

SLOs for Assessment Key:

1. Accessible / Attainable - (Not included in drop down list)

2.

Grade 9									
Domains	Standards	Benchmarks	Topic	NC SLO #	SLO	Status of SLOs	SLOs for Assessment	Cognitive Domain	Comment
Domain A: Nature of Science in Chemistry	Standard: Students will demonstrate an understanding, skill and attitude to deal in the areas of chemistry as an introduction to chemistry.	Benchmark 1: Students can describe the history of chemistry, including major contributors and key developments in the field.	Nature of Science in Chemistry	SLO: C-09-A-01	Define chemistry as the study of matter, its properties, composition and interactions with other matter and energy. Or study of Earth (solids), Air(gases), Sea (liquids) and sky (plasma) and their interaction with each other.	Modified(rephrased) SLO		Remember	
				SLO: C-09-A-02	Explain with examples that chemistry has many sub-fields and example, and interdisciplinary fields. (some examples includes) Biochemistry Medicinal Chemistry Polymer Chemistry Geochemistry Environmental Chemistry Analytical Chemistry Physical Chemistry Organic Chemistry Inorganic Chemistry Nuclear Chemistry Astrochemistry)	Modified(rephrased) SLO		Understand	
				SLO: C-09-A-03	Formulate examples of essential questions that are important for the branches of Chemistry (e.g. for Analytical Chemistry a question would be 'how can we accurately determine the chemical composition of a sample?')	Modified(rephrased) SLO		Understand	
				SLO: C-09-A-04	Differentiate between 'science', 'technology' and 'engineering' by making reference to examples from the physical sciences. (Science is a process of exploring new knowledge methodically through observation and experiments, technology refers to the process of applying scientific knowledge in practical applications, for various purposes. Engineering is the application of knowledge in order to design, build and maintain a product or a process. that solves a problem and fulfills a need. Science provides the fundamental knowledge and understanding whole engineering applies that knowledge to develop practical solutions.	Modified(rephrased) SLO		Understand	
	Standard: (Matter) Students should be able to: Define matter and describe its physical and			SLO: C-09-B-01	Define matter as a substance having mass and occupying space.	Modified(rephrased) SLO		Remember	
				SLO: C-09-B-02	State the distinguishing macroscopic properties of commonly observed states of solids, liquids and gasses in particular density, compressibility and fluidity.	Modified(rephrased) SLO		Understand	



<p><b>Standard: (Atomic Structure)</b>  <b>Students should be able to:</b>  Describe the structure of atoms, including the nucleus and electron shells.  Explain the concept of atomic number and its relationship to the number of protons in an atom.  Describe the arrangement of electrons in the electron shells and explain how this arrangement affects the chemical properties of an atom.  Discuss the principles of isotopes, including atomic mass and isotopic abundance.  Explain the concept of ionization and describe the formation of ions.</p>	<p><b>Benchmark 1:</b>  Students can describe the structure of atoms, including the protons, neutrons, and electrons and using these concepts to discuss isotopes.</p>	<p><b>Atomic Structure</b></p>	SLO: C-09-B-14	Interpret the relationship between a subatomic particle, their mass and charge.	Modified(rephrased) SLO		Understand	
			SLO: C-09-B-15	Illustrate the path that positively and negatively charged particles would take under the influence of a uniform electric field.	Modified(rephrased) SLO		Understand	
			SLO: C-09-B-16	Define proton number/atomic number as the number of protons in the nucleus of an atom.	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-17	Explain that the proton number is unique to each element and used to arrange elements in periodic table	Modified(rephrased) SLO		Understand	
			SLO: C-09-B-18	State that radioactivity can change the proton number and alter an atom's identity	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-19	Define nucleon number/atomic mass as sum of number of protons and neutrons in the nucleus of an atom.	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-20	Define isotopes as different atoms of the same element that have same number of protons but different neutrons	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-21	State that isotopes can affect molecular mass but not chemical properties of an atom	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-22	Determine the number of protons and neutrons of different isotopes	Modified(rephrased) SLO		Understand	
			SLO: C-09-B-23	Define relative atomic mass as the average mass of isotopes of an element compared to 1/12th of mass of an atom of Carbon-12	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-24	State that isotopes can exhibit radioactivity	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-25	Discuss the importance of isotopes using carbon dating and medical imaging as examples.	Modified(rephrased) SLO		Apply	

<p><b>Standard: (Chemical Bonding)</b>  <b>Students should be able to:</b>            Explain the concept of chemical bonding and describe the different</p>	SLO: C-09-B-26	Describe the formation of positive (cation) and negative (anion) ions from atoms.	Modified(rephrased) SLO		Understand	
	SLO: C-09-B-27	Interpret and use the symbols for atoms and ions	Modified(rephrased) SLO		Remember	
	SLO: C-09-B-28	Calculate relative atomic mass of an element from relative masses and abundance of isotopes,	Modified(rephrased) SLO		Apply	
	SLO: C-09-B-29	calculate the relative mass of an isotope given relative atomic mass and abundance of all stable isotopes.	Modified(rephrased) SLO		Apply	
	SLO: C-09-B-30	Describe that noble gas electronic configuration, octet and duplet rules help predict chemical properties of main group elements	Modified(rephrased) SLO		Understand	
	SLO: C-09-B-31	Compare between the formation of cations and anions	Modified(rephrased) SLO	Repetitive (within same grade)	Understand	
	SLO: C-09-B-32	Account for the electropositive and electronegative nature of metals and non metals.	Modified(rephrased) SLO		Remember	
	SLO: C-09-B-33	Define ionic, covalent, coordinate covalent and metallic bonds	Modified(rephrased) SLO		Remember	
	SLO: C-09-B-34	Differentiate between ionic compounds and covalent compounds. (The following points need to be included in the respective a. Ionic Bond as strong electrostatic attraction between oppositely charged ions b. Covalent bond as strong electrostatic attraction between shared electrons and two nuclei c. Metallic bond as strong electrostatic attraction between cloud/sea of delocalized electrons and positively charged cations)	Modified(rephrased) SLO		Understand	

