GOVERNMENT OF SINDH
SCHOOL EDUCATION & LITERACY DEPARTMENT
Karachi, dated: 20th November, 2019

NOTIFICATION

School Education & Literacy Department, Government of Sindh is pleased to notify the reviewed Curriculum for Grade XI and XII for the subjects of Sindhi, Biology, Physics, Chemistry, English Literature and Computer Science, Ethics for Grade III and IV, Computer Science for Grade IX and X developed by the Directorate of Curriculum, Assessment & Research (DCAR).

(-AHSAN ALI MAANGI-PAS)
Secretary to Government of Sindh

NO: SO (G-III) SELD/3-910/18 Karachi, Dated: 20th November, 2019

Copy is forwarded for information and necessary action:

1. The Chairman, Sindh Textbook Board, Jamshoro.
2. The Director, Directorate of Curriculum, Assessment & Research, Jamshoro
3. The Chief Program Manager, Reform Support Unit (RSU), Karachi.
4. The Chief Advisor, School Education & Literacy Department, Karachi.
5. The P.S to Secretary School Education & Literacy Department, Karachi.
6. Office Order File.

SECTION OFFICER (G-III) 20/11/2019

SINDH CURRICULUM FOR

CHEMISTRY

GRADES XI-XII

2019

GOVERNMENT OF SINDH

SCHOOL EDUCATION AND LITERACY DEPARTMENT

DIRECTORATE OF CURRICULUM, ASSESSMENT & RESEARCH

SINDH JAMSHORO

Sindh Curriculum for

CHEMISTRY

Grades XI-XII

2019

GOVERNMENT OF SINDH
SCHOOL EDUCATION AND LITERACY DEPARTMENT
DIRECTORATE OF CURRICULUM, ASSESSMENT & RESEARCH
SINDH JAMSHORO

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INTRODUCTION

The Chemistry Curriculum for grades IX through XII builds on the vertical progression of the K-VIII Science Curriculum. It now offers a relatively in-depth study of Chemistry as a major, independent science. It focuses on content, process skills, problem-solving, inquiry, a critical and analytical thinking skills.

This Chemistry Curriculum offers a radical shift from the traditional curriculum. The aim of this curriculum is to produce students who will be capable of doing independent thinking, asking questions, and looking for answers on their own.

RATIONALE FOR REVIEW OF THE NATIONAL CURRICULUM 2006

Earlier curriculum development and review process was the federal task, after the 18th constitutional amendment curriculum and related activities are entrusted to the Provinces. In a short time, it was not possible for a province to develop a new Curriculum in the subject of Chemistry grade XI-XII. It was decided that the Curriculum 2006 be adopted after thorough review. In response to the emerging trend of society and the rapid development of science and technology in the world, the School Education and Literacy Department, Government of Sindh constituted a Provincial Review Committee for grade IX-XII to revise the existing Chemistry Curriculum of 2006 for province of Sindh. The main purpose of this review deliberations was to review the existing chemistry curriculum in the light of ground realities, local context and to develop a Chemistry Curriculum that serves as a foundation document for the promotion of University education according to the required standards of education in the 21st century.

The Curriculum for Chemistry 2006 is the foundation of this reviewed curriculum. However, the contextual and contemporary changes have been made in it. The new contents about chemistry includes environment regarding air and water, new industrial products (cosmetics, Pharmaceutical products, adhesive etc.) synthesis reactions of organic compounds, importance and applications of organic and inorganic substances, batteries, solar cells and many new topics are introduced to make students knowledgeful and useful for the betterment of society.

This curriculum helps students to become chemist, scientists or technologists. These professionals are the backbone of our society. Many decisions that we are called upon to make as citizens of this "global village" involve science and technology.

AIMS AND OBJECTIVES

AIMS:

This two-year study of Chemistry aims to develop in all students:

- a scientific understanding of the physical world.
- cognitive, affective, and psychomotor abilities appropriate to the acquisition and use of chemical knowledge, understanding, attitude, and skills.
- an appreciation for the products and influences of science and technology, balanced by a concern for their appropriate application.
- an understanding of the nature and limitations of scientific activity.
- an ability to apply the understanding of Chemistry to relevant problems (including those from everyday real-life) and to approach those problems in rational ways.
- respect for evidence, rationality and intellectual honesty.
- the capacities to express themselves coherently and logically, both orally and in writing, and to use appropriate modes of communication characteristic of scientific work.
- the ability to work effectively with others.

OBJECTIVES:

A statement of objectives relevant to each of the general aims is listed below. The sequence is in no particular order.

Understanding the physical world:
Students should understand the scientific concepts inherent in the theme for each chapter and be able to:

- state, exemplify, and interpret the concepts.
- use appropriately, fundamental terms and Classification related to the concepts.
- cite, explain or interpret, scientific evidence in support of the concepts.

Using appropriate cognitive, affective and psychomotor abilities:

- Students should show ability to:
- formulate questions that can be investigated by gathering first or second-hand data.
- find relevant published background information.
- formulate hypotheses and make predictions from them.
- plan an investigation and carry out the planned procedure.
- use appropriate and relevant motor skills in carrying out investigations.
- observe phenomena and describe, measure and record these as data.
- classify, collate and display data.
- construct and/or interpret visual representations of phenomena and relationships (diagrams, graphs, flowcharts, physical models).
- analyze data and draw conclusions.
- evaluate investigative procedures and the conclusions drawn from such investigations.

Understanding the nature and limitations of scientific activity:

For each facet of scientific activity selected for study, students should:

- describe and exemplify it.
- use appropriately any fundamental terms and classification related to it.
- recognize that the problem-solving nature of science has limitations.
- acknowledge that people engaged in science, a particularly human enterprise, have the characteristics of people in general.

Appreciating influences of science and technology:

Students should:

- recognize that the technology resulting from scientific activity influences the quality of life and economic development through or by improvements in medical / health care, nutrition, and agricultural techniques.
- explain that these influences may be the result of unforeseen consequences, rapid exploitation, or rapid cultural changes.
- realize that advances in technology require judicious applications.

Respecting evidence, rationality and intellectual honesty:

Students should:

- display respect for evidence, rationality and intellectual honesty given the number of emotive issues in the area of Chemistry.

Showing capacities to communicate:

Students should:

- comprehend the intention of a scientific communication, the relationship among its parts and its relationship to what they already know.
- select and use the relevant parts of a communication.
- translate information from communications in particular modes (spoken, written, tables, graphs, flowcharts, diagrams) to other modes.
- structure information using appropriate modes to communicate it.

Working with others:

Students should actively participate in group work and:

- share the responsibility for achieving the group task.
- show concern for the fullest possible involvement of each group

STANDARDS AND BENCHMARKS

In the 21st century, students will remain the most important natural resource to ensuring the continual improvement and ultimate progress of humankind. It is critical that all involved in education prepare students to meet the challenges of a constantly changing global society. It is time to call for a raising in the expectations of student learning.

Preparing students for success in the new millennium and beyond calls for increasing rigor and relevance in the curriculum. In adult roles, individuals are expected to work with others in a team setting, have an acquired knowledge base, be able to extend and refine knowledge, be able to construct new knowledge and applications and have a habit of self-assessing their assimilation of each dimension in their everyday decision making process.

This curriculum document is built upon Standards, Benchmarks, and Learning Outcomes for the benefit of student growth and progress.

STANDARDS are what students should know and be able to do. Standards are broad descriptions of the knowledge and skills students should acquire in a subject area. The knowledge includes the important and enduring ideas, concepts, issues, and information. The skills include the ways of thinking; working, communication, reasoning, and investigating that characterize a subject area. Standards may emphasize interdisciplinary themes as well as concepts in the core academic subjects.

Standards are based on:

- **Higher Order Thinking:** instruction involves students in manipulating information and ideas by synthesizing, generalizing, explaining or arriving at conclusions that produce new meaning and understanding for them.

- **Deep Knowledge:** instruction addresses central ideas of a topic or discipline with enough thoroughness to explore connections and relationships and to produce relatively complex understanding.

- **Substantive Conversation:** Students engage in extended conversational exchanges with the teacher and / or peers about subject matter in a way that builds an improved and shared understanding of ideas or topics.

- **Connections to the World Beyond the Grade room:** Students make connections between substantive knowledge and either public problems or personal experiences.

BENCHMARKS indicate what students should know and be able to do at various developmental levels. Our benchmarks are split into 5 developmental levels:

- Kindergarten to grade III
- Grades IV-V
- Grades VI-VIII
- Grades IX-X
- Grades XI-XII

LEARNING OUTCOMES indicate what students should know and be able to do for each topic in any subject area at the appropriate developmental level. The Learning Outcomes sum up the total expectations from the student. Within this document, the Learning Outcomes are presented fewer than three subheadings:

- Understanding
- Skills including laboratory work
- Science, Technology and Society connections

The Standards and the accompanying Benchmarks will assist in the development of comprehensive curriculum, foster diversity in establishing high quality Learning Outcomes, and provide an accountability tool to individuals involved in the education marketplace. These provide a common denominator to determine how well students are performing and will assure that all students are measured on the same knowledge and skills using the same method of assessment.

STANDARDS

1. Using Scientific Knowledge

Students well-versed in the study of the sciences are better able to understand and appreciate the world around them and are also better able to make calculated decisions and take informed actions. Activities that require scientific thought include the description and explanation of real-world objects, systems, or events; the prediction of future events or observation; and the design of systems or courses of action that help individuals adapt to and modify (for better) the world around them.

In the physical sciences, particularly Chemistry, the specification of real-world contacts often focuses on phenomena, such as a variety of physical, chemical, and nuclear changes in matter.

Standard 1.1

Students will understand the processes of scientific investigation. They will be able to identify problems, design and conduct experiments, and communicate their findings using a variety of traditional and conventional tools including technology.

Standard 1.2

Students will describe and explain common properties, forms, and interactions between matter and energy; their transformations and applications in biological, chemical and physical systems.

2. Constructing New Scientific Knowledge

Students well-versed in the study of the sciences are users of the same knowledge. They possess the ability to ask questions about the world and can develop solutions to problems that they encounter or questions they ask by using scientific knowledge and techniques. In the process of finding solutions, the scientifically literate students may use their own knowledge and reasoning abilities, seek out additional knowledge from other sources, and engage in empirical investigations of the real world. These students can also learn by interpreting texts, graphs, tables, pictures, or other representations of scientific data and knowledge. Finally, such students can remember key points and use sources of information to reconstruct previously learned knowledge, rather than try to remember every detail of what they study.

Standard 2.1

Students will display a sense of curiosity and wonder about the natural world and demonstrate an increasing awareness that this has lead to new developments in science and technology. They will learn from books and other sources of information and reconstruct previously learned knowledge.

3. Reflecting on Scientific Knowledge

Students well-versed in the study of the sciences are also able to "step back" and analyze or reflect on their own knowledge. One such type of analysis is the justification of personal knowledge or beliefs using either theoretically or empirically based arguments. These students can also show an appreciation for scientific knowledge and the patterns it reveals in the world. They are also able to take a historical and cultural perspective on concepts and theories or to discuss institutional relationships among science, technology, and society. Finally, these students can describe the limitations of their own knowledge and scientific knowledge in general.

Standard 3.1

Students will demonstrate an understanding of the impact of science and technology on society and use science and technology to identify problems and creatively address them in their personal, social and professional lives. They will explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; and how people have contributed to and influenced developments in science.

BENCHMARKS

Standard 1.1 Students will display a sense of curiosity and wonder about the natural world and demonstrate an increasing awareness that this has led to new developments in science and technology. They will learn from books and other sources of information and reconstruct previously learned knowledge.

Benchmarks XI-XII

1. Describe various properties of materials that make them suitable and useful for differing jobs.
2. Analyze properties of common household and agricultural materials in terms of risk and benefit balance.
3. Classify elements based on their properties into common families.
4. Explain how elements differ in terms of the structural parts and electrical charges of atoms.
5. Analyze the motion of molecules in the various states of matter including plasma.

Standard 1.2 Students will describe and explain common properties, forms, and interactions between matter and energy; their transformations and applications in biological, chemical and physical systems.

Benchmarks XI-XII

1. Explain chemical changes in terms of the breaking of bonds and the rearrangement of atoms to form new substances.
2. Explain how and why mass is conserved in chemical changes.
3. Contrast the different types of chemical reactions in inorganic and organic chemistry.
4. Describe energy transformations involved in physical and chemical changes, and contrast their relative magnitudes.
5. Explain changes in matter and energy involving heat transfer.

Standard 2.1 Students will display a sense of curiosity and wonder about the natural world and demonstrate an increasing awareness that this has led to new developments in science and technology. They will learn from books and other sources of information and reconstruct previously learned knowledge.

Benchmarks XI-XII

1. Ask questions that can be answered empirically.
2. Develop solutions to problems through reasoning, observation, and investigations.
3. Design and conduct scientific investigations.
4. Recognize and explain the limitations of measuring devices.
5. Gather and synthesize information from books and other sources of information.
6. Discuss topics in groups by making clear presentations, restating or summarizing what others have said, asking for clarification or elaboration, and defending a position.

