbohydrates to learn more about how they work, so food technologists extract oil from seeds. Chemical engineers design oil production equipment and processes so that oil is produced efficiently and safely for cooking.



- v) **Plastic bags**

Think about the science behind plastic bags. Scientists study the small building blocks known as monomers. When monomers combine, they form long chains known as polymers. One of those long chains is polyethylene, which is one of the many polymers found in plastic bags! Engineers and technicians use these discoveries to create bags that are durable, flexible and easy to make.





10.1. Evaluate the role of chemistry in environmental science

Answer

Ans. Chemistry helps in finding ways to understand various factors in environment by composition and behaviour of substances, finding methods to study air, environment, soil and water quality, resources to protect our environment.

1. Role of Chemistry in Air Pollution

Chemistry study the chemical reactions involved in air pollution and develop strategies to reduce pollution. This can study the decreasing level of hydrogen and molecular oxygen in chemistry is an essential part of pollution assessment. Chemistry also helps in a better understanding of air.

2. Role of Chemistry in Water Pollution

Chemistry help in finding water quality, study the effects of chemicals in water and finding ways to control environmental damage.

3. Role of Chemistry in Soil Pollution

Chemistry can help study pollution in chemistry. It can also understand soil and find ways to remediate the pollution. Chemistry helps in finding the effects of chemicals in soil and soil pollution and find ways to control it.

4. Role of Chemistry in our Daily Life

Chemistry has become an important part of our daily lives, including in agriculture. This science is used to study the way our bodies react to the food we eat and the effects of medicine. It changes from a simple to a complex science. The chemistry is divided into two parts: one that can study the body and the other that can study the body. The body is made of many different parts and the body is made of many different parts. The body is made of many different parts and the body is made of many different parts. The body is made of many different parts and the body is made of many different parts.

10.2. How does geochemistry help us to solve the problems such as pollution and climate change?

Answer

Ans. Geochemistry is the science that helps us to understand the earth's processes and how they relate to pollution and climate change.

In studying the chemical composition of rocks, soil, water and the atmosphere, geochemistry can identify sources of pollution and find ways to reduce them. It can also help us to understand the processes that control the earth's climate and how they relate to pollution and climate change.

Geochemistry also helps us to understand the earth's processes and how they relate to pollution and climate change. This science is used to study the way our bodies react to the food we eat and the effects of medicine. It changes from a simple to a complex science. The chemistry is divided into two parts: one that can study the body and the other that can study the body. The body is made of many different parts and the body is made of many different parts. The body is made of many different parts and the body is made of many different parts.

10.3. How is organic chemistry applied in medicine, biotechnology and industrial science?

Answer

Ans. Medicine

Organic chemistry plays a vital role in the development of medicines. Organic chemistry study the structure and properties of carbon-based compounds which are building blocks of many drugs. They study the reactions and properties that can help identify diseases and conditions. They can also help us to understand the processes that control the earth's climate and how they relate to pollution and climate change.

Organic chemistry also helps in the process of drug development. Organic chemistry study the structure and properties of carbon-based compounds which are building blocks of many drugs. They study the reactions and properties that can help identify diseases and conditions. They can also help us to understand the processes that control the earth's climate and how they relate to pollution and climate change.

Biotechnology

Organic chemistry and biotechnology go hand in hand. Organic chemistry study the structure and properties of carbon-based compounds which are building blocks of many drugs. They study the reactions and properties that can help identify diseases and conditions. They can also help us to understand the processes that control the earth's climate and how they relate to pollution and climate change.



Organic chemistry and biotechnology of biological molecules like proteins, nucleic acids & carbohydrates. By understanding the organic chemistry reactions, biotechnologists can study the complex molecules of life such as amino acids, DNA, lipids and carbohydrates. Organic chemistry techniques are also used to study drugs and organic biological molecules in the laboratory. Organic chemistry is also used to study the effects of chemicals in the environment.

Industrial Science

Organic chemistry plays a significant role in industrial and scientific research. It helps in the development and production of various materials and chemicals used in industry.

Organic chemistry helps in the development of new materials and chemicals. It helps in the development of new materials and chemicals. It helps in the development of new materials and chemicals. It helps in the development of new materials and chemicals. It helps in the development of new materials and chemicals. It helps in the development of new materials and chemicals.

Concept Assessment 10.1

10.1. How does chemistry help us to understand the behaviour of matter in the natural world?

Answer

Ans. Chemistry helps in finding ways to understand various factors in environment by composition and behaviour of substances, finding methods to study air, environment, soil and water quality, resources to protect our environment.

Concept Assessment 10.2

10.2. Identify the branch of chemistry in each of the following examples

Answer

- Photosynthesis process glucose and oxygen from carbon dioxide and water in presence of chlorophyll and sunlight.
- Photosynthesis helps in understanding green house effect.
- Human's proteins convert large quantities of biological and nitrogen into ammonia (NH₃).
- Ammonia is a colourless gas with pungent irritating odour. It is highly soluble in water.
- A chemist performed an experiment to check the percentage purity of a sample of glucose in solution.
- An scientist determined that NH₃ is responsible for acid rain.
- A biochemist studied compounds are responsible for the digestion of foods by us.
- A geologist study a rock sample and nitrogen atoms, a process is studied.

Branches of Chemistry:

1. Environmental Chemistry

2. Analytical Chemistry

3. Organic Chemistry

4. Inorganic Chemistry

5. Environmental Chemistry

6. Physical Chemistry

7. Biochemistry

Concept Assessment 10.3

10.3. Identify the branch of chemistry in each of the following examples

Answer

- There is a special class of proteins called enzymes, which are present in both food and living organisms.
- Enzymes are the complex biological molecules that catalyze various chemical reactions.
- There is a special class of proteins called enzymes, which are present in both food and living organisms.
- Enzymes are the complex biological molecules that catalyze various chemical reactions.
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Branches of Chemistry:

1. Environmental Chemistry

2. Analytical Chemistry

3. Organic Chemistry

4. Inorganic Chemistry

5. Environmental Chemistry

6. Physical Chemistry

7. Biochemistry



Multiple Choice Questions (Exercise)

Select the correct answer:

- Which branch of chemistry is the study of elements and their compounds except for organic compounds? **inorganic**
 a) physical chemistry
 b) organic chemistry
 c) inorganic chemistry
 d) geochemistry chemistry
- Which branch of chemistry helps to protect water that has been polluted by soil? **environmental**
 a) environmental chemistry
 b) organic chemistry
 c) inorganic chemistry
 d) geochemistry chemistry
- Which area of chemistry improves to gauge the behavior of pollutants and develop techniques for pollution control? **analytical**
 a) analytical chemistry
 b) organic chemistry
 c) environmental
 d) geochemistry chemistry
- The branch of chemistry that helps to treat diseases, organic and to synthesize new medicines: **organic**
 a) physical
 b) organic
 c) inorganic
 d) environmental
- The branch of science helps to understand chemical products and processes that reduce the use of hazardous substances: **green**
 a) analytical chemistry
 b) physical chemistry
 c) green chemistry
 d) astrochemistry

6. To identify the concentration of a particular solution through titration is and application of: **analytical**

- a) astrochemistry b) analytical chemistry
 c) geochemistry d) organic chemistry
- The batteries in our vehicles are built on the principle of electrochemistry. It is the application of: **analytical**
 a) astrochemistry
 b) analytical chemistry
 c) organic chemistry
 d) physical chemistry
- The branch of chemistry that is concerned with the large-scale production of chemical substances is: **industrial**
 a) industrial chemistry
 b) physical chemistry
 c) inorganic chemistry
 d) environmental chemistry
- The branch of chemistry that focuses on the study of polymers, their types, properties, uses is called: **polymer**
 a) industrial chemistry
 b) polymer chemistry
 c) organic chemistry
 d) astrochemistry
- The study of the interaction between drugs and biological targets, as well as the development of new medicinal agents. **medicinal**
 a) organic chemistry
 b) medicinal chemistry
 c) inorganic chemistry
 d) environmental chemistry

SLO Based Additional MCQs

- Which is deal with composition, structure, properties, behavior and changes of matter & energy? **science**
 a) technology b) engineering
 c) chemistry d) science
- Which branch of chemistry deals with the changes that occur in atomic nuclei? **radioactive**
 a) environmental chemistry
 b) astrochemistry

- a) biochemistry
 d) nuclear chemistry
- Which branch of chemistry deals with elements and compounds in earth's crust? **geochemical**
 a) polymer chemistry
 b) geochemistry
 c) organic chemistry
 d) physical chemistry



14. Which branch of chemistry deals with the study of stars, planets, comets and interstellar space? **astrochemical**

- a) medicinal chemistry
 b) geochemistry
 c) astrochemistry
 d) physical chemistry
- Vinegar contains _____ acetic acid. **5%**
 a) 15% b) 5%
 c) both a and b d) None of these
- The formula of acetic acid is: **CH₃COOH**
 a) CH₃COOH b) C₂H₅OH
 c) CH₃NH₂ d) CO₂
- The colour of acetic acids is: **colourless**
 a) red b) blue
 c) colourless d) yellow
- Hair contains special class of protein called: **keratin**
 a) keratin b) enzyme
 c) amino acid d) sucrose
- The formula of galena is: **PbS**
 a) FeS b) PbS
 c) Pb(NO₃)₂ d) CuFeS₂
- Which branch of chemistry tells us sulphuric acid is extremely corrosive to skin? **inorganic**
 a) organic chemistry
 b) physical chemistry
 c) biochemistry
 d) inorganic chemistry
- The king of chemical is: **H₂SO₄**
 a) H₂SO₄ b) HNO₃
 c) HCl d) CH₃COOH
- The acid used in vinegar is: **CH₃COOH**
 a) H₂SO₄ b) HNO₃
 c) HCl d) CH₃COOH
- Which deals with systematic study to explore the natural world? **science**
 a) Technology b) science
 c) engineering d) chemistry
- The integration of scientific knowledge is: **technology**
 a) Technology b) science
 c) engineering d) chemistry

25. _____ is the application of scientific principles to construct and improve systems, structures and machines. **technology**

- a) machines b) technology
 c) chemistry d) engineering
- The conversion of sunlight into electricity: **solar**
 a) solar energy b) atomic energy
 c) wind energy d) sound energy
- Potatoes contain: **carbohydrates**
 a) proteins b) vitamins
 c) nucleic acids d) carbohydrates
- Oil is extracted from: **seed**
 a) seed b) flower
 c) leave d) root
- When monomers combine they form: **polymers**
 a) energy b) CH₃COOH
 c) polymers d) none of these
- Science is the study of: **nature**
 a) chemicals b) nature
 c) earth d) medicines
- The Karachi nuclear power plant has a power generating capacity: **1.1 GW**
 a) 0.1 GW b) 1.5 GW
 c) 2.0 GW d) 1.1 GW
- The K-3 nuclear unit was build with an investment of: **\$ 2.7 bn**
 a) \$ 2.7 bn b) \$ 3.7 bn
 c) \$ 4.7 bn d) \$ 1.7 bn
- Which branch of chemistry give information about starch synthesis in plants? **biochemistry**
 a) organic chemistry
 b) biochemistry
 c) environmental chemistry
 d) inorganic chemistry
- Which branch of chemistry support the bronsted-lowery theory of acid & base? **inorganic**
 a) organic chemistry
 b) biochemistry
 c) environmental chemistry
 d) inorganic chemistry



35. Polymers are sometimes called: example

- a) monomers
b) macromolecules

- c) macromolecules
d) none of these

Answer Key

1	c	2	a	3	c	4	b	5	c
6	b	7	d	8	a	9	b	10	b
11	c	12	d	13	b	14	c	15	b
16	a	17	c	18	a	19	b	20	d
21	a	22	d	23	b	24	a	25	d
26	a	27	d	28	a	29	c	30	b
31	d	32	a	33	b	34	d	35	c

Short Questions (Exercise)

Q.1. Differentiate between science & technology. example

Science	Technology
1. Science is defined as the study of nature. 2. Science is the systematic process of constructing and organizing knowledge about the universe. Thus, science seeks to understand the natural world.	1. Technology is the application of science. 2. Technology is the process of applying scientific knowledge to practical applications, resulting in the creation of tools, machines and system that enhance our lives.

Q.2. Differentiate between geochemistry and astrochemistry. example

Geochemistry	Astrochemistry
Geochemistry is the branch of chemistry that deals with the study of chemical composition, distribution and transformation of elements and compounds in the earth's crust, such as rocks, minerals, soils, water and the atmosphere.	Astrochemistry is a branch of chemistry that deals with the study of chemical processes and reactions that occur in astronomical environments, such as stars, planets, comets, and interstellar space.

Q.3. With the help of an example correlated the use of science, technology and engineering. example

Ans. Scientists may study the principles of photovoltaic cells to understand how sunlight can be converted into electricity. Technologists can develop solar panels based on the scientific principles discovered. Engineers play their role in designing and implementing large-scale renewable energy systems. For instance, an electrical engineer might design the wiring and connections of a solar power plant, a civil engineer could be involved in designing the infrastructure. In this example, science helps us understand the underlying principles of converting sunlight into electricity. Technology transforms this knowledge into practical applications, such as solar panels and energy storage systems. Engineers takes these technologies and implement them on a larger scale. Together, science, technology, and engineering contribute to the development and utilization of sustainable energy sources.



Q.4. How does forensic Chemistry help us? example

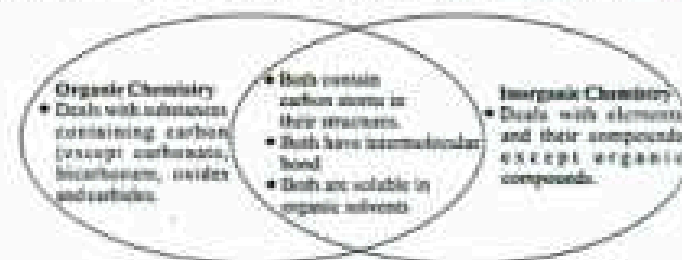
Ans. Forensic chemistry helps solve crimes by analyzing drugs, toxins, explosives, gunshot residue, and trace evidence (like fibers or paint) to link suspects to crime scenes, identify substances, and provide scientific proof in investigations. It uses chemical analysis to identify evidence (drugs, poisons, explosives, etc.) and connect criminals to crimes.

Q.5. What are the uses of nuclear chemistry? example

Ans. It has vast applications in medical treatment (radiotherapy), preservation of food and generation of electrical power through nuclear reactors etc.

SLO Based Additional Short Questions (Reference Material)

Q.6. With the help of the venn diagram compare and contrast organic and inorganic chemistry. example



Q.7. Define chemistry. example

Ans. Chemistry deals with the composition, structure, properties, behavior, and changes of matter and energy.

Q.8. How does chemistry help us to understand the behavior of matter in natural world and critical thinking about scientific method? example

Ans. It Insight Matter and the Natural World

Chemistry helps to develop a deep understanding of how our world works. Everything that has matter breaks down into chemical building blocks. Chemistry helps us to know why leaves change color in the fall and how food is made and preserved.

ii) Scientific Method and Critical Thinking

Chemistry is based on the approach of critical thinking. Chemistry helps us to understand the scientific method, which involves observation, experimentation, and analysis.

Q.9. How does chemistry help us to understand the predicting of reaction proceeding and constructing new materials? example

Ans. i) Predicting and Controlling Reactions

Chemistry investigates predicting and controlling chemical reactions. Predicting reactions promotes the development of critical thinking skills. Pharmacists consistently work on reaction predictions to produce new medicines.



III) Constructing New Materials

Chemistry research has led to breakthrough and expansion of new and improved medicines, plastics, fertilizers, cleaners and batteries.

Q.18. How does chemistry help us to understand the energy storage and help a doctor to know about the chemical nature of medicine?

ANSWER

Ans. Chemistry is important in the development of energy-making and storage devices like smartphones, watches, computers, flashlights and generators. The knowledge of chemistry helps a doctor to know about the chemical nature and chemical composition of medicine. It helps us know the relations between medicines and biological targets.

Q.11. How does chemistry help us to understand the environmental effect and food science?

ANSWER

Ans. Chemistry helps us to recognize, observe, defend and improve the environment around us. Chemistry helps us to gauge the behavior of pollutants and develop techniques for pollution control. The knowledge of chemistry is vital in agriculture and food science. It helps us to understand the chemical composition of soils, fertilizers and pesticides, indicating enhanced crop yields and sustainable farming methods.

Q.12. How does chemistry help us to understand the advancement in technology and in reducing pollution?

ANSWER

Ans. Technological advancement is the innovation of knowledge that upgrades the understanding of science or technology. Technological advancement enables us to experiment with innovative ideas and test new concepts. It helps to understand how to utilize new technology in the development of new

materials, electronics, renewable energy, and wastewater treatment methods.

Q.13. Differentiate between organic and inorganic chemistry.

ANSWER

Ans. Inorganic Chemistry

Inorganic chemistry is the branch of chemistry that deals with elements and their compounds except organic compounds.

Organic Chemistry

Organic chemistry is a branch of chemistry that deals with substances containing carbon (except carbonates, bicarbonates, oxides and carbides).

Q.14. Differentiate between physical and analytical chemistry.

ANSWER

Ans.

Physical	Analytical
Physical chemistry is the branch of chemistry that deals with laws and theories to understand structure and changes of matter.	Analytical chemistry is a branch of chemistry that deals with the methods and instruments for determining the composition and properties of matter.

Q.15. Differentiate between biochemistry & environment chemistry.

ANSWER

Ans. Biochemistry

The branch of chemistry that deals with physical and chemical changes that occur in living organisms is called biochemistry.

Environmental Chemistry

Environmental chemistry is the branch of chemistry that deals with the study of chemical and toxic substances that pollute the environment and their adverse effects on human beings.

Q.16. Differentiate between industrial and medicinal chemistry.

ANSWER

Ans. Industrial Chemistry

Industrial chemistry is the branch of chemistry that deals with the large-scale production of chemical substances.

Medicinal Chemistry

The branch of chemistry deals with the study of the interaction between drugs and biological targets, as well as the development of new medicinal agents.

Q.17. Differentiate between polymer and geochemistry.

ANSWER

Ans. Polymer Chemistry

The branch of chemistry that focuses on the study of polymers, their types, properties, uses, importance, and types of polymerizations is called polymer chemistry.

Geochemistry

Geochemistry is the branch of chemistry that deals with the study of chemical composition, distribution and transformation of elements and compounds in the earth's crust, such as rocks, minerals, soils, water and the atmosphere.

Q.18. Differentiate between astrochemistry and nuclear chemistry.

ANSWER

Ans. Nuclear Chemistry

The branch of chemistry that deals with the changes that occur in atomic nuclei is called nuclear chemistry.

Astrochemistry

Astrochemistry is a branch of chemistry that deals with the study of chemical processes and reactions that occur in astronomical environments, such as stars, planets, comets and interstellar space.

Q.19. What do you know about acetic acid write its use?

ANSWER

Ans. Vinegar contains 3% acetic acid. Acetic acid (CH_3COOH) is a colourless liquid that has characteristic vinegar like smell. It is used to flavor food.

Q.20. What information does physical and organic chemistry provide about acetic acid?

ANSWER

Ans. Explanation of its transformation into gaseous state or solid state, help to understand its structure is physical chemistry.

Since this is a carbon compound, its

method of preparations and study of its physical and chemical characteristics is organic chemistry.

Q.21. What does inorganic & biochemistry tell us about acetic acid?

ANSWER

Ans. The study of its component elements, carbon, hydrogen and oxygen is inorganic chemistry. This is because inorganic chemistry deals with elements and their compounds except carbon compounds. However, some carbon compounds such as CO_2 , CO , metal carbonates, hydrogen carbonates and carbides are studied in inorganic chemistry.

The study of chemical reactions that acetic acid undergoes in the bodies of human beings is biochemistry.

Q.22. What information does industrial and nuclear chemistry provide about acetic acid?

ANSWER

Ans. Use of technology and ways to obtain acetic acid on the large scale is industrial chemistry.

The study of the effect of radioactive radiations or neutron on this compound or its component elements is nuclear chemistry.

Q.23. What information does environmental and analytical chemistry provide about acetic acid?

ANSWER

Ans. The study of any adverse effects of this compound or the compounds that are derived from it, on the humans is environmental chemistry.

The method and instruments used to determine its percentage composition, melting point, boiling point etc. is analytical chemistry.

Q.24. What essential questions does physical and biochemistry raise?

ANSWER

Ans. Physical Chemistry

1. What is the structure of an atom and how does it influence chemical behavior?
2. How do different types of chemical bonds (ionic, covalent, metallic) form and function?



3. How do chemical reactions occur, and what factors influence reaction rates?

Biochemistry

1. How do bio molecules such as carbohydrates, proteins, nucleic acid lipids contribute to the structure and function of living organisms?
2. What is the role of enzymes in biochemical reactions and how do they catalyze specific reactions?

Q.25. What essential questions does organic and inorganic chemistry raise?

main

Ans. Organic Chemistry

1. Why carbon is considered the backbone of organic compounds.
2. What are the major functional groups in organic molecules and how do they affect chemical properties?
3. How are organic compounds synthesized?

Inorganic Chemistry

1. What distinguishes inorganic compounds from organic compounds?
2. How does periodic table helps to organize elements?

Q.26. What essential questions does analytical and environmental chemistry raise?

main

Ans. Analytical Chemistry

1. How are analytical methods used to identify and quantify chemical substances?
2. How composition of matter can be determined?

Environmental Chemistry

1. How do human activities contribute to air pollution, and what are the consequences for the environment?
2. What role do greenhouse gases play in climate change, and how can we mitigate their effects?
3. How are pollutants removed from water through various treatment process?

Q.27. What essential questions does medicinal and polymer chemistry raise?

main

Ans. Medicinal Chemistry

1. How are drugs designed and developed for specific therapeutic purposes?
2. How does medicinal chemistry contribute to the treatment of specific diseases?

Polymer Chemistry

1. What are polymers and how do their structures affect their properties?
2. How are polymers synthesized through various polymerization techniques?

Q.28. What essential questions does geochemistry, Nuclear and Astronomical chemistry raise?

main

Ans. Geochemistry

1. How do geological processes influence the distribution of elements in the Earth's crust?
2. What is the role of geochemistry in understanding Earth's history and evolution?

Nuclear Chemistry

1. How do nuclear reactions differ from chemical reactions and what are their applications?
2. What is the role of radioisotopes in medicine and industry?
3. What are the risks and benefits associated with nuclear energy?

Astronomical Chemistry

1. What types of reactions occur in astronomical environments?

Q.29. What are the applications of organic and inorganic chemistry in our daily life?

main

Ans. Organic Chemistry

To treat diseases, organic chemists synthesize new medicines that interact with specific targets like proteins or enzymes.

Inorganic Chemistry

Lithium-ion (Li-ion) batteries are used as rechargeable batteries for electronics, toys, wireless headphones, handheld power tools, small and large appliances, electrical storage devices and electric vehicles.

Q.30. What are the applications of analytical chemistry in our daily life?

main

Ans. Forensic chemistry is the application of analytical chemistry. It involves the examination of physical traces, such as body fluids, bones, fibres and drugs. It can be used to identify an unknown compound. For example drugs are often found in various colored powders and are analyzed to determine their content.

Q.31. What are the applications of physical and environmental chemistry in our daily life?

main

Ans. Environmental Chemistry

Environmental chemistry is used to protect water that has been poisoned by soil, and dust by using different methods e.g., sedimentation, filtration, and disinfection.

Physical Chemistry

Physical chemistry is a part of our everyday life. The batteries in our vehicles are built on the principle of electrochemistry.

Q.32. How does chemistry help a doctor to know about the chemical nature of medicine?

main

Ans. The knowledge of chemistry helps a doctor to know about the chemical nature and chemical composition of medicine. It helps us know the relations between medicines and biological targets.

Q.33. What is polythene & how it is made?

main

Ans. Polythene bag is made up of polymer called polythene. It is made up of repeatedly joined ethene molecule.

Q.34. What is the role of science and technology in the field of chemistry?

main

Ans. Science and technology play a major role in the field of chemistry by providing tools, machines, techniques and methods which can help in discovery and development of new materials. These also help in improving quality of products. Technology has revolutionized

the field of chemistry making research and applications more efficient. It has enabled chemists to more effectively analyze and identify substances. Their work is beneficial for chemists working in pharmaceutical and chemical industries.

Q.35. What is engineering?

main

Ans. Engineering is the use of science and mathematics to design and construct systems, structures, and tools for various processes. Chemical engineers develop and design manufacturing processes for the production of chemicals, fuels, food medicines, polymers, detergents, paper etc. They often work to maximize productivity and product quality.

Q.36. How science, technology and engineering help us in investigating rusting of iron?

main

Ans. Imagine trying to figure out why a bike or car will rust over time. Scientists could investigate the chemical reactions that occur between iron, water and oxygen that cause rust to form. Experiments could be conducted to understand the factors that influence this process and help develop strategies to prevent rust.

Q.37. How science, technology and engineering help us to use of solar energy?

main

Ans. Scientists may study the principles of photovoltaic cells to understand how sunlight can be converted into electricity. Technologists can develop solar panels based on the scientific principles discovered. Engineers play their role in designing and implementing large-scale renewable energy systems. For instance, an electrical engineer might design the wiring and connections of a solar power plant, a civil engineer could be involved in designing the infrastructure. In this example, science helps us understand the underlying principles of converting



sunlight into electricity. Technology transforms this knowledge into practical applications, such as solar panels and energy storage systems. Engineering takes these technologies and implements them on a larger scale. Together, science, technology, and engineering contribute to the development and utilization of sustainable energy sources.

Q.38. How science, technology and engineering help us to design a water filtration system? medium

Ans. Let's look at how engineers design water filtration systems. Chemical engineers can help develop process to remove contaminants from water while mechanical engineers design physical components. Together, they create a solution to clean drinking water for a community. From understanding chemical reactions to using technological devices to solving practical problems through engineering.

SLOs Based Additional Short Questions (Reference Material)

Q.41. What are the contributions of Galileo towards science & technology? Give examples. medium

Ans. Galileo Galilei did not simply build a telescope (technology); he used it to observe celestial bodies, leading to groundbreaking discoveries about planetary motion (science). Other examples include:

- Observing the stars to understand the formation of galaxies (Astronomy).
- Experimenting with chemicals to explain how they react (chemistry).
- Analyzing light waves to discover their properties (physics).

Q.39. How science, technology and engineering help us in field of food? medium

Ans. How do you make French fries. The oil used to fry potatoes contains carbohydrates, which are organic molecules. Scientists study carbohydrates to learn more about how they work, so food technologists extract oil from seeds. Chemical engineers design oil production equipment and processes, so that oil is produced efficiently and safely for cooking.

Q.40. How science, technology and engineering help in manufacturing of plastic bags? medium

Ans. Scientists study the small building blocks known as monomers. When monomers combine, they form long chains known as polymers. One of these long chains is polyethylene, which is one of the many polymers found in plastic bags! Engineers and technicians use these discoveries to create bags that are durable, flexible and easy to make.

Q.42. What are the role played by engineers towards science & technology? Give examples. medium

Ans. Based on the understanding of electromagnetism (science), engineers developed MRI machines, revolutionizing medical imaging technology. Other examples include:

- Building telescopes to study distant galaxies based on astronomical knowledge.
- Developing new medicines based on our understanding of chemical reactions.
- Creating lasers based on the science of light behavior.



Q.43. Differentiate between science, technology and engineering in aspects of focus. medium
Ans.

Aspect	Science	Technology	Engineering
Focus	Science is about understanding.	Technology is about application.	Engineering is about problem solving.

Q.44. Differentiate between science, technology and engineering in aspects of process. medium
Ans.

Aspect	Science	Technology	Engineering
Process	Science uses observation and experimentation.	Technology uses design and development.	Engineering uses analysis and building.

Q.45. Differentiate between science, technology and engineering in aspects of output. medium
Ans.

Aspect	Science	Technology	Engineering
Output	Science generates knowledge.	Technology creates tools.	Engineering builds solutions.

Q.46. Define polymerization and what you know about different types of polymer. medium

Ans. The process of linking monomers together to form a molecule of high molecular mass is called polymerization. There are many different types of polymer (plastic), including polythene, PVC, Perspex, Teflon and polystyrene. Polymers contain very large molecules, often with hundreds or thousands of atoms. Within each molecule, the atoms are joined to each other by covalent bond.

Q.47. There are two branches of chemistry categorised in chemistry of life. Name these branches. Give reason for your answer. medium

Ans. The two branches of chemistry that are categorised under the chemistry of life are organic chemistry and biochemistry.

Organic chemistry focuses on the study of carbon-based compounds, which are essential for life. While biochemistry examines the chemical processes that occur within living organisms.



Matter

Q.1. Define the term allotropes explain the allotropes of carbon. (10 MARKS)

Ans. The property of an element to exist in different physical forms is called allotropy. These different forms in the same physical state are called allotropes. Atoms of the same element arranged in different manners in the same physical state is allotropes. They are different structural forms of the same element. For example,

Diamond, graphite and buckyballs are three important allotropes of carbon.

a) **Graphite**

Graphite is composed of flat two dimensional layers of hexagonally arranged carbon atoms. In a layer, each C-atom is covalently bonded to three other Carbon atoms. Weak intermolecular bonds exist between each layer which allows the layers to slide over one another without breaking the bonds. This arrangement makes graphite soft and slippery, making it ideal to be used as a lubricant. Graphite is a good conductor of electricity.

b) **Diamond**

Diamond is the hardest and the purest crystalline allotrope of carbon. In its structure, each C-atom is covalently bonded to four other carbon atoms forming rigid network of tetrahedral shape. This tetrahedral, three-dimensional arrangement makes it the hardest substance with a very high melting point. Since all the Carbon atoms are bonded with other carbon atoms, no free electrons are present resulting in the structure being non-conductive. Diamond is non-conductor of electricity.)

c) **Buckyballs (C-60)**

Buckyballs, also known as fullerenes, have a football like fused hollow ring structure made up of twenty hexagons and twelve pentagons. Each of its 60 carbon atoms are bonded to 3 carbon atoms.

Q.2. What is difference between Homogeneous and heterogeneous solution? (10 MARKS)

Ans. Mixture

Definition

Properties: When two or more elements or compounds mix-up physically without any fixed ratio, they form a solution.

- On mixing up, the component substances retain their own chemical identities and properties.
- The mixture can be separated into parent components by physical methods such as distillation, filtration, evaporation, crystallization or magnetization.

Classification:

i. **Homogeneous Solution:**

Solution that have uniform composition throughout are called homogeneous solution e.g. HCl , gasoline, ice cream.

ii. **Heterogeneous Solution:**

Heterogeneous solution are those in which composition is not uniform throughout e.g. soil, rock and wood.



Q.3. Differentiate between the colloids, suspension and solution. (10 MARKS)

Colloids	Suspension	Solution
A heterogeneous mixture of two or more components	A heterogeneous mixture of two more components	The particles exist in their simplest form i.e. as molecules or ions. Particles dissolve uniformly throughout and form a homogeneous mixture.
Particle size vary from $1-10^3$ nm. Visible by naked eye.	Particle size greater than 10^3 nm. Visible by naked eye.	Their diameter is 10^{-7} cm. Particles are so small that they can't be seen with naked eye.
Particles can pass through normal filter paper but not through ultra-filter paper	Particles can pass through normal as well as ultra-filter paper	Solute particles can pass easily through a filter paper.
Can scatter the light (Tyndall effect)	Can scatter the light (Tyndall effect)	Particles are so small that they cannot scatter the rays of light, thus do not show Tyndall effect.
Does not separate	Separate or settles down when stationary	The solute particles can be separated from solution by chemical means.
Example: Milk	Example: Muddy water	Example: In sugar solution, sugar is solute and water is solvent.

Q.4. How can you identify solvent and solute? (10 MARKS)

Ans. Solute:

The component of solution which is present in smaller quantity is called solute. Solute is dissolved in solvent to make a solution, e.g. In water solution, salt is solute.

Solvent:

The component of a solution which is present in larger quantity is called solvent, e.g. in sugar solution, sugar is solute and water is solvent.

Q.5. If there are 18 protons in the Argon atom, then what is the atomic number of argon? (10 MARKS)

Ans. If there are 18 protons in the argon atom, then the atomic number of argon (noble gas) is also 18. Because, atomic number is the number of protons present in the nucleus of an atom.

Q.6. Describe the state of matter with example. (10 MARKS)

Ans. Matter can exist in five states: Solid, liquid, gas, plasma and BEC.

Solid State

A solid is a state of matter with a fixed shape and volume. e.g. ice or a rock.

Liquid State

A liquid is a state of matter that flows and takes the shape of its container e.g. water or juice.

Gas State

A gas is a state of matter that has no fixed shape or volume e.g. air or steam.

Plasma State

Plasma is the fourth state of matter. It is an ionized gas, it consists of positively and negatively charged particles e.g. lightning, fluorescent light and stars like the sun.

Bose-Einstein Condensates (BEC)

BEC are unique state of matter that occurs at low temperature they are formed when a group of bosons particles with integer spin, come together and occupy the same quantum state. E.g. superfluid helium and ultracold atoms trapped in a laboratory setting.

Q.7. Differentiate between the following. (10 MARKS)

- Colloids and suspensions
- Elements and compounds
- Concentrated and dilute solutions



Colloid	Suspension
A heterogeneous mixture of two or more components.	A heterogeneous mixture of two or more components.
Particle size vary from 1-10 ³ nm. Visible by naked eye by naked eye.	Particle size greater than 10 ³ nm. Visible by naked eye by naked eye.
Particles can pass through normal filter paper but not through ultra-filter paper.	Particles can pass through normal as well as ultra-filter paper.
Can scatter the light (Tyndall effect).	Can scatter the light (Tyndall effect).
Does not separate.	Separate or settle down when stationary.
Example: Milk.	Example: Muddy water.

b) Elements and Compounds

Elements

The simplest form of matter made up the same type of atoms, having same atomic numbers and cannot be broken down into chemical means.

Compounds

A substance formed when two or more different atoms chemically combine, undergo a chemical reaction to form a new substance called compound.

Dilute and Concentrated Solution

c) Dilute solution:

Dilute solutions are those which contain relatively small amount of dissolved solute in the solution.

Concentrated solution:

Concentrated solutions are those which contain relatively large amount of dissolved solute in the solution are called concentrated solutions.

Example:

(i) Brine is a concentrated solution of common salt in water. Addition of more solvent will dilute the solution and its concentration decreases.

(ii) 0.5M NaOH solution is dilute solution as compared to 1M NaOH solution (Concentrated Solution).

Q.8. Examine the concept of solubility.

Ans. Solubility:

The number of grams of the solute dissolved in 100g of solvent to prepare a saturated solution at a particular temperature is called solubility.

General Principle of Solubility:

- The general principle of solubility is, like dissolves like. Na_2CO_3 , CaSO_4 .
- Polar substances are soluble in polar solvents, ionic solids and polar covalent compounds are soluble in water (Polar Solvent) e.g. KCl , Na_2CO_3 , CaSO_4 , sugar and alcohol are all soluble in water.
- Non-polar substances are not soluble in polar solvents. Non-polar covalent compounds are not soluble in water such as ether, benzene and petrol are insoluble in water.
- Non-polar covalent substances are soluble in non-polar solvents (mostly organic solvents). Grease, paints, naphthalene are soluble in ether or carbon tetrachloride.

2. Solute - Solvent Interaction

3. Temperature



Think Tank

Q.9. Why is relative consider mixture?

Ans. Because components of a solution show their property. They can be separated by physical means and can be mixed in any ratio.

Q.10. How will you test whether given solution is a colloid or a solution?

Ans. If a solution causes the scattering of light (Tyndall effect) it is a colloidal solution while a solution showing no Tyndall effect is not a colloidal solution.

Multiple Choice Question (Exercise)

Select the correct answer:

1. Anything that has mass and occupies space is called: answer

- (a) liquid (b) gas
(c) solid (d) matter

2. Following are states of matter: answer

- (a) gas (b) liquid
(c) solid (d) all of these

3. Macroscopic properties are properties that can be visualized by: answer

- (a) the naked eye
(b) microscope

(c) electron microscope

(d) telescope

4. Matter can be described by both its: answer

- (a) physical properties and chemical properties
(b) physical properties
(c) chemical properties
(d) none of these

5. A substance formed when two or more different combine chemically, answer

- (a) atom (b) compound
(c) element (d) solution

SLO Based Additional MCQs

Select the correct answer:

6. How many states of matter exist? answer

- (a) One (b) Two
(c) Three (d) Four

7. In which state matter does not have definite shape and volume? answer

- (a) Solid (b) Liquid
(c) Gas (d) All of these

8. Pressure is a significant property of: answer

- (a) Solid (b) Liquid
(c) Gas (d) None of these

9. Which state of matter has fixed shape and volume? answer

- (a) Solid (b) Liquid
(c) Gas (d) All of these

10. The simplest form of matter is: answer

(a) Gas (b) Liquid

(c) Solid (d) Both 'b' and 'c'

11. Building block of all matter is: answer

- (a) element (b) compound
(c) atom (d) mixture

12. Mixture can be separated by means of: answer

- (a) Nuclear method
(b) Chemical method

- (c) Physical method
(d) All of these

13. Number of protons in the nucleus of an atom is called: answer

- (a) Mass no. (b) Atomic no.
(c) Electron no. (d) Mass Unit

14. Atom is electrically: answer

- (a) Positive particle
(b) Negative particle



- (c) Neutral particle
(d) None of these
15. Fourth state of matter is: 00140001
(a) Solid (b) Liquid
(c) Gas (d) Plasma
16. A piece of matter in its pure form is called: 00140001
(a) Element (b) Substance
(c) Mixture (d) Matter
17. Example of heterogeneous mixture is: 00140001
(a) Air (b) Gasoline
(c) Ice cream (d) Soil
18. A piece of matter in impure form is termed as: 00140001
(a) Mixture (b) Compound
(c) Substance (d) All of these
19. The properties that are associated with physical state of matter are called: 00140001
(a) Chemical properties
(b) Physical properties
(c) Nuclear Properties
(d) None of these
20. The properties which depend upon the composition of the substance are called: 00140001
(a) Physical properties
(b) Chemical properties
(c) Atomic Properties
(d) Nuclear Properties
21. The most abundant gas present in atmosphere is: 00140001
(a) Nitrogen (b) Oxygen
(c) Argon (d) Carbon dioxide
22. Formula of common salt is: 00140001
(a) NaOH (b) CaO
(c) CaCO₃ (d) NaCl
23. Which one of the following represents Sand? 00140001
(a) SiO₂ (b) H₂O
(c) NaCl (d) CaCO₃
24. Sodium Hydroxide is also known as: 00140001
(a) Washing Soda (b) Caustic Soda
- (c) Soda Ash (d) Quick lime
25. Washing Soda is represented by the formula: 00140001
(a) NaOH (b) CaO
(c) CaCO₃ (d) Na₂CO₃·10H₂O
26. Limestone is another name of: 00140001
(a) Sodium hydroxide
(b) Calcium Carbonate
(c) Sodium Carbamate
(d) Silicon dioxide
27. Formula of Caustic Soda is: 00140001
(a) CaH₂O₃ (b) CaH₂O₄
(c) CaO (d) NaOH
28. Symbol of Tungsten metal is: 00140001
(a) Al (b) Ti
(c) W (d) As
29. Which is chemical formula of Quick lime? 00140001
(a) CaCO₃ (b) CaO
(c) NaOH (d) NaCl
30. Example of homogeneous mixture is: 00140001
(a) Soil (b) Rock
(c) Wood (d) Gasoline
31. Which one of the following is a mixture? 00140001
(a) Sugar (b) Table Salt
(c) Blood (d) Tin
32. Symbol of Barium element is: 00140001
(a) Br (b) Be
(c) Bi (d) Ba
33. Formula of ozone is: 00140001
(a) O₂ (b) O₃
(c) S₈ (d) CO₂
34. Formula of sugar is: 00140001
(a) C₁₂H₂₂O₁₁ (b) C₆H₁₂O₆
(c) NH₃ (d) CH₃COOH
35. A good example of homogeneous mixture is: 00140001
(a) Soil (b) Rock
(c) Wood (d) Ice-cream
36. Allotropes of oxygen are: 00140001
(a) 2 (b) 4
(c) 3 (d) 5

37. Graphite is _____ conductor of electricity. 00140001
(a) good (b) bad
(c) moderate (d) none of these
38. In diamond, each C-atom is covalently bonded with _____ C-atoms. 00140001
(a) two (b) three
(c) four (d) five
39. Diamond is _____ 00140001
(a) conductor (b) non-conductor
(c) both a and b (d) none of these
40. The structure of C-atom in diamond is _____ 00140001
(a) pentagonal (b) tetrahedral
(c) triangle (d) hexahedral
41. Buckyballs also known as _____ 00140001
(a) graphite (c) fullerenes
(b) both a and b (d) none of these
42. Mist is an example of solution: 00140001
(a) Liquid in gas (b) Gas in liquid
(c) Solid in gas (d) Gas in solid
43. Which one of the following is a 'liquid in solid' solution? 00140001
(a) Sugar in water (b) Butter
(c) Opal (d) Fog
44. Which one of the following will show negligible effect of temperature on its solubility? 00140001
(a) KCl (b) KNO₃
(c) NaNO₃ (d) NaCl
45. Which one of the following is heterogeneous mixture? 00140001
(a) Milk
(b) Ink
(c) Milk of magnesia
(d) Sugar solution
46. Tyndall effect is shown by: 00140001
(a) Sugar solution (b) Paints
(c) Jelly (d) Chalk solution
47. Tyndall effect is due to: 00140001
(a) Blockage of beam of light
(b) Non-scattering of beam of light
(c) Scattering of beam of light
(d) Passing through beam of light
48. Which one of the following solvents is polar? 00140001
(a) Benzene (b) Water
(c) Ether (d) Petrol
49. Solubility of which salt increases with the increase of temperature: 00140001
(a) KNO₃ (b) NaNO₃
(c) KCl (d) All of these
50. The solubility of which salt decreases with the increase of temperature? 00140001
(a) KNO₃ (b) NaNO₃
(c) Li₂SO₄ (d) KCl
51. Which of the following shows Tyndall effect? 00140001
(a) Albumin (b) Milk
(c) Paints (d) Both a and b
52. Which one is example of colloid? 00140001
(a) Jelly
(b) Paints
(c) Milk of magnesia
(d) None of these
53. Which one is a suspension? 00140001
(a) Blood (b) Toothpaste
(c) Ink (d) Chalk in water
54. Brass is a solid solution of Zn and: 00140001
(a) C (b) Sn
(c) Fe (d) Cu
55. In soft drinks, CO₂ is: 00140001
(a) Solvent (b) Solute
(c) Solution (d) None of these
56. Air is an example of solution: 00140001
(a) Gas in liquid (b) Liquid in liquid
(c) Gas in gas (d) Solid in gas
57. Hydrogen adsorbed in palladium is an example of solution: 00140001
(a) Solid in gas (b) Solid in liquid
(c) Gas in gas (d) Gas in solid
58. Example of liquid-gas solution is: 00140001
(a) Mist
(b) Fog
(c) Liquid Air pollutants
(d) All of these



59. Smoke in air is example of solution:

- (a) Gas in gas (b) Solid in liquid
(c) Solid in gas (d) All of these

60. Example of solid in solid solution is:

- (a) Brass (b) Bronze
(c) Opals (d) All of these

61. Example of liquid in liquid is:

- (a) Alcohol in water
(b) Butter in water
(c) Fog
(d) Mist

62. Metal alloys are:

- (a) Solution of solid in gas
(b) Solution of solid in liquid
(c) Solution of solid in solid
(d) Solution of gas in solid

63. Which one of the following is suspension?

- (a) Milk of magnesia
(b) Sugar Solution
(c) Ink
(d) Milk

64. The example of solution of a solid solute in a solid solvent.

- (a) Fog (b) Brass
(c) Cheese (d) Air

65. Which one of following is solid in gas solution?

- (a) Smoke in air (b) Butter
(c) Brass (d) Fog

66. The acid used in vinegar is:

- (a) H_2SO_4 (b) HNO_3
(c) HCl (d) CH_3COOH

Answer Key

1	d	2	d	3	a	4	a
5	b	6	c	7	c	8	c
9	a	10	a	11	c	12	c
13	b	14	c	15	d	16	b
17	d	18	a	19	b	20	b
21	a	22	d	23	a	24	b
25	d	26	b	27	d	28	c
29	b	30	d	31	c	32	d
33	b	34	a	35	d	36	a
37	a	38	c	39	b	40	b
41	b	42	a	43	b	44	d
45	c	46	c	47	c	48	b
49	d	50	c	51	d	52	a
53	d	54	d	55	b	56	c
57	d	58	d	59	c	60	d
61	a	62	c	63	a	64	b
65	a	66	d				



Short Questions (Exercise)

Q.1. Can you write the formula of the carbon dioxide gas that we exhale?

Ans. The formula of the carbon dioxide gas that we exhale is (CO_2) .

Q.2. Define the element, Compound, Mixture.

Ans. Element

The simplest form of matter made up the same type of atoms, having same atomic number and cannot be broken down into chemical means.

Compound

When two or more elements chemically

combine, meaning undergo a chemical reaction to form a new substance, this is called a compound. As this is a completely new substance, it is completely different from the elements that were used to make it.

Mixture

Mixtures are the physical combinations of substances. A mixture that does not contain the same types of particles.

It is a substance formed when two or more substance physically combine.

Q.3. Differentiate between compound and mixture.

Sr.	Compound	Mixture
i.	It is formed by a chemical combination of atoms of elements.	Mixture is formed by the simple mixing up of the substances.
ii.	The constituents lose their identity and form a new substance having entirely different properties from them.	Mixture shows the properties of the constituents.
iii.	Compounds always have fixed composition by mass.	Mixtures do not have fixed composition.
iv.	The components cannot be separated by physical means.	The components can be separated by simple physical methods.
v.	Every compound is represented by a chemical formula.	It consists of two or more components and does not have any chemical formula.
vi.	Compounds have homogeneous composition.	They may be homogeneous or heterogeneous in composition.
vii.	Compounds have sharp and fixed melting points.	Mixtures do not have sharp and fixed melting points.

Q.4. Differentiate between concentrated and dilute solution.

Ans.

Ans. Dilute solution:

Dilute solutions are those which contain relatively small amount of dissolved solute in the solution.

Concentrated solution:

Concentrated solutions are those which contain relatively large amount of dissolved solute in the solution are

called concentrated solutions.

Example:

- i) Brine is a concentrated solution of common salt in water. Addition of more solvent will dilute the solution and its concentration decreases.
ii) 0.5M NaOH solution is dilute solution as compared to 1M NaOH solution (Concentrated Solution).



SLO Based Additional Short Questions (Reference Material)

Q.5. Define matter. Give examples. 01-02001
Ans. Anything that has mass and occupies space is called matter. This makes air, water, rocks and even people are examples of matter.

Q.6. What are the physical states of matter? 01-02001

Ans. There are five states of matter.

i) Gas ii) Liquid

iii) Solid iv) Plasma

v) Bose-Einstein condensates

Q.7. How can matter change its state? 01-02001

Ans. Energy can change matter into different states. For example, solids become liquids or gases when heated. At very high temperatures or when subjected to a strong electric field, the gas transforms into plasma. Under normal conditions, most substances remain in one distinct state: solid, liquid or gas. Temperatures and energy levels on the earth are not sufficient to ionize atoms and create plasma.

Q.8. What is liquid crystal? 01-02001

Ans. When heated, some crystalline solids turn into cloudy liquids that completely dissolve. This cloudy state is called liquid crystal. Liquid crystal states have many properties of liquids and some properties of solids. This form exists within a certain temperature range. When heated further, the state of the liquid crystal changes to a transparent liquid.

Q.9. Define BEC. 01-02001

Ans. Bose-Einstein condensates (BEC) is the state of matter in which separate atoms cooled to temperatures very close to absolute zero. BEC is observable under extreme conditions of cold temperature. Superfluid and superconductors are the two main materials which contain BEC.

Q.10. Why are the densities of gases lower than that of liquids? 01-02001

Ans. Densities of gases are 1000 times lesser than liquids because there are large empty spaces between the molecules of gases. Due to large volume and small mass, the density of gases is lower than liquids.

Q.11. Why are the gases compressible? 01-02001

Ans. Gases are highly compressible due to empty spaces between their molecules. When gases are compressed, the molecules come closer and occupy less volume as compared to uncompressed state.

Q.12. What are classification of matter? 01-02001

Ans. Matter can be classified as:

1. Pure substance

a) Element b) Compound

2. Mixture

a) Homogeneous

b) Heterogeneous mixture are

i) Colloid

ii) Suspension

Q.13. Define element. 01-02001

Ans. Element

The simplest form of matter made up of the same type of atoms, having same atomic numbers and cannot be broken down into chemical mean.

Q.14. Define compound. 01-02001

Ans. When two or more elements chemically combine, meaning undergo a chemical reaction to form a new substance, this is called a compound.

Q.15. Define mixture. Give example and allotropes. 01-02001

Ans. Mixtures are the physical combinations of substances. A mixture that does not contain the same types of particles.

It is a substance formed when two or more substance physically combine without any fixed ratio by mass.

Q.16. Define the term allotropy with examples. 01-02001

Ans. The property of an element to exist in different physical forms is called allotropy. These different forms in the same physical state are called allotropes. Atoms of the same element arranged in different manners in the same physical state in allotropes. They are different structural forms of the same element. For example,

Diamond, graphite and buckyballs are three important allotropes of carbon.

Q.17. What do you know about graphite? 01-02001

Ans. Graphite is composed of flat two dimensional layers of hexagonally arranged carbon atoms. In a layer, each C-atom is covalently bonded to three other Carbon atoms. Weak intermolecular bonds exist between each layer which allows the layers to slide over one another without breaking the bonds. This arrangement makes graphite soft and slippery, making it ideal to be used as a lubricant. Graphite is a good conductor of electricity.

Q.18. What is the structure of diamond? 01-02001

Ans. Diamond is the hardest and the purest crystalline allotrope of carbon. In its structure, each C-atom is covalently bonded to four other carbon atoms forming rigid network of tetrahedral shape. This tetrahedral, three-dimensional arrangement makes it the hardest substance with a very high melting point. Since all the Carbon atoms are bonded with other carbon atoms, no free electrons are present resulting in the structure being non-conductive. Diamond is non-conductor of electricity.

Q.19. How bucky balls are made? 01-02001

Ans. Buckyballs, also known as fullerenes, have a football like fused hollow ring structure made up of twenty

hexagons and twelve pentagons. Each of its 60 carbon atoms are bonded to 3 carbon atoms.

Q.20. Define solution. 01-02001

Ans. A solution is a homogeneous mixture of two or more substances in which one substance is dissolved in the other.

Q.21. Differentiate between solute and solvent with the help of examples. 01-02001

Ans. The component of solution which is present in smaller quantity is called solute. Solute is dissolved in solvent to make a solution, e.g. In salt in water solution, salt is solute.

Solvent:

The component of a solution which is present in larger quantity is called solvent, e.g. In sugar solution, sugar is solute and water is solvent.

Q.22. What are physical states of solutions? 01-02001

Ans. Solutions are found in three physical states depending upon the physical state of solvent e.g. brass is a solid solution of Zn and Cu, sea water is liquid solution and air is a gaseous solution. Liquid solutions are the most common solutions because of the most common solvent that is water.

Q.23. Give examples of gases solution. 01-02001

Ans. In gaseous solutions solvent is a gas and solute can be a gas or liquid or solid. For example a mixture of nitrogen and hydrogen used in Haber's process (ammonia formation) and other is mixture of ammonia and carbon dioxide used for urea preparation. Fog, clouds and mist are examples of solutions where liquid water (solute) is dissolved in air (solvent). Smoke is a solution of carbon particle in gaseous air in our daily life.



Q.24. Give examples of liquid solutions.

ANSWER

Ans. Carbonated drinks are solutions where solvent is liquid water and solute is gaseous carbon dioxide. Rectified spirit produced by fermentation of sugar cane, vinegar (acetic acid in water), are examples of solutions where liquid dissolved in liquid. Brine and sugar syrup are solutions of solid salt and sugar in water.

Q.25. Give examples of solid solutions.

ANSWER

Ans. Hydrogen gas on the nickel metal surface is used in ghee industry where hydrogen gas is solute and nickel catalyst is solvent. Solution of any metal (solid) in liquid mercury is called amalgam. Alloy industry is very common these days. Alloys are formed by mixing different metal (brass, bronze, steel).

Q.26. What is alloy? Give an example.

ANSWER

Ans. Alloy is a homogeneous mixture of one metal with one or more other metals or non-metals. For example stainless steel is an alloy of iron, chromium and nickel.

Q.27. Write down example of a solution in which solute is liquid and solvent is gas.

ANSWER

Ans. Mist, fog and liquid air pollutants are some examples of the solutions in which solute is liquid and solvent is a gas.

Q.28. Give an example of 'Gas in solid' solution.

ANSWER

Solute	Solvent	Example of Solution
Gas	Solid	Hydrogen adsorbed on palladium.

Q.29. What is aqueous solution?

ANSWER

Ans. The solution which is formed by dissolving a substance in water is called an aqueous solution, e.g. sugar dissolved in water.

Q.30. Why water is called a universal solvent?

ANSWER

Ans. Water is called a universal solvent because it dissolves majority of compounds present in Earth's crust. Water is a polar solvent. Due to this polar covalent compounds and ionic compounds mostly dissolve in it.

Q.31. Define a saturated solution and give example.

ANSWER

Ans. A solution containing maximum amount of solute at a given temperature is called a saturated solution. On particle level, a saturated solution is the one, in which undissolved solute is in equilibrium with dissolved solute, e.g. 20.9g of sodium thiosulphate ($\text{Na}_2\text{S}_2\text{O}_4$) dissolved in 100cm^3 of water at 20°C makes saturated solution of this salt.

Q.32. Define unsaturated solution.

ANSWER

Ans. A solution which contains lesser amount of solute than that which is required to saturate it at a given temperature, is called unsaturated solution, e.g. $0.1\text{ M Na}_2\text{S}_2\text{O}_4$ solution.

Q.33. Define supersaturated solution.

ANSWER

Ans. The solution that is more concentrated than a saturated solution is known as supersaturated solution. For example if $\text{Na}_2\text{S}_2\text{O}_4$ at 20°C in 100cm^3 water is more than 20.9g then it is supersaturated solution of $\text{Na}_2\text{S}_2\text{O}_4$.

Q.34. How unsaturated solution can be prepared?

ANSWER

Ans. Take 100g water in a beaker. Add a tea spoon of sugar in it. Stir it. The sugar will dissolve. Repeat the process and the added sugar will again dissolve in it. A solution which can dissolve more of the solute at a given temperature is called an unsaturated solution.

Q.35. How saturated solution can be prepared?

ANSWER

Ans. Go on adding sugar in the unsaturated solution till it starts settling

down at the bottom of the beaker at a particular temperature. The solution which cannot dissolve more solute at a particular temperature is called a saturated solution.

Q.36. How super-saturated solution can be prepared?

ANSWER

Ans. Heat the solution, stir it, add more sugar and it will dissolve. Go on adding more sugar and stir it. A stage will reach when no more sugar will dissolve and will start settling down at the bottom of the beaker. This solution is called supersaturated solution. A solution that contains more of the solute than is contained in the saturated solution is called supersaturated solution.

Q.37. How to know whether a solution is saturated or super-saturated?

ANSWER

Ans. Add a Seed Crystal or Small Amount of Solute. Carefully add a small crystal of the solute to the solution. If the crystal dissolves: The solution is unsaturated.

If the crystal does not dissolve and remains unchanged: The solution is saturated.

If the crystal causes more solute to precipitate out of the solution: The solution is supersaturated. In a supersaturated solution, the addition of a seed crystal can trigger the excess solute to crystallize out rapidly.

Q.38. Distinguish between the following pairs as compound or solution.

ANSWER

- Water and salt solution
- Vinegar and benzene
- Carbonated water and acetone

Ans. (a) Water is compound and salt solution is solution.

(b) Vinegar is solution and benzene is a compound.

(c) Carbonated water is solution and acetone is compound.

Q.39. What is the major difference between a solution and a mixture?

ANSWER

Ans. A solution is always homogeneous

but mixture may be homogeneous or heterogeneous.

Q.40. What is the difference between dilute & concentrated solution?

ANSWER

Ans. Dilute solutions

Dilute solutions are those which contain relatively small amount of dissolved solute in the solution.

Concentrated solutions

Concentrated solutions are those which contain relatively large amount of dissolved solute in the solution are called concentrated solutions.

e.g. 0.5M NaOH solution is dilute solution as compared to 1M NaOH solution (Concentrated Solution).

Q.41. Define solubility.

ANSWER

Ans. Solubility is defined as the number of grams of the solute dissolved in 100g of solvent to prepare a saturated solution at a particular temperature. Its factors are: (i) like dissolves the like (ii) solute-solvent interaction (iii) effect of temperature.

Q.42. Justify with example that solubility of a salt increases with increase in temperature.

ANSWER

Ans. When a salt like KNO_3 is dissolved in water, heat is absorbed. It means heat is required to break the attractive forces between ions of solute. Therefore solubility of such salt increases with increase of temperature.

Q.43. Why does solubility of Li_2SO_4 and $\text{Ce}_2(\text{SO}_4)_3$ decrease with increase of temperature?

ANSWER

Ans. Li_2SO_4 and $\text{Ce}_2(\text{SO}_4)_3$ dissolve in water with the evolution of heat, therefore solubility of such salts decrease with the increase of temperature. In such cases attractive forces among the solute particles are weaker and solute-solvent interaction are stronger. As a result, there is release of energy.



Q.44. Which one of the following solutions is more concentrated; one molar or three molar?

Ans. Three molar solution is more concentrated than one molar solution because 3M solution contains 3.0 moles of solute dissolved in it.

Q.45. Why does suspension and solution not show Tyndall effect while colloids do?

Ans. Because particles of colloids are big enough to scatter the beam of light but there is no scattering of light by particles of solution because they are so small they cannot scatter the rays whereas particles of suspensions are so big that light is blocked.

Q.46. What is the reason for the difference between solutions, colloids and suspensions?

Ans. In solution particles are very small. In colloid, particles are larger than solution particles. In suspension particles are big enough to be seen with naked eye and do not dissolve in solvent.

Q.47. Why does the suspension not form a homogeneous mixture?

Ans. Particles in suspension remain undissolved and settle down after some time. Therefore suspension does not form a homogeneous mixture.

Q.48. Why do we stir paints thoroughly before using?

Ans. Paint is a suspension. In suspension particles remain undissolved and settle down. Due to this we stir paints thoroughly before using.

Q.49. Which of the following will scatter light and why? Sugar solution, Soap solution, Milk of Magnesia.

Ans. Sugar solution:
Sugar solution will not scatter light because particles of solution are so small that they cannot scatter light.

Soap solution:

Soap solution scatter the light because it is colloidal solution and its particles are large enough that they can scatter light i.e. exhibit the Tyndall effect.

Milk of magnesia:

Milk of magnesia cannot scatter the light because it is suspension and its particles are so big that light is blocked.

Q.50. What is the difference between colloid and suspension?

Ans. Colloid: In colloid particles are larger than those present in the true solution. The solute particles can pass through the filter paper. It shows Tyndall effect.

Suspension:

Suspension is a heterogeneous mixture of undissolved particles in given medium. Solute particles are bigger which cannot pass through the pores of filter paper. It blocks the light and does not show Tyndall effect.

Q.51. Can colloids be separated by filtration, if not why?

Ans. Colloids cannot be separated by filtration. Because particles are not so big and pass through the filter paper.

Q.52. What is Tyndall effect and on what factors does it depend?

Ans. The scattering of beam of light by particles of colloids is called Tyndall effect. It depends upon the size of particles.

Q.53. Why are the colloids quite stable?

Ans. Colloids are quite stable because particles do not settle down for a long time.

Q.54. Identify as colloids or suspension from the following:

Paints, milk, milk of magnesia, soap solution.

Ans. Suspension: Paints, milk of magnesia.

Colloid: Soap solution, milk.



Q.55. How can you justify that milk is a colloid?

Ans. Milk is colloid because particles of milk do not settle down for a long time. These particles are large but can not be seen by naked eye and these particles cause the scattering of beam of light and therefore, show Tyndall effect.

Q.56. Classify the following into true solution and colloidal solution.

Blood, starch solution, Glucose solution, toothpaste, copper sulphate solution, silver nitrate solution.

Ans. True solution:

Glucose solution, copper sulphate solution, silver nitrate solution.

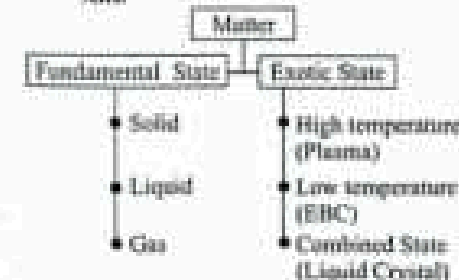
Colloidal solution:

Blood, starch solution, toothpaste.

SI-De Based Additional Short Questions (Reference Material)

Q.59. What are the fundamental and exotic states of matter?

Ans.



Q.60. What is kinetic theory of particles?

Ans. The kinetic theory of particles explains the relationship between particle arrangement and properties of solids, liquids and gases.

- All matter is made up of tiny particles in constant motion.
- The type of particles varies across different matters.
- Particles movement is proportional to temperature.

Q.57. How saturated solution become super saturated solution?

Ans. A supersaturated solution can be prepared by preparing a saturated solution of a respective salt at high temperature. It is, then cooled to a temperature where excess solute crystallizes out and leaves behind a saturated solution. A solution having more amount than 20.9g of sodium thiosulphate per 100cm³ of water at 20°C will be a supersaturated solution.

Q.58. Why is a solution considered mixture?

Ans. Because components of a solution show their properties. They can be separated by physical means and can be mixed in any ratio.

- Lighter particles move more swiftly than heavier ones at a given temperature.

Q.61. Why solids are non-compressible and cannot diffuse?

Ans. In solids, the atoms or molecules are tightly packed in fixed positions. Although they can vibrate, they cannot move past each other. This close arrangement makes solids have a fixed volume and a rigid shape.

For example, substances such as ice, aluminium and diamond are solids at room temperature. Solids are non-compressible and cannot diffuse into each other due to this reason.

Q.62. Why solids have high density?

Ans. Solids generally have high density because their particles are closely packed together. They lack fluidity and do not flow or conform to the shape of their container.

Q.63. What is meant by liquid?

Ans. Liquids consist of atoms or molecules that are closely packed, similar to solids. However, unlike solids, the molecules in liquids can move



relative to each other, providing mobility. This characteristics allows liquids to have a fixed volume but not a fixed shape, taking the shape of their containers. For example, ice water, alcohol and gasoline are all examples of liquids at room temperature.

Q.64. What is plasma? Write its uses. 011402140

Ans. Plasma is the fourth state of matter. Naturally, plasma is present in the sun and other stars and produces though lightning. It is produced through certain high-intensity lamps on earth that are used in streetlights, gymnasiums, warehouses, large retail facilities, stadiums and plant growing rooms etc.

Q.65. How plasma is formed? 011401410

Ans. Once a gas is heated to an extremely high temperature, the electrons within its atoms begin to oscillate, potentially leading to their release from the atom itself. As a result, certain atoms may acquire a positive charge. This process gives rise to a unique state of matter known as plasma, which comprises of positively charged ions, neutral atoms and unbound electrons.

Q.66. How plasma is different from fundamental states of matter? 011401410

Ans.

Properties	Plasma
Particles	Charged particles (ions, electrons)
Shape & volume	Indefinite shape & volume
Conductivity	Excellent conductor

Q.67. Which substances are used to create BEC? 011401410

Ans. Following substances that have been used to create Bose-Einstein condensates (BECs).

- Rubidium-87 • Sodium-23
- Lithium-6 • Hydrogen-1
- Photons (light particles)
- Helium atoms etc.

Q.68. What are the properties of Bose-Einstein condensate? 011402140

Ans.

Properties	Bose-Einstein Condensate (BEC)
Particle Distribution	Large fraction of particles occupy the lowest energy state (Bose-Einstein condensate)
Temperature	Extremely low (near absolute zero)
Order	All particles in phase
Fluidity	Superfluid (no viscosity)
Conductivity	Superconductor (perfect conductivity)
Shape & Volume	Can be deformed, but maintains coherence

Q.69. What are the properties of liquid crystal? 011401410

Ans.

Properties	Liquid Crystal
Order	Partially ordered, intermediate between solid and liquid.
Shape & volume	Can flow but retains some order, variable depending on type.
Fluidity	Exhibits both rigid and fluid-like behavior depending on type.
Molecular Arrangement	Molecules arranged with some long-range order, but not a rigid structure.

Q.70. Give different examples of liquid crystal from our daily life. 011401410

Ans. A few common examples of these applications include: liquid crystal displays (LCD), Oscillographic and TV displays that also use liquid crystal screens), Forehead strip changes colour based on body temperature due to liquid crystals, Electronic liquid crystal clock with digital indication of time.