Physical Chemistry	<p>Describe the different types of bonds, including ionic, covalent, and metallic bonds. Discuss the factors that affect bond strength, including bond length and bond energy. Describe the properties of molecular compounds and how they are affected by the type of bond they contain. Apply the principles of chemical bonding to explain the physical properties of materials.</p>	<p><b>Benchmark 1:</b> Students can describe the types of chemical bonds, including ionic, covalent coordinate covalent, and metallic bonds.</p>	Chemical Bonding	SLO: C-09-B-35	Explain the properties of compounds in terms of bonding and structure	Modified(rephrased) SLO		Analyse	
				SLO: C-09-B-36	Compare uses and properties of materials such as strength and conductivity as determined by the type of chemical bond present between their atoms.	Modified(rephrased) SLO		Analyse	
				SLO: C-09-B-37	Interpret the strength of forces of attraction and their impact on melting and boiling points of ionic and covalent compounds.	Modified(rephrased) SLO		Understand	
				SLO: C-09-B-38	Justify the availability of free charged particles (electrons or ions) for conduction of electricity in ionic compounds( solid and molten) covalent compounds and metallic bonds.	New SLO		Analyse	(The concept of free charged particles and its availability for compounds, and relate with conduction of electricity)
				SLO: C-09-B-39	Recognize that some substances can ionize when dissolved in water. (e.g. acids dissolves in water and conduct electricity)	Grade 10 SLO		Remember	
				SLO: C-09-B-40	Justify the suitability of usage of graphite, diamond and metals for industrial purposes. Some examples may include: a. graphite as lubricant or an electrode b. diamond in cutting tools c. metals for wires, and sheets)	Modified(rephrased) SLO		Understand	
				SLO: C-09-B-41	Draw the structure of ionic and covalent compounds along with their formation. (some examples can include: a. ionic bonds in binary compounds such as NaBr, NaF, CaCl <sub>2</sub> using dot-and-cross diagrams and Lewis dot structures b. simple molecules including H <sub>2</sub> , Cl <sub>2</sub> , O <sub>2</sub> , N <sub>2</sub> , H <sub>2</sub> O, CH <sub>4</sub> , NH <sub>3</sub> , HCl, CH <sub>3</sub> OH, C <sub>2</sub> H <sub>4</sub> , CO <sub>2</sub> , HCN, and similar molecules using dot-and- cross diagrams and Lewis dot structures).	Modified(rephrased) SLO		Apply	
				SLO: C-09-B-42	State the formulae of common elements and compounds.	Modified (Split) SLO		Remember	
				SLO: C-09-B-43	Define molecular formula of a compound as the number and type of different atoms in one molecule	Modified (Split) SLO		Remember	

Domain B: Phys	<p>Standard: (Stoichiometry) Students should be able to: Explain the mole concept and its application in chemical calculations, including stoichiometry. Apply the law of conservation of mass to predict the quantities of reactants and products in chemical reactions. Constructing chemical equations and understanding the balancing of these chemical equations. Use stoichiometry to calculate the amount of reactants and products in a chemical reaction. Describe the relationship between moles, mass, and volume, and apply this relationship to stoichiometric calculations.</p>	Benchmark 1: Students should be able to balance chemical equations and perform stoichiometry calculations using the mole concept.	Stoichiometry	SLO: C-09-B-44	Define empirical formula of a compound as the simplest whole number ratio of different atoms in a molecule.	Modified (Split) SLO		Remember	
				SLO: C-09-B-45	Deduce the formula and name of a binary ionic compounds from ions given relevant information.	Modified(rephrased) SLO		Apply	
				SLO: C-09-B-46	Deduce the formula of a molecular substance from the given structure of molecules.	Modified (Split) SLO		Apply	
				SLO: C-09-B-47	Use the relationship amount of substance = mass / molar mass to calculate number of moles, mass, molar mass, relative mass (atomic/molecular/formula) and number of particles	Modified(rephrased) SLO		Apply	
				SLO: C-09-B-48	Define mole as amount of substance containing avogadro's number ( $6.02 \times 10^{23}$ ) of particles	Modified(rephrased) SLO		Remember	
				SLO: C-09-B-49	Explain the relationship between a mole and Avogadro's constant	Modified(rephrased) SLO		Understand	
				SLO: C-09-B-50	Construct chemical equations and ionic equations to show reactants forming products, including state	Modified(rephrased) SLO		Apply	
				SLO: C-09-B-51	Deduce the symbol equation with state symbols for a chemical reaction given relevant information.	Modified(rephrased) SLO		Apply	
				SLO: C-09-B-52	Define redox reactions as simultaneous oxidation and reduction in terms of oxygen, hydrogen, electrons and changes in oxidation state	Matched SLO		Remember	