Standard 3.1 Students will demonstrate an understanding of the impact of science and technology on society and use science and technology to identify problems and creatively address them in their personal, social and professional lives. They will explain how scientists decide what constitutes scientific knowledge; how science is related to other ways of knowing; and how people have contributed to and influenced developments in science.

Benchmarks XI-XII

1. Justify plans or explanations on a theoretical or empirical basis.
2. Describe some general limitations of scientific knowledge.
3. Show how common themes of science, mathematics, and technology apply in real-world contexts.
4. Discuss the historical development of key scientific concepts and principles.
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20.3.3 Oxidation of Alcohols (review)
20.3.4 Friedel-Crafts Acylation of Aromatic compounds (review)

20.4 Reactivity

20.5 Reactions of Aldehydes and Ketones

20.5.1 Nucleophilic Addition Reactions (Acid and Base Catalyzed)
20.5.2 Reduction of Aldehydes and Ketones to:
20.5.2.1 Hydrocarbons
20.5.2.2 Alcohols
20.5.3 Oxidation Reactions
20.5.4 Difference between Aldehyde and Ketone

Chapter 21 Carbonyl Compounds 2: Carboxylic Acids and Functional Derivatives

Introduction
21.1 Physical Properties
21.2 Structure
21.3 Acidity
21.4 Preparations of Carboxylic Acids and their derivatives
21.4.1 Carbonation of Grignard's Reagent (review)
21.4.2 Hydrolysis of Nitriles
21.4.3 Oxidation of Primary Alcohols (review)
21.4.4 Oxidation of Aldehydes (review)
21.4.5 Oxidation of Alkyl benzenes (review)

21.5 Reactions of Carboxylic Acids and their derivatives
21.5.1 Conversion of Carboxylic Acids
21.5.1 Acyl Halides
21.5.2 Acid Anhydrides
21.5.3 Esters
21.5.4 Amides
21. 5.5 Alcohols
21. 5.6 Alkane

Chapter 22 Biochemistry

Introduction
22.1 Carbohydrates
22.1.1 Classification based on structure
22.1.2 Importance of carbohydrates
22.2 Proteins
22.2.1 Classification
22.2.2 Structure
22.2.3 Properties
22.2.4 Importance of Proteins

22.3 Lipids

22.3.1 Classification
22.3.2 Structure
22.3.3 Properties of Lipids
22.3.4 Importance of lipids

22.4 Minerals of Biological Significance

22.4.1 Sources of Important Minerals
22.4.2 Biological Significance of Iron Calcium Phosphorous and Zinc

Chapter 23 Industrial Chemistry

Introduction

23.1 Introduction to the Chemical Industry

23.2 Pharmaceutical Industry

23.3 Pesticides

23.4 Synthetic Polymers (PVC and Nylon)

23.5 Cosmetics: Lipsticks, Nail Polish and Remover, Perfumes

23.6 Adhesives

Chapter 24 Environmental Chemistry

Introduction

24.1 Chemistry of the Troposphere

24.1.1 Reactions of COx, NOx, VOCs, SOx , O_3 with atmosphere
24.1.2 Automobile, Pollutants and the Catalytic Converter
24.1.3 Industrial Smog
24.1.4 Global Warming and Climate Change
24.1.5 Acid Rain

24.2 Chemistry of the Stratosphere:

24.2.1Production and Destruction of Ozone

24.3 Water Pollution and Water Analysis

24.3.1 Types of Water Pollutants
24.3.1.1 Suspended Solids and Sediments
24.3.1.2 Dissolved Solids
24.3.1.3 Waste water Analysis

24.4 Green Chemistry

Chapter 25 Spectroscopy

Introduction

25.1 Methods of Spectroscopy

25.1.1 Infrared (IR)
25.1.2 Ultra-Violet / Visible (UV-VIS)
25.1.3 Nuclear Magnetic Resonance (NMR)
25.1.4 Atomic Emission and Absorption
25.1.5 Mass Spectrometry (MS)

XI - LEARNING OUTCOMES

Chapter 1 Stoichiometry

Introduction
Major Concepts

1.1 Mole and Avogadro's Number
1.2 Rounding off Data
1.3 Exponential Notations
1.4 Limited Reactant and its Calculations
1.5 Theoretical Yield and Practical Yield as percentage

Conceptual Linkages
This unit is built on

- Atomic Mass Unit (Grade IX-X)
- Relative Atomic Mass and Relative Molecular Mass (Grade IX-X)
- Chemical Species (Grade IX-X)
- Mole Concept (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Describe mole and Avogadro's Number with examples (Understanding)
- Determine Avogadro's Number and give relationship between mole and Avogadro's Number (Applying)
- Define rounding off data, Exponential notation and their practical applications in solving numerical. (Understanding)
- Perform stoichiometric calculations with balanced equations using moles, representative particles, masses and volumes of gases (at STP) (Analyzing).
- Identify the limiting reactant in a reaction. (Analyzing)
- Knowing the limiting reactant in a reaction, calculate the maximum amount of product(s) produced and the amount of any unreacted excess reactant. (Analyzing)
- Given information from which any two of the following may be determined, calculate theoretical yield, actual yield, percentage yield. (Understanding)
- Calculate theoretical yield and the percent yield by using the balanced equation, the amounts of reactants and the actual yield. (Applying)

SKILLS:

Students will be able to:

- Use the volume (22.4 dm^3) of one mole of a gas at STP to solve mole-volume problems (Analyzing)
- Convert mass, volume and number of particles into moles (Analyzing)
- Identify and calculate the limiting reactant in a chemical reaction. (Applying)
- Perform calculations based on moles, mass, volume and number of particles. (Understanding)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Understand that Chemistry is a quantitative Science (understanding)

Chapter 2 Atomic Structure

Introduction

Major Concepts

2.1 Subatomic particles and their characteristics
2.2 Introduction and Application of Bohr's Theory
2.3 Planck's Quantum Theory
2.4 X-Rays
2.5 Radio Activity
2.6 Quantum Numbers and Orbitals
2.7 Electronic Configurations

Conceptual Linkages

This unit is built on

- Rutherford's Atomic Model (Grade IX-X)
- Bohr's Atomic Theory (Grade IX-X)
- Isotopes (Grade IX-X)
- Concept of s and p Subshells (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Describe properties of sub atomic particles (Understanding)
- Summarize Bohr's atomic theory (Applying)
- Use Bohr's model for calculating radii of orbits. (Understanding)
- Use Bohr's atomic model for calculating energy,frequency and wave Number of radiation emitted or absorbed by electron. (Applying)
- Describe spectrum and relate discrete line spectrum of hydrogen to energy levels of electrons in the hydrogen atom. (Applying)
- Explain production, properties, types and uses of X-rays. (Understanding)
- Uses of nuclear radiation in health, agricultural etc. (Applying)
- Define photon as a unit of radiation energy. (Remembering)
- Describe the concept of orbitals. (Understanding)
- Explain the significance of quantized energies of electrons. (Applying)
- Distinguish among principal energy levels, energy sub levels, and atomic orbitals. (Understanding)
- Describe the general shapes of s, p, and d orbitals. (Understanding)
- Describe the hydrogen atom using the Quantum Theory. (Understanding)
- Use the Aufbau Principle, the Pauli Exclusion Principle, and Hund's Rule to write the electronic configuration of the elements. (Applying)
- Describe the orbits of hydrogen atom in order of increasing energy. (Understanding)
- Explain the sequence of filling of electrons in many electron atoms. (Applying)
- Describe radioactivity and uses of Nuclear radiation daily life. (Understanding)

SKILLS:

Students will be able to:

- Calculate the frequency given the wavelength or wave number. (Applying)
- Calculate the energy of a photon associated with a given wavelength or frequency of radiation. (Applying)
- Calculate energy differences between different energy levels of the hydrogen atom. (Analyzing)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Describe how making models helps to better understand the structure of atoms and molecules. (Applying)
- Explain firework displays

Chapter 3 Theories of Covalent Bonding and Shapes of Molecules

Introduction

Major Concepts

3.1 Theories of Covalent Bonding
3.2 Shapes of Molecules
3.3 Bond Characteristics
3.4 Effects of Bonding on Physical and Chemical Properties

Conceptual Linkages

This unit is built on

- Why do Atoms Form Bonds? (Grade IX-X)
- Types of Bonds (Grade IX-X)
- Intermolecular Forces (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Describe the features of sigma and pi bonds. (Understanding)
- Use VSEPR and VBT theories to describe the shapes of simple covalent molecules. (Applying)
- Describe the shapes of simple molecules using orbital hybridization. (Applying)
- Determine the shapes of some molecules from the number of bonded pairs and lone pairs of electrons around the central atom. (Analyzing)
- Define bond energies and explain how they can be used to compare bond strengths of different chemical bonds. (Analyzing)
- Predict the molecular polarity from the shapes of molecules. (Applying)
- Describe how knowledge of molecular polarity can be used to explain some physical and chemical properties of molecules. (Analyzing)
- Describe the change in bond lengths of hetero-nuclear molecules due to difference in Electronegativity values of bonded atoms. (Understanding)
- Explain what is meant by the term ionic character of a covalent bond. (Understanding)

SKILLS:

Students will be able to:

- Use ball and stick models to represent different molecular shapes.

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Explain how hydrogen bonds and covalent disulphide bridges are responsible for straight and curly hair. (Applying)

Chapter 4 States of Matter I: Gases

Introduction

Major Concepts

4.1 Kinetic Molecular Theory of Gases
4.2 Absolute Temperature on the Basis of Charles Law
4.3 Avogadro's Law
4.4 Ideal Gas Equation
4.5 Deviation from Ideal Gas Behavior
4.6 Van der Waals Equation
4.7 Dalton's Law of Partial Pressure
4.8 Graham's Law of Diffusion and Effusion
4.9 Liquefaction of Gases
4.10 Fourth State of Matter: Plasma

Conceptual Linkages

This unit is built on

- Physical Properties of Gases due to Intermolecular Forces
- Boyle's Law
- Charles' Law

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- List the postulates of Kinetic Molecular Theory. (Remembering)
- Describe the motion of particles of a gas according to Kinetic Theory. (Applying)
- State the values of standard temperature and pressure (STP). (Remembering)
- Relate temperature to the average kinetic energy of the particles in a substance. (Applying)
- Use Kinetic Theory to explain gas pressure. (Applying)
- Describe the effect of change in atmospheric pressure on the weather. (Applying)
- Describe the effect of change in temperature on the volume of gas. (Applying)
- Explain the significance of absolute zero, giving its value in degree Celsius and Kelvin. (Understanding)
- State and explain the significance of Avogadro's Law. (Understanding)
- Derive Ideal Gas Equation using Boyle's, Charles' and Avogadro's law. (Understanding)
- Explain the significance and different units of ideal gas constant. (Understanding)
- Distinguish between real and ideal gases. (Understanding)
- Explain why real gases deviate from the gas laws. (Analyzing)
- Define and describe the properties of Plasma. (Applying)

UNDERSTANDING:

Students will be able to:

- Derive new form of Gas Equation with volume and pressure corrections for real gases. (Applying)
- State and use Graham's Law of Diffusion. (Understanding)
- State and use Dalton's Law of Partial Pressures. (Understanding)
- Describe some of the implications of the Kinetic Molecular Theory, such as the velocity of molecules and Graham's Law. (Applying)
- Explain Lind's method for the liquefaction of gases. (Understanding)
- Describe Liquid Air and its uses (Applying)
- Define pressure and give its various units. (Remembering)

SKILLS:

Students will be able to:

- Interconvert pressure units in pascals, kilopascals, atmospheres and bar. (Applying)
- Calculate the partial pressure of a gas collected over water. (Applying)
- Calculate the new volume of a gas when the pressure of the gas changes. (Applying)
- Use the combined gas law in calculations. (Applying)
- Determine the molar volume of the gas under various conditions. (Applying)
- Apply the ideal gas laws to calculate the pressure or the volume of a gas. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Predict the effect of heating gases to extremely high temperatures. (Applying)
- Predict how pressure affects scuba divers at varying depths. (Analyzing)
- Explain the need to liquefy gases for different purposes. (Analyzing)
- Provide examples of uses of liquefied gases in the community. (Applying)
- Prediction of rain based on atmospheric pressure. (Applying)

Chapter 5 States of Matter II: Liquids

Introduction

Major Concepts

5.1 Kinetic Molecular Interpretation of Liquids
5.2 Intermolecular Forces (Van der Walls forces)
5.3 Physical Properties of Liquids
5.4 Energetics of Phase Changes
5.5 Liquid Crystals

