

Chemistry
GRADE 11

SLOs for Assessment Key:

1. Assessible / Attainable - (Not included in drop down list) cell will be blank and empty
White)
 - (Grey)
 - (Grey)
 learning level) -- (Grey)
2. **Ambiguous (assessable in longer run)** - (**BOLD**)
 3. Not assessable in Summative
 4. Repetitive (with in same grade)
 5. Repetitive (with in same

Domains	Standards	Benchmarks	Topic/Title	NC SLO #	NCP (2022) - SLO	Status of SLOs	SLOs for Assessment	Cognitive Domain	Comments
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 I: Students should be able to: - explain the role of thought experiments in chemical theory - consider the ethical aspects of developing and using chemical substances and processes	Thought Experiments	[SLO: C-11-A-01]	Describe how Al Ghazali's burning cotton thought experiment highlight the challenges of inductive reasoning	New SLO	Ambiguous	Understand	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
				[SLO: C-11-B-01]	Describe that, each atomic shell and subshell are further divided into degenerate orbitals having the same energy.	Matched SLO		Understand	Already included in currently teaching curriculum of 2006
Physical Chemistry	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.	Benchmark 1: The student will be able to explain the energy levels and electron configurations of atoms, and use these models to predict and interpret trends in the periodic table, such as atomic radius and electron shielding.	Atomic Structure	[SLO: C-11-B-02]	describe protons, neutrons and electrons in terms of their relative charges and relative masses	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX And XI
				[SLO: C-11-B-03]	Recognize that the terms atomic and proton number represent the same concept	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX And XI
				[SLO: C-11-B-04]	Recognize the terms mass and nucleon number represent the same concept	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX And XI
				[SLO: C-11-B-05]	Describe the behavior of beams of protons, neutrons and electrons moving at the same velocity in an electric field	New SLO		Understand	Already included in currently teaching curriculum of 2006 XI
				[SLO: C-11-B-06]	Determine the numbers of protons, neutrons and electrons present in both atoms and ions given atomic or proton number, mass/or nucleon number and charge	Matched SLO		Analyse	Already included in currently teaching curriculum of 2006 IX And XI
				[SLO: C-11-B-07]	Explain the change in atomic and ionic radius across a period and down a group	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX, XI & XII

Benchmark 2: Students can describe the electronic configuration of atomic shells and subshells in detail, and relate electronic configuration to patterns in ionization energy

[SLO: C-11-B-08]	Determine the electronic configuration of elements and their ions with proton numbers. (Some examples include: a. simple configuration e.g. 2,8, b. subshells e.g. 1s ² , 2s ² , 2p ⁶ , 2s ¹ c. Students should be able to determine both of these from periodic table and are not required to memorize these d. students should understand that chemical properties of an atom are governed by valence electrons)	Matched SLO		Analyse	Already included in currently teaching curriculum of 2006 IX, XI & XII
[SLO: C-11-B-09]	Define terms related to electronic configuration (Some examples include shells, subshells, orbitals, principal quantum number (n), ground state),	Matched SLO		Remember	Already included in currently teaching curriculum of 2006 IX & XI
[SLO:C-11-B-10]	Relate Quantum Numbers to Electronic distribution of elements.	Matched SLO		Analyse	Already included in currently teaching curriculum of 2006 of XI only
[SLO: C-11-B-11]	Describe the number of orbitals making up s, p d and f subshells, and the number of electrons that can fill s, p d and f subshells	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX & XI
[SLO:C-11-B-12]	Apply aufbau principle, pauli exclusion principle and hunds rule to write the electronic configuration of elements			Apply	Already included in currently teaching curriculum of 2006 of XI
[SLO: C-11-B-13]	Describe the order of increasing energy of the subshells(s,p,d and f)	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 of XI
[SLO: C-11-B-14]	Describe the electronic configurations to include the number of electrons in each shell, subshell and orbital.	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX & XI
[SLO: C-11-B-15]	Explain the electronic configurations in terms of energy of the electrons and inter-electron repulsion	Modified (Split) SLO	Repetitive (within same learning level)	Understand	Already included in currently teaching curriculum of 2006 IX & XI
[SLO: C-11-B-16]	Determine the electronic configuration of atoms and ions given the proton or electron number and charge,	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX & XI
[SLO: C-11-B-17]	Illustrate the importance of electronic configurations in development of new materials for electronic devices. (For example, semiconductors such as silicon have a specific electronic configuration that makes them ideal for use in electronic devices.)	New SLO		Understand	Not included in the current SLOs
[SLO: C-11-B-18]	Describe the shapes of s, p and d orbitals	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX & XI
[SLO: C-11-B-19]	Describe a free radical as a species with one or more unpaired electrons	Modified(rephrased) SLO	Not assessable in summative	Understand	Already taught in IX SLO's
[SLO: C-11-B-20]	Explain that ionization energies are due to the attraction between the nucleus and the outer electron	Matched SLO		Understand	Already included in currently teaching curriculum of 2006 IX, XI & XII
[SLO: C-11-B-21]	Explain how ionization energy helps account for the trends across a period and down a group of the Periodic Table	Grade 12 SLO	Repetitive (within same learning level)	Understand	Already included in currently teaching curriculum of 2006 IX, XI & XII
[SLO: C-11-B-22]	Account for the variation in successive ionization energies of an element	Grade 12 SLO		Understand	Already taught in current IX& XII syllabus

				[SLO: C-11-B-23]	Explain the factors influencing the ionization energies of elements in terms of nuclear charge, atomic/ionic radius, shielding by inner shells and subshells and spin-pair repulsion	Grade 12 SLO	Repetitive (within same learning level)	Understand	Already taught in current IX& XII syllabus
				[SLO: C-11-B-24]	Deduce the electronic configurations of elements using successive ionization energy data	New SLO	Not assessable in summative	Apply	Not included in the current SLOs
				[SLO: C-11-B-25]	Deduce the position of an element in the Periodic Table using successive ionization energy data	New SLO	Not assessable in summative	Apply	Not included in the current SLOs
				[SLO: C-11-B-26]	Explain how a mass spectrometer can be used to determine the relative atomic mass of an element from its isotopic composition.	New SLO		Understand	Not included in the current SLOs
				[SLO: C-11-B-27]	Perform calculations involving non-integer relative atomic masses and abundance of isotopes from given data, including mass spectra.	Matched SLO		Apply	Included in the XI current SLO's
				[SLO: C-11-B-28]	Explain the concept of emission spectra Use the concept of emission spectra to deduce the electronic configuration of elements.	New SLO	Ambiguous	Understand	Not included in the current SLOs
			Chemical Bonding	[SLO: C-11-B-29]	Define electronegativity as the power of an atom to attract electrons to itself	Grade 12 SLO	Repetitive (within same learning level)	Remember	Also included in XII current SLO'S
				[SLO: C-11-B-30]	Explain the factors influencing the electronegativities of elements in terms of nuclear charge, atomic radius, shielding by inner shells and subshells	Grade 12 SLO	Repetitive (within same learning level)	Understand	Also included in XII current SLO'S
				[SLO: C-11-B-31]	Explain the trends in electronegativity across a period and down a group of the Periodic Table	Grade 12 SLO	Repetitive (within same learning level)	Understand	Also included in XII current SLO'S
				[SLO: C-11-B-32]	Use the differences in Pauling electronegativity values to predict the formation of ionic and covalent bonds	New SLO		Apply	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
				[SLO: C-11-B-33]	Describe covalent bonding in molecules using the concept of hybridization to describe sp, sp ² and sp ³ orbitals	Matched SLO		Understand	Already present in current SLO'S
				[SLO: C-11-B-34]	Use bond energy values and the concept of bond length to compare the reactivity of covalent molecules	New SLO		Apply	Not included in the current SLOs
				[SLO: C-11-B-35]	Describe the shapes and bond angles in molecules using VSEPR theory (including describing by sketching)	Matched SLO		Understand	Already present in current SLO'S
				[SLO: C-11-B-36]	Predict the shapes, and bond angles in molecules and ions.	Matched SLO		Understand	Already present in current SLO'S
				[SLO: C-11-B-37]	Explain hybridization and types of hybridization.	Matched SLO		Understand	Already present in current SLO'S
				[SLO: C-11-B-38]	Explain valence bond theory.	Matched SLO		Understand	Already present in current SLO'S
				[SLO: C-11-B-39]	Explain the importance of VSEPR theory in the field of drug design by discussing how the shape and bond angles of the molecules helps chemists predict their interactions in the body.	New SLO	Ambiguous	Understand	Not included in the current SLOs
	Explain the concept of chemical bonding and 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.	Benchmark 1: Students can apply the concepts of chemical bonding to predict the structure and properties of molecules, including molecular geometry, and polarity							