Q.71. What do you know about graphene? 011401410

Ans. Graphene is the single layer of graphite, which is extremely strong, light weight, and can be used to enhance

the strength of other materials. It has superior electrical conductivity compared to many other materials.

Q.72. How water can be decomposed into its components? 011401410

Ans. Water decomposes into its component elements, hydrogen and oxygen, when an electrical current is passed through it.

Q.73. Why do different liquids flow differently? 011401410

Ans. One important factor is viscosity. Liquids with high viscosity like honey or syrup, flow slowly because their molecules are more tightly packed and have stronger intermolecular forces. On the other hand, the liquids with low viscosity like water or alcohol flow more easily because their molecules are less tightly packed and have weak intermolecular forces.

Q.74. How is mixture of iron and sulphur different from the compound of iron sulphide? 011401410

Ans. In a mixture, the iron and sulphur particles are physically combined but can still be separated using physical methods like filtration or magnetism.

In the compound of iron sulphide, the iron and sulphur atoms chemically bond together to form a new substance with different properties. This compound cannot be easily separated into its original elements.

Q.75. Sugar dissolves in water to form a clear liquid while orange juice appears cloudy. Justify. 011401410

Ans. The reason is that sugar molecules are smaller and can be easily mix with water molecules and to form homogeneous mixture.

While orange juice contains suspended particles like pulp and fibers that do not fully dissolve in water. These particles scatter light, giving the juice a cloudy appearance.

Q.76. Can allotropy exist in other elements besides carbon? 011401410

Ans. Allotropy can exist in various elements besides carbon. For examples, oxygen can exist in two allotropes: oxygen (O_2) and ozone (O_3). Oxygen gas is colourless and odourless molecule while ozone is a pale blue gas with a distinct smell. Sulphur also exist in rhombic and monoclinic form. Phosphorus also exist in red & white allotropes form.



UNIT 03

Atomic Structure

Q.1. The electronic configurations listed are incorrect. Explain what mistake have been made in each and write correct configurations.

(1 mark)

$$x = 1s^2, 2s^2, 2p^4, 3p^2 \quad y = 1s^2, 2s^2, 2p^2 \quad z = 1s^2, 2s^2, 2p^2, 3s^1$$

Ans. $x = 1s^2, 2s^2, 2p^4, 3p^2$

According to rule, electron first fill in low energy orbital. In this electronic configuration, the electrons first fill the 2p orbital completely then go to the 3p orbital. Hence, the correct electronic configuration is:

$$x = 1s^2, 2s^2, 2p^6$$

$$y = 1s^2, 2s^2, 2p^2$$

In this electronic configuration, same mistake is repeated. In this also first fill 2s orbital completely then further electron go to 2p-orbital. Hence, its correct electronic configuration is:

$$y = 1s^2, 2s^2$$

$$z = 1s^2, 2s^2, 2p^2, 3s^1$$

In this electronic configuration, first fill 2p orbital completely and next electron go to 3s orbital. So, its correct electronic configuration:

$$z = 1s^2, 2s^2, 2p^3$$

Q.2. Which orbital in each of the following pairs is lower in energy?

(1 mark)

- a) 2s, 2p b) 3p, 2p c) 3s, 4s

Ans.

a) 2s, 2p

In this pair, 2s is lower energy orbital than 2p.

b) 3p, 2p

In this pair, 2p is lower energy orbital than 3p.

c) 3s, 4s

In this pair, 3s is lower energy orbital than 4s.

Q.3. Draw Bohr's Model for the following atoms indicating the location for electron, protons and neutrons:

(3 marks)

a) Potassium (Atomic No. 19, Mass No. 39)

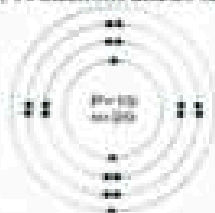
b) Silicon (Atomic No. 14, Mass No. 28)

c) Argon (Atomic No. 18, Mass No. 39)

Ans.

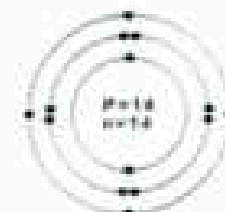
a) Potassium (Atomic No. 19, Atomic Mass 39):

In potassium, there are 19 protons, 19 electrons and 20 neutrons in it.



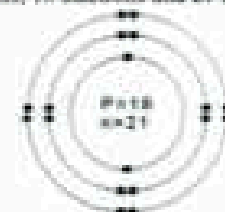
b) Silicon (Atomic No. 14, Atomic Mass 28):

In silicon, there are 14 protons, 14 electrons and 14 neutrons in it.



c) Argon (Atomic No. 18, Atomic Mass 39):

In argon, there are 18 protons, 18 electrons and 21 neutrons in it.



Q.4. Write electronic configuration for the following elements.

(3 marks)

- a) ${}_{14}^{28}\text{Si}$ b) ${}_{12}^{24}\text{Mg}$ c) ${}_{13}^{27}\text{Al}$ d) ${}_{18}^{39}\text{Ar}$

Ans.

a) The electronic configuration of ${}_{14}^{28}\text{Si}$:

$$1s^2, 2s^2, 2p^6, 3s^2, 3p^2$$

b) The electronic configuration of ${}_{12}^{24}\text{Mg}$:

$$1s^2, 2s^2, 2p^6, 3s^2$$

c) The electronic configuration of ${}_{13}^{27}\text{Al}$:

$$1s^2, 2s^2, 2p^6, 3s^2, 3p^1$$

d) The electronic configuration of ${}_{18}^{39}\text{Ar}$:

$$1s^2, 2s^2, 2p^6, 3s^2, 3p^6$$

Q.5. State the importance and uses of isotopes in various fields of life.

(3 marks)

Ans. Stable and radioactive isotopes have many applications in science and medicines. Some of these are follows:

- Radioactive iodine-131 is used as a tracer in diagnosing thyroid problem.
- Na-24 is used to trace the flow of blood and detect possible constrictions or obstructions in the circulatory system.
- Iodine-123 is used to image the brain.
- Cobalt-60 is commonly used to irradiate cancer cells in the hope of killing or shrinking the tumors.
- Carbon-14 is used to trace the path of carbon in photosynthesis.
- Radioactive isotopes are used to determine the molecular structure e.g. sulphur-35 has been used in the structure determination of thiosulphate, $\text{S}_2\text{O}_3^{2-}$ ion.
- Radioactive isotope C-14 are used to date rocks, soils, archaeological objects, and mummies.



- Q.6. The atomic number of an element is 23 and its mass number is 56.
 a) How many protons and electrons does an atom of this element have?
 b) How many neutrons does this atom have?

Ans. The element has atomic number 23 and mass number 56:

- No. of protons = 23
- No. of electrons = 23
- Atomic Mass = Atomic No. + No. of neutron
 $56 = 23 + \text{No. of neutron}$
 $56 - 23 = \text{No. of neutron}$
 No. of neutron = 33

- Q.7. The atomic symbol of aluminium is written as ${}_{13}^{27}\text{Al}$. What information do you get from it?

Ans. The atomic symbol of aluminium ${}_{13}^{27}\text{Al}$, it gives following information:

- Atomic No. of Al = 13
- Atomic Mass of Al = 27
- No. of protons = 13
- No. of electrons = 13
- Atomic mass = Atomic no. + no. of neutron
 $27 = 13 + \text{No. of neutron}$
 No of neutron = 14

Concept Assessment 3.1

- Q.8. An element has two isotopes A and B.
 The relative atomic mass of element is 35.5 amu. Relative abundance of isotope A is 75.77% and its isotopic mass is 35. Find the isotopic mass of B if its relative abundance is 24.23%.

Data:

Relative atomic Mass	= 35.5 amu
Relative abundance of A	= 75.77%
Isotopic Mass of A	= 35
Relative abundance of B	= 24.23%
Isotopic Mass of B	= ?

Solution:

Relative atomic mass of element =

$$\frac{(\text{Relative abundance of A} \times \text{At. mass of A}) + (\text{Relative abundance of B} \times \text{At. Mass of B})}{100}$$

$$35.5 = \frac{(75.77 \times 35) + (24.23 \times \text{at. mass of B})}{100}$$

$$35.5 \times 100 = (2651.95) + (24.23 \times \text{at. mass of B})$$

$$3550 - 2651.95 = 24.23 \times \text{at. mass of B}$$

$$\frac{898.05}{24.23} = \text{at. mass of B}$$

$$\text{At. mass of B} = 37$$



Concept Assessment 3.2

- Q.9. Describe the formation of cations for the following metal atoms:

- Li (atomic no. 3)
- Al (atomic no. 13)

Solution:

- a) Formation of Li^+ ion



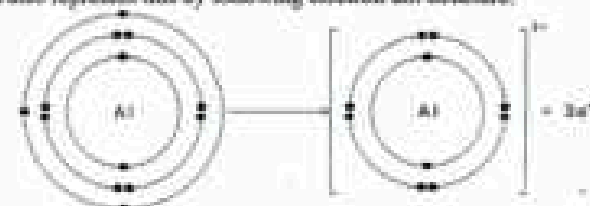
You can also represent this by following electron dot structure.



- b) Formation of Al^{3+} ion.



You can also represent this by following electron dot structure.



Concept Assessment 3.3

- Q.10. Describe the formation of anions by the following non-metals.

- Sulphur (atomic No. 16)
- Chlorine (atomic No. 17)

Solution:

- a) Formation of S^{2-} ion



You can also represent this by following electron dot structure.



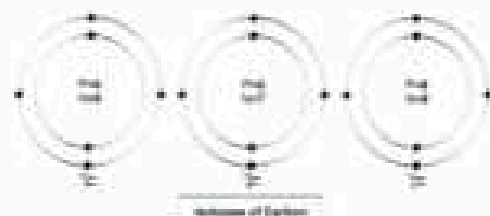
b) Formation of Cl^- ion

You can also represent this by following electron dot structure.



Activity 3.1

- Carbon has three isotopes ^{12}C , ^{13}C , ^{14}C . Figure shows incomplete structure of isotopes of carbon. Can you complete it?



- Natural abundance of isotopes of carbon is as follows:
 $^{12}\text{C} = 98.89\%$, $^{13}\text{C} = 1.11\%$, $^{14}\text{C} = 0.0099\%$

Activity 3.2

- Chlorine has two isotopes. Figure shows the structure of isotopes of chlorine. Can you write isotope symbol for each?



Isotope symbols: $^{35}_{17}\text{Cl}$, $^{37}_{17}\text{Cl}$
 Natural abundance: 75.77%, 24.23%

Activity 3.3

- Uranium has three isotopes with mass number 234, 235 and 238 respectively.



The ^{235}U isotope is used in nuclear reactors and atomic bombs, whereas the ^{238}U isotope lacks the properties necessary for these applications. ^{234}U is rare. Natural abundance of Uranium isotopes is as follows:

$$^{234}\text{U} = 0.00004\%, ^{235}\text{U} = 0.72\%, ^{238}\text{U} = 99.27\%$$

Fill in the blanks.

^{234}U has 92 protons, 92 electrons and 142 neutrons

^{235}U has 92 protons, 92 electrons and 143 neutrons

^{238}U has 92 protons, 92 electrons and 146 neutrons

When uranium-238 decays into thorium-234, it emits alpha particle. An alpha particle is doubly positively charged helium nucleus.

Multiple Choice Questions (Exercise)

Select the correct answer:

- Chlorine has two isotopes, both of which have: answer
 (a) same mass number
 (b) same number of neutrons
 (c) different number of protons
 (d) same number of electrons
- Number of neutrons in ^{23}M are: answer
 (a) 13
 (b) 14
 (c) 27
 (d) 15
- Which isotope is commonly used to irradiate cancer cells? answer
 (a) iodine-23
 (b) Carbon-14
 (c) Cobalt-60
 (d) iodine-131
- M-shell has sub-shells: answer
 (a) 1s, 2s
 (b) 2s, 2p
 (c) 3s, 3p, 3d
 (d) 1s, 2s, 3s
- A sub-shell that can accommodate 6 electrons is: answer
 (a) s
 (b) p
 (c) d
 (d) f
- ^{23}Na has electronic configuration: answer
 (a) $1s^2, 2s^2, 3s^1$
 (b) $1s^2, 2s^2, 2p^1$
 (c) $1s^2, 2s^2, 2p^6, 3s^1$
 (d) $1s^2, 2s^2, 2p^6, 3s^1$
- Which of the following statement is not correct about isotopes? answer
 (a) they have same atomic number
 (b) they have same number of protons
 (c) they have same chemical properties
 (d) they have same physical properties
- Which isotope is used in nuclear reactors? answer
 (a) U-234
 (b) U-238
 (c) U-235
 (d) all of these

SLO Based Additional MCQs

- John Dalton put forward his atomic theory: answer
 (a) 1800
 (b) 1805
 (c) 1903
 (d) 1863
- Rutherford used a gold foil in his experiment, which had a thickness of: answer
 (a) 0.002cm
 (b) 0.00004cm
 (c) 0.0001cm
 (d) 0.001cm
- Who performed first experiment to split atom? answer
 (a) Soddy
 (b) Rutherford
 (c) Bohr
 (d) Newton
- According to Rutherford's atomic theory, atom should produce: answer



- (a) Line spectrum
(b) Continuous spectrum
(c) Both a & b
(d) None of these
13. Quantum means: ANSWER
(a) Variable energy
(b) Fixed energy
(c) High energy
(d) Maximum energy
14. Who described the concept line spectrum in his atomic model? ANSWER
(a) Rutherford (b) Bohr
(c) Goldstein (d) Chadwick
15. The Heisenberg Uncertainty Principle was put forward in: ANSWER
(a) 1947 (b) 1927
(c) 1940 (d) 1927
16. The theory of dual nature of matter was formulated by: ANSWER
(a) Dalton (b) Avogadro
(c) Goldstein (d) de-Broglie
17. The relative atomic mass of proton is: ANSWER
(a) 1.6726×10^{-27} kg
(b) 1.6749×10^{-27} kg
(c) 9.11×10^{-31} kg
(d) None of these
18. The relative atomic mass of neutron is: ANSWER
(a) 1.6726×10^{-27} kg
(b) 1.6749×10^{-27} kg
(c) 9.11×10^{-31} kg
(d) None of these
19. The relative atomic mass of electron is: ANSWER
(a) 1.6726×10^{-27} kg
(b) 1.6749×10^{-27} kg
(c) 9.11×10^{-31} kg
(d) None of these
20. Protons are deflected toward plate: ANSWER
(a) Positive
(b) Negative
(c) both a and b
(d) None of these
21. Number of isotopes of hydrogen is:

- (a) 2 (b) 3
(c) 4 (d) 5
22. Symbol for Deuterium is: ANSWER
(a) ${}^1_1\text{H}$ (b) ${}^2_1\text{H}$
(c) ${}^3_1\text{H}$ (d) ${}^4_1\text{H}$
23. ${}^{12}\text{C}$ and ${}^{13}\text{C}$ are both present in nature: ANSWER
(a) 0.1% (b) 0.9%
(c) 1.1% (d) 1.5%
24. The percentage of ${}^{127}\text{I}$ is found in nature: ANSWER
(a) 97% (b) 95%
(c) 0.72% (d) 0.02%
25. Which isotope is used for diagnosis of goiter? ANSWER
(a) Iodine-131 (b) Cobalt-60
(c) P-32 (d) Sr-90
26. The nucleus of an atom is composed of: ANSWER
(a) Electrons
(b) Electrons and protons
(c) Electrons and neutrons
(d) Protons and neutrons
27. How many electrons can be accommodated in s-subshell? ANSWER
(a) 2 (b) 6
(c) 10 (d) 14
28. Number of electrons that can be accommodated in f-subshell: ANSWER
(a) 2 (b) 6
(c) 10 (d) 14
29. Which subshells are present in l shell? ANSWER
(a) s & p
(b) Only s-subshell
(c) Only p-subshell
(d) Subshell
30. How many subshells are there in M shell? ANSWER
(a) 2 (b) 3
(c) 4 (d) 5



31. N-shell contains number of subshells: ANSWER
(a) 1 (b) 2
(c) 3 (d) 4
32. An element has 5 electrons in M-shell. Its atomic number is: ANSWER
(a) 5 (b) 10
(c) 15 (d) 20
33. $1s^2, 2s^2, 2p^6, 3s^1, 3p^2$ represents electronic configuration of: ANSWER
(a) Cl (b) Na
(c) F (d) Na^+
34. Electronic configuration of Neon is: ANSWER
(a) $1s^2, 2s^2, 2p^6$
(b) $1s^2, 2s^2$
(c) $1s^2, 2s^2, 2p^6, 3s^1, 3p^2$
(d) $1s^2, 2s^2, 2p^6, 3s^2$
35. Chlorine has isotopes: ANSWER
(a) ${}^{35}_{17}\text{Cl}$ (b) ${}^{37}_{17}\text{Cl}$
(c) ${}^{35}_{17}\text{Cl}$ (d) both a & b
36. Carbon-14 is used for the: ANSWER
(a) Age determination of old objects
(b) Growth of bones
(c) Diagnosis of goiter
(d) All of these
37. d-subshell can accommodate maximum electrons: ANSWER
(a) 2 (b) 6
(c) 10 (d) 14

38. Number of protons in the nucleus of an atom is called: ANSWER
(a) Mass number
(b) Atomic number
(c) Electron number
(d) Mass Unit
39. Atom is electrically: ANSWER
(a) Positive particle
(b) Negative particle
(c) Neutral particle
(d) None of these
40. The removal of electron from a neutral atom gives rise to: ANSWER
(a) Molecular anion
(b) Molecular cation
(c) Anion
(d) Cation
41. Atomic number is represented by: ANSWER
(a) Z (b) A
(c) P (d) At
42. ${}^{238}_{92}\text{U}$ has number of neutrons: ANSWER
(a) 92 (b) 238
(c) 146 (d) 330
43. Mass number is represented by: ANSWER
(a) A (b) Z
(c) M (d) N
44. Mass of Proton in amu is: ANSWER
(a) 1.0073
(b) 1.0087
(c) 1.6726×10^{-27}
(d) None of these

Answer Key

1	d	2	b	3	c	4	c	5	c
6	d	7	d	8	c	9	d	10	b
11	b	12	b	13	b	14	b	15	b
16	d	17	a	18	b	19	c	20	b
21	b	22	b	23	c	24	c	25	a
26	d	27	a	28	d	29	a	30	b
31	d	32	c	33	a	34	a	35	d
36	a	37	c	38	b	39	c	40	d
41	a	42	c	43	a	44	a		



Short Questions (Exercise)

Q.1. Distinguish between shell and sub-shell.

Ans. Shells:

The electron in an atom revolves around the nucleus in one of the circular paths called shells or orbits. Each shell has a fixed energy. So each shell is also called energy level. Each shell is described by an n value. n can have values 1, 2, 3, ...

When,

$n = 1$, it is K shell.

$n = 2$, it is L shell.

$n = 3$, it is M shell etc.

Sub-Shells

A shell or energy level is sub-divided into sub-shells or sub-energy levels. n value of a shell is placed before the symbol for a sub-shell.

- s sub-shell can accommodate maximum 2 electrons.
- p sub-shell can accommodate maximum 6 electrons.
- d sub-shell can accommodate maximum 10 electrons.
- f sub-shell can accommodate maximum 14 electrons.

Q.2. Why an atom is electrically neutral?

Ans. Atoms are electrically neutral because the number of protons (positively charged) in the nucleus is equal to the number of electrons (negatively charged) in the electron cloud. The charges cancel out each other so there is no net charge on the atoms.

Q.3. How many sub-shells are there in N shell?

Ans. There are four sub-shells in N shell.

Q.4. Give notation for sub-shells of M shell.

Ans. The notation for sub-shell of M-shell is 3s, 3p, 3d.

Q.5. List the sub-shells of M Shell in order of increasing energy.

Ans. 3s, 3p, 3d.

Q.6. Can you identify an atom without knowing number of neutrons in it?

Ans. Yes, we can identify an atom by knowing its atomic number or number of protons.

positively charged α -particles and the positively charged part of atom.

ii. Massive α -particles are not deflected by electrons.

Q.9. What are the defects of Rutherford's atomic model?

Ans.

- Classical physics suggests that electron being charged particle will emit energy continuously while revolving around the nucleus. Thus the orbit of the revolving electron becomes smaller and smaller until it would fall into the nucleus. This would collapse the atomic structure.
- If revolving electron emits energy continuously it should form a continuous spectrum.

Q.10. Define Heisenberg Uncertainty

Principle.

Ans. The German physicist Werner Heisenberg, who formulated it in 1927. This principle states that, "It is impossible to simultaneously determine the exact location and future trajectory of an electron".

Q.11. Who put forward the theory of dual nature of matter?

Ans. In 1924 de-Broglie put forward the theory of dual nature of matter. This theory explains that matter has dual both the properties i.e. particle property as well as wave property.

Q.12. How de-Broglie explain the corpuscular nature of matter?

Ans. De-Broglie stated that matter has both the properties of particles as well as waves. He advocated that these two systems could not remain detached from each other. By mathematical evidences he proved that every moving object is attached with waves and every wave has corpuscular nature as well. Corpuscular means any minute particle. Corpuscular related to particle.

Q.13. Briefly explain the structure of an atom.

Ans. The nucleus of an atom is in the center. It contains protons and neutrons. Protons and neutrons are collectively called nucleons. The nucleus is surrounded by electrons in shells. Protons and neutrons are massive particles. The mass of electrons is so small. So, in practice, the mass of an atom is concentrated in the nucleus.

Q.14. Define Nuclear force.

Ans. The strong attractive force that binds protons and neutrons together. This force is stronger than electrostatic or magnetic forces. This force exists between neutrons and neutrons, protons and protons, and neutrons and protons.

Q.15. What are sub-atomic particles?

Ans. Subatomic particles are the fundamental particles that make up atoms. The three main subatomic particles are:

Proton:

- Relative charge: +1
- Relative mass: Approximately 1 atomic mass unit (amu) or 1.6749×10^{-27} kg

Neutron:

- Relative charge: 0 (neutral)
- Relative mass: Approximately 1 atomic mass unit (amu) or 1.6726×10^{-27} kg

Electron:

- Relative charge: -1
- Relative mass: Approximately $1/1836$ amu or 9.11×10^{-31} kg

Q.16. Why the mass of electron is neglected for determining the mass of an atom?

Ans. Protons and neutrons have roughly the same mass, around 1 amu. This mass contributes significantly to the total mass of the atom. Electrons have much less

SLO Based Additional Short Questions (Reference Material)

Q.7. What is Dalton's atomic theory?

Ans. In 1803, the British chemist John Dalton presented a scientific theory on the existence and nature of matter. This theory is called Dalton's atomic theory. Main postulates of his theory are as follows:

- All elements are composed of tiny indivisible particles called atoms.
- Atoms of a particular element are identical. They have same mass and same volume.
- During chemical reaction atoms combine or separate or re-arrange. They combine

in simple ratio.

iv. Atoms can neither be created nor destroyed.

Q.8. What conclusions are made by Rutherford?

Ans: Rutherford made the following conclusions:

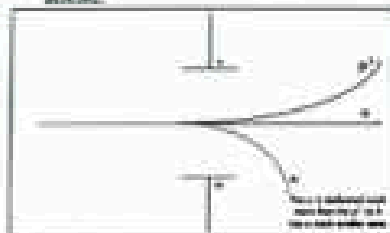
- Since majority of the α -particles passed through the foil undeflected, most of the space occupied by an atom must be empty.
- The deflection of a few α -particles through angles greater than 90° show that these particles are deflected by electrostatic repulsion between the



mass, so their contribution to the total mass of an atom is usually negligible.

Q.17. What happens when a beam of electron, proton & neutron passes between two electrically charged plates?

- Ans.**
- Protons are positively charged and are deflected on a curved path toward the negative plate.
 - Electrons are negatively charged and are deflected on a curved path toward the positive plate.
 - Neutrons have no charge, go straight ahead.



Q.18. Define radioactive isotopes.

Ans. Radioactive isotopes of an element can be defined as atoms that contain an unstable combination of neutrons and protons, or excess energy in their nucleus. Some isotopes of an element are unstable and show radioactive decay. For example hydrogen - 3 (protium), carbon-14, uranium - 238 etc.

Q.19. Define Proton number/ Atomic number.

Ans. Proton number refers to the number of protons in the nucleus of an atom. It is also known as the atomic number and is indicated by the symbol "Z".

For example: There is only one proton in the nucleus of H atom, therefore its atomic number is 1.

Q.20. Define Nucleon number/ atomic mass.

Ans. The total number of protons and neutrons in an atom is known as its mass number or nucleon number. Some atoms of an element have different number of neutrons, such atoms are called isotopes.

Formula:

No. of neutrons = mass number - atomic number.

Q.21. Define Radioactivity.

Ans. In stable elements, the nuclear force is balanced. In some elements, the nuclear forces are not naturally balanced. The nucleus of these atoms decays and becomes another atom. This process is called radioactive decay and this phenomenon is called radioactivity.

Q.22. How the process of radioactivity is occurred in an atom?

Ans. The process continues until the forces in the nuclear core are balanced. In radioactive decay, when an atom emits a neutron, it changes to another isotope of that atom, but when it emits a proton, it becomes another atom. This means that radioactivity can change the number of protons in an atom and thus change the identity of the atom.

For example:

- Carbon - 14 is a radioactive isotope of carbon. It is naturally present in the atmosphere. When any living organism takes carbon dioxide from the air, it incorporates both C-14 and C-12 atoms into its tissues. The radioactive C-14 undergoes radioactive decay, transforms into nitrogen-14.
- Uranium-238 is a radioactive isotope of uranium. It decays over time and finally transforms into stable lead-206 atom.

Q.23. Define atomic mass unit. Why is it needed?

Ans. The unit for relative atomic mass is called atomic mass unit. Its symbol is

"amu". One atomic mass unit is $\frac{1}{12}$ th the mass of one atom of carbon-12. **Need:** The mass of an atom is too small to be determined practically. That's why to determine the atomic mass of various elements, atomic mass unit is needed.

Q.24. What is the relative atomic mass? How is it related to gram? OR Define relative atomic mass based on C-12 scale.

Ans. The relative atomic mass of an element is the average mass of atoms of that element as compared to $\frac{1}{12}$ th the mass of one atom of carbon-12 isotope. Its unit is called atomic mass unit with symbol "amu".

$$1 \text{ amu} = 1.66 \times 10^{-24} \text{ g}$$

Q.25. Define Isotopes.

Ans. Isotopes are atoms of an element whose nuclei have the same atomic number but different mass number. This is because atoms of an element can differ in the number of neutrons. Example: isotopes of hydrogen (${}^1_1\text{H}$, ${}^2_1\text{H}$, ${}^3_1\text{H}$)

Q.26. What are the isotopes of hydrogen?

Ans. Hydrogen has three isotopes. Hydrogen - 1 (Protium) has no neutron. Its symbol is ${}^1_1\text{H}$. Hydrogen - 2 (deuterium) has one neutron and hydrogen - 3 (Tritium) has two neutrons. Their symbols are ${}^2_1\text{H}$ and ${}^3_1\text{H}$ respectively.



Q.26. How relative atomic mass can be determined?

Ans. The relative atomic mass of an element can be calculated from the relative masses of its isotopes and their relative abundance.

Natural abundance of isotopes of carbon is as follows

$${}^{12}_6\text{C} = 98.8\%, {}^{13}_6\text{C} = 1.1\%, {}^{14}_6\text{C} = 0.009\%$$

Q.27. What do you know about isotopes of carbon?

Ans. Isotopes of Carbon

Carbon has three isotopes. Carbon-12, carbon-13 and carbon-14. Almost all the carbon is carbon-12. Its symbol is ${}^{12}_6\text{C}$. It has six neutrons and six protons. Carbon-13 has symbol, ${}^{13}_6\text{C}$ it has seven neutrons and six protons. Carbon-14 has eight neutrons and six protons. Its symbol is ${}^{14}_6\text{C}$. Different forms of carbon are black or greyish black solids except diamond. They are odourless and tasteless. They have high melting and boiling points and are insoluble in water.

Q.28. What do you know about isotopes of chlorine?

Ans. There are two natural isotopes of chlorine-35 and chlorine-37. An atom of chlorine-35 has 17 protons and 18 neutrons. An atom of chlorine-37 has 17 protons and 20 neutrons. Chlorine-35 occurs in nature about 75% and chlorine-37 about 25%. Chlorine is a grayish yellow gas with sharp pungent irritating smell. It is fairly soluble in water.

Q.29. What are the isotopes of Uranium?

Ans. Uranium has three isotopes with mass number 234, 235 and 238 respectively.



The ${}^{235}_{92}\text{U}$ isotope is used in nuclear reactors and atomic bombs, whereas the ${}^{238}_{92}\text{U}$ isotope lacks the properties necessary for these applications.

${}^{238}_{92}\text{U}$ is rare. Natural abundance of Uranium isotopes is as follows:

$${}^{238}_{92}\text{U} = 0.006\%, {}^{235}_{92}\text{U} = 0.72\%, {}^{234}_{92}\text{U} = 92.27\%$$



Example: Calculating relative atomic mass of carbon.

The relative atomic mass is a weighed average of the all the naturally occurring isotopes of an element, taking into consideration of their natural abundance. Use general formula

Relative atomic mass of C =

RA of C-12 = at.mass of C-12 + RA of C-13 = at.mass of C-13 + RA of C-14 = at.mass of C-14

$$\text{Relative atomic mass of C} = \frac{98.9 \times 12 + 1.1 \times 13 + 0.009 \times 14}{100}$$

$$\text{Relative atomic mass of C} = \frac{1185.6 + 14.3 + 0.126}{100}$$

$$\text{Relative atomic mass of C} = 12.00026 \text{ amu}$$

Q.31. What is meant by carbon dating or radio carbon dating? medium

Ans. Carbon-14 is used to estimate the age of carbon-containing substances. Carbon atoms circulate between the oceans, and living organism at a rate very much faster than they decay. As a result, the concentration of C-14 in all living things, keep on increasing. After death organisms no longer pick up C-14. By comparing the activity of a sample of skull or jaw bones, with the activity of living tissues, we can estimate how long it has been since the organism died. This process is called carbon dating.

Q.32. How Cations are formed? medium

Ans. Cations are positively charged ions that form when an atom loses one or more electrons. Cations are usually formed from metal atoms that tend to lose electrons to achieve a stable electron configuration similar to a noble gas.

e.g: $\text{Na} \rightarrow \text{Na}^+ + e^-$

Q.33. How Anions are formed? medium

Ans. Anions are negatively charged ions that form when an atom gains one or more electrons. This process usually

occurs when an atom has a relatively high electron affinity, meaning that it can easily attract and capture more electrons to achieve a stable electron configuration similar to a noble gas. When an atom gains one or more electrons, the number of electrons becomes greater than protons, so it acquires negative charge.

e.g: $\text{Cl} + e^- \rightarrow \text{Cl}^-$

Q.34. Define symbol. medium

Ans. The symbol for an atom represent the element. It consists of one or two letters, the mass number as a left superscript, the atomic number as a left subscript, and the charge as a right superscript. For example;



This diagram shows symbol for magnesium "Mg" which stands for magnesium. The number to the upper left of the symbol is the mass number, which is 24. The number to the upper right of the symbol is the charge which is positive 2. The number to the lower left of the symbol is the atomic number which is 12.



UNIT 04

Periodic Table and Periodicity of Properties

Q.1. Arrange the elements in each of the following groups in order of increasing ionization energy. medium

(a) Li, Na, K (b) Cl, Br, I

Ans:

- The order of increasing ionization energy is: $K < Na < Li$ because ionization energy decreases along group. These elements belong to Group - 1A. Li has smaller atomic size and high nuclear charge that's why, it has high ionization energy. While Na & K has low ionization energies.
- The increasing order of ionization energies is: $I < Br < Cl$. Chlorine has smaller atomic size & high nuclear charge that's why, Cl has high ionization energy while Br & I has low ionization energy.

Q.2. Arrange the elements in each of the following in order of decreasing shielding effect.

(a) Li, Na, K (b) Cl, Br, I (c) Cl, Br

medium

Ans:

- The decreasing order of shielding effect is $K > Na > Li$. Potassium has bigger atomic size that's why, it has high shielding effect while Na & Li has low shielding effect than K.
- The decreasing order of shielding effect is $I > Br > Cl$. Iodine has bigger atomic size. That's why, it has high shielding effect while Br & Cl has low shielding effect than I.
- The decreasing order of shielding effect is $Br > Cl$ because Br has bigger atomic size than Cl that's why, Br has high shielding effect.

Q.3. Specify which of the following elements you would expect to have the greatest electron affinity. medium

S, P, Cl

Ans: Electronegativity increase from left to right in a period. The order of increasing electron affinity is $\text{Cl} > \text{S} > \text{P}$. Cl has smaller atomic size and high nuclear charge that's why, Cl has high electron affinity than S & P.

Q.4. Electronic configuration of some elements are given below, group the elements in pairs that would represent similar chemical properties. medium

A = $1s^2, 2s^2$ B = $1s^2, 2s^2, 2p^4$ C = $1s^2, 2s^2, 2p^3$
 D = $1s^2$ E = $1s^2, 2s^2, 2p^6, 3s^2, 3p^2$ F = $1s^2, 2s^2$
 G = $1s^2, 2s^2, 2p^6, 3s^1$ H = $1s^2, 2s^2, 2p^6, 3s^2$

Ans:

- A & H has similar chemical properties because they belong to same group & have same no. of valence electrons.
- B & D has similar chemical properties because they belong to same group.
- C & E has similar chemical properties because they belong to same group & have same no. of valence electrons.
- F & G has similar chemical properties because they belong to same group & have same no. of valence electrons.



Q.5. Arrange the elements in groups and periods in Q No. 4.

00140000

IA		IIA		IIIA	IVA	VA	VIA	VIIA	VIIIA

Ans.

IA		IIA		IIIA	IVA	VA	VIA	VIIA	VIIIA
F	A					C			B
G	H					E			

Q.6. For normal elements, the number of valence electrons of an element is equal to the group number. Find the group number of the following elements.

00140000

Ans: ${}_{13}^{27}\text{Al}$

Electronic configuration of Al = $1s^2, 2s^2, 2p^6, 3s^2, 3p^1$



Valence shell has configuration = $3s^2 3p^1$

No. of valence electrons = $2 + 1 = 3$

Group no. = $3 + 10 = 13$

Aluminium is present in Group 13 or Group III A.

${}_{16}^{32}\text{S}$

Electronic configuration of S = $1s^2 2s^2 2p^6 3s^2 3p^4$

Valence shell has configuration = $3s^2 3p^4$

No. of valence electrons = $2 + 4 = 6$

Group no. = $6 + 10 = 16$

Sulphur is present in Group 16 or Group VI A.

${}_{19}^{39}\text{K}$

Electronic configuration of K = $1s^2 2s^2 2p^6 3s^2 3p^4 4s^1$

Valence shell has configuration = $4s^1$

No. of valence electrons = 1

Group no. = 1

Potassium is present in Group 1 or Group I A.

${}_{8}^{16}\text{O}$

Electronic configuration of O = $1s^2 2s^2 2p^4$

Valence shell has configuration = $2s^2 2p^4$

No. of valence electrons = 6

Group no. = 16

Oxygen is present in Group 16 or Group VI A

Q.7. Write the valence shell electronic configuration for the following groups: main group
(a) alkali metals (b) Alkaline earth metals (c) Halogens (d) Noble gases

Ans:

a) The valence shell electronic configuration of alkali metal is ns^1 .

b) The valence shell electronic configuration of alkaline earth metal is ns^2 .

c) The valence shell electronic configuration of halogens is $ns^2 np^5$.

d) The valence shell electronic configuration of noble gases is $ns^2 np^6$.

Q.8. Write electron dot symbols for an atom of the following elements:

00140000

(a) Be (b) K^+ (c) N (d) I

Ans:

a) Electronic configuration of Be = $1s^2 2s^2$

Be

b) Electronic configuration of K^+ = $1s^2 2s^2 2p^6 3s^2 3p^4 4s^1$

K^+

c) Electronic configuration of N = $1s^2 2s^2 2p^3$

N

d) Electronic configuration of I^- = $1s^2 2s^2 2p^6 3s^2 3p^4 4s^2 3d^{10} 4p^6 5s^2 4d^{10} 5p^5$

I^-



- Which element will form dipositive cation?
- Write electronic configuration of element E.
- Which two elements can form ionic bond?
- Can element C form C_2 molecule? Interpret.
- Which element can form covalent bonds?
- Is element F a metal or non-metal?

Ans:

- The atom with electronic configuration $1s^2 2s^2 2p^6 3s^1$ having ionization energy $+496 \text{ KJ/mol}$ because it is large in size and low nuclear charge. That's why, it has low ionization energy. The atom with electronic configuration $1s^2 2s^2 2p^6$ having ionization energy $+2080 \text{ KJ/mol}$ because it is small in size and high nuclear charge. So, it is difficult to remove its electron. That's why, it has high ionization energy.
- The second member of Group I A is lithium (${}_{3}\text{Li}$). The electronic configuration is $1s^2 2s^1$. It has one valence electron because it belongs to Group I A.
 - The second member of Group II A is magnesium (${}_{12}\text{Mg}$). The electronic configuration is $1s^2 2s^2 2p^6 3s^2$. It has two valence electrons because it belongs to Group II A.
 - The second member of Group VII A is chlorine (${}_{17}\text{Cl}$). The electronic configuration is $1s^2 2s^2 2p^6 3s^2 3p^5$. It has seven valence electrons because it belongs to Group VII A.
- The elements A & B belongs to same 3rd period. The elements D & E belongs to same 4th period.
 - The valence shell electronic configuration of D is $4s^2$.
 - A & D are metals. A is alkali metal while D is alkaline earth metal.
 - The element D can lose two electrons because it belongs to Group II A.
 - Element E is present in Group V A.
 - Element F is halogen.
 - Element D form dipositive cation because it lose two electrons.
 - The electronic configuration of element ${}_{23}\text{E} = 1s^2 2s^2 2p^6 3s^2 3p^4 4s^1 3d^{10} 4p^3$.
 - The element A and element F can form ionic bond. Because A is electropositive element and F is electronegative element.
 - Yes, element C can form C_2 molecule because it is non-metals it can share two electrons with its own atom and form double covalent bond.
 - Element B, C, E & F can form covalent bonds.
 - Element F is non-metals.

Q.14. Electronic configurations of four elements are given below:

- (a) $1s^1$, $2s^1$ (b) $1s^2$, $2s^2$, $2p^3$ (c) $1s^2$, $2s^2$, $2p^4$, $3s^2$ (d) $1s^2$

Which of these elements is:

- An alkali metal
- An alkaline earth metal
- A noble gas
- A halogen

Ans:

- $1s^2 2s^1$ is an alkali metal.
- $1s^2 2s^2 2p^6 3s^2$ is an alkaline earth metal.
- $1s^2$ is a noble gas.
- $1s^2 2s^2 2p^5$ is a halogen.



Q.15. Argue in what region of the periodic table you will find elements with relatively.

- High ionization energies
- Low ionization energies

Ans:

- The elements on right side of the periodic table are non-metals which are small in size and having high nuclear charge. So, they have high ionization energies.
- The elements on left side of the periodic table are metals which are large in size and having low nuclear charge. So, they have low ionization energies.

Concept Assessment Exercise 4.2

Q.16. Identify the group and period of the following elements on the basis of electronic configurations.

- (a) ${}_{15}\text{Si}$ (b) ${}_{15}\text{S}$ (c) ${}_{16}\text{F}$ (d) ${}_{16}\text{Ar}$

Ans:

- ${}_{15}\text{Si}$
Electronic configuration of Si = $1s^2 2s^2 2p^6 3s^2 3p^2$
As, $n = 3$, Si is present in 3rd period.
Total no. of electrons in the valence shell = 4
Hence, Si belongs to Group IV A or Group - 14.
- ${}_{16}\text{S}$
Electronic configuration of S = $1s^2 2s^2 2p^6 3s^2 3p^4$
As, $n = 3$, S is present in 3rd period.
Total no. of electrons in the valence shell = 6
Hence, S belongs to Group VI A or Group - 16.
- ${}_{16}\text{F}$
Electronic configuration of F = $1s^2 2s^2 2p^5$
As, $n = 2$, F is present in 2nd period.
Total no. of electrons in the valence shell = 7.
Hence, F belongs to Group VII A or Group - 17.
- ${}_{16}\text{Ar}$
Electronic configuration of Ar = $1s^2 2s^2 2p^6 3s^2 3p^6$
As $n = 3$, Ar is present in 3rd period.
Total no. of electrons in valence shell = 8
Hence, Ar belongs to Group VIII A or Group - 18.

Concept Assessment Exercise 4.3

Q.17. Electronic configuration of atoms of some elements are given below. Place them into groups and periods.

- | | | |
|---|--|----------------------------|
| i. P = $1s^2, 2s^2, 2p^3$ | ii. Q = $1s^2, 2s^2, 2p^5$ | iii. R = $1s^2$ |
| iv. S = $1s^2, 2s^1$ | v. T = $1s^2, 2s^1$ | vi. W = $1s^2, 2s^2, 2p^4$ |
| vii. X = $1s^2, 2s^2, 2p^4, 3s^2, 3p^2$ | viii. Y = $1s^2, 2s^2, 2p^6, 3s^2, 3p^6$ | |
| ix. Z = $1s^2, 2s^2, 2p^5$ | | |



Ans:

IA		VIIA					
	IIA		IIIA	IVA	VA	VIA	VIIA
T	E		Q, Z	P, X			W
							Y

- i. Electronic configuration of $P = 1s^2 2s^2 2p^2$.
As $n = 2$, P is present in 2nd period.
Total no. of electrons in valence shell = 4
Hence, P belongs to Group IVA or Group - 14.
- ii. $Q = 1s^2, 2s^2, 2p^1$
As $n = 2$, Q is present in 2nd period.
Hence, total no. of valence electrons = 3
So, Q belongs to Group IIIA or Group - 13.
- iii. Electronic Configuration of $R = 1s^2$
As $n = 1$, R is present in 1st period.
Hence, it belongs to Group VIIA or Group - 18.
- iv. Electronic Configuration of $S = 1s^2 2s^2$
As $n = 2$, S is present in 2nd period.
Total no. of electrons in valence shell = 2
Hence, S belongs to Group IIA or Group - 2.
- v. Electronic Configuration of $T = 1s^2 2s^1$
As $n = 2$, T is present in 2nd period.
Total no. of electrons in valence shell = 1
Hence, T belongs to Group IA or Group - 1.
- vi. Electronic Configuration of $W = 1s^2 2s^2 2p^6$
As $n = 2$, W is present in 2nd period.
Total no. of electrons in valence shell = 8
Hence, W belongs to Group VIIA or Group - 18.
- vii. Electronic Configuration of $X = 1s^2 2s^2 2p^6 3s^2 3p^2$
As $n = 3$, X is present in 3rd period.
Total no. of electrons in valence shell = 4
Hence, X belongs to Group IVA or Group - 14.
- viii. Electronic Configuration of $Y = 1s^2 2s^2 2p^6 3s^2 3p^4$
As $n = 3$, Y is present in 3rd period.
Total no. of electrons in valence shell = 6
Hence, Y belongs to Group VIIA or Group - 18.
- ix. Electronic Configuration of $Z = 1s^2 2s^2 2p^1$



As $n = 2$, Z is present in 2nd period.
Total no. of electrons in valence shell = 3
Hence, Z belongs to Group IIIA or Group - 13.

Concept Assessment Exercise 4.4

Q.18. Obtain the valence shell configuration of Al and S from their position in the periodic table.

SOL: 18/01/2018

Ans:

- a) Electronic Configuration of $Al = 1s^2 2s^2 2p^6 3s^2 3p^1$
Valence shell has configuration = $3s^2 3p^1$
Period number = 3
No. of valence electrons = 3
 Al belongs to p -block.
So, Group number = $3 + 10 = 13$
 Al is present in 3rd period of Group - 13.
- b) Electronic Configuration of $S = 1s^2 2s^2 2p^6 3s^2 3p^4$
Valence shell has configuration = $3s^2 3p^4$
Period number = 3
No. of valence electrons = 6
 S belongs to p -block.
So, Group number = $6 + 10 = 16$.
 S is present in 3rd period and Group - 16.

Concept Assessment Exercise 4.5

Q.19. Choose the element whose atom you expect to have smaller shielding effect.

- (a) F or Cl (b) Li or Na (c) B or Al

Ans:

- a) F atom will have smaller shielding effect.
- b) Li atom will have smaller shielding effect.
- c) B atom will have smaller shielding effect.

Concept Assessment Exercise 4.6

Q.20. Using the periodic table, choose the element whose atom you expect to have smaller atomic radius in each of the following pairs.

SOL: 20/01/2018

- (a) O or S (b) O or F

Ans:

- a) Oxygen will have smaller atomic radius.
- b) F will have smaller atomic radius.

Concept Assessment Exercise 4.7

Q.21. Which has the smaller ionization energy?

SOL: 21/01/2018

- (a) B or N (b) Be or Mg (c) C or Si

Ans:

- a) B will have smaller ionization energy.



- b) Mg will have smaller ionization energy.
c) Si will have smaller ionization energy.

Concept Assessment Exercise 4.3

Q.22. Which element has lower metallic character?

00140022

- (a) *Li* or *K* (b) *Mg* or *Ca*
(c) Compare and contrast ionization energy and electron affinity

Ans:

- i. Li will have lower metallic character.
ii. Mg will have lower metallic character.

iii.

Ionization Energy

Electron Energy

- | | |
|---|---|
| <ul style="list-style-type: none"> It is the amount of energy required to remove the most loosely bound electron from the valence shell of an isolated gaseous atom. As a result of this energy, cation (positively charged ion) is formed. It decrease along group and increase along period. | <ul style="list-style-type: none"> The amount of energy released when an electron is added in the valence shell of an isolated gaseous atom. As a result of this energy, anion (negatively charged ion) is formed. It also decrease along group and increase along period. |
|---|---|

Concept Assessment Exercise 4.5

Q.23. Which of the following displacement reactions will occur?

00140023

- $\text{Cl}_{2(g)} + 2\text{NaF}_{(aq)} \rightarrow 2\text{NaCl}_{(aq)} + \text{F}_{2(g)}$
- $\text{Br}_{2(l)} + 2\text{KI}_{(aq)} \rightarrow 2\text{KBr}_{(aq)} + \text{I}_{2(g)}$
- $\text{I}_{2(g)} + 2\text{KBr}_{(aq)} \rightarrow 2\text{KI}_{(aq)} + \text{Br}_{2(l)}$
- $\text{Cl}_{2(g)} + 2\text{KBr}_{(aq)} \rightarrow 2\text{KCl}_{(aq)} + \text{Br}_{2(l)}$
- $\text{Cl}_{2(g)} + 2\text{NaI}_{(aq)} \rightarrow 2\text{NaCl}_{(aq)} + \text{I}_{2(s)}$

Ans:

- $\text{Cl}_2 + 2\text{NaF} \rightarrow 2\text{NaCl} + \text{F}_2$
This reaction will not occur because chlorine is less reactive than fluorine. So, Cl can't replace fluorine.
- $\text{Br}_2 + 2\text{KI} \rightarrow 2\text{KBr} + \text{I}_2$
This reaction will occur because bromine is more reactive than iodine. So, Br can replace I.
- $\text{I}_2 + 2\text{KBr} \rightarrow 2\text{KI} + \text{Br}_2$
This reaction will not occur because I is less reactive than Br. So, I can't replace Br.
- $\text{Cl}_2 + 2\text{KBr} \rightarrow 2\text{KCl} + \text{Br}_2$
This reaction will occur because Cl is more reactive than Br. So, Cl can replace Br.
- $\text{Cl}_2 + 2\text{NaI} \rightarrow 2\text{NaCl} + \text{I}_2$
This reaction will also occur because Cl is more reactive than I. So, Cl can replace I.



Concept Assessment Exercise 4.16

Q.24. Compare the physical properties of metals and non-metals.

00140024

Ans:

	Physical Properties of Metals	Physical Properties of Non-Metals
i.	Almost all metals are solids. (Except Mercury)	Non-metals are solids, liquids and gases.
ii.	Usually metals have high melting and boiling points.	Non-metals have low melting and boiling points.
iii.	Metals have metallic luster (shiny surfaces).	Non-metals are not shiny, they are dull. (Except Iodine)
iv.	Metals are malleable and ductile.	Non-metals do not show malleability and ductility.
v.	Metals are good conductor of heat and electricity.	Non-metals are bad conductor of heat and electricity.
vi.	Metals have high densities.	Non-metals have low densities.
vii.	Metals are hard.	Non-metals are soft and brittle.

Multiple Choice Questions (Exercise)

- Number of periods in the periodic table are:
 - 8
 - 7
 - 16
 - 5
- Which of the following groups contains alkaline earth metals?
 - IA
 - IIA
 - VII A
 - VIIIA
- Which of the following elements belongs to VIIIA?
 - Na
 - Mg
 - Br
 - Xe
- Main group elements are arranged in _____ groups.
 - 6
 - 7
 - 8
 - 10
- Period number of ${}_{13}\text{Al}$ is:
 - 1
 - 2
 - 3
 - 4
- Valence shell electronic configuration of an element M (atomic no. 14) is:
 - $2s^2, 2p^3$
 - $2s^2, 2p^2$
 - $2s^2, 2p^2$
 - $3s^2, 3p^2$
- Which of the following elements you expect to have greater shielding effect?
 - Li
 - Na
 - K
 - Rb
- As you move from left to right across a period, which of the following does not increase:
 - Electron affinity
 - Ionization energy
 - Nuclear charge
 - Shielding effect
- All the elements of Group IIA are less reactive than alkali metals. This is because these elements have:
 - High ionization energies
 - Relatively greater atomic sizes
 - Similar electronic configuration
 - decreased nuclear charge



SLO Based Additional MCQs

10. The atomic radii of the elements in periodic table:
 (a) Increase from left to right in a period
 (b) Increase from top to bottom in a group
 (c) Do not change from left to right in a period
 (d) Decrease from top to bottom in a group
11. The amount of energy given out when an electron is added to an atom is called:
 (a) Lattice energy
 (b) Ionization energy
 (c) Electronegativity
 (d) Electron affinity
12. 4th and 5th period of the long form of Periodic Table are called:
 (a) Short periods
 (b) Normal periods
 (c) Long periods
 (d) Very long periods
13. Which one of the following halogens has lowest electronegativity?
 (a) Fluorine (b) Chlorine
 (c) Bromine (d) Iodine
14. Along the period, which one of the following decreases:
 (a) Atomic radius
 (b) Ionization energy
 (c) Electron affinity
 (d) electronegativity
15. Transition elements are:
 (a) All gases (b) All metals
 (c) All non-metals (d) All metalloids
16. Mark the incorrect statement about ionization energy:
 (a) It is measured in kJ mol^{-1}
 (b) It is absorption of energy
 (c) It decreases in a period
 (d) It decreases in a group
17. Point out the incorrect statement about electron affinity:
 (a) It is measured in kJ mol^{-1}
 (b) It involves release of energy
 (c) It decreases in a period
 (d) It decreases in a group
18. How many groups are present in the modern periodic table?
 (a) 8 (b) 10 (c) 15 (d) 18
19. How many periods are present in the modern periodic table?
 (a) 7 (b) 8 (c) 10 (d) 12
20. How many elements are present in 1st period?
 (a) 1 (b) 2 (c) 8 (d) 18
21. How many elements are present in each 1st & 2nd period?
 (a) 2 (b) 8 (c) 18 (d) 32
22. How many elements are present in each 4th & 5th period?
 (a) 2 (b) 8 (c) 18 (d) 32
23. How many elements are present in 6th period?
 (a) 2 (b) 8 (c) 18 (d) 32
24. How many elements are present in 7th period?
 (a) 2 (b) 8 (c) 18 (d) 32
25. Elements of a period show properties:
 (a) Same (b) Different
 (c) Both a & b (d) None of these
26. The elements of a group show properties:
 (a) Same (b) Different
 (c) Both a & b (d) None of these
27. How many blocks are present in modern periodic table?
 (a) 2 (b) 3 (c) 4 (d) 5
28. Elements are classified into four blocks depending upon:
 (a) Shell (b) Sub-shell
 (c) Atomic mass (d) Atomic number



29. The elements of group 1 and 2 are placed in which block:
 (a) s (b) p (c) d (d) f
30. Elements of groups 13 to 18 have their valence electrons in subshell:
 (a) s (b) p (c) d (d) f
31. Which of the following elements is present in 1st period?
 (a) Hydrogen (b) Helium
 (c) Both a & b (d) None of these
32. Second and third periods are called:
 (a) Normal periods
 (b) 1st transition series
 (c) 2nd transition series
 (d) 3rd transition series
33. Which element is present in 2nd period?
 (a) Lithium (b) Beryllium
 (c) Boron (d) All of these
34. Elements with atomic no. 58 to 71 are called:
 (a) Lanthanides (b) Actinides
 (c) Both a & b (d) None of these
35. Lanthanides belong to period:
 (a) 4th (b) 5th (c) 6th (d) 7th
36. Elements with atomic no. 90 to 103 are called:
 (a) Lanthanides (b) Actinides
 (c) Both a & b (d) None of these
37. Actinides belong to period:
 (a) 4th (b) 5th (c) 6th (d) 7th
38. Lanthanide series starts after the element:
 (a) Lanthanum (b) Actinium
 (c) Osmium (d) None of these
39. Atomic number of lanthanum is:
 (a) 57 (b) 58 (c) 59 (d) 60
40. Actinide series starts after the element:
 (a) Lanthanum (b) Actinium
 (c) Osmium (d) Silver
41. Atomic number of actinium is:
 (a) 57 (b) 60 (c) 80 (d) 89
42. Group number tells about the:
 (a) Number of valence electrons
 (b) Number of shells
 (c) Both a & b
 (d) None of the above
43. Period number tells about the:
 (a) No. of valence electrons
 (b) No. of electronic shells
 (c) Both a & b
 (d) None of the above
44. Which period of the modern periodic table is considered as incomplete period?
 (a) 4th (b) 5th (c) 6th (d) 7th
45. Which of the following elements is present in group 1A?
 (a) Hydrogen (b) Lithium
 (c) Sodium (d) All of these
46. Elements of Group 1 are called:
 (a) Alkali metals
 (b) Alkaline earth metals
 (c) Transition metals
 (d) Halogens
47. How many electrons are present in the valence shell of group-1 elements?
 (a) 1 (b) 2 (c) 3 (d) 4
48. 17th group elements are known as:
 (a) Alkali metals
 (b) Alkaline earth metals
 (c) Halogens
 (d) Noble gases
49. 17th group elements contain electron in their outer most shell:
 (a) 4 (b) 5 (c) 6 (d) 7
50. The elements of group 3 to 12 are called:
 (a) Normal elements
 (b) Transition elements
 (c) Halogens
 (d) Noble gases



51. All transition elements belong to:
(a) s & p block (b) d-block
(c) f-block (d) d & f block
52. Unit of atomic size is:
(a) cm (b) pm
(c) $\text{Å}/\text{mol}^{-1}$ (d) Both a & b
53. The distance between the nuclei of two carbon atoms in its elemental form is:
(a) 150 pm (b) 152 pm
(c) 154 pm (d) 156 pm
54. When we move from left to right in a period, atomic number:
(a) Increases
(b) Decreases
(c) First increases then decreases
(d) None of the above
55. When we move from left to right in a period, atomic size:
(a) Increases
(b) Decreases
(c) First increases then decreases
(d) None of the above
56. When we move from top to bottom in a group, atomic size:
(a) Increases
(b) Decreases
(c) First increases then decreases
(d) None of the above
57. With the increase of atomic number, the number of electron in an atom shall:
(a) Increases
(b) Decreases
(c) First increases then decreases
(d) None of the above
58. When we move from top to bottom in a groups, shielding effect:
(a) Increases (b) Decreases
(c) No effect (d) None of these
59. When we move from left to right in a period, shielding effect:
(a) Increases (b) Decreases
(c) Remains same (d) None of these
60. The minimum amount of energy which is required to remove an electron from

valence shell of the gaseous state of an atom is called:

- (a) Ionisation energy
(b) Electron affinity
(c) Electronegativity
(d) Potential energy
61. The unit of ionization energy is:
(a) cm and pm (b) $\text{kJ}/\text{mol}^{-1}$
(c) Newton (d) Pascal
62. When we move top to bottom in a group, ionization energy:
(a) Increases (b) decreases
(c) No effect (d) None of these
63. When we move from left to right in a period, ionization energy:
(a) Increases (b) Decreases
(c) No effect (d) None of these
64. The first ionization energy of sodium atom is:
(a) $+496 \text{ kJ}/\text{mol}^{-1}$
(b) $-495.8 \text{ kJ}/\text{mol}^{-1}$
(c) $-490.5 \text{ kJ}/\text{mol}^{-1}$
(d) $-495.7 \text{ kJ}/\text{mol}^{-1}$
65. The amount of energy released when an electron is added in the outermost shell of an isolated gaseous atom is called:
(a) Ionisation energy
(b) Electron affinity
(c) Electronegativity
(d) Potential energy
66. Unit of electron affinity is:
(a) pm (b) kJ/mol
(c) $\text{kJ}/\text{mol}^{-1}$ (d) Newton
67. Electron affinity of fluorine is $\text{kJ}/\text{mol}^{-1}$ is:
(a) 328 (b) -328
(c) -330 (d) -340
68. The ability of an atom to attract the shared pair of electrons towards itself in a molecule is called:
(a) Ionisation energy
(b) Electron affinity
(c) Electronegativity
(d) Shielding effect

69. Which one of the following halogens has highest electronegativity?

- (a) Iodine (b) Chlorine
(c) Fluorine (d) Bromine
70. The vertical columns present in the periodic table are called:
(a) Groups (b) Periods
(c) Both a & b (d) None of these
71. The horizontal lines present in the periodic table are called:
(a) Groups (b) Periods
(c) Both a & b (d) None of these
72. Electronegativity of oxygen is:
(a) 2.1 (b) 3.2 (c) 3.2 (d) 3.4
73. Number of elements in each normal period are:
(a) 18 (b) 10 (c) 8 (d) 32
74. The electronegativity of carbon is:
(a) 2.0 (b) 1.0 (c) 2.5 (d) 4.0
75. Elements of group 13 to 18 have their valence electrons in subshell:
(a) s (b) p (c) d (d) f
76. Metals can form ions carrying charges:
(a) Uni-positive (b) Di-positive
(c) Tri-positive (d) All of these
77. Pure alkali metals can be cut simply by knife but iron cannot because of alkali metals have:
(a) Strong metallic bonding
(b) Weak metallic bonding
(c) Non-metallic bonding
(d) Moderate metallic bonding
78. Metals lose their electrons easily because:
(a) They are electronegative
(b) They have electron affinity
(c) They are electropositive
(d) Good conductors of heat
79. Metals are the elements which have:
(a) Electropositive character
(b) Electronegative character
(c) Both a & b
(d) None of the above



80. Which are good conductor of heat and electricity?

- (a) Metals (b) Non-metals
(c) Metalloids (d) All of these
81. All metals bear:
(a) Positive charge (b) Negative charge
(c) Both a & b (d) None of these
82. Metals possess:
(a) ionic bond
(b) Covalent bond
(c) Co-ordinate covalent bond
(d) Metallic bond
83. Sodium metal has electronic:
(a) 10 (b) 12 (c) 11 (d) 14
84. Which group of elements has low ionization energies?
(a) Alkali Metals
(b) Alkaline Earth Metals
(c) Halogens
(d) Noble Gases
85. The elements in which d-orbital is in the process of filling constitute a group of metals called:
(a) Alkali metals
(b) Alkaline Earth Metals
(c) Transition Metals
(d) Noble gases
86. Platinum alloyed with which metal is used as catalyst in automobiles as catalytic converter?
(a) Palladium (b) Rhodium
(c) Gold (d) Both a & b
87. Which element has highest electronegativity value?
(a) Fluorine (b) Oxygen
(c) Chlorine (d) Nitrogen
88. Group 17 elements are called:
(a) Alkali Metals
(b) Alkaline Earth Metals
(c) Halogens
(d) Noble gases
89. Which is strongest oxidizing agent?
(a) Fluorine (b) Chlorine
(c) Bromine (d) Iodine



98. The order of stability of Hydrides is: 09140113

- (a) $HF > HCl > HBr > HI$
 (b) $HF > HBr > HCl > HI$
 (c) $HI > HBr > HCl > HF$
 (d) $HCl > HI > HF > HBr$

99. Which halogen member exists in a liquid state at room temperature? 09140114

- (a) Fluorine (b) Chlorine
 (c) Bromine (d) Iodine

100. Which one of the following is a metal? 09140115

- (a) Hydrogen
 (b) Carbon
 (c) Nitrogen
 (d) Magnesium

101. The heaviest metal is: 09140116

- (a) Iron (b) Platinum
 (c) Osmium (d) Lead

102. The ionization energy of oxygen: 09140117

- (a) +1314 (b) +1086
 (c) +1000 (d) +1351

103. The ionization energy of Magnesium: 09140118

- (a) +1481 (b) +738
 (c) +520 (d) +419

104. The ionization energy of Aluminium: 09140119

- (a) +419 (b) +706
 (c) +578 (d) +941

105. The electron affinity of Potassium: 09140120

- (a) -48 (b) -29
 (c) -110 (d) -328

106. The electron affinity of Chlorine: 09140121

- (a) -71.7 (b) -120
 (c) -349 (d) -295

99. The electron affinity of Arsenic: 09140122

- (a) -120 (b) -27
 (c) -101 (d) -77

100. The melting point of Tungsten is: 09140123

- (a) 3422 (b) 1768
 (c) 3423 (d) 3429

101. The melting point of Platinum is: 09140124

- (a) 1768 (b) 3422
 (c) 3423 (d) 3427

102. The valency of Copper is: 09140125

- (a) +2 & +3 (b) +3 & +4
 (c) +1 & +2 (d) +3 & +5

103. The valency of Iron is: 09140126

- (a) +2 & +3 (b) +3 & +4
 (c) +1 & +2 (d) +3 & +5

104. The density of iron is: 09140127

- (a) 7.87 g/cm³ (b) 19.3 g/cm³
 (c) 2.70 g/cm³ (d) 1.00 g/cm³

105. The density of Tungsten is: 09140128

- (a) 7.87 g/cm³ (b) 19.3 g/cm³
 (c) 2.70 g/cm³ (d) 1.00 g/cm³

106. The colour of Fluorine is: 09140129

- (a) Grey-black (b) Red-brown
 (c) Yellow-green (d) Pale yellow

107. The colour of Chlorine is: 09140130

- (a) Grey-black (b) Red-brown
 (c) Yellow-green (d) Pale yellow

108. The colour of Bromine is: 09140131

- (a) Grey-black (b) Red-brown
 (c) Yellow-green (d) Pale yellow

109. The colour of Iodine is: 09140132

- (a) Grey-black (b) Red-brown
 (c) Yellow-green (d) Pale yellow

110. The density of Fluorine at 25°C is: 09140133

- (a) 0.0017 (b) 0.0032
 (c) 3.1028 (d) 4.933



Answer Key

1	b	2	b	3	d	4	c	5	c
6	d	7	d	8	d	9	a	10	b
11	d	12	c	13	d	14	a	15	b
16	c	17	c	18	d	19	a	20	b
21	b	22	c	23	d	24	d	25	b
26	a	27	c	28	b	29	a	30	b
31	c	32	a	33	d	34	a	35	c
36	b	37	d	38	a	39	a	40	b
41	d	42	a	43	b	44	d	45	d
46	a	47	a	48	c	49	d	50	b
51	d	52	d	53	c	54	a	55	b
56	a	57	a	58	a	59	c	60	a
61	b	62	b	63	a	64	a	65	b
66	c	67	b	68	c	69	c	70	a
71	b	72	d	73	c	74	c	75	b
76	d	77	b	78	c	79	a	80	a
81	a	82	d	83	c	84	a	85	c
86	d	87	a	88	c	89	a	90	a
91	c	92	d	93	c	94	a	95	b
96	c	97	a	98	c	99	d	100	a
101	a	102	c	103	a	104	a	105	b
106	d	107	c	108	b	109	a	110	a

Short Questions (Exercise)

Q.1. Write the 'valence shell electronic configuration of an element present in the 3rd period and Group IIIA.

Ans. Aluminium (Al) belongs to 3rd period and group IIIA. The electronic configuration of (Al) is $1s^2 2s^2 2p^6 3s^2 3p^1$

Q.2. Define halogens.

Ans. Halo means, 'salt' and gens means 'former'. So, halogens means salt former because these elements combine with metals to form salt.

Q.3. Which atom has higher shielding effect, Li or Na?

Ans. Sodium (Na) has high shielding effect than Lithium (Li) because Sodium

(Na) has greater atomic size and low nuclear charge.

Q.4. Explain why, Na has higher ionization energy than K?

Ans. Na has higher ionization energy than K because Na has smaller atomic size and high nuclear charge that's why it is difficult to remove valence electron from Na than K.