<p>Standard: (Electrochemistry) Students should be able to: Describe the principles of electrochemistry, including the movement of electrons in terms of oxidation and reduction in a chemical reaction. Explain the concept of oxidation and reduction, including the role of electrons in these processes. Describe the process of electrolysis and its applications. Discuss the relationship between electricity and chemical reactions, including the use of electrodes and electrolytes. Apply the principles of electrochemistry to explain the behavior of batteries, fuel cells, and other electrochemical devices.</p>	<p><b>Benchmark 1:</b> Students should be able to describe the principles of electricity and electrochemistry, including redox reactions, oxidation and reduction, and the behavior of electrolytes. <b>Benchmark 2:</b> Students can apply the concepts of electrochemistry to explain and predict the behavior of electrochemical cells and the transfer of electrons in chemical reactions. They also understand the role of electrochemistry in real-world applications, such as voltaic or galvanic cells batteries, corrosion, and electroplating.</p>	<p><b>Electrochemistry</b></p>	SLO: C-09-B-53	Use roman numerals to indicate oxidation number of an element in a compound	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-54	Identify oxidizing and reducing agents in a redox reaction	Matched SLO		Understand	
			SLO: C-09-B-55	Recognize that the oxidation number of elements in their free state is zero	Modified(rephrased) SLO		Remember	
			SLO: C-09-B-56	Derive the formula of ionic compounds from ionic charges and oxidation numbers	Modified (Split) SLO		Apply	
			SLO: C-09-B-57	Identify that the oxidation number of monatomic ion is the same as the charge on the ion	Modified (Split) SLO		Remember	
			SLO: C-09-B-58	Explain that the sum of the oxidation numbers in a neutral compound is zero	Modified (Split) SLO		Understand	
			SLO: C-09-B-59	Explain that the sum of the oxidation numbers in an ion is equal to the charge on the ion	Modified (Split) SLO		Understand	
			SLO: C-09-B-60	Identify redox reactions by the colour changes involved when using acidified aqueous potassium manganate(VII) to (1) or aqueous potassium iodide	Modified (Split) SLO		Understand	
			SLO: C-09-B-61	Define corrosion and discuss methods to prevent it. (some examples may include barrier method such as using paint galvanizing, electroplating; sacrificial protection such as using magnesium blocks in ships).	Modified(rephrased) SLO		Understand	

<p>Standard: (Energetics) Students should be able to: Describe the nature of energy, including energy profile diagrams. Explain the relationship between energy and chemical reactions, including exothermic and endothermic reactions. Apply the principles of thermochemistry to calculate heat transfer and changes in enthalpy. Describe the laws of thermodynamics and their application in chemical systems. Discuss the relationship between energy and work, and apply this relationship to thermodynamic processes.</p>	<p>Benchmark 1: Students should be able to define and use energy concepts, including energy change, internal energy, enthalpy, and thermochemistry, in chemical reactions.</p>	<p><b>Energetics</b></p>	SLO: C-09-B-62	Explain the idea of a chemical system and its connection with its surroundings influences energy transfer during a chemical reaction.	New SLO		Remember	
			SLO: C-09-B-63	Differentiate between exothermic and endothermic reactions by giving examples.	New SLO		Analyse	
			SLO: C-09-B-64	State that thermal energy is called enthalpy change and recognize its sign as negative for exothermic and positive for endothermic reactions	New SLO	<b>Ambiguous</b>	Remember	
			SLO: C-09-B-65	Define activation energy as the minimum energy that colliding particles must have for a successful collision.	New SLO	<b>Ambiguous</b>	Remember	
			SLO: C-09-B-66	Explain that activation energy depends on reaction pathway which can be changed using catalysts or enzyme (detailed pathways not required)	New SLO	<b>Ambiguous</b>	Understand	
			SLO: C-09-B-67	Draw, label and interpret reaction pathway diagram for exothermic and endothermic reaction which includes enthalpy change, activation energy (uncatalyzed and catalyzed), reactants and products	New SLO	<b>Ambiguous</b>	Apply	
			SLO: C-09-B-68	Recognize that bond breaking is endothermic and bond making is exothermic processes.	New SLO	<b>Ambiguous</b>	Remember	
			SLO: C-09-B-69	explain that enthalpy change is sum of energies absorbed and released in bond breaking and bond forming	New SLO	<b>Ambiguous</b>	Remember	
			SLO: C-09-B-70	Calculate enthalpy change of a reaction given bond energy values	New SLO	<b>Ambiguous</b>	Apply	
SLO: C-09-B-71	Explain how respiration (aerobic and anaerobic), an exothermic process, provides energy for biological systems and lipids as reserve stores of energy.	New SLO	<b>Ambiguous</b>	Understand				
<p>Standard: (Equilibrium) Students should be able to: Describe the concept of chemical equilibrium and the dynamic nature of chemical reactions.</p>	<p>Benchmark 1:</p>		SLO: C-09-B-72	Recognize that reversible reaction are shown by symbol = and may not go to completion	Grade 10 SLO	<b>Ambiguous</b>	Understand	