				[SLO: C-11-B-40]	Explain the salient features of molecular orbital theory.	Matched SLO		Understand	Already included in current SLO'S
				[SLO: C-11-B-41]	Explain the paramagnetic nature of Oxygen molecule in the light of MOT.	Matched SLO		Understand	Already included in current SLO'S
				[SLO: C-11-B-42]	Calculate Bond order of N ₂ , O ₂ , F ₂ & He.	Matched SLO		Understand	Already included in current SLO'S
				[SLO: C-11-B-43]	Describe the types of van der Waals' force Including: a. instantaneous dipole – induced dipole (id-id) force, also called London dispersion forces b. permanent dipole – permanent dipole (pd-pd) force, including hydrogen bonding c. Hydrogen bonding as a special case of permanent dipole – permanent dipole force between molecules where hydrogen is bonded to a highly electronegative atom)	Matched SLO		Understand	Already included in current SLO'S
				[SLO: C-11-B-44]	Describe hydrogen bonding, limited to molecules containing N–H , O–H and H–F groups, (including ammonia, water and H–F as simple examples)	Matched SLO		Understand	Already included in current SLO'S
				[SLO: C-11-B-45]	Use the concept of hydrogen bonding to explain the anomalous properties of H ₂ O (ice and water)	Matched SLO		Understand	Already included in current SLO'S
				[SLO: C-11-B-46]	Use the concept of electronegativity to explain bond polarity and dipole moments of molecules	Matched SLO		Understand	Already included in current SLO'S
				[SLO: C-11-B-47]	State that, in general, ionic, covalent and metallic bonding are stronger than intermolecular forces	Modified(rephrased) SLO	Repetitive (within same learning level)	Understand	IX CLASS SLO'S
				[SLO: C-11-B-48]	Recognize that molecular ions/polyatomic ions can have expanded octets e.g. sulfate and nitrate	New SLO		Understand	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
				[SLO: C-11-B-49]	Analyze the formation of dative bond in CO, ozone and H ₃ O ⁺ ion (resonance structure not required)	New SLO		Analyse	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
			Stoichiometry	[SLO: C-11-B-50]	Express balanced chemical equations in terms of moles, representative particles, masses, and volumes of gases (at STP).	Matched SLO		Apply	Already present in current SLO'S
				[SLO: C-11-B-51]	Explain the concept of limiting reagents	Matched SLO		Understand	Already present in current SLO'S
				[SLO: C-11-B-52]	Calculate the maximum amount of product and amount of any unreacted excess reagent.	Matched SLO		Apply	Already present in current SLO'S
				[SLO: C-11-B-53]	Calculate theoretical yield, actual yield, and percentage yield when given appropriate information.	Matched SLO		Apply	Already present in current SLO'S
				[SLO: C-11-B-54]	State the volume of one mole of a gas at STP	Matched SLO		Remember	Already present in current SLO'S
	<p>Explain the mole concept and its application in chemical calculations, including stoichiometry.</p> <p>Apply the law of conservation of mass to predict the quantities of reactants and products in chemical reactions.</p> <p>Constructing chemical equations and understanding the balancing of these chemical equations.</p> <p>Use stoichiometry to calculate the amount of reactants and products in a chemical reaction.</p> <p>Describe the relationship between moles, mass, and volume, and apply this relationship to</p>	Benchmark 1: Students can use stoichiometry to predict the quantities of reactants and products in chemical reactions, identify the limiting reactants and write balanced chemical equations.							

				[SLO: C-11-B-62]	Describe types of intermolecular forces.	Matched SLO		Understand	Already present in current IX and XI SLO'S
				[SLO: C-11-B-63]	Explain the strength and applications of dipole-dipole forces, hydrogen bonding and London forces.	Matched SLO		Understand	Already present in current IX and XI SLO'S
				[SLO: C-11-B-64]	Describe physical properties of liquids such as evaporation, vapor pressure, boiling point, viscosity and surface tension.	Matched SLO		Understand	Already present in current IX and XI SLO'S
				[SLO: C-11-B-65]	Apply the concept of hydrogen bonding to explain the properties of water (specifically high surface tension, high specific heat, low vapor pressure, high heat of vaporization, and high boiling point)	Matched SLO		Apply	Already present in current XI SLO'S
				[SLO: C-11-B-66]	Define molar heat of fusion and molar heat of vaporization.	Matched SLO		Remember	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-67]	Describe how heat of fusion and heat of vaporization affect the particles that make up matter.	Matched SLO		Understand	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-68]	Outline the importance of heat of fusion in the study of glaciers and ice sheets (particularly while studying polar ice caps).	New SLO		Understand	Reason based SLO'S
				[SLO: C-11-B-69]	Describe the physical properties of gases (including compressibility, expandability and pressure exerted by gases)	Matched SLO		Understand	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-70]	Describe liquid crystals and give their uses in daily life.	Matched SLO		Understand	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-71]	Differentiate liquid crystals from pure liquids and crystalline solids	Matched SLO		Analyse	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-72]	Describe simple properties of solids e.g. compression, expansion, motion of molecules, inter particle space, intermolecular forces and kinetic energy based on kinetic molecular theory.	Matched SLO	Not assessable in summative	Understand	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-73]	Differentiate between amorphous and crystalline solids.	Matched SLO		Analyse	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-74]	Describe properties of crystalline solids like geometrical shape, melting point, cleavage planes, habit of a crystal, crystal growth.	Matched SLO		Understand	Already present in current 2006 XI SLO'S
	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.	Benchmark 1: Students should be able to apply the laws of thermodynamics to analyze and predict energy changes in chemical systems, including exothermic and endothermic reactions, enthalpy and entropy changes	Energetics	[SLO: C-11-B-75]	Describe that chemical reactions are accompanied by enthalpy changes and these changes can be exothermic (ΔH is negative) or endothermic (ΔH is positive)	Matched SLO		Understand	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-76]	interpret a reaction pathway diagram, in terms of the enthalpy change of the reaction and of the activation energy	Modified (Split) SLO		Apply	Already present in current 2006 XI SLO'S but this addition is with some modification
				[SLO: C-11-B-77]	Define terms such as standard conditions, enthalpy change, reaction, formation, combustion, neutralization	Matched SLO		Understand	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-78]	Explain that energy transfer occurs during chemical reactions because of the breaking and making of bonds	Matched SLO		Understand	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-79]	Calculate the bond energies for the enthalpy change of reaction, ΔH	Matched SLO		Apply	Already present in current 2006 XI SLO'S
				[SLO: C-11-B-80]	Describe that some bond energies are exact and some bond energies are approximate	New SLO		Understand	Not included in the current SLOs