Q.5. Alkali metals belong to s-block in the periodic table, why?

Ans. Because alkali metals (Group IA) has valence electron in s-subshell. That's why, on the basis of completion of valence subshell alkali metals are placed in s-block.



SLO Based Additional Short Questions (Reference Material)

Q.6. Define periodic table. answer
 Ans. The arrangement of elements in groups and periods on the basis of the similarities and differences in their properties is called periodic table.

Q.7. What do you mean by groups and periods in the Periodic Table? answer

Ans. Groups: Vertical columns in the periodic table are called groups. They are studied from top to bottom. There are 18 groups in the periodic table.

Periods: Horizontal rows in the periodic table are called periods. They are studied from left to right. There are 7 periods in the periodic table.

Q.8. What do you mean by group number and period number? answer

Ans. Group Number: It tells about the number of electrons present in the outermost shell of an atom.

Period Number: It tells about the number of electronic shells present in an atom.

Q.9. What is effective nuclear charge (Z_{eff})? answer

Ans. The valence electrons experience less nuclear charge than the actual charge due to the presence of inner electrons called effective nuclear charge.

Q.10. Define normal or representative elements. answer

Ans. Elements which belong to 's' and 'p' blocks are called normal or representative elements. In these elements all the inner shells are completely filled with electrons. Only their outermost shells are incomplete.

Q.11. Define transition elements. answer

Ans. Those elements which belong to 'd' and 'f' blocks are called transition elements. Their d-subshells or f-subshells

are in the process of completion with electrons.

Q.12. Write down the names of any four elements of group 17. answer

Ans. Four elements of group 17 are:

(i) Fluorine (F) (ii) Chlorine (Cl)
 (iii) Bromine (Br) (iv) Iodine (I)

Q.13. Write the names or symbols of any four elements of Noble Gases. answer

Ans. The names or symbols of any four elements of Noble Gases are as follows:

Element Name	Symbol
1. Helium	${}_2\text{He}$
2. Neon	$_{10}\text{Ne}$
3. Argon	$_{18}\text{Ar}$
4. Krypton	$_{36}\text{Kr}$

Q.14. How many elements are there in first period and what are their names and symbols? answer

Ans. First period contains only two elements.

These are:

(i) Hydrogen (H) (ii) Helium (He)

Q.15. Write down the names of elements found in second period. answer

Ans. Second period consists of eight elements.

Lithium (Li), Beryllium (Be),
 Boron (B), Carbon (C),
 Nitrogen (N), Oxygen (O),
 Fluorine (F), Neon (Ne).

Q.16. How many elements are present in 3rd period? Write their names and symbols. answer

Ans. There are 8 elements present in 3rd period. Their names and symbols are:

I. Sodium Na
 II. Magnesium Mg
 III. Aluminium Al



IV. Silicon Si
 V. Phosphorus P
 VI. Sulphur S
 VII. Chlorine Cl
 VIII. Argon Ar

Q.17. What is the reason of arranging elements in a group? answer

Ans. The reason for arranging elements in a group is that elements in a group have similar valence shell electronic configuration and hence show similar chemical properties.

Q.18. What is maximum capacity of a subshell? answer

Ans:

s - subshell can accommodate 2 electrons.

p - subshell can accommodate 6 electrons.

d - subshell can accommodate 10 electrons.

f - subshell can accommodate 14 electrons.

Q.19. How are elements arranged into four blocks? answer

Ans: Elements are arranged on the basis of completion of a particular subshell which gets last electrons and elements with similar subshell electronic configuration.

Q.20. How many block are present in modern periodic table? answer

Ans: There are four blocks present in modern periodic table.

(i) s-block (ii) p-block
 (iii) d-block (iv) f-block

Q.21. Define s-block elements. answer

Ans. Group 1 and Group 2 elements contain their valence electrons in the s-sub-shell. Therefore, these elements are called s-block elements.

Q.22. Define p-block elements. answer

Ans. Elements in groups 13 - 18 (except He) are known as p-block elements because their valence electrons are located in the p-sub-shell.

Q.23. Define f-block elements. answer

Ans. Lanthanides and actinides are known as f-block elements since their valence electrons lie in f sub-shell.

Q.24. Difference b/w Mono-valent and Di-valent cation with examples. answer

Ans. Mono-valent cation: The atoms which lose one electron from their valence shell to complete their octet or duplet, form ions carrying +1 charge. These cation carrying +1 charge are called mono-valent cations.

Example: Sodium (Na) after losing one electron from valence shell form Na^+ ion.

Divalent cation: The atoms which lose two electrons from their valence shell to complete their octet or duplet form ions carrying +2 charge. These cations carrying +2 charge are called di-valent cations.

Example: Calcium (Ca) after losing two electrons from valence shell. Form Ca^{2+} ion.

Q.25. Difference b/w Mono-valent and Di-valent anion with examples. answer

Ans. Mono-valent anions: The atoms which gain one electron in their valence shell to complete their octet/duplet form. Anions carrying -1 charge. These anions carrying -1 charge are called mono-valent anions.

Example: Fluorine (F) gains one electron to complete its octet and form F^- anion.

Divalent anions

The atoms which gain two electrons in their valence shell to complete their octet form anions carrying -2 charge. These anions carrying -2 charge are called divalent anions.

Example: Oxygen (O) gains two electrons to complete its octet and form O^{2-} anion.



Q.26. What do you mean by periodic function? medium

Ans. Periodic function means properties of elements repeat after regular intervals such that elements of similar properties and similar configuration are placed in the same group.

Q.27. What is shielding effect? medium

Ans. The decrease in the attractive force exerted by the nucleus on the valence shell electrons due to the presence of electrons lying between the nucleus and valence shell is called shielding effect.

Q.28. How does shielding effect decrease the forces of electrostatic attractions between nucleus and outermost electrons? medium

Ans. The electrons present between the nucleus and the outermost shell of an atom, reduce the nuclear charge felt by the electrons present in the outermost shell. The attraction of outer electrons towards nucleus is partially reduced because of presence of inner electrons. As a result an atom experiences less nuclear charge than that of the actual charge which is called effective nuclear charge (Z_{eff}).

Q.29. Why does the bigger size atoms have more shielding effect? medium

Ans. The bigger size atoms have more shielding effect because the number of inner shells and inner shell electrons increases; hence the shielding effect also increases.

Q.30. Why does shielding effect of electrons make cation formation easy? medium

Ans. The shielding effect of electrons makes the cation formation easy because the electrons present between the nucleus and the outer most shell of an atom, reduce the nuclear charge felt by the electrons present in the outermost shell.

Q.31. Write trends of electronegativity in periodic table. medium

Ans. It increases in a period from left to right. Higher effective nuclear charge (Z_{eff}) shortens the distance of nucleus and shared electrons. Thus enhances the ability to attract the shared pair of electrons. It generally decreases down a group as the size of the atom increases, thus attraction for the shared pair of electrons weakens.

Q.32. Define atomic radius. medium

Ans. Atomic radius:
Half of the distance between the nuclei of the two bonded atoms in elemental form is referred to as atomic radius. e.g. Atomic radius of C is 77 pm.

Q.33. What are SI units of atomic radius? medium

Ans. The SI unit of atomic radius is nanometer (nm) = 10^{-9} m and picometer (pm) = 10^{-12} m.

Q.34. Why does atomic radius of elements increase down the group? medium

Ans. The atomic radius increases from top to bottom in a group.
Reason: Because the increase of one more electronic shell in atoms of successive elements decreases the effective nuclear charge.

Q.35. Why does the size of atoms decrease in a period? medium

Ans. In a period, the atomic radii gradually decreases from left to right. Because of increase of atomic number, the effective nuclear charge increases gradually left to right due to addition of one more proton in the nucleus of each every atom. This increased nuclear force pulls more strongly the outermost shell towards the nucleus.

Q.36. Define ionization energy. medium

Ans. The ionization energy is the amount of energy required to remove the most loosely bound electron from the

valence shell of an isolated gaseous atom. Its unit is kJ/mol^{-1} . Ionization energy of Na is 496 kJ/mol^{-1} , e.g.



Q.37. Why is the 2nd ionization energy of an element higher than first one? medium

Ans. When an electron is removed from an atom, mono-positive ion is formed. Mono-positive ion has one extra proton than the number of electrons. Its nuclear charge attracts the remaining electrons more strongly. Hence more energy is needed to remove second electron. That is why 2nd I.E. has greater value.

Q.38. Why is the ionization energy of sodium less than that of magnesium? medium

Ans. Both sodium and magnesium belong to same period in such a way that sodium is on the left of magnesium. From left to right in period atomic size decreases and ionization energy increases that is why sodium has low ionization energy because of its greater atomic size than magnesium.

Q.39. Give the trend of ionization energy in periodic table. medium

Ans. Along Group: Ionization energy decreases while moving from top to bottom in a group. **Reason:**

- Because in group more and more shells lie between the valence shell and nucleus.
- Nucleus which exerts the electrostatic force of attraction between nucleus and valence electrons as they are taken away easily.

Along Period:

Ionization energy increases while moving from left to right in a period.

Reason: Because in period the size of atoms reduce and valence shell electrons are held strongly by the electrostatic force of attraction of nucleus.



Q.40. Define electron affinity. Write down its unit. medium

Ans. The amount of energy released when an electron is added up in the outermost shell of an isolated gaseous atom. Its unit is kJ/mol^{-1} . e.g. Electron affinity of fluorine is -328 kJ/mol .



Q.41. Why does electron affinity decrease in a group? medium

Ans. Electron affinity decreases in a group because of increasing atomic size and shielding effect in a group.

Q.42. Why does electron affinity increase in a period? medium

Ans. Electron affinity increases in a period because of decrease in atomic size from left to right in a period.

Q.43. Define electronegativity. Write the electronegativity of Nitrogen and oxygen. medium

Ans. The ability of an atom to attract the shared pair of electrons towards itself in a molecule is called electronegativity. Electronegativity of Nitrogen is 3.0 while that of Oxygen is 3.4.

Q.44. Why does reactivity of metals increase down the groups? medium

Ans. The reactivity of metals increase down the group because of increasing atomic size and decreasing ionization energy. As the atomic size increases down the group of metals due to the addition of shells, it becomes easy to remove electron from the outermost shell of a metal which causes increased reactivity of metals.

Q.45. What is electropositivity? Explain with an example. medium

Ans. Electropositivity is the property of an element to readily lose its valence electrons and gain a positive charge. Metals are highly electropositive elements. e.g. Sodium atom can lose 1 electron to form a positive ion.





Q.46. Why does metallic character decrease along a period and increase in a group? medium

Ans. In a period: Atomic radius of elements decreases in a period so removal of electron becomes more difficult which results in decrease of metallic character.

In a group: Atomic radius increases down the group so removal of electron becomes easier which results in increase of metallic character.

Q.47. What is the trend of variation in densities of alkali metals? medium

Ans. Densities of alkali metals increase down the group in the periodic table due to increase in atomic masses.

Q.48. State the physical properties of metals. medium

Ans. i. Metals have high melting and boiling points.

ii. They are good conductor of heat and electricity.

iii. They are mostly solids, possess metallic luster and can be polished.

iv. They are hard, malleable and ductile.

Q.49. Write down any two chemical properties of metals. medium

Ans. Chemical properties of metals are:

(i) They can easily lose electrons and form positively charged ions.

(ii) They readily react with oxygen to form basic oxides.

Q.50. How the position of unknown element in the periodic table can be determined? medium

Ans. By examining the electronic configuration of unknown element, we can find out to which group and period an element belongs and hence, we can determine its position in periodic table.

Q.51. Define lanthanides. To which period do they belong? medium

Ans. The elements which follow the Lanthanum with atomic number 57 to 71 are called lanthanides. They belong to 6th period. Lanthanum is the first element

upon which the series of the elements is named as lanthanides.

Q.52. Define actinides. To which period do they belong? medium

Ans. The elements which follow the actinium having atomic number 89 to 103 are called actinides. They belong to 7th period. The name of the series is based upon element named actinium.

Q.53. Write the uses of transitional metals as a catalyst in industrial process? medium

Ans. Transition metals and their compounds are widely used as catalyst in various industrial processes. For example,

(a) Iron is used in the Haber's process for the synthesis of ammonia.

(b) Platinum and palladium are used as catalyst in catalytic converters to reduce harmful emissions in automobiles and industrial units.

(c) Nickel is used as catalyst in the manufacture of margarine.

(d) Platinum is used as catalyst in the contact process for the manufacture of sulphuric acid.

Q.54. Why transition elements exhibit multiple oxidation state? medium

Ans. Transition elements exhibit multiple oxidation states. This is because of *d*-subshell can also participate in bonding along with *s*-subshell. For example, iron (Fe) has oxidation states +2 and +3, copper (Cu) has oxidation states +1 and +2.

Q.55. What are halogens? medium

Ans. Halogens means salt formers. Elements of group - 17 of the periodic table consist fluorine, chlorine, bromine, iodine and astatine. They are collectively called halogens.

Q.56. Write down the physical states of halogens. medium

Ans. Both fluorine and chlorine exist in gaseous form, bromine exists in liquid form and iodine exists in solid form.

Q.57. What do you know about the colors of halogens? medium

At room temperature and pressure fluorine (F_2) exist as pale yellow gas, chlorine (Cl_2) as yellow - green gas, bromine (Br_2) as red-brown liquid and iodine (I_2) as grey - black solid. Iodine easily turn into a dark purple vapour on warming.

Q.58. Write general electronic configuration of Halogens. medium

Ans. Halogens possess 7 electrons in their valence shell. They have general electronic configuration ns^2, np^5 . They need only one electron to complete their valence shell. Consequently, they tend to gain one electron to form univalent negative ions, F^-, Cl^-, Br^-, I^- .

Q.59. What are the densities of Halogens? medium

Ans.

Halogens	g/cm^3 at $25^\circ C$
Fluorine	0.0017
Chlorine	0.0032
Bromine	3.1028
Iodine	4.933



Q.60. Why is fluorine more non-metallic than chlorine? medium

Ans. Small sized elements having high nuclear charge are electronegative in nature and have high electron affinity so they possess non-metallic character.

Non-metallic character decreases down a group so fluorine being the first element of halogen group is more non-metallic than chlorine.

Q.61. Why are noble gases not reactive? medium

Ans. Noble gases do have 2 or 8 electrons in their valence shells. It means that all the noble gases have their valence shells completely filled. Their atoms do not have vacant spaces in their valence shells to accommodate extra electrons. That is why noble gases are not reactive.



Chemical Bonding

Q.1. Describe the importance of noble gas electronic configuration.

ANSWER

Ans. Chemical Bond: A chemical bond is defined as a force of attraction between atoms that holds them together in a substance. In other words, during bond formation there is some force which holds the atoms together.

Why do atoms form chemical bonds?

It is a universal rule that everything in this world tends to become more stable. Atoms achieve stability by attaining electronic configuration of noble gases (He, Ne or Ar etc.) i.e. $ns^2 np^6$. Having 2 or 8 electrons in the valence shell is sign of stability.

The importance of the noble gas electronic configuration lies in the fact that all other atoms try their best to have the noble gas electronic configuration. For this purpose, atoms combine with one another, which is called chemical bonding.

Q.2. Explain how elements attain stability?

ANSWER

Ans. Octet Rule: The attaining of 8 electrons in the outermost shell either by sharing, by losing or by gaining electrons, is called octet rule.

Explanation:

It is a universal rule that everything in this world tends to become more stable. Atoms achieve stability by attaining electronic configuration of noble gases (He, Ne or Ar) i.e. $ns^2 np^6$. Having 2 or 8 electrons in the valence shell is sign of stability.

The importance of the noble gas electronic configuration lies in the fact that all other atoms try their best to have the noble gas electronic configuration. For this purpose atoms combine with one another, which is called chemical bonding. In other words, atoms form chemical bonds to achieve stability by acquiring inert gas electronic configuration.

An atom can accommodate 8 electrons in its valence shell in three ways:

- By giving valence shell electrons (if they are less than three) to other atoms.
- By gaining electrons from other atoms (if the valence shell has five or more electrons in it).
- By sharing valence electrons with other atoms.

It means every atom has a natural tendency to have 2 or 8 electrons in its valence shell. The atoms having less than 2 or 8 electrons in their valence shells are unstable.

Q.3. Describe the ways in which bonds may be formed.

ANSWER

Ans. Bonds are formed through various types of chemical interactions, primarily involving the sharing or transfer of electrons between atoms. The main types of chemical bonds are:

i. Covalent Bond

Non-polar Covalent Bond: Electrons are shared equally between two atoms with similar electronegativities.

Polar Covalent Bond: Electrons are shared unequally between two atoms with different electronegativities, creating a dipole.

ii. Ionic Bond:

This bond is formed when one atom donates one or more electrons to another atom, resulting in positively and negatively charged ions that attract each other.

iii. Metallic Bond:

It is formed due to presence of free electrons among a lattice of metal atoms, creating a "sea of electrons" that contributes to the conductivity and malleability of metals.



iv. Hydrogen Bonds:

A weak bond occurring when a hydrogen atom, covalently bonded to a highly electronegative atom (like oxygen, nitrogen, or fluorine), is attracted to another electronegative atom.

v. Vander Waal's Forces:

Weak, short-range forces arising from temporary fluctuations in electronic distribution in atoms and molecules. This includes London dispersion forces and dipole-dipole interactions.

Q.4. Describe the formation of covalent bond between two non-metallic elements.

ANSWER

Ans. Definition of covalent bond: Non-metal atoms tend to share electrons with each other or with other non-metal atoms, forming a chemical bond called a covalent bond. A chemical bond formed by mutual sharing of electrons between two atoms is called a covalent bond.

Representation: General representation of a covalent bond is given below.

Covalent Bond



i. Formation of Hydrogen Molecule: Consider the formation of a covalent bond between two hydrogen atoms. A hydrogen atom has one valence electron. Two hydrogen atoms share their valence electrons to form a diatomic molecule.



In the formation of this molecule, each hydrogen atom reaches the electronic configuration of the noble gas helium with two valence electrons. An electron pair in the region between two atoms attracts both hydrogen nuclei. This creates a strong electrostatic attraction between the shared electrons and the two nuclei. This means that the situation is more stable than in individual atoms. Because of this stability, the two atoms form a covalent bond.

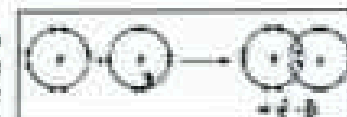
Dot-Cross Structure:

A covalent bond between two atoms can be represented by using electron-dot and electron-cross symbols for the atoms and the resulting molecule.

Valence electrons are represented by dots. Just to understand sharing, we represent valence electrons in one atom by dots and in the other atom by crosses. All the electrons are identical and cannot be differentiated. A shared pair of electrons is also represented by a dash (-) in a molecule.

ii. Formation of Fluorine Molecules:

Consider the formation of a bond between two fluorine atoms. Fluorine belongs to Group VIIA, so it has seven electrons in the valence shell. It needs one more electron to attain the electronic configuration of a noble gas. Thus, two F-atoms share an electron pair and achieve electronic configuration of Ne. For sharing each F-atom contributes one electron to complete its octet.





Q.5. Explain with examples single, double and triple covalent bond.

Ans. Covalent Bond: A bond which is formed due to mutual sharing of electrons between atoms is called covalent bond. The electrons that pair up to form a chemical bond are called 'bond pair' electrons. The formation of hydrogen, chlorine, nitrogen and oxygen gases are few examples of this type of bonding.

Types of covalent bonds:

Depending upon the number of bond pairs, covalent bond is classified into following three types:

i. Single Covalent bond (—): When one electron is contributed by each bonded atom, one bond pair is formed and forms a single covalent bond. It is indicated by a line (—) between two atoms.

Examples of molecules with single covalent bonds are chlorine (Cl_2), methane (CH_4) and hydrochloric acid (HCl) etc.



ii. Double Covalent bond (=):

When each bonded atom contributes two electrons, two bond pairs are shared and a double covalent bond is formed. It is indicated by double line (=) between two atoms.

Example: Ethene contains double covalent bond in its molecule.



iii. Triple Covalent Bond ($\equiv$):

When each bonded atom contributes three electrons, three bond pairs are shared and a triple covalent bond is formed. It is indicated by three lines ($\equiv$) between two atoms.

Example: Ethyne contains triple covalent bond in its molecule.



By this mutual sharing of valence shell electrons, each of the contributing atom attains the 'octet' or nearest noble gas electronic configuration.

Q.6. Find the number of valence electrons in the following atoms using the periodic table?

(i) Boron (ii) Neon (iii) Rubidium (iv) Barium (v) Arsenic

Ans.

i. Boron (B):

Boron belongs to Group 13. Its atomic number is 5, the electronic configuration of Boron is $K = 2, L = 3$. The valence shell of Boron is L-shell and it has three valence electrons.



ii. Neon (Ne):

Neon is a noble gas which belongs to Group 18. Its atomic number is 10. The electronic configuration of neon is $K = 2, L = 8$. The valence shell of neon is L-shell and it has eight valence electrons and is stable according to



octet rule.

iii. Rubidium (Rb):

Rubidium belongs to Group 1. Its atomic number is 37. The electronic configuration of Rubidium is $K = 2, L = 8, M = 18, N = 8, O = 1$. The valence shell of Rubidium is N-shell and it has one valence electron.



iv. Barium (Ba):

Barium belongs to Group 2. Its atomic number is 56. The electronic configuration of Barium is $K = 2, L = 8, M = 18, N = 18, O = 8, P = 2$. The valence shell of Barium is P-shell and it has two valence electrons.



v. Arsenic (As):

Arsenic belongs to Group 15. Its atomic number is 33. The electronic configuration of Arsenic is $K = 2, L = 8, M = 18, N = 5$. The valence shell of arsenic is N-shell and it has 5 valence electrons.



Q.7. Represent the formation of cations for the following metal atoms using electron dot structures.

(i) Al

(ii) Sr

(iii) Ba

Ans.

i. Al

Al belongs to Group - 13. It has only three valence electrons. The Al atom loses its three valence electrons and is left with an octet.

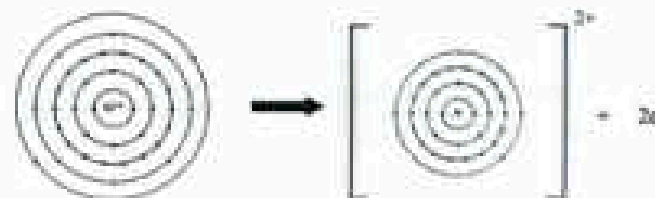
Formation of Al^{3+} ion.



ii. Sr

Sr belongs to Group - 2. It has only two valence electrons. The Sr atom loses its two valence electrons and is left with an octet.

Formation of Sr^{2+} ion.

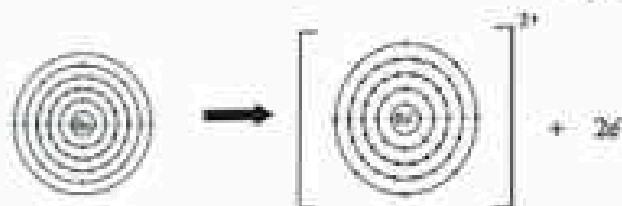


iii. Ba

Ba belongs to Group - 2. It loses its two valence electrons and is left with an octet.



Formation of Ba^{2+} ion.



Q.8. A sample of Sulphur from a volcano was analyzed to give the following composition of isotopes (At no of S = 16)

Isotope	Abundance (%)
S = 32	95.0
S = 33	0.76
S = 34	4.22

- Define the term isotope.
- Define the term relative atomic mass.
- Calculate the relative atomic mass of Sulphur.
- Complete the following table.

	Protons	Neutrons	Electrons
S = 32			
S = 34			

- Where will you place S in the periodic table?
- How many electrons S will lose or gain to acquire stable configuration?
- How many atoms of S are there in 0.3 mole of Sulphur?

Ans. (a) Isotope: Atoms of an element have same atomic number but different mass number are called isotopes e.g. Hydrogen has three isotopes.

Protium (^1H), Deuterium (^2H), Tritium (^3H).

(b) Relative atomic mass: The relative atomic mass of an element is the average mass of atoms of that element as compared to $\frac{1}{12}$ the mass of one atom of carbon - 12 isotope. Its unit is atomic mass unit with symbol "amu".

$$1 \text{ amu} = 1.66 \times 10^{-24} \text{ g}$$

(c) Relative atomic mass of Sulphur:

$$\begin{aligned} \text{Relative atomic mass of Sulphur} &= \frac{(95 \times 32) + (0.76 \times 33) + (4.22 \times 34)}{100} \\ &= \frac{30.40 + 25.08 + 143.48}{100} \end{aligned}$$



$$\begin{aligned} \text{Relative atomic mass of Sulphur} &= \frac{3208.56}{100} \\ &= 32.08 \end{aligned}$$

(d) Completing Table:

	Protons	Neutrons	Electrons
S = 32	16	16	16
S = 34	16	18	16

- Sulphur is placed in third period and Group - 16 of the periodic table.
- Sulphur gains two electrons to complete its octet and acquire the nearest electronic configuration of noble gas.
- Number of S-atoms in 0.3 mol = $0.3 \times N_A$
 $= 0.3 \times 6.02 \times 10^{23}$
 $= 1.806 \times 10^{23}$ atoms

Q.9. An atom of an element has atomic number 9 and mass number 19.

- State the number of protons and neutrons in the nucleus of this atom.
- Show with electron cross-dot diagrams, the formation of ions by this atom.
- Show with electron cross-dot diagrams, the formation of ions by this atom.
- Write electronic configuration of this element.
- Point out its group in the periodic table.
- Point out its period in the periodic table.

Ans. (a) An atom has atomic number 9 and mass number 19:

$$\begin{aligned} \text{Number of protons} &= 9 \\ \text{Mass number} &= \text{Atomic No} + \text{number of neutrons} \\ 19 &= 9 + \text{number of neutrons} \\ 19-9 &= \text{number of neutrons} \\ \text{Number of neutrons} &= 10 \end{aligned}$$

- It has 9 electrons.
- An atom has seven electrons in its valence shell. It gains one electron to complete its octet.

Formation of X^- ion:



- An atom has atomic number 9. So, its electronic configuration is: $1s^2 2s^2 2p^5$
- This atom is placed in Group-17 of the periodic table.
- This atom is placed in second period of the periodic table.



Think Tank

Q.10. Magnesium oxide is a compound made up of a magnesium ions and oxide ions.



(a) What is the charge on these ions.

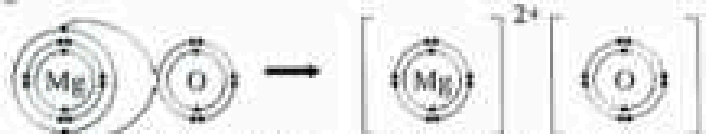
(b) How these ions get these charges.

(c) Show with electron cross-dot diagrams the formation of these ions.

Ans. (a) Magnesium oxide is a compound made up of magnesium ions and oxide ions in which magnesium gets 2^+ charge while oxide has 2^- charge respectively.

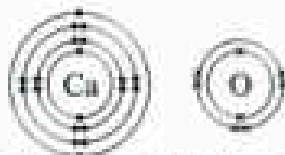
(b) Magnesium atom loses its two valence electrons. So, it gets 2^+ charge on it while oxygen atom gains two electrons and gets 2^- charge on it.

(c) Mg atom has two electrons in outermost shell. It loses two electrons to form Mg^{2+} .



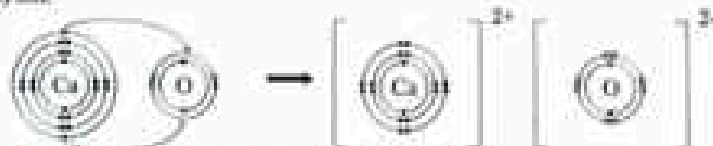
Oxygen atom has six electrons in the outermost shell, so it gains two electrons to form O^{2-} ion.

Q.11. The diagrams below show the electronic structures of an atom of calcium and an atom of oxygen.



Draw structures of the ions that are formed when these atoms react.

Ans. Ca-atom has two electrons in outermost shell. It loses two electrons to form Ca^{2+} ion. Oxygen atom has six electrons in the outermost shell. So, it gains two electrons to form O^{2-} (oxide) ion.



Q.12. The table below shows the properties of four substances;

Substance	Melting point	Electrical conductivity	
		In solid state	In molten state
A	High	Nil	Nil
B	High	Nil	Good
C	Low	Nil	Nil
D	High	Good	Good



(a) Which substance is a metal?

(b) Which substance is an ionic compound?

(c) Which substance is a covalent compound?

(d) Which substance is a non-metal?

Ans. (a) D is a metal. Because, it has high melting point and good conductor of electricity in solid state or molten state.

(b) B is an ionic compound. Because, it has high melting point and do not conduct electricity in solid state, but conduct electricity in molten state.

(c) A is a covalent compound. Because, it has high melting point and does not conduct electricity in solid or molten state.

(d) C is a non-metal. Because it has low melting point and does not conduct electricity in solid or molten state.

Concept Assessment 5.1

Q.13. I. Describe the formation of cations for the following metal atoms;

(a) Li (atomic no 3)

(b) Al (atomic no 13)

ii. Represent the formation of cations for the following metal atoms using electron dot structures.

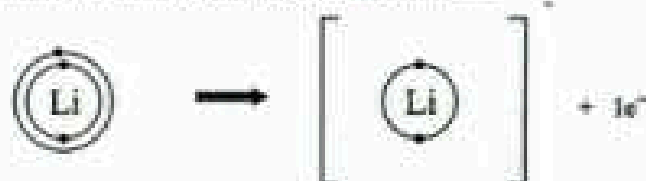
(a) K

(b) Ca

Ans. I. (a) Formation of Li^+ ion



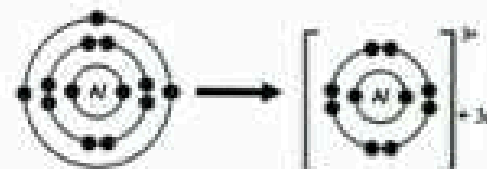
You can also represent this by following electron dot structure



(b) Formation of Al^{3+} ion.



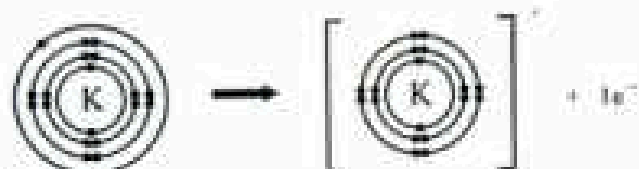
You can also represent this by following electron dot structure



II. (a) Formation of K^+ ion.



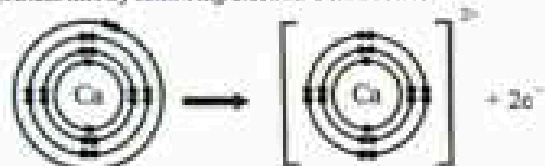
You can also represent this by following electron dot structure



(b) Formation of Ca^{2+} ion.



You can also represent this by following electron dot structure.



Concept Assessment 5.2

- Q.14. i. Describe the formation of anions by the following non-metals.
 (a) Sulphur (atomic no 16) (b) Chlorine (atomic no 17)
- ii. Represent the formation of cations for the following non-metal atom using electron dot structure.
 (a) N (b) P (c) Br (d) H
- iii. Compare differences between the formation of cations and anions.

Ans. I. (a) Formation of S^{2-} ion



You can also represent this by following electron dot structure:



(b) Formation of Cl^- ion.



You can also represent this by following electron dot structure:



II. (a) Formation of N^{3-} ion.



You can also represent this by following electron dot structure:



(b) Formation of P^{3-} ion.



You can also represent this by following electron dot structure:



(c) Formation of Br^- ion.



You can also represent this by following electron dot structure:



(d) Formation of H^+ ion.



You can also represent this by following electron dot structure:



III. Difference between the formation of cation and anion:

Cation	Anion
It is formed by loss of electron by an atom.	It is formed by gain of electron by an atom.
The size of cation is smaller than its parental atom.	The size of anion is greater than its parental atom.
It is positively charged species.	It is negatively charged species.
e.g. Na^+ , K^+	e.g. Cl^- , Br^-

Concept Assessment 5.3

- Q.15. For each of the following pairs of atoms, use electron dot and electronic cross structures to write the equation for the formation of ionic compound.

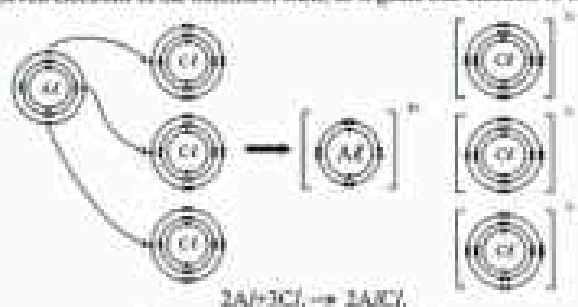
- (a) Mg and O (b) Al and Cl

Ans. (a) Mg and O

Mg-atom has two electrons in the outermost shell. It loses two electrons to form Mg^{2+} ion. Since, O-atom has six electrons in the outermost shell, so it gains two electrons to form O^{2-} ion.

**(b) Al and Cl**

Al-atom has three electrons in the outermost shell. It loses three electrons to form Al^{3+} ion. Cl -atom has seven electrons in the outermost shell, so it gains one electron to form Cl^{-} ion.

**Concept Assessment 5.4**

Q.16. Recognize the following compounds as having ionic bonds.

- (a) KCl (b) AlCl_3 (c) MgF_2 (d) NaF (e) NaBr

Ans.

(a) KCl : K is metal and Cl is non-metal. K-atom has one electron in outermost shell. So, it loses one electron to form K^{+} ion. Since, Cl-atom has seven electrons in outermost shell, so it gains one electron to form Cl^{-} ion. In this way, both the atoms acquire nearest noble gas configuration. Each K^{+} ion needs one Cl^{-} ion. Chemical formula of resulting compound is KCl . Therefore, KCl is an ionic compound.

(b) AlCl_3 : Al is metal and Cl is non-metal. An Al-atom has three electrons in outermost shell. So, it loses three electrons to form Al^{3+} ion. Since Cl-atom has seven electrons in outermost shell, so it gains one electron to form Cl^{-} ion. In this way, both the atoms acquire nearest noble gas configuration. Each Al^{3+} ion needs three Cl^{-} ions. Chemical formula of resulting compound is AlCl_3 . Therefore, AlCl_3 is an ionic compound.

(c) MgF_2 : Mg is metal and F is non-metal. Mg-atom has two electrons in outermost shell. So, it loses two electrons to form Mg^{2+} ion. Since F-atom has seven electrons in outermost shell, so it gains one electron to form F^{-} ion. In this way, both the atoms acquire nearest noble gas configuration. Each Mg^{2+} ion needs two F^{-} ions. Chemical formula of resulting compound is MgF_2 . Therefore, MgF_2 is an ionic compound.

(d) NaF : Na is metal and F is non-metal. Na-atom has one electron in outermost shell. So, it loses one electron to form Na^{+} ion. Since F-atom has seven electrons in outermost shell, so it



gains one electron to form F^{-} ion. In this way, both the atoms acquire nearest noble gas configuration. Each Na^{+} ion needs one F^{-} ion. Chemical formula of resulting compound is NaF . Therefore, NaF is an ionic compound.

(e) NaBr : Na is metal and Br is non-metal. Na-atom has one electron in outermost shell. So, it loses one electron to form Na^{+} ion. Since Br has seven electrons in outermost shell. So, it gains one electron to form Br^{-} ion. In this way, both the atoms acquire nearest noble gas configuration. Each Na^{+} ion needs one Br^{-} ion. Chemical formula of resulting compound is NaBr . Therefore, NaBr is an ionic compound.

Concept Assessment 5.5

Q.17. Draw electron cross and dot structures for the following molecules:

- (a) NH_3 (b) HCl (c) CH_3OH

Ans. (a) NH_3 : N-atom has five electrons in the valence shell and needs three electrons to complete its octet. H-atom has only one valence electron and needs one electron to complete the duplet. So, N can form three single bonds with three H-atoms and N is the central element.



OR



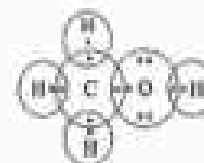
(b) HCl : H-atom has one electron in the valence shell and needs one electron to complete its octet. Cl-atom has seven valence electrons and needs one electron to complete the octet. So, H can form one single bond with one Cl-atom.



OR



(c) CH_3OH : C-atom has four electrons in the valence shell and needs four electrons to complete its octet. H-atom has only one valence electron and needs one electron to complete the duplet. O has six electrons in its outermost shell and needs two electrons to complete its octet.



OR



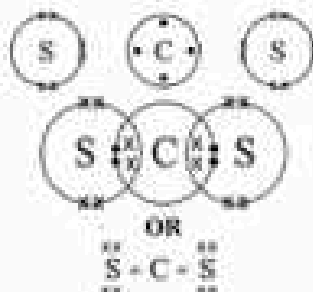

Concept Assessment 5.6

Q.18. Draw electron cross and electron dot structures for the following molecules:

- (a) CS_2 an organic solvent that dissolves Sulphur, phosphorus etc.
 (b) N_2 a component of air.
 (c) C_2H_6 , ethane, a component of natural gas.

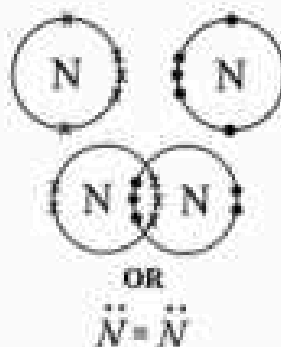
Ans. (a) CS_2 :

- (i) C-atom has four electrons in the valence shell. It needs four electrons to complete octet.
 (ii) Each S-atom has six valence electrons and needs two electrons to have an octet.
 (iii) C-atom is central atom, arrange S-atoms around it.
 (iv) Since C-atom needs four electrons and there are only two S-atoms. So, it will share its two electrons with each Sulphur atom.



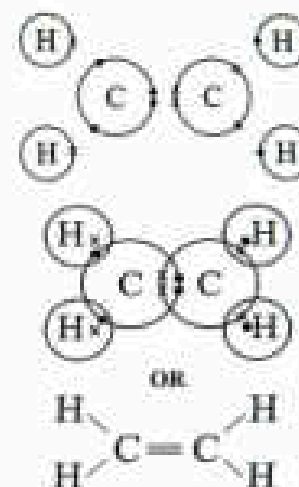
(b) N_2 :

- (i) Each nitrogen atom has five electrons and needs three electrons to have an octet.
 (ii) Nitrogen atom has five electrons in its valence shell. So, it will share its three electrons with other nitrogen atom.



(c) C_2H_6 :

- (i) C-atom has four electrons in the valence shell. It needs four electrons to complete octet.
 (ii) H-atom has one electron in its valence shell. It needs one electron to complete octet.
 (iii) So, each C-atom share two electrons with two H-atoms and also share its two electrons with other carbon atom.


Concept Assessment 5.7

- Q.19. i. Differentiate between polar and non-polar covalent bond.
 ii. How is coordinate covalent bond different from normal covalent bonds?

Ans. (i) Non-polar and Polar covalent bond

Non-polar covalent bond	Polar covalent bond
It is formed between two similar atoms (homo-atoms). The shared pair of electrons is attracted by both the atoms equally.	It is formed between two different types of atoms (hetero-atoms) then the bond pair of electrons will not be attracted equally by the bonded atoms.
These bonds are formed by equal sharing of electron pair between the two bonding atoms having same electronegativity values.	In this type of bond, one of the atoms will attract the bond pair of electrons more strongly than the other one. This atom (element) will be called as more electronegative.
This type of bond is called a pure covalent bond.	This type of bond is called an impure covalent bond.
Examples: the bond formation in H_2 , Cl_2 , O_2 , N_2 etc.	Examples: The bond formation in HCl , HF , H_2O etc.

(ii) Covalent and Co-ordinate Covalent bond.

Covalent bond	Co-ordinate Covalent Bond
This bond is formed by mutual sharing of electrons between atoms.	This bond is formed by donated bond pair of electron one bonded atom only.
This bond is represented by solid line between atoms.	This bond is represented by small arrow. Arrow head is always towards acceptor.
There is no need of lone pair for the formation of this bond.	Presence of lone pair is necessary for the formation of this bond.



Multiple Choice Question (Exercise)

1. Which of the following atoms will form an ion of charge -2 ?

	Atomic number	Mass number
(a)	12	24
(b)	14	28
(c)	8	16
(d)	16	32

2. Which of the following atoms will not form cation or anion?

- (a) Atomic no. 16
(b) Atomic no. 17
(c) Atomic no. 18
(d) Atomic no. 19

3. Which of the following atoms will form cation?

- (a) Atomic no. 20
(b) Atomic no. 19
(c) Atomic no. 17
(d) Atomic no. 15

4. Which of the following atoms obey duplet rule?

- (a) O (b) H
(c) F (d) N

5. Silicon belongs to Group IVA. It has _____ electrons in the valence shell.

- (a) 2 (b) 3
(c) 4 (d) 8

6. Phosphorus belongs to third period of Group VA. How many electrons it needs to complete its valence shell.

- (a) 2 (b) 3
(c) 4 (d) 5

7. In the formation of AlF_3 , aluminium atom loses _____ electrons.

- (a) 1 (b) 2
(c) 3 (d) 4

8. Which of the following is not true about the formation of Na_2S ?

- (a) Each sodium atom loses one electron.
(b) Sulphur forms anion.
(c) Sulphur forms cation.
(d) Each Sulphur atom gains one electron.

9. Identify the covalent compound:

- (a) $NaCl$ (b) MgO
(c) H_2O (d) KF

SLO Based Additional MCQs

10. Atoms react with each other because:

- (a) They are attracted towards each other.
(b) They are short of electrons.
(c) They want to attain stability.
(d) They want to disperse.

11. An atom having six electrons in its valence shell will achieve noble gas electronic configuration by:

- (a) Gaining one electron.
(b) Losing all electrons.
(c) Gaining two electrons.
(d) Losing two electrons.

12. Octet rule is:

- (a) Description of eight electrons.
(b) Picture of electronic configuration.
(c) Pattern of electronic configuration.
(d) Attaining of eight electrons.

13. Transfer of electrons between elements result in:

- (a) Metallic bonding.
(b) Ionic bonding.
(c) Covalent bonding.
(d) Coordinate-covalent bonding.

14. When an electronegative element combines with electropositive element, the type of bonding is:

- (a) Covalent.
(b) Ionic.
(c) Polar covalent.
(d) Coordinate covalent.

15. A bond formed between two non-metals is expected to be:

- (a) Covalent.
(b) Ionic.
(c) Coordinate covalent.
(d) Metallic.

16. A bond pair in covalent molecules usually has:

- (a) One electron.
(b) Two electrons.
(c) Three electrons.
(d) Four electrons.

17. Which of the following compounds is non-directional in its bonding?

- (a) CH_4 (b) KBr
(c) CO_2 (d) H_2O

18. Covalent bond involves the:

- (a) Donation of electrons.
(b) Acceptance of electrons.
(c) Sharing of electrons.
(d) Repulsion of electrons.

19. How many covalent bonds does C_2H_2 molecule have?

- (a) Two (b) Three
(c) Four (d) Five

20. Triple covalent bond involves how many electrons?

- (a) Eight (b) Six
(c) Four (d) Only three

21. Which pair of the molecules has same type of covalent bonds?

- (a) O_2 and HCl (b) O_2 and N_2
(c) O_2 and C_2H_2 (d) O_2 and C_2H_4

22. Identify the compound which is not soluble in water:

- (a) C_2H_6 (b) $NaCl$
(c) KBr (d) $MgCl_2$

23. Which one of the following is electron deficient molecule?

- (a) NH_3 (b) BF_3
(c) Ne (d) O_2

24. Identify which pair has polar covalent bonds:

- (a) O_2 and Cl_2 (b) H_2O and N_2
(c) H_2O and C_2H_2 (d) H_2O and HCl

25. Which one of the following is the weakest force among the atoms?

- (a) Ionic force.
(b) Metallic forces.
(c) Intermolecular force.
(d) covalent forces.

26. A bond formed due to complete transfer of electrons from one atom to another is called:

- (a) Covalent bond.
(b) Hydrogen bond.
(c) Ionic bond.
(d) Metallic bond.

27. The electronic configuration of sodium atom is:

- (a) $1s^2 2s^2 2p^6$
(b) $1s^2 2s^2 2p^6$
(c) $1s^2 2s^2 2p^6 3s^2$
(d) $1s^2 2s^2 2p^6 3s^1$

28. How many electrons are there in the valence shell of sodium atom?

- (a) One (b) Two
(c) Three (d) Four

29. The electropositive elements have the tendency to:

- (a) Gain electrons.
(b) Lose electrons.
(c) Share electrons.
(d) All of these.

30. How many valence shell electrons are there in Na^+ ion?

- (a) 8 (b) 9
(c) 10 (d) 1

31. During the formation of ionic bond, heat is?

- (a) Absorbed (b) Released
(c) Remains same (d) Both a & b

32. Which type of attractive forces are present in ionic compounds?

- (a) Covalent bonds.
(b) Coordinate covalent bonds.
(c) Metallic bonds.
(d) Electrostatic forces of attraction.

33. Covalent bond is most commonly found between the elements of group:

- (a) 13 to 17 (b) 1 to 13
(c) 16 to 18 (d) 15 to 18



34. A bond formed by the mutual sharing of an electron pair is called: (01/05/2021)

- (a) Ionic bond
- (b) Covalent bond
- (c) Coordinate covalent bond
- (d) Metallic bond

35. A covalent bond formed by the mutual sharing of two pairs of electrons between bonded atoms is called: (01/05/2021)

- (a) Single covalent bond
- (b) Double covalent bond
- (c) Triple covalent bond
- (d) Polar covalent bond

36. Which molecule contains a single covalent bond? (01/05/2021)

- (a) CH_4
- (b) C_2H_4
- (c) C_2H_2
- (d) O_2

37. Nitrogen molecule contains: (01/05/2021)

- (a) Polar covalent bond
- (b) Single covalent bond
- (c) Double covalent bond
- (d) Triple covalent bond

38. How many electrons are involved in the formation of single covalent bond? (01/05/2021)

- (a) One
- (b) Two
- (c) Three
- (d) Four

39. Dative covalent bond is also known as: (01/05/2021)

- (a) Coordinate covalent bond
- (b) Covalent bond
- (c) Ionic bond
- (d) Metallic bond

40. How many lone pairs are present on nitrogen in ammonia molecule? (01/05/2021)

- (a) One
- (b) Two
- (c) Three
- (d) Four

41. Which type of bond is present between NH_3 and BF_3 ? (01/05/2021)

- (a) Covalent bond
- (b) Coordinate covalent bond
- (c) Ionic bond
- (d) Metallic bond

42. A covalent bond formed by two similar atoms is known as: (01/05/2021)

- (a) Polar covalent bond
- (b) Non-polar covalent bond
- (c) Metallic bond
- (d) Double covalent bond

43. Which of the following is an example of polar covalent compound? (01/05/2021)

- (a) HCl
- (b) Cl_2
- (c) O_2
- (d) H_2

44. A covalent bond is formed by the elements having: (01/05/2021)

- (a) Low electronegative values
- (b) High electronegative values
- (c) Comparable electronegative value
- (d) High electron affinity values

45. In metals, the hold of nucleus over the valence shell electrons is weak due to: (01/05/2021)

- (a) Large sized atoms
- (b) High ionization energies
- (c) Low ionization affinity
- (d) All of the above

46. Metals have the tendency to lose electrons due to: (01/05/2021)

- (a) High ionization energies
- (b) Low electron affinity
- (c) Low ionization energy
- (d) none of the above

47. Hydrogen bonding is always found in: (01/05/2021)

- (a) Non-polar molecules
- (b) Polar molecules
- (c) Homonuclear molecules
- (d) All of the above

48. The force of attraction between water molecule is: (01/05/2021)

- (a) Ionic bonding
- (b) Covalent bonding
- (c) Hydrogen bonding
- (d) Coordinate covalent bonding

49. The boiling point of water is: (01/05/2021)

- (a) 0°C
- (b) 35°C
- (c) 100°C
- (d) 25°C

50. The boiling point of alcohol is: (01/05/2021)

- (a) 40°C
- (b) 19°C
- (c) 35°C
- (d) 78°C

51. Water has high boiling points as compared to alcohol due to: (01/05/2021)

- (a) Hydrogen bonding
- (b) High vapour pressure
- (c) Low density
- (d) High surface tension

52. The density of ice at 0°C is: (01/05/2021)

- (a) 0.917 g/cm^3
- (b) 1.24 g/cm^3
- (c) 1.7 g/cm^3
- (d) 2.17 g/cm^3

53. The density of water at 4°C is: (01/05/2021)

- (a) 0.917 g/cm^3
- (b) 1.24 g/cm^3
- (c) 1.00 g/cm^3
- (d) 1.17 g/cm^3

54. The compounds formed by opposite charges are known as: (01/05/2021)

- (a) Non-polar Covalent compounds
- (b) Ionic compounds
- (c) Metallic solids
- (d) None of the above

55. Ionic compounds are good conductors electricity in: (01/05/2021)

- (a) Solid state
- (b) Molten state
- (c) Solution
- (d) Both b and c

56. Ionic compounds have: (01/05/2021)

- (a) High melting and boiling points
- (b) High melting and low boiling points
- (c) Low melting and high boiling points
- (d) Low melting and boiling points

57. The melting point of NaCl is: (01/05/2021)

- (a) 318°C
- (b) 1000°C
- (c) 310°C
- (d) 800°C

58. Which of the following is an example of a covalent compound? (01/05/2021)

- (a) $\text{C}_6\text{H}_{12}\text{O}_6$
- (b) CH_4
- (c) H_2SO_4
- (d) All of these

59. At room temperature, higher molecular mass covalent compounds are: (01/05/2021)

- (a) Solids
- (b) Liquids
- (c) Gases
- (d) All of these

60. Non-polar compounds are insoluble in: (01/05/2021)

- (a) Water
- (b) Benzene
- (c) Ether
- (d) Alcohol

61. Malleability is the property by virtue of which a metal can be drawn into: (01/05/2021)

- (a) Sheets
- (b) Wires
- (c) Rods
- (d) Plates

62. Metals usually have:

- (a) High ionization energy
- (b) Low ionization energy
- (c) High electron affinity
- (d) High electronegativity

63. Metals are good conductors of heat and electricity in solid and liquid state due to: (01/05/2021)

- (a) Mobile electron
- (b) Lone pair electrons
- (c) Bond pair electrons
- (d) All of the above

64. Which type of adhesives is less expensive to produce? (01/05/2021)

- (a) Synthetic
- (b) Natural
- (c) Both a and b
- (d) None of the above

65. Epoxy adhesives can be made: (01/05/2021)

- (a) Flexible or rigid
- (b) Transparent or opaque
- (c) Coloured
- (d) All of the above

66. Epoxy adhesives are: (01/05/2021)

- (a) Good heat resistant
- (b) Good chemical resistant
- (c) Both a and b
- (d) None of the above

67. Epoxy adhesives are also known as: (01/05/2021)

- (a) Medical adhesives
- (b) Engineering adhesives
- (c) Surgical adhesives
- (d) All of the above

68. The forces responsible for binding the atoms together in a molecule are called: (01/05/2021)

- (a) Hydrogen bond
- (b) Ionic bond
- (c) Chemical bond
- (d) Covalent bond



69. Atoms achieve stability by attaining electronic configuration of: *answer*
 (a) Alkali metals
 (b) Inert gases
 (c) Alkaline earth metals
 (d) Coinage metals
70. Attaining two electrons in the valence shell is called: *answer*
 (a) Duplet rule
 (b) Triplet rule
 (c) Octet rule
 (d) All of these
71. All the noble gases have their valence electrons: *answer*
 (a) Partially filled
 (b) Completely filled
 (c) Incomplete
 (d) None of the above
72. Noble gases are non-reactive, because they do not: *answer*
 (a) Gain electrons
 (b) Lose electrons
 (c) Share electrons
 (d) All of these
73. Every atom has a natural tendency to accommodate electrons in its valence shell: *answer*
 (a) 2 or 6
 (b) 2 or 4
 (c) 2 or 8
 (d) 2 or 10

74. Hydrogen and Helium follow: *answer*
 (a) Octet rule
 (b) Duplet rule
 (c) Triplet rule
 (d) None of these
75. The formation of ionic bond between two ions is due to: *answer*
 (a) Hydrogen bonding
 (b) Metallic force
 (c) Electrostatic forces
 (d) All of the above
76. Which group of the periodic table has the tendency to gain electrons? *answer*
 (a) Group 1
 (b) Group 18
 (c) Group 2
 (d) Group 17
77. The electronegative elements have: *answer*
 (a) High electron affinities
 (b) Low electron affinities
 (c) Large atomic sizes
 (d) High melting points
78. Number of bond pair electrons in nitrogen molecule is: *answer*
 (a) 2
 (b) 4
 (c) 6
 (d) 8
79. How many covalent bonds do N₂ molecule have? *answer*
 (a) 2
 (b) 3
 (c) 4
 (d) 5

Answer Key

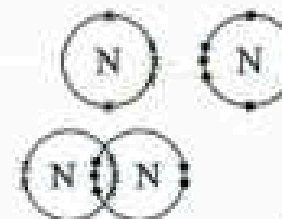
1	c	1	c	3	a	4	b	5	c
6	b	7	c	8	d	9	c	10	c
11	c	12	d	13	b	14	b	15	a
16	b	17	b	18	c	19	d	20	b
21	c	22	a	23	b	24	d	25	d
26	c	27	d	28	a	29	b	30	a
31	b	32	d	33	a	34	b	35	b
36	a	37	d	38	b	39	a	40	a
41	b	42	b	43	a	44	c	45	a
46	c	47	b	48	c	49	c	50	d



51	a	52	a	53	c	54	b	55	d
56	a	57	d	58	d	59	a	60	a
61	a	62	b	63	a	64	b	65	d
66	c	67	b	68	c	69	b	70	a
71	b	72	d	73	c	74	b	75	c
76	d	77	a	78	c	79	b		

Short Questions (Exercise)

- Q.1. State octet and duplet rules. *answer*
Ans. Octet rule: The attaining of eight electrons in the outermost shell by sharing, by losing or by gaining electrons is called octet rule. e.g. Na
 Duplet rule: The attaining of two electrons in the outermost shell by sharing, by losing or by gaining electrons is called duplet rule. e.g. He
- Q.2. Explain formation of covalent bond between two nitrogen atoms. *answer*
Ans. N)
 (i) Each nitrogen atom has five electrons and needs three electrons to have an octet.
 (ii) Nitrogen atom has five electrons in its valence shell. So it will share its three electrons with other nitrogen atom.



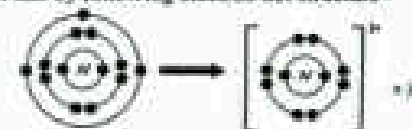
- Q.3. How does Al form cation? *answer*

Ans.

Formation of Al³⁺ ion.



You can also represent this by following electron dot structure



- Q.4. How does O form anion? *answer*

Ans. Formation of anion by oxygen atom: Oxygen belongs to Group VIA on the periodic table. So it has six electrons in its valence shell. It needs two electrons to achieve noble gas configuration.





You can also represent this by electron dot structure.

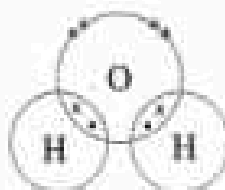


Q.5. Draw electron cross and dot structure for H_2O molecule.

Ans. (i) O-atom has six valence electrons and each hydrogen atom has one valence electron. So, O-atom needs two electrons to complete the octet. Each H-atom needs one electron to complete duplet.

(ii) O-atom is central atom and will form two single bonds with H-atoms.

(iii) Arrange H-atoms around O-atom and connect them by a pair of electrons (one dot and one cross).



SLO Based Additional Short Questions (Reference Material)

Q.6. Why do atoms react?

Ans. Atoms react to form a chemical bond and achieve stability by acquiring inert gas electron configuration.

Q.7. Why are noble gases non-reactive in nature?

Ans. Noble gases have 2 or 8 electrons in their valence shells. It means that all the noble gases have their valence shells completely filled. Their atoms do not have

vacant space in their valence shell to accommodate extra electrons. Therefore, noble gases do not gain, lose or share electrons. That is why they are non-reactive, at ordinary conditions.

Q.8. What is meant by duplet rule?

Ans. The attaining of two electrons in the outermost shell by sharing, by losing or by gaining electrons is called duplet rule, e.g. He.

Q.9. What is meant by octet rule?

Ans. The attaining of eight electrons in the outermost shell by sharing, by losing or by gaining electrons is called octet rule, e.g. Ne.

Q.10. What is meant by a chemical bond?

Ans. A force of attraction between atoms that holds them together in a molecule is called a chemical bond, e.g. H-H.

Q.11. When are atoms considered to be unstable?

Ans. The atoms having less than 2 or 8 electrons in their valence shells are unstable.

Q.12. Differentiate between Electropositive and Electronegative Elements.

Ans. Metals are electropositive in nature because all metal atoms lose electrons from their outermost shell in order to become stable and become positively

charged. They have low ionization energy and low electronegativity allowing them to easily lose electrons. Therefore, they can form positive ions by losing electrons.

Example:



Non-metals are electronegative in nature because all non-metals gain electrons in order to become stable and hence become negatively charged. They have high electronegativity and have high electron affinity. So they can easily form negative ions by gaining electrons.

For example:



Q.13. Name different types of chemical bonds.

- Ans. (i) Ionic bond
(ii) Covalent bond
(iii) Co-ordinate covalent bond
(iv) Metallic bond

Q.14. Define ionic bond with an example.

Ans. The bond formed by the complete transfer of electrons from one atom (electropositive) to another (electronegative) is called ionic bond, e.g. Formation of bond between sodium and chloride ions.

Q.15. Define ionic compounds and why these compounds are neutral?

Ans. Compounds that consist of ions joined by electrostatic forces are called ionic compounds. The total positive charge of the cations must be equal to the total negative charge of the anions. This is because ionic compounds are electrically neutral as a whole.

Q.16. What is meant by covalent bond?

Ans. The bond formed by the mutual sharing of electrons between atoms are called covalent bond.

bond. Covalent bond is classified into three types.

- Single covalent bond
- Double covalent bond
- Triple covalent bond

Q.17. What is meant by single covalent bond? Give examples.

Ans. When one electron is contributed by each bonded atom, one bond pair is formed and it forms a single covalent bond. It is represented by (—). Examples of molecules with single covalent bonds are hydrogen, ($\text{H}—\text{H}$), hydrochloric acid, ($\text{H}—\text{Cl}$).

Q.18. What is meant by double covalent bond? Give examples.

Ans. When each bonded atom contributes two electrons, two bond pairs are shared and a double covalent bond is formed. It is represented by (=). e.g. A molecule with double covalent bond is oxygen, ($\text{O}=\text{O}$); O_2 .

Q.19. What is a triple covalent bond? Explain with an example.

Ans. Triple Covalent Bond (≡): When each bonded atom contributes three electrons, three bond pairs are shared and a triple covalent bond is formed. It is indicated by (≡).

Example of molecules with triple covalent bonds are nitrogen (N_2) and ethyne (C_2H_2).



Q.20. What is meant by non-polar covalent bond? Give examples.

Ans. If a covalent bond is formed between two similar atoms, the shared pair of electrons is attracted by both atoms equally.

Such type of bond is called non-polar covalent bond. A few examples of molecules with non-polar covalent bonds are hydrogen, chlorine, nitrogen etc.



Q.21. What is meant by polar covalent bond? Give examples. MANI RAMAN

Ans. If a covalent bond is formed between two different types of atoms, then the bond pair of electrons will not be attracted equally by the bonded atoms. Such type of bond is called polar covalent bond. A few examples of molecules with polar covalent bonds are hydrochloric acid, water etc.

Q.22. Give the formation of polar covalent bond in HCl molecule. MANI RAMAN

Ans. The difference between electro negativities of hydrogen and chlorine is 1.9. As the electronegativity of chlorine is more, it attracts the shared pair of electron towards itself with a greater force. A partial negative charge is therefore created on chlorine and in turn a partial positive charge is developed on hydrogen due to electronegativity difference. It creates polarity in the bond and is called a polar covalent bond.

Q.23. Why does a covalent bond become polar? MANI RAMAN

Ans. When there is difference in the electronegativities between two covalently bonded atoms, there will be unequal attractions for the bond pair of electrons between such atoms. More electronegative atom gets (δ^-) and less electronegative gets (δ^+). In this way a covalent bond becomes polar, e.g HCl, H_2O .

Q.24. Define coordinate covalent bond. MANI RAMAN

Ans. A type of covalent bond in which the bond pair of electrons is donated by one of the bonded atoms only is called coordinate covalent or dative bond.

Q.25. How is coordinate covalent bond formed in NH_4^+ ? MANI RAMAN

Ans. Nitrogen from ammonia molecule donates its lone pair of electrons to H^+ in order to form a coordinate covalent bond.



Q.26. Differentiate between donor and acceptor atom. MANI RAMAN

Donor atom	Acceptor atom
1. During the formation of coordinate covalent bond the atom which donate a lone pair of electron is called donor. Example: In formation of NH_4^+ , N is donor.	1. During the formation of coordinate covalent bond the atom which accept an electron pair is called acceptor. Example: In formation of NH_4^+ , H^+ is acceptor.

Q.27. Why is the BF_3 electron deficient? MANI RAMAN

Ans. Boron has the electron configuration as $1s^2 2s^2 2p^1$. This means that it needs five more electrons to be stabilized. In BF_3 it shares three electrons with three fluorine atoms and attains six electrons in its valence shell. It still retains the tendency to gain two more electrons and therefore remains electron deficient.

Q.28. Why does oxygen molecule not form polar covalent bond? MANI RAMAN

Ans. In oxygen molecule (O_2) two oxygen atoms are covalently bonded to each other.

As the atoms are similar, the electronegativity difference is zero, and the electron pairs are equally shared between them. Hence, there is no polarity in the bond.

Q.29. Why water molecules carries polar covalent bonds? MANI RAMAN

Ans. Oxygen is a highly electronegative atom as compared to hydrogen. So during the mutual sharing, the electron pair is attracted more towards oxygen and it acquires a partial negative charge. While a partial positive charge develops on hydrogen.

Hence, poles are created and the covalent bond becomes polar.

Q.30. Define intermolecular forces. MANI RAMAN

Ans. A weak force of attraction formed between two molecules is called intermolecular force.

e.g. (i) Dipole-Dipole forces' attraction

(ii) Hydrogen Bonding



Q.31. Why HCl has dipole-dipole forces of attraction? MANI RAMAN

Ans. In HCl chlorine being more electronegative attracts the shared electron pair, partial negative charge is created on chlorine and in turn partial positive charge on hydrogen.

When partial positive and partial negative charges exist at different poles in a molecule, the adjacent molecules will arrange themselves in such a way that negative end of that molecule comes near to positive end of other molecule. It results a net force of attraction called dipole-dipole interaction.



Q.32. Why are dipole forces of attraction not found in halogen molecules? MANI RAMAN

Ans. Halogen molecules form a non-polar covalent bond between them. In order to make non-polar bonds, no electronegativity difference of elements is required, due to which dipole forces do not develop in halogen molecules.

Q.33. What types of attractive forces exist between HCl molecules? MANI RAMAN

Ans. Weak intermolecular forces exist between HCl molecules, i.e. Dipole-Dipole forces between HCl molecule.

Q.34. What is meant by hydrogen bonding? MANI RAMAN

Ans. A bond formed between partially positive hydrogen atom of one molecule

and partially negative atom (F, O or N) of the other molecule is called hydrogen bonding.

Q.35. Draw a structure of water molecules showing hydrogen bonding. MANI RAMAN



Q.36. What are synthetic adhesives? MANI RAMAN

Ans. Adhesives based on synthetic resins and rubbers excel in versatility and performance. Synthetic adhesives can be produced in a sufficient supply with uniform properties and they can be modified in many ways, e.g. thermoplastics and thermosetting.

Q.37. Polymers or resins used in synthetic adhesives belong to which category? MANI RAMAN

Ans. i. Thermoplastics
ii. Thermosetting

Q.38. Give composition of epoxy. MANI RAMAN

Ans. Epoxy is polymer that is formed from two different chemicals.

i. Resin ii. Hardener

Q.39. Give uses of adhesives. MANI RAMAN

Ans. These high performance adhesives are used in the construction of:
i. Aircrafts ii. Automobiles
iii. Bicycles

iv. Boats v. Golf clubs

Q.40. What are the applications of epoxy adhesives? MANI RAMAN

Ans. These are used in the construction of materials where high strength bonds are required, e.g. aircrafts, automobiles, and boats etc.

Q.41. Which factors are determining the properties of a substance? MANI RAMAN

Ans. Three main factors are important for determining properties of a substance:

(a) Types of properties
(b) The way elementary particles are connected to each other.
(c) The arrangement of particles.



Q.42. Ionic compounds conduct electricity in solution or molten form. Why?