<p>of chemical reactions. Explain the relationship between concentration of reactants or products and the position of equilibrium. Apply the law of mass action to predict the position of chemical equilibrium. Discuss the effect of temperature and pressure on chemical equilibria. Describe the concept of Le Chatelier's principle.</p>	<p>Benchmark 1: Students will be able to describe the concept of chemical equilibrium and how reversible reactions can be influenced by the adjustment of physical parameters</p>	<p><b>Equilibria</b></p>	<p>SLO: C-09-B-73</p>	<p>Describe how changing the physical conditions of a chemical equilibrium system can redirect reversible reactions. a. effect of heat on hydrated equilibrium b. addition of water to anhydrous substances in particular copper(II) sulfate and cobalt (II) chloride.</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	
			<p>SLO: C-09-B-74</p>	<p>State that reversible reaction can achieve equilibrium in a closed system when rate of forward and backward reactions are equal.</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Remember</p>	
<p>Standard: (Acid-Base Chemistry and pH) Students should be able to: Define acids and bases and describe their properties. Explain the concept of pH and describe the relationship between pH and the concentration of hydrogen ions in a solution. Describe the different types of acid-base reactions, including neutralization and proton transfer. Discuss the use of buffers to control pH, including the relationship between buffer capacity and the concentration of buffer components.</p>	<p>Benchmark 1: Students will be able to identify and distinguish between acids and bases based on their properties, chemical behavior, and their definition using Brønsted-Lowry theory</p>	<p><b>Acid Base Chemist</b></p>	<p>SLO: C-09-B-75</p>	<p>Define Brønsted-Lowry acids as proton donors and Brønsted-Lowry bases as proton acceptors.</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Remember</p>	
			<p>SLO: C-09-B-76</p>	<p>Recognize that aqueous solutions of acids contain H<sup>+</sup> ions and aqueous solutions of alkalis contain OH<sup>-</sup> ions</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Remember</p>	
			<p>SLO: C-09-B-77</p>	<p>Define a strong acid and bases as an acid or base that completely dissociates in aqueous solution and weak acid and base that partially dissociates in aqueous solution. (Some examples include: Student writing symbol equationsto show these for hydrochloric acid, sulphuric acid, nitric acid, and ethanoic acid.</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Remember</p>	
			<p>SLO: C-09-B-78</p>	<p>Formulate dissociation equations for an acid or base in aqueous solution.</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Apply</p>	
			<p>SLO: C-09-B-79</p>	<p>Recognize that bases are oxides or hydroxides of metals and that alkalis are water-soluble bases</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Remember</p>	
			<p>SLO: C-09-B-80</p>	<p>Describe the characteristic properties of acids in terms of their reactions with metals, bases and carbonates.</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	
			<p>SLO: C-09-B-81</p>	<p>Identify the characteristic properties of bases in terms of their reactions with acids and ammonium salts</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	

				SLO: C-09-B-82	Define acid rain.	Grade 10 SLO	<b>Ambiguous</b>	Remember	
				SLO: C-09-B-83	Discuss effects of acid rain and relate them with properties of acids.	Grade 10 SLO	<b>Ambiguous</b>	Apply	
Standard: (Periodic Table and Periodicity) Students should be able to: Describe the organization of the periodic table, including the arrangement of elements by atomic number,			Benchmark 1: The students will be able to explain the	SLO: C-09-C-01	Define the periodic table as an arrangement of elements in periods and groups in order of increasing proton number / atomic number	Modified(rephrased) SLO		Remember	
				SLO: C-09-C-02	Identify the group or period or block of an element using its electronic configuration (only the idea of subshells related to the blocks can be introduced)	Modified(rephrased) SLO		Understand	
				SLO: C-09-C-03	Explain the relationship between group number and the charge of ions formed from elements in the group in terms of their outermost shells	Modified(rephrased) SLO		Understand	
				SLO: C-09-C-04	Explain similarities in the chemical properties of elements in the same. group in terms of their electronic configuration	Modified(rephrased) SLO		Understand	

Domain C: Inorganic Chemistry	<p>electron configuration, and chemical properties. Explain the concept of periodicity, including the repeating patterns of physical and chemical properties of elements. , Discuss the trends in the periodic table, including ionization energy, electron affinity, and electronegativity. Apply the principles of periodicity to predict the properties and reactivity of elements. Describe the role of the periodic table in the study of chemistry and its importance in the prediction of chemical behavior.</p>	<p>similarities and differences in properties of elements within the same group (vertical column) and across the periods (horizontal row) of the periodic table, including the demarcation of elements into s and p blocks based on their electron configurations.</p>	Periodic Table and periodicity	SLO: C-09-C-05	Identify trends in group and periods, given information about the elements, including trends for atomic radius, electron affinity, electronegativity, ionization energy, metallic character, reactivity and density	Modified(rephrased) SLO		Understand	
				SLO: C-09-C-06	Use terms alkali metals, alkaline earth metals, halogens, noble gases, transition metals, lanthanides and actinides in reference to the periodic table.	Modified(rephrased) SLO		Remember	
				SLO: C-09-C-07	Predict the characteristic properties of an element in a given group by using knowledge of chemical periodicity.	Modified(rephrased) SLO		Apply	
				SLO: C-09-C-08	Deduce the nature, possible position in the Periodic Table and the identity of unknown elements from given information about their physical and chemical properties	Modified(rephrased) SLO		Apply	
				SLO: C-09-C-09	Alkali metals as relatively soft metals with general trends down the group limited to decreasing melting point, increasing density and increasing reactivity	Grade 10 SLO		Remember	

<p>Standard: (Group Properties and Elements) Students should be able to: Describe the group properties of elements, including their electron configurations and reactivity. Explain the trends in reactivity, size, and electronegativity of elements within a group. Discuss the chemical behavior of elements in different oxidation states and their role in chemical reactions. Apply the concepts of electron configuration and electron transfer to explain the reactivity of elements. Describe the properties and applications of elements in different groups, including the alkali metals, alkaline earth metals, halogens, and noble gases.</p>	<p>Benchmark 1: Students can describe the physical and chemical properties of elements in different groups of the periodic table, including their reactivity and their tendency to form compounds.</p>	<p><b>Group Properties and Elements</b></p>	SLO: C-09-C-10	Predict properties of other elements in group I, given information about the elements.	Modified(rephrased) SLO		Apply	
			SLO: C-09-C-11	Predict properties of elements in group 1 in order of reactivity given relevant information.	Modified(rephrased) SLO		Apply	
			SLO: C-09-C-12	Define group VII halogens as diatomic non-metals with general trends limited to increasing density, and decreasing reactivity.	Grade 10 SLO		Remember	
			SLO: C-09-C-13	Identify the appearance of halogens at rtp as flourine as pale yellow gas, chiorine as yellow-green gas, bromine as red-brown liquid, iodine as greyblack solid.	Grade 10 SLO		Remember	
			SLO: C-09-C-14	Explain the displacement reactions of halogens with other halide ions and also as reducing agents	Grade 10 SLO		Understand	
			SLO: C-09-C-15	Predict the properties of elements in group VI, given information about the elements	Modified(rephrased) SLO		Apply	
			SLO: C-09-C-16	Analyze the relative thermal stabilities of the hydrogen halides and explain these in terms of bond strengths.	New SLO		Analyse	
			SLO: C-09-C-17	metals that: have high densities, high melting points, variable oxidation numbers, form colored compounds and act as catalysts for industrial purposes. (some examples include catalyts being used are the Haber process, catalytic converters, Contact process and manufacturing of margarine)	Modified(rephrased) SLO		Remember	