Conceptual Linkages

This unit is built on

- Physical Properties of Liquids due to Intermolecular Forces (Grade IX-X)
- Effects of Temperature and Pressure on Vapor Pressure (Grade IX-X)
- Effects of Temperature and Pressure on Boiling Point (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Describe simple properties of liquids e.g., diffusion, compression, expansion, motion of molecules, spaces between them, intermolecular forces and kinetic energy based on Kinetic Molecular Theory. (Understanding)
- Explain applications of dipole-dipole forces, hydrogen bonding and London forces. (Applying)
- Explain physical properties of liquids such as evaporation, vapour pressure, boiling point, viscosity and surface tension. (Understanding)
- Use the concept of Hydrogen bonding to explain the following properties of water: high surface tension, high specific heat, low vapor pressure, high heat of vaporization, and high boiling point. And anomalous behaviour of water when its density shows maximum at 4 degrees centigrade(Applying)
- Define molar heat of fusion and molar heat of vaporization. (Remembering)
- Describe how heat of fusion and heat of vaporization affect the particles that make up matter. (Understanding)
- Relate energy changes with changes in intermolecular forces. (Applying)
- Define dynamic equilibrium between two physical states. (Remembering)
- Describe liquid crystals and give their uses in daily life. (Applying)
- Differentiate liquid crystals from pure liquids and crystalline solids. (Applying)

SKILLS:

Students will be able to:

- Identify types of intermolecular attractions between the molecules of a liquid from a given list of liquids based on its molecular structures. (Applying)
- Compare and explain the volatility of different liquids at same temperature based on intermolecular forces. (Analyzing)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Provide examples of liquid crystals used in objects like digital wrist watches, computers, mobile screens and calculators. (Applying)

Chapter 6 States of Matter III: Solids

Introduction
Major Concepts

6.1 Kinetic Molecular Interpretation of Solids
6.2 Types of Solids
6.3 Properties of Crystalline Solids
6.4 Types of Crystalline Solids
6.5 Crystal Lattice

Conceptual Linkages
This unit is built on

- Physical Properties of Solids (Grade IX-X)
- Amorphous Solids (Grade IX-X)
- Crystalline Solids (Grade IX-X)
- Allotropic Solids (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Describe simple properties of solids e.g., diffusion, compression, expansion, motion of molecules, spaces between them, intermolecular forces and kinetic energy based on kinetic molecular theory. (Understanding)
- Differentiate between amorphous and crystalline solids. (Understanding)
- Describe properties of crystalline solids like geometrical shape, melting point, cleavage planes, crystal growth, anisotropy, symmetry, isomorphism, polymorphism, allotropy and transition temperature. (Understanding)
- Use Sulphur to define allotropy. (Understanding)
- Explain the significance of the unit cell to the shape of the crystal using NaCI as an example. (Applying)
- Name three types of packing arrangements and draw or construct models of them. (Applying)
- Name three factors that affect the shape of an ionic crystal. (Understanding)
- Define lattice energy. (Remembering)
- Differentiate between ionic, covalent, molecular and metallic crystalline solids. (Applying)
- Explain the low density and high heat of fusion of ice. (Understanding)
- Define and explain molecular and metallic solids. (Understanding)

SKILLS:

Students will be able to:

- List some common amorphous solids encountered in daily life. (Applying)
- Explain why a compound like C^aCl_2 will fluctuate in mass from day to day because of humidity. (Applying)
- To check purity of solid by melting point (Applying).

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- List examples of crystalline and amorphous solids in their community and relate these to their specific uses. (Analyzing)

Chapter 7 Chemical Equilibrium

Introduction

Major concepts

7.1 Reversible Reactions and Dynamic Equilibrium
7.2 Factors Affecting Equilibrium (Le-Chatelier's Principle).
7.3 Industrial Application of Le-Chatelier's Principle (Haber's Process)
7.4 Solubility Products
7.4 Common Ion Effect

Conceptual Linkages

This unit is built on

- Reversible Reactions and Dynamic Equilibrium (Grade IX-X)
- Equilibrium Constant and its Derivation (Grade IX-X)
- Law of Mass Action (Grade IX-X)
- Equilibrium Calculations (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Define chemical equilibrium in terms of a reversible reaction. (Remembering)
- Write both forward and reverse reactions and describe the macroscopic characteristics of each. (Understanding)
- State the necessary conditions for equilibrium and the ways that equilibrium can be recognized. (Understanding)
- Write the equilibrium expression for a given chemical reaction. (Understanding)
- Relate the equilibrium expression in terms of concentration, partial pressure, number of moles and mole fraction. (Applying)
- Write expression for reaction quotient. (Understanding)
- Determine if the equilibrium constant will increase or decrease when temperature is changed, given the equation for the reaction. (Applying)
- Determine the reactants or products are favored in a chemical reaction, given the equilibrium constant. (Analyzing)
- State Le Chatelier's Principle and be able to apply it to systems in equilibrium with changes in concentration, pressure, temperature, or the addition of catalyst. (Applying)
- Explain industrial applications of Le Chatelier's Principle using Haber's process as an example. (Analyzing)
- Define and explain solubility product. (Understanding)
- Define and explain common ion effect giving suitable examples. (Applying)

SKILLS:

Students will be able to:

- Calculate the equilibrium constant for a reaction given the equilibrium concentrations of reactants and products. (Applying)
- Calculate the concentration specified, given the equilibrium constant and appropriate information about the equilibrium concentrations. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Relate the role of chemical equilibrium in industries that focus on high yields. (Applying)

Chapter 8 Acids, Bases and Salts

Introduction

Major Concepts

8.1 Acidic, basic and Amphoteric substances
8.2 Bronsted-Lowery Definitions of Acids and Bases
8.3 Conjugate Acid-Base Pairs
8.4 Strength of Acids and Bases
8.5 Lewis Definitions of Acids and Bases
8.6 Buffer Solutions and their applications
8.7 Salts, their types and applications

Conceptual Linkages

This unit is built on

- Concepts of Acids and Bases (Grade IX-X)
- pH and pOH (Grade IX-X)
- Salts (Grade IX-X)
- Buffers (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Define Bronsted and Lowery concepts for acids and bases (Remembering)
- Identify conjugate acid-base pairs of Bronsted-Lowery acid and base (Analyzing)
- Explain ionization constant of water (Understanding)
- Calculate pH, pOH in aqueous medium using Kw values. (Applying)
- Define and explain leveling effect. (Understanding)
- Define Lewis acid and base with suitable examples (Remembering)
- Define a buffer and make buffer solutions. (Applying)
- Show with equations how a buffer system works. (Applying)
- Applications of salts like NaCl, KCl, KI, $NaHCO_3$, $MgSO_4$, etc. (in tabular form) (Applying).
- Use the concept of hydrolysis to explain why aqueous solutions of some salts are acidic or basic. (Applying)
- Use concept of hydrolysis to explain why the solution of a salt is not necessarily neutral. (Understanding)

SKILLS:

Students will be able to:

- Know the nature of solutions on the basis of pH & pOH values. (Applying)
- Identify the nature of acid and base on the basis of hydronium ion concentration. (Analyzing)
- Know the importance of salts in daily life. (Remembering)
- Calculate the strength of acid and base. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Link preservatives in food products and allergic reactions in people. (Analyzing)
- Explain why essential elements like iodine are added to table salt for better human health. (Analyzing)
- Explain gastric acidity and use of anti-acid drugs. (Analyzing)
- Explain curdling of milk with lemon juice. (Analyzing)

Chapter 9 Chemical Kinetics

Introduction

Major Concepts

9.1 Chemical Kinetics
9.2 Rates of reactions
9.3 Collision Theory, transition state and activation energy
9.4 Catalysis

Conceptual Linkages

This unit is built on

- Rate of Reaction (Grade IX-X)
- Law of Mass Action (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDINGS

Students will be able to:

- Define chemical kinetics. (Remembering)
- Explain the terms rate of reaction, rate equation, order of reaction, rate constant and rate determining step. (Understanding)
- Determine the order of reaction (Applying)
- Calculate units of rate constant. (Applying)
- Explain effects of concentration, temperature and surface area on reaction rates. (Applying)
- Explain why powdered zinc reacts faster. (Analyzing)
- Explain what is meant by the terms activation energy and activated complex. (Understanding)
- Relate the ideas of activation energy and the activated complex to the rate of a reaction. (Applying)
- Illustrate the collision theory to explain how the rate of a chemical reaction is influenced by the temperature, concentration, size of molecules. (Applying)
- Illustrate a potential energy diagram for a reaction, discuss the reaction mechanism for the reaction. (Applying)
- Define terms catalyst, catalysis, homogeneous catalysis and heterogeneous catalysis. (Understanding)
- Enlist examples of catalyst in tabular form (Understanding)
- Explain that a catalyst provides a reaction pathway that has low activation energy. (Applying)
- Describe enzymes as biological catalysts. (Understanding)

SKILLS:

Students will be able to:

- Draw energy diagrams that represent the activation energy and show the effect of a catalyst. (Understanding)
- Calculate initial rate using concentration data. (Applying)
- Deduce the order of a reaction using the method of initial rates. (Analyzing)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Describe how enzymes can be effective in removing stains from fabrics. (Applying)
- Understand that Chemistry deals with the transformation of matter. (Understanding)

Chapter 10 Solutions and Colloids

Introduction

Major Concepts

10.1 General Properties of Solutions
10.2 Concentration Units
10.3 Raoult's Law
10.4 Colligative Properties of dilute Solutions
10.5 Colloids

Conceptual Linkages

This unit is built on

- Types of Solutions (Grade IX-X)
- Molarity (Grade IX-X)
- Solubility (Grade IX-X)
- Suspensions and Colloids (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- List the characteristics of colloids and suspensions that distinguish them from solutions. (Understanding)
- Define hydrophilic and hydrophobic molecules. (Remembering)
- Explain the nature of solutions in liquid phase giving examples of completely miscible, partially miscible and immiscible liquid-liquid solutions. (Applying)
- Explain the effect of temperature on solubility. (Understanding)
- Express solution concentration in terms of mass percent, molality, molarity, parts per million, billion and trillion and mole fraction. (Remembering)
- Define Raoult's Law with suitable examples (Understanding)
- Define the term colligative property. (Remembering)
- List some colligative properties of liquids (Understanding)
- Describe on a particle basis why a solution has a lower vapor pressure than the pure solvent. (Applying)
- Explain on a particle basis how the addition of a solute to a pure solvent causes an elevation of the boiling point and depression of the freezing point of the resultant solution. (Applying)
- Explain osmotic pressure, reverse osmosis and give their daily life applications. (Applying)
- Describe types of colloids and their properties. (Understanding)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Describe the effect of pressure on gas solubility and the effervescence observed when a bottle of carbonated drink is uncapped. (Applying)
- Know the concept of reverse osmosis in R.O. Plant. (Understanding)

Chapter 11 Thermochemistry

Introduction

Major Concepts

11.1 Thermodynamics
11.2 Thermochemical Reactions
11.3 First Law of Thermodynamics
11.4 Hess's Law: Enthalpy change calculations

Conceptual Linkages

This unit is built on

- Exothermic and Endothermic Reactions (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Define thermodynamics. (Remembering)
- Define the terms system, surrounding, boundary, state of system, state function, internal energy, enthalpy, entropy, heat of formation, standard heat of formation (Remembering)
- Classify reactions as exothermic and endothermic. (Analyzing)
- Relate change in enthalpy to the heat of reaction and heat of combustion of a reaction. (Applying)
- Relate change in internal energy of a system with thermal energy at constant volume and constant pressure. (Applying)
- Explain Hess's Law with examples. (Understanding)
- Apply Hess's Law to construct simple energy cycles. (Applying)
- Explain reaction pathway diagram in terms of enthalpy changes of the reaction. (Born Haber's Cycle) (Applying)

SKILLS:

Students will be able to:

- Use standard heats of formation to calculate the enthalpy change of a reaction. (Applying)
- Perform calculations involving energy cycles related to Hess's Law. (Applying)
- Calculate lattice energy and enthalpy of formation of NaCI and MgO from given set of appropriate data. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Use of cold and hot pouches for cooling and heating. (Applying)
- Understand that transformation of matter is accompanied with changes in energy. (Understanding)

Chapter 12 Electrochemistry

Introduction

Major Concepts

12.1 Oxidation-Reduction Concepts
12.2 Electrode, Electrode Potential and Electrochemical Series
12.3 Batteries
12.4 Corrosion and its prevention

Conceptual Linkages

This unit is built on

- Redox Reactions (Grade IX-X)
- Rules for Assigning Oxidation States (Grade IX-X)
- Electrochemical Cells (Grade IX-X)
- Electrochemical Industries (Grade IX-X)
- Corrosion and Its Prevention (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Give the characteristics of a Redox reaction. (Understanding)
- Determine oxidation and reduction in terms of a change in oxidation number. (Applying)
- Determine the oxidation number of an atom of any element in a pure substance. (Applying)
- Enlist the oxidizing and reducing agents. (Remembering)
- Balance redox reactions that take place in acid solutions. (Applying)
- Break a redox reaction into oxidation and reduction half reactions. (Applying)
- Balance the redox equation by using half-cell reaction method. (Applying)
- Define cathode, anode, electrode potential and S.H.E. (Standard Hydrogen Electrode). (Remembering)
- Identify the substance oxidized and the substance reduced in batteries. (Applying)
- Describe the cell potential and how it is determined. (Understanding)
- Describe the reaction that occurs when a lead storage battery is recharged. (Applying)
- Illustrate how a fuel cell produces electrical energy. (Applying)
- Explain the types and uses of batteries in daily life. (Applying)
- Define corrosion and describe simple methods like electroplating and galvanizing for its prevention