[SLO: C-11-B-81]	Calculate enthalpy changes from appropriate experimental results, including the use of the relationships $q = mc\Delta T$ and $\Delta H = -mc\Delta T/n$	Matched SLO		Apply	Already present in current 2006 XI SLO'S
[SLO: C-11-B-82]	Define terms such as enthalpy change of atomization, ΔH , lattice energy, ΔH , first electron affinity, EA	Matched SLO		Remember	Already present in current 2006 XI SLO'S
[SLO: C-11-B-83]	Use terms such as enthalpy change of atomization, ΔH , lattice energy, ΔH , first electron affinity, EA	Matched SLO		Apply	Already present in current 2006 XI SLO'S
[SLO: C-11-B-84]	Explain the factors affecting the electron affinities of elements	Grade 12 SLO	Ambiguous	Understand	The SLO is currently studying in grade XII
[SLO: C-11-B-85]	Construct Born-Haber cycles for ionic solids	Matched SLO		Apply	Already present in current 2006 XI SLO'S
[SLO: C-11-B-86]	Perform calculations involving Born-Haber cycles	Matched SLO		Apply	Already present in current 2006 XI SLO'S
[SLO: C-11-B-87]	Explain the effect of ionic charge and ionic radius on the numerical magnitude of lattice energy	New SLO	Ambiguous	Understand	Not included in current XI SLO'S
[SLO: C-11-B-88]	Apply enthalpy change with reference to hydration, and solution	Matched SLO		Apply	Already present in current 2006 XI SLO'S
[SLO: C-11-B-89]	Construct an energy cycle involving enthalpy change of solution, lattice energy and enthalpy change of hydration	Matched SLO	Not assessable in summative	Apply	Already present in current 2006 XI SLO'S
[SLO: C-11-B-90]	Perform calculations involving the energy cycles	Matched SLO		Apply	Already present in current 2006 XI SLO'S
[SLO: C-11-B-91]	Explain the effect of ionic charge and ionic radius on the numerical magnitude of an enthalpy change of hydration	New SLO	Ambiguous	Understand	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
[SLO: C-11-B-92]	Define the term entropy, S, as the number of possible arrangements of the particles and their energy in a given system	New SLO		Understand	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
[SLO: C-11-B-93]	explain the sign of the entropy changes that occur during a change in state, temperature change and a reaction in which there is a change in the number of gaseous molecules	New SLO		Understand	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
[SLO: C-11-B-94]	Calculate the entropy change for a reaction, ΔS , given the standard entropies, S, of the reactants and products	New SLO		Apply	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
[SLO: C-11-B-95]	Explain the concept of heat as a form of energy	Matched SLO		Understand	Already present in current 2006 XI SLO'S
[SLO: C-11-B-96]	Explain the relationship between temperature and kinetic energy of particles	Modified (Split) SLO		Understand	Already studying in current SLO'S In chaptre kinetic molecular theory of gases
[SLO: C-11-B-97]	State that total energy is conserved in chemical reactions	Matched SLO		Remember	Already present in current 2006 XI SLO'S
[SLO: C-11-B-98]	Explain the concept of standard conditions and standard states in measuring energy changes	Matched SLO		Understand	Already present in current 2006 XI SLO'S
[SLO: C-11-B-99]	Explain of Hess's Law	Matched SLO		Understand	Already present in current 2006 XI SLO'S
[SLO: C-11-B-100]	Apply Hess's Law to calculate enthalpy changes in a reaction carried out in multiple steps.	Matched SLO		Apply	Already present in current 2006 XI SLO'S
[SLO: C-11-B-101]	Explain the relationship between bond formation energy, and bond breaking energy	New SLO		Understand	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
[SLO: C-12-B-102]	Explain Gibbs free energy	New SLO		Understand	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
[SLO: C-12-B-103]	Apply the concept of Gibbs free energy to solve problems	New SLO		Apply	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006

				[SLO: C-12-B-104]	Outline how enthalpy change relates to the calorie content of the food we eat.	New SLO		Apply	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
<p>Describe the nature of chemical reactions, including the activation energy and rate of reaction.</p> <p>Explain the factors that affect the rate of reaction, including temperature, concentration, surface area, and catalysts.</p> <p>Discuss the mathematical models used to describe reaction kinetics, including rate laws and rate constants.</p>	<p>Benchmark 1: The student will be able to calculate the rate of reaction and rate constant using the rate law equation and be able to interpret the meaning of the rate constant in terms of reaction rate.</p>	<p>Reaction Kinetics</p>	[SLO: C-11-B-105]	Explain the rate of reaction and rate constant.	Matched SLO		Understand	Already present in XI 2006 SLO'S	
			[SLO: C-11-B-106]	Use experimental data to calculate the rate of a reaction	Matched SLO		Apply	Already present in XI 2006 SLO'S	
			[SLO: C-11-B-107]	Explain the concept of activation energy and its role in chemical reactions	Matched SLO		Understand	Already present in XI 2006 SLO'S	
			[SLO: C-11-B-108]	Use the Boltzmann distribution curve to explain the effect of temperature on the rate of a reaction	Matched SLO		Analyse	Already present in XI 2006 SLO'S	
			[SLO: C-11-B-109]	Explain the concept of catalyst and how they increase the rate of a reaction by lowering the activation energy	Matched SLO		Understand	Already present in XI 2006 SLO'S	
			[SLO: C-11-B-110]	Interpret reaction pathway diagrams, including in the presence and absence of catalysts	Matched SLO		Apply	Already present in XI 2006 SLO'S	
			[SLO: C-11-B-111]	Explain the relationship between Gibbs free energy change, ΔG , and the feasibility of a reaction	New SLO	Ambiguous	Understand	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006	
			[SLO: C-11-B-112]	Use rate equations, including orders of reaction and rate constants	Matched SLO		Apply	Already present in XI 2006 SLO'S	
			[SLO: C-11-B-113]	Calculate the numerical value of a rate constant using the initial rates and half-life method	New SLO	Ambiguous	Apply	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006	
			[SLO: C-11-B-114]	Suggest a reaction mechanism that is consistent with a given rate equation and rate-determining step	Matched SLO		Analyse	Already present in XI 2006 SLO'S	
			[SLO: C-11-B-115]	Describe the effect of temperature change on the rate constant and rate of a reaction.	Matched SLO		Understand	Already present in XI 2006 SLO'S	

Describe the concept of chemical equilibrium and the dynamic nature 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 and its application in predicting the effect of changes on chemical equilibria.

Benchmark 1: Students can apply the principles of chemical equilibrium to analyze and predict the position and extent of chemical reactions, and to gauge the extent of dissociation of solutes into solvents based on adjustment of physical parameters

Equilibria

[SLO: C-11-B-116]	Describe what is meant by a reversible reaction and dynamic equilibrium in terms of the rate of forward and reverse reactions being equal and the concentration of reactants and products remaining constant	Matched SLO		Understand	Already present in XI 2006 SLO'S
[SLO: C-11-B-117]	Define dynamic equilibrium between two physical states.	Matched SLO		Remember	Already present in XI 2006 SLO'S
[SLO: C-11-B-118]	State the necessary conditions for equilibrium and the ways that equilibrium can be recognized.	Matched SLO		Remember	Already present in XI 2006 SLO'S
[SLO: C-11-B-119]	Describe the microscopic events that occur when a chemical system is in equilibrium Define with examples.	Matched SLO		Understand	Already present in XI 2006 SLO'S
[SLO: C-11-B-120]	Deduce the equilibrium constant expression [Kc] from an equation for homogeneous reaction.	Matched SLO		Analyse	Already present in XI 2006 SLO'S
[SLO: C-11-B-121]	Determine the relationship between different equilibrium constants (Kc) for the same reaction at the same temperature.	Matched SLO		Understand	Already present in XI 2006 SLO'S
[SLO: C-11-B-122]	Write the equilibrium expression for a given chemical reaction in terms of concentration, K_c , partial pressure, number of moles and mole fraction.	Matched SLO		Apply	Already present in XI 2006 SLO'S
[SLO: C-11-B-123]	Differentiate between Microscopic and Macroscopic events in a chemical reaction.	Matched SLO		Understand	Already present in XI 2006 SLO'S
[SLO: C-11-B-124]	Propose microscopic events that account for observed macroscopic changes that take place during a shift in equilibrium.	New SLO		Analyse	New SLO not included in IX and X Curriculum and not mentioned in current followed curriculum 2006
[SLO: C-11-B-125]	Determine if the equilibrium constant will increase or decrease when temperature is changed, given the equation for the reaction.	Matched SLO		Understand	Already present in XI 2006 SLO'S
[SLO: C-11-B-126]	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.	Matched SLO		Remember	Already present in XI 2006 SLO'S
[SLO: C-11-B-127]	Explain industrial applications of Le Chatelier's Principle using Haber's process and the Contact Process as an example.	Matched SLO		Understand	Already present in XI 2006 SLO'S
[SLO: C-11-B-128]	Discuss the industrial applications of chemical equilibria and how it can be used to optimize chemical reactions to maximize yields and minimize waste products.	Matched SLO		Analyse	Already present in XI 2006 SLO'S
[SLO: C-11-B-129]	Use the concept of hydrolysis to explain why aqueous solutions of some salts are acidic or basic.	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter

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.