09140017

Ans. Ionic compounds in solid state are bad conductor of electricity because ions are tightly packed and unable to move, whereas in solution or molten form ions can move freely which make them good conductor of electricity.

Q.43. Metals are good conductor of electricity. Why?

09140018

Ans. Electricity is produced as a result of movement of free electrons. Metals are good conductor of electricity as they have free or mobile electrons which move freely in the spaces between atoms of a metal.

Q.44. How can covalent compounds conduct electricity?

09140019

Ans. Covalent compounds have no free charged particles, so they do not conduct electricity. However, some covalent compounds conduct electricity when dissolved in water. For instance, acids like HCl , H_2SO_4 , HNO_3 etc. When these acids are dissolved in water, they ionise and form high concentrations of H^+ ion and negatively charged ion. These ion can move freely in aqueous solution. Therefore, aqueous solutions of acids conduct electricity.

Q.45. Why covalent compounds have lower melting points than ionic compounds.

09140020

Ans. This is because ionic compounds involve breaking the ionic bond. Breaking the electrostatic force between ions requires large amount of energy. Thus, ionic compounds have high melting points and boiling points. Melting of covalent solids involves the breaking of intermolecular forces, which are much weaker than electrostatic forces. Thus, less energy is required to break the intermolecular forces between covalent molecule.

Q.46. What do you know about Graphite?

09140021

Ans. Graphite's name is derived from the Greek word "graphein", meaning "to write". It is commonly called black lead. Graphite is an allotrope of carbon. Graphite is formed when carbon is subjected to the intense heat and pressure of the earth's crust and upper mantle.

Q.47. What is the structure of Graphite?

09140022

Ans. In graphite, each carbon atom is linked with 3 other carbon atoms by a single covalent bond resulting in the hexagonal ring arranged in a layer. It has a 2-dimensional layers structure. The 4^{th} valency of the carbon atom is satisfied by weak van der Waal's forces between 2 layers.

Q.48. Write two uses of Graphite.

09140023

Ans. (i) Due to its stability in high temperatures and chemical inertness, graphite is used in many refractory items such as carbon refractory bricks.

(ii) The electrodes of graphite are used in electrical metallurgical furnace. It is used as an anode in electrolytic processes.

Q.49. What do you know about diamond?

09140024

Ans. Diamond is an allotrope of carbon in which the carbon atoms are arranged in a diamond cubic crystal lattice. Thanks to the presence of strong covalent bonds and a rigid tetrahedral structure, diamond is the hardest material ever discovered.

Q.50. What is the structure of Diamond?

09140025

Ans. In a diamond, the carbon atoms are arranged tetrahedrally. Each carbon atom is attached to four other carbon atoms 1.544×10^{-10} meter away with a C-C-C bond angle of 109.5° . It is a strong, rigid three-dimensional structure that results in an infinite network of

atoms. This accounts for diamond's hardness, extraordinary strength and durability and gives diamond a higher density than graphite (3.514 grams per cubic centimeter).

Q.51. Write the properties of Diamond?

09140026

Ans. The giant structure and extensive covalent bonding in diamond renders it extraordinary hardness, elasticity, high yield strength, low conductivity, and chemical inertness.

Q.52. Write two uses of Diamond.

09140027

Ans. (i) Diamonds are most commonly used in ornaments like rings, necklaces, ear rings, etc. In the gem industry, the value of diamonds is very high. They are used in making jewelry because of their durability and luster property.

(ii) Its property of hardness is useful to drill, grind or cut materials. Hence, some blades used for cutting and drills in the industry used diamonds. They are present on the edges and tips in small sizes.

Q.53. Differentiate between ionic and Covalent compound.

09140028

Ans. Ionic compounds are strong in compression, but they are brittle, i.e. they can break easily. In the solid state ionic compounds are poor conductors of electricity. But when they melt or dissolve in water, they conduct electricity due to the free movement of ions. Therefore, batteries and fuel cells use ionic compounds as electrolytes.

Covalent compounds with giant structure, such as diamond, quartz, silica, etc. are usually very strong and hard. Because of its hardness, diamond is used in cutting and drilling tools. Quartz and silicon dioxide are used in the production of abrasives. Graphite, quartz and silica, because they are stable at high temperatures, are used to make ceramics, glass and refractories. Most covalent compounds are poor conductors of electricity.

Q.54. What is meant by metallic bond?

09140029

Ans. A bond formed between atoms (positively charged ions) due to mobile or free electrons is called metallic bond.

Q.55. How is metallic bond formed?

09140030

Ans. In metals, the hold of nucleus over the outermost electrons is weak because of large sized atoms and greater number of shells in between nucleus and valence electrons.

Because of low ionization potentials, metals have the tendency to lose their valence electrons easily. Due to which, these loose or free electrons of all metal atoms move freely in the spaces between atoms of a metal. The nuclei of metal atoms appear submerged in sea of free mobile electrons. These mobile electrons are responsible for holding the atoms of metals together forming a metallic bond.

Q.56. Why is the hold of nucleus over the outermost electrons in metals remains weak?

09140031

Ans. The hold of nucleus on the outermost electrons in metals is very weak because of the increased screening or shielding effect due to the intervening electrons. This trend decreases the force of attraction between nucleus and the electrons. Distance also plays the same role. As the electrons are at a greater distance from nucleus, the force of attraction on valence electron, thus becomes weak.

Q.57. Why do the electrons move freely in metals?

09140032

Ans. The hold of nucleus over the outermost electrons is weak because of large size and greater number of shells in between the nucleus and valence electrons. Furthermore, because of low ionization potentials, metals have the tendency to lose their outer electrons easily. Resultantly, these loose or free



electrons of all metal atoms move freely in free space between atoms of a metal.

Q.58. Which type of electrons are responsible for holding the atoms together in metals?

Ans. The mobile or free electrons are responsible for holding the atoms of metals together forming a metallic bond.

Q.59. What do you mean by malleable and ductile?

Ans. Malleable means a material that can be hammered into sheets and ductile

means a material that can be drawn into wire, e.g. metals.

Q.60. State the physical properties of metals.

Ans. i. Metals have high melting and boiling points.

ii. They are good conductors of heat and electricity.

iii. They are mostly solids, possess metallic luster and can be polished.

iv. They are hard, malleable and ductile.



WSP
06

Stoichiometry

Q.1. Define ion, molecular ion, formula unit, free radical, atomic number, mass number, atomic mass unit.

Ans. Ion: An atom or group of atoms having a charge on it, is called ion. There are two types of ions i.e. cation and anion.

(i) Cation: An atom or group of atoms having positive charge on it, is called cation.

Cations are formed when an atom loses electrons from its innermost shell e.g.



(ii) Anion: An atom or group of atoms that has negative charge on it, is called anion. Anion is formed by the gain or addition of electrons to an atom, e.g. Cl^- and O^{2-}



Molecular ion:

Molecular ion or radical is a species having positive or negative charge on it. When a molecule loses or gains an electron, it forms a molecular ion. Hence, like other ions they can be cationic molecular ions (if they carry positive charge) or anionic molecular ions (if they carry negative charge). Cationic molecular ions are more abundant than anionic molecular ions.

Formation: When gases are bombarded with high-energy electrons in a discharge tube, they start to give molecular ions.

Example: CH_4^+ , H_2^+ , N_2^+

Formula unit:

A formula unit is the simplest ratio of ions represented in an ionic compound. It represents the lowest whole number ratio of the ions involved. For example, the formula unit for sodium chloride (NaCl) consists of one sodium ion (Na^+) and one chloride ion (Cl^-). Unlike a molecule, which is a distinct group of atoms bonded together, a formula unit refers to the simplest representation of the ionic structure without implying a discrete unit.

Free Radical:

Free radical is atom or group of atoms possessing an odd number of (unpaired) electrons. It is represented by putting a dot over the symbol of an element e.g. $\dot{\text{H}}$, $\dot{\text{Cl}}$, $\dot{\text{N}}$, $\dot{\text{C}}$. Free radicals are generated by the homolytic (equal) cleavage of the bond between two atoms, when they absorb heat or light energy.

Atomic Number (Z):

The number of protons present in the nucleus of an atom of an element is called its atomic number. It is represented by symbol 'Z'. e.g. carbon atom has 6 protons, its atomic number (Z) is 6.

**Mass Number (A):**

The sum of protons and neutrons present in the nucleus of an atom of an element is called mass number or nucleon number. It is represented by symbol 'A' e.g. carbon atom has 6 protons and 6 neutrons, hence its mass number (A) is 12.

Atomic Mass Unit:

The unit for relative atomic mass is called atomic mass unit. Its symbol is "amu". One atomic mass unit is $\frac{1}{12}$ th the mass of one atom of carbon-12. The mass of an atom is too small to be denominated practically. So to determine the atomic mass of various elements atomic mass unit is needed.

Q.2. Describe how Avogadro's number is related to a mole of any substance. answer

Ans. A mole is an amount of substance that contains 6.02×10^{23} particles of that substance. This experimentally determined number is known as Avogadro's number. It is represented by N_A . Just as a dozen eggs represent twelve eggs, a ream of paper represents 500 papers, a mole of a substance represents 6.02×10^{23} representative particles of substance.

Example: A mole of carbon is 6.02×10^{23} atoms. A mole of Sulphur is 6.02×10^{23} atoms. A mole of water is 6.02×10^{23} molecules.

Q.3. Calculate the number of moles of each substance in samples with the following masses:

(a) 2.4 g of He

(b) 250mg of Carbon

(c) 15g of sodium chloride

(d) 40g of Sulphur

(e) 1.2kg of MgO

Ans.

a) 2.4g of He

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ &= \frac{2.4\text{g}}{4\text{ g/mol}} \\ &= 0.6\text{ mol}\end{aligned}$$

b) 250mg of Carbon

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ &= \frac{250 \times 10^{-3}\text{g}}{12\text{ g/mol}} \\ &= 0.021\text{ mol}\end{aligned}$$

c) 15g of sodium chloride

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ &= \frac{15\text{g}}{58.5\text{ g/mol}} \\ &= 0.25\text{ mol}\end{aligned}$$

d) 40g of Sulphur

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ &= \frac{40\text{g}}{32\text{ g/mol}}\end{aligned}$$



= 1.25 mol

e) 1.5 kg of MgO

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ &= \frac{1.5 \times 10^3\text{g}}{40\text{ g/mol}} \\ &= 37.5\text{ mol}\end{aligned}$$

Q.4. Calculate the mass in grams of each of the following samples:

(a) 1.2 moles of K

(b) 75 moles of H_2

(c) 0.25 moles of steam

(d) 1.05 moles of $CuSO_4 \cdot 5H_2O$

(e) 0.15 moles of H_2SO_4

Ans.

a) 1.2 moles of K

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ 1.2\text{ mol} &= \frac{\text{Mass of K}}{39\text{ g/mol}} \\ 1.2 \times 39 &= \text{Mass of K} \\ \Rightarrow \text{Mass of K} &= 46.8\text{g}\end{aligned}$$

b) 75 moles of H_2

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ 75\text{ mol} &= \frac{\text{Mass of } H_2}{2.016\text{ g/mol}} \\ \text{Mass of } H_2 &= 75\text{ mol} \times 2.016\text{ g/mol} \\ \text{Mass of } H_2 &= 151.2\text{g}\end{aligned}$$

c) 0.25 moles of steam

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ 0.25\text{ mol} &= \frac{\text{Mass of steam}}{18\text{ g/mol}} \\ \text{Mass of steam} &= 0.25\text{ mol} \times 18\text{ g/mol} \\ \text{Mass of steam} &= 4.5\text{g}\end{aligned}$$

d) 1.05 moles of $CuSO_4 \cdot 5H_2O$

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ 1.05\text{ mol} &= \frac{\text{Mass of } CuSO_4 \cdot 5H_2O}{249.5\text{ g/mol}} \\ \text{Mass of } CuSO_4 \cdot 5H_2O &= 1.05\text{ mol} \times 249.5\text{ g/mol} \\ \text{Mass of } CuSO_4 \cdot 5H_2O &= 261.9\text{g}\end{aligned}$$

e) 0.15 moles of H_2SO_4

$$\begin{aligned}\text{No. of mole} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ 0.15\text{ mol} &= \frac{\text{Mass of } H_2SO_4}{98\text{ g/mol}} \\ \text{Mass of } H_2SO_4 &= 0.15\text{ mol} \times 98\text{ g/mol}\end{aligned}$$



Q.5. Mass of $H_2SO_4 = 14.7\text{ g}$
Calculate the number of molecules present in each of the following samples: medium

- (a) 2.5 moles of carbon dioxide (b) 3.4 moles of ammonia, NH_3
(c) 1.09 moles of benzene, C_6H_6 (d) 0.01 moles of acetic acid, CH_3COOH

Ans.

a) 2.5 moles of carbon dioxide

1 mole of carbon dioxide contain $= 6.02 \times 10^{23}$ molecule

So,

2.5 mole of carbon dioxide contain

$$= 2.5 \times 6.02 \times 10^{23} \text{ molecule}$$

$$= 1.505 \times 10^{24} \text{ molecule}$$

b) 3.4 moles of ammonia

1 mole of ammonia contain 6.02×10^{23} molecules

So,

3.4 moles of ammonia contain

$$= 3.4 \times 6.02 \times 10^{23} \text{ molecules}$$

$$= 2.046 \times 10^{24} \text{ molecules}$$

c) 1.09 moles of benzene

1 mole of benzene contain $= 6.02 \times 10^{23}$ molecules

So,

1.09 moles of benzene contain

$$= 1.09 \times 6.02 \times 10^{23}$$

$$6.561 \times 10^{23} \text{ molecules}$$

d) 0.01 moles of acetic acid

1 mole acetic acid contain

$$= 6.02 \times 10^{23} \text{ molecules}$$

So,

0.01 mole acetic acid contain

$$= 0.01 \times 6.02 \times 10^{23}$$

$$= 6.02 \times 10^{21} \text{ molecules}$$

Q.6. Decide whether or not each of the following is an example of empirical formula: easy

- (a) Al_2Cl_6 (b) Hg_2Cl_2 (c) $NaCl$ (d) C_2H_4O

Ans.

a) No, Al_2Cl_6 is not the example of empirical formula of aluminium chloride. While the empirical formula of aluminium chloride is $AlCl_3$.

b) No, Hg_2Cl_2 is not example of empirical formula of mercury chloride. While the empirical formula of mercury chloride is $HgCl_2$.

c) Yes, the empirical formula of sodium chloride is $NaCl$.

d) Yes, the empirical formula of ethanol is C_2H_4O .

Q.7. TNT or trinitrotoluene is an explosive compound used in bombs. It contains 7 C-atoms, 5 H-atoms, 3 N-atoms and 6 O-atoms. Write its empirical formula. medium

Ans. The ratio of atoms in trinitrotoluene or TNT are:



$$7 : 5 : 3 : 6$$

Divide the each atom by smallest number.

$$\begin{array}{cccc} C & : & H & : & N & : & O \\ 7 & : & 5 & : & 3 & : & 6 \\ \frac{7}{3} & : & \frac{5}{3} & : & 1 & : & 2 \\ 2.3 & : & 1.6 & : & 1 & : & 2 \end{array}$$

Now, round the ratios to the nearest whole number.

$$\begin{array}{cccc} C & : & H & : & N & : & O \\ 2 & : & 2 & : & 1 & : & 2 \end{array}$$

So, the empirical formula of the compound containing 7 carbon atoms, 5 hydrogen atoms, 3 nitrogen atoms and 6 oxygen atoms is $C_2H_2NO_2$.

Q.8. A molecule contains four phosphorus atoms and ten oxygen atoms. Write the empirical formula of this compound. Also determine the molar mass of this molecule. medium

Ans.

a) Empirical formula: The ratio of atoms in a molecule contain 4 phosphorus atoms and ten oxygen atoms:

$$\begin{array}{cc} P & : & O \\ 4 & : & 10 \end{array}$$

Divide the each atom by smallest number

$$\begin{array}{cc} P & : & O \\ 4 & : & 10 \\ \frac{4}{4} & : & \frac{10}{4} \\ 1 & : & 2.5 \end{array}$$

Multiply both by 2, to get whole number.

$$\begin{array}{cc} P & : & O \\ 1 \times 2 & : & 2.5 \times 2 \\ 2 & : & 5 \end{array}$$

So, the empirical formula of molecule containing 4 phosphorus atoms and ten oxygen atoms is P_2O_5 .

b) Molar Mass of P_4O_{10} :

$$= 31(4) + 16(10)$$

$$= 124 + 160$$

$$= 284 \text{ g/mol}$$

Q.9. Indigo ($C_{16}H_{10}N_2O_2$), the dye used to colour blue jeans is derived from a compound known as indoxyl (C_8H_7ON). Calculate the molar masses of these compounds. Also write their empirical formulas. easy

Ans.

a) Molar Mass of Indigo ($C_{16}H_{10}N_2O_2$)

$$= 16(12) + 10(1.008) + 2(14) + 2(16)$$

$$= 192 + 10.08 + 28 + 32$$

$$= 262.08 \text{ g/mol}$$

b) Molar Mass of indoxyl (C_8H_7ON)

$$= 8(12) + 7(1.008) + 1(16) + 1(14)$$

$$= 96 + 7.056 + 16 + 14$$

$$= 133.056 \text{ g/mol}$$


 c) Empirical formula of Indigo ($C_{16}H_{10}N_2O_2$)

The ratio of atoms in indigo contain 16 C - atoms, 10 H-atoms, 2 N-atoms and 2 O-atoms.

$$C : H : N : O$$

$$16 : 10 : 2 : 2$$

Divide the each atom by smallest number.

$$C : H : N : O$$

$$\frac{16}{2} : \frac{10}{2} : \frac{2}{2} : \frac{2}{2}$$

$$8 : 5 : 1 : 1$$

$$8 : 5 : 1 : 1$$

 Hence, the empirical formula of indigo is C_8H_5NO .

 d) Empirical formula of Indoxyl (C_8H_7ON)

The ratio of atoms in indoxyl contain 8 C - atoms, 7 H - atoms, one O - atom and one N - atom.

$$C : H : N : O$$

$$8 : 7 : 1 : 1$$

Divide the each atom by smallest number.

$$C : H : O : N$$

$$8 : 7 : 1 : 1$$

$$8 : 7 : 1 : 1$$

$$8 : 7 : 1 : 1$$

 Hence, the empirical formula of indoxyl is C_8H_7ON .

Q.13. Calculate the number of atoms in each of the following samples:

- (a) 3.4 moles of nitrogen atoms (b) 23g of Na (c) 5g of H atoms

Ans.

a) 3.4 moles of nitrogen atoms

$$\text{No. of atoms} = \text{No. of moles} \times N_A$$

$$= 3.4 \times 6.02 \times 10^{23}$$

$$= 2.046 \times 10^{24} \text{ atoms}$$

b) 23g of Na

$$\text{No. of mole} = \frac{\text{Given Mass}}{\text{Molar Mass}} = \frac{23g}{23 \frac{g}{mol}} = 1 \text{ mole}$$

$$23g \text{ of Na equal to 1 mole of Na}$$

$$\text{No. of atoms} = \text{No. of moles} \times N_A$$

$$= 1 \times 6.02 \times 10^{23}$$

$$= 6.02 \times 10^{23} \text{ atoms}$$

c) 5g of H - atoms

$$\text{No. of mole} = \frac{\text{Given Mass}}{\text{Molar Mass}} = \frac{5g}{1.008 \frac{g}{mol}} = 4.96 \text{ mol}$$

$$5g \text{ of H - atoms equal to } 4.96 \text{ mol of H - atoms.}$$

So,

$$\text{No. of atoms} = \text{No. of moles} \times N_A$$

$$= 4.96 \times 6.02 \times 10^{23}$$

$$= 2.985 \times 10^{24} \text{ atoms}$$



Q.14. Calculate the mass of the following:

- (a)
- 3.4×10^{23}
- atoms of iron (b)
- 2×10^{23}
- molecules of nitrogen gas
-
- (c)
- 1×10^{23}
- molecules of water (d)
- 3×10^6
- atoms of Al

Ans.

 a) 3.24×10^{23} atoms of iron

$$\text{No. of mole} = \frac{\text{No. of atoms}}{N_A}$$

$$= \frac{3.24 \times 10^{23}}{6.02 \times 10^{23}}$$

$$\text{No. of moles} = 0.0000538206 \text{ mol}$$

$$\text{Mass} = \text{No. of moles} \times \text{Molar mass}$$

$$= 0.0000538206 \times 55.845$$

$$\text{Mass} = 0.0003g$$

 b) 2×10^{23} molecules of Nitrogen gas

$$\text{No. of mole} = \frac{\text{No. of atoms}}{N_A}$$

$$= \frac{2 \times 10^{23}}{6.02 \times 10^{23}}$$

$$= 3.322 \times 10^{-14} \text{ mol}$$

$$\text{Mass} = \text{No. of moles} \times \text{Molar mass}$$

$$= 3.322 \times 10^{-14} \times 28$$

$$= 9.30 \times 10^{-13} g$$

 c) 1×10^{23} molecules of water

$$\text{No. of moles} = \frac{\text{No. of molecules}}{N_A}$$

$$= \frac{1 \times 10^{23}}{6.02 \times 10^{23}}$$

$$= 16.611 \text{ mol}$$

$$\text{Mass} = \text{No. of Moles} \times \text{Molar Mass}$$

$$= 16.611 \times 18$$

$$= 298.998 g$$

 d) 3×10^6 atoms of Al

$$\text{No. of moles} = \frac{\text{No. of atoms}}{N_A}$$

$$= \frac{3 \times 10^6}{6.02 \times 10^{23}}$$

$$= 4.983 \times 10^{-18} \text{ mol}$$

$$\text{Mass} = \text{No. of moles} \times \text{Molar Mass}$$

$$= 4.983 \times 10^{-18} \times 26.98$$

$$= 1.344 \times 10^{-16} g$$

Q.15. Balance the following chemical equations



Ans.





Q.16. Potassium is Group 1 element. It is silvery white metal. It burns in air and forms K_2O potassium oxide and potassium nitride. The nitride ion is N^{3-} .

PROBLEM 1

(a) Predict the formula of potassium oxide and potassium nitride.

(b) A 0.5g sample of K was added in 100 cm³ of water.



Show that 1.28×10^{-2} mole of K were added to the water.

(c) Balance above chemical equation.

(d) Transform above chemical equation into ionic equation.

(e) Calculate the number of atoms present in the sample of K.

(f) Predict period number of potassium in the periodic table.

Ans.

a) Formula of potassium oxide = K_2O

Formula of potassium nitride = K_3N

$$\begin{aligned} \text{b) No. of Moles} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ &= \frac{0.5g}{39.10g/mol} \end{aligned}$$

No. of moles of K = 0.0128 moles

Therefore, 0.5g of K = 1.28×10^{-2} moles of K.

Since, the amount of K added to the water was 1.28×10^{-2} moles which matches the given value of 1.28×10^{-2} moles. It shows that 1.28×10^{-2} moles of K were added to the water.

c) The balanced chemical equation is



d) Transform the above chemical equation into ionic equation:



$$\begin{aligned} \text{e) No. of Moles} &= \frac{\text{Given Mass}}{\text{Molar Mass}} \\ &= \frac{0.5g}{39.10g/mol} \end{aligned}$$

No. of moles of K = 0.0128 moles

$$\begin{aligned} \text{No. of atoms} &= \text{No. of moles} \times N_A \\ &= 0.0128 \times 6.02 \times 10^{23} \end{aligned}$$

No. of atoms in 0.5g of K = 7.7×10^{21} atoms

f) Potassium is belong to 4th period of the periodic table.

Concept Assessment 6.1

Q.17. Write the empirical formulas for the compound containing carbon to hydrogen in ^{the} following ratios:

PROBLEM 2

(a) 1 : 4

(b) 2 : 6

(c) 2 : 2

(d) 6 : 6

Ans.

a) The ratio of carbon and hydrogen in a compound is:

$$\begin{array}{l} C : H \\ 1 : 4 \end{array}$$



Divide the each atom by smallest number.

$$\begin{array}{l} C : H \\ 1/1 : 4/1 \\ 1 : 4 \end{array}$$

So, the empirical formula of compound is CH_4 .

b) The ratio of carbon and hydrogen in a compound is:

$$\begin{array}{l} C : H \\ 2 : 6 \end{array}$$

Divide the each atom by smallest number.

$$\begin{array}{l} C : H \\ 2/2 : 6/2 \\ 1 : 3 \end{array}$$

So, the empirical formula of a compound is CH_3 .

c) The ratio of carbon and hydrogen in a compound is:

$$\begin{array}{l} C : H \\ 2 : 2 \end{array}$$

Divide the each atom by 2.

$$\begin{array}{l} C : H \\ 2/2 : 2/2 \\ 1 : 1 \end{array}$$

So, the empirical formula of a compound is CH .

d) The ratio of carbon and hydrogen in a compound is:

$$\begin{array}{l} C : H \\ 6 : 6 \end{array}$$

Divide the each atom by 6.

$$\begin{array}{l} C : H \\ 6/6 : 6/6 \\ 1 : 1 \end{array}$$

So, the empirical formula of a compound is CH .

Concept Assessment 6.2

Q.18. i. Aspirin is used as a mild pain killer. There are nine carbon atoms, eight hydrogen atoms and four oxygen atoms, in this compound. Write its empirical and molecular formulas.

PROBLEM 3

ii. Vinegar is 5% acetic acid. It contains 2 carbon atom, four hydrogen atoms and 2 oxygen atoms. Write its empirical and molecular formulas.

iii. Caffeine ($C_8H_{10}N_4O_2$) is found in tea and coffee. Write the empirical formula for caffeine.

Ans.

i. Aspirin contains 9 C - atoms, 8 H - atoms and 4 O - atoms.

a) Molecular formula of Aspirin is $C_9H_8O_4$

b) The ratio of C, H & O in aspirin are:

$$\begin{array}{l} C : H : O \\ 9 : 8 : 4 \end{array}$$



Divide the each atom by smallest number

$$\begin{array}{ccc} C & : & H & : & O \\ 9/4 & : & 8/4 & : & 4/4 \\ 2.25 & : & 2 & : & 1 \end{array}$$

Hence, it is not a whole no. ratio that's why, empirical formula of aspirin would be $C_9H_8O_4$.

B. Vinegar contains 2 C – atoms, 4 H – atoms and 2 O – atoms.

a) Molecular formula of vinegar is $C_2H_4O_2$.

b) The ratio of C, H & O in vinegar are:

$$\begin{array}{ccc} C & : & H & : & O \\ 2 & : & 4 & : & 2 \end{array}$$

Divide the each atom by smallest number

$$\begin{array}{ccc} C & : & H & : & O \\ 2/2 & : & 4/2 & : & 2/2 \\ 1 & : & 2 & : & 1 \end{array}$$

So, the empirical formula of vinegar is CH_2O .

III. The ratio of C, H, N and O in caffeine are:

$$\begin{array}{cccc} C & : & H & : & N & : & O \\ 8 & : & 10 & : & 4 & : & 2 \end{array}$$

Divide the each atom by smallest number:

$$\begin{array}{cccc} C & : & H & : & N & : & O \\ 8/2 & : & 10/2 & : & 4/2 & : & 2/2 \\ 4 & : & 5 & : & 2 & : & 1 \end{array}$$

So, the empirical formula of caffeine is $C_4H_5N_2O$.

Concept Assessment 6.3

- Q.19. I. Potassium Chlorate ($KClO_3$) is used commonly for the laboratory preparation of oxygen gas. Calculate its formula mass.
- II. When baking soda, $NaHCO_3$ is heated carbon dioxide is released, which is responsible for the rising of cookies and bread. Determine the formula masses of baking soda and carbon dioxide.
- III. Following compounds are used as fertilizers. Determine their formula masses.
- (i) Urea, $(NH_2)_2CO$ (ii) Ammonium nitrate, NH_4NO_3

Ans.

i. Formula mass of $KClO_3$

$$\begin{aligned} &= 39.1(1) + 35.5(1) + 16(3) \\ &= 39.1 + 35.5 + 48 \\ &= 122.6 \text{ amu} \end{aligned}$$

ii. (a) Formula mass of Baking soda ($NaHCO_3$)

$$\begin{aligned} &= 23(1) + 1(1) + 12(1) + 16(3) \\ &= 23 + 1 + 12 + 48 \\ &= 84 \text{ amu} \end{aligned}$$

(b) Formula mass of Carbon dioxide (CO_2)

$$= 12(1) + 16(2)$$



$$= 12 + 32$$

$$= 44 \text{ amu}$$

III. (a) Formula mass of urea $(NH_2)_2CO$

$$\begin{aligned} &= 14(2) + 1(4) + 12(1) + 16(1) \\ &= 20 + 4 + 12 + 16 \\ &= 60 \text{ amu} \end{aligned}$$

(b) Formula mass of Ammonium nitrate NH_4NO_3

$$\begin{aligned} &= 14(1) + 1(4) + 14(1) + 16(3) \\ &= 14 + 4 + 14 + 48 \\ &= 80 \text{ amu} \end{aligned}$$

Concept Assessment 6.4

Q.20. i. Calculate the mass of one mole of:

(a) Copper (b) Iodine (c) Potassium (d) Oxygen

ii. Differentiate between gram formula mass and gram molecular mass.

Ans.

i. Mass of one mole:

Copper	63.5 g
Iodine	126.9 g
Potassium	39.1 g
Oxygen	16 g

ii. Molecular mass of a substance expressed in grams is called gram molecular mass.

$$\begin{aligned} \text{Molecular mass of } H_2O &= 2 \times 1.008 + 16 \\ &= 18.016 \text{ amu} \end{aligned}$$

$$\begin{aligned} \text{So, gram molecular mass of } H_2O &= 18.016 \text{ g} \\ \text{Molecular mass of } C_6H_{12}O_6 &= 6 \times 12 + 12 \times 1.008 + 16 \times 6 \\ &= 180.096 \text{ amu} \end{aligned}$$

$$\text{So, gram molecular mass of } C_6H_{12}O_6 = 180.096 \text{ g}$$

Formula mass of a substance expressed in gram is called gram formula mass.

An ionic compound is represented by the formula unit that represents the simplest ratio between the ions of a compound. For example $NaCl$, KCl

$$\begin{aligned} \text{Formula mass of } NaCl &= 23 + 35.5 \\ &= 58.5 \text{ amu} \end{aligned}$$

$$\text{Therefore, gram formula mass of } NaCl = 58.5$$

$$\begin{aligned} \text{Formula mass of } KCl &= 39 + 35.5 \\ &= 74.5 \text{ amu} \end{aligned}$$

$$\text{So, gram formula mass of } KCl = 74.5 \text{ g}$$



Concept Assessment 6.5

- Q.21. i. The molecular formula of a compound used for bleaching hair is H_2O_2 . Calculate (a) Mass of this compound that would contain 2.5 moles. (b) No. of moles of this compound that would exactly weigh 30g.
- ii. A spoon of table salt, $NaCl$ contains 12.5 grams of this salt. Calculate the number of moles it contains.
- iii. Before the digestive system is x-rayed, people are required to swallow suspension of barium sulphate $BaSO_4$. Calculate mass of one mole of $BaSO_4$.

Ans.

i. (a) No. of moles of $H_2O_2 = \frac{\text{Given mass}}{\text{Molar Mass of } H_2O_2}$

$$2.5 \text{ mol} = \frac{\text{Mass of } H_2O_2}{34 \text{ g/mol}}$$

$$2.5 \text{ mol} \times 34 \text{ g/mol} = \text{Mass of } H_2O_2$$

$$\text{Mass of } H_2O_2 = 85 \text{ g}$$

(b) No. of moles of $H_2O_2 = \frac{\text{Mass of } H_2O_2}{\text{Molar Mass of } H_2O_2}$

$$= \frac{30 \text{ g}}{34 \text{ g/mol}}$$

$$\text{No. of moles of } H_2O_2 = 0.88 \text{ mol}$$

ii. No. of moles of $NaCl = \frac{\text{Mass of } NaCl}{\text{Molar mass of } NaCl}$

$$= \frac{12.5 \text{ g}}{58.5 \text{ g/mol}}$$

$$\text{No. of moles of } NaCl = 0.213 \text{ mol}$$

iii. Molar mass of $BaSO_4$

$$= 137.3(1) + 32(1) + 16(4)$$

$$= 137.3 + 32 + 64$$

$$= 233.3 \text{ g/mol}$$

Concept Assessment 6.6

- Q.22. i. Aspirin is a compound that contains carbon, hydrogen and oxygen. It is used as a painkiller. An aspirin tablet contains 1.25×10^{19} molecules. How many moles of this compound are present in the tablet?
- ii. A method used to prevent rusting in ships and underground pipelines involves connecting the iron to a block of a more active metal such as magnesium. This method is called cathodic protection. How many moles of magnesium are present in 1 billion (1×10^9) atoms of magnesium.

Ans.

i. No. of molecules = No. of moles $\times N_A$

$$1.25 \times 10^{19} = \text{No. of moles} \times 6.02 \times 10^{23}$$

$$\text{No. of moles of Aspirin} = \frac{1.25 \times 10^{19}}{6.02 \times 10^{23}}$$



$$= 2.076411.96 \text{ mol}$$

ii. No. of atoms = No. of moles $\times N_A$

$$1 \times 10^9 = \text{No. of mole} \times 6.02 \times 10^{23}$$

$$\text{No. of moles} = \frac{1 \times 10^9}{6.02 \times 10^{23}} = 1.66 \times 10^{-15} \text{ mol}$$

Concept Assessment 6.7

- Q.23. Represent the following chemical reactions by chemical equations.

i. Burning of hydrogen (H_2) to produce water.

ii. Burning of magnesium (Mg) to produce magnesium oxide (MgO).

Ans. i. Burning of hydrogen (H_2) to produce water



ii. Burning of magnesium (Mg) to produce magnesium oxide (MgO).



Concept Assessment 6.8

- Q.24. Transform the following chemical equations into ionic equations.



Ans. i. $AgNO_{3(aq)} + NaCl_{(aq)} \rightarrow AgCl_{(s)} + NaNO_{3(aq)}$

The ionic equation is:



The ionic equation is:



Concept Assessment 6.9

Write the molecular formulas of the following compounds.



Ans. 1. C_2H_6O
2. C_2H_7N
3. C_3H_8O

Multiple Choice Questions (Exercise)

1. What is the formula mass of $CuSO_4 \cdot 5H_2O$. (Atomic masses: $Cu = 63.5$, $S = 32$, $O = 16$, $H = 1$)
- (a) 139.5 (b) 185.5
(c) 249.5 (d) 149.5
2. A compound with chemical formula Na_2CX_2 has formula mass 106amu. Atomic mass of the element X is
- (a) 106 (b) 23 (c) 17 (d) 16
3. How many moles of molecules are there in 16g oxygen?
- (a) 1 (b) 0.5
(c) 0.1 (d) 0.05
4. What is the mass of 4 moles of hydrogen gas?
- (a) 8.064g (b) 4.032g
(c) 1g (d) 1.008g



5. What is the mass of carbon present in 44g of carbon dioxide? easy

- (a) 12g (b) 6g
(c) 7g (d) 1g

6. Which term is the same for one mole of oxygen and one mole of water? easy

- (a) volume (b) molecules
(c) mass (d) atoms
7. If one mole of carbon contains x atoms, what is the number of atoms contained in 12g of Mg . easy
- (a) x (b) $0.5x$
(c) $2x$ (d) $1.5x$

SLO Based Additional MCQs

8. The mass of one molecule of water is: easy

- (a) 18 amu (b) 18 g
(c) 18 mg (d) 18 kg

9. The molar mass of H_2SO_4 is: easy

- (a) 98 g (b) 98 amu
(c) 9.8 g (d) 9.8 amu

10. Which one of the following is molecular mass of O_2 in amu? easy

- (a) 32 amu
(b) 32.12×10^{-23} amu
(c) 1.92×10^{-25} amu
(d) 192.64×10^{-23} amu

11. How many number of moles are equivalent to 8 grams of CO_2 ? easy

- (a) 0.15 (b) 0.18
(c) 0.21 (d) 0.24

12. Which one of the following pairs has the same number of ions? easy

- (a) 1 mole of $NaCl$ and 1 mole of $MgCl_2$
(b) $\frac{1}{2}$ mole of $NaCl$ and $\frac{1}{2}$ mole of $MgCl_2$
(c) $\frac{1}{2}$ mole of $NaCl$ and $\frac{1}{2}$ mole of $MgCl_2$
(d) $\frac{1}{2}$ mole of $NaCl$ and $\frac{1}{2}$ mole of $MgCl_2$

13. Which one of the following pairs has the same mass? easy

- (a) 1 mole of CO and 1 mole of N_2
(b) 1 mole of CO and 1 mole of CO_2
(c) 1 mole of O_2 and 1 mole of H_2
(d) 1 mole of O_2 and 1 mole of CO_2

14. Empirical formula of sand is: easy

- (a) SiO_2 (b) SiO
(c) SiO_4 (d) SiO

15. Which compound has same molecular and empirical formula? easy

- (a) $C_6H_{12}O_6$ (b) C_6H_6
(c) H_2O_2 (d) H_2O

16. 1 gram formula of $NaCl$ contains grams: easy

- (a) 100 g (b) 32 g
(c) 58.5 g (d) 49 g

17. 1 gram atom of carbon contains how many moles? easy

- (a) 2 moles (b) 12 moles
(c) 1 mole (d) 6 moles

18. Value of Avogadro's number is: easy

- (a) 6.02×10^{23} (b) 1.32×10^{23}
(c) 6.6×10^{23} (d) 6.00×10^{23}

19. Empirical formula of glucose is: easy

- (a) CH_2O (b) CHO
(c) CHO_2 (d) C_2H_4O

20. How many atoms are present in one gram atomic mass of a substance? easy

- (a) 6.20×10^{24} (b) 12.04×10^{23}
(c) 6.02×10^{23} (d) 6.2×10^{23}

21. 48 g of H_3PO_4 contains number of moles: easy

- (a) 0.58g (b) 0.408g
(c) 4.8g (d) 5.8g

22. Formula mass of K_2SO_4 is: easy

- (a) 174 amu (b) 180 amu
(c) 110 amu (d) 145 amu

23. Empirical formula of acetic acid (CH_3COOH) is: easy

- (a) CHO (b) CH_2O
(c) CH (d) None of these

24. Mass of 3 moles of oxygen atoms is: easy

- (a) 48 g (b) 32 g
(c) 64 g (d) 16 g

25. How many molecules of water will be present in half mole of water? easy

- (a) 6.02×10^{23} (b) 3.01×10^{23}
(c) 6.02×10^{24} (d) 1.66×10^{-24}

26. Number of moles in 29.25g $NaCl$ is: easy

- (a) 0.25 (b) 0.21
(c) 0.50 (d) 0.75

27. How many atoms of carbon are present in one molecule of glucose? easy

- (a) 11 (b) 12
(c) 6 (d) 22

28. Formula of sulphate radical is: easy

- (a) SO_4^{2-} (b) SO_4^{1-}
(c) HSO_4^- (d) HSO_5^-

29. Which one of the following radicals is Thiosulphate? easy

- (a) $S_2O_7^{2-}$ (b) PO_4^{3-}
(c) SO_4^{2-} (d) HSO_4^-

30. Which is ammonium radical? easy

- (a) H_3O^+ (b) OH^-
(c) CN^- (d) NH_4^+

31. Formula of sulphite radical is: easy

- (a) SO_4^{2-} (b) CN^{-1}
(c) SO_3^{2-} (d) $S_2O_7^{2-}$

32. Which is phosphate radical? easy

- (a) N^{3-} (b) H_2O^2
(c) P^{3-} (d) PO_4^{3-}

33. Formula of common salt is: easy

- (a) $NaOH$ (b) CaO
(c) $CaCO_3$ (d) $NaCl$

34. Sodium Hydroxide is also known as: easy

- (a) Washing soda (b) Caustic Soda
(c) Soda Ash (d) Quick lime

35. Which of the following represents sand? easy

- (a) SiO_2 (b) H_2O
(c) $NaCl$ (d) $CaCO_3$

36. Washing Soda is represented by the formula: easy

- (a) $NaOH$ (b) CaO
(c) $CaCO_3$ (d) $Na_2CO_3 \cdot 10H_2O$

37. Limestone is another name of: easy

- (a) Sodium hydroxide
(b) Calcium Carbonate
(c) Sodium Carbonate
(d) Silicon dioxide

38. Formula of Caustic Soda is: easy

- (a) $C_{12}H_{10}O_{11}$ (b) $C_6H_{12}O_6$
(c) CaO (d) $NaOH$

39. Which is chemical formula of Quick lime? easy

- (a) $CaCO_3$ (b) CaO
(c) $NaOH$ (d) $NaCl$

40. Empirical formula of hydrogen peroxide is: easy

- (a) H_2O (b) CHO
(c) CH (d) CO

41. Empirical formula of Benzene is: easy

- (a) CH_2O (b) CH
(c) CH_2 (d) C_2H

42. Molecular mass of acetic acid is: easy

- (a) 43 amu (b) 70 amu
(c) 60 amu (d) 80 amu

43. Formula of ozone is: easy

- (a) O_2 (b) O_3
(c) S_8 (d) CO_2

44. No. of formula units present in 58.5 g of $NaCl$ are: easy

- (a) $2 \times 6.02 \times 10^{23}$
(b) 6.02×10^{23}
(c) $3 \times 6.02 \times 10^{23}$
(d) $58.5 \times 6.02 \times 10^{23}$

45. Number of hydrogen atoms present in 18g of water: easy

- (a) $2 \times N_A$ (b) N_A
(c) $3 \times N_A$ (d) $\frac{1}{2} N_A$

46. Total number of ions present in one mole of sodium chloride is: easy

- (a) $\frac{1}{2} \times 6.02 \times 10^{23}$ (b) 6.02×10^{23}
(c) 1.204×10^{24} (d) None of these

47. Formula of sugar is: answer

- (a) $C_{12}H_{22}O_{11}$ (b) $C_6H_{12}O_6$
(c) NH_3 (d) CH_3COOH

48. The mass number of sodium is: answer

- (a) 19 (b) 23
(c) 27 (d) 21

Answer Key

1	a	2	d	3	b	4	a	5	d
6	b	7	c	8	a	9	a	10	a
11	b	12	c	13	a	14	b	15	d
16	c	17	c	18	a	19	a	20	c
21	b	22	a	23	b	24	a	25	b
26	c	27	c	28	b	29	a	30	d
31	c	32	d	33	d	34	b	35	a
36	d	37	b	38	d	39	b	40	a
41	b	42	c	43	b	44	b	45	a
46	c	47	a	48	b				

Short Questions (Exercise)Q.1. What is mole? answer

Ans. A mole is defined as the amount (mass) of a substance that contains 6.02×10^{23} number of particles (atoms, molecules or formula units). It is abbreviated as 'mol', e.g. 1 mole of carbon = 12 g = 6.02×10^{23} particles.

It can also be defined as the atomic mass, molecular mass or formula mass of a substance expressed in grams is called mole. e.g. atomic mass of carbon expressed as 12 g = 1 mole of carbon.

Q.2. Differentiate between empirical formula and molecular formula? answer

Ans.

Empirical Formula	Molecular Formula
It is the formula which shows the simplest whole number ratio of atoms present in a compound. e.g. Glucose has simplest ratio 1:2:1 of carbon, hydrogen and oxygen respectively. Hence its empirical formula is CH_2O .	The formula which shows actual number of atoms of each element present in a molecule of that compound is called molecular formula. e.g. Molecular formula of benzene is C_6H_6 .

Q.3. What is the number of molecules in 9g of steam? answer

Ans. Data:

Given Mass of steam = 9g

Molar mass of steam (H_2O) = 18g/mol

To find:

No. of molecules = ?

Sol:

$$\text{No. of moles} = \frac{\text{Given Mass}}{\text{Molar mass}} = \frac{9}{18} = \frac{1}{2}$$

No. of moles = 0.5 mol

As, 1 mole contains = 6.02×10^{23} 0.5 mole contains = $0.5 \times 6.02 \times 10^{23}$
= 3.015×10^{23} molecules.Q.4. What are the molar masses of uranium - 238 and uranium - 235? answer

Ans. Molar mass of an atom is actually its atomic mass. So,

Molar mass of Uranium - 238

= 238 g/mol

Molar mass of Uranium - 235

= 235 g/mol

Q.5. Why one mole of hydrogen molecules and one mole of H - atoms have different masses? answer

Ans. One mole of hydrogen molecule (H_2) has 6.02×10^{23} molecules of H_2 .

Each hydrogen (H_2) molecule consists of two hydrogen atoms. So, in one mole of hydrogen molecule have twice the no. of hydrogen atoms as compared to one mole of hydrogen atom.

The atomic mass of hydrogen is 1.008 g/mol. Since, there are two hydrogen atoms in one molecule of hydrogen. The molar mass of hydrogen molecule is 2.016 g/mol. So, one mole of hydrogen molecule weighs more than one mole of hydrogen atom.

SLO Based Additional Short Questions (Reference Material)Q.6. What is Dalton's atomic theory? answer

Ans. In the beginning of 19th century John Dalton put forward atomic theory, according to which:

- Every matter is made up of very small indivisible particles called atoms.
- An atom is indivisible, hard, dense sphere.
- Atoms of same element are alike.
- They combine in different ways to form compounds.

Q.7. Differentiate between molecular mass and formula mass. Which of the following have molecular formula? H_2O , $NaCl$, KI , H_2SO_4 . answer

Ans. Molecular Mass: The sum of atomic masses of all the atoms present in one molecule of a molecular substance is called molecular mass.

e.g. Molecular mass of water is 18 amu.

Formula mass:

Formula mass is the sum of atomic masses of all atoms present in one formula unit of a substance is called formula mass.

e.g. Formula mass of sodium chloride is 58.5 amu.

H_2O and H_2SO_4 are molecular formulae of molecular compounds (water and sulphuric acid) respectively.

Q.8. What is empirical formula of acetic acid (CH_3COOH)? Find out its molecular mass. answer

Ans. Empirical formula of acetic acid is CH_2O .

Molecular Mass of CH_3COOH =

12 + 3 + 12 + 16 + 16 + 1 = 60 amu.

Q.9. Calculate the formula masses of: Na_2SO_4 , $ZnSO_4$ and $CuCO_3$. answer

Ans.

i. Formula mass of Na_2SO_4
= 2(23) + 1(32) + 4(16)
= 46 + 32 + 64
= 142 amu

ii. Formula mass of $ZnSO_4$
= 1(65) + 32 + 4(16)
= 65 + 32 + 64
= 161 amu

iii. Formula mass of $CuCO_3$
= 1(63.5) + 12 + 3(16)
= 63.5 + 12 + 48
123.5 amu

Q.10. Find out the mass of 3 moles of oxygen atoms. answer

Ans.

No. of moles of oxygen

= 3 moles

Molar mass of oxygen atoms

= 16 g/mol



Mass (grams) = No. of moles $\times$ Molar mass

Mass of 3 moles of oxygen atoms
= $3 \times 16 = 48$ g

Q.11. How many molecules of water are present in half mole of water?

Ans.

Q.12. How many atoms of sodium are present in 3 moles of sodium and what is the mass of it?

Ans. No. of moles of sodium = 3 mol

No. of atoms = No. of moles $\times N_A$

No. of atoms of sodium present in 3 moles = $3 \times 6.02 \times 10^{23} = 18.06 \times 10^{23} = 1.806 \times 10^{24}$ atoms

Molar mass of sodium

= 23 g/mol

Mass of 1 mole of sodium

= 23 g

Mass (grams)

= No. of moles $\times$ Molar mass

The mass of 3 moles of sodium

= $3 \times 23 = 69$ g

Q.13. How many atoms are present in 16 g of O and 8 g of S?

Ans.

I. Molar mass of O = 16 g/mol

No. of atoms in 16 g of O = ?

Using the formula,

$$\text{No. of atoms} = \frac{\text{Given Mass}}{\text{Molar Mass}} \times N_A$$

$$\frac{16\text{g}}{16\text{g/mol}} \times 6.02 \times 10^{23} = 6.02 \times 10^{23} \text{ atoms}$$

II. Molar mass of S = 32 g/mol

Given mass of S = 8 g

No. of atoms = ?

Using the formula,

$$\text{No. of atoms} = \frac{\text{Given mass}}{\text{Molar mass}} \times N_A$$

$$= \frac{8}{32} \times 6.02 \times 10^{23} = 1.505 \times 10^{23} \text{ atoms}$$

Q.14. Is the mass of 1 mole of O and 1 mole of S same?

Ans. No, because the mass of 1 mole of O is 16 g whereas the mass of 1 mole of S is 32 g.

Q.15. What do you mean by 1 atom of C and 1 gram atom of C?

Ans. One atom of carbon means single smallest particle of carbon with mass 12

No. of molecules = No. of moles $\times N_A$

One mole of water contains molecules

= 6.02×10^{23}

Half mole of water will contain molecules

= $0.5 \times 6.02 \times 10^{23}$

= 3.01×10^{23} molecules

units whereas one gram atom means 12 g or mole of carbon having 6.02×10^{23} carbon atoms.

Q.16. If 16 gram of oxygen contains 1 mole of oxygen atoms, calculate the mass of one atom of oxygen in grams.

Ans.

The mass of (1 mole = 6.02×10^{23}) of oxygen atoms = 16 g

The mass of 1 atom of oxygen atom

$$= \frac{1}{6.02 \times 10^{23}} = 1.66 \times 10^{-24} \text{ g}$$

Q.17. How many times is 1 mole of oxygen atom heavier than 1 mole of hydrogen atom?

Ans. Molar mass of H = 1 g/mol

Molar mass of O = 16 g/mol

Therefore, 1 mole of O-atom is 16 times heavier than 1 mole of H-atom.

Q.18. Why does 10 g nitrogen gas contain the same number of molecules as 10 g of carbon monoxide?

Ans. Because Nitrogen (N_2) gas and carbon monoxide (CO) gas have same molar mass 28g. Therefore, their equal

mass i.e. 10g will have same number of molecules.

Q.19. Which one has more atoms: 10g of Al or 10g of Fe?

Ans.

I. Given mass of Al = 10g

Molar mass of Al = 27 g/mol

No. of atoms in 10g of Al

$$= \frac{\text{Given mass}}{\text{Molar mass}} \times N_A$$

$$= \frac{10\text{g}}{27\text{g/mol}} \times 6.02 \times 10^{23} \text{ atoms}$$

= 2.23×10^{23} atoms

II. Given mass of Fe = 10g

Molar mass of Fe = 56 g/mol

No. of atoms in 10g of Fe

$$= \frac{10}{56} \times 6.02 \times 10^{23} \text{ atoms}$$

= 1.075×10^{23} atoms

Therefore, 10g of Al contains more atoms as compared to 10g of Fe.

Q.20. Which one has more molecules: 9g of water or 9g of sugar ($C_{12}H_{22}O_{11}$). OR

Q.21. Which one has more formula units: 1g of NaCl or 1g of KCl.

Ans.

I. Given mass of NaCl

Formula mass of NaCl

No. of formula units in 1g of NaCl

II. Formula mass of KCl

Given mass of KCl

No. of formula units in 1g of KCl

Therefore, 1g of NaCl contains more formula units than 1g of KCl.

Q.22. Sulphuric acid is the king of chemicals. If you need 5 moles of sulphuric acid for a reaction, how many grams of it will you weigh?

Data.

No. of moles of H_2SO_4 = 5mol

Molar mass of H_2SO_4 = $2(1) + 1(32) + 4(16)$

= $2 + 32 + 64$

= 98 g/mol

Mass of H_2SO_4

= ?



Find out the molecules in 9 gram of water.

Ans.

I. Given mass of water (H_2O)

= 9g

Molar mass of water (H_2O)

= 18 g/mol

No. of molecules in 9g of water

$$= \frac{\text{Mass of water}}{\text{Molar mass}} \times N_A$$

$$= \frac{9}{18} \times 6.02 \times 10^{23} \text{ molecules}$$

= 3.01×10^{23} molecules

II. Given mass of sugar = 9g

Molar mass of sugar ($C_{12}H_{22}O_{11}$)

= 342 g/mol

No. of molecules in 9g of sugar

$$= \frac{9}{342} \times 6.02 \times 10^{23} \text{ molecules}$$

= 1.584×10^{22} molecules

Therefore, 9g of water contains more molecules than 9g of sugar.



Solution:

$$\text{No. of moles} = \frac{\text{Mass in grams}}{\text{Molar mass}}$$

$$\text{Mass in grams} = \text{No. of moles} \times \text{Molar mass} \\ = 5 \times 98 = 490 \text{ g}$$

Therefore, 5 moles of sulphuric acid will have mass 490 g.

Q.23. Calculate the number of molecules in the following compounds:

(a) 16g of H_2CO_3 (b) 20g of HNO_3 (c) 30g of $\text{C}_6\text{H}_{12}\text{O}_6$ (a) 16g of H_2CO_3

Data:

$$\text{Given mass of } \text{H}_2\text{CO}_3 = 16 \text{ g}$$

$$\text{Molar mass of } \text{H}_2\text{CO}_3 = 2(1) + 1(12) + 3(16) \\ = 2 + 12 + 48 = 62 \text{ g/mol}$$

$$\text{No. of molecules} = ?$$

Solution:

$$\text{No. of molecules of } \text{H}_2\text{CO}_3 = \frac{\text{Given mass of } \text{H}_2\text{CO}_3}{\text{Molar mass of } \text{H}_2\text{CO}_3} \times N_A$$

$$= \frac{16}{62} \times 6.02 \times 10^{23}$$

$$= 1.55 \times 10^{23} \text{ molecules}$$

(b) 20g of HNO_3

Data:

$$\text{Given Mass of } \text{HNO}_3 = 20 \text{ g}$$

$$\text{Molar mass of } \text{HNO}_3 = 1(1) + 1(14) + 3(16) \\ = 1 + 14 + 48 \\ = 63 \text{ g/mol}$$

$$\text{No. of molecules of } \text{HNO}_3 = ?$$

Solution:

$$\text{No. of molecules of } \text{HNO}_3 = \frac{\text{Given Mass of } \text{HNO}_3}{\text{Molar mass of } \text{HNO}_3} \times N_A$$

$$= \frac{20}{63} \times 6.02 \times 10^{23}$$

$$= 1.91 \times 10^{23} \text{ molecules}$$

(c) 30g of $\text{C}_6\text{H}_{12}\text{O}_6$

Data:

$$\text{Given Mass of } \text{C}_6\text{H}_{12}\text{O}_6 = 30 \text{ g}$$

$$\text{Molar mass of } \text{C}_6\text{H}_{12}\text{O}_6 = 6(12) + 12(1) + 6(16) \\ = 72 + 12 + 96 \\ = 180 \text{ g/mol}$$

$$\text{No. of molecules of } \text{C}_6\text{H}_{12}\text{O}_6 = ?$$

Solution:

$$\text{No. of molecules of } \text{C}_6\text{H}_{12}\text{O}_6 = \frac{\text{Given mass of } \text{C}_6\text{H}_{12}\text{O}_6}{\text{Molar mass}} \times N_A$$



$$= \frac{30}{180} \times 6.02 \times 10^{23}$$

$$\text{No. of molecules of } \text{C}_6\text{H}_{12}\text{O}_6 = 1 \times 10^{23} \text{ molecules}$$

Q.24. What will be the mass of 2.05×10^{24} molecules of H_2SO_4 ?

Data:

$$\text{Given molecules of } \text{H}_2\text{SO}_4 = 2.05 \times 10^{24}$$

$$\text{Molar mass of } \text{H}_2\text{SO}_4 = 1(2) + 1(32) + 4(16) \\ = 2 + 32 + 64 \\ = 98 \text{ g/mol}$$

$$\text{Mass of } \text{H}_2\text{SO}_4 = ?$$

Solution:

Using the formula

$$\text{No. of molecules of } \text{H}_2\text{SO}_4 = \frac{\text{Mass of } \text{H}_2\text{SO}_4}{\text{Molar mass of } \text{H}_2\text{SO}_4} \times N_A$$

$$2.05 \times 10^{24} = \frac{\text{Mass of } \text{H}_2\text{SO}_4}{98} \times 6.02 \times 10^{23}$$

$$\text{Mass of } \text{H}_2\text{SO}_4 = \frac{2.05 \times 10^{24} \times 98}{6.02 \times 10^{23}}$$

$$= 33.4 \times 10^{-7}$$

$$= 3.34 \times 10^{-6} \text{ g}$$

Q.25. How many atoms are required to prepare 60 g of HNO_3 ?

Data:

$$\text{Given Mass of } \text{HNO}_3 = 60 \text{ g}$$

$$\text{Molar mass of } \text{HNO}_3 = 1(1) + 1(14) + 3(16) \\ = 1 + 14 + 48 \\ = 63 \text{ g/mol}$$

$$\text{No. of atoms of } \text{HNO}_3 = ?$$

Solution:

$$\text{No. of molecules of } \text{HNO}_3 = \frac{\text{Given Mass of } \text{HNO}_3}{\text{Molar mass of } \text{HNO}_3} \times N_A$$

$$= \frac{60}{63} \times 6.02 \times 10^{23}$$

$$= 0.952 \times 6.02 \times 10^{23}$$

$$= 5.73 \times 10^{23} \text{ molecules}$$

As one molecule of HNO_3 has 5 atoms so,

$$\text{No. of atoms in } 5.73 \times 10^{23} \text{ molecules} = 5 \times 5.73 \times 10^{23}$$

$$= 2.87 \times 10^{24} \text{ atoms}$$

Q.26. How many molecules of HCl will be required to have 10 grams of it?

Data:

$$\text{Given Mass of } \text{HCl} = 10 \text{ g}$$

$$\text{Molar mass of } \text{HCl} = 1(1) + 1(35.5) \\ = 1 + 35.5 \\ = 36.5 \text{ g/mol}$$



No. of molecules of HCl = 7

Solution:

$$\begin{aligned}\text{No. of HCl molecules} &= \frac{\text{Given Mass of HCl}}{\text{Molar mass of HCl}} \times N_A \\ &= \frac{10}{36.5} \times 6.02 \times 10^{23} \\ &= 1.65 \times 10^{23} \text{ molecules}\end{aligned}$$

Q.27. How many grams of Mg will have the same number of atoms as 6 grams of C have?

Data:

Given Mass of Carbon	= 6 g
Molar mass of Carbon	= 12 g/mol
Mass of Mg	= ?

Solution:

$$\begin{aligned}\text{No. of moles of Carbon} &= \frac{\text{Given Mass of Carbon}}{\text{Molar mass of Carbon}} \\ &= \frac{6}{12} \\ &= 0.5 \text{ mole}\end{aligned}$$

$$\begin{aligned}\text{Number of Carbon atoms} &= 0.5 \text{ mol} \times N_A \\ &= 0.5 \times 6.02 \times 10^{23} \\ &= 3.01 \times 10^{23} \text{ atoms}\end{aligned}$$

$$\text{Number of atoms of Mg} = \frac{\text{Given mass of Mg}}{\text{Molar mass of Mg}} \times N_A$$

$$3.01 \times 10^{23} = \frac{\text{mass of Mg}}{24} \times 6.02 \times 10^{23} \quad (\text{as } 24 \times 10^2 \text{ carbon atoms} = 2.4 \times 10^3 \text{ Mg atoms})$$

$$\begin{aligned}\text{Mass of Mg} &= \frac{3.01 \times 10^{23} \times 24}{6.02 \times 10^{23}} \\ &= 12 \text{ g}\end{aligned}$$

So, 12 g of Mg will have same no. of atoms as that of 6g of carbon.

Q.28. Write the chemical of Aluminum sulphate and calcium phosphate.

Ans.

(i) Aluminum Sulphate = $Al_2(SO_4)_3$

(ii) Calcium Phosphate = $Ca_3(PO_4)_2$

Q.29. What is Avogadro's number?

Ans. Avogadro's number is a collection of 6.02×10^{23} particles. It is represented by symbol ' N_A '. Hence, the 6.02×10^{23} number of atoms, molecules or formula

units are called Avogadro's number that is equivalent to one 'mole' of respective substance.

e.g:

6.02×10^{23} atoms of carbon = 1 mole of carbon.

Q.30. Define molar mass.

Ans. The mass of one mole of a substance is called as molar mass.

e.g. Molar mass of O-atom = 16 g.

Q.31. Write a note on the followings:

(i) Gram Atomic Mass (ii) Gram Molecular Mass (iii) Gram Formula Mass

Ans.

i. Gram Atomic Mass:

The atomic mass of an element expressed in grams is called gram atomic mass or gram atom. It is also called a mole, e.g.

1 gram atom of hydrogen = 1.008 g = 1 mol of hydrogen

1 gram atom of carbon = 12.0 g = 1 mol of carbon

It means that 1 gram atom of different elements has different masses.

ii. Gram Molecular Mass:

The molecular mass of a compound expressed in grams is called gram molecular mass or gram molecule. It is also called a mole, e.g.

1 gram molecule of H_2 = 2.0 g = 1 mol of hydrogen

1 gram molecule of H_2O = 18.0 g = 1 mol of water

1 gram molecule of H_2SO_4 = 98.0 g = 1 mol of sulphuric acid

iii. Gram Formula Mass:

The formula mass of an ionic compound expressed in grams is called gram formula mass or gram formula. This is also called a mole, e.g.

1 gram formula of NaCl = 58.5 g = 1 mol of sodium chloride

1 gram formula of $CaCO_3$ = 100 g = 1 mol of calcium carbonate

Q.32. Differentiate between reactants and products.

Ans.

Reactants	Products
In a chemical reaction, the substances that combine or decompose to form products are called reactants.	In a chemical reaction, the new substances which are formed by the combination or decomposition of reactants are called products.
e.g. $2H_2 + O_2$ (Reactants)	$\rightarrow 2H_2O$ (Product)

Q.33. Define ionic equation and spectator ions.

Ans. Ionic equation: A chemical equation in which substances dissolved in water are written as individual ions is called an ionic equation.

Example:



Write the substances that are soluble in water in their dissociated form are represented as:



Spectator Ions:

Remove common ions from both sides. These ions do not actually take part in the chemical reaction and are called spectator ions. Net ionic equation is:





Electrochemistry

Q.1. Compare and contrast oxidation and reduction.

answer

Ans.

Oxidation	Reduction
• Oxidation is the loss of electrons from an atom, molecule or an ion.	• Reduction is the gain of electrons from an atom, molecule or an ion.
• Oxidation involves the increase of oxidation state.	• Reduction involves the decrease of oxidation state.
• It causes the increase of positive charge of chemical species.	• It causes the increase of negative charge of a chemical species.
• It occurs in reducing agents.	• It occurs in oxidizing agents.
• It involves the addition of oxygen.	• It involves the removal of oxygen.
• In oxidation, hydrogen is removed from a substance. e.g. $Zn \rightarrow Zn^{+2} + 2e^{-}$	• In reduction, hydrogen is added in a substance. e.g. $Cl_2 + 2e^{-} \rightarrow 2Cl^{-}$

Q.2. Define oxidation and reduction in terms of loss or gain of electrons.

answer

Ans. Many chemical reactions which do not involve oxygen or hydrogen, but they are considered redox reactions. To deal with these reactions, new concept loss or gain of electron is used. Therefore, the reactions which involve loss or gain of electrons are also oxidation and reduction reactions.

According to this concept:

Oxidation:	Reduction:
Oxidation is loss of electrons by an atom or an ion e.g. $Zn_{(s)} \rightarrow Zn_{(aq)}^{+2} + 2e^{-}$ $Fe_{(s)}^{+2} \rightarrow Fe_{(s)}^{+3} + 1e^{-}$ $2Cl_{(aq)}^{-} \rightarrow Cl_{2(g)} + 2e^{-}$	Reduction is gain of electrons by an atom or ion e.g. $2H_{(g)}^{+} + 2e^{-} \rightarrow H_{2(g)}$ $Cl_{2(g)} + 2e^{-} \rightarrow 2Cl_{(aq)}^{-}$

Explanation:

A reaction between sodium metal and chlorine is redox reaction which takes place in three steps. First sodium atom loses an electron, to form sodium ion, such as:



Simultaneously, this electron is accepted by chlorine atom to form chloride ion (reduction process)



Ultimately, both these ions attract each other to form sodium chloride. Complete redox reaction is sum of the oxidation and reduction reactions between sodium and chlorine atoms. Because chlorine element

exists as a molecule (Cl_2) not as atoms (Cl).

Q.3. Explain how food and beverage industries deal with corrosion.

answer

Ans. In the food and beverage industries corrosion can be a big issue. To avoid this, they use various methods:

- Material Selection:** They use materials like stainless steel (combination of Fe, Cr, Ni) that resist corrosion well for their equipment.
- Protective Coating:** They apply coating like "Tin coating" inside the container, to give it a longer life and protect the food against rusting.
- Regular Maintenance:** They clean and maintain equipment on regular basis to remove the corrosive substances like food residue.
- pH Control:** As, the process of corrosion is accelerate in acidic medium. So, they monitor and control pH levels of products and processing areas to prevent against corrosion.
- Proper Storage:** Corrosion is occur in the presence of moist air. Therefore, they ensure food and beverages are stored properly air-tight to avoid exposure to element like moisture that can cause corrosion.