SKILLS:

Students will be able to:

- Use standard electrode potentials to calculate the standard emf of cell (Applying)
- Predict the feasibility of an electrochemical reaction from emf data. (Analyzing)
- Calculate the cell potential for an electrochemical cell under standard conditions. (Applying)
- Deduce the direction of flow of electrons in an electrochemical cell. (Analyzing)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Provide examples of applications of oxidation-reduction reactions in daily life. (Applying)
- Identify solar cells as the source of energy. (Applying)
- Explain how batteries work. (Applying)
- Illustrate how a lead storage battery produces electricity. (Understanding)
- Explain many reactions as the result of electron transfer. (Understanding)

XII - LEARNING OUTCOMES

Chapter 13 Chemistry of Representative Elements

Introduction

Major Concepts

13.1 General group trends of representative elements
13.2 Reactions of Representative Elements.
13.3 Flame Test S – Block Elements
13.4. Chemistry of Important Compounds of S - Block Elements
13.5 Reactions of P – Block Elements
13.6 Chemical Behaviour of Halogens
13.7. Chemistry of Sulphuric Acid
13.8 Diagonal relationship of representative elements

Conceptual Linkages

This unit is built on

- Periodic Table (Grade IX-X)
- Periodicity of Properties (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Recognize the demarcation of the Periodic Table into s block, p block, d block, and f block. (Understanding)
- Describe physical properties like atomic radius, ionization energy, electronegativity, electrical conductivity, oxidation states of elements and melting and boiling points of elements change within groups of representative elements (Analyzing)
- Explain reactions of S – Block elements with oxygen, water, Halogens, nitrogen, hydrogen, alcohol and acids. (Understanding)
- Enlist flame test of S – Block Elements (Applying)
- Explain Chemistry of Sodium Hydroxide and bleaching powder. (Understanding)
- Enlist functions of S – Block Elements and their important compounds in tabular form. (Understanding)
- Explain reactions of P – Block elements with oxygen, water, Halogens, nitrogen and hydrogen. (Understanding)
- Differentiate beryllium from other members of its group. (Analyzing)

UNDERSTANDING:

Students will be able to:

- Explain the relative behaviour of halogens as oxidizing agents and reducing agents. (Applying)
- Compare the acidity of hydrogen halides. (Analyzing)
- Distinguish between an oxide and a peroxide. (Understanding)
- Write representative equations for the formation of oxides and sulphides. (Applying)
- Explain Chemistry of Sulphuric acid (Understanding)
- Enlist functions of some P block elements and their important compounds in tabular form (Understanding)
- Compare the diagonal relationship of s and p block elements (Analyzing)

SKILLS:

Students will be able to:

- Perform flame tests and explain the appearance of colors in the flame. (Analyzing)
- Analyze acidic and basic Ions using various tests. (Analyzing)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Describe how the food and beverage industry uses steel, tin, aluminum and glass for canning purposes. (Analyzing)
- Explain how certain elements are mined and extracted from the earth. (Applying)
- Relate the properties of the halogens to their important commercial uses. (Applying)
- Explain that iodine deficiency leads to goiter. (Understanding)
- Explain the applications of bleaching powder. (Understanding)
- Explain fluoride toxicity and deficiency. (Understanding)

Chapter 14 Chemistry of outer Transition (d-block) elements

Introduction
Major Concepts

14.1 General Features
14.2 Nomenclature of Coordination compounds
14.3 Chemistry of Some Important Transition Elements

Conceptual Linkages
This unit is built on

- Periodic Table (Grade IX-X)
- Periodicity of Properties (Grade IX-X)
- Metals and Metalloids (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Describe electronic structures of elements and ions of d-block elements. (Applying)
- Explain why the electronic configuration for chromium and copper differ from those assigned using the Aufbau principle. (Analyzing)
- Describe general features of transition elements (Understanding)
- Enlist oxidation states of Cr, Mn, Fe, Co. (Applying)
- Explain origin of colors and nomenclature of coordination compounds. (Applying
- Describe important reactions and uses of Chromium, Manganese, Iron and Copper.
- Define an alloy and describe some properties of an alloy that are different from the metals that compose it. (Analyzing)
- Describe the Steel, types and its applications. (Understanding)
- Enlist alloys of d block elements and their applications in tabular form (Applying).
- Describe the reactions of potassium dichromate with oxalic acid and Mohr's salt. (Understanding)
- Describe the reactions of potassium per magnate with ferrous sulphate, oxalic acid and Mohr's salt. (Understanding)
- Explain clearly the rules of nomenclature of coordination compounds with suitable examples (Applying)
- Enlist functions of some d block elements and their important compounds in tabular form.

SKILLS:

Students will be able to:

- Determine the concentration of iron (II) ions in solution by titration with $KMnO_4$. (Applying)
- Understand the uses of Alloys in daily life. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Compare properties of Brass, Bronze and their constituent elements. (Applying)
- Identify that certain transition metal compounds are used in paints (Understanding)

Chapter 15 Organic Compounds

Introduction

Major Concepts

15.1 Sources
15.2 Coal as a source of Organic Compounds
15.3 Characteristics of Organic Compounds
15.4 Uses of Organic Compounds
15.5 New Allotrope of Carbon: Bucky Ball
15.6 Functional Groups and Homologous Series

Conceptual Linkages

This unit is built on

- Definition of Organic Chemistry (Grade IX-X)
- Sources and Uses of Organic Compounds (Grade IX-X)
- Functional Groups (Grade IX-X)
- Homologous Series (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Define organic chemistry and organic compounds. (Remembering)
- Explain why there is such a diversity and magnitude of organic compounds. (Analyzing)
- Explain the use of coal as a source of both aliphatic and aromatic hydrocarbons. (Understanding)
- Explain the use of plants as a source of organic compounds. (Understanding)
- Explain that organic compounds are also synthesized in the lab. (Understanding)
- Define functional groups and homologous series. (Remembering)
- Explain reforming of petroleum. (Understanding)
- Explain different uses of organic compounds in our daily life. (Understanding)
- Explain Bucky ball. (Understanding)

SKILLS:

Students will be able to:

- Make distinction among different organic compounds on the basis of their formula. (Analyzing)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Realize that many organic compounds are obtained from plants and animals. (Understanding)
- Understand that organic compounds are partially or totally synthesized in the lab. (Understanding)
- List many medicines are obtained from plants. (Remember)

Chapter 16 Nomenclature of Organic Compounds

Introduction
Major Concepts

16.1 Introduction of Hydrocarbons and their derivatives
16.2 History of Nomenclature
16.3 IUPAC System
16.4 Nomenclature of Alkane.
16.5 Nomenclature of Alkene
16.6 Nomenclature of Alkyne
16.7 Nomenclature of Alkyl Halide
16.8 Nomenclature of Amines
16.9 Nomenclature of Alcohol
16.10 Nomenclature of Phenol
16.11 Nomenclature of Ether
16.12 Nomenclature of Aldehyde and Ketone
16.13 Nomenclature of Carboxylic Acid
16.14 Nomenclature of Ester
16.15 Nomenclature of Amide
16.16 Nomenclature of Acyl Halides

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Enlist the families of organic compound with functional groups. (Remembering)
- Describe nomenclature rules of each family by applying common name system and IUPAC system. (Understanding)
- Write nomenclature of alkane, alkene, alkyne cyclo alkanes with five examples of each family. (Applying)
- Write nomenclature of Alkyl Halide, Amine, Ether, alcohol, Phenol, Aldehyde, Ketone, Carboxylic acid, Ester, Amide and Acyl Halide with at least five examples of each family. (Applying)
- Explain the outlines to draw structures for IUPAC of organic compounds of each family. (Applying)
- Explain outlines to draw structures of common names of organic compounds of each family. (Applying)

SKILLS:

Students will be able to:

- Know about the structural formulas of organic compounds. (Understanding)
- Draw structures of compounds and to name them in accordance with IUPAC system. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Name the organic compounds. (Applying)
- Draw the structure of organic compound. (Applying)

Chapter 17 Hydrocarbons

Introduction

Major Concepts

17.1 Types of Hydrocarbons
17.2 Alkanes and Cycloalkanes
17.3 Radical Substitution Reactions
17.4 Alkenes
17.5 Isomerism
17.6 Alkynes
17.7 Benzenes and Substituted Benzenes

Conceptual Linkages

This unit is built on

- Introduction to Alkane and Alkyl Radicals (Grade IX-X)
- Alkenes and Alkynes (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Classify hydrocarbons as aliphatic and aromatic. (Understanding)
- Explain the shapes of alkanes and cycloalkanes exemplified by ethane and cyclopropane. (Applying)
- Explain unreactive nature of alkanes towards polar reagents. (Applying)
- Define homolytic and heterolytic fission, free radical initiation, propagation and termination. (Remembering)
- Describe the mechanism of free radical substitution in alkanes exemplified by methane and ethane. (Understanding)
- Explain what is meant by a chiral centre and show that such a centre gives rise to optical isomerism. (Understanding)
- Identify chiral centers in given structural formula of a molecule. (Analyzing)
- Analyze glucose molecules by optical activity. (Applying)
- Explain the terms isomerism and structural isomerism with suitable examples. (Remembering)
- Define stereoisomerism (cis and trans) with example of alkene. (Remembering)
- Explain shape of ethene molecule in terms of sigma and pi C-C bonds. (Understanding)
- Describe the structure and reactivity of alkenes as exemplified by ethene. (Applying)
- Draw all possible isomers of molecular formula C_4H_{10}, C_5H_{12}, C_4H_8, C_5H_{10}, C_4H_6, C_5H_8 with their IUPAC names. (Applying)

- Draw all possible isomers of molecular formula C_3H_7OH, C_3H_7Cl, $C_4H_9NH_2$ with their IUPAC names. (Applying)
- Draw all possible isomers of molecular formula C_2H_6O, C_3H_6O, $C_2H_4O_2$ with their IUPAC names. (Applying)
- Explain dehydration of alcohols and dehydrohalogenation of RX for the preparation of ethene. (Understanding)
- Describe the chemistry of alkenes by the following reactions of ethene: Hydrogenation, hydrohalogenation, hydration, halogenation, halohydration, epoxidation, ozonolysis, polymerization. (Understanding)
- Explain the shape of benzene molecule (molecular orbital aspect). (Understanding)
- Describe what is meant by the term delocalized electrons in the context of the benzene ring. (Understanding)
- Describe addition reactions of Benzene (with hydrogen and halogen). (Understanding)
- Describe the general mechanism of electrophilic substitution in benzene. (Understanding)
- Discuss the electrophilic reactions of benzene and toluene (nitration, sulphonation, halogenation, Friedel Craft's alkylation and acylation). (Applying)
- Apply the knowledge of positions of substituents in the electrophilic substitution of benzene. (Applying)
- Compare the reactivity of alkanes, alkenes and alkynes. (Analyzing)
- Discuss the shape of acetylene in terms of sigma and pi bonds. (Applying)
- Describe the preparation of alkynes using elimination reactions. (Applying)
- Describe acidity of acetylene. (Understanding)
- Discuss reaction of alkynes by hydrogenation, hydrohalogenation, hydration, bromination, ozonolysis, and reaction with metals. (Understanding)

SKILLS:

Students will be able to:

- Draw different possible ring structures of benzene (Kekule structures). (Understanding)
- Draw the structures of alkanes, alkenes and alkynes up to 10 carbon atoms. (Understanding)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Identify and link uses of various hydrocarbons used in daily life. (understanding)
- Identify various hydrocarbons which will be important as fuels for the future energy needs of Pakistan (understanding)

Chapter 18 Alkyl Halides and Amines

Introduction

Major Concepts

18.1 Alkyl Halides
18.2 Grignard's Reagents (Organometallic Compounds)
18.3 Amines

Conceptual Linkages

This unit is built on

- Functional Groups (Grade IX-X)
- Amino Acids (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Discuss the physical properties, structure and reactivity of RX. (Understanding)
- Describe the preparation of RX by the reaction of alcohols with HX, $SOCl_2$ and PX_3 and by halogenation of alkanes. (Understanding)
- Explain the mechanism and types of nucleophilic substitution reactions. (Applying)
- Explain the mechanism and types of elimination reactions. (Applying)
- Compare the nucleophilic substitution versus elimination reaction. (Analyzing)
- Explain the preparation and reactivity of Grignard's Reagents. (Applying)
- Applications of Grignard's reagent (Water, esters and carbon dioxide and amines). (Applying)
- Explain the structure and basicity of amines. (Applying)
- Describe the preparation of amines by alkylation of ammonia to RX and reduction of nitriles, nitro and amide functional groups. (Understanding)
- Explain the reactions of amines (RX, aldehydes, ketones) and preparation of amides and diazonium salts. (Understanding)
- Enlist the important compounds of Alkyl Halides and Amines with their applications. (Applying)
- Explain the reactivity of alkyl halide with respect to polarity of C- Xbond. (Understanding)
- Explain why primary alkyl halide favors SN^2 reactions and tertiary alkyl halide $SN^{1.}$ (Understanding)