Benchmark 1: Students will be able to calculate pH values for dissolved acids and alkalis, including in titration experiments

Acid-Base Chemistry and pH

[SLO: C-11-B-130]	define conjugate acid–base pairs	Matched SLO		Understand	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-131]	identify conjugate acid-base pairs in reactions	Matched SLO		Analyse	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-132]	Apply the concept of conjugate acid and conjugate base on salt hydrolysis	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-133]	define mathematically the terms pH, K_a , pK_a and K_w and use them in calculations (K_b and the equation $K_w = K_a \times K_b$ will not be tested)	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-134]	calculate $[H^+(aq)]$ and pH values for <ol style="list-style-type: none"> strong acids strong alkalis weak acids weak alkalies 	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-135]	Distinguish that Lewis acids accept lone pair, and Lewis bases donate lone pair to make a coordinate covalent bond.	Matched SLO		Analyse	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-136]	calculate the pH of buffer solutions in given appropriate data	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-137]	Demonstrate the ability to comprehend and effectively apply the concept of solubility product. (K_{sp})	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-138]	Construct an expression for K_{sp}	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-139]	calculate K_{sp} from concentrations and vice versa	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-140]	Apply the concept of the common ion effect to describe why the solubility of a substance changes when it is dissolved in a solution containing a common ion.	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-141]	perform calculations using K_{sp} values and concentration of a common ion	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-142]	Use the concept of hydrolysis to explain why aqueous solutions of some salts are acidic or basic.	Matched SLO		Understand	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-143]	Calculate the $[H_3O^+]$ given the K_a and molar concentration of weak acid.	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-144]	Calculate concentrations of ions of slightly soluble salts.	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-145]	Perform acid-base titrations to calculate molarity and strength of given sample solutions.	Matched SLO		Apply	present in current SLO'S but in acid base and salt chapter
[SLO: C-11-B-146]	Select suitable indicators for acid-alkali titrations, given appropriate data (pK_a values will not be used)	New SLO		Analyse	present in current SLO'S but in acid base and salt chapter

Inorganic Chemistry

Describe the organization of the periodic table, including the arrangement of elements by atomic number, 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

Benchmark 1: The student will be able to interpret and explain the periodic trends of electron configuration, ionization energy, electron affinity, and atomic radius, predict the properties and reactivity of elements based on their position in the periodic table and use periodic properties to classify elements and compounds into groups and identify relationships between them.

Periodic Table and Periodicity

[SLO: C-11-C-01]	Explain the arrangement of elements in the periodic table	Grade 12 SLO	Ambiguous	Understand	present in current XII SLO'S
[SLO: C-11-C-02]	Explain that the periodic table is arranged into four blocks associated with the four sublevels—s, p, d, and f.	Grade 12 SLO		Understand	present in current XII SLO'S
[SLO: C-11-C-03]	Recognize that the period number (n) is the outer energy level that is occupied by electrons.	Grade 12 SLO		Understand	present in current XII SLO'S
[SLO: C-11-C-04]	State that the number of the principal energy level and the number of the valence electrons in an atom can be deduced from its position on the periodic table.	Grade 12 SLO		Remember	present in current XII SLO'S
[SLO: C-11-C-05]	Identify the positions of metals, nonmetals and metalloids in the periodic table.	Grade 12 SLO		Understand	present in current XII SLO'S
[SLO: C-11-C-06]	Explain that vertical and horizontal trends in the periodic table exist for atomic radius, ionic radius, ionization energy, electron affinity and electronegativity.	Grade 12 SLO		Understand	present in current XII SLO'S
[SLO: C-11-C-07]	Recognize that trends in metallic and non-metallic behavior are due to the trends in valence electrons.	New SLO		Understand	present in current XII SLO'S
[SLO: C-11-C-08]	Deduce the electron configuration of an atom from the element's position on the periodic table, and vice versa (based on s,p,d and f subshells).	Grade 12 SLO		Analyse	present in current XII SLO'S
[SLO: C-11-C-09]	Write equations for, the reactions of Na and Mg with oxygen, chlorine and water	Grade 12 SLO		Apply	present in current XII SLO'S
[SLO: C-11-C-10]	Explain the variation in the oxidation number of the oxides and chlorides (NaCl, MgCl ₂ in terms of their outer shell (valence shell) electrons	Grade 12 SLO		Understand	present in current XII SLO'S
[SLO: C-11-C-11]	describe (including writing equations for) the reactions, if any, of the oxides (acidic and basic) with water (including the likely pHs of the solutions obtained)	Matched SLO		Understand	Already present in XI 2006 SLO'S acid base and salt chapter
[SLO: C-11-C-12]	Explain with the help of equations for, the acid / base behavior of the oxides and the hydroxides NaOH, Mg(OH) ₂ including, where relevant, amphoteric behavior in reactions with acids and bases (sodium hydroxide only)	Matched SLO		Understand	Already present in XI 2006 SLO'S acid base and salt chapter
[SLO: C-11-C-13]	Explain with equations for, the reactions of the chlorides with water including the likely pHs of the solutions obtained.	Grade 12 SLO		Understand	Already present in XII SLO'S chemistry of halogens
[SLO: C-11-C-14]	explain the variations and trends in terms of bonding and electronegativity	New SLO		Understand	XII current book SLO'S
[SLO: C-11-C-15]	suggest the types of chemical bonding present in the chlorides and oxides from observations of their chemical and physical properties	New SLO	Ambiguous	Understand	Not mentioned in current SLO'S
[SLO: C-11-C-16]	predict the characteristic properties of an element in a given group by using knowledge of chemical periodicity	Grade 12 SLO		Apply	Some relevant information about SLO'S Present in current XII SLO'S

				[SLO: C-11-C-17]	deduce the nature, possible position in the Periodic Table and identity of unknown elements from given information about physical and chemical properties	Matched SLO		Analyse	SLO'S presnt in SINDH old text book of XII
				[SLO: C-11-C-18]	Explain the trends in the ionization energies and electron affinities of the Group 1 and Group 17 elements	Grade 12 SLO		Understand	XII current book SLO'S
<p>Describe the trends in the properties of Group 17 elements (fluorine, chlorine, bromine, iodine, and astatine) including volatility, reactivity, and electronegativity.</p> <p>Explain the industrial and everyday uses of Group 17 elements and their compounds, such as the production of refrigerants and disinfectants.</p> <p>Identify the halide ions (chloride, bromide, and iodide) and predict their reactivity based on the trends in Group 1 elements.</p> <p>Demonstrate an understanding of the reactions of Group 17 elements and their</p>	Benchmark 1: Describe trends and reactivity of halogens and their tendency to form compounds with various elements in the periodic table.	Group 17	[SLO: C-11-C-19]	Describe the colors and trend in volatility of chlorine, bromine and iodine	Grade 12 SLO		Understand	XII current book SLO'S	
			[SLO: C-11-C-20]	Describe the trend in bond strength of halogen molecules	Grade 12 SLO		Understand	XII current book SLO'S	
			[SLO: C-11-C-21]	Interpret the volatility of the elements in terms of instantaneous dipole-induced dipole forces	Matched SLO		Analyse	XI Current book SLO'S In liquid state chapter	
			[SLO: C-11-C-22]	Describe the relative reactivity of the halogen elements as oxidizing agents	Grade 12 SLO		Understand	present in current XII SLO'S	
			[SLO: C-11-C-23]	Describe the reactions of the elements with hydrogen and explain their relative reactivity in these reactions	New SLO		Understand	Not mentioned in current XII SLO'S	
			[SLO: C-11-C-24]	Describe the relative thermal stabilities of the hydrogen halides and explain these in terms of bond strengths	Grade 12 SLO		Understand	present in current XII SLO'S	
			[SLO: C-11-C-25]	Describe the relative reactivity of halide ions as reducing agents	Grade 12 SLO		Understand	present in current XII SLO'S	
			[SLO: C-11-C-26]	explain the reactions of halide ions with aqueous silver ions and concentrated sulfuric acid	Grade 12 SLO	Ambiguous	Understand	Reaction with H ₂ SO ₄ is available in current XII SLO'S	
			[SLO: C-11-C-27]	Describe the reaction of halides with aqueous silver ions followed by aqueous ammonia	New SLO	Ambiguous	Understand	New SLO not mentiones in XII SLO'S	
			[SLO: C-11-C-28]	interpret the reaction of chlorine with cold and hot aqueous sodium hydroxide as disproportionation reactions	New SLO	Ambiguous	Analyse	New SLO not mentiones in XII SLO'S	
[SLO: C-11-C-29]	Explain the use of chlorine in water purification, including the production of the active species HOCl and ClO ⁻ which kill bacteria.	New SLO		Understand	New SLO not mentiones in XII SLO'S				