Q.4. State the substances which are oxidized or reduced. Give reason for your answer.

answer

- $N_2 + 3H_2 \rightarrow 2NH_3$
- $CO_2 + 2Mg \rightarrow 2MgO + C$
- $Mg + H_2O \rightarrow MgO + H_2$
- $H_2S + Cl_2 \rightarrow 2HCl + S$
- $2NH_3 + 3CuO \rightarrow 3Cu + N_2 + 3H_2O$

Ans.



In this reaction, N_2 is reduced and H_2 gets oxidized. Because the oxidation number of H_2 decreases from zero to -3 and that of hydrogen increases from zero to $+1$.



In this reaction, CO_2 is reduced and Mg gets oxidized.



In this reaction, Mg is oxidized and H_2O gets reduced.



In this reaction, H_2S is oxidized and Cl_2 gets reduced.



In this reaction, nitrogen is oxidized and Cu gets reduced because the oxidation state of nitrogen increases from -3 to zero and that of Cu decreases from $+2$ to zero.

Q.5. (a) Define oxidation number or oxidation state.

answer

(b) Find the oxidation state of nitrogen in the following compounds.

- (i) NO_2 (ii) N_2O (iii) N_2O_5 (iv) HNO_3

Ans.

- a) Oxidation state or oxidation number is the apparent charge assigned to an atom of an element in a molecule or in an ion. For example in HCl , the oxidation number of hydrogen is $+1$ and that of chlorine is -1 .

Rules for assigning oxidation number (O.N):

- The oxidation number of all elements in the free state is zero.
- The oxidation number of an ion consisting of a single element is the same as the charge on the ion.



- iii. The oxidation number of different elements in the periodic table is: in Group 1 it is +1, in Group 2 it is +2 and in Group 13 it is +3.
- iv. The oxidation number of hydrogen in all its compounds is +1. But in metal hydrides it is -1.
- v. The oxidation number of oxygen in all its compounds is -2. But it is -1 in peroxides, $(-\frac{1}{2})$ in superoxides and +2 in OF_2 .
- vi. In any substance the more electronegative atom has the negative oxidation number.
- vii. In neutral molecules, the algebraic sum of the oxidation numbers of all the elements is zero.
- viii. In ions, the algebraic sum of oxidation number is equal to the charge on the ion.

b)

i. NO_2

$$\begin{aligned} [O.N \text{ of } N] + 2[O.N \text{ of } O] &= 0 \\ [O.N \text{ of } N] + 2(-2) &= 0 \\ [O.N \text{ of } N] - 4 &= 0 \\ [O.N \text{ of } N] &= +4 \end{aligned}$$

ii. N_2O

$$\begin{aligned} 2[O.N \text{ of } N] + [O.N \text{ of } O] &= 0 \\ 2[O.N \text{ of } N] + (-2) &= 0 \\ 2[O.N \text{ of } N] - 2 &= 0 \\ 2[O.N \text{ of } N] &= +2 \\ [O.N \text{ of } N] &= +2/2 \\ [O.N \text{ of } N] &= +1 \end{aligned}$$

iii. N_2O_3

$$\begin{aligned} 2[O.N \text{ of } N] + 3[O.N \text{ of } O] &= 0 \\ 2[O.N \text{ of } N] + 3(-2) &= 0 \\ 2[O.N \text{ of } N] - 6 &= 0 \\ 2[O.N \text{ of } N] &= +6 \\ [O.N \text{ of } N] &= +6/2 \\ [O.N \text{ of } N] &= +3 \end{aligned}$$

iv. HNO_3

$$\begin{aligned} [O.N \text{ of } H] + [O.N \text{ of } N] + 3[O.N \text{ of } O] &= 0 \\ (+1) + [O.N \text{ of } N] + 3(-2) &= 0 \\ +1 + [O.N \text{ of } N] - 6 &= 0 \\ [O.N \text{ of } N] - 5 &= 0 \\ [O.N \text{ of } N] &= +5 \end{aligned}$$

Q.6. Find the oxidation state of S in the following compounds.

(i) H_2S (ii) H_2SO_3 (iii) $Na_2S_2O_3$

Ans.

a) H_2S

$$\begin{aligned} 2[O.N \text{ of } H] + [O.N \text{ of } S] &= 0 \\ 2(+1) + [O.N \text{ of } S] &= 0 \\ +2 + [O.N \text{ of } S] &= 0 \\ [O.N \text{ of } S] &= -2 \end{aligned}$$

b) H_2SO_3

$$2[O.N \text{ of } H] + [O.N \text{ of } S] + 3[O.N \text{ of } O] = 0$$



$$\begin{aligned} 2(+1) + [O.N \text{ of } S] + 3(-2) &= 0 \\ +2 + [O.N \text{ of } S] - 6 &= 0 \\ [O.N \text{ of } S] - 4 &= 0 \\ [O.N \text{ of } S] &= +4 \end{aligned}$$

c) $Na_2S_2O_3$

$$\begin{aligned} 2[O.N \text{ of } Na] + 2[O.N \text{ of } S] + 3[O.N \text{ of } O] &= 0 \\ 2(+1) + 2[O.N \text{ of } S] + 3(-2) &= 0 \\ +2 + 2[O.N \text{ of } S] - 6 &= 0 \\ 2[O.N \text{ of } S] - 4 &= 0 \\ 2[O.N \text{ of } S] &= +4 \\ [O.N \text{ of } S] &= +4/2 \\ [O.N \text{ of } S] &= +2 \end{aligned}$$

Q.7. (a) Define oxidizing and reducing agents.

(b) Identify the oxidizing agents and reducing agents in the following reactions:

- i. $H_2S + Cl_2 \rightarrow 2HCl + S$
- ii. $2FeCl_2 + Cl_2 \rightarrow 2FeCl_3$
- iii. $2KI + Cl_2 \rightarrow 2KCl + I_2$
- iv. $Mg + 2HCl \rightarrow MgCl_2 + H_2$

Ans.

a) Oxidizing Agent:

An oxidizing agent is the species that oxidizes a substance by taking electrons from it. The substance (atom or ion) which is reduced itself by gaining electrons is also called oxidizing agent.

e.g. Non-metals are oxidizing agents because they accept electrons being more electronegative elements.

Reducing Agent:

Reducing agent is the species that reduces a substance by donating electron to it. The substance (atom or ion) which is oxidized itself by losing electrons is also called reducing agent.

e.g. Almost all metals are good reducing agents because they have the tendency to lose electrons.

Example:

Let us discuss a reaction of zinc metal with hydrochloric acid.



The oxidation states or oxidation numbers of all the atoms or ions in this reaction are indicated below:



Let us find, the atoms that are oxidized or reduced or whether there is a change in their oxidation state, it is indicated as follows:

In above reaction:

Zinc is oxidized and acts as a reducing agent.

Hydrogen is reduced and acts as an oxidizing agent.

Similarly in the case of formation of water from hydrogen and oxygen gases, redox reaction takes place as follows:





The oxidation states or oxidation numbers of all the atoms or ions in this reaction are:



The atoms that have been oxidized or reduced in this reaction can be represented as:



In this reaction:

Hydrogen is oxidized and acts as a reducing agent. Oxygen is reduced and acts as an oxidizing agent.



In above reaction, Sulphur is oxidized and acts as reducing agent. While Chlorine is reduced and acts as oxidizing agent.



In above reaction, Iron is oxidized and acts as reducing agent while, Chlorine is reduced and acts as oxidizing agent.



In above reaction, Iodine is oxidized and acts as reducing agent. While, Chlorine is reduced and acts as oxidizing agent.



In above reaction, Magnesium is oxidized and acts as reducing agent. While, Hydrogen is reduced and acts as oxidizing agent.

Q.8. Hydrogen peroxide reacts with silver oxide and lead (II) sulphide according to the following equations.

In hydrogen peroxide an oxidizing or reducing agent in these reactions? Argue.



Ans.



In above reaction, Silver is reduced and acts as oxidizing agent. While, Oxygen is oxidized and acts as reducing agent.



In above reaction, hydrogen peroxide is reduced and acts as oxidizing agent while lead (II) sulphide is oxidized and acts as reducing agent.

Concept Assessment 7.1

Q.9. Identify elements undergoing oxidation and reduction in the following reactions:



Ans.



In above reaction, N_2 is reduced and H_2 gets oxidized.



In above reaction, H_2 is oxidized and O_2 gets reduced.



In above reaction, Fe_2O_3 is reduced and CO gets oxidized.



In above reaction, Al is oxidized and O_2 gets reduced.

Concept Assessment 7.2

Q.10. In the following reactions, identify which element is oxidized as which element is reduced in terms of electron transfer:



Ans.



In above reaction, Na is oxidized and O_2 gets reduced.



In above reaction, Al is oxidized and Cl_2 gets reduced.



In above reaction, Mg is oxidized and Cl_2 gets reduced.

Concept Assessment 7.3

Q.11. (i) Determine oxidation number of N:



Ans.



(ii) Determine oxidation number of S:



Ans.





Concept Assessment 7.4

answer

Q.12. Determine the oxidation state of:

- S in sulphate ion, SO_4^{2-}
- P in phosphate ion, PO_4^{3-}
- N in ammonium ion, NH_4^{+}

Ans.

- Determine oxidation number of S in sulphate ion SO_4^{2-}

$$[O.N \text{ of } S] + 4[O.N \text{ of } O] = -2$$

$$[O.N \text{ of } S] + 4(-2) = -2$$

$$[O.N \text{ of } S] - 8 = -2$$

$$[O.N \text{ of } S] = -2 + 8$$

$$[O.N \text{ of } S] = +6$$

- Determine oxidation number of P in phosphate ion PO_4^{3-}

$$[O.N \text{ of } P] + 4[O.N \text{ of } O] = -3$$

$$[O.N \text{ of } P] + 4(-2) = -3$$

$$[O.N \text{ of } P] - 8 = -3$$

$$[O.N \text{ of } P] = -3 + 8$$

$$[O.N \text{ of } P] = +5$$

- Determine oxidation number of N in NH_4^{+}

$$[O.N \text{ of } N] + 4[O.N \text{ of } H] = +1$$

$$[O.N \text{ of } N] + 4(+1) = +1$$

$$[O.N \text{ of } N] + 4 = +1$$

$$[O.N \text{ of } N] = +1 - 4 = -3$$

Concept Assessment 7.5

Q.13. (i) Identify oxidizing and reducing agents in the following reactions:

answer

- $2S + Cl_2 \rightarrow S_2Cl_2$
- $2Na + Br_2 \rightarrow 2NaBr$

(ii) Differentiate between oxidizing and reducing agents.

Ans.



In above reaction, Sulphur is oxidized and act as reducing agent while, Chlorine is reduced and act as oxidizing agent.



In above reaction, Na is oxidized and act as reducing agent while, Bromine is reduced and act as oxidizing agent.



(ii) Differentiate between Oxidizing and Reducing agent.

Oxidizing Agent	Reducing Agent
A specie that oxidizes a substance by taking electrons from it.	A specie that reduces a substance by donating electrons to it.
A substance which is reduced itself by gaining electrons. $Cl + e^- \rightarrow Cl^-$	A substance which is oxidized itself by losing electrons. $Na \rightarrow Na^+ + e^-$
A substance that reduces itself and oxidizes other.	A substance that oxidizes itself and reduces other.
Examples are non-metals.	Examples are metals.

Multiple Choice Questions (Exercise)

Encircle the correct answer.

- In which of the following changes, the nitrogen atom is reduced? answer

- N_2 to NO
- N_2 to NO_2
- N_2 to NH_3
- N_2 to HNO_3

- Which of the following changes reaction is an example of oxidation? answer

- Chlorine molecule to chloride ion
- Silver atoms to silver (I) ion
- Oxygen molecule to oxide ion
- Iron (III) ion to iron (II) ion

- Which of the following elements in the given reaction is reduced? answer



- H_2
- ZnO
- Zn
- H_2O

- Consider the following reaction: answer



In this reaction H_2S behaves as

- Reducing agent
- Oxidizing agent
- Catalyst
- Electrolyte

- The oxidation state of Cr in $K_2Cr_2O_7$ is: answer

- +12
- +6
- +3
- 6

SLO Based Additional MCQs

- Formation of water from hydrogen and oxygen is: answer

- Redox reaction
- Acid-base reaction
- Neutralization
- Decomposition

- The oxidation number of manganese in $KMnO_4$ is: answer

- +2
- +6
- +7
- +14

- The most common example of corrosion is: answer

- Chemical decay
- Rusting of iron
- Rusting of aluminium
- Rustin of tin

- During the formation of water from hydrogen and oxygen, which of the following does not occur? answer

- Hydrogen has oxidized
- Oxygen has reduced
- Oxygen gains electrons
- Hydrogen behaves as oxidizing agent

- The formula of rust is: answer

- $Fe_2O_3 \cdot nH_2O$
- Fe_2O_3
- $Fe(OH)_3 \cdot nH_2O$
- $Fe(OH)_3$

- In the redox reaction between Zn and HCl, the oxidizing agent is: answer

- Zn
- H^+
- Cl^-
- H_2



12. Chemical reactions in which the oxidation state of one or more substances changes are called: **answer**
(a) Corrosion (b) Reduction
(c) Redox (d) Oxidation
13. Cl_2 gas is formed, when Cl^- ions are: **answer**
(a) Reduced (b) Oxidized
(c) Removed (d) Reacted with metals
14. Corrosion of iron is called: **answer**
(a) Rusting (b) Seeding
(c) Rimming (d) All of these
15. Which medium accelerates the process of rusting? **answer**
(a) Acidic (b) Basic
(c) Buffer (d) Neutral
16. A region of stain or dent on iron surface when rusting takes place act as: **answer**
(a) Cathodic region (b) Anodic region
(c) Both of the above (d) None of the above
17. Rusting occurs on: **answer**
(a) Iron (b) Steel
(c) Aluminium (d) Both (a) and (b)
18. Stainless steel contains: **answer**
(a) Nickel (b) Iron
(c) Chromium (d) All of these
19. Which of the following is not a corrosion resistant metal? **answer**
(a) Fe (b) Zn (c) Sn (d) Cr
20. In order to give longer life, the containers of iron are coated by: **answer**
(a) Tin (b) Chromium
(c) Carbon (d) Both a and b
21. A process of coating a thin layer of Zn on iron is called: **answer**
(a) Cathexation (b) Rusting
(c) Smelting (d) Galvanizing
22. Which metal has a great tendency to corrosion? **answer**
(a) Potassium (b) Sodium

- (c) Aluminium (d) All of these
23. The branch of chemistry which deals with the relationship between electricity and chemical reactions: **answer**
(a) Electrochemistry
(b) Thermochemistry
(c) Analytical chemistry
(d) Industrial chemistry
24. Oxidation involves: **answer**
(a) Removal of oxygen
(b) Addition of oxygen
(c) Gain of electrons
(d) Addition of hydrogen
25. In HCl , oxidation number of H is: **answer**
(a) -1 (b) +1 (c) +2 (d) -2
26. The oxidation number of all elements in free state is: **answer**
(a) One (b) Two (c) Three (d) Zero
27. The oxidation number of Group-I elements is: **answer**
(a) +1 (b) +2 (c) +3 (d) +4
28. The oxidation number of hydrogen in metal hydrides is: **answer**
(a) +1 (b) -1 (c) +2 (d) -2
29. The oxidation number of oxygen in OF_2 : **answer**
(a) -1 (b) -2 (c) +1 (d) +2
30. In neutral molecules, the algebraic sum of the oxidation numbers of all the elements is: **answer**
(a) One (b) Two (c) Three (d) Zero
31. The oxidation number of sulphur in H_2SO_4 is: **answer**
(a) +1 (b) +4 (c) +6 (d) +8
32. Oxidizing agent is a substance which: **answer**
(a) Reduces itself and oxidizes other
(b) Reduces itself and also reduces other
(c) Oxidizes itself and reduces other
(d) Oxidizes itself and also oxidizes other
33. Addition of oxygen during chemical reaction is called: **answer**
(a) Reduction (b) Oxidation
(c) Evaporation (d) Conduction



34. What is the oxidation number of oxygen in water? **answer**
(a) +1 (b) -1 (c) +2 (d) -2
35. The oxidation number of oxygen in peroxides is: **answer**
(a) zero (b) -1 (c) -2 (d) +2
36. The loss of electrons by an atom or ion during a chemical reaction is termed as: **answer**
(a) Oxidation (b) Reduction
(c) Electrolysis (d) Electricity
37. In ions, the algebraic sum of oxidation number equals the on the ion. **answer**
(a) charge (b) atoms
(c) symbols (d) none of these
38. In rusting process, Iron is: **answer**
(a) reduced (b) oxidized
(c) removed (d) catalyst
39. Tin is usually electroplated: **answer**
(a) Copper (b) Silver
(c) Zinc (d) Steel
40. Removal of oxygen from a compound is: **answer**
(a) Oxidation (b) Reduction
(c) Redox reaction (d) None of these
41. $2\text{H}^+_{(\text{aq})} + 2\text{e}^- \rightarrow \text{H}_{2(\text{g})}$ is a reaction: **answer**
(a) Oxidation (b) Reduction
(c) Redox (d) All of these
42. $\text{Zn}_{(\text{s})} \rightarrow \text{Zn}^{2+}_{(\text{aq})} + 2\text{e}^-$ is a reaction: **answer**

- (a) Oxidation (b) Reduction
(c) redox (d) All of these
43. $2\text{Na} + \text{Cl}_2 \rightarrow 2\text{NaCl}$ is a reaction: **answer**
(a) Oxidation (b) Reduction
(c) redox (d) All of these
44. Which one of the following is an oxidizing agent? **answer**
(a) Sodium (b) Magnesium
(c) Aluminium (d) Oxygen
45. Which one of the following are good reducing agents? **answer**
(a) metals (b) non metals
(c) metalloids (d) Noble gases
46. The oxidation number of Cl in KClO_3 is: **answer**
(a) +4 (b) +5 (c) +6 (d) +1
47. Which one of the following is used for galvanizing? **answer**
(a) Zn (b) Cr (c) Fe (d) Cu
48. Deposition of one metal over the other by means of electrolysis: **answer**
(a) Electroplating (b) Oxidation
(c) Reduction (d) Corrosion
49. The apparent charge assigned to an atom of an element in a molecule or an ion is called: **answer**
(a) Electronegativity
(b) Oxidation number
(c) Ionization potential
(d) Bond

Answer Key

1	c	2	b	3	b	4	a	5	b
6	a	7	c	8	b	9	d	10	a
11	b	12	c	13	b	14	a	15	a
16	b	17	a	18	d	19	a	20	a
21	d	22	c	23	a	24	b	25	b
26	d	27	a	28	b	29	d	30	d
31	c	32	a	33	b	34	d	35	b
36	a	37	a	38	b	39	d	40	b
41	b	42	a	43	c	44	d	45	a
46	b	47	a	48	a	49	b		



Short Questions (Exercise)

- What is oxidation state? meanings
Ans. Oxidation state or oxidation number is the apparent charge assigned to an atom of an element in a molecule or in an ion. For example in HCl, the oxidation number of hydrogen is +1 and that of chlorine is -1.
- What is the oxidation number of Cr in chromic acid (H_2CrO_4)? meanings
Ans. H_2CrO_4 is a neutral compound sum of all oxidation number in $H_2CrO_4 = 0$
 $2[\text{O.N. of H}] + [\text{O.N. of Cr}] + 4[\text{O.N. of O}] = 0$
 $2(+1) + [\text{O.N. of Cr}] + 4(-2) = 0$
 $+2 + [\text{O.N. of Cr}] - 8 = 0$
 $[\text{O.N. of Cr}] - 6 = 0$
 $\text{O.N. of Cr} = +6$

- Identify reducing agent in the following reaction: meanings



Ans.



In this reaction, CuO is reduced and H_2 is oxidized. While H_2 is reducing agent.

- Why tin plated steel is used to make food cans? meanings

Ans. Tin coating is the most widely applied technique in the food industry where food is tin-packed. The containers of iron are coated with tin to give it a longer life by protecting it against corrosion.

- Explain one example from daily life which involves oxidation - reduction reaction? meanings

Ans. An example of an oxidation-reduction reaction from our daily life is the process of rusting.

When iron (Fe) reacts with oxygen (O_2) in the presence of water, it undergoes oxidation to form iron oxide, commonly known as rust ($Fe_2O_3 \cdot nH_2O$).

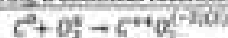
SLO Based Additional Short Questions (Reference Material)

- What is meant by electrochemistry? meanings

Ans. The branch of chemistry that deals with the relationship between electricity and chemical reactions is called electrochemistry.

- Define oxidation. meanings

Ans. Oxidation is defined as the addition of oxygen or removal of hydrogen or loss of electron or increase in oxidation number during a chemical reaction.



Oxidation (Increase in O.N.) or addition of oxygen

- Define reduction. meanings

Ans. Reduction is defined as the removal of oxygen or addition of hydrogen or gain of electron or decrease in oxidation number during a chemical reaction.



Reduction (decrease in O.N.) or removal of oxygen

- What is meant by Redox reaction? meanings

Ans. Chemical reactions in which the oxidation state of one or more substances changes are called oxidation-reduction or redox reactions.

Oxidation (Increase in O.N.)



Reduction (Decrease in O.N.)

- Define oxidation in terms of electrons. Give an example. meanings

Ans. Oxidation: Oxidation is loss of electrons by an atom or an ion e.g.



- Differentiate between Oxidation and Reduction. meanings

Oxidation	Reduction
Addition of oxygen	Removal of oxygen
Removal of hydrogen	Addition of hydrogen
Loss of electrons	Gain of electrons
Increase in oxidation number	Decrease in oxidation number

- Justify that the reaction between ZnO and C is Redox reaction. meanings

Ans. A redox reaction can be explained in terms of:

- Gain of electrons (Reduction)
- Loss of electrons (Oxidation)
- Gain of oxygen and removal of hydrogen (Oxidation)
- Gain of hydrogen and removal of oxygen (Reduction)

Oxidation (Increase in O.N. and gain of oxygen)



Reduction (decrease in O.N. and loss of oxygen)

- Justify that the reaction between Zn and HCl is Redox reaction. meanings

Ans.



- Justify that the reaction between H_2S and Cl_2 is Redox reaction. meanings

Ans.



Reduction (Decrease in O.N. and gain of oxygen)



- Justify that the reaction between Na and Cl_2 is Redox reaction. meanings

Ans.



- Define reduction in terms of electrons? Give an example. meanings

Ans. Gain of electrons by an atom or ion is called reduction. e.g.



- How can you justify that a reaction between magnesium and oxygen is a redox reaction, while the reaction shows only addition of oxygen (oxidation). meanings



Ans. A redox reaction is defined in two ways:

- in terms of gain or loss of e^- s
- in terms of addition or removal of oxygen or addition or removal of hydrogen.

Reaction between magnesium and oxygen is a redox reaction because it involves loss and gain of e^- s by the involved elements at the same time.



- A Reaction between carbon and oxygen involved only addition of oxygen (oxidation), but it is called a Redox reaction. Comment on this. meanings

Ans. Oxidation = addition of oxygen or loss of e^- s

Reduction = removal of oxygen or gain of e^- s





Individual oxidation and reduction reaction can be represented as:



Oxidation number of carbon and oxygen is changed that is why it redox reaction.

19. Oxidation and reduction proceed simultaneously. Explain, with an example. answer

Ans. Oxidation and reduction are opposite processes and take place simultaneously because electrons lost by an atom (Oxidation) are simultaneously accepted (Reduction) by the other.

Example:



21. What is difference between valency and oxidation state? answer

Ans.

Valency	Oxidation State
The combining capacity of an element with other element is called valency.	The apparent charge assigned to an atom of an element in a molecule or to an ion called oxidation state.
Assigning valency the sign is followed by the number i.e. 2+	Assigning oxidation number the sign precedes the number i.e. +2.
For example, the valency of sodium is 1+	For example, the oxidation number of sodium is +1

22. How can you explain, that following reaction is oxidation in terms of increasing of oxidation number? answer



Ans. Increase in oxidation number is oxidation. Oxidation number of Al increases from zero to +3 by losing 3e as given below:



So it is an oxidation reaction.

23. How can you prove with an example that conversion of anion to an atom is an oxidation process? answer

Ans. When anions (negatively charged ions) lose electron, they are converted into atoms. In this way they are oxidised. E.g.

24. Identify which of the following is oxidation or reduction reaction. answer

- $K \rightarrow K^+ + 1e^-$
- $Br + 1e^- \rightarrow Br^-$
- $Cu \rightarrow Cu^{2+} + 2e^-$
- $I^- \rightarrow I + 1e^-$
- $Fe^{+2} \rightarrow Fe^{+3} + 1e^-$

Ans.

- $K \rightarrow K^+ + 1e^-$ (Oxidation)
- $Br + 1e^- \rightarrow Br^-$ (Reduction)
- $Cu \rightarrow Cu^{2+} + 2e^-$ (Oxidation)
- $I^- \rightarrow I + 1e^-$ (Oxidation)
- $Fe^{+2} \rightarrow Fe^{+3} + 1e^-$ (Oxidation)

conversion of chloride ion to chlorine atom is an oxidation process.



Oxidation (increase in O.N.)

24. Write oxidation numbers of oxygen in its binary compounds. answer

Ans.

- Normal oxides = -2
- Peroxides = -1
- OF_2 = +2

25. What is the oxidation number of an element in its free state? answer

Ans. The oxidation number of any element in free state is zero.

26. What is the oxidation number of elements of group 1, group 2 and group 13? answer

Ans. The oxidation number of elements of group 1 is +1, in group 2 it is +2 and in group 13 it is +3.

27. Give an example to show that in neutral molecules, the algebraic sum of the oxidation number of all the elements is zero. answer

Ans. HNO_3 is a neutral compound.

Sum of all oxidation numbers in HNO_3 = 0

$$(O.N. \text{ of } H) + (O.N. \text{ of } N) + 3(O.N. \text{ of } O) = 0$$

$$(+1) + (+5) + 3(-2) = 0$$

$$+1 + 5 - 6 = 0$$

$$+6 - 6 = 0$$

$$0 = 0$$

$$L.H.S = R.H.S$$

Hence, it is proved that in neutral

Compounds sum of oxidation numbers of all elements is zero.

28. Find out the oxidation numbers of the following elements marked in bold in the formulae: $Ba_3(PO_4)_2$, $CaSO_4$, $Cu(NO_3)_2$, $Al_2(SO_4)_3$ answer

Ans.

$$i) Ba_3(PO_4)_2$$

$$3(O.N. \text{ of } Ba) + 2(O.N. \text{ of } P) + 8(O.N. \text{ of } O) = 0$$

$$3[+2] + 2[P] + 8[-2] = 0$$

$$+6 + 2P - 16 = 0$$

$$2P - 10 = 0$$

$$2P = +10$$

$$P = +5$$

$$ii) CaSO_4$$

$$[O.N. \text{ of } Ca] + [O.N. \text{ of } S] + 4[O.N. \text{ of } O] = 0$$

$$[+2] + [S] + 4[-2] = 0$$

$$+2 + S - 8 = 0$$

$$S - 6 = 0$$

$$S = +6$$

$$iii) Cu(NO_3)_2$$

$$[O.N. \text{ of } Cu] + 2[O.N. \text{ of } N] + 6[O.N. \text{ of } O] = 0$$

$$[+2] + 2[N] + 6[-2] = 0$$

$$+2 + 2N - 12 = 0$$

$$2N - 10 = 0$$

$$2N = +10$$

$$N = +5$$

$$iv) Al_2(SO_4)_3$$

$$2[O.N. \text{ of } Al] + 3[O.N. \text{ of } S] + 12[O.N. \text{ of } O] = 0$$

$$2[+3] + 3[S] + 12[-2] = 0$$

$$+6 + 3S - 24 = 0$$

$$3S - 18 = 0$$

$$3S = +18$$

$$S = +6$$

29. In a compound MX_3 , find out the oxidation number of M and X. answer

$$\text{Ans. } M = +3$$

$$X = -1$$

30. In H_2S , SO_2 and H_2SO_4 , the sulphur atom has different oxidation number. Find out the oxidation number of sulphur in each compound. answer

Ans.

$$i) H_2S$$

$$2[O.N. \text{ of } H] + [O.N. \text{ of } S] = 0$$

$$2[+1] + [O.N. \text{ of } S] = 0$$

$$+2 + O.N. \text{ of } S = 0$$

$$S + 2 = 0$$

$$O.N. \text{ of } S = -2$$

$$ii) SO_2$$

$$[O.N. \text{ of } S] + 2[O.N. \text{ of } O] = 0$$

$$[O.N. \text{ of } S] + 2[-2] = 0$$

$$O.N. \text{ of } S - 4 = 0$$

$$O.N. \text{ of } S = +4$$

$$iii) H_2SO_4$$

$$2[O.N. \text{ of } H] + [O.N. \text{ of } S] + 4[O.N. \text{ of } O] = 0$$

$$+2 + [S] + 4[-2] = 0$$

$$2[+1] + [S] + 4[-2] = 0$$

$$+2 + S - 8 = 0$$

$$S - 6 = 0$$

$$S = +6$$



31. An element X, has oxidation state 0. What will be its oxidation state when it gains three electrons? answer

Ans. When X will gain three electrons in its valence shell, its oxidation state will become X^{-3} .



32. An element in oxidation state +7 gains electrons to be reduced to oxidation state +2. How many electrons did it accept? answer

Ans. When an element in oxidation state +7 gains electrons and reduced to oxidation state +2, it shows that it has accepted +5 electrons in its valence shell.



33. If the oxidation state of an element changes from +5 to -3. Has it been reduced or oxidized? How many electrons are involved in this process? answer

Ans. When the oxidation state of an element changes from +5 to -3, it is considered to be reduced because it has gained electrons.

There are eight electrons involved in this process.



34. How the chemical formula of ionic compound can be found? answer

Ans. To determine the formula of an ionic compound from the ionic charges and oxidation numbers of the constituent ions, you must determine the simplest whole-number ratio of cations (positively charged ions) to anions (negatively charged ions) that results in a neutral compound. Ionic compounds are electrically neutral, meaning that the total positive charge of the cations is equal to the total negative charge of the anions.

35. How the chemical formula of calcium chloride can be written? answer

Ans. Step 1: Identify the ions in the compound and their charges. Consider, for example, the combination of calcium ions (Ca^{2+}) and chloride ions (Cl^{-})

Step 2: Determine the ratio of charges needed to balance each other. In this case, calcium has a charge of +2 and chloride has a charge of -1. You need two chloride ions for every calcium ion to balance the charges.

Step 3: Write a formula with subscripts that represents the relationship defined in Step 2. The formula for calcium chloride is $CaCl_2$.

36. How the chemical formula of Magnesium oxide can be written? answer

Ans. Magnesium oxide:

Step 1: Identify the ions and their charges - magnesium ions (Mg^{2+}) and oxide ions (O^{2-}).

Step 2: Determine the charge - the magnesium has a charge of 2 and the oxide has a charge of -2. Thus, one magnesium ion is required for each oxide ion.

Step 3: Write the formula - MgO .

37. How the chemical formula of Aluminium sulphate can be written? answer

Ans. Aluminium sulphate:

Step 1: Identify the ions and their charges - aluminium ions (Al^{3+}) and sulphate ions (SO_4^{2-}).

Step 2: Determine the charge - aluminium has a charge of +3 and sulphate has a charge of -2. You need two aluminium ions for every three sulphate ions to balance the charges.

Step 3: Write the formula - $Al_2(SO_4)_3$.

38. Why Roman numeral are used in oxidation number? answer

Ans. Roman numerals are used to indicate the oxidation states of elements in compounds, when a metal exhibits variable oxidation in compounds. For example in transition metal compounds. $CuSO_4$ is written as copper (II) sulphate. $FeCl_2$ is written as iron (II) chloride. $FeCl_3$ is written as iron (III) chloride.



39. What is meant by oxidizing agent? Give examples. answer

Ans. An oxidizing agent is specie that oxidizes a substance by taking electrons from it. The substance (atom or ion) which is reduced itself by gaining electrons is called oxidizing agent. For example:

- Concentrated sulphuric acid, H_2SO_4
- Potassium permanganate, $KMnO_4$ etc

40. Differentiate between Oxidizing and reducing agents. answer

Ans.

Oxidizing Agent	Reducing Agent
A specie that oxidizes a substance by taking electrons from it.	A specie that reduces a substance by donating electrons to it.
A substance which is reduced itself by gaining electrons. $Cl + e^- \rightarrow Cl^-$	A substance which is oxidized itself by losing electrons. $Na \rightarrow Na^+ + e^-$
A substance that reduces itself and oxidizes other.	A substance that oxidizes itself and reduces other.
Examples are non-metals.	Examples are metals.

41. In the following reaction, how can you justify that H_2S is oxidized and SO_2 is reduced. answer



Ans. There is an addition of oxygen (replacement of S with oxygen) in H_2S therefore H_2S is oxidized, while removal of oxygen takes place in SO_2 , therefore SO_2 is reduced to S.



42. The reaction between MnO_2 and HCl is a Redox reaction written as balanced chemical equation. answer



Find out.

- The substance oxidized
- The substance which acts as oxidizing agent
- The substance which acts as reducing agent

43. What is meant by reducing agent? Give examples. answer

Ans. Reducing agent is the specie that reduces a substance by donating electron to it. The substance (atom or ion) which is oxidized by losing electrons is called reducing agent. For example:

- Hydrogen (H_2)
- Hydrogen sulphide (H_2S) etc

Ans.



- Cl is oxidized
- Mn is reduced
- MnO_2 is oxidizing agent
- HCl is reducing agent

44. The following reactions are Redox reactions. Find out the element which has been reduced and the element which has been oxidized. answer

- $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$
- $Cu + 2AgNO_3 \rightarrow Cu(NO_3)_2 + 2Ag$
- $H_2S + Cl_2 \rightarrow 2HCl + S$

Ans.

- Zn is oxidized and Cu is reduced





b) Cu is oxidised and Ag is reduced



c) S is oxidised and Cl is reduced



45. Define corrosion.

Ans. It is a redox reaction that takes place by the action of air and moisture with the metals. For example rusting of iron.

46. Why is O_2 necessary for rusting?

Ans. The loss of electrons damage the iron, the free electrons move through iron sheet, until they reach a region to relatively high O_2 concentration near the surface surrounded by water layer. This region acts as cathode and electrons reduce the oxygen molecule in the presence of H^+ ions.



47. What is meant by rust?

Ans. The Fe^{2+} formed spreads throughout the surrounding water and react with O_2 to form the salt $\text{Fe}_2\text{O}_3 \cdot n\text{H}_2\text{O}$, which is called rust.



48. What is the difference between corrosion and rusting?

Ans. Corrosion is slow and continuous eating away of a metal by the surrounding medium. It is a Redox chemical reaction that takes place by the action of air and moisture with metals. While, rusting is an example of corrosion. It is a special term used for corrosion of iron. The condition for rusting is the moist air (air having water vapours in it).

49. What happens to iron in the rusting process?

Ans. As a result of rusting, surface of iron gets damaged and rusting process

continues until all the pieces of iron is eaten up.

50. Define alloy.

Ans. Alloy is homogeneous mixture of one metal with one or more other metals or non-metals. For example stainless steel is an alloy of iron, chromium and nickel.

51. Why is galvanizing done? / What do you mean by Galvanizing? Write its advantages.

Ans. The process of coating a thin layer of zinc on iron is called galvanizing. Advantage of galvanizing is that zinc protects the iron against corrosion even after the coated surface is broken.

52. How does galvanizing process take place?

Ans. This process is carried out by dipping a clean iron sheet in a zinc chloride bath and then heating it. After this iron sheet is removed, rolled into molten zinc metal bath and finally air cooled.

53. What is meant by stainless steel?

Ans. It is alloy which is made up of iron, chromium and nickel, which does not corrode.

54. What is the important condition for rusting?

Ans. The important condition for rusting is moist air (air having water vapours in it). There will be no rusting in water vapours free of air or air free of water vapours.

55. Why non-metals are oxidizing agents while metals are reducing agents?

Ans. Non-metals are oxidizing agents because they accept electrons being more electronegative elements. Metal is reducing agents because they have the tendency to lose electrons being electropositive elements.

56. What is the advantage of galvanizing?

Ans. A major advantage of galvanizing is that zinc protects the iron against

corrosion even after the coating surface is broken.

57. Define electroplating.

Ans. Electroplating is depositing of one metal over the other by means of electrolysis.

58. Which material is used to make cathode in electroplating?

Ans. The cathode is made up of the project that is to be electroplated like some sheet made up of iron.

59. Why is the anode made up of a metal to be deposited during electrolysis?

Ans. When current is passed, the metal from anode dissolves in the solution and metallic ions migrate to the cathode and discharge or deposit on the cathode.

60. Why is an iron grill painted frequently?

Ans. Paint protects iron from attack of moisture and oxygen. So, iron is protected from corrosion.



61. What is the chemistry of redox reaction in photographic film?

Ans. A photographic film is basically an emulsion of silver bromide, (AgBr) in gelatin. When the film is exposed to light, Silver bromide granules become activated. This activation depends on the intensity of the light falling upon them. When exposed film is placed in the developer solution that is actually a reducing agent. Hydroquinone which is a mild reducing agent is used as developer. In hydroquinone the activated granules of silver bromide are reduced to black metallic silver. Reduced silver atoms form image.



Inactivated silver bromide is removed from the film by using a solvent called a fixer. Sodium thiosulphate is used for this purpose. The areas of the film exposed to the light appear darkest because they have the highest concentration of metallic silver. Thus photography involves oxidation-reduction reaction.



Energetics

Q.1. How can you determine the enthalpy of a chemical reaction? [10 MARKS]

Ans. Bond Energy and Bond Dissociation Energy:

When a chemical reaction occurs, old bonds are broken and new bonds are formed. Breaking bonds always requires energy, and forming a bond always releases energy.

Bond dissociation energy:

The amount of energy required to break one mole of a particular bond to form neutral atoms is called the bond dissociation energy.

Bond energy:

The amount of energy released when neutral atoms form one mole of a bond is called bond energy.

Enthalpy of a reaction:

The difference between the bond dissociation energy and the bond energy determines whether the reaction absorbs or releases energy.

The enthalpy change in a chemical reaction is the sum of energies absorbed and released in bond breaking and bond forming.

$\Delta H^{\circ} = \text{Sum of bond dissociation energies of reactants} - \text{Sum of bond energies of products}$

Q.2. Explain, how does the process of respiration provides us energy? [10 MARKS]

Ans. Respiration:

Respiration is a biochemical process in which energy is released from food in a biological system. During this process, glucose is oxidized in the body of living organisms and energy is released. Therefore, respiration is an exothermic reaction. There are two types of respiration process.

Types of respiration:

i. **Aerobic Respiration:** Respiration that requires oxygen to break down glucose to release energy is called aerobic respiration.



ii. **Anaerobic respiration:** Respiration that does not require oxygen to break down glucose to release energy is called anaerobic respiration.



Aerobic respiration release more energy than anaerobic respiration.

Importance of Lipids:

Lipids are important substances for building our body. They also act as reserve energy sources. Lipids can store very large amounts of energy in our body. When you exercise intensely, the oxidation of glucose is not enough for energy. At this stage, lipids are oxidized for energy.

Q.3. Draw labeled reaction pathway diagram for an exothermic and an endothermic reaction. [10 MARKS]

Ans. Exothermic Reactions:

A chemical reaction that proceeds with the evolution of heat is called an exothermic reaction. In an exothermic reaction the chemical system transfers energy to the surroundings as the reactants are converted to products.

Example:

Burning of fuels is a highly exothermic reaction. The energy released can be used to heat a room, or to drive an engine or to cook food. Examples of exothermic reactions are given below:



Endothermic Reactions:

A chemical reaction that proceeds, with the absorption of heat is called an endothermic reaction. In these reactions heat is transferred from surrounding to the system.

Example:

Examples of endothermic reactions are given below:



Q.4. Calculate the enthalpy of reaction between hydrogen and chlorine to form hydrogen chloride from the given bond energy data. Bond energy of $\text{H}-\text{H}$, $\text{Cl}-\text{Cl}$, $\text{H}-\text{Cl}$ are 436 kJ/mol , 243 kJ/mol , 432 kJ/mol respectively. [10 MARKS]

Ans. Data:

Bond energy of $\text{H}-\text{H} = 436 \text{ kJ/mol}$

Bond energy of $\text{Cl}-\text{Cl} = 243 \text{ kJ/mol}$

Bond energy of $\text{H}-\text{Cl} = 432 \text{ kJ/mol}$

To find:

Enthalpy of reaction = $\Delta H^{\circ} = ?$

Solve:



$$\Delta H^{\circ} = [\text{B.E of H-H} + \text{B.E of Cl-Cl}] - [2 \times \text{B.E of H-Cl}]$$

$$= [436 + 243] - [2 \times 432]$$

$$= 679 - 864$$

$$\Delta H^{\circ} = -185 \text{ kJ/mol}$$

Q.5. Justify the statement that the process of respiration is crucial for us. [10 MARKS]

Ans. The process of respiration is crucial for us because of following reasons:

i. **Oxygen Supply:** Respiration brings the oxygen into the body which is essential for cellular respiration. This process produce ATP for the body's various functions.

ii. **CO₂ removal:** Respiration removes CO₂, a waste product of cellular respiration. If CO₂ accumulates in the body, it can cause damage to organs and tissues.

iii. **Regulation of pH level:** Respiration helps to maintain the body's acid base balance by removing excess H⁺ ions.



- iv. **Supports Metabolic Processes:** Respiration provides the oxygen necessary for metabolic processes. Such as breakdown of glucose to produce energy.
- v. **Physical Activity:** Respiration provides the energy needed for physical activity. Allowing us to move, exercise and perform daily tasks.

Concept Assessment 8.1

Q.6. Classify the following processes as exothermic or endothermic.

- (a) Freezing of water (b) Combustion of methane
(c) Sublimation of dry ice (d) $H_2O_{(g)} \rightarrow H_2O_{(l)}$

(e) Decomposition of limestone

Ans.

- (a) Freezing of water: Exothermic (b) Combustion of methane: Exothermic
(c) Sublimation of dry ice: Endothermic (d) $H_2O_{(g)} \rightarrow H_2O_{(l)}$: Exothermic
(e) Decomposition of limestone: Endothermic

Concept Assessment 8.2

Q.7. Calculate the enthalpy of the following reaction from the given bond energy data. Bond energy of $H-H$, $F-F$, $H-F$ bonds are 436 kJ/mol , 155 kJ/mol and 567 kJ/mol respectively.

DATA:

$$B.E \text{ of } H-H = 436 \text{ kJ/mol}$$

$$B.E \text{ of } F-F = 155 \text{ kJ/mol}$$

$$B.E \text{ of } H-F = 567 \text{ kJ/mol}$$

$$\text{To find: Enthalpy of reaction} = \Delta H^\circ = ?$$



$$\Delta H^\circ = [B.E \text{ of } H-H + B.E \text{ of } F-F] - [2 \times B.E \text{ of } H-F]$$

$$= [436 + 155] - [2 \times 567]$$

$$= 591 - 1134$$

$$\Delta H^\circ = -543 \text{ kJ/mol}$$

Multiple Choice Questions (Exercise)

Encircle the correct answer.

- If the ΔH value is negative then reaction will be:
 - Exothermic
 - Endothermic
 - May or may not be Exothermic or Endothermic
 - None of these
- All chemical reactions involve:
 - Catalysts
 - Enzymes
 - Energy changes
 - All of these
- Which is not released in an aerobic respiration?
 - Carbon dioxide
 - Water
 - Energy
 - Lactic acid
- A catalyst increase the rate of a chemical reaction by:
 - increasing activation energy
 - increasing the enthalpy of reaction
 - Decreasing the enthalpy of reaction
 - None of these
- Activation energy of a chemical reaction must be _____ the average kinetic energy of reacting molecules.
 - Lower than
 - greater than
 - equal to
 - None of these



SLO Based Additional MCQs

- The study of energy changes in chemical reactions is called:
 - Electrochemistry
 - Chemical Energetics
 - Thermochemistry
 - Biochemistry
- When old bonds are broken, the energy is:
 - Consumed
 - Released
 - Remains same
 - None of these
- When new bonds are formed, the energy is:
 - Consumed
 - Released
 - Remains same
 - None of these
- The part of the universe that we want to focus our attention called:
 - system
 - Surrounding
 - Energy
 - Both a & b
- The enthalpy of reaction $C + O_2 \rightarrow CO_2$
 - 571.6 kJ
 - 110.5 kJ
 - 393.5 kJ
 - +53.8 kJ
- The enthalpy of reaction $2H_2 + O_2 \rightarrow 2H_2O$
 - 571.6 kJ
 - 110.5 kJ
 - 393.5 kJ
 - +53.8 kJ
- The enthalpy of reaction $C + \frac{1}{2}O_2 \rightarrow CO$
 - 571.6 kJ
 - 110.5 kJ
 - 393.5 kJ
 - +53.8 kJ
- The enthalpy of reaction $H_2 + I_2 \rightarrow 2HI$
 - 571.6 kJ
 - 110.5 kJ
 - 393.5 kJ
 - +53.8 kJ
- The enthalpy of reaction $C + H_2O \rightarrow CO + H_2$
 - +131.4 kJ
 - 110.5 kJ
 - 393.5 kJ
 - +53.8 kJ
- The enthalpy of reaction $N_2 + O_2 \rightarrow 2NO$
 - +131.4 kJ
 - +180.5 kJ
 - 393.5 kJ
 - 110.5 kJ
- No reaction occurs if the energy of reacting particles _____ activation energy.
 - Greater than
 - Lower than
 - Equal to
 - Nearest to
- The speed of reaction depends on:
 - Thermal energy
 - Activation energy
 - limitation energy
 - system
- The higher the activation energy, the _____ the reaction rate.
 - higher
 - lower
 - equal
 - none of these
- In the living organisms, _____ catalyze chemical reactions.
 - enzyme
 - Vitamins
 - Proton
 - Carbohydrate
- Respiration is an _____.
 - Exothermic reaction
 - Endothermic reaction
 - Nuclear reaction
 - Addition reaction
- Aerobic respiration occurs in the presence of:
 - CO_2
 - CO
 - O_2
 - H_2O
- _____ acts as reserve energy sources.
 - Vitamins
 - Proteins
 - Lipids
 - Enzyme
- Which is released in anaerobic respiration?
 - Amino acid
 - Stearic acid
 - Citric acid
 - Lactic acid
- Aerobic respiration releases _____ energy than anaerobic respiration.
 - Equal
 - less
 - more
 - None of these
- If ΔH° is positive then reaction will be:
 - Exothermic
 - Endothermic
 - Both a & b
 - None of these



Answer Key

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

Short Questions (Exercise)

Q.1. Define exothermic and endothermic reactions.

Ans. Exothermic Reactions:

A chemical reaction that proceeds with the evolution of heat is called an exothermic reaction.



Endothermic Reactions:

A chemical reaction that proceeds with the absorption of heat is called an endothermic reaction.



Q.2. Define enthalpy of a chemical reaction.

Ans. Enthalpy of Reaction: The amount of heat or thermal energy evolved or absorbed in a chemical reaction is called enthalpy of reaction. Its sign is negative for exothermic and positive for endothermic reactions. Enthalpy of reaction measured at 25°C (or 298K) and one atmospheric pressure is known as standard enthalpy change. It is denoted by ΔH° .



Q.3. What is anaerobic respiration?

Ans.

Ans. Anaerobic respiration: Respiration that does not require oxygen to break down glucose to release energy is called anaerobic respiration.



Q.4. Define activation energy.

Ans.

Ans: The minimum amount of energy that, in addition to the average kinetic energy, particles must have an effective collision is called the activation energy.

Q.5. What is the role of a catalyst in a chemical reaction?

Ans.

Ans. The catalyst provides a new mechanism for the reaction with low activation energy. Thus, a catalyst increases the rate of a reaction by lowering its activation energy. The catalyst does not affect the overall thermodynamics or enthalpy of the reaction. In the bodies of living organisms, enzymes catalyst chemical reactions.

Q.6. Differentiate between aerobic and anaerobic respiration.

Ans.

Ans. Aerobic respiration: Respiration that requires oxygen to break down glucose to release energy is called aerobic respiration.



Anaerobic respiration: Respiration that does not require oxygen to break down glucose to release energy is called anaerobic respiration.



SLO Based Additional Short Questions (Reference Material)

Q.7. Define Chemical energetics.

Ans. The study of energy changes in chemical reactions is called chemical energetics.

Q.8. When an energy is released or absorbed during a chemical reaction?

Ans. If the energy released in forming a bond is greater than the energy expended in breaking the bond, there is a net release of chemical energy. On the other hand, energy is absorbed when the energy expended in breaking a bond is greater than the energy released in forming the bond. Thus, during chemical reactions, energy is exchanged with the surroundings.

Q.9. Differentiate between system and environment.

Ans. System and Surroundings:

The part of the universe that we want to focus our attention on is called a system. Surroundings: The rest of the universe is called the environment.

In chemistry, a system is usually a substance that changes physically or chemically.

For example When studying the reaction of limestone and hydrochloric acid solution in a test tube, limestone and hydrochloric acid solution form a system. The test tube and everything around the test tube is the environment. Similarly, when studying the thermal decomposition of a compound, the sample of the compound would be the system. While the beaker, heat source, and everything else would be the environment.

Q.10. Define a thermochemical equation.

Ans.

Ans. A balanced chemical equation which shows heat change of a chemical reaction is called thermochemical equation.

Q.11. What is difference between ΔE and ΔH ?

Ans.

Ans. ΔE is the change in internal energy and is equal to the heat absorbed by the system at constant volume. Whereas, ΔH represents the enthalpy change (Enthalpy is equal to the internal energy E plus the product of pressure and volume i.e. $H = (E + PV)$ and it is equal to the heat of reaction at constant pressure.

Q.12. What is thermochemistry?

Ans.

Ans. The branch of chemistry which deals with the heat or thermal energy changes in chemical reactions is called thermochemistry.

Q.13. Define catalyst and catalysis.

Ans.

Ans. A substance that accelerates a chemical reaction, but remains chemically unchanged at the end of the reaction, is called a catalyst, and the phenomenon is called catalysis.

Q.14. Why is it necessary to use a catalyst?

Ans.

Ans. Many industrial reactions are carried out at high temperatures over a period of time to maximize the amount of product that can be synthesized. High temperature reactions cause safety problems and many chemicals are not stable at high temperatures. So it would be useful to use another method to increase the speed of chemical reactions. Another way to increase the reaction rate is to change this mechanism in a way that lowers the activation energy. This can be done by adding a catalyst.

Q.15. What is collision theory?

Ans.

Ans. Collision theory was proposed to explain the observed reaction kinetics. For a chemical reaction to occur, the bonding atoms or molecules must collide with each other. These collisions can be effective or ineffective depending on the energy and direction of the colliding particles. An effective collision can only occur if the energy of the colliding particles is high enough to overcome the repulsion between the electrons around



the reacting particles. The correct orientation means to form new bonds must collide with each other.

Q.16. Define standard enthalpy change.

(1 mark)

Ans. Enthalpy of reaction measured at 25°C (or 298K) and one atmospheric pressure is known as standard enthalpy change. It is denoted by ΔH° .

Q.17. Explain the term enthalpy.

(2 marks)

Ans. Enthalpy of a system may be defined as the sum of its internal energy and the product of pressure and volume.

$$H = E + PV$$

It is not possible to measure absolute value of H , but change in enthalpy

$$\Delta H = \Delta E + P\Delta V$$



UNIT
09

Chemical Equilibrium

Q.1. Coal reacts with hot steam to form CO and H_2 . These substances react further in the presence of a catalyst to give methane and water vapour.

(2 marks)



Write forward and reverse reactions for it.

Ans: Coal reacts with hot steam to form CO and H_2 . These substances react further in the presence of a catalyst to give methane and water vapours.



Forward Reaction:

The forward reaction for the above reaction is:



In this reaction, CO and H_2 are react to form CH_4 and H_2O . Initially the rate of forward reaction is fast because the concentration of CO and H_2 are maximum but with the passage of time, the rate of forward reaction slow down gradually.

Reverse Reaction:

The reverse reaction for the above reaction is:



In this reaction, the rate of reverse reaction is slow at the beginning, because the concentration of CH_4 and H_2O are less. But with the passage of time, the rate of reverse reaction speeds up gradually.

Q.2. How does temperature affect hydrated cobalt chloride and anhydrous cobalt chloride equilibrium?

(2 marks)

Ans: Hydrated cobalt (II) chloride is a pink solid. When heated, it loses water and becomes anhydrous cobalt (II) chloride, a blue solid. So the equilibrium shifts towards right. But when water is added to it, it absorbs water and the equilibrium shifts to the left to form hydrated cobalt (II) chloride again.



Think Tank

Q.3. Bromine chloride ($BrCl$) decomposes to form chlorine and bromine. Write reversible chemical reaction for this reaction.

(2 marks)

Ans. Bromine chloride decomposes to form chlorine & bromine. The reversible reaction for this is:



Multiple Choice Questions (Exercise)

Encircle the correct answer.

- | | |
|---|---|
| <p>1. Which is true about the equilibrium state?</p> <p>(a) The forward reaction stops</p> <p>(b) The reverse reaction stops</p> <p>(c) Both forward and reverse reactions stop</p> <p>(d) Both forward and reverse reactions continue at the same rate</p> | <p>2. When a mixture of and is sealed in a flask and temperature is kept at 25°C, following equilibrium is established.</p> $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$ <p>Which substance or substances will be present in the equilibrium mixture?</p> <p>(a) H_2 and I_2 (b) HI only (c) H_2 only (d) H_2, I_2 and HI</p> |
|---|---|



3. Concentration of reactants and products at equilibrium remains unchanged if: ANSWER
- (a) concentration of any reactant or product is not changed
(b) temperature of the reaction is not changed
(c) pressure or volume of the system is not changed
(d) all of the above are observed
4. Which of the following does not happen, when a system is at equilibrium state? ANSWER

SLO Based Additional MCQs

6. The characteristics of reversible reactions are the following except: ANSWER
- (a) products never recombine to form reactants
(b) they never complete
(c) they proceed in both ways
(d) they have a double arrow between reactants and products
7. When a system is at equilibrium state: ANSWER
- (a) the concentration of reactants and product becomes equal
(b) the opposing reactions (forward the reverse) stop
(c) the rate of the reverse reaction becomes very low
(d) the rate of the forward and reverse reactions become equal
8. A reverse reaction is one that: ANSWER
- (a) proceeds from left to right
(b) in which reactants react to form products
(c) slows down gradually
(d) speeds up gradually
9. Nitrogen and hydrogen were reacted together to make ammonia: ANSWER
- $$N_2 + 3H_2 \rightleftharpoons 2NH_3 \quad K_c = 1.6 \text{ mol}^{-1} \text{ dm}^3$$

- (a) forward and reverse reactions stop
(b) forward and reverse rates become equal
(c) concentration of reactants and products stop changing
(d) reaction continues to occur in both the directions
5. In an irreversible reaction equilibrium is: ANSWER
- (a) established quickly
(b) established slowly
(c) never established
(d) established when reaction stops

What will be present in the equilibrium mixture?

- (a) NH_3 only
(b) N_2 , H_2 and NH_3
(c) N_2 and H_2 only
(d) H_2 only
10. The reaction in which the products do not recombine to form reactants are called: ANSWER
- (a) irreversible reactions
(b) reversible reactions
(c) decomposition reactions
(d) addition reactions
11. The reactions in which the products can recombine to form reactants are called: ANSWER
- (a) irreversible reactions
(b) reversible reactions
(c) decomposition reactions
(d) addition reactions
12. When the rate of the forward reaction takes place at the rate of reverse reaction the composition of the reaction mixture remains constant, it is called: ANSWER
- (a) chemical equilibrium
(b) static equilibrium
(c) both (a) & (b)
(d) none of the above



13. Which type of reactions do not go to completion? ANSWER
- (a) irreversible reactions
(b) reversible reactions
(c) addition reactions
(d) decomposition reactions
14. Which type of reactions speed up gradually? ANSWER
- (a) irreversible reactions
(b) reverse reactions
(c) forward reactions
(d) decomposition reactions
15. Such reactions which continue in both directions are called: ANSWER
- (a) irreversible (b) Reversible
(c) Non-reactive (d) Dynamic
16. In a chemical reaction, the substances that combine are called: ANSWER
- (a) reactants (b) products
(c) masses (d) materials
17. The forward reaction takes place from: ANSWER
- (a) right to left (b) left to right
(c) Both a & b (d) None of the above
18. For the following reaction, equilibrium mixture will contain: ANSWER
- $$N_2O_{4(g)} \rightleftharpoons 2NO_{2(g)} \quad K_c = 0.211$$
- (a) Only N_2O_4
(b) Only NO_2
(c) NO_2 and N_2O_4 in reasonable amount
(d) NO_2 in large amount
19. Equilibrium state is achievable in: ANSWER
- (a) Closed system
(b) Open system

- (c) Both a & b
(d) None of these

20. A complete reaction is in which: ANSWER
- (a) All the reactants convert into products
(b) All the reactants do not convert into products
(c) Half reactants convert into products
(d) Only 10% reactants convert into products
21. In the beginning the rate of reverse reaction is: ANSWER
- (a) moderate (b) Negligible
(c) slow (d) very fast
22. The new substance formed in a chemical reaction is: ANSWER
- (a) reactant (b) product
(c) forward (d) reverse
23. The colour of anhydrous copper (II) sulphate solid is: ANSWER
- (a) blue (b) pink
(c) black (d) white
24. The colour of hydrated copper (II) sulphate solid is: ANSWER
- (a) blue (b) pink
(c) black (d) white
25. The colour of anhydrous cobalt (II) chloride solid is: ANSWER
- (a) blue (b) pink
(c) black (d) white
26. The colour of hydrated cobalt (II) chloride solid is: ANSWER
- (a) blue (b) pink
(c) black (d) white

Answer Key

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



Short Questions (Exercise)

Q.1. Differentiate between forward and reverse reactions.

ANSWER

Ans. Macroscopic characteristics of forward and reverse reactions:

Forward Reaction	Reverse Reaction
i) It is a reaction in which reactants react to form products.	It is reaction in which products react to produce reactants.
ii) It takes place from left to right.	It takes place from right to left.
iii) At initial stage the rate of forward reaction is very fast.	In the beginning the rate of reverse reaction is negligible.
iv) It slows down gradually.	It speeds up gradually.

Q.2. What is chemical equilibrium?

ANSWER

Ans. When the rate of the forward reaction takes place at the rate of reverse reaction, the composition of the reaction mixture remains constant; it is called a chemical equilibrium state.

Q.3. Write two chemical equations of reversible reactions.

ANSWER

Ans.



Q.4. Write down the conditions for equilibrium.

ANSWER

Ans. The following physical conditions for equilibrium is:

- The concentration of reactant or product remains unchanged.
- The temperature of the system remains constant.
- The pressure or volume of the system remains constant.

SLO Based Additional Short Questions (Reference Material)

Q.5. What is meant by complete reaction?

ANSWER

Ans. A complete reaction is a reaction in which all reactants have been converted to products.

Q.6. Define reversible reactions. Write their two characteristics.

ANSWER

Ans. "The reactions in which products react to produce reactants are called reversible reactions."

- These reactions never go to completion.
- They are represented by a double arrow ($\rightleftharpoons$) between reactants and products.

Example:



Q.7. Give the example of equilibrium from daily life.

ANSWER

Ans. When fizzy drinks are made, CO_2 is dissolved in the liquid drink under pressure and sealed. When you remove

lid of the bottle, bubbles CO_2 of suddenly appear. When you put the lid back on the bottle, the bubbles stop. This is due to the following equilibrium.



The forward reaction happens during manufacturing and the reverse reaction happens on opening.

Q.8. What are irreversible reactions? Give a few characteristics of them.

ANSWER

Ans. The reactions in which products do not recombine to form reactants are called irreversible reactions.

Characteristics:

- These reactions proceed in one direction only.
- These are represented by a single arrow ($\rightarrow$) between reactants and products.
- Reactants are completely converted into products at the end of reaction.



Q.9. Differentiate between reactants and products.

ANSWER

Ans.

Reactants	Products
In a chemical reaction, the substances that combine or decompose to form products are called reactants.	In a chemical reaction, the new substances which are formed by the combination or decomposition of reactants are called products.
e.g. $2\text{H}_2 + \text{O}_2$ (Reactants)	$\rightarrow 2\text{H}_2\text{O}$ (Product)

Q.10. What is the effect of temperature on hydrated copper (II) sulphate?

ANSWER

Ans. Procedure:

- Place 5 g of hydrated copper (II) sulphate in a test tube and heat slowly.
- Observe the colour change from blue to white.
- Allow the test tube and its contents to cool at room temperature.
- Add a few drops of water to the test tube using a dropper.
- Observe the colour change from white to blue again. When copper (II) sulphate is heated, the water in it is removed, forming anhydrous copper (II) sulphate, which is a white solid. This copper (II) sulphate changes back to the hydrated form on adding water.



Q.11. Write equation of forward reaction between hydrogen and iodine.

ANSWER

Ans. Equation of forward reaction between hydrogen and iodine is given below:



Q.12. Why do reversible reactions never complete?

ANSWER

Ans. Reversible reactions never complete because products recombine to form reactants again, that is why forward and reverse reactions keep on taking place continuously.



UNIT 10

Acids, Bases and Salts

- Q.1. Ammonium hydroxide and nitric acid react and produce ammonium nitrate and water. Write balanced chemical equation for this neutralization reaction. (10/10)

Ans. Ammonium hydroxide and nitric acid react and produce ammonium nitrate and water. This is neutralization reaction.



- Q.2. Write balanced chemical equations for the following chemical reactions. (10/10)

- Sulphuric acid + Magnesium hydroxide $\rightarrow$ Magnesium sulphate + water
- Sulphuric acid + Sodium Carbonate $\rightarrow$ Sodium sulphate + water + Carbon dioxide
- Hydrochloric acid + Magnesium $\rightarrow$ Magnesium chloride + hydrogen gas

Ans.

- $H_2SO_4 + Mg(OH)_2 \rightarrow MgSO_4 + 2H_2O$
- $H_2SO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + CO_2 + H_2O$
- $2HCl + Mg \rightarrow MgCl_2 + H_2$

- Q.3. Identify Brønsted – Lowry acids or bases in the following reactions. (10/10)

- $HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$
- $NH_3 + HNO_3 \rightarrow NH_4NO_3$

Ans.

- $HNO_3 + H_2O \rightarrow H_3O^+ + NO_3^-$

In this reaction, HNO_3 is converted to NO_3^- by donating proton. HNO_3 is an acid. While H_2O is converted to H_3O^+ by accepting proton. H_2O is a base.

- $NH_3 + HNO_3 \rightarrow NH_4NO_3$

In this reaction, NH_3 act as base by accepting proton to form NH_4^+ while HNO_3 act as acid by donating proton to form NO_3^- .

- Q.4. Give the Brønsted – Lowry definition of an acid. Write an equation that illustrates the definition. (10/10)

Ans. Definition of Brønsted – Lowry Acid:

Acid is a substance that donate proton (H^+) to other substances.

Examples:

- $HCl_{(aq)} + NH_{3(aq)} \rightleftharpoons NH_4^+_{(aq)} + Cl^-_{(aq)}$

HCl act as an acid while NH_3 act as a base.

- $HCl_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(aq)}$

HCl is dissolved in water. HCl act as an acid and H_2O as a base.

- $CH_3COOH_{(aq)} + H_2O_{(l)} \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$

CH_3COOH act as an acid while H_2O act as a base.

- Q.5. Identify Brønsted acids and Brønsted bases in the following reactions. Classify water as proton donor or proton acceptor. (10/10)

- $CH_3COOH_{(aq)} + H_2O \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$
- $HCO_3^-_{(aq)} + H_2O_{(l)} \rightleftharpoons CO_3^{2-}_{(aq)} + H_3O^+_{(aq)}$



- $NH_{3(aq)} + H_2O \rightleftharpoons NH_4^+_{(aq)} + OH^-_{(aq)}$
- $HCl_{(aq)} + HCO_3^-_{(aq)} \rightleftharpoons H_2CO_{3(aq)} + Cl^-_{(aq)}$
- $HS^-_{(aq)} + H_2O \rightleftharpoons S^{2-}_{(aq)} + H_3O^+_{(aq)}$

Ans.

- $CH_3COOH_{(aq)} + H_2O \rightleftharpoons CH_3COO^-_{(aq)} + H_3O^+_{(aq)}$

In this reaction, CH_3COOH act as an acid by donating proton. While H_2O act as a base by accepting proton.

- $HCO_3^-_{(aq)} + H_2O_{(l)} \rightleftharpoons CO_3^{2-}_{(aq)} + H_3O^+_{(aq)}$

In this reaction, HCO_3^- act as an acid by donating proton. While H_2O act as a base by accepting proton.