				SLO: C-09-C-18	Define the Group 18 noble gases as unreactive, monatomic gases	Modified(rephrased) SLO		Remember	
				SLO: C-09-C-19	explain this (Noble gases) in terms of electronic configuration	Modified(rephrased) SLO		Understand	
				[SLO: C-09-C-19]	Compare the general physical properties of metals and non-metals. (Specifically in terms of: a. thermal conductivity b. electrical conductivity c.malleability and ductility d. melting points and boiling points)	Modified(rephrased) SLO		Understand	
				SLO: C-09-D-01	State that composition of clean, dry air is approximately 78% Nitrogen N <sub>2</sub> , 21% Oxygen O <sub>2</sub> , and the remainder as a mixture of noble gases and carbondioxide CO <sub>2</sub>	Grade 10 SLO		Remember	
				SLO: C-09-D-02	State the major sources of air pollutants (Some examples include: a. carbon dioxide from the complete combustion of carbon-containing fuels b. carbon monoxide and particulates from the incomplete combustion of carbon-containing fuels c. methane from the decomposition of vegetation and waste gasses from digestion in animals d.oxides of nitrogen from car engines e. sulfur dioxide from the combustion of fossil fuels which contain sulfur compounds f. ground level ozone from reactions of oxides of nitrogen, from car engines, and volatile organic compounds, in presence of light)	Grade 10 SLO		Understand	

<p>Standard: (Atmosphere) Students should be able to: Describe the composition and structure of the Earth's atmosphere, including the major gases and trace gases. Explain the role of the atmosphere in the Earth's climate, including the greenhouse effect. Discuss the sources and effects of atmospheric pollutants, including greenhouse gases and air pollutants. Apply the principles of chemical reactions to explain the formation and removal of atmospheric pollutants. Describe the role of atmospheric chemistry in environmental chemistry and its impact on air quality and climate.</p>	<p>Benchmark 1: Demonstrate an understanding of the composition, structure and functions of the Earth's atmosphere, including the role of atmospheric gases, pollutants and greenhouse effect.</p>	<p><b>Atmosphere</b></p>	<p>SLO: C-09-D-03</p> <p>State the adverse effects of air pollutants (Some examples include: a. carbon dioxide: higher levels of carbon dioxide leading to increased global warming, which leads to climate change b. carbon monoxide: toxic gas c. particulates: increased risk of respiratory problems and cancer d. methane: higher levels of methane leading to increased global warming, which leads to climate change e. oxides of nitrogen: acid rain, photochemical smog and respiratory problems f. sulfur dioxide: acid rain and haze)</p>	<p>Grade 10 SLO</p>		<p>Understand</p>	
			<p>SLO: C-09-D-04</p> <p>Explain how the greenhouse gasses carbon dioxide and methane cause global warming, (Some examples include: a. the absorption, reflection and emission of thermal energy b reducing thermal energy loss to space)</p>	<p>Grade 10 SLO</p>		<p>Understand</p>	
			<p>SLO: C-09-D-05</p> <p>Describe the role of sulfur in the formation of acid rain and its impact on the environment.</p>	<p>Grade 10 SLO</p>		<p>Understand</p>	
			<p>SLO: C-09-D-06</p> <p>Describe the strategies to reduce the effects of major environmental issues (Some examples include: a. climate change: planting trees, reduction in livestock farming, decreasing use of fossil fuels, increasing use of hydrogen and renewable energy, e.g. wind, solar b. acid rain: use of catalytic converters in vehicles, reducing emissions of sulfur dioxide by using low sulfur fuels and flue gas desulfurization with calcium oxide)</p>	<p>Grade 10 SLO</p>		<p>Evaluate</p>	
			<p>SLO: C-09-D-07</p> <p>Describe the role of NO and NO2 in the formation of acid rain, both directly and through their catalytic role in the oxidation of atmospheric sulfur dioxide.</p>	<p>Grade 10 SLO</p>		<p>Understand</p>	
			<p>SLO: C-09-D-08</p> <p>Explain how oxides of nitrogen form in car engines and describe their removal by catalytic converters, e.g. <math>\text{CO} + 2\text{NO} \rightarrow 2\text{CO} + \text{N}_2</math></p>	<p>Grade 10 SLO</p>		<p>Understand</p>	
			<p>SLO: C-09-D-09</p> <p>Define photosynthesis as the reaction between carbon dioxide and water to produce glucose and oxygen in the presence of chlorophyll and using , energy from light.</p>	<p>New SLO</p>		<p>Remember</p>	