<p>Describe the reactivity of nitrogen and sulfur compounds.</p> <p>Describe the major chemical reactions and products involving nitrogen and sulfur.</p> <p>Discuss the environmental effects of nitrogen and sulfur compounds.</p> <p>Explain the differences between nitrification and denitrification.</p> <p>Describe the industrial processes for the production of nitrates and sulfates.</p>	<p>Benchmark 1: Describe the reactivity of Nitrogen and Sulphur and the properties of their compounds in addition to their reactions and roles in our environment.</p>	<p>Nitrogen and Sulfur</p>	[SLO: C-11-C-30]	Explain the lack of reactivity of nitrogen due to its triple bond strength and lack of polarity	New SLO	Ambiguous	Understand	New SLO not mentioned in XII SLO'S
			[SLO: C-11-C-31]	Describe the basicity of ammonia using the Brønsted–Lowry theory	Matched SLO		Understand	Mentioned in current SLO'S OF XI acid base and salt chapter
			[SLO: C-11-C-32]	Identify the structure of the ammonium ion and explain how it is formed by an acid-base reaction	Matched SLO		Understand	Mentioned in current SLO'S OF XI acid base and salt chapter
			[SLO: C-11-C-33]	Describe how ammonia can be displaced from ammonium salts through acid-base reactions	Matched SLO		Understand	Mentioned in current SLO'S OF XI acid base and salt chapter
			[SLO: C-11-C-34]	Describe the natural and man-made occurrences of oxides of nitrogen and their catalytic removal from exhaust gases of internal combustion engines	New SLO		Understand	New SLO not mentioned in XII SLO'S
			[SLO: C-11-C-35]	Explain the role of NO and NO ₂ in the formation of photochemical smog, specifically in the reaction with unburned hydrocarbons to form peroxyacetyl nitrate (PAN)	New SLO		Understand	New SLO not mentioned in XII SLO'S
			[SLO: C-11-C-36]	Differentiate between nitrification and denitrification	New SLO	Ambiguous	Analyse	New SLO not mentioned in XII SLO'S
			[SLO: C-11-C-37]	Explain the lack of reactivity of sulfur, with reference to its bonding and stability of its compounds.	New SLO	Ambiguous	Understand	New SLO not mentioned in XII SLO'S
			[SLO: C-11-C-38]	Describe the different oxidation states of sulfur and their relative stability.	New SLO	Ambiguous	Understand	New SLO not mentioned in XII SLO'S
			[SLO: C-11-C-39]	Describe the properties and uses of sulfuric acid, including its production and industrial applications.	Grade 12 SLO		Understand	Already present in current XII SLO'S
[SLO: C-11-C-40]	describe the chemical reactions and processes involving sulfur, such as combustion and oxidation.	New SLO		Understand	New SLO not mentioned in XII SLO'S			
[SLO: C-11-C-41]	Explain the uses of sulfur compounds in industry and everyday life, such as in fertilizers, gunpowder and rubber, and in the Synthetic organic chemistry, including the synthesis of dyes, drugs and fragrances.	New SLO	Repetitive (within same learning level)	Understand	New SLO not mentioned in XII SLO'S			

Environmental Chemistry

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

Benchmark 1: Evaluate the impact of various pollutants on the environment and life and describe possible solutions to mitigate these impacts.

Atmosphere

[SLO: C-11-D-01]

[SLO: C-11-D-02]

[SLO: C-11-D-03]

[SLO: C-11-D-04]

[SLO: C-11-D-05]

[SLO: C-11-D-06]

[SLO: C-11-D-07]

[SLO: C-11-D-08]

[SLO: C-11-D-09]

[SLO: C-11-D-10]

[SLO: C-11-D-11]

[SLO: C-11-D-12]

[SLO: C-11-D-13]

[SLO: C-11-D-14]

Identify the properties and composition of the atmosphere. (Include the concepts of 4 layers of atmosphere and their composition)

Describe the factors that affect air quality

Describe the sources and understand the effects of air pollution, (This can include both natural and human-caused pollutants including Ozone (O₃), Lead (Pb), Mercury (Hg), Polycyclic aromatic hydrocarbons (PAHs), Persistent organic pollutants (POPs), Greenhouse gases (such as carbon dioxide, methane, and nitrous oxide), Chlorofluorocarbons (CFCs) and other ozone-depleting substances, Volatile organic compounds (VOCs), Heavy metals (such as lead, mercury, and cadmium))

Familiarize with use of the methods and techniques to measure and monitor air quality

Describe the impact of human activities on the atmosphere, including the effects of burning fossil fuels and deforestation

Identify the chemical reactions and processes that occur in the atmosphere (some examples include the formation of smog and acid rain)

Identify laws and regulations related to air quality and the measures used to control air pollution

analyze data and interpret air quality measurements and trends

Explain the link between air quality and human health

evaluate the potential health risks associated with air pollution

Explain the technologies and strategies used to reduce air pollution and improve air quality, such as emissions control and renewable energy sources.

Design experiments and collect data to test hypotheses about air quality

Identify with the global scale problems of air pollution, such as global warming and the greenhouse effect.

Analyze the economic, social and political issues related to air pollution and air quality management and demonstrate through answers.

Modified(rephrased) SLO	Repetitive (within same learning level)	Understand	X CLASS CURRENT SLO'S
Modified(rephrased) SLO	Repetitive (within same learning level)	Understand	X CLASS CURRENT SLO'S
Modified(rephrased) SLO	Repetitive (within same learning level)	Understand	X CLASS CURRENT SLO'S
New SLO		Understand	New SLO'S
Modified(rephrased) SLO	Repetitive (within same learning level)	Understand	X CLASS CURRENT SLO'S
Modified (Split) SLO	Repetitive (within same learning level)	Understand	X CLASS CURRENT SLO'S
New SLO		Understand	New SLO'S
New SLO		Analyse	New SLO'S
New SLO		Understand	New SLO'S
New SLO		Understand	New SLO'S
Modified(rephrased) SLO		Understand	X CLASS CURRENT SLO'S
New SLO	Not assessable in summative	Apply	New SLO
Grade 12 SLO		Understand	Current XII SLO'S Environmental chemistry
New SLO	Not assessable in summative	Analyse	New SLO

	<p>Describe the properties and composition of water, including its chemical and physical properties.</p> <p>Explain the sources and recycling of water on Earth, including the water cycle and groundwater.</p> <p>Discuss the effects of pollutants on water quality, including acid rain, chemical pollutants, and eutrophication.</p> <p>Apply the principles of chemical reactions to explain the formation and removal of water pollutants.</p> <p>Describe the role of water in environmental chemistry and its impact on water resources and aquatic</p>		Water	[SLO: C-11-D-15]	Identify different types of water pollution, (some examples include point source and nonpoint source pollution)	Grade 12 SLO		Understand	Current XII SLO'S Environmental chemistry
				[SLO: C-11-D-16]	Identify common water pollutants (Some examples include oil, pesticides, and heavy metals)	Grade 12 SLO		Understand	Current XII SLO'S Environmental chemistry
				[SLO: C-11-D-17]	Identify and explain the sources and effects of water pollution on human health and the environment	New SLO		Understand	New SLO
				[SLO: C-11-D-18]	Identify and explain water treatment methods and technologies, such as filtration and purification	New SLO		Understand	New SLO
				[SLO: C-11-D-19]	Explain the laws and regulations related to water pollution and conservation	New SLO	Not assessable in summative	Understand	New SLO
				[SLO: C-11-D-20]	Evaluate the impact of human activities on water resources, such as agriculture and industrial processes	Grade 12 SLO		Understand	Current XII SLO'S Environmental chemistry
				[SLO: C-11-D-21]	Explain conservation and management strategies for protecting and preserving water resources	New SLO	Not assessable in summative	Understand	New SLO
				[SLO: C-11-D-22]	Explain the chemical properties of water and how they relate to water quality and pollution.	New SLO	Not assessable in summative	Understand	New SLO
Organic Chemistry	<p>Basics of organic chemistry (catenation, isomerism, nomenclature, functional groups, homologous series)</p> <p>Students should be able to: 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</p>	Benchmark 1: Analyze the chemical and physical properties of organic compounds based on their functional groups and be acquainted with the structures and terminology of different compounds and organic mechanisms.	Basics of organic chemistry	[SLO: C-11-E-01]	Recognize that hydrocarbons are compounds made up of C and H atoms only	Modified(rephrased) SLO	Repetitive (within same learning level)	Understand	Current X and XII SLO'S
				[SLO: C-11-E-02]	Recognize that alkanes are simple hydrocarbons with no functional group	Modified(rephrased) SLO	Repetitive (within same learning level)	Understand	Current X and XII SLO'S
				[SLO: C-11-E-03]	Recognize that compounds contain a functional group which dictates their physical and chemical properties	Modified(rephrased) SLO	Repetitive (within same learning level)	Understand	Current X and XII SLO'S