- $NH_{3(aq)} + H_2O \rightleftharpoons NH_4^+_{(aq)} + OH^-_{(aq)}$

In this reaction, NH_3 act as a base by accepting proton while H_2O act as an acid by donating proton.

- $HCl_{(aq)} + HCO_3^-_{(aq)} \rightleftharpoons H_2CO_{3(aq)} + Cl^-_{(aq)}$

In this reaction, HCl act as an acid by donating proton while HCO_3^- act as a base by accepting proton.

- $HS^-_{(aq)} + H_2O \rightleftharpoons S^{2-}_{(aq)} + H_3O^+_{(aq)}$

In this reaction, HS^- act as an acid by donating proton while H_2O act as a base by accepting proton.

- Q.6. Write equations showing the ionization of the following as Arrhenius acids. (10/10)

- $HI_{(aq)}$
- $HNO_{2(aq)}$

Ans.

- $HI_{(aq)} \rightleftharpoons H^+_{(aq)} + I^-_{(aq)}$

- $HNO_{2(aq)} \rightleftharpoons H^+_{(aq)} + NO_2^-_{(aq)}$

Think Tank

- Q.7. Compare the relative concentration of hydrogen ions and hydroxide ions in each kind of solution? (10/10)

Ans:

- Acidic solutions have high concentration of hydrogen ions (H^+).
- Basic solutions have high concentration of hydroxide ions (OH^-).
- Neutral solutions are free of hydrogen ion and hydroxide ion.

- Q.8. Codeine, $C_{18}H_{21}NO_3$ is a commonly prescribed pain killer. It dissolves in water by the following reaction? (10/10)



Differentiate Codeine and water as Brønsted – Lowry acid or base.

Ans. $C_{18}H_{21}NO_3 + H_2O \rightleftharpoons [C_{18}H_{21}HNO_3]^+ + OH^-$

In this reaction, codeine ($C_{18}H_{21}NO_3$) act as a base by accepting a proton while H_2O act as an acid by donating proton.

- Q.9. Examine some ways in which you might determine whether a particular water solution contains an acid or a base. (10/10)

Ans.

- If a particular water solution contain high concentration of hydrogen ion then it will be an acid.



- If a particular water solution contain high concentration of hydroxide ion then it will be a base.

Concept Assessment 10.1

Q.10. Identify Brønsted acids and Brønsted bases in the following reactions.

- $H_2SO_4 + H_2O \rightleftharpoons HSO_4^- + H_3O^+$
- $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$
- $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$

Ans.

- $H_2SO_4 + H_2O \rightleftharpoons HSO_4^- + H_3O^+$

In this reaction, H_2SO_4 act as an acid by donating proton while H_2O act as a base by accepting a proton.

- $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$

In this reaction, CH_3COOH act as an acid by donating proton while H_2O act as a base by accepting proton.

- $H_2S + NH_3 \rightleftharpoons NH_4^+ + HS^-$

In this reaction, H_2S act as an acid by donating proton while NH_3 act as a base by accepting a proton.

Multiple Choice Question (Exercise)

Encircle the correct answer.

- Which of the following cannot be classified as Arrhenius acid?
 - HNO_3
 - H_2CO_3
 - CO_2
 - H_2SO_4

- Which of the following is Brønsted base?
 - NH_3
 - HCl
 - CH_3COOH
 - H_3O^+

- Milk of magnesia contains $Mg(OH)_2$. It is used as antacid. It neutralizes excess stomach acid. Which salt is formed in this reaction?
 - $MgSO_4$
 - $MgCO_3$

- $MgCl_2$
- MgO

- Ammonia is a base, because it
 - ionizes in water to give OH^- ions.
 - Contains OH group
 - Can accept an electron pair
 - Can accept proton

- Consider the following reaction?

$$H_2O + HCl \rightleftharpoons H_3O^+ + Cl^-$$

Which species is an electron proton acceptor in this reaction?

- H_2O
- HCl
- H_3O^+
- none

SLO Based Additional MCQs

- A base is a substance which neutralizes an acid. Which of these substances is not a base?
 - aqueous ammonia
 - sodium chloride
 - sodium carbonate
 - calcium oxide

- Acetic acid is used for:
 - flavouring food

- making explosives
- etching designs
- cleaning metals

- A reaction between an acid and a base produces:
 - salt and water
 - salt and gas
 - salt and an acid
 - salt and a base



- Acidus means:
 - sour
 - bitter
 - sweet
 - salty

- Which acid is present in our stomach?
 - nitric acid
 - hydrochloric acid
 - sulphuric acid
 - all of the above

- All acids turn blue litmus:
 - red
 - colourless
 - pink
 - white

- All bases turn red litmus:
 - colourless
 - blue
 - pink
 - white

- According to Arrhenius concept acid is a substance which dissociates in aqueous solution to give:
 - hydrogen ions
 - hydroxide ions
 - protons
 - pair of electrons

- According to Arrhenius concept base is a substance which dissociates in aqueous solution to give:
 - hydrogen ions
 - hydroxide ions
 - protons
 - pair of electrons

- Which one is not an Arrhenius acid?
 - HCl
 - H_2SO_4
 - CO_2
 - HNO_3

- Which one is not an Arrhenius base?
 - $NaOH$
 - KOH
 - $Ca(OH)_2$
 - NH_3

- According to Brønsted and Lowry concept, an acid is a substance that can donate:
 - proton
 - Electron pair
 - Neutron
 - Electron

- A substance which can behave as an acid as well as a base is called:
 - acid
 - base
 - amphoteric species
 - neutral species

- When acids react with metals, which gas evolved?
 - H_2
 - O_2
 - Cl_2
 - N_2

- When acids react with carbonates and bicarbonates, which gas is:
 - H_2
 - CO_2
 - Cl_2
 - N_2

- Alkalies react with ammonium salts to liberate:
 - SO_2
 - CO_2
 - NH_3
 - H_2

- Which is used to manufacture soap?
 - $NaOH$
 - $Ca(OH)_2$
 - NH_4OH
 - $Mg(OH)_2$

Answer Key

1	c	2	a	3	c	4	d	5	a
6	b	7	a	8	a	9	a	10	b
11	a	12	b	13	a	14	b	15	c
16	d	17	a	18	c	19	a	20	b
21	c	22	a						

Short Questions (Exercise)

- Write the equation for the self-ionization of water.

Ans. Pure water is a weak electrolyte. It ionizes to small extent and produce less ions by the process called self-ionization.



- Define and give examples of Arrhenius acids.

Ans. According to Arrhenius concept, acid is a substance which dissociates in aqueous solution to give hydrogen ions. For example, ' HCl ' is an acid because it



ionize in aqueous solution to provide H^+ ions.



Q.3. Why HCl acts as a strong acid?

ANSWER

Ans. HCl ionises completely in aqueous solution that's why, HCl act as a strong acid.



Q.4. Why NH_3 acts as Brønsted-Lowry base?

ANSWER

Ans. Ammonia (NH_3) act as a base in water. Ammonia is a gas at room

temperature when it is dissolved in water, it can accept proton (H^+) from water and form ammonium (NH_4^+) radical.



Q.5. Why ammonia acts as a weak base?

ANSWER

Ans. Ammonia (NH_3) ionize to a little extent and produce fewer OH^- ions in aqueous solution. That's why, NH_3 act as a weak base.



SLO Based Additional Short Questions (Reference Material)

Q.6. Give some uses of acids in our daily life.

ANSWER

Ans. Vinegar, aspirin, lemon juice, cola drinks, apple, tomato and toilet cleaners contain acids.

Q.7. Give some uses of bases in our daily life.

ANSWER

Ans. Substances containing bases such as drain cleaner, antacid tablets, baking powder, soda, etc.

Q.8. Write down characteristic properties of Acids.

ANSWER

Ans. Characteristic properties of acids:

- Acids have sour taste. For example orange citrus fruits or lemon juice.
- They turn blue litmus red.
- They are corrosive in concentrated form.
- Their aqueous solutions conduct electric current.

Q.9. Write down characteristic properties of Bases.

ANSWER

Ans. Characteristic properties of bases:

- Bases have bitter taste and feel slippery. For example soap is slippery to touch.
- They turn red litmus blue.
- They are non-corrosive except concentrated forms of $NaOH$ and KOH .

iv. Their aqueous solutions conduct electric current.

Q.10. Define Arrhenius acid. Give an example.

ANSWER

Ans. According to Arrhenius concept, acid is a substance which dissociates in aqueous solution to give hydrogen ions. For example, 'HCl' is an acid because it ionizes in aqueous solution to provide H^+ ions.



Q.11. Define Arrhenius base. Give an example.

ANSWER

Ans. According to Arrhenius concept, base is a substance which dissociates in aqueous solution to give hydroxide ions. For example the substance ' $NaOH$ ' is a base because it ionizes in aqueous solution to provide OH^- ions.



Q.12. Write down uses of hydrochloric acid.

ANSWER

Ans. Uses of hydrochloric acid (HCl):
Cleaning of metals, bricks and removing scale from boilers.

Q.13. Write down uses of Nitric acid.

ANSWER

Ans. Uses of Nitric acid (HNO_3):

Manufacture of fertilizers, explosive.

Q.14. Write down uses of Sulphuric acid.

ANSWER

Ans. Uses of Sulphuric acid (H_2SO_4):
Manufacture of many chemicals, drugs, dyes, paints and explosives.

Q.15. Write down uses of phosphoric acid.

ANSWER

Ans. Uses of Phosphoric acid (H_3PO_4):
Manufacture of fertilizers, soaps, polishes and detergents.

Q.16. Write down the uses of sodium hydroxide.

ANSWER

Ans. Uses of sodium hydroxide ($NaOH$):
Soap making, drain cleaners.

Q.17. Write down uses of potassium hydroxide.

ANSWER

Ans. Uses of potassium hydroxide (KOH):

Making liquid soap, shaving cream.

Q.18. Write down uses of calcium hydroxide.

ANSWER

Ans. Uses of Calcium hydroxide $Ca(OH)_2$:

Making mortar, plaster, cement.

Q.19. Write down uses of magnesium hydroxide.

ANSWER

Ans. Uses of magnesium hydroxide $Mg(OH)_2$:

Antacid, laxative.

Q.20. Write down limitations of Arrhenius Concept.

ANSWER

Ans. Limitations of Arrhenius

concept:

- This concept is applicable only in aqueous medium and does not explain nature of acids and bases in non-aqueous medium.
- According to this concept, acids and bases are only those compounds which contain hydrogen (H^+) and hydroxyl (OH^-) ions, respectively. It cannot explain the nature of compounds like CO_2 , NH_3 , etc., which are acid and base respectively.



Q.21. Define Brønsted-Lowry acid and base.

ANSWER

Ans. Brønsted-Lowry acid:

An acid is substance (molecule or ion) that can donate a proton (H^+) to another substance. e.g. HCl and CH_3COOH .

Brønsted-Lowry Base:

A base is a substance that can accept a proton (H^+) from another substance. e.g. H_2O and NH_3 .

Q.22. Define strong acid. Give examples.

ANSWER

Ans. An acid that ionizes completely in aqueous solution is called a strong acid. For example, HCl , HNO_3 , H_2SO_4 , etc are strong acids. They ionize 100% in aqueous solution. All the molecules of strong acids ionize in water.



Q.23. Define weak acid. Give examples.

ANSWER

Ans. Acids that do not ionize completely in aqueous solution are called weak acids. Fewer molecules of weak acids ionize in water. For example, ethanoic acid (acetic acid) which is found in vinegar ionizes only up to 3% in water. So, ethanoic acid is a weak acid.



Q.24. Define strong base. Give examples.

ANSWER

Ans. A base that ionizes completely or 100% in aqueous solution is termed as strong base. For example, $NaOH$, KOH , $Ca(OH)_2$ etc are strong bases.



Q.25. Define weak base. Give example.

ANSWER

Ans. A base that ionizes to a little extent is called a weak base. Such bases produce few OH^- ions in aqueous solution. $Al(OH)_3$, NH_3 etc are weak bases.





Q.26. Define alkali.

ANSWER

Ans. A base which is soluble in water is called an alkali. This means that all the bases are not alkalis. On the other hand all the alkalis are bases.

Many bases do not dissolve in water. For example, copper hydroxide $\text{Cu}(\text{OH})_2$, aluminium hydroxide $\text{Al}(\text{OH})_3$ and ferric hydroxide $\text{Fe}(\text{OH})_3$. All hydroxides are bases and only water soluble bases are alkalis. Many household items such as soaps, detergents, shampoos, toilet papers contain alkali.

Q.27. Define neutralization reaction.

ANSWER

Ans. Acids combine with bases to produce salt and water. This reaction is called as neutralization reaction. For example hydrochloric acid neutralizes sodium hydroxide to form sodium chloride and water. Similarly sulphuric acid combines with potassium hydroxide to produce potassium sulphate and water. Neutralization reaction can be represented by the following general reaction.



Q.28. Why normal rain water is weakly acidic?

ANSWER

Ans. Normal rain is slightly acidic due to dissolved carbon dioxide.

Q.29. Define acid rain. What are its effects?

ANSWER

Ans. As a result of human activity, many oxides enter the atmosphere, which makes rainwater more acidic, which falls as acid rain. Acid rain contains dissolved nitric and sulphuric acid. Due to the corrosive nature of acids, acid rain can damage structures, buildings, and statues containing metals and metal carbonates.

Q.30. How metallic oxides are formed?

EXAMPLE

Ans. Metallic oxides are the compounds formed by the reaction of metals with oxygen. For example, sodium reacts with oxygen to produce sodium oxide (Na_2O). Similarly magnesium on ignition in air burns producing magnesium oxide (MgO).



Q.31. How metallic oxides are converted into hydroxides?

EXAMPLE

Ans. When metal oxides dissolve in water, resulting in metal cations and oxide ions in aqueous solution. Because oxide ions are unstable in water, they immediately accept protons from water molecules and become hydroxide ions, and the water molecules also become hydroxide ions.



Q.32. Define amphoteric substances. Give examples.

EXAMPLE

Ans. Most metal oxides and hydroxides are very basic in nature. They show the characteristic properties of bases. However, some metal oxides and hydroxides do not dissolve in water but behave in chemical reactions like both acids and bases. Such metal oxides and hydroxides are called amphoteric oxides and hydroxides, respectively. For example, aluminium oxide (Al_2O_3), aluminium hydroxide, $\text{Al}(\text{OH})_3$, zinc oxide (ZnO) and zinc hydroxide $\text{Zn}(\text{OH})_2$, etc.

UNIT
11

Environmental Chemistry – Air

Q.1. Describe sources of air pollutants.

EXAMPLE

Ans. Sources of Air Pollutants:

Air that contains harmful particles and gases is said to be polluted. Some air pollution occurs naturally. But many types of air pollution are the result of human activities.

Natural Sources

Many natural processes such as forest fires, dust storms release smoke, and dust particles into the air. Volcanoes emit clouds of dust and poisonous gases along with ash. Termites and cows also release large amount of methane in the air. Considerable electrical discharges in the atmosphere produce nitrogen oxides.

Human Activities

Most of the air pollution is the result of burning fossil fuels such as coal, petroleum, and natural gas. Nearly half of the air pollution comes from cars and other motor vehicles. Factories and power plants that burn coal or oil release poisonous gases in the air. Burning of fossil fuels and incineration release carbon monoxide (CO), nitrogen oxides (NO , NO_2), and sulphur oxides (SO_2 , SO_3).



Q.2. Describe acid rain and its effects.

ANSWER

Ans. Formation of Acid Rain:

Normal rain water is saturated with carbon dioxide. It has a pH of 5.6. However, the acidity of rain increases during thunderstorms in polluted areas. Fossil fuels contain compounds of sulphur and nitrogen. Sulphur dioxide from fossil fuels used in power plants and nitrogen oxides from car exhausts dissolve in rain water, creating acids such as sulphuric acid, nitrous acid, and nitric acid. Nitrogen dioxide also play a significant role in the catalytic oxidation of sulphur dioxide into sulphur trioxide which forms sulphuric acid in the atmosphere. These reactions are key contributors to the acidity of rain water.



Therefore, the pH of rain water can be much lower due to sulphuric acid and nitric acid from precipitation during thunderstorm. The pH of this rain can be as low as 2.1. This value is lower than the pH of vinegar or lemon juice.

Definition of Acid Rain:

Acid rain is defined as rain having pH less than 5.6. Acid rain can often fall hundreds of kilometres from its source.

Effects of Acid Rain:

Acid rain corrodes metals, stone structures and statues. Sulphuric acid eats metals and forms water-soluble salts and hydrogen.



Marble buildings and statues are disintegrated by acid rain.





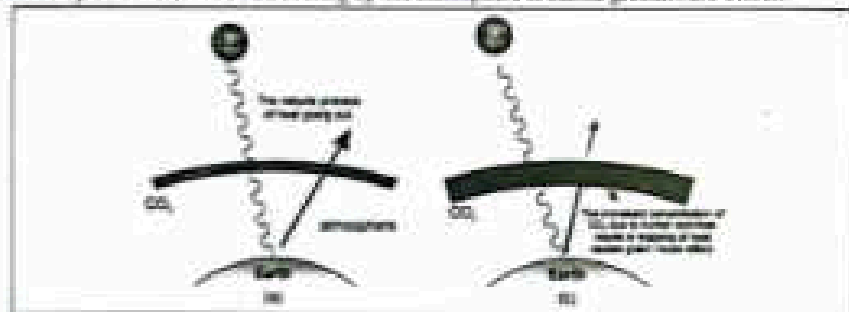
Acid rain also kills fish, and destroys trees. Lakes and river may become too acidic for living things to survive.

Q.3. Describe global warming.

ANSWER

Ans. The increasing use of fossil fuels and deforestation have led to an increase the level of CO_2 in air. Gases like water vapour, methane and CO_2 are called green house gases and they are responsible for global warming.

Green House Effect: CO_2 forms a layer around earth, that absorbs the infrared radiations emitted by earth surface. Thus, heating up the atmosphere is called greenhouse effect.

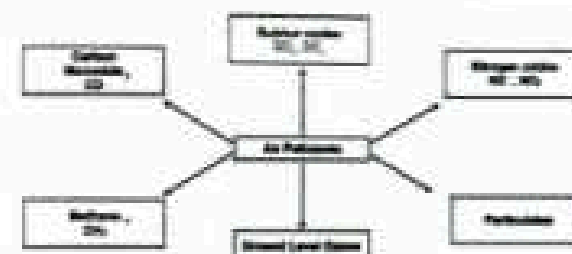


CO_2 is not a poisonous gas, but its increasing concentration due to burning of fossil fuels in different human activities is alarming. Because CO_2 in the atmosphere acts like a glass wall of a green house. It allows UV radiations to pass through it but does not allow the IR radiations to pass through it. It traps some of the infrared radiations emitted by the Earth. Hence, increased concentration of CO_2 layer absorbs the infrared radiations emitted by the Earth's surface that prevents heat energy escaping from the atmosphere. It helps to stop surface from cooling down during night. As the concentration of CO_2 in air increases, less heat energy is lost from the surface of the Earth. Therefore, the average temperature of the surface gradually increases. This is called **greenhouse effect** as shown in figure. This effect is proportional to amount of CO_2 in air. Greater is amount of CO_2 , more is trapping of heat or warming. Due to increased warming this phenomenon is also called **global warming**.

Q.4. What is ground level ozone? Explain.

ANSWER

Ans. Ground Level Ozone: Ground-level ozone is often called smog. It is secondary pollutant produced by complex reactions between nitrogen oxides and volatile organic compounds (VOC) under the influence of sunlight. These reactions occur mainly in industrial and urban areas where emissions from industrial units and car engines are common. In sunlight, a series of chemical reactions occur between volatile organic compounds and nitrogen oxides. These reactions are called photochemical reactions. Sunlight breaks nitrogen dioxide into nitrogen monoxide and atomic oxygen. Atomic oxygen (O) then reacts with oxygen molecules (O_2) to form ozone (O_3). This ozone can irritate the respiratory organs and cause asthma and other respiratory problems. It can also damage vegetation, reduce yield and damage forests.



Q.5. Why global warming often is referred to as the green house effect? Justify your answer.

ANSWER

Ans. Global warming is often called the green house effect because it is similar to how a greenhouse works.

Just like a greenhouse traps heat from the sun to keep the inside warm, certain gases in the earth's atmosphere trap heat from the sun, causing the atmosphere to warm up. This trapped heat leads to rising global temperatures, hence the term "Greenhouse effect". It is like Earth is wrapped in a blanket of gases that hold in heat, similar to how a greenhouse keeps warm inside. The greenhouse effect is natural process but human activities like burning fossil fuels have intensified it, leading to global warming.

Q.6. Sulphur dioxide is a common pollutant from burning coal. State two effects caused by this pollutant.

ANSWER

Ans. Sulphur is found naturally in fossil fuels. The burning of fossil fuels in power plants, vehicles, industrial units, power generators and residential heating systems, therefore release significant amounts of sulphur dioxide.

Sulphur dioxide is readily absorbed in the respiratory system. Being powerful irritant, it aggravates the symptoms of people who suffer from asthma, bronchitis, emphysema, and other lung diseases. Sulphur dioxide also responsible for acid rain and haze.

Think Tank

Q.7. Dibenzothiophene ($\text{C}_{12}\text{H}_8\text{S}$) is a common Sulphur containing compound of coal. It is responsible for acid rain. Elaborate this statement.

ANSWER

Ans. Dibenzothiophene is a sulphur containing compound found in coal. When coal is burned, dibenzothiophene releases sulphur dioxide reacts with water vapour in the air to form Sulphuric acid, a major component of acid rain.



This acid rain can harm the environment by damaging forests, aquatic life and buildings. So, dibenzothiophene in coal plays a role in the formation of acid rain.

Q.8. There is dire need to remove Sulphur from coal before it is burned. Give reason.

ANSWER

Ans. Removing sulphur from coal before burning is crucial because when coal containing sulphur is burned, it releases sulphur dioxide into the air. This sulphur dioxide contributes to the formation of acid rain which can have harmful effects on the environment, ecosystems, and human health. By reducing the sulphur content in coal before combustion, we can significantly decrease the emission of sulphur dioxide and mitigate the negative impacts of acid rain.

It is essential for environmental protection and human well-being to remove sulphur from coal before it is burned.



Q.9. Examine the option there are some ways to reduce pollution caused by cars? minimise

Ans. There are indeed several ways to reduce pollution caused by cars.

- One effective method is to promote the use of electric vehicles which produce zero pollution.
- Other effective method is to improve public transportation systems to encourage people to use buses, trains instead of driving individual cars.
- Additionally, implementing strict emission standards for vehicles and promoting the use of alternative fuels like biofuels can also help to reduce pollution from cars.

Q.10. Certain human activities are responsible for a significant increase in greenhouse effect, argue. minimise

Ans. Human activities that contribute to greenhouse effect include:

- Burning of fossil fuels such as coal, petroleum and natural gas for energy production.
 - Transportation
 - Industrial processes
 - Deforestation which reduce the number of trees that can absorb carbon dioxide.
- All of these factors are responsible for a significant increase in greenhouse effect.

Q.11. As a global citizen, how can you play a part to reduce air pollution at a personal level? minimise

Ans. As a global citizen, you can reduce air pollution at a personal level by using:

- Public transportation
- Planting trees
- Supporting clean energy initiatives
- Properly disposing of waste
- Biking or walking instead of driving alone
- Reduce energy consumption by using energy-efficient appliances
- Turning off lights when not in use
- Reducing heating and cooling usage. By adopting these habits, you can also help to reduce air pollution.

Concept Assessment 11.1

Q.12. What two gases make up most of air? minimise

Ans. Nitrogen (78.09%) and oxygen (20.94%) make up the 99% volume of the atmosphere.

Concept Assessment 11.2

Q.13. I. What are pollutants? minimise

II. List some effects of Sulphur dioxide on human beings.

III. List some of the air pollutants.

Ans. I. These harmful substances that can pollute air, water and soil are called pollutants.

II. SO_2 is colourless gas. It has irritating smell. It causes suffocation, irritation and severe respiratory problems to asthmatic people.

III. Some air pollutants are as:

Sulphur dioxide (SO_2).	Sulphur trioxide (SO_3)
Carbon Monoxide (CO).	Carbon Dioxide (CO_2)
Ammonia (NH_3).	Methane (CH_4)
Nitric oxide (NO).	Nitrogen dioxide (NO_2)



Concept Assessment 11.3

Q.14. I. Write the names of main pollutants in the air. minimise

2. Complete the following reactions.



Ans. I. Some air pollutants are as:

Sulphur dioxide (SO_2).	Sulphur trioxide (SO_3)
Carbon Monoxide (CO).	Carbon Dioxide (CO_2)
Ammonia (NH_3).	Methane (CH_4)
Nitric oxide (NO).	Nitrogen dioxide (NO_2)



Concept Assessment 11.4

Q.15. I. Write three human activities that are responsible for air pollution. minimise

II. Write three natural processes that are contributing in air pollution.

III. List main sources of the following air pollutants.

(a) SO_2 (b) CO (c) NO_2

Ans. I. Three human activities that are responsible for air pollution are:

- a) Burning of fossil fuel in automobile.
- b) Burning of fossil fuel in thermal power station.
- c) Forest fire/ Deforestation.

II. Three natural processes that are responsible for air pollution are:

- a) Volcanic Eruption
- b) Bacterial decay of organic matter
- c) Forest fire

III. a) Sulphur is found naturally in fossil fuels. The burning of fossil fuels in power plants, vehicles, industrial units, power generators and residential heating systems, therefore releases significant amounts of sulphur dioxide.

b) Incomplete combustion, occurs when there is not enough oxygen in the combustion process. It is a major source of carbon monoxide and particulate matter. It is mainly emitted by vehicles, industrial processes and residential heating systems that use fossil fuels and wood. Particulate matter refers to a mixture of fine particles suspended in the air, including soot, smoke, dust and other solid or liquid substances.

c) The biggest source of nitrogen oxides is the burning of fossil fuels in vehicles, power plants, industrial units, and generators used to produce electricity.



Concept Assessment 11.5

Q.16. i. Define global warming.

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ii. List some effects of global warming.

iii. List some substances that are responsible for global warming.

iv. Establish the link between greenhouse effect and global warming.

Ans.

i. Global warming is rising of temperature because of trapping of heat energy by carbon dioxide gas in the atmosphere.

ii. Effects of Global Warming:

- Increase in atmospheric temperature: Accumulation of carbon dioxide in air is resulting in increasing atmospheric temperature about 0.05°C every year.
- Changes in weather patterns: It is causing major changes in weather patterns. Extreme weather events are occurring more commonly and intensely than previously.
- Increasing of flood risks: It melts glaciers and snow caps that are increasing flood risks and intense tropical cyclones.
- Rising of Sea-Level: Sea-level is rising due to which low lying areas are liable to be submerged, turning previously populated areas no longer habitable.

iii. Human activities that contribute to greenhouse effect include:

- Burning of fossil fuels such as coal, petroleum and natural gas for energy production.
- Transportation
- Industrial processes
- Deforestation which reduce the no. of trees that can absorb carbon dioxide.

All of these factors are responsible for a significant increase in greenhouse effect.

iv. The greenhouse effect is closely link to global warming. Greenhouse gases such as CO_2 , CH_4 , H_2O vapours trap heat in the earth's atmosphere. When these gases accumulate in the atmosphere, they prevent some of the heat from escaping back into atmosphere, similar to how a greenhouse traps heat. This trapped heat leads to an increase in Earth's average temperature causing global warming.

Concept Assessment 11.6

Q.17. i. Define acid rain.

09/01/19

ii. Write names of gases that cause acid rain.

iii. What is the effect of acid rain on iron and marble? Give balanced chemical equation.

iv. List some effects caused by acid rain.

v. Justify that acid rain is dangerous than normal rain.

Ans. i. Acid rain means presence of excessive acids in rain water. This rain is produced when normal rain water dissolves oxides of sulphur and nitrogen in air. Rain water converts SO_2 into H_2SO_4 and NO_x to HNO_2 and HNO_3 . These acids reduce the pH of rain water upto 4. Thus acid rain is formed on dissolving acidic air pollutants such as SO_2 and NO_x in rain water.

ii. The gases which are responsible for acid rain:

- Sulphur dioxide (SO_2)



• Sulphur trioxide (SO_3)

• Carbon dioxide (CO_2)

• Nitric oxide (NO)

• Nitrogen dioxide (NO_2)

iii. Acid rain corrodes metal, sulphuric acid and form water soluble salts and hydrogen.



Marble buildings are disintegrated by acid rain.



iv. Effects of Acid Rain:

Acid rain corrodes metals, stone structures and statues. Sulphuric acid eats metals and forms water-soluble salts and hydrogen.



Marble buildings and statues are disintegrated by acid rain.



Acid rain also kills fish, and destroys trees. Lakes and river may become too acidic for living things to survive.

v. Acid rain is more dangerous than normal rain. Because it contains pollutants like Sulphur dioxide and nitrogen oxides. When these pollutants mix with water vapours in the atmosphere, they form sulphuric acid and nitric acid, which fall to the ground as acid rain.

Multiple Choice Questions (Exercise)

1. Which gas has the highest percentage in the air?

09/01/19

- (a) O_2 (b) CO_2
(c) N_2 (d) O_3

2. Which is / are responsible for acid rain?

09/01/19

- (a) SO_2
(b) NO_2
(c) Both NO_2 and SO_2
(d) O_3

3. Which is reddish brown gas?

09/01/19

- (a) NO (b) NO_2
(c) SO_2 (d) O_3

4. Most air pollution is caused by:

09/01/19

- (a) Ozone
(b) Acid rain
(c) Carbon monoxide
(d) The burning of fossil fuels

SLO Based Additional MCQs

5. A group of gases that maintains temperature of atmosphere is:

09/01/19

- (a) carbon dioxide and water vapours
(b) nitrogen and carbon dioxide
(c) oxygen and water vapours

(d) nitrogen and oxygen

6. The Earth's atmosphere is getting hotter because of:

09/01/19

- (a) increasing concentration of CO
(b) increasing concentration of CO_2



- (c) increasing concentration of O_3
(d) increasing concentration of SO_2
7. Which one of the following is not a greenhouse effect? ANSWER
(a) increasing atmospheric temperature
(b) increasing food chains
(c) increasing flood risks
(d) increasing sea-level
8. Normally rain water is weakly acidic because of: ANSWER
(a) SO_2 gas (b) CO_2 gas
(c) SO_2 gas (d) NO_2 gas
9. Buildings are being damaged by acid rain because it attacks: ANSWER
(a) calcium sulphate
(b) calcium nitrate
(c) calcium carbonate
(d) calcium oxalate
10. Acid rain affects the aquatic life by clogging fish gills because of: ANSWER
(a) lead metal
(b) chromium metal
(c) mercury metal
(d) aluminium metal
11. Which one of the following is not an air pollutant? ANSWER
(a) Nitrogen
(b) carbon monoxide
(c) nitrogen dioxide
(d) ozone
12. Iron and steel structures are damaged by: ANSWER
(a) carbon monoxide
(b) sulphur dioxide
(c) methane
(d) carbon dioxide
13. Global warming causes rising of the sea level. The cause of global warming is: ANSWER
(a) CO_2 gas (b) SO_2 gas
(c) NO_2 gases (d) O_3 gas
14. Which one of these pollutants are not found in car exhaust fumes? ANSWER
(a) CO (b) O_3
(c) NO_2 (d) SO_2

15. Global warming is because of: ANSWER

- (a) Absorption of infrared radiations emitted by Earth's surface
(b) Absorption of infrared radiations coming from the sun
(c) Absorption of ultraviolet radiations coming from the sun
(d) Emission of ultraviolet radiations from the Earth's surface
16. Carbon monoxide is harmful to us because: ANSWER
(a) it paralyzes the lungs
(b) it damages lungs tissues
(c) it reduces oxygen carrying ability of haemoglobin
(d) it makes the blood coagulate
17. The envelope of different gases around the Earth is called: ANSWER
(a) atmosphere (b) biosphere
(c) lithosphere (d) hydrosphere
18. The percentage by volume of nitrogen in dry air is: ANSWER
(a) 78.09% (b) 20.94%
(c) 0.93% (d) 0.03%
19. Which gas is responsible for warming the atmosphere? ANSWER
(a) nitrogen (b) hydrogen
(c) helium (d) carbon dioxide
20. The percentage of SO_2 released by the combustion of coal and petroleum products is: ANSWER
(a) 40% (b) 60%
(c) 70% (d) 80%
21. Which is not a characteristic of SO_2 ? ANSWER
(a) it is colourless gas
(b) it has irritating smell
(c) it causes suffocation
(d) it does not form sulphuric acid
22. Which gas is produced by the electrical lightning in air? ANSWER
(a) NO (b) SO_2
(c) SO_3 (d) CO_2
23. Which of the following can be used as a fuel? ANSWER
(a) methanol (b) ethanol
(c) bio-diesel (d) all of these



24. The pH of normal rain water is: ANSWER
(a) 4 – 6 (b) 5.6 – 6
(c) 6 – 7 (d) 7 – 8
25. The pH of acid rain is: ANSWER
(a) 2 (b) 3
(c) 4 (d) 5
26. Which is not an air pollutant? ANSWER
(a) CO_2 (b) SO_2
(c) CO (d) NH_3
27. The gas used by plants to perform photosynthesis is: ANSWER
(a) O_2 (b) CO_2
(c) N_2 (d) CO
28. The gas used by animals to perform respiration is: ANSWER
(a) O_2 (b) N_2
(c) SO_2 (d) Cl_2
29. Which is not a poisonous gas? ANSWER
(a) ozone
(b) carbon monoxide
(c) carbon dioxide
(d) all of these
30. Which gas in atmosphere acts as a glass wall of a green house? ANSWER
(a) oxygen (b) carbon dioxide
(c) Sulphur dioxide (d) hydrogen
31. Increased concentration of CO_2 in air, results: ANSWER
(a) decreases in temperature
(b) increase in temperature
(c) temperature remains the same
(d) none of the above
32. The green house effect is proportional to the amount of which gas in air? ANSWER
(a) CO_2 (b) O_2
(c) N_2 (d) SO_2
33. Which is the major effect of global warming? ANSWER
(a) increase in temperature
(b) rise in sea level
(c) melting of glaciers
(d) all of the above
34. Higher concentration of CO causes: ANSWER
(a) fatigue
(b) headache
(c) breathing difficulties
(d) all of the above
35. Catalytic converters convert: ANSWER
(a) CO to CO_2 (b) N_2 to NO
(c) CO_2 to CO (d) N_2 to NO_2
36. Which gas is also known as life gas for plants? ANSWER
(a) CO (b) O_2
(c) CO_2 (d) NO_2
37. In the bacterial decay, the compounds of which element are emitted? ANSWER
(a) Sulphur (b) phosphorus
(c) iodine (d) all of the above
38. A pollutant is a waste material that pollutes: ANSWER
(a) air (b) water
(c) soil (d) all of these
39. Which factor determines the severity of a pollutant? ANSWER
(a) chemical nature
(b) concentration
(c) persistence
(d) all of the above
40. Which type of pollutants are responsible for changing weather? ANSWER
(a) air pollutants (b) water pollutants
(c) soil pollutants (d) all of the above
41. Which of the following is a poisonous gas? ANSWER
(a) oxygen (b) ozone
(c) nitrogen (d) carbon dioxide
42. 99% of atmosphere consists of: ANSWER
(a) N_2 and H_2 (b) N_2 and O_2
(c) N_2 and CO_2 (d) O_2 and CO_2
43. Which gas is emitted due to volcanic eruption? ANSWER
(a) CO_2 (b) SO_2
(c) H_2 (d) Both a & b
44. Fossil fuel means: ANSWER
(a) coal (b) petroleum
(c) natural gas (d) all of these



45. Forest fires and burning of wood emit: medium

- (a) CO_2 (b) O_2
(c) N_2 (d) Cl_2

46. Incinerator reduces solid waste into: medium

- (a) ash (b) flue gas
(c) heat (d) all of these

47. Which is not a part of flue gas? medium

- (a) fumes (b) dioxins
(c) HCl (d) H_2SO_4

48. % age of oxygen gas by volume in dry air is: medium

- (a) 90% (b) 20.94%
(c) 50.94% (d) 40%

Answer Key

1	c	2	c	3	b	4	d	5	a
6	b	7	b	8	b	9	c	10	d
11	a	12	b	13	a	14	b	15	a
16	c	17	a	18	a	19	d	20	d
21	d	22	a	23	d	24	b	25	c
26	a	27	b	28	a	29	c	30	b
31	b	32	a	33	d	34	d	35	a
36	c	37	a	38	d	39	d	40	a
41	b	42	b	43	d	44	d	45	a
46	d	47	d	48	b				

Short Questions (Exercise)

Q.1. List two main sources of acid rain. medium

Ans. The acidity of rain increases during thunderstorms in polluted areas. Fossil fuels contain compounds of Sulphur and nitrogen. Sulphur dioxide from fossil fuels used in power plants and nitrogen oxides from car exhausts dissolve in rainwater, creating acids, such as sulphuric acid, nitrous acid, and nitric acid. These acids make the rain water acidic.

Q.2. List four human activities which contribute to air pollution. medium

Ans. Most of the air pollution is the result of burning fossil fuels, such as coal, petroleum, and natural gas. Nearly

half of the air pollution comes from cars and other motor vehicles. Factories and power plants that burn coal or oil release poisonous gases in the air.

Q.3. What is the importance of catalytic converters? medium

Ans. Catalysts are installed in the exhaust system of cars. They contain catalysts that facilitate chemical reactions that convert nitrogen oxides into less harmful substances. The catalyst transforms CO to CO_2 , NO to N_2 and O_2 , and unburnt hydrocarbons to CO_2 and H_2O . Metals such as platinum, palladium and rhodium are used as catalysts in the transformer.



Q.4. What is the role of automobile in air pollution? medium

Ans. Car engines produce a lot of nitrogen oxides. Oxides of nitrogen are highly toxic and are responsible for acid rain, photochemical smog, headache, and respiratory problems.

Q.5. Define global warming. medium

Ans. Global warming is rising of temperature because of trapping of heat energy by carbon dioxide gas in the atmosphere.

SEO Based Additional Short Questions (Reference Material)

Q.6. What do you mean by atmosphere? medium

Ans. Atmosphere is the envelope of different gases around the Earth.

Q.7. What is the difference between atmosphere and environment? medium

Ans. Atmosphere: Atmosphere is the envelope of different gases around the Earth.

Environment: Environment is the sum of all social, biological, physical and chemical factors which constitutes the surroundings of living things.

Q.8. Write composition of dry air. medium

Ans. Composition of dry air

Gas	% by Volume
Nitrogen	78.09
Oxygen	20.94
Argon	0.93
Carbon dioxide	0.03

Q.9. What are pollutants? Which factors determine the severity of a pollutant? medium

Ans. A pollutant is a waste material that pollutes air, water or soil. Three factors determine the severity of a pollutant.

- (i) Its chemical nature
(ii) Concentration
(iii) Persistence

Q.10. What is the difference between a pollutant and contaminant? medium

Ans. Pollutants are those substances which cause pollution while contaminants are those substances that make something impure.

Q.11. How are sulphur containing compounds emitted naturally? medium

Ans. Naturally sulphur compounds are emitted in bacterial decay of organic matter, in volcanic gases and forest fires.

Q.12. How is the temperature of atmosphere maintained? medium

Ans. CO_2 and water vapours maintain temperature of atmosphere. These gases absorb much of infrared radiations coming from Earth surface and warm the atmosphere.

Q.13. Comment: burning in open air is preferred. medium

Ans. In open air burning produces CO_2 gas which becomes part of atmosphere. CO_2 is not a poisonous gas. Whereas in closed places CO is produced due to limited supply of oxygen. CO is poisonous gas and can be fatal. That's why burning in open air is preferred.

Q.14. CO is a hidden enemy. Explain its action. OR (How is CO considered a health hazard?) medium

Ans. CO is poisonous gas. Being colourless and odourless its presence can be noticed easily and readily. It binds with haemoglobin. So, supply of oxygen is cut off. If inhaled for a longer time, it causes breathing difficulty which leads to death.



Q.15. State the major sources of CO and CO₂ emission. (Write down the sources of oxides of carbon).

Ans. Sources of CO and CO₂ Emission:

- Both of these gases are emitted due to volcanic eruption and decomposition of organic matter naturally.
- The major source for the emission of these gases is combustion of fossil fuels (coal, petroleum and natural gas). Fossil fuels burn in combustion engine of any type of automobile, kiln of any industry, or open air fires emit CO₂ and CO.
- Forest fires and burning of wood also emit CO₂ and CO. Especially, when supply of oxygen is limited, emission of CO dominates.

Q.16. Which air pollutant is produced in an anaerobic decomposition of organic matter?

Ans. CH₄ is an air pollutant produced by anaerobic decomposition.

Q.17. Write down the physical properties, sources and effects of carbon monoxide?

Ans. Physical properties: Colourless, odourless and poisonous gas.

Sources: Incomplete burning of wood, fuels and vehicle exhaust.

Harmful effects: Headache, brain damage, death.

Q.18. Write down the physical properties, sources and effects of Sulphur dioxide.

Ans. Physical properties: Colourless gas with unpleasant and irritating odour.

Sources: Power stations and industrial units using fossil fuels.

Harmful effects: Breathing difficulties, bronchitis, emphysema, lung cancer, acid rain and green house effect.

Q.19. Write down the physical properties, sources and effects of oxides of nitrogen.

Ans. Physical properties: NO is colourless, odourless gas soluble in water. NO₂ is reddish brown gas with pungent odour soluble in water. Both are highly toxic gases.

Sources: Exhaust fumes of motor vehicles, power stations and industries using fossil fuels.

Harmful effects: Cough, headaches, lung diseases, acid rain and greenhouse effect (global warming).

Q.20. CO₂ is responsible for heating up atmosphere. How? What do you mean by Green House effect?

Ans. CO₂ is greenhouse gas. In atmosphere it acts like a glass wall of greenhouse. It absorbs infrared radiations and allows visible light to pass through. So, it absorbs most of outgoing radiations which result in heating of atmosphere. This is called Greenhouse effect.

Q.21. What do you mean by green house effect?

Ans. CO₂ layer acts like an envelope around the earth. It absorbs infrared radiations emitted by the Earth's surface and helps to keep it warm at night. Increased concentration of CO₂ increases the average temperature of the earth surface gradually. This is called green house effect.

Q.22. Define global warming.

Ans. Global warming is rising of temperature because of trapping of heat

energy by carbon dioxide gas in the atmosphere.

Q.23. Why are the flood risks increasing?

Ans. Increase in the temperature of the earth due to Global warming melts glaciers and snow caps that are increasing flood risk.

Q.24. What do you mean by incineration?

Ans. Incineration is a waste treatment process that involves the burning of solid waste at high temperature. The temperature ranges from 650°C to 1100°C in incinerators.

Q.25. What is the importance of incinerator?

Ans. Incinerator reduces the solid mass of the original waste by 80 - 85% and convert waste material into ash, flue gas and heat.

Q.26. What is the disadvantage of incineration? OR (How does incineration of waste cause air pollution?)

Ans. Incineration produces highly poisonous gases and toxic ash. The flue gas include dioxins, furans, Sulphur dioxide, carbon dioxide, carbon monoxide, hydrochloric acid and large amount of particulate matter.

Q.27. What is the composition of flue gas produced during incineration of waste material?

Ans. The flue gas includes dioxins, furans, Sulphur dioxide, carbon dioxide, carbon monoxide, hydrochloric acid and a large amount of particulate matter.

Q.28. How is acid rain produced?

Ans. Acid rain means presence of excessive acids in rain water. This rain is produced when normal rain water dissolves oxides of sulphur and nitrogen in air. Rain water converts SO₂ into

H₂SO₄ and NO_x to HNO₃ and HNO₂. These acids reduce the pH of rain water upto 4. Thus acid rain is formed on dissolving acidic air pollutants such as SO₂ and NO_x in rain water.

Q.29. How is aquatic life affected by acid rain? / How aluminium harm the fish?

Ans. Acid rain on soil and rocks leaches heavy metals (Al, Hg, Pb, Cr, etc.) with it and discharges these metals into rivers and lakes. Aquatic life present in lakes suffers because of high concentration of these metals. Especially high concentration of aluminium metal clogs the fish gills. It causes suffocation and ultimately death of fish.

Q.30. Why are plants dying day by day? Comment.

Ans. Acid rain directly damages the leaves of trees and plants, thus limiting their growth. Depending upon the severity of the damage, plant growth can be hampered. Plants ability to bear cold or diseases reduces and they ultimately die.

Q.31. What is photosynthesis?

Ans. Photosynthesis is a biochemical process in which plants use solar energy to convert carbon dioxide and water into glucose in the presence of chlorophyll. It is an essential process that sustains most life on earth by producing oxygen and organic compounds. Photosynthesis plays a key role in the carbon cycle by removing carbon dioxide from the atmosphere and turning it into organic matter.



Q.32. How to reduce personal exposure to harmful pollutants?

Ans. Several tools and strategies can be employed. For instance:

1. Masks and Respiratory Protection
a) N-95 masks are designed to filter out particles, including pollutants.



such as dust, smoke, and some airborne chemicals.

- b) Gas masks contain activated carbon filters that absorb certain gases and volatile organic compounds.

Note: It is vital to choose masks certified by the relevant regulatory authorities and use precisely according to their instructions.

2. Air Quality Indices

Air quality indices provide information about the general air quality of a certain location. They usually use a numerical scale or a colour-coded system to indicate the level of air pollution. By regularly checking the air quality, you can take the necessary precautions.

3. Carbon monoxide detector

Installing carbon monoxide detectors in homes and offices which alert people to carbon monoxide levels. This allows quick action to be taken, such as ventilating the area, sealing off potential sources or evacuating the area or enclosed spaces.

Q.33. What are the strategies to reduce or control the acid rain? min:10

Ans. Acid rain mitigation:

- Emission control:** Measures to reduce emissions of sulfur dioxide, nitrogen oxides from industrial units, power plants, and vehicles are important for reducing acid rain. This can be achieved through the introduction of anti-pollution technologies and the use of cleaner fuels.
- Flue gas desulfurization:** Flue gas desulfurization systems, such as wet or dry scrubbers in power plants and industrial units can remove sulphur dioxide from flue gases before they are released into the atmosphere.
- Low sulphur fuels:** Preventing low sulphur fuels can also minimise the amount of sulphuric acid in the atmosphere that causes acid rain.



UNIT 12

Environmental Chemistry – Water

Q.1. How does tap water differ from distilled water? min:10

Ans. Distilled Water: Water purified by distillation is called distilled water.

The process of distillation involves heating water to boiling point, collecting the vapours, and condensing it back into the liquid. The impurities are left behind. Distilled water is free of any contaminants. The electrical conductivity of distilled water is very low. The pH of distilled water is 7.

Uses in Chemistry:

- Distilled water is usually used in laboratories to prepare chemical reagents and solutions.
- Distilled water is used in the calibration of sensors in analytical instruments, e.g. pH meter.

Tap water:

Water supplied through the municipal water system to households and for commercial purposes is called tap water. It comes from various sources, including, streams, rivers, lakes, reservoirs, and groundwater. It undergoes processes to meet safety standards to make it safe for people.

Applications in Chemistry Laboratory:

- Tap water is used as a solvent for general purposes, such as cleaning glassware, equipment, etc.
- It is also used for educational and simple demonstration as a readily available solvent.

Q.2. Why are municipal water supplies treated with aluminium sulphate? min:10

Ans: Raw water is treated in a municipal water purification plant, to make it fit for drinking and domestic purposes. Various stages in this treatment are:

- Sedimentation:** It is the process in which water is allowed to stand in a reservoir. The suspended matter sinks to the bottom.
- Coagulation:** It is the process in which water is treated with slaked lime and alum. These materials react to form a gelatinous mass of aluminum hydride.



- The aluminum hydride carries down dirt particles and bacteria.

- Filtration:** The water is then filtered through sand and gravel. Sometimes it is filtered through charcoal to remove coloured and odorous compounds.

- Chlorination:** In the final step, chlorine is added to kill any remaining bacteria. Chlorine reacts with water to form hypochlorous acid HClO which kills bacteria.



Q.3. What are some health effects of biological contamination of water? min:10

Ans. Human wastes are dumped on the ground or into the nearest stream. Human waste contains infectious microorganisms, which spread diseases like typhoid fever, dysentery, and hepatitis.

Chemical and bacterial contents in livestock waste can pollute surface and groundwater causing the above-mentioned diseases. Hepatitis, a viral disease occasionally spreads through drinking polluted water. Unclean water supplies, poor sanitation, and poor hygiene kill 2,668,000 people worldwide each year. Water in swimming pools is purified from pathogenic organisms by aeration and chlorination.

Some waterborne diseases are given below:

i. Dysentery

Dysentery is also an intestinal disease. It is caused by a parasite, *entamoeba*. This infection is transmitted by fecal contamination of water or food by the encysted organism. Patients have mild to severe abdominal cramps, diarrhea, chocolate-colored stool with mucus and sometimes blood.

ii. Jaundice

This disease proceeds from obstruction of the liver. Excess of bile from the liver enters the blood and causes yellowness of skin and eyes. It leads to loss of appetite, weakness, and fatigue.

iii. Hepatitis

Hepatitis is an acute inflammation of the liver. It is caused by viruses and is classified as Hepatitis A, B, C, D, and E. Hepatitis A and E spread through polluted water.

iv. Typhoid

Typhoid is a dangerous intestinal disease. It spreads by polluted water containing bacteria such as *salmonella typhi*, *salmonella paratyphi*, and *salmonella enteritidis*. It is characterized by continuous fever between 101°F to 104°F and irregular pulse.

Q.4. Identify the negative effects of water pollutants on life.

09/04/2019

Ans. Ways to deal with the negative effects of water pollution:

Water pollution affects life in many ways. Here are some ways to deal with them are it follows.

- Some pollutants reduce oxygen level in water bodies and make the survival of aquatic life difficult. To prevent this, it is important to control nutrient flow and properly treat sewage and industrial waste that encourage excessive algae growth.
- Heavy metals present in polluted water, can accumulate in the tissues of aquatic organisms. These metals also harm human health if people consume them as food. Preventing industrial wastewater from entering waterways can minimize emissions of such pollutants.
- Water-borne diseases like hepatitis, cholera, dysentery, etc. are caused by harmful microbes. Ensuring proper treatment of domestic and industrial wastewater, compliance with good sanitary and hygiene requirements, and providing access to clean drinking water are crucial in preventing water-borne diseases.

Q.5. Water scarcity is an important issue in Pakistan. Give your comments on it.

09/04/2019

Ans. Water scarcity in Pakistan:

Water scarcity is a major problem in Pakistan. This is mainly due to the following factors.

i. Population Growth:

The population of Pakistan is growing rapidly, which increases the demand for water in agriculture, industry, and homes.

ii. Climate change:

Climate change has caused irregular rainfall patterns, which affects water availability. The country's water resources are also declining due to excessive extraction of water from groundwater aquifers and insufficient irrigation practices.

iii. Inadequate water supply:

Traditional flood irrigation methods are widely used in Pakistan. This has resulted in significant water losses through evaporation and inadequate water distribution.

Solution:

- Effective water management practices.
- Development of infrastructure.
- Policy reforms.

d) Public awareness of responsible water use and its promotion.

e) Strict regulations and monitoring systems to control groundwater and prevent illegal drilling are essential.

Q.6. What are fertilizers?

09/04/2019

Ans. Fertilizers: Fertilizers are substances that provide essential elements for plant growth. These elements are essential to enhance crop yields.

Nutrients of fertilizer:

Fertilizers mainly provide three main nutrients, nitrogen (N), phosphorus (P), and potassium (K), hence known as NPK fertilizers. Urea, potassium nitrate, and ammonium salts such as diammonium phosphate (superphosphate) are important fertilizers.

Nutrient Management:

Fertilizers dissolve in water. So they provide nutrients to the plants in a readily available form. It is important to give fertilizers at the right time and in the right amount. This practice is called nutrient management. It optimizes the intake of nutrients by plants and reduces the loss of nutrients. This practice can minimize environmental problems such as nutrient runoff into water bodies.

THINK TANK

Q.7. Public health depends on water quality. Give arguments.

09/04/2019

Ans. Water Pollution:

Water pollution is a contamination of water bodies (e.g. lakes, rivers, oceans and ground water). Water pollution occurs when pollutants are discharged directly or indirectly into water bodies without adequate treatment to remove harmful compounds.

Effects of Water Pollution:

Water pollution has the following effects:

- It is hazardous to human health. Drinking polluted water can cause cholera, typhoid and diarrhea.
- The use of polluted water is not only devastating for people but also for animals and birds.
- It causes rapid growth of algae. Death and decomposition of algae causes deficiency of oxygen in water that affects organisms living in water.
- It is damaging aquatic life, thus breaking a link in food chain.
- It reduces the aesthetic quality of lakes and rivers.
- It is unfit for cleaning or washing purposes.

Q.8. How chemistry helps maintain a clean swimming pool? Explain.

09/04/2019

Ans. Swimming pools are cleaned by chlorination process. It is the addition of chlorine solution in swimming pools. Chlorine kills bacteria and other micro-organisms. Cl_2 itself does not kill rather it dissociates in water to form hypochlorous acid (HOCl) and hydrochloric acid.



HOCl further ionizes to produce hypochlorite and proton.



Both the products HOCl and OCl^- kill bacteria and micro-organisms.

Q.9. It is advisable to wash hands well with soap after using bathrooms. Evaluate it.

09/04/2019

Ans. Washing hands well with soap after using the bathroom is highly advisable. It helps to remove harmful bacteria and viruses that may be present on your hands, reducing the risk of spreading infections to yourself and others.



Proper hand washing is one of the most effective ways to prevent the transmission of diseases and maintain good personal hygiene.

Remember to wash your hands thoroughly with soap and water for at least 20 seconds to ensure proper cleanliness.

Concept Assessment 12.1

- Q.19. I. List some water borne diseases.
II. List sources of water borne diseases.
III. List steps used in raw material treatment.

Ans. (i) These are following waterborne diseases:

- a. Dysentery b. Cholera c. Diarrhoeal disease
d. Jaundice e. Hepatitis f. Typhoid

(ii) Diseases that spread because of drinking polluted water or eating food prepared with polluted water are called water-borne infectious diseases. Microorganisms like viruses, bacteria, protozoa and worms present in water cause water borne diseases.

(iii) Steps used in raw water treatment:

- a. Sedimentation
b. Coagulation
c. Filtration
d. Chlorination

Multiple Choice Questions (Exercise)

Encircle the correct answer.

1. Which of the followings is not a water borne disease?
(a) hepatitis (b) typhoid
(c) dysentery (d) anaemia
2. Which human activity results in contamination of water bodies?
- (a) livestock waste
(b) pesticides

- (c) septic tanks
(d) all of these
3. pH of distilled water is:
(a) 7 (b) Less than 7
(c) Greater than 7 (d) None of these
4. Anhydrous copper (II) sulphate is _____ solid.
(a) blue (b) white
(c) yellow (d) None of these

SLO Based Additional MCQs

5. Which one of the following properties of water is responsible for rising of water in plants?
- (a) specific heat capacity
(b) surface tension
(c) excellent solvent action
(d) capillary action
6. Water dissolves non-ionic compound by:
- (a) ion-ion forces
(b) ion-dipole forces
(c) dipole-dipole forces
(d) hydrogen bonding



7. Rapid growth of algae in water bodies is because of detergent having:
(a) carbonate salts
(b) sulphonic acid salts
(c) sulphate salts
(d) phosphate salts
8. Depletion of O_2 from water is not because of:
(a) Decaying of aquatic plants
(b) Biodegradation of aquatic plants
(c) Rapid growth of aquatic plants
(d) Decomposition of aquatic plants
9. Which one of the following diseases causes liver inflammation?
(a) typhoid (b) jaundice
(c) cholera (d) hepatitis
10. Which one of the following diseases causes severe diarrhea and can be fatal?
(a) jaundice (b) dysentery
(c) cholera (d) typhoid
11. Which one of the following gases is used to destroy harmful bacteria in water?
(a) iodine (b) chlorine
(c) fluorine (d) bromine
12. Ionic compounds are soluble in water due to:
(a) hydrogen bonding
(b) ion dipole forces
(c) dipole - dipole forces
(d) dipole - induced dipole forces
13. The chemicals used to kill or control pests are called pesticides. They are:
(a) dangerous inorganic chemicals
(b) dangerous organic chemicals
(c) beneficial inorganic chemicals
(d) beneficial organic chemicals
14. The percentage of potable (drinkable) water on earth is:
(a) 2% (b) 0.2%
(c) 0.02% (d) 0.002%

15. The freezing point of water is:
(a) 10°C (b) 100°C
(c) 0°C (d) -60°C
16. The percentage of water in human body is:
(a) 40% (b) 30%
(c) 60% (d) 70%
17. What percentage of world water exists as oceans?
(a) 50% (b) 67%
(c) 97% (d) 25%
18. Inland water includes:
(a) river (b) lakes
(c) streams (d) all of these
19. Sea water is unfit for drinking purpose due to the presence of:
(a) salts (b) algae
(c) fishes (d) all of these
20. Water has a maximum density at:
(a) 10°C (b) 0°C
(c) 4°C (d) 100°C
21. Maximum density of water at 4°C :
(a) 12gcm^{-3} (b) 2gcm^{-3}
(c) 1gcm^{-3} (d) 4gcm^{-3}
22. How many times the heat capacity of water is greater than that of rocks:
(a) two (b) three
(c) four (d) six
23. Which of the following salts is soluble in water?
(a) NaCl (b) KCl
(c) Na_2SO_4 (d) All of these
24. One water molecule can form hydrogen bonding with how many other water molecules?
- (a) one (b) two
(c) three (d) four
25. Water molecules show structure:
(a) tetrahedral (b) trigonal
(c) pentagonal (d) linear



26. Some organic compounds are soluble in water due to the presence of: ANSWER
 (a) $-OH$
 (b) H^+
 (c) both a and b
 (d) covalent bond
27. Which of the following is soluble in water? ANSWER
 (a) organic acids (b) glucose
 (c) alcohols (d) all of these
28. Calcium carbonate in water is: ANSWER
 (a) insoluble
 (b) sparingly soluble
 (c) soluble
 (d) none of the above
29. Industrial effluents are highly toxic: ANSWER
 (a) organic compounds
 (b) inorganic salts
 (c) heavy metals
 (d) all of the above
30. The depletion of which gas in water results in the death of aquatic life: ANSWER
 (a) oxygen
 (b) carbon dioxide
 (c) both of the above
 (d) none of the above
31. Which disease is caused by polluted water? ANSWER
 (a) cholera (b) typhoid
 (c) diarrhea (d) all of these
32. Which element does not cause toxicity in water? ANSWER
 (a) lead (b) arsenic
 (c) sodium (d) mercury
33. Which hepatitis is caused by contaminated water? ANSWER
 (a) Hepatitis A (b) Hepatitis B
 (c) Hepatitis D (d) Hepatitis C
34. Which organ ceases to function during Jaundice? ANSWER
 (a) liver
 (b) kidney
 (c) stomach
 (d) large intestine

35. Swimming pools are cleaned by the process: ANSWER
 (a) chlorination
 (b) hydrogenation
 (c) ozonification
 (d) none of the above
36. Chemical formula of hypochlorous acid is: ANSWER
 (a) HCl (b) $HOCl$
 (c) H_2CO_3 (d) HF
37. Water present in the atmosphere as water vapour is in the percentage: ANSWER
 (a) 2.1% (b) 0.6%
 (c) 0.001% (d) 0.2%
38. What percentage of water exists as inland water? ANSWER
 (a) 0.2% (b) 1.1%
 (c) 0.6% (d) 0.001%
39. Alcohol is soluble in water due to: ANSWER
 (a) hydrogen bonding
 (b) ion-dipole forces
 (c) ionic bonding
 (d) Coordinate covalent bonding
40. How many people are infected by Hook worm, worldwide, per annum: ANSWER
 (a) about 1 billion
 (b) about 2 billion
 (c) about 4 billion
 (d) about 5 billion
41. Diarrhea can be caused by: ANSWER
 (a) bacteria (b) viruses
 (c) parasites (d) all of these
42. Dysentery is a disease of: ANSWER
 (a) intestine (b) stomach
 (c) heart (d) liver
43. In chemical reactions, water behaves as: ANSWER
 (a) a basic species
 (b) an acidic species
 (c) an amphoteric species
 (d) an inert species



44. Glaciers and ice caps comprise world water: ANSWER
 (a) 2.1% (b) 2.5%
 (c) 3.1% (d) 9.1%
45. What is the product of the reaction between carbon dioxide mixed in water and calcium carbonate: ANSWER
 (a) CaO
 (b) $Ca_2(HCO_3)_2$
 (c) $Ca(HCO_3)_2$
 (d) $Ca(HCO_3)_2$
46. Water is a universal solvent because of its: ANSWER
 (a) polarity
 (b) covalent nature
 (c) hydrogen bonding ability
 (d) polarity and hydrogen bonding
47. Jaundice is due to an excess of ____ in blood. ANSWER
 (a) bile pigments
 (b) red blood cells
 (c) white blood cells
 (d) Thrombocytes
48. Typhoid is caused by: ANSWER
 (a) viruses (b) parasites
 (c) bacteria (d) all of these
49. Pure water has: ANSWER
 (a) high conductivity
 (b) moderate conductivity
 (c) least conductivity
 (d) no conductivity

50. Boiling point of water is: ANSWER
 (a) $0^\circ C$ (b) $75^\circ C$
 (c) $100^\circ C$ (d) $25^\circ C$
51. A good quality water is: ANSWER
 (a) colourless (b) odourless
 (c) tasteless (d) all of these
52. During distillation of impure water which of the following is called distillate: ANSWER
 (a) a pure water collected at the end
 (b) raw water
 (c) impurities left behind
 (d) boiling water in the condenser
53. Which of the following is responsible to kill bacteria and micro-organisms in chlorinated water: ANSWER
 (a) $HOCl$
 (b) OCl^-
 (c) Cl^-
 (d) $HOCl + OCl^-$
54. In which of the following diseases liver ceases to function and eyes turn yellow: ANSWER
 (a) hepatitis (b) typhoid
 (c) jaundice (d) fluorosis
55. The high nitrate contents in ground water is because of: ANSWER
 (a) seepage of acidic rain water
 (b) extensive use of detergents
 (c) irrigation run-off from agricultural fields
 (d) all of the above

Answer Key

1	d	2	d	3	a	4	b	5	b
6	d	7	d	8	c	9	d	10	c
11	b	12	b	13	b	14	b	15	c
16	d	17	c	18	d	19	a	20	c
21	c	22	d	23	d	24	d	25	a
26	a	27	d	28	a	29	d	30	a
31	d	32	c	33	a	34	a	35	a
36	b	37	c	38	a	39	a	40	a
41	d	42	a	43	c	44	a	45	d
46	d	47	a	48	c	49	c	50	c
51	d	52	a	53	d	54	c	55	c



Short Questions (Exercise)

Q.1. List the impurities present in rain water.

Ans. Impurities present in rain water may include various pollutants such as dust, dirt, microorganisms, pollutants from atmosphere like sulphur dioxide, nitrogen oxides and other chemicals.

These impurities can come from natural sources like volcanic eruption or human activities such as industrial emissions and vehicle exhaust.

Q.2. List toxic substances present in household wastes.

Ans. Household wastes include human wastes, livestock wastes, soaps and detergents, paints and oil, food, vegetable wastes, garbage, etc.

Q.3. In what ways, industrial wastes pollute water.

Ans. Water used as a cleaning agent in industrial units is directly discharged out. This water contains all kinds of toxic chemicals and detergents. When this water enters lakes, streams, rivers or oceans, they either get dissolved or float suspended in water. Even the get

dependent on the bed. This results in the pollution of water.

Q.4. What is water pollution?

Ans. Many human activities also pollute the surface and groundwater. Human activities such as household waste, agricultural waste, livestock waste, pesticides, oil leaks, detergents, septic tanks, petroleum, and natural gas production may result in contamination of water bodies.

Q.5. List some waterborne diseases.

Ans. There are following waterborne diseases:

- | | |
|-------------------------|--------------|
| i. dysentery | ii. cholera |
| iii. diarrhoeal disease | iv. jaundice |
| v. hepatitis | vi. typhoid |

Q.6. What are pathogenic microorganisms?

Ans. Pathogenic microorganisms are harmful bacteria, viruses, fungi or parasites that can cause diseases in humans, animals and plants. These microorganisms can be transmitted through various routes such as contaminated water, food, air etc.

SLO Based Additional Short Questions (Reference Material)

Q.7. What is the importance of water for existence of life?

Ans. Its importance is because of two reasons.

Firstly, it is an essential and major component of each and every living cell. For example, human body consists of about 70% water. Secondly, it provides an environment for animals, and plants that live in water. So, all living organisms owe their life because of water.

Q.8. Write two properties of water. OR (Write characteristics of pure water)

Ans. Pure water is a clear, colourless, odourless and tasteless liquid with following properties:

- It is neutral to litmus.
- Its freezing point is 0°C and boiling point is 100°C at sea level.