<b>Domain D: Environmental Chemistry</b>				SLO: C-09-D-10	Analyze how to use tools to reduce personal exposure to harmful pollutants (some examples include the usage of masks, air quality indices and CO detectors)	Grade 10 SLO		Analyse		
				SLO: C-09-D-11	Identify high risk situations in life including those where long-term exposure to these pollutants can lead to respiratory issues and reduction in quality and longevity of life	Grade 10 SLO		Analyse		
				SLO: C-09-D-12	Investigate chemical tests for the presence of water using anhydrous copper(I) sulfate	Grade 10 SLO	<b>Not assessable in summative</b>	Analyse	For practical	
	Standard: (Water) Students should be able to: Describe the properties and composition of water, including its chemical and physical properties	Benchmark:			SLO: C-09-D-13	Explain how to test the purity of water using melting point and boiling point	Grade 10 SLO	<b>Ambiguous</b>	Understand	
					SLO: C-09-D-14	Distinguish between Distilled water and tap water with their applications in practical chemistry.	Grade 10 SLO	<b>Ambiguous</b>	Understand	
					SLO: C-09-D-15	State that water from natural sources may contain useful and harmful substances (Some examples include: a. dissolved oxygen b. metal compounds c. plastics d. sewage e. harmful microbes f. nitrates from fertilizers g. phosphates from fertilizers and detergents)	Grade 10 SLO	<b>Ambiguous</b>	Remember	
					SLO: C-09-D-16	Recognize that some naturally occurring substances in water are beneficial (some examples include: a. dissolved oxygen for aquatic life b. some metal compounds provide essential minerals for life)	Grade 10 SLO	<b>Ambiguous</b>	Remember	

<p>properties.</p> <p>Explain the sources and recycling of water on Earth, including the water cycle and groundwater. Discuss the effects of pollutants on water quality, including acid rain, chemical pollutants, and eutrophication. Apply the principles of chemical reactions to explain the formation and removal of water pollutants. Describe the role of water in environmental chemistry and its impact on water resources and aquatic ecosystems.</p>	<p>Explain how to measure the purity of water and evaluate the role of water in various natural and industrial processes (like making fertilizers), and describe the impact of human activities on the quality and availability of freshwater resources.</p>	<p><b>Water</b></p>	<p>SLO: C-09-D-17</p>	<p>Recognize that some naturally occurring substances in water are potentially harmful (some examples include:  a. some metal compounds that are toxic  b. some plastics that harm aquatic life  c. sewage that contains harmful microbes which cause disease  d. nitrates and phosphates that lead to deoxygenation of water and damage to aquatic life  Details of the eutrophication process are not required)</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Analyse</p>	
			<p>SLO: C-09-D-18</p>	<p>Explain the treatment of the domestic water supply (some examples of this includes:  (a) sedimentation and filtration to remove solids  (b) use of carbon to remove tastes and odors  (c) chlorination to kill microbes)</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	
			<p>SLO: C-09-D-19</p>	<p>Describe various water-borne diseases and the steps that can be taken to avoid them.</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	
			<p>SLO: C-09-D-20</p>	<p>Identify the negative effects of water pollutants on life and the ways to avoid them</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	
			<p>SLO: C-09-D-21</p>	<p>Explain water scarcity as an important issue faced by Pakistan and the ways in which it can be resolved</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	
			<p>SLO: C-09-D-22</p>	<p>State that urea, ammonium salts and nitrates are used as fertilizers</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Remember</p>	
			<p>SLO: C-09-D-23</p>	<p>Explain the use of NPK fertilizers to provide the elements nitrogen, phosphorus and potassium for improved plant growth</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	



<p>Standard: Basics of organic chemistry (catenation, isomerism, nomenclature, functional groups, homologous series)</p> <p>Students should be able to:</p> <p>Describe the concept of catenation, including the ability of carbon atoms to bond with each other to form complex structures.</p> <p>Explain the concept of isomerism in organic compounds, including structural and stereoisomers.</p> <p>Discuss the systematic nomenclature of organic compounds, including IUPAC rules.</p> <p>Describe the functional groups in organic compounds, including alcohols, carboxylic acids, amines, and aldehydes.</p> <p>Explain the concept of homologous series, including the similarity in properties and reactivity among members of a series.</p> <p>Apply the knowledge of the properties of organic compounds to predict the outcome of common organic reactions, including substitution, elimination, addition, oxidation, and reduction.</p>	<p>Benchmark 1: Recognize and classify organic compounds based on their functional groups, nomenclature, isomerism, and homologous series.</p>	<p>Basics of organic c</p>	SLO: C-09-E-01	Describe organic molecules as either straight-chained, branched or cyclic	Grade 10 SLO	<b>Ambiguous</b>	Understand	
			SLO: C-09-E-02	State that a structural formula is an unambiguous description of the way the atoms in a molecule are arranged, including CH <sub>2</sub> =CH <sub>2</sub> , CH <sub>3</sub> CH <sub>2</sub> OH, CH <sub>3</sub> COOCH <sub>3</sub>	Grade 10 SLO	<b>Ambiguous</b>	Remember	
			SLO: C-09-E-03	Identify and draw structural formulae for molecules.	Grade 10 SLO	<b>Ambiguous</b>	Apply	(Here student have to apply the knowledge of rule of structure formula/ molecular formula to draw structural formula)
			SLO: C-09-E-04	interpret general formulae of compounds in the same homologous series including alkanes, alkenes, alkynes, alcohols and carboxylic acids.	Grade 10 SLO	<b>Ambiguous</b>	Understand	
			SLO: C-09-E-05	Define structural isomers as compounds with the same molecular formula, but different structural formulae, including C <sub>4</sub> H <sub>10</sub> as CH <sub>3</sub> -CH <sub>2</sub> -CH <sub>2</sub> -CH <sub>3</sub> and CH-CH(CH <sub>3</sub> )-CH <sub>3</sub> ; and C <sub>4</sub> H <sub>8</sub> as CH <sub>3</sub> -CH <sub>2</sub> -CH=CH <sub>2</sub> and CH <sub>3</sub> -CH=CH-CH <sub>3</sub>	Grade 10 SLO	<b>Ambiguous</b>	Understand	
			SLO: C-09-E-06	Identify a functional group as an atom or group of atoms that determine the chemical properties of a homologous series including that for alcohols, aldehydes, ketones, phenols, carboxylic acids, amine, esters, and amide.	Grade 10 SLO	<b>Ambiguous</b>	Remember	