				[SLO: C-11-E-18]	Describe the mechanism of free radical substitution in alkanes exemplified by methane and ethane.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-19]	Identify organic redox reactions.	New SLO	Ambiguous	Understand	New SLO'S
				[SLO: C-11-E-20]	Explain the nomenclature of alkenes.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-21]	Explain shape of ethene molecule in terms of π and σ C-C bonds.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-22]	Describe the structure and reactivity of alkenes as exemplified by ethene.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-23]	explain with suitable examples the terms isomerism, stereoisomerism and structural isomerism.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-24]	Explain dehydration of alcohols and dehydrohalogenation of RX for the preparation of ethene.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-25]	Describe the chemistry of alkenes by the following reactions of ethene: hydrogenation, hydrohalogenation, hydration, halogenation, halohydrate, epoxidation, ozonolysis, polymerization.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-26]	Explain the concept of conjugation in alkenes having alternate double bonds.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-27]	Use the IUPAC naming system for alkenes.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-28]	Describe the mechanism of electrophilic addition in alkenes, using bromine / ethene and hydrogen bromide /propene as examples	New SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-29]	explain the inductive effects of alkyl groups on the stability of primary, secondary and tertiary cations formed during electrophilic addition (this should be used to explain Markovnikov addition)	Grade 12 SLO		Understand	Current XII SLO'S
	Explain the Synthesis of halogenoalkanes and their classifications based on their molecular structure. Describe the common reactions of halogenoalkanes, including elimination reactions and substitutions, with a focus on SN1 and SN2 substitution mechanisms. Predict the reactivity of halogenoalkanes based on their molecular structure and the reaction conditions. Describe simple halogenoalkane syntheses and explain the organic functional groups involved in the reactions. Analyze the mechanisms and products of	Benchmark 1: Explain the reactions by which Halogenoalkane and halogenoarenes are produced and the chemical reactions of these compounds.	Halogenoalkanes	[SLO: C-11-E-30]	Classify halogenoalkanes based on the type of halogen atom and its position in the carbon chain, and explain how the molecular structure affects their reactivity.	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-31]	Explain the organic functional groups involved in a simple halogenoalkane synthesis, and predict the major product(s) based on the reaction conditions. (this includes: a) the free-radical substitution of alkanes by Cl or Br in the presence of ultraviolet light, as exemplified by the reactions of ethane b) electrophilic addition of an alkene with a halogen, X ₂ , or hydrogen halide, HX(g), at room temperature. c) substitution of an alcohol, e.g. by reaction with HX or KBr with H ₂ SO ₄ or H ₃ PO ₄ ; or with PCl ₃ and heat; or with PCl ₅ ; or with SOCl ₂)	Grade 12 SLO		Understand	Current XII SLO'S

				[SLO: C-11-E-32]	<ul style="list-style-type: none"> describe nucleophilic substitution reactions (specifically: <ol style="list-style-type: none"> the reaction with NaOH(aq) and heat to produce an alcohol the reaction with KCN in ethanol and heat to produce a nitrile the reaction with NH₃ in ethanol heated under pressure to produce an amine the reaction with aqueous silver nitrate in ethanol as a method of identifying the halogen present as exemplified by bromoethane) 	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-33]	describe the elimination reaction with NaOH in ethanol and heat to produce an alkene as exemplified by bromoethane	Grade 12 SLO		Understand	Current XII SLO'S
<p>Describe the structure and properties of alcohols, including primary, secondary, and tertiary alcohols.</p> <p>Explain the reaction mechanisms and products of alcohol reactions, including oxidation, esterification, and dehydration.</p> <p>Discuss the applications of alcohols, including their use as solvents, fuels, and starting materials for organic synthesis.</p> <p>Apply the concepts of chemical bonding and reactivity to predict the products of alcohol reactions.</p> <p>Describe the importance of</p>	Benchmark 1: Analyze the different reactions through which different hydroxy compounds can be produced and the physical and chemical properties of corresponding alcohols.	Hydroxy Compounds	[SLO: C-11-E-34]	<p>State the reactions (reagents and conditions) by which alcohols can be produced:</p> <ol style="list-style-type: none"> electrophilic addition of steam to an alkene, H₂O(g) and H₃PO₄ catalyst reaction of alkenes with cold dilute acidified potassium manganate(VII) to form a diol substitution of a halogenoalkane using NaOH (aq) and heat reduction of an aldehyde or ketone using NaBH₄ or LiAlH₄ reduction of a carboxylic acid using LiAlH₄ hydrolysis of an ester using dilute acid or dilute alkali and heat <p>describe the reaction with oxygen (combustion) of organic hydroxy compounds</p>	Grade 12 SLO		Remember	Current XII SLO'S	
			[SLO: C-11-E-35]	Describe substitution to halogenoalkanes, e.g. by reaction with HX or KBr with H ₂ SO ₄ or H ₃ PO ₄ ; or with PCl ₅ and heat; or with PCl ₃ ; or with SOCl ₂	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-36]	Describe the reaction of hydroxy organic compounds with Na(s)	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-37]	Describe the oxidation with acidified K ₂ Cr ₂ O ₇ or acidified KMnO ₄ to: carbonyl compounds by distillation, carboxylic acids by refluxing (primary alcohols give aldehydes which can be further oxidized to carboxylic acids, secondary alcohols give ketones, tertiary alcohols cannot be oxidized)	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-38]	Describe the dehydration of alcohols to alkenes by using a heated catalyst, e.g. Al ₂ O ₃ or a concentrated acid	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-39]	Describe the formation of esters by reaction with carboxylic acids and concentrated H ₂ SO ₄ or H ₃ PO ₄ as catalyst as exemplified by ethanol	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-40]	classify alcohols as primary, secondary and tertiary alcohols, to include examples with more than one alcohol group	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-41]	state characteristic distinguishing reactions, e.g. mild oxidation with acidified K ₂ Cr ₂ O ₇ , colour change from orange to green	New SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-42]	deduce the presence of a CH ₂ CH(OH)- group in an alcohol, CH ₂ CH(OH)-R, from its reaction with alkaline I ₂ (aq) to form a yellow precipitate of tri-iodomethane and an ion, RCO ₂ ⁻	Grade 12 SLO		Analyse	Current XII SLO'S	
			[SLO: C-11-E-43]	explain the acidity of alcohols compared with water	Grade 12 SLO		Understand	Current XII SLO'S	

Describe the structure and properties of carbonyl Compounds , including their characteristic functional groups.

Explain the reaction mechanisms and products of carboxylic acid reactions, including decarboxylation, esterification, and acid-base reactions.

Discuss the applications of carboxylic acids and esters, including their use as fragrances, flavors, and starting materials for organic synthesis.

Apply the concepts of chemical bonding and reactivity to predict the products of carboxylic acid reactions.

Benchmark 1: Explain the reactions by which carboxylic acids are produced and the nature, reactions and uses of these aldehydes and ketones.

Carbonyl Compounds

[SLO: C-11-E-44]	state the reactions (reagents and conditions) by which aldehydes and ketones can be produced: a. the oxidation of primary alcohols using acidified $K_2Cr_2O_7$ or acidified $KMnO_4$ and distillation to produce aldehydes b. the oxidation of secondary alcohols using acidified $K_2Cr_2O_7$ or acidified $KMnO_4$ and distillation to produce ketones	Grade 12 SLO		Understand	Current XII SLO'S
[SLO: C-11-E-45]	describe: a. the reduction of aldehydes and ketones, using $NaBH_4$ or $LiAlH_4$ to produce alcohols b. the reaction of aldehydes and ketones with HCN , KCN as catalyst, and heat to produce hydroxynitriles exemplified by ethanal and propanone	Grade 12 SLO		Understand	Current XII SLO'S
[SLO: C-11-E-46]	describe the mechanism of the nucleophilic addition reactions of hydrogen cyanide with aldehydes and ketones	Grade 12 SLO		Understand	Current XII SLO'S
[SLO: C-11-E-47]	describe the use of 2,4-dinitrophenylhydrazine (2,4-DNPH reagent) to detect the presence of carbonyl compounds	Grade 12 SLO		Understand	Current XII SLO'S
[SLO: C-11-E-48]	deduce the nature (aldehyde or ketone) of an unknown carbonyl compound from the results of simple tests (Fehling's and Tollens' reagents; ease of oxidation)	Grade 12 SLO		Analyse	Current XII SLO'S
[SLO: C-11-E-49]	deduce the presence of a CH_3CO- group in an aldehyde or ketone, CH_3CO-R , from its reaction with alkaline $I_2(aq)$ to form a yellow precipitate of tri-iodomethane and an ion, $RCO(-)_2$	Grade 12 SLO		Analyse	Current XII SLO'S
[SLO: C-11-E-50]	recall the reactions by which carboxylic acids can be produced: a) oxidation of primary alcohols and aldehydes with acidified $K_2Cr_2O_7$ or acidified $KMnO_4$ and refluxing b) hydrolysis of nitriles with dilute acid or dilute alkali followed by acidification c) hydrolysis of esters with dilute acid or dilute alkali and heat followed by acidification	Grade 12 SLO		Remember	Current XII SLO'S