Q.9. Why is water considered to be a universal solvent?

Ans. Water is the universal solvent because ability to dissolve substances is because of two unique properties of water.

- Polarity of water molecule
- Exceptional hydrogen bonding ability

Q.10. Write occurrence of water.

Ans. The oceans contain about 97% of world water. The rest of the water is in the form of glaciers, ice caps, ground water and inland water (river, lakes, and streams). It is also present in atmosphere in the form of water vapours.

Q.11. Which forces are responsible for dissolving polar substances in water?

Ans. Dipole forces are responsible for dissolving polar substances in water because water is a polar solvent. Positive end of polar substance is attracted by negative end of water while negative end of polar molecule is attracted by positive end of water molecule.

Q.12. Why are non-polar compounds insoluble in water?

Ans. Non-polar compounds like benzene, ether etc. have covalent bonds. They do not have polar ends. So non polar compounds are not attracted by water molecules.

Q.13. How does water dissolve sugar and alcohol?

Ans. Sugar and alcohols have hydroxyl group ($O^{2-} - H^{+}$) having polar ends. These substances are soluble in water due to hydrogen bonding which is possible due to the polar (O^{2-} and H^{+}) ends of water.

Q.14. What are the effects of water pollution on aquatic life?

Ans. Metal compounds: Natural water can contain metals such as iron, sodium, potassium, magnesium, calcium, manganese, zinc and copper. Some of these metals are necessary for biological

processes, their excessive concentration can be poisonous for aquatic organisms and humans.

Plastics: Plastic waste can pollute water bodies. This is a serious threat to aquatic life and ecosystem.

Wastewater: Wastewater can enter natural water supplies. Wastewater carries pathogens, bacteria, viruses and other harmful substances. These pollutants pose a serious threat to humans and aquatic life.

Q.15. How do fertilizers make the water unfit?

Ans. Nitrates from fertilizers: Fertilizers add nitrates to water bodies through agricultural runoff. High concentrations of nitrates in drinking water cause health risks, especially for young children.

Phosphates from fertilizers and detergents: Phosphates in fertilizers and detergents can enter water bodies through runoff. High concentrations of phosphate can cause eutrophication. This can cause harmful algae blooms and oxygen caps in water bodies. Detergents used in water systems can destroy the outer mucous membranes that protect fish from bacteria and parasites. In addition, detergents can also damage their gills.

Q.16. What are the benefits of natural substances found in water?

Ans. Some naturally occurring substances are useful and necessary for life. For example,

- Dissolved oxygen:** Existence of aquatic life depends on dissolved oxygen. This oxygen supports the respiration process of aquatic organisms.
- Essential minerals:** Metal compounds in natural water can provide essential minerals needed for various biological processes.



For example: iron is necessary for the production of hemoglobin in the blood, which carries oxygen to the cells of our body. Metals like zinc, copper, and manganese activate enzyme activity the proper functioning of biological systems.

Q.17. What is the effect/ disadvantage of drinking distilled water for long term? MINOR

Ans. Long-term drinking of distilled water can cause mineral deficiency because it lacks essential minerals found in natural water sources. For drinking purposes, it is better to use treated tap water, bottled water or natural spring water.

Q.18. What is the difference between biodegradable and non-biodegradable substances? MINOR

Ans. Those substances that can be decomposed by microorganisms like bacteria are called biodegradable substances and those substances that cannot be decomposed by microorganisms like bacteria are called non-biodegradable.

Q.19. What are domestic effluents? MINOR

Ans. Domestic effluents consist of a wide variety of dissolved and suspended impurities. They include food and vegetable waste, garbage, cans, bottles, chemical soaps and washing powder etc. all these substances add to water pollution.

Q.20. What is the effect of detergents on scarcity of oxygen? MINOR

Ans. Household water in the sewage from toilets, baths, kitchens, etc. contains detergent used for cleaning purposes. Detergent being non-biodegradable causes rapid growth of algae. When these plants die and decay, they consume O_2 present in the water. Thus, aquatic life is badly affected because of scarcity of O_2 .

Q.21. Define water borne diseases. MINOR

Ans. These diseases that spread because of drinking and eating food prepared with polluted water are called waterborne infectious diseases. These diseases spread because of lack of sanitation arrangements. e.g. Typhoid, Hepatitis.

Q.22. What are the reasons of waterborne diseases? MINOR

Ans. Diseases that spread because of drinking polluted water or eating food prepared with polluted water are called water-borne infectious diseases. Microorganisms like viruses, bacteria, protozoa and worms present in water cause waterborne diseases.

Q.23. How can waterborne diseases be prevented? MINOR

Ans. Prevention from waterborne diseases:

Waterborne diseases can be prevented by taking the following measures:

- Provision of safe water:** Drinking water must be properly treated and purified.
- Disposal of sewage:** There must be adequate sanitary disposal of sewage. Any type of waste must not be thrown or discharged directly in water supplies or reservoirs.
- Control of toxic chemicals:** Chemical contamination can cause acute illness, but often toxic contaminants are slow poisons and carcinogens. There must be a strict control over the use of pesticides and other chemicals.

Q.24. What is dysentery? MINOR

Ans. Dysentery is also an intestinal disease. It is caused by a parasite, amoeba. This infection is transmitted by fecal contamination of water or food by the encysted organism.

Patients have mild to severe abdominal cramps, diarrhea, chocolate-colored stool with mucus and sometimes blood.

Q.25. What is Jaundice? MINOR

Ans. This disease proceeds from obstruction of the liver. Excess of bile from the liver enters the blood and causes yellowness of skin and eyes. It leads to loss of appetite, weakness, and fatigue.

Q.26. What is hepatitis and typhoid? MINOR

Ans. Hepatitis: Hepatitis is an acute inflammation of the liver. It is caused by viruses and is classified as Hepatitis A, B, C, D, and E.

Hepatitis A and E spread through polluted water.

Typhoid: Typhoid is a dangerous intestinal disease. It spreads by polluted water containing bacteria such as salmonella typhi, salmonella paratyphi, and salmonella enteritidis. It is characterized by continuous fever between $101^\circ F$ to $104^\circ F$ and irregular pulse.

Q.27. Describe chlorination of water. Give its importance. / State the method of swimming pool cleaning. MINOR

Ans. It is addition of chlorine solution in water. Chlorine kills bacteria and other microorganisms. Chlorine itself does not kill rather it dissociate in water to form hypochlorous acid ($HOCl$) and hydrochloric acid (HCl).



$HOCl$ further ionizes to produce hypochlorite and proton.



So, swimming pools are cleaned by chlorination. Both the products, $HOCl$ and OCl^- kill bacteria and microorganisms.

Q.28. What is function of fertilizers? MINOR

Ans. Fertilizers are used to make up the deficiency of nitrogen and phosphorous of soil.

Q.29. Why water treatment is essential? MINOR

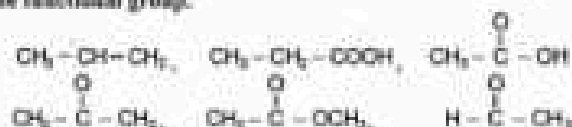
Ans. Water treatment is essential for many reasons.

- Through water purification, we can avoid drinking impure and contaminated water, which causes many epidemic diseases and unsafe for healthy life.
- It removes bacteria, viruses and parasites which may cause diarrhea, dysentery, botulism, typhoid, cholera, polio, and hepatitis.
- It also removes heavy metals like As, Cr and Pb which can cause long term neurological problems, kidney diseases, nausea, dizziness, and cancer.
- It also improves the flavor and appearance.



Organic Chemistry

Q.1. Identify the following compounds on the basis of functional groups they contain and encircle the functional group.



Ans. (i) $\text{H}_3\text{C}-\text{CH}=\text{CH}_2$ Alkene

(ii) $\text{H}_3\text{C}-\text{CH}_2-\text{C}(=\text{O})-\text{OH}$ Carboxylic acid

(iii) $\text{H}_3\text{C}-\text{C}(=\text{O})-\text{OH}$ Carboxylic acid

(iv) $\text{H}_3\text{C}-\text{C}(=\text{O})-\text{CH}_3$ Ketone

(v) $\text{H}_3\text{C}-\text{C}(=\text{O})-\text{OCH}_3$ Ester

(vi) $\text{H}-\text{C}(=\text{O})-\text{CH}_3$ Aldehyde

Q.2. What is the name of alkane having four carbon atoms in the chain?

Ans. Butane has four carbon atoms in the chain.

Molecular Formula = C_4H_{10}

Structural Formula = $\begin{array}{cccc} \text{H} & \text{H} & \text{H} & \text{H} \\ | & | & | & | \\ \text{H}-\text{C}-\text{C}-\text{C}-\text{C}-\text{H} \\ | & | & | & | \\ \text{H} & \text{H} & \text{H} & \text{H} \end{array}$

Q.3. Give the structural formula of two simple alkanes and one alkyne.

Ans. (i) The structural formula of ethane (C_2H_6) is:



(ii) The structural formula of propane (C_3H_8):



(iii) The structural formula of butyne (C_4H_6):



Q.4. What is meant by the term functional group?

Ans. Functional Group

"An atom or group of atoms or presence of double or triple bond which determines the characteristic properties of an organic compound is known as the functional group". The remaining part of the molecule mainly determines the physical properties such as melting point, boiling point, density etc.

Examples

-OH group is the functional group of alcohols, which gives characteristic properties of alcohols. The characteristic properties of carboxylic acids are due to the presence of -COOH group in them. Therefore, functional group of carboxylic acids is -COOH group.

Functional group containing Carbon, Hydrogen and Oxygen

The organic compounds containing carbon, hydrogen and oxygen as functional group are alcohols, ethers, aldehydes, ketones, carboxylic acids and esters. Their class name, functional group, class formula and examples are given below:

(i) Alcoholic Group

The functional group of alcohols is -OH. Their general formula is ROH . Where R is any alkyl group e.g.:



(ii) Ether Linkage

The functional group of ether is C-O-C. Their general formula is $\text{R}-\text{O}-\text{R}'$. Where R and R' are alkyl groups. R and R' may be same or different such as:



(iii) Aldehydic Group

Aldehyde family consists of functional group $-\text{C}(=\text{O})-\text{H}$

Their general formula is RCHO .

Where R stands for H or some alkyl group, such as:



Formaldehyde



Acetaldehyde

(iv) Ketonic Group

Organic compounds containing the functional group $\text{C}(=\text{O})$ are called ketones.

They have the general formula $\text{R}-\text{C}(=\text{O})-\text{R}'$

Where R and R' alkyl group. They may be same or different, such as:



Acetone (Dimethyl Ketone)



Ethyl methyl Ketone

(v) Carbonyl Group

Organic compounds containing functional group $\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$ are called carboxylic acids.

Their general formula is $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$

Where R stands for $-\text{H}$ or some alkyl group. Such as:



Formic acid



Acetic acid

(vi) Ester linkage

Organic compounds containing functional group $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}'$ are called esters and their

general formula is $\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}'$

Where R and R' are alkyl groups, they may be same or different, such as:



Methyl Acetate



Ethyl Acetate

Table: Functional groups containing formulae

Class Name	Functional Group	Class Formula	Examples
Alcohols Primary	$-\text{CH}_2-\text{OH}$	$\text{R}-\text{CH}_2-\text{OH}$	$\text{H}_3\text{C}-\text{CH}_2-\text{OH}$
Alcohols Secondary	$\text{>CH}-\text{OH}$	$\text{R}-\text{CH}(\text{OH})-\text{R}$	$\text{H}_3\text{C}-\text{CH}(\text{OH})-\text{CH}_3$
Alcohols Tertiary	$-\text{C}-\text{OH}$	$\text{R}-\text{C}(\text{OH})_3$	$\text{H}_3\text{C}-\text{C}(\text{OH})_3$
Ethers	$-\text{O}-$	$\text{R}-\text{O}-\text{R}$	$\text{H}_3\text{C}-\text{O}-\text{CH}_3$
Aldehydes	$\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$	$\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$
Ketones	$\overset{\text{O}}{\parallel}{\text{C}}-$	$\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{R}$	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$
Carboxylic acids	$\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$	$\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OH}$
Esters	$\overset{\text{O}}{\parallel}{\text{C}}-\text{R}'$	$\text{R}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OR}'$	$\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{OC}_2\text{H}_5$



Q.5. Identify the type of following compounds as an alcohol, aldehyde or ketone: medium

- (a) HCOH , which is used to manufacture polymers, such as uretroplax which is used to treat urinary tract infection.
 (b) CH_3COCH_3 , which is used in nail polish remover.
 (c) $\text{CH}_3\text{CH}_2\text{OH}$, which is used in the preparation of many organic substances such as plastics, cosmetics, tinctures etc.

Ans. (a) Aldehyde: It contains hydrogen atom on both sides of carbonyl group.
 (b) Ketone: It contains alkyl group on both sides of carbonyl group.
 (c) Alcohol: It contains hydroxyl group with ethyl group.

THINK TANK

Q.6. Give molecular formula of a compound containing C, H and O and single bonds. List all the possible functional groups this compound can have? medium

Ans. $\text{H}_3\text{C}-\text{CH}_2-\overset{\text{OH}}{\text{C}}$ Alcohol

Ethanol (Ethyl alcohol) containing C, H, O and single bond.

Q.7. Give the condensed structural formulas of the following compounds and classify each on the basis of functional group. medium



Ans. (a) $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\overset{\text{OH}}{\text{C}}$ Alcohol

(b) $\text{H}_3\text{C}-\text{O}-\text{CH}_3$ Ether

Q.8. The diagram represents an organic compound that contains three different elements. medium



Select the possible compound from the following:

- (a) Ethanoic acid (b) Propane (c) Ethanol (d) Propane

Ans. The given organic compound is ethanol in which X represents hydrogen atoms, Y represents carbon atoms, Z represents oxygen atom. The structure of ethanol is:



Q.9. Polyvinyl chloride (PVC) is a polymer. It is used for making vinyl sheets, drainage pipes, wire insulation etc. It is obtained from vinyl chloride. Classify vinyl chloride as saturated or unsaturated compound. medium



Ans. Polyvinyl chloride (PVC) is a polymer. It is used for making vinyl sheets, drainage pipes, wire insulation etc. It is obtained from vinyl chloride.





This vinyl chloride is unsaturated compound because it contains double bond between carbon atoms.

Q.10. For each of the following, Sketch the structural formulas of a two-carbon compound containing the indicated functional group.

- (a) Alcohol (b) Aldehyde (c) Carboxylic acid (d) alkene

Ans. The structural formulas of two carbon compound is given below:



Q.11. Aspirin is a mild pain killer and fever reducer. It is manufactured from salicylic acid.



Select functional groups present in it and encircle them. Justify your selection.

Ans. Aspirin is a mild pain killer & fever reducer. It is manufactured from salicylic acid.



Q.12. Construct the general formula for an alkane, an alkene, alkyne and an alcohol containing 4 carbon atoms.



Q.13. Water adds to ethene according to the following reaction



Compare the functional groups in the reactant and product molecules.

Ans. Water adds to ethene and forms ethyl alcohol.



Concept Assessment 13.1

Q.14. Write the molecular formulae of the following compounds using general formulae

- Alkane containing (i) 4 carbon atoms (ii) 6 carbon atoms
- Alkene containing (i) 3 carbon atoms (ii) 4 carbon atoms
- Alkyne containing (i) 3 carbon atoms (ii) 4 carbon atoms
- Alcohol containing (i) 2 carbon atoms (ii) 3 carbon atoms

Ans.

1. Alkane containing

(i) 4 carbon atoms C_4H_{10}

(ii) 6 carbon atoms C_6H_{14}

General Formula for alkane is $\text{C}_n\text{H}_{2n+2}$

2. Alkene containing

(i) 3 carbon atoms C_3H_6

(ii) 4 carbon atoms C_4H_8

General Formula for alkene is C_nH_{2n}

3. Alkyne containing

(i) 3 carbon atoms C_3H_4

(ii) 4 carbon atoms C_4H_6

General Formula for alkyne is $\text{C}_n\text{H}_{2n-2}$

4. Alcohol containing

(i) 2 carbon atoms $\text{C}_2\text{H}_5\text{OH}$

(ii) 3 carbon atoms $\text{C}_3\text{H}_7\text{OH}$

General Formula for alcohol is $\text{C}_n\text{H}_{2n+1}\text{OH}$

Concept Assessment 13.2

Q.15. Give the molecular, structural and condensed structural formulas for

- (a) Butane (b) Hexane (c) Octane

Ans. (a) Butane

Molecular formula =



Structural formula =





Condensed formula =

(b) Hexane

Molecular formula =

Structural formula =

Condensed formula =

(c) Octane

Molecular formula =

Structural formula =

Condensed formula =



Concept Assessment 13.3

Q.16. Classify saturated and unsaturated from the following



Ans.



This compound contains all single bonds so that it is a saturated compound.



This compound contains one triple bond. So, this is an unsaturated compound.



This compound contains one double bond. So, this is an unsaturated compound.



This compound contains two double bonds. So, this is an unsaturated compound.

Concept Assessment 13.4

Q.17. A to E are the structural formulas of some organic compounds.



Give the letters which represent

i. A branched chain compound.

ii. A cyclic compound.

iii. Two straight compounds.



Ans.

i. Structural formula E represents branched chain compound.

ii. Structural formula C represents cyclic compound.

iii. Structural formulas A, B and D represent two straight compounds.

Concept Assessment 13.5

Q.18. Classify the following compound as alcohol, ether or phenol.



Ans.



Ether



Alcohol



Phenol



Alcohol

Concept Assessment 13.6

Q.19. Identify the following compounds as an aldehyde, or a ketone or a carboxylic acid.



Ans.



Ketone

It contains alkyl groups on both sides of carbonyl group.



Aldehyde

It contains one hydrogen atom with carbonyl group.



Carboxylic acid

It contains one hydroxyl group with carbonyl group.



Multiple Choice Questions (Exercise)

- Condensed structural formula for butane is: MS-001118
 (a) $\text{CH}_3\text{-CH}_2\text{-CH}_3$
 (b) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_3$
 (c) $\text{CH}_3\text{-CH}_2\text{-CH}_2\text{-CH}_2\text{-CH}_3$
 (d) $\text{CH}_3\text{-CH}_2$
- $\text{CH}_3\text{-CH}_2\text{-CH}_3$ is the chemical formula for: MS-001111
 (a) ethane (b) propane
 (c) butane (d) pentane
- Which compound is not a saturated hydrocarbon? MS-001119
 (a) $\text{CH}_3\text{-CH}_3$
 (b) CH_4
 (c) $\text{CH}_2 = \text{CH} = \text{CH}_2$
 (d) $\text{CH}_3\text{-CH}_2\text{-CH}_3$
- Stem "but" stands for how many Carbon atoms? MS-001121
 (a) 2 (b) 3
 (c) 4 (d) 5
- The functional group $\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-}$ is found in: MS-001124
 (a) alcohols (b) ketone
 (c) ether (d) ester
- In which of the following compounds, oxygen is attached to two alkyl carbon atoms? MS-001125
 (a) alcohols (b) phenol
 (c) ether (d) ester
- Which of the following is an alcohol? MS-001126
 (a) $\text{CH}_3\text{-CH}_2\text{-O-CH}_2\text{-CH}_3$
 (b) $\text{CH}_3\text{-CH}_2\text{-COOH}$
 (c) $\text{C}_2\text{H}_5\text{-OH}$
 (d) $\text{CH}_3\text{-CH}_2\text{-OH}$
- The functional group of amines is: MS-001127
 (a) -OH (b) -COOH
 (c) -NH_2 (d) -CHO
- Ethanoic acid contains functional group: MS-001128
 (a) -OH (b) -CO-
 (c) -COOH (d) -CHO

SLO-Based Additional MCQs

- The ability of carbon atoms to form a long chains and large rings is called: MS-001129
 (a) isomerism (b) catenation
 (c) resonance (d) condensation
- Identify which one of the following compounds is a ketone: MS-001130
 (a) $(\text{CH}_3)_2\text{CHOH}$
 (b) $(\text{CH}_3)_2\text{CHCl}$
 (c) $(\text{CH}_3)_2\text{CO}$
 (d) $(\text{CH}_3)_2\text{NH}$
- The functional group -COOH is found in: MS-001131
 (a) carboxylic acids
 (b) aldehydes
 (c) alcohols
 (d) esters
- In which of the following groups, oxygen is attached on both sides with carbon atoms? MS-001132
 (a) ketone (b) ether
 (c) aldehyde (d) ester
- Which one of the following compounds is an aldehyde? MS-001133
 (a) $\text{CH}_3\text{-CH}_2\text{-OH}$
 (b) $\text{CH}_3\text{-COOH}$
 (c) $\text{CH}_3\text{-CHO}$
 (d) $\text{CH}_3\text{-COCH}_3$
- Formula of acetaldehyde is: MS-001134
 (a) $\text{CH}_3\text{-CH}_2\text{-OH}$ (b) $\text{CH}_3\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-OH}$
 (c) $\text{CH}_3\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-H}$ (d) $\text{H-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-H}$



- The 1st organic compound prepared in laboratory: MS-001135
 (a) sodium chloride (b) urea
 (c) thiourea (d) pyridine
- The branch of chemistry which deals with the study of hydrocarbons and their derivatives is known as: MS-001136
 (a) organic chemistry
 (b) inorganic chemistry
 (c) biochemistry
 (d) nuclear chemistry
- The formula which represents the actual number of atoms in one molecule of an organic compound is called: MS-001137
 (a) molecular formula
 (b) structural formula
 (c) condensed formula
 (d) dot and cross formula
- Molecular formula of butane is: MS-001138
 (a) C_4H_{10} (b) C_4H_8
 (c) C_4H_6 (d) C_4H_4
- Which of the following formula of a arrangement of the different atoms of various elements present in a molecule of a substance? MS-001139
 (a) molecular formula
 (b) structural formula
 (c) condensed formula
 (d) dot and cross formula
- Which one contains double covalent bond? MS-001140
 (a) pentane (b) ethylene
 (c) acetylene (d) all of the above
- Which one contains triple covalent bond? MS-001141
 (a) pentane (b) ethylene
 (c) acetylene (d) all of the above
- The general formula of alkanes is: MS-001142
 (a) $\text{C}_n\text{H}_{2n-2}$ (b) $\text{C}_n\text{H}_{2n+2}$
- (c) C_nH_{2n} (d) $\text{C}_n\text{H}_{2n+1}$
- The functional group of alcohol is: MS-001143
 (a) -OH (b) -X
 (c) -C-H (d) -C-OH
- Aldehyde family consists of functional group: MS-001144
 (a) -OH (b) -X
 (c) $\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-H}$ (d) $\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-OH}$
- Ketonic group contains the functional group: MS-001145
 (a) -OH (b) -X
 (c) $\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-}$ (d) $\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-OH}$
- Carboxylic group contains functional group: MS-001146
 (a) -X (b) -OH
 (c) $\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-}$ (d) $\text{-}\overset{\text{O}}{\underset{\text{||}}{\text{C}}}\text{-OH}$
- The formula of pentane is: MS-001147
 (a) C_5H_{12} (b) C_5H_{10}
 (c) C_5H_8 (d) C_5H_{14}
- The first organic compound urea was prepared from which inorganic substance? MS-001148
 (a) NH_3 (b) NH_4CN
 (c) NH_4CNO (d) H_2CNO
- Molecular formula of Nonane is: MS-001149
 (a) C_9H_{20} (b) C_9H_{18}
 (c) C_9H_{16} (d) C_9H_{22}
- How many elements are known today? MS-001150
 (a) 92 (b) 110
 (c) 118 (d) 12
- Number of isomers of a compound with chemical formula C_4H_{10} is: MS-001151
 (a) 1 (b) 3
 (c) 5 (d) 7



33. Pulses and beans are sources of: 01/04/2018
 (a) proteins (b) vitamins
 (c) carbohydrates (d) oils
34. Geraniol is an organic compound which consists of two functional groups? 01/04/2018
 (a) carbon-carbon double bond and carboxylic group

- (b) carbon-carbon triple bond and carboxylic group
 (c) carboxylic group and alcoholic group
 (d) carbon-carbon double bond and hydroxyl group
35. Which of the following compounds is present in human sweat? 01/04/2018
 (a) aldehydes (b) ketones
 (c) carboxylic acids (d) ethers

Answer Key

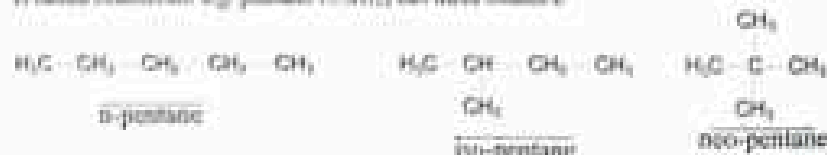
1	b	2	b	3	c	4	c	5	b
6	c	7	d	8	c	9	c	10	b
11	c	12	a	13	b	14	c	15	c
16	b	17	a	18	a	19	a	20	b
21	b	22	c	23	a	24	a	25	c
26	c	27	d	28	a	29	c	30	a
31	c	32	b	33	a	34	d	35	c

Short Questions (Exercise)

- Q.1. What is catenation? 01/04/2018
 Ans. The ability of carbon atoms to link with other carbon atoms to form long chains and large rings is called catenation. e.g.



- Q.2. Define isomerism. 01/04/2018
 Ans. The compounds having same molecular formulae but different arrangement of atoms in their molecules or different structural formulae are called isomers and the phenomenon is called isomerism. e.g. pentane (C_5H_{12}) has three isomers.



- Q.3. Give three examples of unsaturated compounds. 01/04/2018
 Ans. (a) Ethene C_2H_4 or $\text{H}_2\text{C}=\text{CH}_2$
 (b) Propyne C_3H_4 or $\text{H}_3\text{C}-\text{C}\equiv\text{CH}$
 (c) Hexene C_6H_{12} or $\text{H}_3\text{C}-\text{CH}_2-\text{CH}=\text{CH}-\text{CH}_2-\text{CH}_3$



- Q.4. Define a functional group. 01/04/2018
 Ans. "An atom or group of atoms or presence of double or triple bond which determines the characteristic properties of an organic compound is known as the functional group".
 e.g: $-\text{OH}$ is the functional group of alcohol.
- Q.5. What is the difference between an alkene and alkyne? 01/04/2018
 Ans. Alkynes have triple covalent bond between two carbon atoms and Alkenes have double covalent bond. Alkynes have greater carbon to hydrogen ratio. So they give smokier flames than that of alkenes.

SLO Based Additional Short Questions (Reference Material)

- Q.6. Define organic chemistry. 01/04/2018
 Ans. The study of carbon-containing compounds and their properties is called organic chemistry.

- Q.7. Define organic compounds. 01/04/2018
 Ans. Organic compounds are hydrocarbons (compounds of carbon and hydrogen) and their derivatives in which covalently bonded carbon is an essential constituent. e.g. Carbohydrates, Proteins and Enzymes etc. are organic compounds.

- Q.8. Define Homologous series. 01/04/2018
 Ans. A series of similarly constituted organic compounds having same functional group in which successive member differ by $-\text{CH}_2$ group in their molecular formulae and 14 units in their molecular masses, is called Homologous series.

- Q.9. Explain the strength of covalent bonds of carbon. 01/04/2018
 Ans. Carbon forms covalent bonds with itself and other elements. C-C single bonds are much stronger (355 kJ/mol) than C=C double bond and $\text{C}\equiv\text{C}$ triple bond. The strength of C-C covalent bonds can be predicted from the order of reactivity of alkanes, alkenes and alkynes which is given below:
 $\text{C}\equiv\text{C} > \text{C}=\text{C} > \text{C}-\text{C}$

- Q.10. Define molecular formula. Give one example. 01/04/2018
 Ans. The formula which represents the actual number of atoms in one molecule of the organic compound is

called molecular formula. For example molecular formula of butane is C_4H_{10} .

- Q.11. Write down the general formula of alkane, alkene, alkyne, alcohol, carboxylic acid. 01/04/2018

Ans.

General formulae of some homologous series	
Alkane,	$\text{C}_n\text{H}_{2n+2}$
Alkene,	C_nH_{2n}
Alkyne,	$\text{C}_n\text{H}_{2n-2}$
Alcohol,	$\text{C}_n\text{H}_{2n+1}\text{OH}$
Carboxylic acid,	$\text{C}_n\text{H}_{2n+1}\text{COOH}$

- Q.12. Define structural formula. Draw the structural formulae of n-butane and iso-butane. 01/04/2018
 Ans. Structural formula: Structural formula of a compound represents the exact arrangement of the different atoms of various elements present in a molecule of a substance.

Following are structural formulae of butane (C_4H_{10}).



- Q.13. Define condensed formula. 01/04/2018
 Ans. The short form of formula that indicates the group of atoms attached to each carbon atom in a straight chain or branched chain is called a condensed formula.
 e.g: $\text{H}_3\text{C}-\text{CH}_2-\text{CH}_2-\text{CH}_3$



Q.14. Differentiate between saturated and unsaturated hydrocarbons.

09/04/20

Ans.

Saturated Hydrocarbons	Unsaturated Hydrocarbons
The hydrocarbons in which all the four valencies of carbon atoms are fully satisfied (saturated) by single bond with other carbon atoms and hydrogen atoms are called saturated hydrocarbons.	The hydrocarbons in which two carbon atoms are linked by a double or a triple bond are called unsaturated hydrocarbons.
They are also called alkanes.	They are also called alkenes and alkynes.
The general formula of saturated hydrocarbons is C_nH_{2n+2} .	The general formula of alkenes is C_nH_{2n} and that of alkynes is C_nH_{2n-2} .
Examples: CH_4 , C_2H_6 , C_3H_8 .	Examples: C_2H_4 , C_2H_2 .

Q.15. Write down the names of classes in which organic compounds are classified.

09/04/20

Ans. All organic compounds are broadly classified into two classes.

- Open chain or Acyclic compounds.
- Closed chain or Cyclic compounds.

Q.16. Define open chain or acyclic compounds. Explain their types.

09/04/20

Ans. Open chain compounds are those in which the end carbon atoms are not joined with each other and form a long chain of carbon atoms.

There are two types of open chain compounds.

- Straight chain compounds**
Compounds in which carbon atoms link with each other through a single, double or triple bonds forming a straight chain.

Q.18. What are amines? Give examples.

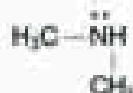
09/04/20

Ans. The organic compounds containing carbon, hydrogen and nitrogen as a functional group ($-NH_2$) are called amines. Their functional group is ($-NH_2$) and their general formula is $R-NH_2$.

Examples:



Methyl amine



Dimethyl amine



Trimethyl amine

For example:



Straight chain (butane)

(b) Branched chain compounds

Compounds in which there is a branch along a straight chain.

For example:



Branched chain (Isobutane)

Q.17. Define closed chain or cyclic compounds. Write names of their types.

09/04/20

Ans. Those compounds in which the carbon atoms at the end are not free and they join to form rings. They are further divided into two classes.

- Homocyclic compounds
- Heterocyclic compounds

Q.19. What is functional group for aldehyde and ketone?

09/04/20

Ans. Functional group for aldehyde is:



Functional group for ketone is:



Q.20. What is functional group for ether and carboxylic compounds?

09/04/20

Ans. Functional group for ether is ($R-OR'$) and for carboxylic compound is



Q.21. What is functional group for an alkyl Halide?

09/04/20

Ans. Functional group for alkyl halide is $R-X$ where R is alkyl radical and X is halogen i.e. F, Cl, Br or I etc.

Q.24. Write condensed formula of any two hydrocarbons.

09/04/20

Ans. (i) $H_3C-CH_2-CH_2-CH_3$ (n-butane)

or $H_3C-(CH_2)_2-CH_3$

(ii) $H_3C-CH_2-CH_2-CH_2-CH_3$ (n-pentane)

or $H_3C-(CH_2)_3-CH_3$

e.g. CH_3-Cl (Methyl chloride)

Q.22. Define alkynes. Give one example.

09/04/20

Ans. Organic compounds having triple covalent bond (functional group) between two carbon atoms in their molecule are called alkynes.

e.g. $HC\equiv CH$ Ethyne.

Q.23. What is Ether linkage?

09/04/20

Ans. The functional group of ether is $C-O-C$. Their general formula is $R-OR'$. Where R and R' alkyl groups. R and R' may be same or different such as:

$H_3C-O-CH_3$ Dimethyl ether

$C_2H_5-O-C_2H_5$ diethyl ether

$H_3C-O-C_2H_5$ Ethyl methyl ether



UNIT 14

Hydrocarbons

Q.1. Discuss methods for the preparation ethane.

ANSWER

Ans. Alkanes form a series of homologous compounds. So, their methods of preparation and chemical properties are similar. Although, there are many methods of preparation, but only two methods are discussed here.

(i) Hydrogenation of alkenes and alkynes

Hydrogenation: means addition of molecular hydrogen in alkenes and alkynes. As we know alkenes and alkynes are unsaturated compounds, so they have the capacity to add up atoms in them. This reaction is carried out in the presence of nickel catalyst at 250°C to 300°C . However, in the presence of catalyst platinum or palladium, the reaction takes place at room temperature, such as:



Similarly,



(ii) Reduction of alkyl halides

Reduction means addition of nascent hydrogen. In fact, it is a replacement of a halogen atom with a hydrogen atom. This reaction takes place in the presence of Zn metal and HCl.



Q.2. Describe properties of alkanes.

ANSWER

Ans. Alkanes give only substitution reactions. They are least reactive compounds being saturated hydrocarbons. However, they give reactions at high temperatures.

Substitution reactions

A reaction in which one or more hydrogen atoms of a saturated compound are replaced with some other atoms (like halogen) is called a **substitution reaction**.

Halogenation

These reactions are a characteristic property of alkanes. Alkanes react fairly with halogens in diffused sunlight only. In dark there is no reaction. In direct sunlight, reaction is explosive and carbon is deposited, e.g.,



In diffused sunlight, a series of reactions take place and at each step one hydrogen atom is substituted by halogen atoms, so that all the hydrogen atoms are substituted one by one by halogen atoms.



Chloromethane



Dichloromethane



Trichloromethane (Chloroform)



Tetrachloromethane (Carbon Tetrachloride)

Combustion

Alkanes burn in the presence of excess of air or oxygen to produce a lot of heat, carbon dioxide and water. This reaction takes place in automobile combustion engines, domestic heaters and cooking appliances. It is highly exothermic reaction and because of it alkanes are used as fuel.



In the limited supply of oxygen, there is incomplete combustion. As a result carbon monoxide is produced that creates suffocation and causes death.



Q.3. Write a chemical equation to show the preparation of an alkane from an alkene and an alkyne.

ANSWER

Ans. By the hydrogenation of alkenes and alkynes:

Addition of hydrogen molecule across carbon-carbon multiple-bond is called hydrogenation. Hydrogenation takes place in presence of finely divided nickel at $200 - 300^{\circ}\text{C}$ and high pressure. Hydrogenation can also be done in presence of Pt or Pd at room temperature.

Alkynes add two molecules of hydrogen as explained below:



THINK TANK

Q.4. Write chemical equations for the preparation of propane.

ANSWER

Ans.





Concept Assessment 14.1

Q.5. Complete the reaction:



Ans.



Concept Assessment 14.2

Q.6. Complete the following reactions.



Cl

Ans.



Cl

Multiple Choice Questions (Exercise)

- Which molecule contains a carbon-carbon single bond? (a) Ethane (b) Ethene (c) Ethyne (d) Methanol
- Which product is obtained when chloromethane (or methyl chloride) is reduced? (a) Ethane (b) Ethene (c) Methane (d) Ethyne
- By hydrogenation we mean, the addition of: (a) hydrogen (b) water (c) halogen (d) hydrogen halide

- Combustion of methane produces (a) carbon dioxide (b) water (c) heat (d) all of these
- Reduction of chloromethane gives (a) hydrogen (b) chlorine (c) methane (d) all of these

SLO Based Additional MCQs

- Which one of these hydrocarbon molecules would have no effect on an aqueous solution of bromine? (a) C_2H_6 (b) C_2H_4 (c) C_2H_2 (d) C_2H_6
- If an organic compound has 4 carbon atoms, all singly bonded, it will have the following characteristics except one: (a) it will be saturated hydrocarbon (b) it will have 8 hydrogen atoms (c) its name will be n-butane (d) it will be least reactive



- The reduction of alkyl halides takes place in the presence of: (a) Zn/HCl (b) Na/HCl (c) Mg/HCl (d) Cu/HCl
- Halogenation of methane produces following valuable chemical compounds used as solvent except: (a) carbon tetrachloride (b) chloroform (c) carbon black (d) chloromethane
- Incomplete combustion of alkanes produces: (a) carbon dioxide only (b) carbon monoxide only (c) carbon monoxide and carbon black (d) carbon dioxide and carbon black
- What is the molecular formula for the eight alkane member, octane, which is found in petrol? (a) C_8H_{18} (b) C_8H_{16} (c) C_8H_{14} (d) C_8H_{12}
- One of the hydrocarbons reacts with one mole of hydrogen to form a saturated hydrocarbon. What formula could be of the X? (a) C_2H_6 (b) C_2H_4 (c) C_2H_2 (d) C_2H_8
- Substitution reaction is the characteristic of: (a) alkanes (b) alkenes (c) alkynes (d) none of these
- Halogenation of alkanes in the presence of diffused sunlight takes: (a) suddenly, only in one step (b) slowly in one step (c) in a series of four steps (d) slowly in two steps
- Which one of the following is a substitution reaction? (a) halogenation of alkynes (b) halogenation of alkenes (c) halogenation of alkanes (d) bromination of alkanes
- Which is the simplest alkane? (a) CH_4 (b) C_2H_6 (c) C_2H_2 (d) C_2H_4
- Alkanes give reaction only: (a) addition (b) decomposition (c) substitution (d) displacement
- Condensed formula of ethane is: (a) C_2H_6 (b) C_2H_4 (c) H_2CCH_2 (d) none of these
- Alkanes do not react in: (a) diffused sunlight (b) bright sunlight (c) dark (d) none of these
- The alkanes consisting of C_1 to C_{10} are: (a) gases (b) liquids (c) solids (d) plasma
- Alkanes are least reactive compounds because they are: (a) saturated hydrocarbons (b) unsaturated hydrocarbons (c) both (a) and (b) (d) none of the above
- Which is the main component of natural gas? (a) methane (b) propane (c) butane (d) propyne
- Hydrogenation of alkanes and alkynes takes place at room temperature in the presence of: (a) Ni (b) Pt (c) Pd (d) both (b) and (c)
- Which one is the formula of chloromethane? (a) CH_3Cl (b) CCl_4 (c) CHCl_3 (d) CH_3Cl
- The formula of octane is: (a) C_8H_{18} (b) C_8H_{16} (c) C_8H_{14} (d) C_8H_{12}



26. Marsh gas consists of (a) methane (b) ethane (c) propane (d) butane
27. The general formula of saturated hydrocarbons is: (a) C_nH_{2n+1} (b) C_nH_{2n} (c) C_nH_{2n-1} (d) C_nH_{2n+2}
28. Saturated hydrocarbons are also called: (a) olefins (b) paraffins (c) alkenes (d) alkynes
29. Example of simplest alkane is: (a) methane (b) ethane (c) propane (d) all of these
30. Alkane molecules are: (a) polar (b) non-polar (c) both (a) and (b) (d) none of these
31. Alkanes containing one to four carbon atoms are: (a) solid (b) liquid (c) gas (d) all of these

32. Alkanes containing five to seven carbon atoms are: (a) solid (b) liquid (c) gas (d) all of these
33. Higher alkanes are: (a) solid (b) liquid (c) gas (d) all of these
34. Which alkane is used to extract vegetable oil from corn, soyabean, cotton seeds? (a) methane (b) butane (c) octane (d) hexane
35. Temperature range for thermal cracking is: (a) $450 - 750^\circ\text{C}$ (b) $350 - 650^\circ\text{C}$ (c) $500 - 800^\circ\text{C}$ (d) $550 - 850^\circ\text{C}$
36. Decane ($C_{10}H_{22}$) breaks down into (a) ethane (b) ethyne (c) ethene (d) acetylene

Answer Key

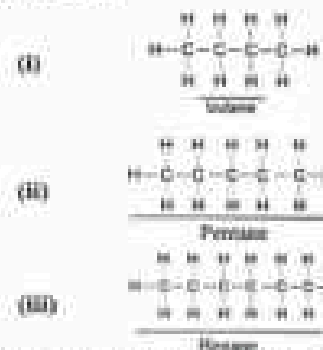
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6	a	7	b	8	a	9	c	10	c
11	c	12	b	13	a	14	c	15	c
16	a	17	c	18	c	19	c	20	b
21	a	22	a	23	d	24	d	25	b
26	a	27	d	28	b	29	a	30	b
31	c	32	b	33	a	34	d	35	a
36	c								



Short Questions (Exercise)

- Q.1. Give three examples of saturated hydrocarbons. Ans. Those hydrocarbons in which there is a single covalent bond between carbon atoms called saturated hydrocarbons.

Examples



- Q.4. What do you mean by hydrogenation reaction? Give one example. Ans. Hydrogenation means addition of molecular hydrogen to an unsaturated hydrocarbon in presence of a catalyst (Ni, Pt) to form saturated compound e.g.

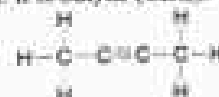


- Q.5. What is meant by cracking? Ans. A large hydrocarbon (alkane) molecule breaks into smaller hydrocarbons when heated at high temperatures such as $450 - 750^\circ\text{C}$ and high pressure. This process is

called thermal cracking. This process produces a mixture of alkanes and alkenes. For example, when decane is heated at high temperature and high pressure, it breaks down into octane and ethene.

SLO Based Additional Short Questions (Reference Material)

- Q.6. A compound consisting of four carbon atoms has a triple bond in it. How many hydrogen atoms are present in it? Ans. There are six hydrogen atoms in a compound containing the four carbon atoms and having a triple bond in it. It is butyne (C_4H_6).



- Q.7. Why are the alkanes called paraffins? Ans. Alkanes are saturated hydrocarbons. In these compounds all the bonds of carbon atoms are single that means valencies of carbon atoms are fully satisfied (saturated). Therefore they are least reactive. That is the reason alkanes are called paraffins.



Q.8. What do you know about hydrogenation of alkenes? (OR) (Define hydrogenation. Give an example.)

Ans. Hydrogenation means addition of molecular hydrogen to an unsaturated hydrocarbon in presence of a catalyst (Ni, Pt) to form saturated compound e.g.



Q.9. How are alkyl halides reduced?

Ans. Reduction of alkyl halides:

Reduction means addition of nascent hydrogen. In fact, it is a replacement of a halogen atom with a hydrogen atom. This reaction takes place in the presence of Zn metal and HCl, e.g.



Q.10. Why are the alkanes used as fuel? (How hydrocarbons act as a fuel?) / How does combustion of methane take place? / Describe the combustion process with equation.

Ans. Alkanes burn in the presence of excess of air or oxygen to produce a lot of heat, carbon dioxide and water. This reaction takes place in automobile combustion engines, domestic heaters and cooking appliances. It is highly

exothermic reaction and because of it alkanes are used as fuel, e.g.



Q.11. Why alkanes can't be oxidized with KMnO_4 solution?

Ans. Alkanes are saturated hydrocarbons.

They are least reactive that is why alkanes can't be oxidized with KMnO_4 solution.

Q.12. Justify that alkanes give substitution reactions.

Ans. A reaction in which one or more hydrogen atoms of a saturated compound are replaced with some other atoms is called a substitution reaction. These reactions are characteristic property of alkanes. For example in diffused sunlight alkanes react fairly with halogens. In these reactions at each step one hydrogen atom is substituted by halogen atom.



Chloromethane



Dichloromethane



Trichloromethane (Chloroform)



Tetrachloromethane (Carbon Tetrachloride)

Q.13. Why are hydrocarbons soluble in organic solvents?

Ans. Hydrocarbons are soluble in organic solvents because they are non-polar in nature.

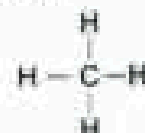
Q.14. Give the physical properties of alkanes.

Ans. (i) Alkanes are non-polar, therefore they are insoluble in water but soluble in organic solvents, (ii) The density of alkanes increases gradually with the increase of molecular size, (iii) The alkanes become more viscous as their molecular sizes increase, (iv) Alkanes become less flammable i.e. difficult to burn with the increase of molecular size.



Q.15. Define alkanes and give one example.

Ans. Alkanes are saturated hydrocarbons in which all the carbon atoms are connected by only single covalent bond.



Methane



Ethane

The general formula of alkanes is $\text{C}_n\text{H}_{2n+2}$

Q.16. What are hydrocarbons?

Ans. Hydrocarbons are organic compounds of carbon and hydrogen elements. They are alkanes, alkenes, alkynes and aromatics.

Q.17. What are aliphatic hydrocarbons?

Ans. These are the compounds in which the first and the last carbon are not directly joined to each other. These may be straight or branched chain hydrocarbons.

Examples:



pentane



isobutane

Q.18. Give a few uses of methane.

Ans. (i) Natural gas is chiefly methane and is used as domestic fuel.

(ii) Compressed natural gas (CNG) is used as automobile fuel.

Q.19. Write the sources of alkanes.

Ans. (i) The main sources of alkanes are petroleum and natural gas.

(ii) Methane forms about 83% of Natural gas.

(iii) Fuel gases obtained from coal gas contain alkanes in small amount.

Q.20. Why is methane known as marsh gas?

Ans. Methane is known as Marsh Gas. It can be explained through a simple experiment. Poke around with

a stick in the muddy bottom of a pond or marsh. You may see bubbles coming out of the mud. These bubbles are the hydrocarbon gas methane, which is sometimes called 'marsh gas'. If you collect the gas in a jar you can set fire to it.

Q.21. Why is butane used in portable torches and gas lighters?

Ans. Propane and butane burn with very hot flames and are sold as liquefied petroleum gas (LPG). They are kept as liquids under pressure, but they vaporize easily when the pressure is released. Cylinders of butane are used in the homes. Butane is also used in portable torches and gas lighters.

Q.22. Describe the hydrogenation of ethene and ethyne.

Ans. Hydrogenation means addition of molecular hydrogen in alkenes and alkynes. As we know alkenes and alkynes are unsaturated compounds, so they have the capacity to add up atoms in them. This reaction is carried out in the presence of nickel catalyst at 150°C to 300°C . However, in the presence of catalyst platinum or palladium, the reaction takes place at room temperature, such as:





Similarly,



Q.23. Why is combustion of alkanes in limited supply of oxygen harmful?

answer

Ans. In the limited supply of oxygen, there is incomplete combustion. As a result, carbon monoxide is produced that causes suffocation and causes death. As shown in chemical equation.



Q.24. Why are hydrocarbons considered as parent organic compounds?

answer

Ans. Hydrocarbons are those compounds which are made up of only carbon and hydrogen elements.

Hydrocarbons are regarded as the parent organic compounds since other organic compounds are considered to be derived from them by replacement of one or more hydrogen atoms by other atoms or group of atoms.

Q.25. Give the general formula of saturated and unsaturated hydrocarbons.

answer

Ans. i) General formula of saturated hydrocarbons:

Alkanes are saturated hydrocarbons, their general formula is $\text{C}_n\text{H}_{2n+2}$.

ii) General formula of unsaturated hydrocarbons:

Alkenes and alkynes are unsaturated hydrocarbons.

- General formula of alkenes is C_nH_{2n} .

- General formula of alkynes is $\text{C}_n\text{H}_{2n-2}$.

Q.26. Which is the simplest alkane?

answer

Ans. The simplest hydrocarbons are alkanes, while simplest alkane is methane having formula CH_4 .

Q.27. Give the structural formula of isopentane and isobutane.

answer

Ans.



Q.28. What do you mean by halogenation?

Give the reaction of methane with chlorine in bright sunlight.

answer

Ans. Halogenation is a substitution reaction in which one or more hydrogen atoms of saturated hydrocarbon, such as methane are replaced with halogen atom (F, Cl or Br). In bright sunlight, the reaction of methane with chlorine is explosive and carbon is deposited.



Q.29. Define photochemical reaction.

answer

Ans. A chemical reaction that takes place in presence of sun light is called as photochemical reaction.

Biochemistry

Q.1. What are lipids? How are lipids important to our body?

answer

Ans. Properties of Lipids:

Lipids are fatty, waxy, or oily compounds that are soluble in organic solvents like alcohol, chloroform and insoluble in polar solvents such as water. Lipids are mainly composed of hydrocarbons and little oxygen, making them an excellent form of energy storage.

Functions of lipids in our body:

Lipids are fatty compounds that perform a variety of functions in your body. They're part of your cell membranes and help control what goes in and out of your cells. They help with moving and storing energy, absorbing vitamins, and making hormones.

Vitamin A, D, K, and E are the four fat-soluble vitamins and can be found in different foods like butternut squash, broccoli, and salmon fish. Eating dietary fat in a balanced diet helps you to absorb these fat-soluble vitamins, such as a cabbage salad with olive oil dressing and walnuts.

Q.2. How do you maintain a balanced diet?

answer

Ans. A healthy diet requires lots of different nutrients in appropriate amounts that include fats, proteins, and carbohydrates; micronutrients such as vitamins and minerals and an adequate amount of water to meet the needs for human nutrition. That means eating a variety of foods from each of the main food groups.

Consider the following tips for your meal:

- Eat more vegetables and fruit.
- Eat less carbohydrates.
- Eat less sugar.
- Eat less salt.
- Eat less fat.

Q.3. What percentage of fat is required in a balanced diet? Why is the percentage of fat being lowest in major food components? Justify.

answer

Ans. Percentage of fat in balanced diet:

In a balanced diet, it is generally recommended that fat makes up about 20 – 35% of total daily calories.

Fat is an essential nutrient that plays a crucial role in the body. It provides energy, helps absorb fat-soluble vitamins (Vitamins A, D, E, and K), insulates the body and supports cell growth.

However, it is important to consume the right types of fats.

Unsaturated fat: These fats found in nuts, seeds, avocados and fish. Unsaturated fats are healthy for us.

Saturated fat: These fats found in processed and fried foods. Saturated fats are unhealthy for us.

Lower percentage of fats in balanced diet: The percentage of fat in a balanced diet is often lower as compared to other food like carbohydrates and proteins. Because fats are more calorie-dense.

1 gram of fat contains 9 kilocalories energy while both carbohydrates and proteins provides 4 kilocalories energy. Consuming too much fat lead to excess calorie intake which cause to weight gain and various health issues.



Q.4. What are the sources and functions of nucleic acids?

ANSWER

Ans. Sources of nucleic acid: Seeds, grain, and fish eggs are good sources of the genetic material, DNA.

Functions of nucleic acid: DNA is a type of genetic material that contains all a person's genetic information.

DNA also allows genetic information to be passed down from one generation to the next.

RNA play a role in the expression of DNA's genetic code by generating certain proteins.

Q.5. Imagine you are a nutritionist task to design a meal plan for athletes participating in a marathon. Explain the role of carbohydrates can affect an athlete's performance during the marathon.

ANSWER

Ans. Role of Carbohydrate: As a nutritionist designing a meal plan for athletes in a marathon, carbohydrates play a crucial role in enhancing their performance during the race.

Carbohydrates are the body's primary source of energy especially endurance activities like a marathon.

Before the marathon: Athletes should consume a meal rich in carbohydrates to fuel their muscles and provide a readily available source of energy. Carbohydrates are stored in the muscles and liver as glycogen, which is broken down into glucose to fuel the body during exercise.

During the marathon: Maintaining adequate carbohydrate stores is essential to sustain energy levels and prevent fatigue. Consuming easily digestible carbohydrates during the race such as energy gels, sports drinks or energy bars can help replenish glycogen stores and provide a quick source of energy to keep the athletes going strong.

Concept Assessment 15.1

Q.6. (i) Differentiate between DNA and RNA.

ANSWER

(ii) Differentiate between proteins and lipids.

Ans. (i) DNA: DNA (deoxyribonucleic acid) is a double stranded form of nucleic acid that contains the genetic substance employed for the growth and functioning of all inferred living organisms.

RNA: RNA is a single-stranded nucleic acid that converts genetic information from genes into amino acid sequences of proteins.

(ii) The main role of proteins is to carry out functions for cells.

Proteins are also essential for wound healing and for brain function. Proteins also help other types of communication within the body. Many hormones, or chemical messengers, are proteins. They speed up chemical reactions.

Lipids primarily function as an energy reserve. Lipids are an important source of energy. They are insoluble in water. They also provide insulation to the body.



Multiple Choice Questions (Exercise)

- In small village children frequently suffered from different infectious diseases due to weak immune system. Which major nutrients were lacking in their food?
(a) Amino acids (b) Carbohydrates
(c) Proteins (d) Lipids
- Which of the following food components are rich in fat?
(a) Rice and maize
(b) Pulses and wheat
(c) Milk, egg and beans
(d) Cheese, butter and oil
- Potatoes, cereals, beans, pulses, and nuts are rich in:
(a) Proteins (b) Carbohydrates
(c) amino acids (d) Fat
- What is a bond between amino acids called?
(a) Ionic bond (b) Acidic bond
(c) Peptide bond (d) hydrogen bond
- The major function of carbohydrates includes:
(a) Storage
(b) Structural framework
(c) Defense system of body
(d) Messenger
- Which of the following disorders is NOT caused by the deficiency of proteins?
(a) Weight loss
(b) Muscle fatigue
(c) Loss in muscle strength
(d) Constipation
- Food containing starch and carbohydrates are important because:
(a) They make your bones strong.
(b) They stop you from getting overweight.
(c) They are easy to cook.
(d) They give you energy.
- Meat, fish, and other alternatives provide the following important nutrients:
(a) Carbohydrates (b) Protein
(c) Lipids (d) Sugar
- Which nutrients builds, maintains and repairs body tissues and cells?
(a) Carbohydrates (b) Protein
(c) Lipids (d) Water
- Marlene's doctor told her that she is facing shortage of blood and have anemia. What nutrients are lacking in Marlene's diet?
(a) Carbohydrates (b) Protein
(c) Lipids (d) Water

SLO Based Additional MCQs

- Thousands of amino acids polymerize to form:
(a) Carbohydrates (b) Proteins
(c) Lipids (d) Vitamins
- Enzymes are proteins which have the following properties except:
(a) they catalyze reactions
(b) they are highly non-specific
(c) they are highly efficient
(d) they are produced by living cells
- Which one of the following vitamins is water soluble?
(a) Vitamin A (b) Vitamin C
(c) Vitamin D (d) Vitamin E
- Which one of the following is a fat soluble vitamin?
(a) A (b) E
(c) K (d) All of these



15. Lipids are macromolecules. They have characteristics except one of the following: ANSWER: (a)
 - (a) They are high energy foods
 - (b) They are soluble in water
 - (c) They are poor conductor of heat
 - (d) They are esters of fatty acids
16. Human body uses carbohydrates in the form of: ANSWER: (a)
 - (a) Glucose
 - (b) Maltose
 - (c) Fructose
 - (d) galactose
17. Which carbohydrates is used directly by muscles of energy? ANSWER: (a)
 - (a) galactose
 - (b) lactose
 - (c) glucose
 - (d) fructose
18. Which helps to keep the bowel functioning properly? ANSWER: (b)
 - (a) vitamins
 - (b) fibre
 - (c) lipids
 - (d) all of these
19. Amino acids are the building blocks of: ANSWER: (a)
 - (a) proteins
 - (b) carbohydrates
 - (c) vitamins
 - (d) fats
20. Protein is not found in: ANSWER: (c)
 - (a) muscles
 - (b) skin
 - (c) corns
 - (d) hair
21. A bond formed between two amino acids is: ANSWER: (a)
 - (a) peptide linkage
 - (b) covalent bond
 - (c) hydrogen bond
 - (d) glycosidic linkage
22. The nature of enzymes is: ANSWER: (b)
 - (a) vitamin
 - (b) protein
 - (c) carbohydrate
 - (d) fat
23. The building blocks of lipids are: ANSWER: (a)
 - (a) fatty acids
 - (b) carboxylic acids
 - (c) mineral acids
 - (d) alcohols
24. Nucleic acids are made up of long chains of: ANSWER: (a)
 - (a) nucleotides
 - (b) fatty acids
 - (c) amino acids
 - (d) none of these
25. RNA consists of: ANSWER: (a)
 - (a) ribose sugar
 - (b) deoxy sugar
 - (c) hexoses
 - (d) trioses
26. Which is a hereditary material? ANSWER: (a)
 - (a) DNA
 - (b) RNA
 - (c) Protein
 - (d) All of these

27. Basic structural unit of nucleic acid is: ANSWER: (d)
 - (a) amino acid
 - (b) glucose
 - (c) nucleoside
 - (d) nucleotide
28. Number of amino acids in proteins is: ANSWER: (d)
 - (a) 1000
 - (b) more than 1000
 - (c) less than 10000
 - (d) more than 10000
29. Glucose absorbs in which part of the digestive system: ANSWER: (a)
 - (a) stomach
 - (b) liver
 - (c) small intestine
 - (d) large intestine
30. Which of the following statements is incorrect about enzymes? ANSWER: (c)
 - (a) They are used for purification of fruit juices
 - (b) They are used in paper industry
 - (c) They are used for fermentation of molasses to produce methanol
 - (d) They are used in detergents
31. Which of the following is responsible for the synthesis of new proteins? ANSWER: (b)
 - (a) DNA
 - (b) RNA
 - (c) DNA and RNA
 - (d) Vitamins
32. 1 gram of carbohydrate contains _____ energy. ANSWER: (a)
 - (a) 9 kilo-calories
 - (b) 7 kilo-calories
 - (c) 4 kilo-calories
 - (d) 5 kilo-calories
33. They study of organic and inorganic molecules present in living organisms known as: ANSWER: (d)
 - (a) Environmental chemistry
 - (b) Nuclear chemistry
 - (c) Physical chemistry
 - (d) Biochemistry
34. A calorie raise the temperature of 1 gram of water by _____ ANSWER: (a)
 - (a) 2°C
 - (b) 1°C
 - (c) 3°C
 - (d) 4°C
35. 1 gram protein contains _____ energy. ANSWER: (b)
 - (a) 4 kilo-calories
 - (b) 7 kilo-calories
 - (c) 9 kilo-calories
 - (d) 5 kilo-calories



Answer Key

1	c	2	d	3	b	4	c	5	a
6	d	7	d	8	b	9	b	10	b
11	b	12	b	13	b	14	d	15	b
16	a	17	c	18	b	19	a	20	c
21	a	22	b	23	a	24	a	25	a
26	a	27	d	28	d	29	c	30	b
31	b	32	c	33	d	34	b	35	a

Short Questions (Exercise)

Q.1. Give three reasons why living organisms need food. ANSWER:

Ans. Living organisms need food for three main reasons:

- a) Food provides the energy necessary for various biological processes like growth, movement and reproduction.
- b) Food contains essential nutrients such as carbohydrates, proteins, fats, vitamins and minerals. These are required for maintaining health, supporting growth and repairing tissues.
- c) Food provides the building blocks needed for the maintenance and repair of cells and tissues in the body. Proteins from food are crucial for building and repairing tissues.

Q.2. What is a balanced diet? What is the importance of balanced diet? ANSWER:

Ans. A "balanced diet" provides all the nutrients in suitable amounts needed to carry out the life processes. At every life stage, our diet is fundamental to our overall health and happiness. A healthy diet can lower the risk of disease. It also increases bone health and muscle strength.

A balanced diet includes a variety of foods in limited amounts and proportions to satisfy the needs for calories, proteins, minerals, vitamins, and other nutrients. A balanced diet should contain the correct proportion of

six basic nutrients e.g., carbohydrates, lipids, proteins, vitamins, minerals, water, and dietary fibre.

Q.3. State four functions of proteins. Give one example to illustrate your answer. ANSWER:

Ans. Proteins are macromolecules that are responsible for most of the function that take place in the body. They do most of the work in cells and are required for the structure, function, and regulation of the body's tissues and organs. The building blocks of proteins are amino acids.

1 gram protein → 4 kilocalories energy

Q.4. Suggest two major foods a mother could give to her growing child? And why? ANSWER:

Ans. Two major foods a mother could give to her growing child are fruits and vegetables. Fruits and vegetables are rich in essential vitamins, minerals and antioxidants that are crucial for the child's growth and development. They provide a wide range of nutrients that support overall health, strengthen the immune system and promote proper growth.

Q.5. Carbohydrates are a major source of energy. Defend the statement. ANSWER:

Ans. Carbohydrates are broken down by the body into glucose - a type of sugar. Your body cells, tissues, and organs use



glucose as fuel. When your body does not get suitable carbohydrates, it looks for another energy source, breaking down the protein in your muscles and body fat to use as energy. Glucose is the preferred fuel for the brain, which can't simply use other fuel resources like fat or protein for energy.

- Q.6. Fatima has fond of junk food like French fries, burgers, and pizza. What will happen if Fatima only eats junk food? What should she add to her routine food?

Ans. If Fatima only eats junk food, she may experience several negative health effects. Junk food is typically high in unhealthy fats, sugars and calories but low in essential nutrients like vitamins, minerals and fiber. This causes weight gain, increased risk of heart disease, diabetes and high blood pressure. Fatima should add more nutritious foods to her routine such as fruits, vegetables, whole grains, proteins and healthy fats. These foods provide essential nutrients, vitamins and minerals that are vital for overall health and well-being.

SLO Based Additional Short Questions: (Reference Material)

- Q.7. Define Nutrition/ diet.
- Ans. Nutrition is the source of food required by living things to stay alive. Our food choices impact our health. Good nutrition forms an important part of a healthy lifestyle. All living organisms are made up of molecules that carry out characteristics of life. The total number of molecules or nutrients that we need is called nutrition or diet.
- Q.8. What are the benefits of healthy balanced diet?
- Ans. Benefits of healthy diet:
- Reduces high blood pressure.
 - Lowers high cholesterol.
 - A healthy balanced diet can prevent certain diseases, such as obesity, diabetes, cardiovascular diseases, cancer, and skeletal problems.
- Q.9. What are the basic nutrients for a healthy balanced diet?
- Ans. A balanced diet includes a variety of foods in limited amounts and proportions to satisfy the needs for calories, proteins, minerals, vitamins, and other nutrients. A balanced diet should contain the correct proportion of

six basic nutrients e.g., carbohydrates, lipids, proteins, vitamins, minerals, water, and dietary fiber.

- Q.10. Define biochemistry.
- Ans. Biochemistry is a combination of biology and chemistry. It is the study of living matter. The study of organic and inorganic molecules present in a living organism is known as biochemistry.
- Q.11. What are carbohydrates?
- Ans. Carbohydrates or hydrates of carbon are macromolecules made of carbon, hydrogen, and oxygen. The primary function of carbohydrates is to supply energy to all cells of body.
1 gram of carbohydrates $\rightarrow$ 4 kilocalories energy.
- Q.12. What do you know about Calorie?
- Ans. A calorie is a unit that is used to measure the energy in your food. A calorie is the energy that it takes to raise the temperature of 1 gram of water by 1 degree centigrade. Calories are the amount of energy released when your body breaks down (digests and absorbs) food. The more calories a food has, the more energy it can provide to your body.



- Q.13. What do you know about Enzyme?

Ans. Enzymes are protein that act as biological catalysts in living organisms. They help speed up chemical reactions in the human body.

- Q.14. Where are the proteins found? / Write occurrence of proteins organism.

Ans. Proteins are present in all living organisms. They make up bulk of non-bony structure of the animal bodies. They are major component of all cells and tissues of animals. About 50% of the dry weight of cell is made up of proteins. They are found in muscles, skin, hair, nails, wool, feathers, etc.

- Q.15. How are proteins formed?

Ans. Formation of Proteins:

Two amino acids link through peptide linkage. Peptide linkage is formed by the elimination of water molecule between the amino group of one amino acid and carboxyl group of another amino acid.

When thousands of amino acids polymerize they form proteins.



- Q.16. What are proteins? Write their composition.

Ans. Proteins are highly complicated nitrogenous compounds made up of amino acids. Proteins consist of carbon, hydrogen, oxygen, nitrogen and sulphur. They are polymers of amino acids. Amino acids are linked with each other through peptide linkage. Protein has more than 10,000 amino acids. All proteins yield amino acids upon hydrolysis.

- Q.17. What are amino acids? Write their general formula.

Ans. Amino acids are organic compounds consisting of both amino and carboxyl groups.

They have the general formula:



Side chain 'R' is different for different amino acids. There are 20 amino acids.

- Q.18. What is the function of lipids in our body?

Ans. Lipids are fatty compounds that perform a variety of functions in your body. They're part of your cell membranes and help control what goes in and out of your cells. They help with moving and storing energy, absorbing vitamins, and making hormones.

- Q.19. Where do lipids come from?

Ans. Most of the cholesterol in your body is produced by your liver. Your lifestyle choices, including diet, have a major influence on the production of cholesterol and triglycerides.

- Q.20. What are the sources of fat soluble vitamins?