**Domain E: Organic Chemistry**

Standard:  
(Hydrocarbons)  
Students should be able to:  
Describe the structures and properties of alkanes, alkenes, and alkynes, including their classification as saturated and unsaturated hydrocarbons.  
Explain the reaction

SLO: C-09-E-07	Describe the general characteristics of a homologous series (These can include: (a) having the same functional group (b) having the same general formula (c) differing from one member to the next by a $\text{—CH}_2\text{—}$ unit (d) displaying a trend in physical properties (e) sharing similar chemical properties)	Grade 10 SLO	<b>Ambiguous</b>	Understand	
SLO: C-09-E-08	State that a saturated compound has molecules in which all carbon-carbon bonds are single bonds	Grade 10 SLO	<b>Ambiguous</b>	Remember	
SLO: C-09-E-09	State that an unsaturated compound has molecules in which one or more carbon—carbon bonds are not single bonds	Grade 10 SLO	<b>Ambiguous</b>	Remember	
SLO: C-09-E-10	State that the bonding in alkanes is single covalent and that alkanes are saturated hydrocarbons	Grade 10 SLO	<b>Ambiguous</b>	Remember	
SLO: C-09-E-11	Describe the properties of alkanes as being generally unreactive, except in terms of combustion and substitution by chlorine	Grade 10 SLO	<b>Ambiguous</b>	Understand	
SLO: C-09-E-12	State that in a substitution reaction one atom or group of atoms is replaced by another atom or group of atoms	Grade 10 SLO	<b>Ambiguous</b>	Remember	

<p>mechanisms and products of alkane, alkene, and alkyne reactions, including combustion, addition, and substitution reactions.</p> <p>Discuss the applications of hydrocarbons, including their use as fuels and starting materials for the synthesis of other organic compounds.</p> <p>Apply the concepts of chemical bonding and reactivity to predict the products of hydrocarbon reactions (including aromatic compounds).</p> <p>Describe the importance of hydrocarbons in organic chemistry and their role in industry and daily life.</p>	<p>Benchmark 1: Classify and identify different types of hydrocarbons (alkanes, alkenes, alkynes) based on their molecular structure, reactivity, and physical properties.</p>	<p><b>Hydrocarbons</b></p>	<p>SLO: C-09-E-13</p>	<p>Describe the substitution reaction of alkanes with chlorine as a photochemical reaction, and draw the structural or displayed formulae of the products, limited to monosubstitution</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	
			<p>SLO: C-09-E-14</p>	<p>Describe, using symbol equations, preparation of alkanes from cracking of larger hydrocarbons, hydrogenation of alkenes and alkynes, and reduction of alkyl halides</p>	<p>Grade 10 SLO</p>	<p><b>Ambiguous</b></p>	<p>Understand</p>	
<p>Standard: Biochemistry (carbohydrates, proteins, fats, DNA, vitamins)</p> <p>Students should be able to:</p> <p>Describe the structure and properties of carbohydrates, proteins, and lipids, including their classification as monosaccharides, disaccharides, polysaccharides, amino acids, peptides, and fatty acids.</p> <p>Explain the metabolic pathways and functions of carbohydrates, proteins, and lipids, and their support, and regulatory roles.</p>	<p>Benchmark 1: Identify the importance of carbohydrates, proteins, fats, DNA and vitamins in biological systems.</p>	<p><b>Biochemistry</b></p>	<p>SLO: C-09-E-15</p>	<p>Explain the importance and basics of nutrition and healthy eating</p>	<p>Grade 10 SLO</p>		<p>Understand</p>	
			<p>SLO: C-09-E-16</p>	<p>Recognize the main biomolecules; carbohydrates, proteins, lipids and nucleic acids. their sources, along with the required daily intake for young adults</p>	<p>Grade 10 SLO</p>		<p>Understand</p>	

	and regulatory roles. Describe the structure and function of DNA and RNA, including the role of DNA in genetics.			SLO: C-09-E-17	Identify carbohydrates as a source of energy	Grade 10 SLO		Remember	
Standard: Analyze and interpret data from experiments, using mathematical and statistical tools as needed. Evaluate the accuracy and precision of data, and identify sources of error in experimental results. Communicate experimental results clearly and effectively, using appropriate graphical and written formats.		Benchmark 1: Students can use standard scientific notation for physical quantities and can justify the appropriate use of common lab instruments to collect data on physical quantities related to chemistry	<b>Scientific Notation/Standard Form</b>	SLO: C-09-F-01	Explain that units are standardized for better communication and collaboration. (Some examples may include: In the field of chemistry, the International System of Units (1) is used to measure physical quantities such as mass, volume, and temperature. This standardized system ensures that chemists worldwide can use the same units to measure and communicate their results, facilitating communication and collaboration in the field. - Without standardized units, it would be difficult for chemists to compare their results with one another, and it would be challenging to develop consistent and accurate scientific models. For example, imagine if one chemist measured the mass of a substance in grams, while another used ounces. The two measurements would be difficult to compare and combine, potentially leading to inaccurate or inconsistent results.)	New SLO		Understand	
				SLO: C-09-F-02	Identify SI units for abstract and physical quantities (some examples include mass, time and amount of matter)	New SLO		Understand	
				SLO: C-09-F-03	Apply the concept that units can be combined with terms for magnitude, especially kilo, deci, and mill,	New SLO		Understand	
				SLO: C-09-F-04	Justify why chemists use cm <sup>3</sup> , g and s as more practical units when working with small amounts in lab	New SLO		Understand	
				SLO: C-09-F-05	Explain with examples how different tools and techniques can be used to manage accuracy and precision for inherent errors that arise during measurement	New SLO		Analyse	
				SLO: C-09-F-06	Use the standard form $A \times 10^n$ where n is a positive or negative integer, and $1 \leq A < 10$ .	New SLO		Understand	
				SLO: C-09-F-07	Convert quantitative values into and out of the scientific notation form.	New SLO		Apply	
				SLO: C-09-F-08	Calculate with values in standard form.	New SLO		Apply	