				[SLO: C-11-E-51]	<p>describe</p> <p>a. the redox reaction with reactive metals to produce a salt and H₂(g)</p> <p>b. the neutralization reaction with alkalis to produce a salt and H₂O(l)</p> <p>c. the acid–base reaction with carbonates to produce a salt and H₂O(l) and CO₂(g)</p> <p>d. esterification with alcohols with concentrated H₂SO₄ as catalyst</p> <p>e. reduction by LiAlH₄ to form a primary alcohol</p>	Grade 12 SLO		Understand	Current XII SLO'S
				[SLO: C-11-E-52]	recall the reaction (reagents and conditions) by which esters can be produced: the condensation reaction between an alcohol and a carboxylic acid with concentrated H ₂ SO ₄ as catalyst	Grade 12 SLO		Remember	Current XII SLO'S
				[SLO: C-11-E-53]	describe the hydrolysis of esters by dilute acid and by dilute alkali and heat	Grade 12 SLO		Understand	Current XII SLO'S
<p>Describe the structure and properties of nitrogen compounds, including their characteristic functional groups.</p> <p>Explain the reaction mechanisms and products of reactions with nitrogen containing compounds</p> <p>Discuss the formation of amide bonds to form amino acids</p>	Benchmark 1: Explain the classification and reactions of aliphatic and aromatic amines including their conversion to amides, forming amino acids.	Nitrogen Compounds	[SLO: C-11-E-54]	Define primary and secondary amines, and explain their basic properties and reactivity.	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-55]	Identify the differences between primary and secondary amines in terms of their structure and chemical properties.	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-56]	Describe the preparation methods of primary and secondary amines, including nucleophilic substitution reactions and reduction of nitro compounds.	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-57]	Explain the properties and reactivity of phenylamine and azo compounds, including their use as dyes and pigments.	Grade 12 SLO		Understand	Current XII SLO'S	
			[SLO: C-11-E-58]	Explain the concept of organic synthesis and functional group interconversions.	Grade 12 SLO		Understand	Current XII SLO'S, This part is break down in different chapters of organic compounds in XII current BOOK	
<p>Identify and name common organic functional groups and their physical and chemical properties.</p> <p>Demonstrate understanding of the basic mechanisms of common organic reactions of functional groups.</p> <p>Design a synthetic route for simple organic compounds using reagents and reaction conditions.</p> <p>Perform basic retrosynthetic analysis to deduce the starting materials for the synthesis of a target molecule.</p> <p>Evaluate the feasibility and efficiency of synthetic routes for the preparation of target molecules.</p>	Benchmark 1: Understand that function groups have distinct and varied reactions and how to synthesize one organic compound of a functional group from another.	Organic Synthesis	[SLO: C-11-E-59]	Identify organic functional groups using the reactions in this progression grid.	Grade 12 SLO		Understand	Current XII SLO'S, This part is break down in different chapters of organic compounds in XII current BOOK	

Empirical Data Collection and Analysis	Compare and contrast the different energy sources based on their availability, efficiency, and environmental impact.	Benchmark 2: Understand the use of different sources of energy, their properties and reusability and explain the effect of these sources on the atmosphere.	[SLO: C-11-E-60]	Predict properties and reactions of organic molecules based on functional group presence.	Grade 12 SLO		Apply	Current XII SLO'S, This part is break down in different chapters of organic compounds in XII current BOOK
			[SLO: C-11-E-61]	Devise multi-step synthetic routes for preparing organic molecules..	New SLO	Ambiguous	Analyse	This SLO'S Can be implemented in a longer run
			[SLO: C-11-E-62]	Analyze a given synthetic route in terms of type of reaction and reagents used for each step of it, and possible by-products.	Grade 12 SLO	Ambiguous	Analyse	This SLO'S Can be implemented in a longer run
			[SLO: C-11-E-63]	Explain the concept of retro-synthesis and its application in organic synthesis.	New SLO	Ambiguous	Understand	This SLO'S Can be implemented in a longer run
	Analyze the extraction, processing, and utilization of fossil fuels, including their effects on the environment and human health.	Energy	[SLO: C-11-F-01]	differentiate between the difference between petrochemical and chemicals derived from them,	Grade 12 SLO	Ambiguous	Analyse	Current XII SLO's
			[SLO: C-11-F-02]	identify the various raw materials for the petrochemical industry.	Grade 12 SLO	Ambiguous	Understand	Current XII SLO's
			[SLO: C-11-F-03]	Explain the process of fractional distillation and refining of petroleum, and identify the important fractions.	Grade 12 SLO	Ambiguous	Understand	Current XII SLO's
			[SLO: C-11-F-04]	Describe the basic building block processes in petrochemical technology, and explain the petrochemical process technology.	Grade 12 SLO	Not assessable in summative	Understand	Current XII SLO's
			[SLO: C-11-F-05]	List some major petrochemicals, and understand the importance of petrochemicals in the modern world.	New SLO		Understand	NEW SLO'S BUT ASSESSIBLE
			[SLO: C-11-F-06]	Distinguish between energy density and specific energy of different energy sources, and explain the efficiency of energy transfer.	New SLO		Analyse	NEW SLO'S BUT ASSESSIBLE
			[SLO: C-11-F-07]	Explain the formation, properties, and uses of fossil fuels, and the importance of fossil fuels in the modern world.	New SLO		Understand	Some information about the topic is in X SLO'S
Evaluate the advantages and disadvantages of nuclear energy, including the impact on the environment and safety concerns.	Energy	[SLO: C-11-F-08]	Explain the mechanism and importance of nuclear fusion and fission, and explain the importance of nuclear energy in the modern world.	New SLO		Understand	Some information about the topic is in X SLO'S	
		[SLO: C-11-F-09]	Explain the importance and mechanism of solar energy and its importance as a source of renewable energy in the modern world.	New SLO	Repetitive (within same learning level)	Understand	related with environmental chemistry and energetic	
		[SLO: C-11-F-10]	Explain the environmental impact of energy consumption, particularly in relation to global warming and its relation to the importance of reducing carbon footprint and moving towards sustainable energy sources.	New SLO	Repetitive (within same learning level)	Understand	Related with environmental chemistry	
		[SLO: C-11-F-11]	Apply knowledge of energy sources and their properties to critically evaluate the advantages and disadvantages of different energy sources and make informed decisions about energy consumption.	New SLO	Ambiguous	Apply	NEW SLO'S	
Evaluate the potential of solar energy as a sustainable source of energy and analyze the feasibility of its implementation.	Energy	[SLO: C-11-F-11]	Apply knowledge of energy sources and their properties to critically evaluate the advantages and disadvantages of different energy sources and make informed decisions about energy consumption.	New SLO	Ambiguous	Apply	NEW SLO'S	