Ans. Vitamins A, D, E, and K are the four fat-soluble vitamins and can be found in different foods like butternut squash, broccoli, and salmon fish. Eating dietary fat in a balanced diet helps you to absorb these fat-soluble



vitamins, such as a cabbage salad with olive oil dressing and walnuts.

Q.21. What are Nucleic acids? ANSWER

Ans. Nucleic acids are large biomolecules (macromolecules) that play essential roles in the cells. Nucleic acids contain genetic information and play a key role in protein biosynthesis. They are macromolecules formed by nucleotides. Nucleotide is the basic building block of nucleic acids (RNA and DNA).

Q.22. Differentiate b/w DNA and RNA. ANSWER

Ans. DNA: DNA (deoxyribonucleic acid) is a double stranded form of nucleic acid that contains the genetic substance employed for the growth and functioning of all inferred living organisms.

RNA: RNA is a single-stranded nucleic acid that converts genetic information from genes into amino acid sequences of proteins.

Q.23. Write sources of carbohydrates. ANSWER

Ans. Carbohydrates are the body's main energy source. Dairy products such as yogurt, milk, ice-cream, fruits, grains, plant-based proteins, and beans are major sources of carbohydrates.

Q.24. What are the functions of carbohydrates? ANSWER

Ans. Carbohydrates provide energy to feed the muscles and brain, while fiber helps us feel full and aids digestion and elimination.

Q.25. What are the properties of carbohydrates? ANSWER

Ans. Carbohydrates are soluble in water and readily broken down into sugars that can be oxidized during cellular respiration. These properties allow for carbohydrates to be a source of fuel for living things. Carbohydrates can be converted into fats and amino acids.

Q.26. What diseases can be caused due to lack of carbohydrates? ANSWER

Ans. A carbohydrate-deficient diet may cause headaches, fatigue, weakness, difficulty concentrating, nausea, constipation, bad breath, vitamin and mineral deficiencies.

Q.27. Write sources of proteins. ANSWER

Ans. Proteins are found in meat, fish, and eggs from animals and in peas, pulses, and beans from plants. Soy beans are one of the major sources. They contain very little fat.

Q.28. What are the functions of proteins? ANSWER

Ans. The main role of proteins is to carry out functions for cells. Proteins are also essential for wound healing and for brain function. Proteins also help other types of communication within the body. Many hormones, or chemical messengers, are proteins. They speed up chemical reactions.

Q.29. What are the properties of proteins? ANSWER

Ans. Proteins are colorless and usually tasteless. Proteins are digested in the stomach and small intestine and absorbed as amino acids. Proteins are used to make enzymes.

Q.30. What diseases can be caused due to lack of proteins? ANSWER

Ans. Little growth in children, brittle hair and nails, poor wound healing, anemia, unintentional weight loss, and scaly skin.

Q.31. Write sources of lipids. ANSWER

Ans. Meat and animal foods, e.g., eggs, milk, and cheese, are rich in saturated fats and cholesterol. Plant sources such as sunflower seeds and peanuts are rich in unsaturated fats.

Q.32. What are the functions of lipids? ANSWER

Ans. Lipids primarily function as an energy reserve. Lipids are an important source of energy. They are insoluble in water. They also provide insulation to the body.

Q.33. What are the properties of lipids? ANSWER

Ans. Lipids and fats are digested in small intestine and absorbed as fatty acids, and glycerol. The body can store unlimited amounts of fats contributing to obesity.

Lipids are not soluble in water but are thus soluble in solvents such as chloroform.

Q.34. What diseases can be caused due to lack of lipids? ANSWER

Ans. Dry rashes, hair loss, a weaker immune system, decreased growth in infants, and children, increased risk of different infections.

Q.35. What are the properties of nucleic acid? ANSWER

Ans. Nucleic acid carries genetic information which is read in cells to make the RNA and proteins by which living things work.

Nucleic acids play a central role in a wide variety of cellular processes, including metabolic regulation and the storage and utilization of genetic information.

Q.36. What diseases can be caused due to lack of nucleic acid? ANSWER

Ans. Lesch-Nyhan syndrome (a rare congenital (A birth disorder that affects a child's brain and behavior), and stasis

triangles also known as Louis- Bar syndrome, a rare inherited childhood neurological disorder that affects the part of the brain that controls motor movement, intended movement of muscles and speech.

Q.37. What is Malnutrition? ANSWER

Ans. Malnutrition is a condition that develops when the body is deprived of vitamins, minerals, and other nutrients. Malnutrition occurs in people who are either undernourished or over nourished.

Q.38. What is Marasmus? ANSWER

Ans. Marasmus is a disease caused by insufficient levels of nutrition in the diet. Marasmus is severely undernutrition - a deficiency in all the macronutrients that the body requires to function, including carbohydrates, proteins, and fats.

Q.39. What are the dangers of high calorie foods? ANSWER

Ans. Research proves that food consisting of mostly high-calorie-density foods has a high risk of weight gain and obesity. Calorie density also affects hunger.

Q.40. Why is it good to eat low calorie foods and why? ANSWER

Ans. Low-calorie-density foods tend to provide less fat and more water and fiber.



UNIT 16

Empirical Data Collection and Analysis

Q.1. How to calculate the accuracy of measurements?

ANSWER

Ans. Calculating the accuracy of measurements involves comparing the measured value to the true or accepted value.

The accuracy can be determined by calculating the percent error.

Rules:

- I. Subtract the measured value from the true value to find the error.
- II. Divide the error by the true value.
- III. Multiply the result by 100 to get the percent error.

Formula for percent error

$$\text{Percent error} = \frac{[\text{Measured value} - \text{True Value}]}{[\text{True Value}]} \times 100$$

Conclusion: By calculating the percent error, you can determine how close the measured value is to the true value, providing insight into the accuracy of the measurement.

Q.2. Evaluate how tools for measurements are helpful in performing scientific technique.

ANSWER

Ans. Experimental methods have become a valuable part of human life to learn about the world around them. Chemists used different tools and techniques to perform experimental procedures. Marie Curie, Robert Boyle, Linus Pauling, Ernest Rutherford, and Antoine Lavoisier, for instance, did various experiments to uncover key concepts of chemistry. The same goes for modern experts, who utilize this scientific method to see if new drugs are effective, discover treatments for illnesses, and discover new gadgets.

Advantages	Disadvantages
It gives researchers a high level of control.	It can lead to artificial situations.
It allows researchers to utilize many variations.	It can take a lot of time and money.
It can lead to excellent results.	It can be affected by errors.
It can be used in different fields.	It might not be feasible in some situations.

Q.3. How does scientific notation enhance the ability to communicate about extremely large and small numbers? CONVINCER

ANSWER

Ans. Definition: Scientific notation or standard form is used to represent very large or very small numbers in the form of multiplication of single-digit numbers and exponent raised to the power of 10.

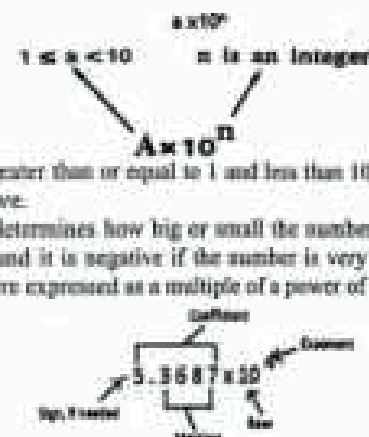
Importance:

Scientific notation simplifies calculations, comparisons, and communication of measurement involving very large or very small numbers. It is a powerful tool for expressing the magnitudes of quantities used in everyday life.

Example:

650,000,000 can be written in scientific notation as 6.5×10^8 .

The magnitude of any physical quantity can be expressed as:



Where A is any number greater than or equal to 1 and less than 10 and n is any integer (whole number), negative or positive.

The exponent of base 10 determines how big or small the number. The exponent is positive if the number is very large, and it is negative if the number is very small. Numbers in scientific notation of standard form are expressed as a multiple of a power of ten.

Q.4. Who do scientists realize the need for a standardized system of measurement? CONVINCER

Ans. Measurement difficulty in past: In the past, people didn't have accurate measuring methods to calculate standard measurements. People used abstract units to measure with. For example, when an object was measured with a cubit or hand span, its length varied from person to person. The simple reason for the variation was the difference in the size of the cubit or hand-span of each person. Thus, this system of measurement was inconvenient as well as inaccurate.



System International Unit:

So, to maintain uniformity in measurement, scientists from all over the world accepted some of the units as standard units. This set of units is generally referred to as Standard International or SI system of units.

In 1960, scientists from different parts of the world gathered and agreed to adopt a single system of units called the International System of Units or SI units.

SI Units in Chemistry:

In the field of chemistry, the international system of units (SI) is used to measure physical quantities such as mass, volume, and temperature. This standard system ensures that chemists around the world can use the same units to measure and communicate their results, facilitating communication and collaboration in the field. Without standard units, it would be difficult for chemists to compare the results with one another, and it would be challenging to develop consistent and accurate scientific models.

Unit of measurement:

During measurement, we compare the unknown quantity of things or substances with a known fixed quantity. This fixed quantity with which we compare unknown quantities is called a unit of measurement. The standard unit of measurement is a value that is fixed and cannot be changed.



Multiple Choice Questions (Exercise)

- What is the volume of the liquid in this graduated cylinder?
(a) 25 (b) 24 (c) 23 (d) 22
- How many cubic centimeters (cm^3) are there in 1 decimeter cube (1 dm^3)?
(a) 100 cm^3 (b) 1000 cm^3 (c) 10 cm^3 (d) 1 cm^3
- To change SI units by factors of ten into smaller or bigger units they use:
(a) Prefixes (b) Symbols (c) Abbreviations (d) Ratio
- A distance of 1 kilometer means?
(a) 100 cm (b) 1000 cm (c) 10 cm (d) 1000 m
- One nanometer is equal to:
(a) 10^{-12} m (b) 10^{-9} m (c) 10^{-6} m (d) 10^{-3} m



- The standard form of 380000000000 is:
(a) 3.8×10^2 (b) 3.8×10^3 (c) 3.8×10^{10} (d) 3.8×10^{11}
- The property of a measuring instrument to give the output very close to the actual value is termed as:
(a) Sensitivity (b) Accuracy (c) Precision (d) Repeatability
- The standard form of 0.00000000004 is:
(a) 3.4×10^{-9} (b) 3.4×10^{-10} (c) 3.4×10^{-11} (d) 3.4×10^{-12}
- In SI, the unit of mass is:
(a) kilogram (b) centimetre (c) kelvin (d) millimetre
- In the measuring instruments, the degree of conformity and closeness to the true value is known as:
(a) precision (b) accuracy (c) Sensitivity (d) Comparability

SLO Based Additional MCQs

- The number of base units in SI are:
(a) 3 (b) 6 (c) 7 (d) 8
- Which one of the following unit is not a derived unit?
(a) Pascal (b) kilogramme (c) kelvin (d) watt
- Amount of a substance in terms of numbers is measured in:
(a) gram (b) kilo-gram (c) newton (d) mole
- An interval of 200 ps equivalent to:
(a) 0.2s (b) 0.02s (c) $2 \times 10^{-12} \text{ s}$ (d) $2 \times 10^{-9} \text{ s}$
- Which one of the following is the smallest quantity?
(a) 0.01g (b) 2mg (c) 100µg (d) 100ng

- A measuring cylinder is used to measure:
(a) mass (b) area (c) volume (d) level of liquid
- Intero(μ) =
(a) 10^{-2} (b) 10^{-6} (c) 10^{-9} (d) 10^{-12}
- 1nm have meters:
(a) 10^{-9} m (b) 10^{-6} m (c) 10^{-8} m (d) 10^{-10} m
- The eleventh general conference was held in Paris in:
(a) 1959 (b) 1961 (c) 1960 (d) 1968
- The number 0.00580 in scientific notation is:
(a) 5.80×10^2 (b) 5.80×10^{-4} (c) 5.80×10^{-3} (d) 5.80×10^{-5}



- One cubic metre is equal to:
(a) 100 litre (b) 1000 litre (c) 10000 litre (d) 1 litre
- The base quantity is:
(a) mass (b) volume (c) torque (d) momentum
- For balancing the beam balance, pointer must be at:
(a) zero (b) extreme position (c) the right side (d) the left side
- Least count of electronic balance is:
(a) 0.001g (b) 0.01g (c) 0.1g (d) 0.0001g
- Least count of digital stop watch is:
(a) 0.01 sec (b) 0.1 sec (c) 1 sec (d) 10 sec
- Mechanical stop watch can measure up to part of a second:
(a) 1 (b) $1/10^6$ (c) $1/100^6$ (d) $1/1000^6$
- Meniscus of which liquid curves upward:
(a) Water (b) Honey (c) Milk (d) Mercury
- A physical quantity possesses characteristics:
(a) 2 (b) 3 (c) 4 (d) 5

- The scientific notation of number 0.00235 is expressed as:
(a) 2.3×10^{-3} (b) 2.35×10^{-3} (c) 0.235×10^{-2} (d) 0.0235×10^{-2}
- In prefix form, 0.000001 would be expressed as:
(a) 0.1mm (b) 0.01mm (c) 0.001mm (d) 0.0001mm
- Standards of physical quantities were established in:
(a) 1910 (b) 1920 (c) 1950 (d) 1960
- Prefix naming as Giga has a symbol:
(a) M (b) G (c) m (d) g
- According to SI-units, intensity of light is measured in:
(a) meters (b) moles (c) candela (d) second
- One mega is equal to:
(a) 10^2 (b) 10^4 (c) 10^7 (d) 10^6
- One litre is equal to:
(a) 1 mm^3 (b) 1 cm^3 (c) 1 dm^3 (d) 1 m^3
- One tera is equal to:
(a) 10^{-12} (b) 10^{-10} (c) 10^{12} (d) 10^{10}

Answer Key

1	b	2	b	3	a	4	d	5	b
6	c	7	b	8	c	9	a	10	b
11	c	12	b	13	d	14	c	15	d
16	c	17	b	18	c	19	d	20	c
21	b	22	a	23	a	24	d	25	a
26	b	27	d	28	a	29	b	30	c
31	d	32	b	33	c	34	d	35	c
36	a								



Short Questions (Exercise)

Q.1. What is system international? Why SI units are standardized for better communication and collaboration.

Ans. Before in past measurement in the past, people didn't have accurate measuring methods to calculate standard measurements. People used abstract units to measure with. For example, when an object was measured with a cubit or hand span of each person its length varied from person to person. The simple reason for the variation was the difference in the size of the cubit or hand-span of each person. Thus, this system of measurement was inconvenient as well as inaccurate.

System International Unit: To maintain uniformity in measurement, scientists from all over the world accepted some of the units as standard units. This set of units is generally referred to as Standard International or SI system of units.

In 1960, scientists from different parts of the world gathered and agreed to adopt a single system of units called the International System of Units or SI units.

Q.2. In a race, why it is essential to use seconds or minutes as the unit for measurement for recording the time instead of hours?

Ans. If we were to use hours as the unit of measurement, the times recorded would be very large number, making it harder to compare and analyze the results efficiently.

Using seconds or minutes allow for more precise and meaningful measurement, making it easier to see the differences in performance between participants.

Q.3. Differentiate b/w accuracy and precision.

Ans. **Accuracy:** Accuracy is a measure of how close an experimental measurement is to the true value. **Precision** refers to how close repeat measurements (using the same device) are to each other. In general, within the laboratory, accuracy is a measure of how well your equipment is adjusted. For example, if your balance is not adjusted correctly, you can make very precise, repeated measurements, but the measurements will not represent the true value.

Precision: Precision is usually determined by how careful the scientist is in making measurements. If you are careless and spill part of your sample on the way, your measurements in repeated experiments will not be precise even if your balance is accurate.

Q.4. A chemist has a sample of mass 0.003 kilograms. How will he convert this mass to milligrams?

Ans. To convert 0.003 kilograms to milligrams, a chemist would multiply the mass in kilograms by 10^3 .

$$0.003 \times 1000000$$

$$= 3000 \text{ milligrams}$$

Therefore, a chemist with a sample of 0.003 kilograms would have a mass of 3000 milligrams.



Q.5. What is the use of prefixes in measurements?

Ans. Prefixes help us to express measurements that are too big or too small in a more manageable way. They

Q.6. What are the advantages of using scientific tools like measuring cylinders, stopwatch and thermometers in measurements?

Ans. Advantages:

- It gives researchers a high level of control.
- It allows researchers to utilize many variations.
- It can lead to excellent results.
- It can be used in different fields.

basically act as a shortcut to avoid having to write out lots of zeros.

e.g. instead of writing 0.000001 kilogram we can just write 1 milligram.

SLO Based Additional Short Questions (Reference Material)

Q.7. What is measurement?

Ans. Measurement is a comparison of an unknown quantity with a known fixed quantity. For example, when you feel sick, your mother measures your body temperature with the help of a thermometer. The thermometer shows a 102°F temperature. Yes, since our normal body temperature is 98.6°F , any value above it confirms that you are suffering from fever. It means that by measuring your body temperature, she will know exactly if you have a fever or not.

Q.8. Define Physical quantity.

Ans. Physical quantity:

A quantity that can be measured is called physical quantity. For instance, mass, amount of substance, length, time, temperature, etc. etc.

Q.9. What is the unit of measurement?

Ans. During measurement, we compare the unknown quantity of things or substances with a known fixed quantity. This fixed quantity with which we compare unknown quantities is called a unit of measurement. The standard unit

of measurement is a value that is fixed and cannot be changed.

Q.10. Difference b/w base units and derived units?

Ans. **Base Units:** The units are standard used to measure physical quantities, such as mass or length. There are seven units called Fundamental Units (or Base Units). These are used to measure different physical quantities. The kilogram, meter, and second are the fundamental base units.

Derived Units: All other units that are derived from fundamental units are called Derived Units.

E.g: Watt, Pascal, Newton etc.

Q.11. Define scientific notation. Give example.

Ans. Scientific notation or Standard form is used to represent very large or very small numbers in the form of multiplication of single-digit numbers and exponent raised to the power of 10. For example, 650,000,000 can be written in scientific notation as 6.5×10^8 .



Q.12. What are the uses of measuring beaker? medium

Ans. Measuring Beakers are tools used to measure the approximate volume of liquids. Beakers are also used for holding samples, stirring, mixing, and heating liquids. Beakers can also be used as a container for reactions and to estimate the volume of liquid.

Q.13. What is the use of volumetric pipettes? medium

Ans. Most pipettes are used to transfer amounts of up to 1 – 100 ml of liquids. It can only measure a single volume, usually 25 cm³. However, they can measure this volume very accurately. They are designed to deliver the measured volume when emptied under gravity, so they hold a slightly greater volume than this. They should only be used with a pipette filler.

Q.14. How graduated cylinder can be used to measure a liquid accurately? medium

Ans. When a solution is in the graduated cylinder the liquid sticks to the sides making a 'U' shape called a meniscus. This makes it difficult to read a measuring cylinder accurately.

If you are too high, you will read a smaller volume. If you are too low, you will read a larger volume.

When you get to 'eye level' you will read an accurate volume of water.

Q.15. What is Burette? medium

Ans. Burettes are designed to deliver any volume up to 50 cm³. They are more accurate than measuring cylinders but less accurate than pipettes. The volume delivered can be deduced by subtracting the initial measurement from the final measurement. They need to be used with a stand, clamp and havis and they are mainly used in titrations.

Q.16. For what purpose gas syringes is used? medium

Ans. Gas syringes are used to collect and measure the volume of gas. They

have a similar accuracy to measuring cylinders.

Q.17. Write the use of laboratory thermometer? medium

Ans. Thermometer is used to be used for measuring temperatures other than the human body temperature. It ranges from -10°C to 110°C. The laboratory thermometers are used for laboratory purposes such as checking the boiling point and freezing points or temperature of other substances.

Q.18. For what purpose analytical balance is used? medium

Ans. Analytical balances are precise measuring instruments used in quantitative chemical analysis. It is used to determine the mass of solid objects, liquids, powders, and granular substances.

Q.19. What is an electronic balance? medium

Ans. Electronic balance is an instrument used in the accurate measurement of the weight of materials. Electronic balance is a significant instrument for laboratories for precise measurement of chemicals that are used in various experiments. Laboratory electronic balance provides digital results of measurement.

Q.20. What is the use of stop watch? medium

Ans. Stopwatches and timers are instruments used to measure time intervals, which is defined as the elapsed time between two events. Stopwatches show time reading up to 2 decimal places. So, the precision of most stopwatches is 0.01 seconds.

Q.21. What are the disadvantages of using scientific tools? medium

Ans. Advantages:

- It can lead to artificial situations.
- It can take a lot of time and money.
- It can be affected by errors.
- It might not be feasible in some situations.



UNIT 17

Separation Techniques

Q.1. What technique would you use to separate sand from water? There are two possibilities. Mention their names. medium

Ans. There are two possible methods to separate sand from water.

i. **Separation of sand from water by filtration:** To separate sand from water, filtration technique can be used.

Definition: Filtration is a method that separates solid particles from a liquid by passing the mixture through a filter medium.

Procedure: In this case, you can pour the sand and water mixture through a filter paper. The water will pass through, leaving the sand behind on the filter paper. This process effectively separates the sand from water, allowing you to collect the sand separately.

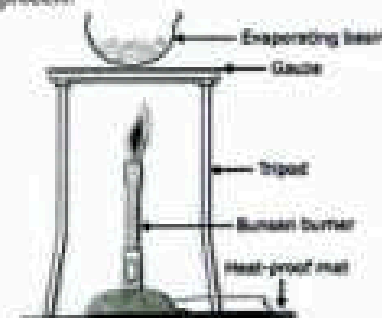
Use: It is simple technique commonly used in laboratories and at home to separate solid – liquid mixtures.



ii. **Separation of sand from water by Evaporation:** The process of evaporation can also be used to separate sand from water.

Procedure: In this method, you can pour the sand and water mixture into a container and allow the water to evaporate under the sunlight or using heat. As the water evaporates, it left behind sand which does not evaporate.

Note: This technique is effective when you want to recover both sand and water separately after the separation process.





Q.2. What technique would you use to separate alcohol from water?

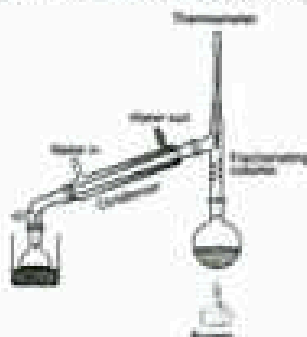
Ans. Separation of alcohol from water by distillation:

Distillation technique can be used to separate alcohol from water.

Definition: Distillation is a separation technique used to separate components of a liquid mixture by a process of heating and cooling which exploits the differences in the volatility of each of the components. This process is based on the difference in boiling points of components of mixture.

Procedure:

- The round bottom flask contains the mixture of alcohol and water which is heated to vigorous boil.
- The boiling point of alcohol (78°C) is lower than that of water (100°C). So, that's why, alcohol will change into gaseous state first.
- On coming in contact with the water cooled condenser, the alcohol vapours will condense.
- The condensed vapours of alcohol will trickle down into the graduated cylinder where the chemist can collect the final distilled alcohol.
- The water liquid remains in the round bottom flask.



Q.3. What are mixtures?

Ans. Mixture: When two or more elements or compounds mix-up physically without any fixed ratio, they form a mixture.

Properties:

- On mixing up, the component substances retain their own chemical identities and properties.
- The mixture can be separated into parent components by physical method such as distillation, filtration, evaporation, crystallization or magnetization.

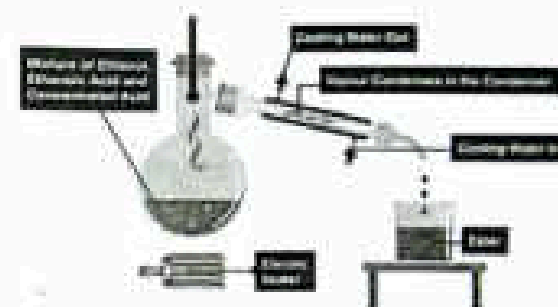
Classification:

I. Homogeneous Mixture:

Mixtures that have uniform composition throughout are called homogeneous mixtures e.g. air, gasoline, ice cream.

II. Heterogeneous Mixture:

Heterogeneous mixtures are those in which composition is not uniform throughout e.g. soil, rock and wood.



Q.4. How separation of mixtures of two or more liquids is done. Name the separation technique.

Ans. Fractional distillation technique is used to separate the mixture of two or more liquids.

Why is it needed?

Fractional distillation is similar to regular distillation but is used when separating liquids with closer boiling points.

Procedure:

- In this process, the mixture is heated and the vapours produced are passed through a fractionating column.
- The fractionating column contains multiple packing materials that helps in repeated condensation and vaporization of the components.
- As the vapour rise in the column, they cool and condense at different levels based on their boiling points.
- This allows for the separation of liquids based on their boiling points with different components collected at different levels of the fractionating column.

Uses: Fractional distillation is a powerful technique commonly used in industries like oil refineries and chemical plants to separate complex mixtures of liquids effectively.

Q.5. How to separate a mixture of two solids?

Ans. To separate a mixture of two solids, you can use various techniques depending on the properties of solids.

- Magnetic separation:** Magnetic separation is useful for this when one solid is magnetic and other is non-magnetic. By using a magnet, you can attract the magnetic solid, separating it from the non-magnetic one.
- Filtration:** Filtration process is used to separate a mixture of two solids. This process is effective when one of the solid is insoluble in a liquid and other solid is soluble.

Procedure:

- Mix the solid mixture with a liquid.
- Allowing the soluble solid to dissolve while the insoluble solid remains settle down at the bottom of the container.
- Now, pass the mixture through a filter paper or a filter flannel. The liquid (containing the dissolved solid) will pass through the filter medium, leaving the insoluble solid behind.
- In this way, separate the two solids based on their solubility in the liquid.



Q.6. What method will you use to separate a sand and sugar mixture?

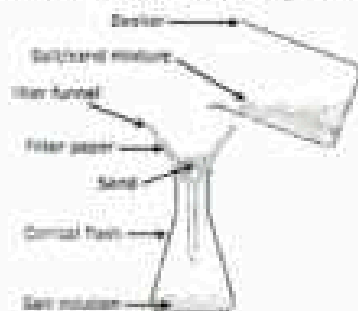
answer

Ans. Separation of sand and sugar by filtration.

To separate a mixture of sand and sugar, filtration method can be used. Since, sugar is soluble in water while sand is insoluble in water.

Procedure:

- Mix the sand and sugar mixture with water.
- The sugar will dissolve in the water leaving sand as a residue.
- Pass the mixture through a filter paper or filter funnel to separate the sand from the sugar solution.
- The sand will be retained by the filter while the sugar solution will pass through it.
- By evaporating the water from the sugar solution, sugar can be recovered.



SLO Based Additional MCQs

- Which one of the following can be separated by physical means? *answer*
(a) Mixture (b) Element
(c) Compound (d) Radical
- Brass is a mixture of. *answer*
(a) Cu & Zn (b) Cu & Sn
(c) Cu & Al (d) Al & Fe
- Mixture can be separated means of. *answer*
(a) Nuclear method (b) Chemical method
(c) Physical method (d) All of these
- A piece of matter in impure form is termed as. *answer*
(a) Mixture (b) Compound
(c) Substance (d) All of these
- Which one of the following is a mixture? *answer*
(a) Sugar (b) Table Salt
(c) Blood (d) Tin
- If pressure is increased, the rate of evaporation. *answer*

- (a) Increase (b) Decrease
(c) Remain same (d) None of these
- The rate of evaporation is increases by _____ temperature. *answer*
(a) Increase (b) Decrease
(c) Remain same (d) None of these
- Larger the surface area, the rate evaporation will be. *answer*
(a) Increase (b) Decrease
(c) Remain same (d) None of these
- A liquid having strong intermolecular forces, the rate of evaporation will be. *answer*
(a) Increase (b) Decrease
(c) Remain same (d) None of these
- The liquid that obtained by performing the condensation of vapour called. *answer*
(a) Filtrate (b) Distillate
(c) Residue (d) Mother liquor



- Boiling takes place when the vapour pressure is _____ to the atmospheric pressure. *answer*
(a) Less than (b) Greater than
(c) Equal to (d) None of these
- How many types of distillation? *answer*
(a) 1 (b) 2
(c) 3 (d) 4
- Distillation process is based upon. *answer*
(a) Boiling point (b) Freezing point
(c) Melting point (d) Density
- Vacuum distillation takes place under _____ pressure. *answer*
(a) Increased (b) Reduced
(c) Same (d) Atmospheric
- The mechanism of filtration can be. *answer*
(a) Mechanical (b) Biological
(c) Physical (d) All of these
- In salt solution, the salt is. *answer*
(a) Solute (b) Solvent
(c) Residue (d) Solution
- Crystallization is a process that separates a _____. *answer*
(a) Solid from solution
(b) Liquid from solution

- (c) Gas from solution
(d) Solid from solid

- The principle of crystallization is based upon the. *answer*
(a) Boiling point (b) Freezing point
(c) Density (d) Solubility
- Rapid cooling of solution will cause formation of _____ crystals. *answer*
(a) Large (b) Tiny
(c) Medium (d) Both a & b
- Slow cooling of solution will cause a formation of _____ crystals. *answer*
(a) Large (b) Tiny
(c) Medium (d) Both a & b
- The boiling point of water is. *answer*
(a) 0°C (b) 100°C
(c) 78°C (d) 70°C
- The water melts at. *answer*
(a) 0°C (b) 100°C
(c) 78°C (d) 70°C
- Dark chocolate melts _____ much longer than milk chocolate. *answer*
(a) 10% (b) 70%
(c) 50% (d) 65%

Answer Key

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

Short Questions (Exercise)

Q.1. Why is it important to separate materials from a mixture? *answer*
Ans. It is important to separate materials from a mixture because sometimes we need the individual components for specific purposes. For example, in a

mixture of sand and iron filings, separating them can help us obtain pure sand and iron for different uses. Different separation techniques like filtration, distillation and crystallization



are used based on the properties of the substances in the mixture.

This process is crucial in various fields like chemistry, environmental science to extract and utilize specific components efficiently.

Q.2. What is distillation? easy

Ans. Distillation is a separation technique used to separate components of a liquid mixture by a process of heating and cooling, which exploits the differences in the volatility of each of the components. The liquid that is obtained by performing the condensation of vapour is called the distillate. Distillation is carried out at the solvent's boiling point.

SLO Based Additional Short Questions (Reference Material)

Q.5. How was gold separated from sand in ancient times? easy

Ans. The approach that the people of the ancient time took was to place the soil and gold mixture in a pan and cover with water. The mixture was stirred, the soil would dissolve in the water and the gold would not. After thorough mixing, the pan was gently swirled to remove dissolved material while the heavier gold settled to the bottom of the pan. The gold was then separated from the mixture of soil and water.

Q.6. What is the importance of separation of mixture? easy

Ans. Not only the separation of mixtures is helpful to obtain the useful and valuable components of the mixture, but we are also able to find out the properties of the known/unknown substances from mixtures and possibly use them for the production of useful substances such as medicines.

Q.7. Which methods are used to separate the mixtures? easy

Q.3. What is filtration? easy

Ans. Filtration is a separation technique used to separate the components of a mixture containing an undissolved solid in a liquid. The exact method used depends on the purpose of the filtration, whether it is for the isolation of a solid from a mixture or removal of impurities from a mixture.

Q.4. What is evaporation? easy

Ans. Evaporation is a separation method used to separate components of a mixture in which a solid is dissolved in a liquid, where the liquid changes into the gaseous phase and solid is left behind. The application is based on the fact that solids do not evaporate easily, whereas liquids do.

Ans. Some of the common methods of the separation are filtration, evaporation, distillation, sedimentation and decantation, magnetic separation, centrifugation.

Q.8. Define solution. / Define true solution with example. easy

Ans. A homogeneous mixture of two or more substances is called solution e.g. sugar dissolved in water is an example of solution.

Q.9. What is aqueous solution? easy

Ans. The solution which is formed by dissolving a substance in water is called an aqueous solution. e.g. sugar dissolved in water.

Q.10. What is the difference between solute and solvent? easy

Ans. Solute: The component of solution which is present in smaller quantity is called solute. Solute is dissolved in solvent to make a solution. e.g. In salt in water solution, salt is solute.

Solvents:

The component of a solution which is present in larger quantity is called solvent. e.g. in sugar solution, sugar is solute and water is solvent.

Q.11. How evaporation is affected by pressure and temperature? easy

Ans. Pressure: An increase in pressure pushes gas particles close together. The force between the particles increases making it difficult for the liquid to convert to gaseous form.

Temperature: On increasing the temperature of the substance, the material heats up and the constituent particles begin moving with greater kinetic energy. This leads to an increase in the rate of evaporation. For example, warm water evaporates faster than cold water.

Q.12. How evaporation is affected by surface area and intermolecular forces? easy

Ans. Surface area of the substance: A substance with a larger surface area will contain more surface molecules per unit of volume, it triggers the potential of the particles to escape, thereby increasing the rate of evaporation.

Inter-molecular forces: Stronger inter-molecular forces between the molecules of the liquid require greater amounts of energy to break and turn into a gas. Therefore, substances with stronger intermolecular forces have lower rate of evaporation. An indicator of the intermolecular forces is provided by the enthalpy of vaporization.

Q.13. What are the applications of evaporation in our daily life? easy

Ans.

- Sea water can be evaporated to produce drinking water
- Dye from ink: ink is mixture of water and dye

- Dairy producers also use the technique of evaporation to use it to dry lactose into powders.
- Beverage producers can create concentrates, for instance, juice concentrates by reducing water content through evaporation.

Q.14. What is distillate? easy

Ans. The liquid that is obtained by performing the condensation of vapours is called the distillate.

Q.15. What is procedure of distillation? easy

Ans.

- The round bottom flask contains the liquid mixture which is heated to a vigorous boil.
- The component with the lower boiling point will change into its gaseous state first.
- On coming in contact with the water-cooled condenser, the gas will condense.
- The condensed gas will trickle down into the graduated cylinder where the chemist can collect the final distilled liquid.
- The other liquid component remains in the round bottom flask.

Q.16. How many types of distillation? Write their names. easy

Ans. Types of Distillation

- Simple distillation.
- Fractional distillation.
- Steam distillation.

Q.17. What is fractional distillation? easy

Ans. This technique works in a very similar way to simple distillation, but fractionating column is used to get a temperature gradient, cooler at the top and hotter at the bottom. This allows careful control of the temperature at which the distillate is being collected, allowing different liquids in a mixture to be separated, each turning into a vapor and being cooled and condensed in the



condensed at their own individual boiling points.

Q.18. What is steam distillation? answer

Ans. Steam distillation is a separation process that consists in distilling water together with other volatile and non-volatile components.

Q.19. What is vacuum distillation? answer

Ans. Vacuum distillation or Distillation under reduced pressure is a type of distillation performed under reduced pressure, which allows the purification of compounds which are not readily distilled at ambient pressure or simply to save time or energy. This technique separates compounds based on differences in their boiling points.

Q.20. What are applications of distillation in our daily life? answer

- Ans.**
- Distillation plays an important role in many water purification techniques. Many desalination plants incorporate this method in order to obtain drinking water from seawater.
 - This process is also used to refine the crude oil and to purify the alcohol.

Q.21. Write down the procedure of filtration process. answer

Ans. The principle of filtration is based on the difference in sizes between the particles. Filtration separates the solid matter from a liquid mixture using a filter medium for example filter paper or filtration membrane that allows the liquid to pass through it and block the solid particles on the other side of it. The pores of the filter medium are bigger as compared to the solvent particle but are smaller compared to the solute particle, so they allow only solvent particles to pass through them the solute particle is left on the other side making the solution free from the insoluble solute.

Q.22. Difference between homogeneous and heterogeneous mixture. answer

Ans. Heterogeneous mixture:

Heterogeneous mixture is a mixture in which the solute particle is not evenly distributed in the solvent phase. Such as sand in the water is an example of a heterogeneous mixture.

Homogeneous mixture: Homogeneous mixture is a mixture in which the solute particles are evenly distributed in the solvent. A brine solution is an example of a homogeneous mixture. Homogeneous mixtures are also called solutions.

Q.23. What is gravity filtration? answer

Ans. Filtration by filter paper is also called gravity filtration. Filter paper is a semi-permeable barrier placed perpendicular to a liquid or air flow. Filter paper can have pore sizes ranging from small to large to permit slow to fast filtering.

Q.24. How filtration can be done by vacuum? answer

Ans. Vacuum filtration uses a Buchner funnel. A Buchner funnel is a flat bottomed, porous, circular porcelain bowl with a short stem. The stem is fitted with a rubber stopper and inserted in the mouth of a side arm filter flask. Circular filter paper, the same diameter as the bowl, is placed on the flat bottom and wetted with the appropriate solvent to create a seal before starting the filtration.

Q.25. What are the applications of filtration in daily life? answer

- Ans.**
- When making coffee, hot water is filtered through the ground coffee and a coffee bean. The filtrate is the coffee in liquid form. Using a tea ball or a tea bag (paper filter) for tea is also an example of filtration.



- A kidney is a biological filter that is used to filter the human blood. Blood filtering in kidneys is another application of the filtration technique.

Q.26. What are HEPA filters? answer

Ans. HEPA filters are used by various vacuum cleaners and air conditioners to filter out dust and pollen from the air.

Q.27. What is crystallization? answer

Ans. The process in which the solid dissolves in the liquid arranges itself into well-defined 3-D structure is called crystallization. When any substance undergoes crystallization its molecule arranges itself in a fixed structure at an angle to form a 3-D structure called the crystal and then the crystal is removed from the solution. The crystal is a pure substance and thus the process of crystallization is widely used in the purification of material from its impure solution.

Q.28. What is the principle of crystallization? answer

Ans. The principle of crystallization is based on the limited solubility of a compound in a solvent at a certain temperature and pressure. A change of those conditions to a state where the solubility is lower will lead to the formation of a crystalline solid.

Q.29. What are the applications of crystallization in our daily life? answer

Ans. It is used to obtain pure salt from sea water. Crystallization can also be used to obtain pure alum crystal from an impure alum.

Q.30. Why is the melting point of a solid considered its 'identification' characteristics? answer

Ans. Melting point is a characteristic property of solids. Pure solids have sharp melting points. Due to this, melting point of solids is considered as their identification characteristic property.



Qualitative Analysis

Q.1. What is the difference between qualitative and quantitative analysis?

ANSWER

Ans. Difference between qualitative and quantitative analysis

Qualitative Analysis	Quantitative Analysis
It focuses on non-numerical data, such as text, images and observation.	It focuses on numerical data and statistics.
The analysis which is made to identify different elements present in a compound.	The analysis which is made to determine the exact amount of each element present in a compound.
It is the initial analysis to detect the element present in the compound.	By this analysis, we can calculate the percentage of elements present in the compound.
e.g. salt analysis, element detection analysis	e.g. Volumetric analysis, combustion analysis.

Q.2. What is the origin of flame colour?

ANSWER

Ans. Detection of Metal Cations by Flame Test

A Bunsen burner flame has two parts the upper part is called oxidizing flame and the lower part is called reducing flame.

Bunsen flame has enough energy to excite the electrons of alkali and alkaline earth metal atoms. Alkali metals have low ionisation potentials that's why their atoms get their electrons excited by the energy of visible wavelength of light. The same energy is released when the electron comes to the ground state showing the colour of flame, so this flame contains the energy of visible wavelength of light it possesses a characteristic flame colour.

Procedure for flame test:

- Sample Preparation:** A small amount of the sample e.g. salt, oxide or any other compound containing the metal ions is usually dissolved in water to create a solution or paste.
- Clean Wire Loop:** A clean, non-reactive wire loop of platinum or even a clean glass rod is used to hold a small amount of the sample solution.
- Heating:** The wire loop with the sample is then introduced into the flame of a Bunsen burner. The heat causes the metal ions in the sample to become excited.
- Observation:** As the metal ions return to their ground state from the excited state, they emit light in the form of characteristic coloured flames. The colour of the flame is then observed and compared to a reference chart to identify the metal ion present.
Sodium gives golden yellow, lithium and strontium give crimson red, Potassium gives purple, Calcium gives blue, barium gives green and copper gives bluish green flame colours.

Q.3. Why does hydrogen gas produce a popping voice when it is exposed to the flame?

ANSWER

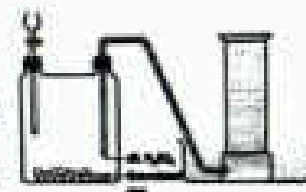
Ans. Hydrogen gas can be prepared by the reaction of zinc metal with sulphuric acid. It can be stored in an open inverted test tube. Because of its light weight it does not go out in a vertically inverted test tube.

Procedure:

- Put some zinc metal pieces in a wolf bottle.



- Wolf bottle has two openings, from one opening using a cork pass a thistle funnel, from the other opening pass a U-shaped tubing.
- Make the apparatus air tight by using wax.
- Take a test tube to collect hydrogen gas coming from the tubing. And place it vertically inverted over the tubing.
- Pour sulphuric acid from the thistle funnel.
- $Zn_{(s)} + H_2SO_{4(aq)} \rightarrow ZnSO_{4(aq)} + H_{2(g)}$
- The test tube will be filled with the hydrogen gas.
- Bring up burning splint after the test tube is filled with hydrogen.
- A popping voice with a flame is observed which will confirm the presence of hydrogen gas.



This reaction of hydrogen with oxygen in the presence of flame and water vapours are formed.

Q.4. Why the blue litmus paper turns white at the end after converting red?

ANSWER

Ans. Detection procedure:

- Prepare Damp Litmus Paper:**

Take a piece of blue litmus paper and dampen it with distilled water. Blue litmus paper is typically used for acidic gases like chlorine.

- Expose to the Gas:**

Place the damp blue litmus paper in the test tube of chlorine gas.

- Observe Colour Change:**

If chlorine gas is present, the blue litmus paper will turn red. This colour change occurs because chlorine gas is acidic and reacts with the red litmus paper, causing it to change from blue to red and then bleaches it to white.

Interestingly, blue litmus after turning red turns white as it bleaches the paper, chlorine gas is a bleaching agent.



Multiple Choice Questions (Exercise)

Encircle the correct answer.

- Ammonia is a gas:
 - Acidic
 - Basic
 - Neutral
 - Amphoteric
- Which gas helps in combustion process?
 - Oxygen
 - Nitrogen
 - Sulphur dioxide
 - Carbon dioxide
- Which gas turns the lime water, milky?
 - Carbon monoxide
 - Carbon dioxide
 - Sulphur dioxide
 - Carbon monoxide
- Electrons of alkali metals excite by absorbing the light in:
 - Visible wavelength
 - UV wavelength
 - IR wavelength
 - Radio wavelength
- The colour imparted by the flame of sodium metal is:
 - Blue
 - Green
 - Golden yellow
 - Purple



SLO Based Additional MCQs

6. The analysis which provides the identity of a substance is called: ANSWER
(a) Clinical analysis
(b) Quantitative analysis
(c) Qualitative analysis
(d) All of these
7. The analysis which is use to determine the amount of each component present in sample called: ANSWER
(a) Clinical analysis
(b) Quantitative analysis
(c) Qualitative Analysis
(d) All of these
8. The formula of Ammonia is: ANSWER
(a) NH_4CNO (b) NH_2CONH_2
(c) NH_3 (d) NH_4OH
9. pH of Ammonia is: ANSWER
(a) Equal to 7 (b) Above 7
(c) Below 7 (d) None of these
10. Ammonia is manufactured by: ANSWER
(a) Contact process
(b) Solvay's process
(c) Haber's process
(d) Both b and c
11. Acid turns blue litmus to: ANSWER
(a) red (b) colourless
(c) pink (d) white
12. Base turns red litmus to: ANSWER
(a) red (b) blue
(c) pink (d) white
13. Formula of lime water: ANSWER
(a) $CaCO_3$ (b) CaO
(c) $CaCl_2$ (d) $Ca(OH)_2$
14. Lime water turns milky due to: ANSWER
(a) CO_2 (b) SO_2 (c) O_2 (d) H_2
15. Chlorine gas is: ANSWER
(a) oxidising agent (b) bleaching agent
(c) reducing agent (d) Both a & b
16. SO_2 gas is: ANSWER
(a) oxidising agent (b) bleaching agent
(c) reducing agent (d) Both b & c
17. Potassium permanganate is: ANSWER
(a) oxidising agent (b) reducing agent
(c) bleaching agent (d) none of these
18. Oxidising flame occurs when oxygen is: ANSWER
(a) limited (b) excess
(c) moderate (d) none of these
19. The colour of oxidising flame is: ANSWER
(a) Red (b) Green
(c) Blue (d) Green
20. Reducing flame occurs when oxygen is: ANSWER
(a) limited (b) excess
(c) moderate (d) none of these
21. The colour of reducing flame is: ANSWER
(a) yellow (b) blue
(c) white (d) green
22. Alkali metals have ____ ionization potential. ANSWER
(a) low (b) high
(c) moderate (d) none of above
23. The flame colour of Sodium is: ANSWER
(a) Crimson red (b) Purple
(c) Golden yellow (d) Green
24. The flame colour of lithium and strontium: ANSWER
(a) green (b) Crimson red
(c) golden yellow (d) Purple
25. The flame colour of Potassium: ANSWER
(a) golden yellow (b) purple
(c) bluish green (d) green
26. The flame colour of Cesium: ANSWER
(a) Golden yellow (b) purple
(c) blue (d) green
27. The flame colour of barium: ANSWER
(a) golden yellow (b) purple
(c) blue (d) green
28. The flame colour of copper: ANSWER
(a) bluish green (b) purple
(c) white (d) red
29. Oxygen helps in: ANSWER
(a) reduction
(b) combustion
(c) photosynthesis
(d) none of the above



30. Ammonia gas turns litmus: ANSWER
(a) blue to red (b) red to blue
(c) red to white (d) White to red
31. Chlorine gas turns litmus: ANSWER
(a) blue to red (b) red to blue

- (c) red to green (d) green to red
32. The colour of $KMnO_4$: ANSWER
(a) red (b) blue
(c) white (d) purple

Answer Key

1	b	2	a	3	b	4	a	5	c
6	c	7	b	8	c	9	b	10	c
11	a	12	b	13	d	14	a	15	d
16	c	17	a	18	b	19	c	20	a
21	a	22	a	23	c	24	b	25	b
26	c	27	d	28	a	29	b	30	b
31	a	32	d						

Short Questions (Exercise)

- I. How is ammonia detected by a litmus paper? ANSWER
Ans. Procedure for detection:
i. Take a red litmus paper.
ii. Moist the filter paper with water spray.
iii. Place the litmus paper at the mouth of test tube or flask containing ammonia gas.
iv. The red litmus paper will turn blue. Turning the litmus paper blue confirm the presence of any basic gas like ammonia.
2. How can you identify carbon dioxide?
Ans. Procedure of production and detection: ANSWER
i. Take some marble pieces in a conical flask.
ii. Cork it with the help of the cork with two holes.
iii. From one hole insert a thistle funnel, and from the other hole a glass tube of U-shape.
iv. Insert the other end of tube in a test tube containing lime water



- v. Hydrochloric acid in the thistle funnel.



- vi. Carbon dioxide gas formed will travel through the tube into lime water.
vii. $CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$
viii. The lime water will turn milky due to the production of calcium carbonate which is insoluble.
ix. $CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$
3. How can you detect hydrogen gas? ANSWER
Ans.
i. Put some zinc metal pieces in a wolf bottle.
ii. Wolf bottle has two openings. From one opening using a cork pass a



thistle funnel, from the other opening pass a U-shaped tube.

- iii. Make the apparatus air tight by using wax.
- iv. Take a test tube to collect hydrogen gas coming from the tubing. And place it vertically inverted over the tubing.
- v. Pour sulphuric acid from the thistle funnel.
- vi. $2\text{FeSO}_4 + \text{H}_2\text{SO}_4 + \text{H}_2\text{O}_2 \rightarrow 2\text{FeSO}_4 + \text{H}_2\text{O}$
- vii. The test tube will be filled with the hydrogen gas.
- viii. Bring up burning splint after the test tube is filled with hydrogen.
- ix. A popping voice with a flame is observed which will confirm the presence of hydrogen gas.

3. Differentiate between oxidizing and reducing flame?

ANSWER

Oxidizing flame	Reducing flame
- The upper part of the Bunsen burner flame is called oxidizing flame. - Oxidizing flame occurs when the oxygen is in excess. - This flame is basically blue in colour.	- The lower part of the Bunsen burner flame is called reducing flame. - Reducing flame occurs when the oxygen is in less. - This flame is basically yellow in colour.

SLO Based Additional Short Questions (Reference Material)

6. Differentiate between qualitative and quantitative analysis.

ANSWER

Ans.

Qualitative analysis provides the identity of a substance (Composition of chemical species)

Quantitative analysis determines the amount of each component present in the sample.

7. What is the nature of ammonia? Write its use.

ANSWER

Ans. Ammonia is basic gas whose pH is more 7. It is used for making urea fertilizer.

8. How is ammonia prepared for the synthesis of Urea? OR How is



This is a reaction of hydrogen with oxygen in the presence of flame and as a result water vapours are formed.

4. How can you detect Sulphur dioxide?

ANSWER

Ans.

i. Prepare a solution of potassium permanganate (KMnO_4) in water it will be of bright purple colour.

ii. Pass the gas sample containing SO_2 through the KMnO_4 solution.

Purple colour of KMnO_4 will be discharged. It shall indicate the presence of SO_2 gas.

10. How hydrogen gas is prepared?

ANSWER

Ans. Hydrogen gas can be prepared by the reaction of zinc metal with sulphuric acid. It can be stored in an open inverted test tube. Because of its light weight it does not go out in a vertically inverted test tube.

11. How can you identify oxygen gas?

ANSWER

Ans. Prepare your source of oxygen:

Using hydrogen peroxide, pour a small amount into the test tube, it generates oxygen gas automatically.

Ignite the wooden splint using a matchstick or lighter until it's glowing at the tip. Carefully insert the glowing splint into the test tube containing the oxygen gas.

Observe what happens to the splint inside the test tube, if oxygen is present, the splint will burst into flames, burning brightly.

Oxygen gas helps in combustion, thus it will suddenly inflame the vanishing splint.

12. What is meant by oxidizing agent?

Give examples.

ANSWER

Ans. An oxidizing agent is species that oxidizes a substance by taking electrons

from it. The substance (atom or ion) which is reduced itself by gaining electrons is called oxidizing agent. For example:

- i) Concentrated sulphuric acid, H_2SO_4
- ii) Potassium permanganate, KMnO_4 etc

13. What is meant by reducing agent?

Give examples.

ANSWER

Ans. Reducing agent is the species that reduces a substance by donating electron to it. The substance (atom or ion) which is oxidized by losing electrons is called reducing agent.

Example:

- i) Hydrogen (H_2)
- ii) Hydrogen sulphide (H_2S) etc

14. What is the effect of acidic and basic substances on litmus paper?

ANSWER

Ans. Acidic substance will turn blue litmus to red. While basic substance will turn red litmus to blue.

15. What happens when limestone react with hydrochloric acid?

ANSWER

Ans. When limestone (CaCO_3) reacts with hydrochloric acid (HCl), it will form calcium chloride, water and carbon dioxide gas is released.




UNIT
19

Chromatography

Q.1. Explain in detail paper chromatography.
ANSWER
Ans. Paper chromatography:

In paper chromatography the stationary phase is the water absorbed on filter paper. The mobile phase can be a solvent or a mixture of solvents. A mixture of inks or some metal ions can be separated with the help of paper chromatography.

Procedure

- Take 1 dm³ measuring cylinder fitted with the rubber bung carrying a glass hook at the lower end.
- Pour 25 cm³ of water and ethanol solvent mixture (6:4) in it and close it. Allow it to stand for 15 minutes.
- Take a strip of paper (what Mann filter paper number one) 2.5 cm wide and longer than the length of the cylinder.
- Mark a line 3 centimeters from one end its mid-point with pencil.
- Prepare a mixture of various inks like blue, black, green, red etc by taking two drops of each in a clean China dish. Mix them thoroughly.
- Apply a very tiny drop of this mixture at the midpoint by means of capillary tube.
- Dry the strip in the air for about 15 minutes and suspend it by the glass hook with its impregnated end dipping into the solvent to a depth of 5-6 mm.
- When the solvent front has risen for about an hour or the solvent front is 2-3 cm below the upper end of the filter paper.
- Remove the paper strip and dry it in air. It is seen that every ink gives coloured bands at different regular intervals.
- Measure the distance of these coloured bands from the baseline and the distance travelled by the solvent front from the baseline.
- Calculate the R_f values for various inks by the formula given. In this way we can separate a mixture of various inks by chromatography.

$$R_f = \frac{\text{Distance travelled by solute}}{\text{Distance travelled by solvent}}$$

R_f factor (retardation factor) is a measure of affinity of a component with mobile phase or stationary phase. If R_f value is greater then, it means that the component is more affine towards the mobile phase than to stationary phase.

Q.2. How can you identify an unknown substance by chromatography?
ANSWER
Ans. Identification of an unknown substance:

A paper chromatogram is used to identify an unknown substance by comparing it with known substances. Two substances are likely to be the same, if their R_f value is same. Therefore, R_f value of an unknown substance is determined. This R_f value is then cross-matched with already known R_f values to identify the potential substance.

A pure substance produces only one spot on the paper chromatogram. An impure substance can produce more than one spots depending on the compounds present in it.

Q.3. Differentiate between stationary and mobile phase.
ANSWER

Stationary Phase	Mobile Phase
- Stationary phase is a solid or a liquid coated on a solid surface. - It is non-moving phase. - It may be solid or liquid.	- Mobile phase is a liquid or gas that moves through or over the stationary phase. - It is moving phase. - It may be liquid or gas.



SLO Based Additional MCQs

- Chroma means:
 - smell
 - Taste
 - Colour
 - Name of these
- Graphels means:
 - reading
 - writing
 - Both a & b
 - None of these
- Chromatography is a technique used to separate _____.
 - Element
 - Compound
 - Mixture
 - None of these
- Stationary phase is:
 - Solid or liquid
 - Liquid or gas
 - solid or gas
 - liquid or liquid
- Mobile phase is:
 - Solid or liquid
 - Liquid or gas
 - solid or gas
 - liquid or liquid
- In paper chromatography, the stationary phase is _____ absorbed on filter paper.
 - water
 - alcohol
 - benzene
 - ether
- If two substances have same R_f value it means they are:
 - same
 - different
 - both a & b
 - none of these
- A pure substance produces _____ spot on the paper chromatogram.
 - two
 - three
 - four
 - one
- To locate amino acid on chromatogram they spray is used:
 - Ninhydrin
 - Hexane
 - Octane
 - Nonane
- A mixture of inks or some metal ions can be separated with the help of:
 - Thin layer chromatography
 - Paper chromatography
 - Gas chromatography
 - Column chromatography

Answer Key

1	c	2	b	3	c	4	a	5	b
6	a	7	a	8	d	9	a	10	b

Short Questions (Exercise)

Q.1. Define chromatography.
ANSWER

Ans. It is a technique for the separation of a mixture by passing it in solution or suspension through a medium in which the components move at different rates.

Q.2. Define locating agent.
ANSWER

Ans. A locating agent is a substance or a solution which is used to locate the components which have been separated by chromatography but are not visible due to being colourless. For example, a mixture of amino acids can be separated by paper chromatography or by thin layer chromatography (TLC) but they are not visible, to locate them, Ninhydrin is sprayed on the chromatogram. Ninhydrin

reacts with amino Acids and develops into a dark purple coloured compound.

Q.3. What is R_f value?
ANSWER
Ans.

R_f factor (retardation factor) is a measure of affinity of a component with mobile phase or stationary phase. If R_f value is greater it means that the component is more affine towards the mobile phase than to stationary phase.

R_f (Retention Factor) value is calculated as the distance travelled by the compound divided by the total distance travelled by the solvent.

$$R_f = \frac{\text{Distance travelled by solute}}{\text{Distance travelled by solvent}}$$



Q.4. Define paper chromatography.

ANSWER

Ans. In paper chromatography the stationary phase is the water absorbed on filter paper. The mobile phase can be a solvent or a mixture of solvents. A mixture of inks or some metal ions can be separated with the help of paper chromatography.

Q.5. What do you mean by paper chromatogram?

ANSWER

Ans. A paper chromatogram is used to identify an unknown substance by comparing it with known substances. Two substances are likely to be same, if their R_f value is same. Therefore, R_f value of an unknown substance is determined. This R_f value is then cross-matched with already known R_f values to identify the potential substance.

SLO Based Additional Short Questions (Reference Material)

Q.6. What is meant by the word "Chromatography".

ANSWER

Ans. The word chromatography has been originated from two words. One is chroma means, "colour" the other graphos means, "writing".

Q.7. What is the principle of Chromatography?

ANSWER

Ans. Chromatography works on the principle of partitioning where the components of a mixture distribute themselves between two phases one is called stationary phase and the other one is said to be mobile phase.

Q.8. How are mixtures separated using chromatography?

ANSWER

Ans. The mixture is carried by the mobile phase through the stationary phase, each component interacts differently with the two phases, leading to different migration

rates. This results in the separation of the components based on their affinity for the stationary phase relative to the mobile phase.

Q.9. What is the procedure for reading chromatogram in a chromatography technique?

ANSWER

Ans. Measure the distance each compound spot travelled from the starting point (origin) to its current position. This is known as the R_f (Retention Factor) value and is calculated as the distance travelled by the compound divided by the total distance travelled by the solvent. Compare the R_f values of the separated compounds to known standards data to identify the components within your chromatogram.



FEDERAL PAST PAPER / MODEL PAPER



FEDERAL PAPER OBJECTIVE

Paper: Chemistry

Time Allowed: 20 minutes

Class: 9th

Marks: 12

SECTION - A

Section - A is compulsory. All parts of this section are to be answered on this page and handedover to the Centre Superintendent. Deleting/overwriting is not allowed. Do not use lead pencil.

Q.1 Fill the relevant bubble for each part. Each part carries one mark. (12)

- (1) 48 gram of Magnesium (Mg) contains _____ atoms.
 a) $\frac{1}{3} N_A$ ☐ b) N_A ☐ c) $2N_A$ ☒ d) $4N_A$ ☐
- (2) Which statement about ^{12}C and ^{13}C is NOT TRUE?
 a) They are isotopes ☐ b) They are the same element ☐
 c) They have same number of electrons ☐ d) They have same number of neutron ☒
- (3) An element has given electronic configuration belongs to:
 $1s^2, 2s^2, 2p^6, 3s^1$
 a) Group = 1 ☒ b) Group = III ☐
 c) Period = 3 ☐ d) Period = 1 ☐
 e) Group = I ☐ f) Group = VII ☐
 g) Period = 7 ☐ h) Period = 1 ☐
- (4) Which group has its valence shell electrons in s-sub shell?
 a) Group I-A ☒ b) Group III-A ☐
 c) Group V-A ☐ d) Group VII ☐
- (5) Identify the ionic compound:
 a) CH_4 ☐ b) HBr ☒ c) HCl ☐ d) H_2O ☐
- (6) The ionic size of an element A of group V-A of periodic table will:
 a) A^+ ☒ b) A^{++} ☐
 c) A^- ☐ d) A^{--} ☐
- (7) A liquid boils when its vapour pressure becomes equal to:
 a) 760 cm Hg ☐ b) 1 Pa ☐
 c) 0.1 atm ☐ d) 101.325 kPa ☒
- (8) Determine the molarity of a solution containing 20g NaOH in 2dm^3 of solution:
 a) 2 M ☐ b) 1 M ☐
 c) 0.25 M ☒ d) 0.5 M ☐
- (9) In ZnO , the oxidation number Zn is:
 a) +1 ☐ b) +2 ☒
 c) -1 ☐ d) -2 ☐
- (10) What is being reduced in the given reaction? $\text{H}_2\text{S} + \text{Cl}_2 \rightarrow 2\text{HCl} + \text{S}$
 a) Cl_2 ☒ b) H_2S ☐
 c) HCl ☐ d) S ☐
- (11) Which of the following will have maximum ionization energy?
 a) Li ☒ b) N_A ☐
 c) K ☐ d) R_A ☐
- (12) Which of the following halogens has highest oxidizing power?
 a) Iodine ☐ b) Bromine ☐
 c) Chlorine ☐ d) Fluorine ☒



FEDERAL PAPER

Paper: Chemistry

Time Allowed: 2:40 Hours

SUBJECTIVE

Class: 9th

Marks: 33

SECTION - B (Marks: 33)

Q.2. Answer any Six parts. The answer to each part should not exceed 5 to 4 lines. (6x3=18)

i. Differentiate between a compound and a mixture?

OR

Convert the following units accordingly:

(a) 850 mmHg to atm (b) 560 torr to cmHg (c) 1.25 atm to Pa

ii. Identify the branch of chemistry that deals with following examples:

(a) Use of wet processes in cement production

(b) White vapours appear when NH_3 is heated

(c) Oxygen is produced during photosynthesis

OR

iii. Write electronic configuration of the following elements:

(a) ^{35}Cl (b) ^{14}N (c) ^{24}Fe

OR

In which block, group and period would be following elements having electronic configuration by placed?

(a) $1s^2$ (b) $1s^2, 2s^2, 2p^2$

iv. Draw Bohr's model for the following atoms indicating the location of electrons, protons and neutrons:

(a) Carbon (C) (b) Magnesium (Mg)

OR

Briefly explain Octet and Duplet rules with suitable examples.

v. Explain briefly:

(a) Periodic law (b) Group (c) Period of Modern periodic table

OR

Fermentation of sugar cane produces 95% v/v of ethyl alcohol called rectified spirit. What does 95% v/v mean? Which concentration unit is it?

vi. Differentiate between diffusion and effusion of gases with examples.

OR

Write empirical formulas of Nicotine ($\text{C}_{10}\text{H}_{14}\text{N}_2$) and caffeine ($\text{C}_8\text{H}_{10}\text{N}_4\text{O}_2$).vii. What is meant by boiling point? Can water be boiled at 70°C ? If yes, how?

OR

How many moles of H_2 are present in a balloon filled with 10g of hydrogen gas?

viii. Draw electron cross and dot structure of following molecules:

(a) H_2S (b) C_2H_6

OR

What are allotropes? Briefly explain allotropic forms of phosphorus.

ix. A flask contains 0.1 M KOH solution, what mass of KOH is present per dm^3 of solution?

OR

Describe the nature of an electrochemical processes.



FEDERAL PAPER

Paper: Chemistry

SUBJECTIVE

Class: 9th

Time Allowed: 2:40 Hours

Marks: 53

SECTION – B (Marks 33)

- x. Glucose easily dissolves in water but Gasoline does not. Why? Explain briefly.

OR

What is oxidation state? What is the common oxidation state of group II and group VII elements in binary compounds?

- xi. Identify the oxidizing and reducing agents in the following redox reactions:



OR

Sodium is a soft metal and can be easily cut with a knife. Give its scientific reason.

Section – C (Marks 20)

Note: Attempt any TWO questions. All questions carry equal marks.

(2 x 10 =20)

- Q.3 Describe the formation of covalent bond in the following compounds:



OR

What is an electrolytic cell? Enlist the possible uses of an electrolytic cell. (Any five)

- Q.4 List of importance and uses of isotopes in various fields of life. (Any six)

OR

Electronic configuration of six elements is given below. Mention their group number and period number in period table.



- Q.5 Write down some important application of gold and silver.

OR

How is ionic bond formed between following pairs of atoms? Explain in detail.

- Q.6 Explain the following concentration units with examples:

(a) Molarity

(b) Percentage

OR

How is Sodium metal produced by the electrolysis of fused $NaCl$ on large scale? Explain.

SUPPLEMENTARY TABLE

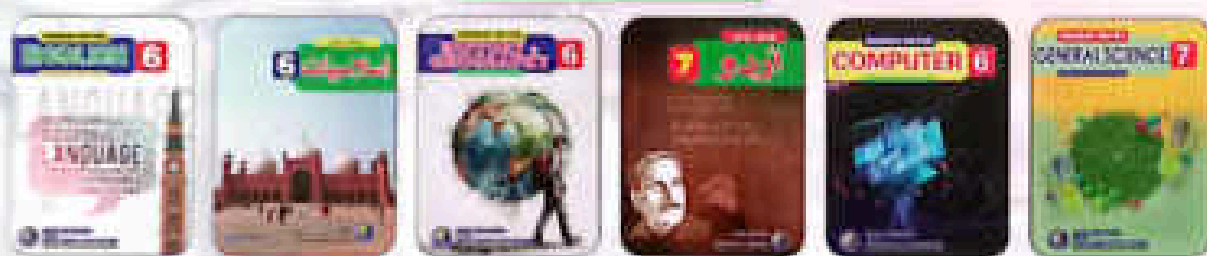
Atomic No	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Symbol	H	He	Li	Be	B	C	N	O	F	Ne	Na	Mg	Al	Si	P	S	Cl	Ar	K	Ca
Mass no	1	4	7	9	11	12	14	15	19	20	23	24	27	28	31	32	35	40	39	40

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