<b>Collection and Analysis</b>				SLO: C-09-F-09	Identify appropriate apparatus for the measurement of time, temperature, mass and volume, including: a. stopwatches b. thermometers c. balances d. burettes e. volumetric pipettes f. measuring cylinders g. gas syringes	New SLO		Understand	
				SLO: C-09-F-10	Suggest advantages and disadvantages of experimental methods and apparatus	New SLO		Analyse	
	Standard: (Separation Techniques) Students should be able to: Understand the principles of different separation techniques and methods, including chromatography, distillation, and extraction. Perform experimental procedures and techniques accurately and safely, using appropriate equipment and instruments. Analyze and interpret data from experiments, using mathematical and statistical tools as needed. Evaluate the efficiency and selectivity of different separation techniques for specific	Benchmark 1: Describe the principles and process of separation techniques in chemistry such as chromatography, distillation, and crystallization, and explain how each technique is used to separate mixtures based on their physical and chemical properties.	<b>(Separation Techn</b>	SLO: C-09-F-11	Define important terms associated with creating chemical solutions. (Some examples include: a) solvent as a substance that dissolves a solute b) solute as a substance that is dissolved in a solvent c) solution as a mixture of one or more solutes dissolved in a solvent d) saturated solution as a solution containing the maximum concentration of a solute dissolved in the solvent at a specified temperature e) residue as a substance that remains after evaporation, distillation, filtration or any similar process f) filtrate as a liquid or solution that has passed through a filter)	New SLO		Remember	
				SLO: C-09-F-12	Explain methods of separation and purification (some example include: a) using a suitable solvent b) filtration c) crystallisation d) simple distillation e) fractional distillation)	Modified (Split) SLO		Understand	
				SLO: C-09-F-13	Suggest suitable separation and purification techniques, given information about the substances involved, and their usage in daily life	New SLO		Understand	

<b>Domain F: Empirical Data</b>	mixtures, and choose the appropriate technique for a given problem.			SLO: C-09-F-14	Identify substances and assess their purity using melting point and boiling point information	Modified (Split) SLO		Understand	Assessible in practicals & theory
	Standard: (Qualitative Analysis) Students should be able to: Understand the principles of qualitative analysis, including the use of reagents and reaction tests to identify unknown substances. Perform experimental procedures and techniques accurately and safely, using appropriate equipment and instruments. Analyze and interpret data from experiments, using logical reasoning and inferential thinking to deduce the identity of unknown substances. Evaluate the reliability and validity of experimental results, and identify sources of error and uncertainty in the analysis. Communicate experimental results clearly and effectively, using appropriate graphical and written formats, and draw conclusions about the identity of unknown substances.	Benchmark 1: Demonstrate understanding of the principles and applications of various qualitative analysis techniques, including observation, precipitation, oxidation-reduction, and complexation , reactions.	Qualitative Analysis	SLO: C-09-F-15	Describe tests to identify important gasses (Some examples include: a. ammonia, NH <sub>3</sub> , using damp red litmus paper b. carbon dioxide, CO <sub>2</sub> , using limewater c. chlorine, Cl <sub>2</sub> , using damp litmus paper d. hydrogen, H <sub>2</sub> , using a lighted splint e. oxygen, O <sub>2</sub> , using a glowing splint f. sulfur dioxide, SO <sub>2</sub> , using acidified aqueous potassium manganate(VII))	New SLO		Apply	Assessible in practicals & theory
				SLO: C-09-F-16	Explain the use of a flame test to identify important cations: (Some examples include: a) lithium, Li <sup>+</sup> b) sodium, Na <sup>+</sup> c) potassium, K <sup>+</sup> d) calcium, Ca <sup>2+</sup> e) copper(II), Cu <sup>2+</sup> f) barium, Ba <sup>2+</sup>	New SLO		Understand	

<p>Standard: (Chromatography) The students will be able to: Define chromatography and explain the principles of its different types including paper chromatography, column chromatography, thin layer chromatography, and gas chromatography. Analyze the results of a chromatography experiment, including identifying spots or peaks and determining their relative sizes and positions. Design and execute chromatography experiments to separate mixtures of compounds based on their physical and chemical properties including the interpretation of R<sub>f</sub> values. Identify any unknown materials in the mixture and determine its quantity.</p>	<p>Benchmark: Define chromatography and explain the principles of paper chromatography and discuss the underlying principles that govern the separation technique.</p>	<p><b>Chromatography</b></p>	<p>SLO: C-09-F-17</p>	<p>Describe how paper chromatography is used to separate mixtures of soluble substances, using a suitable solvent.</p>	<p>New SLO</p>	<p>Understand</p>	
			<p>SLO: C-09-F-18</p>	<p>Describe the use of locating agents when separating chromatography in mixtures containing colorless substances. (For context, knowledge of specific locating agents is not required)</p>	<p>New SLO</p>	<p>Understand</p>	<p>Assessible in practicals &amp; theory</p>
			<p>SLO: C-09-F-19</p>	<p>Interpret simple chromatograms (For context, students should identify: a) unknown substances by comparison with known substances b) pure and impure substances)</p>	<p>New SLO</p>	<p>Analyse</p>	<p>Assessible in practicals</p>
			<p>SLO: C-09-F-20</p>	<p>State and use the equation for R<sub>f</sub></p>	<p>New SLO</p>	<p>Understand</p>	