Lab and Practical Skills

<p>Students should be able to demonstrate knowledge of how to select and safely use techniques, apparatus and materials</p> <p>Students should be able to plan and carry out experiments and investigations.</p> <p>Students should be able to make and record observations and measurements.</p>	<p>Benchmark 1: Students should be able to identify and take safety measures required to conduct experiments.</p>	<p>practically perform chemical experiments</p>	[SLO: C-11-G-01]	Identify the chemical hazards in the lab in context of the experiment being conducted.	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-02]	Test that the equipment is working properly without any potential risk of injury before conducting an experiment.	New SLO	Not assessable in summative	Remember	General instruction of lab work		
			[SLO: C-11-G-03]	Ensure that work space for conducting the experiment is not crowded with apparatus as to be hazardous	New SLO	Not assessable in summative	Remember	General instruction of lab work		
			[SLO: C-11-G-04]	Ensure that safe distance is kept at all times from other investigators who may be handling lab apparatus	New SLO	Not assessable in summative	Remember	General instruction of lab work		
			[SLO: C-11-G-05]	Identify what potential bodily harm could occur from physical, chemical, biological and safety hazards in the context of the experiment being conducted	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-06]	Recognise that it is always better to ask for help from the lab instructor when unsure of how to use new apparatus	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-07]	Identify the proper waste disposal system for chemicals being used.	New SLO		Understand	General instruction of lab work		
	<p>Benchmark I: Collect data under instructor supervision while ensuring quality of measurement and observation</p>	<p>practically perform chemical experiments</p>	[SLO: C-11-G-08]	set up apparatus following instructions given in written or diagrammatic form.	New SLO	Not assessable in summative	Understand	lab protocols		
			[SLO: C-11-G-09]	use apparatus to collect an appropriate quantity of data	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-10]	make observations, including subtle differences in colour, solubility or quantity of materials	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-11]	make measurements using pipettes, burettes, measuring cylinders, thermometers and other common laboratory apparatus;	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-12]	decide how many tests or observations to perform	New SLO	Repetitive (within same learning level)	Analyse	General instruction of lab work		
			[SLO: C-11-G-13]	identify where repeated readings or observations are appropriate	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-14]	replicate readings or observations as necessary, including where an anomaly is suspected	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-15]	identify where confirmatory tests are appropriate and the nature of such tests	New SLO	Not assessable in summative	Understand	General instruction of lab work		
			[SLO: C-11-G-16]	select reagents to distinguish between given ions.	New SLO	Not assessable in summative	Remember	General instruction of lab work		
			[SLO: C-11-G-17]	Carry out procedures using simple apparatus, in situations where the method may not be familiar to the candidate	New SLO	Not assessable in summative	Apply	General instruction of lab work		
			<p>ACID BASE TITRATION</p>	[SLO: C-11-G-18]	<ul style="list-style-type: none"> • Describe an acid–base titration to include the use of a: <ul style="list-style-type: none"> a. burette b. volumetric pipette c. suitable indicator 	Matched SLO			Understand	titration practical already included in XI PRACTICAL SLO'S
				<p>Identification of ions and gases</p>	[SLO: C-11-G-19]	Describe how to identify the end-point of a titration using an indicator	Matched SLO			Understand

Interpret mass spectra and identify isotopes based on their m/e values and relative abundances

Determine the atomic mass of an element from its isotopic composition and mass spectrum

Analyze the molecular mass of organic compounds by analyzing the molecular ion peak in a mass spectrum

Predict the identity of fragmented molecules in a given mass spectrum

Determine the number of carbon atoms in a compound using the M⁺ peak and the formula $n = (1.1 \times \text{abundance of } M^+ \text{ ion})$

Benchmark I: Students should be able to present data in a meaningful way and be able to interpret it.

Data representation and analysis

[SLO: C-11-G-20]	<ul style="list-style-type: none"> Describe tests to identify the anions: <ol style="list-style-type: none"> carbonate by reaction with dilute acid and then testing for carbon dioxide gas chloride, bromide and iodide, by acidifying with dilute nitric acid then adding aqueous silver nitrate nitrate by reduction with aluminum foil and aqueous sodium hydroxide and then testing for ammonia gas sulfate by acidifying with dilute nitric acid then adding aqueous barium nitrate sulfite by reaction with acidified aqueous potassium manganate(VII) 	Grade 12 SLO		Understand	Identification of ion currently available in XII SLO'S salt analysis
[SLO: C-11-G-21]	<ul style="list-style-type: none"> Describe tests using aqueous sodium hydroxide and aqueous ammonia to identify the aqueous cations: <ol style="list-style-type: none"> aluminum, Al³⁺ ammonium, NH₄⁺ (post script) calcium, Ca²⁺ chromium(III), Cr³⁺ copper(II), Cu²⁺ iron(II), Fe²⁺ iron(III), Fe³⁺ zinc, Zn²⁺ 	Grade 12 SLO		Understand	Identification of ion currently available in XII SLO'S salt analysis
[SLO: C-11-G-22]	<ul style="list-style-type: none"> present numerical data, values or observations in a single table of results with headings and units that conform to accepted scientific conventions 	Matched SLO		Apply	DATA REPRESENTATION AND CALCULATION
[SLO: C-11-G-22]	<ul style="list-style-type: none"> record raw readings of a quantity to the same degree of precision and observations to the same level of detail 	Matched SLO		Apply	DATA REPRESENTATION AND CALCULATION
[SLO: C-11-G-23]	<ul style="list-style-type: none"> show working in calculations and key steps in reasoning 	Matched SLO		Apply	DATA REPRESENTATION AND CALCULATION
[SLO: C-11-G-24]	<ul style="list-style-type: none"> use the correct number of significant figures for calculated quantities 	Matched SLO		Apply	DATA REPRESENTATION AND CALCULATION
[SLO: C-11-G-25]	<ul style="list-style-type: none"> draw an appropriate table in advance of taking readings or making observations and record all data in the table 	Matched SLO		Apply	DATA REPRESENTATION AND CALCULATION

Students should be able to evaluate methods and suggest possible improvements.	Benchmark I: Students should be able to evaluate the method used and suggest improvements based on validity, reliability and safety.		[SLO: C-11-G-26]	• use the appropriate presentation method to produce a clear presentation of the data,	Matched SLO		Apply	DATA REPRESENTATION AND CALCULATION
			[SLO: C-11-G-27]	• plot appropriate variables on appropriate, clearly labelled x- and y-axes with carefully chosen scales	New SLO		Apply	DATA REPRESENTATION AND CALCULATION
			[SLO: C-11-G-28]	draw straight lines or smooth curves of best fit to show the trend of a graph;	New SLO		Apply	DATA REPRESENTATION AND CALCULATION
			[SLO: C-11-G-29]	describe the patterns and trends shown by data in tables and graphs	New SLO		Apply	DATA REPRESENTATION AND CALCULATION
			[SLO: C-11-G-30]	describe and summarise the key points of a set of observations	Matched SLO		Apply	DATA REPRESENTATION AND CALCULATION
			[SLO: C-11-G-31]	• determine the gradient of a straight-line graph and extrapolate the line of a graph.	New SLO		Apply	DATA REPRESENTATION AND CALCULATION
			[SLO: C-11-G-32]	• draw conclusions from an experiment, giving an outline description of the main features of the data, considering whether experimental data support a given hypothesis, and making further predictions	New SLO		Analyse	DATA REPRESENTATION AND CALCULATION
			[SLO: C-11-G-33]	• draw conclusions from interpretations of observations, data and calculated values	New SLO	Not assessable in summative	Evaluate	DATA REPRESENTATION AND CALCULATION
			[SLO: C-11-G-34]	• make scientific explanations of data, observations and conclusions that they have described.	New SLO		Analyse	DATA REPRESENTATION AND CALCULATION
	suggest improvements based on validity, reliability and safety.	[SLO: C-11-G-35]	Analyse intrinsic errors in measuring device	New SLO	Ambiguous	Analyse	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-36]	Describe systematic errors	New SLO		Understand	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-37]	identify the most significant sources of error in an experiment	New SLO	Ambiguous	Understand	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-38]	• state the uncertainty in a quantitative measurement and express such uncertainty in a measurement as an actual or percentage error	New SLO	Ambiguous	Understand	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-39]	Analyse the limitations of the experimental design and propose appropriate modifications that will improve the accuracy of the experiment	New SLO	Ambiguous	Analyse	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-40]	evaluate the validity of the methods used	New SLO	Ambiguous	Understand	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-41]	explain improvements or extensions to the methods used	New SLO	Ambiguous	Understand	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-42]	apply scientific language effectively	New SLO	Ambiguous	Apply	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-43]	document the work of others and sources of information used	New SLO	Ambiguous	Apply	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-44]	suggest ways in which to extend the investigation to answer a new question.	New SLO	Ambiguous	Analyse	DATA REPRESENTATION AND CALCULATION	
		[SLO: C-11-G-45]	Suggest alternate chemicals in experimental design which contribute to green chemistry	New SLO	Ambiguous	Analyse	DATA REPRESENTATION AND CALCULATION	