SKILLS:

Students will be able to:

- Identify amines in the laboratory by carrying out appropriate tests. (Applying)
- Perform tests to detect nitrogen in organic compounds. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Identify organometallic compounds in medicines. (understanding)
- Compare hemoglobin and chlorophyll. (Understanding)
- Recognize alkyl halides as precursors of many organic compounds. (Applying)

Chapter 19 Alcohols, Phenols and Ethers

Introduction

Major Concepts

19.1 Alcohols
19.2 Phenols
19.3 Ethers

Conceptual Linkages

This unit is built on

- Functional Groups (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Describe the physical properties and structure of alcohol. (Understanding)
- Explain the preparation of alcohols by reduction of aldehydes, ketones, carboxylic acids and esters. (Applying)
- Explain the preparation of alcohols by hydrolysis of alkyl halide and Grignard reagent with aldehyde and ketone. (Applying)
- Describe reactivity of alcohols (Understanding)
- Describe the preparation of ether and ester by alcohol and oxidative cleavage of 1, 2-diols. (Understanding)
- Discuss the physical properties and structure of phenols. (Applying)
- Explain the preparation of phenol from chlorobenzene and hydrolysis of diazonium salts. (Applying)
- Explain the reactions of phenol. (Applying)
- Differentiate between alcohol and phenol. (Understanding)
- Enlist the important compounds of Alcohols, Phenols and Ethers with their application (Applying)
- Explain identification test of alcohol and phenol. (Understanding)

SKILLS:

Students will be able to:

- Discuss the physical properties, structure of ether.
- Describe the preparation and chemical reactivity of ether.

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Explain the role of disinfectants in hygiene. (Analyzing)
- Differentiate between disinfectants and antiseptics. (Understanding)
- Recognize that ethers are used in anesthesia (Applying)

Chapter 20 Carbonyl Compounds 1: Aldehydes and Ketones

Introduction

Major Concepts

20.1 Physical Properties
20.2 Structure
20.3 Preparations of Aldehydes and Ketones
20.4 Reactivity
20.5 Reactions of Aldehydes and Ketones

Conceptual Linkages

This unit is built on

- Functional Groups (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Explain the physical properties and structure of aldehydes and ketones. (Understanding)
- Explain the preparation of aldehydes and ketones by ozonolysis of alkenes, hydration of alkynes, oxidation of alcohols and Friedel Craft's acylation of aromatics. (Applying)
- Describe reactivity of aldehydes and ketones. (Understanding)
- Explain acid and base catalysed nucleophilic addition reactions of aldehydes and ketones. (Applying)
- Explain reactions of aldehydes and ketones. (Applying)
- Describe oxidation reactions of aldehydes and ketones. (Applying)
- Compare the aldehyde and ketone with reference to their laboratory test (tabular form)(Understanding)
- Enlist the important compounds of Aldehydes and Ketones with their application. (Applying)

SKILLS:

Students will be able to:

- Identify aldehydes in the laboratory tests. (Applying)
- Identify ketones using appropriate laboratory tests. (Applying)
- Determine melting or boiling points of aldehydes and ketones in laboratory. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Explain how oxidation and reduction alters the structure of organic compounds. (Understanding)
- Explain the need to limit exposure to formaldehyde vapors as used in adhesives, varnishes, paints, foam insulation and permanent press clothing. (Applying)
- Describe glucose and fructose as examples of aldehydes and ketones (Understanding)
- Explain the role of ozonolysis in sterilization of drinking water. (Applying)

Chapter 21 Carbonyl Compounds 2: Carboxylic Acids and Functional derivatives

Introduction

Major Concepts

21.1 Physical Properties
21.2 Structure
21.3 Acidity
21.4 Preparations of Carboxylic Acids and their derivatives
21.5 Reactions of Carboxylic Acids and their derivatives

Conceptual Linkages

This unit is built on

- Functional Groups (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Discuss the physical properties and acidity of carboxylic acid. (Understanding)
- Describe preparation of carboxylic acids by carbonation of Grignard's Reagent, hydrolysis of nitriles, oxidation of primary alcohols, oxidation of aldehydes and oxidation of alkyl benzenes. (Applying)
- Conversion of carboxylic acids into their derivatives (acyl halides, acid anhydrides, esters, amides) without mechanism. (Applying)
- Enlist the important compounds of carboxylic acids and their derivatives with their application. (Applying)

SKILLS:

Students will be able to:

- Identify carboxylic acids in the laboratory (Applying)
- Determine melting or boiling points of carboxylic acids in laboratory. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Enlist carboxylic acids present in fruits, vegetables and other natural products. (Applying)
- Link different carboxylic acids with their characteristic test. (Applying)
- Recognize carboxylic acids used as preservatives in food and food products. (Applying)

Chapter 22 Biochemistry

Introduction

Major Concepts

22.1 Carbohydrates
22.2 Proteins
22.3 Lipids
22.4 Minerals of Biological Significance

Conceptual Linkages

This unit is built

- Carbohydrates (Grade IX-X)
- Proteins (Grade IX-X)
- Lipids (Grade IX-X)
- Nucleic Acids (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING

Students will be able to

- Discuss the natural sources of Carbohydrates and classification based on structure. (understanding)
- Enlist the role of various Carbohydrates in health and diseases. (Applying)
- Identify the nutritional importance and their role as energy storage (Applying)
- Explain the classification of protein on the basis of structure and their functions. (Applying)
- Explain classification and Functions of Lipids. (Applying)
- Enlist sources and the role of Iron, Calcium, Phosphorous and Zinc in nutrition. (Applying)

SKILLS:

Students will be able to:

- know Calcium as a requirement for coagulation (Applying)
- know how milk proteins can be precipitated by lowering the pH using lemon juice (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Explain why animals and humans have large glycogen deposits for sustainable muscular activities. Hibernating animals (polar bear, reptiles and amphibians) accumulate fat to meet energy resources during hibernation. (Understanding)
- Know complex Carbohydrates which provide lubrication to elbow and Knee. (Understanding)
- Describe fibrous proteins from hair and silk. (Applying)
- Explain how Cholesterol and amino acid serve as hormones. (Understanding)
- Know insulin as a protein hormone whose deficiency leads to diabetes mellitus. (Understanding)
- Explain the role of minerals in human body. (Understanding)

Chapter 23 Industrial Chemistry

Introduction

Major Concepts

23.1 Introduction to Chemical Industry
23.2 Pharmaceutical Industry
23.3 Pesticides
23.4 Synthetic Polymers (PVC and Nylon)
23.5 Cosmetics: Lipstick, Nail Polish and Remover, Perfumes.
23.6 Adhesive

Conceptual Linkages

This unit is built on

- Basic Metallurgical Operations (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Explain the role of the chemical industries in the economy of Pakistan. (Analyzing)
- Describe the various pharmaceutical products (Understanding)
- Enlist different pharmaceutical products with their functions (Applying)
- Explain the formation and uses of PVC and Nylon. (Applying)
- Describe the composition and effects of various cosmetics like nail polish, nail polish remover, lipsticks and perfumes (Understanding)
- Describe the adhesives and their applications. (Understanding)

SKILLS:

Students will be able to:

- Know different types of Industries in Pakistan and their importance.

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Trace the development and uses of different synthetic fibers. (Applying)
- Know about pharmaceutical products, cosmetics etc. (Understanding)

Chapter 24 Environmental Chemistry

Introduction

Major Concepts

24.1 Chemistry of the Troposphere
24.2 Chemistry of the Stratosphere
24.3 Water Pollution and Water Analysis
24.4 Green Chemistry

Conceptual Linkages

This unit is built on

- Composition of Atmosphere (Grade IX-X)
- Layers of Atmosphere (Grade IX-X)
- Air Pollutants (Grade IX-X)
- Ozone (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Recognize various chemical reactions occurring in the atmosphere. (Understanding)
- Recognize that the release of COx, SOx, NOx, VOCs are associated with the combustion of hydrocarbon based fuels. (Applying)
- Outline problems associated with release of pollutants including acid rain. (Understanding)
- Describe causes and impacts of smog. (Analyzing)
- Explain greenhouse effect and global warming as resulting in climate change. (Analyzing)
- Explain the buildup and the adverse effects of ozone in the troposphere. (Applying)
- Describe the role of CFCs in destroying ozone in the stratosphere. (Applying)
- Describe the role of ozone in the stratosphere in reducing the intensity of harmful UV radiation reaching the earth. (Understanding)
- List possible alternatives of CFCs. (Applying)
- Recognize and describe various water pollutants. (Applying)
- Explain the various parameters of drinking water analysis and compare with WHO standard limits. (Applying)
- List some major products of petrochemicals industry with their uses. (Applying)

SKILLS:

Students will be able to:

- Estimate chloride ions in tap water using titration technique. (Applying)
- Understand the main parameters for drinking water. (Applying)

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Describe how properties of gases promote greenhouse effect. (Analyzing)
- Make connections between Halogens and CFCs and their effects on ozone depletion. (Analyzing)
- Predict effects of radiation pollution. (Applying)
- Explain the need to work in a well-ventilated area when working with toxic solvents as used in adhesives. (Applying)
- Describe how rain water seepage through hazardous wastes dumpsites can dissolve and reach drinking water supplies. (Applying)
- Describe three ways in which water is purified. (Applying)
- Identify ways in which air pollution resulting from auto exhausts can be alleviated. (Applying)
- Recognize the use of catalytic converters in reducing pollutant emissions from petrol driven vehicles. (Analyzing)
- Differentiate between ozone at the earth's surface and ozone formation and depletion in the atmosphere. (Applying)
- Realize that dumping wastewater from household and industry without treatment to the rivers and creeks is dangerous for the environment. (Understanding)

Chapter 25 Spectroscopy

Introduction

Major Concepts

25.1 Methods of Spectroscopy

Conceptual Linkages

This unit is built on

- Structure of atoms and molecules (Grade IX-X)

LEARNING OUTCOMES

UNDERSTANDING:

Students will be able to:

- Define spectroscopy and discuss its applications in different fields (Understanding)
- Enlist the regions of electromagnetic spectrum used in IR and UV/vis spectroscopy (Applying)
- Identify Ethanol by using different techniques of Spectroscopy. (Applying)
- Explain atomic emission and atomic absorption spectrum. (Understanding)
- Describe the application of NMR, UV, IR and Mass Spectroscopy in different fields. (Understanding)

SKILLS:

Students will be able to:

- Understand and Interpret the compound by using spectroscopic techniques

SOCIETY, TECHNOLOGY AND SCIENCE:

Students will be able to:

- Explain how different instruments help in the study of chemistry. (Analyzing)
- Explain how forensic chemists use the MS to identify small amounts of unknown material. (Applying)
- Explain why forensic chemists must have strong problem-solving skills and a broad background in analytical chemistry. (Applying)
- Recognize the link between chemical instrumentation and technology (Analyzing)
- Explain how to analyze food, agriculture and pharmaceutical products by using different spectroscopic techniques (Applying)

XI-XII PRACTICALS

PRACTICALS	EQUIPMENT	CHEMICALS
XI-Practicals **Chapter 1:** **Introduction to Stoichiometry**		
1. Estimate the Amount of Be in the Given Solution of BaCl2 Gravimetrically.	analytical balance, oven, funnel, wash bottle, Whatman filter paper # 42, glass rod, beakers, desiccators, pipette, burner, matches, safety goggles	distilled water, potassium chromate solution, barium chloride solution
Chapter 2: **Atomic Structure**		
None	None	None
Chapter 3: **Theories of Covalent Bonding: Theories and Shapes of molecules**		
None	None	None
Chapter 4: **States of Matter I: Gases**		
2. Demonstrate that Gases spread by diffusion to Areas of lower Concentration.	glass tube 40cm long and 1cm in internal diameter, ring stand, clamp, clamp holder, cotton balls, forceps, dropper, rubber stoppers, safety goggles	concentrated NH3 solution, concentrated HCI
Chapter 5: **States of Matter II: Liquids**		
1. Separate the Given Mixture of Inks by Paper Chromatography.	Whatman filter paper # 1, glass cylinder with a glass support, rubber bung, lead pencil	Water — alcohol mixture, mixture of inks.

2. Separate the Following Ions from a given Mixture of their Salts (Ni^{+2}, Co^{+2}, Cu^{+2}) by Paper Chromatography.	Whatman filter paper # 1, glass cylinder with a glass support, rubber bung, lead pencil	1% solutions of the chlorides of Ni, Co, Cu^{+2}, spraying solution (0.1% rubeanic acid in ethyl alcohol), solvent mixture (acetone, distilled water and concentrated HCI mixed in ratio 43:3:4)
3. Separate Lead and Cadmium in a mixture solution by Paper Chromatography.	Whatman filter paper # 1, glass cylinder with a glass support, rubber bung, lead pencil	sample reagent (mixture of solutions of $PbCl_2$ and $CdC1_2$), solvent mixture (n-butanol + 3M HNO_3), spraying agent (H_2S gas)
4. Prove that the Loss of Thermal Energy When a Liquid Evaporates Will Lower the Temperature of the Liquid.	beaker, thermometer, safety goggles	acetone

Chapter 6:
States of Matter Ill: Solids

• Crystallize Benzoic Acid from water.	China dish, burner, tripod stand, wire gauze, matches, beakers, funnel, filter paper, stirrer, safety goggles	distilled water and benzoic acid

Chapter 7:
Chemical Equilibrium

1. Purify a Given Sample of Sodium Chloride by Passing HCI Gas. (Application of common ion effect)	beaker 500m1, funnel, round-bottom flask, glass tubing, wire gauze, thistle funnel, burner, stirrer, graduated flask and physical balance	distilled water, common salt, concentrated H_2SO_4
2. Demonstrate a Shift in the Equilibrium Point of a Reaction by Changing Concentration. (Le Chatelier's Principle)	3 beakers of 150mL, 4 beakers of 50mL, safety goggles	0.1M K_2CrO_4, 0.1M $K_2Cr_2O_7$, 1M HCI, 1M NaOH, 0.1M $Ba(NO_3)_2$

Chapter 8:
Acids, Bases and Salts

1. Determine the Exact Molarity of the Given Solution of H_2SO_4 and the Volume of this Acid Required to Prepare 500 ml of 0.02 M Acid by Volumetric Method	burette, pipette, funnel, conical flask, beakers, iron stand	phenolphthalein, 0.1M NaOH, 0.2M H_2SO_4, distilled water
2. Determine the Percentage of NaOH in the Given Solution by Volumetric Method.	burette, pipette, funnel, conical flask, beakers, iron stand	phenolphthalein, 0.1M NaOH, 0.1M HCI, distilled water, solution containing 8gms of a mixture of NaCI and NaOH
3. The given solution contains 6gms of Na_2CO_3 dissolved per dm3. Determine the Percentage Purity of the Sample Solution by Volumetric Method.	burette, pipette, funnel, conical flask, beakers, iron stand	methyl orange, 0.1M Na_2CO_3, 0.1M HCI, Distilled water, solution of 6 gms of Na_2CO_3 in 1 liter
4. Determine the Value of X by Volumetric Method in the Given Sample of 6.3g of $(COOH)_2$. XH_2O Dissolved per dm3.	burette, pipette, funnel, conical flask, beakers, iron stand	phenolphthalein, 0.1M NaOH, 0.1 $(COOH)_2.2H_20$, Distilled water
5. Determine the Solubility of Oxalic Acid at Room Temperature Volumetrically.	burette, pipette, funnel, conical flask, beakers, iron stand	Phenolphthalein, 0.1M NaOH, 0.1 (COOH) $2.2H_20$, Distilled water.

Chapter 9:
Chemical Kinetics

1. Show that the Addition of a goggles Catalyst Increases the Rate of Reaction.	500 ml flask, spatula, tray, safety	10% H_20_2, 0.1gm MnO_2, distilled water

Chapter 10:
Solution and Colloids

None	None	None

Chapter 11:
Thermochemistry

Determine the Heat of Neutralization of NaOH and HCI.	calorimeter with stirrer, thermometer, balance	1M NaOH, 1M HCI, distilled water

Chapter 12:
Electrochemistry

1. Standardize the Given Solution of solution, $KMnO_4$ Required for Preparing 1 dm^3 of 0.01M $KMnO_4$ Solution Volumetrically	burette, pipette, funnel, conical flask, beakers, iron stand, test tube	0.1M $FeSO_4$ solution, 0.02M $KMnO_4$ solution, dilute H_2SO_4, distilled water
2. Determine the Amount of Iron in the Given Sample Volumetrically.	burette, pipette, funnel, conical flask, beakers, iron stand, test tube	0.05M $FeSO_4$ solution, 0.01M $KMnO_4$ solution, dilute H_2SO_4, distilled water
3. Determine the Percentage Composition Volumetrically of a Solution Mixture of $K_2C_2O_4$ and K_2SO_4.	burette, pipette, funnel, conical flask, beakers, iron stand, test tube	solution mixture of $K_2C_20_4$ and K_2SO_4, 0.01M $KMnO_4$ solution, dilute H_2SO_4, distilled water
4. Determine the Solubility of Mohr's Salt at Room Temperature Volumetrically.	burette, pipette, funnel, conical flask, beakers, iron stand, test tube	0.05M Mohr's salt solution, 0.01M $KMnO_4$ solution, dilute H_2SO_4, distilled water

XII-Practicals
Chapter 13:
s- and p- Block Elements

1. Prepare Potassium Xanthate	beakers, funnel, filter paper, measuring cylinder, safety goggles	potassium hydroxide, alcohol, carbon disulphide, ether (for washing of crystals), distilled water, copper sulphate solution

2. Detect the Following Cations: NH_4+, Mg^{2+}, Al^{3+}, Ca^{2+}, Cr^{3+}, Mn^{2+}, Fe^{2+}, Fe^{3+}, Cu^{2+}, Zn^{2+}, Ba^{2+}, Pb^{2+}, Detect the Following Anions: $C0_3^{2}$, NO_3, NO_2, $S0_4^{2}$-' $S0_3^{2}$-, CI-, Br, r, $Cr0_4^{2}$- Perform Tests for the Following Gases: NH_3, CO_2, $C1_2$, H_2, 0_2, SO_2.	test tubes, test tube holder, test tube rack, delivery tube, measuring cylinder, match box, wooden splint, Bunsen burner, safety goggles, glass rod, filter paper, litmus paper	sodium hydroxide, ammonium hydroxide, dilute acids, barium, lead, silver salt solutions, Al foil, lime water and other necessary chemical solutions for the identification of these ions and gases
Chapter 14: d-f- Block Elements		
1. Prepare Nickel Dimethyl Glyoxime.	test tubes, test tube holder, test tube rack, measuring cylinder, Bunsen burner, safety goggles, filter paper, funnel	dimethyl glyoxime solution, nickel salt solution, distilled water and NH_4OH
Chapter 15: Organic Compounds		
None	None	None
Chapter 16: Nomenclature of Organic Compounds	None	None
Chapter 17: Hydrocarbons		
1. Prepare Ethylene from Ethylene Bromide	test tubes, test tube holder, test tube rack, delivery tube, measuring cylinder, Bunsen burner, safety goggles	pieces of zinc metal, alcohol, ethylene bromide
Chapter 18: Alkyl Halides and Amines		
1. Prepare Azo dye from Amine.	test tubes, test tube rack, test tube holder, measuring cylinder, balance, filter paper, funnel	amine, phenol, hydrochloric acid, ice, sodium nitrite, alcohol, distilled water
2. Identify the Amine Functional Group.	test tubes, test tube rack, test tube holder, measuring cylinder, balance, filter paper, funnel	Hinsberg test: benzenesulfonyl chloride, sodium hydroxide, HCI

Chapter 19: Alcohols, Phenols and Ethers		
1. Prepare lodoform.	test tubes, test tube holder, test tube rack, measuring cylinder, safety goggles	Litmus solution, Ferric Chloride solution
2. Identify the Amine Functional Group.	test tubes, test tube holder, test tube rack, measuring cylinder, safety goggles	Litmus solution, Ferric Chloride solution
Chapter 20: Carbonyl Compounds I: Aldehydes and Ketones		
1. Prepare Glucosazone.	Beakers, test tubes, measuring cylinders, balance, Bunsen burner. match box, funnel, filter papers	glucose solution, 2,4-dinitrophenyl hydrazine solution, distilled water
2. Identify the Aldehyde and Ketone Functional Groups	breakers, test tubes, measuring cylinders, Bunsen burner, match box, funnel, filter papers	Fehling's solution, Tollen's reagent, benedict solution
Chapter 21: Carbonyl Compounds II Carboxylic Acids and Functional derivatives		
1. Prepare Benzanilide from Benzoic Acid	Breakers, test tubes, measuring cylinders, Bunsen burner, match box, funnel, filter paper	benzoic acid, phosphorous pentachloride, ice, alcohol, distilled water
2. Identify the Carboxylic Acid Functional Group.	test tubes, beakers, balance, measuring cylinders, funnel, filter paper	Dilute sodium hydroxide, saturated potassium bi carbonate
Chapter 22 Biochemistry		
1. Detect glucose as Reducing sugar in urine sample of diabetic patient	test tubes, beakers, conical flask, pipette,	Benedict Reagent, Fehling's Solution

2. Detect Protein Urea denaturation)	test tubes, beakers, conical flask, pipette,	Urea, egg white
3. Observe the digestion of starch with salivary amylase.	test tubes, beakers, conical flask, pipette, slides	Freshly prepared starch solution, iodine solution
4. Detect the presence of different lipid components in an oil sample by TLC	beakers, pipette, slides	Benzene, alcohol, Silica gel Chromatographic Grade
5. Determine the Iodine number of an oil	test tubes, beakers, conical flask, pipette, beakers	Iodine solution, oil
Chapter 23: Industrial Chemistry		
None	None	None
Chapter 24: Environmental Chemistry		
None	None	None
Chapter 25: Analytical Chemistry		
1. Taking Infra Red, Ultra Violet/ visible and Mass Spectra	Subject to the availability of the instruments	As required for the experiment

XI-XII CHEMICALS

(For Group of 20 Students)

Chemicals	**Quantities**
Acetone	5L
Ammonium hydroxide	5L
Aluminum foil	5 Rolls
Aniline	2.5L
$Ba(NO_3)_2$ solution 0.1M	2.5L
Barium Chromate Solution	2.5L
Benedict's Reagent	2.5L
Benzoic acid	500gms
Bromine water	5L
Carbon disulphide	2.5L
Common Salt	5Kg
$(COOH)_2.2H_20$ solution 0.1M	2.5L
Copper sulphate solution	2.5L
Dimethyl glyoxime solution	2L
2,4-dinitrophenyl hydrazine solution	2L
Distilled water	20L
Ether	5L
Ethyl Alcohol	2.5L
Ethylene bromide	2L
Fehling's Reagent	2L
Ferric Chloride solution	2L
$FeSO_4$ solution 0.05M	2L
$FeSO_4$ solution 0.1M	2L
Glucose	2Kg
HCI solution 0.1M	5L
HCI solution 1M	5L
HCI Concentrated	2.5L
H_20_2 solution 10%	2L

H_2SO_4 Dilute	5L
H_2SO_4 solution 0.2M	2.5L
H_2SO_4 Concentrated	5L
Ink mixture	500mL
Iodine solution in potassium iodide	10L
Iron Sulfide	1Kg
K_2Cra_4 solution 0.1M	2.5L
$K_2Cr_2O_7$ solution 0.1M	5L
$KMnO_4$ solution 0.01M	5L
$KMnO_4$ solution 0.02M	5L
Lime water	2L
Magnesium turnings	1Kg
Methyl orange	100gm
$Mn0_2$	250gm
Mohr's salt solution 0.05M	5L
Na_2CO_3 solution 0.1M	5L
NaOH solution 0.1M	5L
NaOH solution 1M	5L
NH_3 solution concentrated	5L
Phenol	2.5L
Phenolphthalein	100gm
Phosphorous pentachloride	1Kg
Potassium hydroxide	2Kg
Potassium iodide	2Kg
Potassium oxalate	1Kg
Potassium sulphate	1Kg
Lead Nitrate	500gm
Cadmium Nitrate	500gm
Salts of the following cations:	

Ni, Co, NH_4+, Mg^{2}+, Al^{3}+, Ca^{2}+, Cr^{3}+,	1Kg each
Mn^{2}+, Fe^{2}+, Fe^{3}+, Cu^{2}+, Zn^{2}+, Ba^{2}+,	
Pb^{2}+.	
Salts of the following anions:	1Kg each
$C0_3^{2}$", NO_3", NO_2", $S0_4^{2}$", $S0_3^{2}$", Cr,	
Br, r, $Cr0_4^{2-}$.	500gm
Silver nitrate	500mg
Sodium nitrite	1 Kg
Solvent mixture (Acetone, Distilled Water	2L
and Concentrated HCI mixed in ratio 43:3:4)	
Solvent mixture (n-butanol + 3M HCI)	2L
Spraying Agent (A Concentrated solution of H_2S)	2L
Starch	1 Kg
Tollen's reagent	2L
Zinc turnings	1 Kg

XI-XII EQUIPMENT/ APPARATUS

(For Group of 20 Students)

Analytical balance (Digital)	5
Beakers 50mL	25
Beakers 100mL	25
Beakers 150mL	25
Burette 50mL	25
Bunsen burner	25
Calorimeter	25
China dish	25
Clamp	25
Clamp holder	25
Conical flask	25
Cotton bundles	2
Delivery tube	25
Desiccators	10
Dropper	50
Filter paper	05 Packets
Forceps	25
Funnel	25
Glass rod	25
Glass tubing	5m
Glass tube 40cm long and 1cm in diameter	25
Graduated flask	25
Iron stand	25
Kipps Apparatus	5
Litmus paper (Red)	05 Packets
Litmus paper (Blue)	05 Packets
Matches Box	10
Measuring flask 100mL	10
Measuring flask 500mL	10
Measuring cylinder 5mL	10
Measuring cylinder 10mL	10
Measuring cylinder 100mL	10
Oven	4
Pipette 10mL	25
Pipette 25mL	25
Pipette filler	25
Rubber bung	25
Ring stand	25
Round bottom flask 250mL	25
Rubber stoppers	25
Safety goggles	20
Soap	12 Bars

Spatula	25
Stirrer	25
Test tube	200
Test tube holder	40
Test tube rack	40
Thermometer	25
Thistle funnel	25
Tray	25
Tripod stand	25
Wash bottle	25
Whatman filters paper No. 42	05 Packets
Whatman filter paper No. 1	05 Packets
Wire gauze	25
Wooden splint	05 Packets

CHAPTER WISE TIME ALLOCATION

Class- XI

Chapter	Teaching	Assessment	Weightage %
Chapter 1: Stoichiometry	**10**	**1**	**8**
Chapter 2: Atomic Structure	**10**	**1**	**8**
Chapter 3: Theories of Covalent Bonding and Shapes of Molecules	**10**	**1**	**10**
Chapter 4: State of Matter I: Gases	**10**	**1**	**11**
Chapter 5: State of Matter II: Liquids	**12**	**1**	**7**
Chapter 6: States of Matter Ill: Solids	**14**	**1**	**8**
Chapter 7: Chemical Equilibrium	**9**	**1**	**7**
Chapter 8: Acids, Bases and Salts	**10**	**1**	**7**
Chapter 9: Chemical Kinetics	**8**	**1**	**7**
Chapter 10: Solutions and Colloids	**8**	**1**	**10**
Chapter 11: Thermochemistry	**8**	**1**	**9**
Chapter 12: Electrochemistry	**12**	**1**	**8**
Total:	**122**	**12**	**100**

Class XII

Chapter 13: Chemistry of Representative Elements	**22**	**2**	**18**
Chapter 14: Chemistry of Outer Transition (d-block) Elements	**9**	**1**	**7**
Chapter 15: Organic Compounds	**4**	**1**	**3**
Chapter 16: Nomenclature of Organic Compounds	**10**	**2**	**8**
Chapter 17: Hydrocarbons	**13**	**1**	**11**
Chapter 18: Alkyl Halides and Amines	**10**	**1**	**8**
Chapter 19: Alcohols, phenols and Ethers	**9**	**1**	**7**
Chapter 20: Carbonyl Compounds 1: Aldehydes and Ketones	**4**	**1**	**3**
Chapter 21: Carbonyl Compounds 2: Carboxylic Acids and Functional derivatives	**7**	**1**	**6**
Chapter 22: Biochemistry	**6**	**1**	**5**
Chapter 23: Industrial Chemistry	**8**	**1**	**7**
Chapter 24: Environmental Chemistry	**9**	**1**	**8**
Chapter 25: Spectroscopy	**11**	**2**	**9**
Total:	**122**	**16**	**100**

INSTRUCTION IN THE CLASSROOM

Educationists have realized that the quality of education cannot be better than the quality of teaching. How to teach well requires on the part of the teachers the following to note:

1. Thorough grinding and mastery of the subject matter which he/she teaches.
2. Scholarly attitude towards teaching/learning in the class and on the campus of the school i.e. thoughtfully reflective personality.
3. Highly polished communication skills in writing, speaking, and listening.
4. Respectful of the methods of science and mindful of the nature of scientific knowledge Practicing believer in the core values of science such as:
5. Longing to know, questioning everything, collecting data and looking for meaning in them, demand for verification, respect for logic, consideration of the premise and paradigm, consideration of the consequences.
6. Letting students express their understanding i.e. their version of what was taught in the class and why.
7. Giving more time to what students think and less time to what teachers think
8. Realizing that students construct their own knowledge and that this construction is greatly influenced by what the student already knows i.e. his/her prior knowledge. This implies that no student comes to the class room with empty head and that no information can be transferred intact from the head of the teacher to the head of the student.
9. There are various theories and models available which deal with understanding the process of learning. Teacher must base his practice of teaching on some theory and be able to explain or try to explain what works in the class room and why.
10. Teacher should realize that teaching is not just drilling information into the head of students nor is it just muddling through to teach as he was taught. It is a form of scholarship in which teachers are involved in action research. They look for new examples and non-examples. They sequence information in different ways and look for the best sequence. They diagnose the learning difficulties of students by looking into their prior knowledge where they search for misconceptions and knowledge gaps. They focus on the learning styles of individual students and recognize slow and fast learners.
11. Students watch their teachers and notice so many things about them and they talk about what they like or do not like. Teaching is close to show business and we can borrow much from the people in the show business.

TEACHING LEARNING PROGRAM

The topics, or objectives within topics, can be taught in any order in keeping with the needs of teachers and students.

It will be clear that achievement of the educational objectives requires thoughtfully designed teaching situations. It is assumed that students will achieve the educational objectives by way of ongoing interplay between theoretical information and practical experience; it therefore follows that the teaching approaches and materials used should:

- represent chemistry as part of the process of scientific inquiry (rather than a rhetoric of conclusions)
- use inquiry-based teaching strategies where possible.
- be student-centered, assisting students to derive their own concepts from evidence and providing practical opportunities to develop individual reasoning abilities and motor skills
- exemplify the concept from local scenario.
- when beginning a new area of study, provide very direct, concrete experience — through classroom, laboratory and field work — or the next best substitute when direct experience is not feasible.
- provide rewarding opportunities to apply scientific understanding and ways of thinking to problems, especially everyday ones.
- provide opportunities refine ideas through dialogue with others, and work with them in ways like to foster cooperative abilities.
- provide opportunities to develop skills of written and oral communications.
- use testing as a diagnostic as well as an achievement tool.

Teachers' Training and Refresher Courses:

Effective and meaningful chemistry education can only be guaranteed if the teacher, the key pivot of change, is developed enough in contents as well as methodology. In-service trainings may help the teachers to become familiar with a variety of strategies for successful delivery of the curriculum.

The curriculum development and revision is a continuous process in all stages of education so is the process of updating the teacher education programs at pre-service as well as at in-service stages. If the teacher is not fully equipped and trained to handle the new curricula, the curriculum transaction would not be appropriate and consequently, the learning will be inadequate. Teachers' training needs the following actions:

1. Pre-service teacher training institutions are strengthened and their curricula be revised to meet the demands of fast changing and developing world.

2. In-service training should cover contents and methodologies. Content upgrading in chemistry is an urgent need for effective teaching. Emphasis should specifically be laid on learner-centered and activity based approaches. Laboratory practices, classroom

demonstrations, active participation by the students, and field interactions should become major components of in-service training programs. Workshops seminars and extension lectures should be organized more frequently and regularly and particularly in summer vacation.

3. Well-equipped resource centers should be established at the training institutions for a ready help to the needy teachers.

ASSESSMENT AND EVALUATION IN CHEMISTRY

The purpose of assessment is to find out whether students have acquired the kind of skills, knowledge, and understanding that we set as goals for our courses.
This purpose is achieved traditionally by conducting an examination at the end of the session called summative assessment. In this form of assessment, teachers require students to express their understanding of what teachers taught them and the performance of students is measured as grade points. This is a convenient form of assessment because it is easy to carry out and it does not consume much time.

However, this form of assessment is a single snap shot at the end of the session and does not provide opportunity either to the student or to the teacher to interact formatively throughout the session as the student strives to develop his understanding of the content and purpose of the course.

This vacuum can be filled by using **FORMATIVE ASSESSMENT,** which is an ongoing process throughout the session and uses Test — Feedback — Adjust cycle repeatedly to improve students' performance and efficiency in learning.

Guidelines for appropriate Assessment

Assessment Procedures

1. In addition to the end of the session exam, the practice of formative assessment should be used throughout the session.
2. Tasks in the Formative mode of assessment should include
   - Homework
   - Lab report writing
   - Quizzes
   - Frequent written tests
   - Group discussion
   - Oral Presentation
3. Feedback on students' work in the above tasks should be provided to the students.
4. Question setting should be specifically directed to finding out the following Skills, Knowledge and Understanding according to the Bloom's Taxonomy as given below

a. recall and retrieve information related to the contents of the course.
Leading words for setting questions:
list, define, identify, label, tabulate, name, who, when, where and so on.

b. comprehend the information i.e. do they know what it means.
Leading words for setting questions:
interpret, predict, distinguish, differentiate, estimate, discuss etc.

c. apply their knowledge i.e. do they know what is it good for.
Leading words for setting questions:
demonstrate, show, solve, classify, illustrate, modify, change, discover etc.

d. analyze and synthesize information i.e. taking things apart and putting together.
Leading words for setting questions:
Analyze: analyze, separate, explain, arrange, compare, infer
Synthesize: combine, integrate, rearrange, create, formulate, design etc

e. Evaluate information i.e. weighing available options leading words for setting questions:
decide, measure, recommend, select, conclude, compare, summarize etc.

5. Assessment should measure the capacity of students for critical judgment.
6. Assessment should focus on learning potentials for future learning at their own.
7. The question paper should cover the entire syllabus.
8. There should be no choice in the paper.
9. The paper should include Essay type questions, Short questions and MCQS.
10. Assessment should not judge weaknesses only but it must also focus on students' strength and capabilities.
11. The assessment should be able to measure the initiative and drive of the students.
12. The teacher must make sure that the student during assessment feels comfortable and relaxed rather than tense and anxious.
13. Assessment language should be simple, clear, and unambiguous.

Formative Assessment

The formative assessment should be a part of the classroom learning. Following may be the devices on which the said objectives can be achieved:

- Lab completion
- Objective enhancement-worksheets, quizzes, and tests
- Observation
- Review questions
- Classroom discussions
- Oral presentation

The formative assessment should be cumulative and comprehensive and cover all objectives as per curriculum. Grading of students should be done through the use of assessment instruments that cover the expectations as defined by the objectives of the curriculum.

Evaluation Strategy:

An external examination is recommended at the end of the course. This evaluation should measure all the domains of learning and through it, the attainment of the objectives can be measured. The Weightage of the different domains of learning is given below;

Learning Domains for Measurement	Weightage in Evaluation
• Knowledge, Comprehension, Analysis, Evaluation, Synthesis, Application:	85
• Skills of Communication, Initiating and Planning, Designing Experiments and Interpreting Data:	05%
• Manipulative skills (performing Lab Work)	10%

Weightage in Evaluation:

For the final evaluation of the learning outcomes, following Weightage is recommended for the contents of XI and XII

Class- XI

Chapter	**Weightage %**
Chapter 1: Stoichiometry	**8**
Chapter 2: Atomic Structure	**8**
Chapter 3: Theories of Covalent Bonding and Shapes of Molecules	**10**
Chapter 4: State of Matter I: Gases	**11**
Chapter 5: State of Matter II: Liquids	**7**
Chapter 6: States of Matter Ill: Solids	**8**
Chapter 7: Chemical Equilibrium	**7**
Chapter 8: Acids, Bases and Salts	**7**
Chapter 9: Chemical Kinetics	**7**
Chapter 10: Solutions and Colloids	**10**
Chapter 11: Thermochemistry	**9**
Chapter 12: Electrochemistry	**8**
Total:	**100**

Class XII

Chapter	**Weightage**
Chapter 13: Chemistry of Representative Elements	**18**
Chapter 14: Chemistry of Outer Transition (d- block) Elements	**7**
Chapter 15: Organic Compounds	**3**
Chapter 16: Nomenclature of Organic Compounds	**8**
Chapter 17: Hydrocarbons	**11**
Chapter 18: Alkyl Halides and Amines	**8**
Chapter 19: Alcohols, phenols and Phenols	**7**
Chapter 20: Carbonyl Compounds 1: Aldehydes and Ketones	**3**
Chapter 21: Carbonyl Compounds 2: Carboxylic Acids and	**6**
Chapter 22: Biochemistry	**5**
Chapter 23: Industrial Chemistry	**7**
Chapter 24: Environmental Chemistry	**8**
Chapter 25: Spectroscopy	**9**
Total:	**100**

Weighing of Assessment Objectives

Theory assessment: The theory examination is suggested to consist of a wide variety of questions. The assessment should be designed to examine the candidate's understanding of the whole syllabus and should test the following range of abilities.

Knowledge and understanding (recall 30%)	60%
Higher abilities (handling information, application. and problem solving etc.)	40%

Practical Assessment

This is designed to test Experimental skills and investigations.

Suggestions for Structuring Assessment and evaluation Tools:

More Emphasis should be on:	Less Emphasis should be on:
• Assessing what I most highly valued	• Assessing what is easily measured
• Assessing rich, well-structured knowledge	• Assessing discrete knowledge
• Assessing scientific understanding and reasoning	• Assessing scientific knowledge
• Assessing to learn what students do understand	• Assessing to learn what students do not know
• Assessing achievement and opportunity to learn	• Assessing to learn what students do not know
• Students engaged in ongoing assessment of their work and that of others	• Assessing only achievement
• Teachers involved in the development of external assessments	• Development of external assessments by experts alone

- Assessment pattern is subject to the requirement, policies, and procedures of the Examination Boards.
- Question paper should be based on the curriculum not on a particular textbook.
- Questions involving unfamiliar contexts or daily-life experiences may be set to asses candidates' problem-solving and higher-order processing skills. In answering such questions, sufficient information be given for candidates to understand the situation or context. Candidates are expected to apply their knowledge and skills included in the syllabus to solve the problems.
- In general, SI units and terminology should be used.

GENERAL INSTRUCTIONS TO AUTHORS

The National Curricula should be a reflection of our national needs and aspirations. This requirement can be met only if the textbooks are written in accordance with this curriculum. This curriculum meets not only the general aims and objectives but also fulfills the specific requirements of the individual subjects. Keeping these points in view the authors should observe the following points, while writing the textbooks.

1. The authors should adhere to the learning outcomes of each concept or chapter as mentioned with the contents in the curricula.
2. The continuity of the concepts with the earlier classes, their integration and logical development should be ensured.
3. Horizontal and vertical overlapping of the concepts should be avoided.
4. The textbook should be informative and interactive with questions to be put at suitable intervals to provoke the students to think.
5. The details of the treatment of the concept should be properly classified into headings and subheadings.
6. The language used should be simple, clear, straight forward, unambiguous and easily comprehensible by the students of the particular level.
7. Simple questions may be asked within the chapter, which requires students to recall, think, and apply what they have just learnt as well as to reinforce the learning of the concepts and principle.
8. The new advancements and development in the subjects should be incorporated where appropriate.
9. The examples and applications should be from every day life and be supportive of our cultural values.
10. SI units should be used throughout the text and the numerical values used for various constants should be same.
11. Photographs and illustrations should be clear, labeled and supportive of the text. Tables, flow charts and graphs may be given wherever needed.
12. Key points at the end of each chapter should provide a summary of the important concepts and principles discussed in the chapter.
13. Review questions should be given at the end of each chapter requiring students to recall, think and apply what they have learnt in this chapter. This should start from simple questions increasing the complexity gradually and should test knowledge, understanding and skills of the students. The last few questions should encourage the student to apply the concepts studied in this chapter.
14. Each chapter should be accompanied with its precise and coherent summary to be given at the end of this chapter
15. Solved numerical examples within the chapter and review questions at the end of the chapter should be based on variety of situations and should be related to local environment and culture.

ELECTRONIC INSTRUCTIONAL MATERIAL

Electronic instructional material is gaining popularity in the developed world. Educational technology providers are successfully marketing courseware with instructional management, assessment, individualized learning paths and professional development. Growing numbers of teachers have convenient and immediate access to entire libraries of instructional video correlated to curriculum. As far the educational scenario in Pakistan and other developing countries is concerned, lack of resources (particularly in schools) would hold back the evolution of electronic publishing in place of or along with printing.

It may be considered that a good ratio of the students of intermediate classes has access to computer technologies. They should be given chances of self-learning (rather exploring the knowledge) and it can be made true by converting the data of the IX-X and XI-XII textbooks into electronic formats e.g. CD-ROMs. The CD-ROMs should be made available at the retail outlets.

In Chemistry, reactions and flow sheet diagrams are more important to convey the desired learning. Printed textbooks cannot tackle the diagrams that need 3-dimensional view for their understanding. Diagrams, photographs and animations should be published in electronic format i.e. CD-ROM that can be made an accessory item with the printed textbook., Such a CD should also have installed software for students' assessment and evaluation in the form of tests, quizzes and games.

CHAPTER ORGANIZING SYSTEM

Chapter Organizing system — It should be taken into account that a consistent numbering system leads the students through each chapter at a glance in the beginning to conceptual heading throughout and finally to the summary of key concepts at the end. Each chapter should be organized in the following pattern:

CHAPTER NAME

Outline:

Major Concepts:

- 1.1 ::::::::::::::::
- 1.2 ::::::::::::::::
- 1.3 ::::::::::::::::

Introduction

1.1 MAJOR CONCEPTS

(Depth of the topic should be kept with the teaching periods advised in the curriculum)

Tit Bits:

STS Connections:

Subheading #1.1.1

Subheading #1.1.2

Critical Thinking

EXERCISE:

The exercise should include;

- Multiple Choice Questions
- Short Questions
- Extensive Questions

(Questions should be made that can check learning outcomes in all the domains i.e. knowledge, comprehension, application, evaluation, synthesis and connection with technology and society.**)**

SALIENT FEATURES OF THE CURRICULUM

The curriculum is fully in harmony with the National Priorities and will provide an important momentum for achieving our vision for students.

Configuration with the Restructured Schemes of Studies:

The Ministry of Education went through an arduous exercise for restructuring the National Schemes of Studies. The Curriculum Development Team; while designing the curriculum, selecting the syllabi contents, carving the learning outcomes (including practical skills) and suggesting the timeframes and evaluation strategies for the contents, maintained a concrete configuration with the restructured Scheme of Study.

The Focused Areas:

It has been focused that the curriculum provides to the students:

- Challenges and Enjoyment
- Breadth
- Progression
- Depth
- Personalization and Choice
- Coherence
- Relevance

Reduction in Load:

Since it was important that the quality of Chemistry education at the secondary level was not compromised in any way, the reduction in load from the syllabus required a very careful selection of topics to be taught. The Team chose to leave topics out if:

- **The question about why the student needs to study the topic at the particular stage could not be answered;**
- **The topic had no direct relevance to the student i.e. was not contextual;**
- **The content was repetitive across stages with no change in expected understanding, and**
- **Any topic was in isolation with no evident horizontal or vertical linkages.**

The need for a network of ideas and cross-linking between the areas being identified was deemed very important. While deciding on the chapters/topics and the depth of each topic for the secondary level, a holistic view of the syllabus across all stages from the primary to the higher secondary and beyond was taken. Reducing the use of too many technical terms and avoiding very large numbers of examples will also help to make the content a little lighter. The importance of careful selection of illustrations and their use to make the concepts more explicit was stressed; in Chemistry, the quality of illustrations can make or mar any attempt at good textbooks/teaching.

The curriculum also takes up issues pertaining to environment, health and other ethical issues that arise with any interference of human beings in the natural processes, which have great relevance from the societal point of view.

Reasoning vs. Comprehension:

In secondary and higher secondary classes, abstraction and quantitative reasoning come to occupy a more central place than in the primary and elementary classes. We have to avoid the attempt to be comprehensive. A topic can be made comprehensive in two ways;

1. Adding many more concepts than can be comfortably learnt in the given time frame
2. Enumeration of things or types of things, even where there is no strong conceptual basis for classification

In the present revision, no attempt is made to be comprehensive. Unnecessary enumeration is avoided. The process by which factual knowledge can be acquired is more important than the facts themselves.

At this stage the disciplines of physics, biology and chemistry are beginning to emerge. The students should be exposed to experiences as well as modes of reasoning that are typical of these subjects. This stage also sees a certain consolidation of knowledge within themes. As a result, a theme may get a lot of space in one class (e. g. organization of life in Class IX) while being absent from the higher classes.

Strengths

The New Chemistry Curriculum;

- has a concrete structure, and well sequenced yet offers flexibility and maintains the momentum overall years of high school chemistry.
- highlights the degree of students expectations by laying out baseline levels of achievement at the end of grade X and XII respectively. These expectations are reflected within the Standards and Benchmarks as well as the Aims and Objects sections of the document.
- emphasizes Higher Order Thinking through the four year periods. Students are encouraged to think at higher levels for themselves, becoming independent of the teacher----a life-long learning skill.
- focuses on all the cognitive levels of the Revised Bloom's Taxonomy. There is a conscious effort to shift from simply knowing, remembering, and understanding to the more complex applying analyzing, evaluating, and creating skills required for success in this 21St century world.
- makes positive connections among the contents taught, skills acquired, and a variety of real-life situational applications. The abstract begins to be more meaningful and students realize the "why" in their learning requirements.
- bridges the gaps between content knowledge and practical laboratory experiences by tying the two together. All laboratory activities are now connected to their respective topics and where there are none, it clearly states so.

- does away with overlapping topics among the three branches of sciences--Chemistry, Biology and Physics. Such topics appear only once in the most relevant branch of science.
- connects every topic to some previous learning experience and to future in-depth study of the same. Horizontal (within the year) and vertical (from year to year) progressions are highlighted through linkages for every topic. This makes it very clear as to where a topic is coming from and where it will heading.
- has done away with redundant and repetitive topics and this made room to accommodate more current and contemporary Chemistry topics that affect the lives of students today and will do so in their future as well.
  provides flexibility to the teachers in terms of teaching time and preparation.
- allows students to experience the learning of science by doing science and not just listening to science.
- focuses on providing "thinking" creative, critical, and analytical---opportunities to students and teachers.
- provides a chance to honestly compare the document with any similar document from around the globe.
- provides opportunities to explore Chemistry and discover the wonder of science for oneself.

GLOSSARY OF TERMS USED IN LEARNING OUTCOMES/ ASSESSMENT

This glossary is intended to ensure that terms commonly used in the context of learning outcomes and assessment are appropriately interpreted so that no confusion
what-so- ever arises in their use.
These words are listed below along with their contextual meaning.
We urge the users of these terms to strictly follow this glossary and associate meanings to the key words as given in this glossary.

1. **Define (the term(s)...)** is intended literally. Only a formal statement or equivalent paraphrase, such as the defining equation with symbols identified, being required.

2. **What is meant by ...** normally implies that a definition should be given, together with some relevant comment on the significance or context of the term(s) concerned, especially where two or more terms are included in the question. The amount of supplementary comment intended should be interpreted in the light of the indicated mark value.

3. **Explain** may imply reasoning or some reference to theory, depending on the context.

4. **State** implies a concise answer with little or no supporting argument, e.g. a numerical answer that can be obtained 'by inspection'.

5. **List** requires a number of points with no elaboration. Where a given number of points are specified, this should not be exceeded.

6. **Describe** requires candidates to state in words (using diagrams where appropriate) the main points of the topic. It is often used with reference either to particular phenomena or to particular experiments. In the former instance, the term usually implies that the answer should include reference to (visual) observations associated with the phenomena. The amount of description intended should be interpreted in the light of the indicated mark value.

7. **Discuss** requires candidates to give a critical account of the points involved in the topic.

8. **Deduce/Predict** implies that candidates are not expected to produce the required answer by recall but by making a logical connection between other pieces of information. Such information may be wholly given in the question or may depend on answers extracted in an earlier part of the question.

9. **Suggest** is used in two main contexts. It may either imply that there is no unique answer or that candidates are expected to apply their general knowledge to a `novel' situation, one that formally may not be 'in the syllabi'.

10. **Calculate** is used when a numerical answer is required. In general, working should be shown.

11. **Measure** implies that the quantity concerned can be directly obtained from a suitable measuring instrument, e.g. Mass using a balance.

12. **Determine** often implies that the quantity concerned cannot be measured directly but is obtained by calculation, substituting measured or known values of other quantities into a standard formula e.g. relative molecular mass or ideal gas equation.

13. **Show** is used where a candidate is expected to derive a given result. It is important that the terms being used by candidates are stated explicitly and that all stages in the derivation are stated clearly.

14. **Estimate** implies a reasoned order of magnitude statement or calculation of the quantity concerned. Candidates should make such simplifying assumptions as may be necessary about points of principle and about the values of quantities not otherwise included in the question.

15. **Sketch,** when applied to graph work, implies that the shape and/or position of the curve need only be qualitatively correct. However, candidates should be aware that, depending on the context, some quantitative aspects may be looked for, e.g. passing through the origin, having an intercept, asymptote or discontinuity at a particular value. On a sketch graph it is essential that candidates clearly indicate what is being plotted on each axis.

16. **Sketch,** when applied to diagrams, implies that a simple, freehand drawing is acceptable; nevertheless, care should be taken over proportions and the clear exposition of important details.

17. **Compare** requires candidates to provide both similarities and differences between things or concepts.

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