# Grade 10

| Domain | Standards | Benchmarks | Topic | NC SLO # | SLO | Status of SLOs | SLOs for | Cognitive Domain |
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| **Domain A: Nature of Science in Chemistry** | Standard:<br>Students wil **demonstrate an understanding,** skill and attitude to deal in the areas of chemistry as an introduction to chemistry. | Benchmark 1:<br>Students can **describe the history** of chemistry, including major contributors and key developments in the field. | **History of Chemistry** | SLO: C-10-A-01 | **Justify, with examples,** that to do science is to be involved in a community of inquiry.<br>(For context in Chemistry:<br>- This community adheres to certain common principles, methodologies, and processes, such as the use of empirical evidence and logical reasoning to develop scientific theories. For example, chemists based their research on the assumptions of conservation of mass and energy and use this to verify whether their calculations and findings are sensible.<br>- Scientists in different fields often share similar methodologies, such as the use of controlled experiments and the peer review process. The scientific community also values objectivity and skepticism, which are essential for ensuring the accuracy and validity of scientific findings). | New SLO | | Understand |
| | | | | SLO: C-10-A-02 | **Explain, with examples,** that a 'scientific paradigm' is a theoretical model of how nature works<br>(Some examples include:<br>- The belief that materials that burn do so because a material called 'phlogiston' was the paradigm in chemistry in the 18th century<br>- Historical models of the atom are paradigms, such as the 'plum-pudding' and the Rutherford models of the atom<br>- The periodic table of elements, and belief in the 'periodicity' of atoms based on the arrangements of their electrons is a paradigm<br>Scientific paradigms in chemistry provide a framework for understanding the properties of materials and developing new materials with specific properties. Overall, scientific paradigms in chemistry guide research and development in the field, and help scientists to better understand the behavior of chemicals and their interactions.) | New SLO | | Understand |

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| | Standard:<br>Students should be able to **explain and evaluate**, with examples, what philosophical assumptions underpin the practice of science | Benchmark I:<br>Students should able to:<br>**identify** common sources of argumentative fallacies<br>**explain** the broad schools of thought about the relationship between chemistry and the nature of knowledge<br>**give examples** of ethical dilemmas that emerge from research and practice of science<br>**explain** the broad schools of thought about how science is distinguished from other fields of inquiry | **Philisophy of Science** | SLO: C-10-A-03 | **Explain, with examples,** how scientists speak of "levels of confidence"<br>(or uncertainty) when discussing experimental outcomes. | New SLO | | Analyse |
| | | | | SLO: C-10-A-04 | **Explain the difference** between repeatability and reproducibility in chemistry.<br>(For context:<br>- repeatability as the idea that scientific results from experiments should be possible to verify by conducting the experiment again under the same physical conditions.<br>- reproducibility as the idea that the same or similar result is obtained when the measurement is made under either different conditions or by a different method or in a different experiment.) | New SLO | | Understand |

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| **Domain B: Physical Chemistry** | Standard:<br>Students should be able to:<br>**Define** matter and describe its physical and chemical properties.<br>**Describe** the structure of atoms and their role in the properties of matter.<br>**Classify** matter as elements, compounds, or mixtures, and explain the characteristics that define each type.<br>**Discuss** the behavior of matter at the macroscopic and microscopic levels, including the kinetic molecular theory and phase changes.<br>**Apply** the mole concept to chemical calculations, including stoichiometry and chemical reactions. | Benchmark 2:<br>Students can **understand** the states of matter and phase changes, and can explain the impact of temperature and pressure on matter. | **Matter** | SLO: C-10-B-01 | **Explain** changes of state and internal energy without change in temperature(melting, boiling, freezing, condensation, sublimation and deposition) in terms of kinetic particle theory. | Grade 9 SLO | | Understand |
| | | | | SLO: C-10-B-02 | **Distinguish** between evaporation and boiling. | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-B-03 | **Interpret** heating and cooling curves in terms of kinetic theory | Grade 9 SLO | | Remember |
| | | | | SLO: C-10-B-04 | **Interpret** in terms of kinetic particle theory the effects of changing pressure, temperature and volume of a gas on the other two with regards to Boyle's law, Charles' Law, and Avogadro's Law. | Grade 9 SLO | | Remember |

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| | | | | SLO: C-10-B-05 | **Explain** qualitatively the effect of external pressure on rate of boiling and evaporation | Grade 9 SLO | | Understand |
| | | | | SLO: C-10-B-06 | **Explain** diffusion of gases in terms of kinetic particle theory. | Grade 9 SLO | | Understand |
| | | | | SLO: C-10-B-07 | **Examine** qualitatively the effect of molecular mass and temperature on the rate of diffusion | Grade 9 SLO | | Analyse |
| | | | | SLO: C-10-B-08 | **Discuss** applications of sublimation around us.<br>(Examples may include: solid air fresheners and 3D printing) | Grade 9 SLO | | Understand |
| | | | | SLO: C-10-B-09 | **Explain**, with the help of kinetic particle theory, the importance of rates of diffusion of medicines in the body | Grade 9 SLO | | Understand |
| | Standard:<br>Students should be able to:<br>**Explain** the mole concept and its application in chemical calculations, including stoichiometry.<br>**Apply** the law of conservation of mass to predict the quantities of reactants and products in chemical reactions.<br>**Constructing** chemical equations and understanding the balancing of these chemical equations.<br>**Use** stoichiometry to calculate the amount of reactants and products in a chemical reaction.<br>**Describe** the relationship between moles, mass, and volume, and apply this relationship to stoichiometric calculations. | Benchmark 1:<br>Students should be able to balance chemical equations and perform stoichiometry calculations using the mole concept. | **Stoichiometry** | SLO: C-10-B-10 | **Use** the molar gas volume, 24 dm3 at room temperature and pressure, in calculations involving gases | Grade 9 SLO | | Apply |

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| | | | | SLO: C-10-B-11 | **Define** concentration, use both g/dm3 and mol/dm3, and convert between them | Grade 9 SLO | | Remember |
| | | | | SLO: C-10-B-12 | **Calculate** stoichiometric relationships between substances relationships<br>(specifically:<br>● reacting masses, limiting reactants,<br>● volume of gasses at r.t.p.,<br>● volumes of solution and concentrations of solutions in g/dm3 or mol/dm3, including conversion between cm and dm3) | Grade 9 SLO | | Apply |
| | | | | SLO: C-10-B-13 | **calculate** concentration of a solution in a titration using empirical data | Grade 9 SLO | | Apply |
| | | | | SLO: C-10-B-14 | **Calculate** empirical formula and molecular formula from appropriate data | Grade 9 SLO | | Apply |
| | | | | SLO: C-10-B-15 | **Calculate** percentage yield, percentage composition by mass and percentage purity from appropriate data | Grade 9 SLO | | Apply |
| | Standard:<br>Students should be able to:<br>**Describe** the principles of electrochemistry, including the movement of electrons in terms of oxidation and reduction in a chemical reaction.<br>**Explain** the concept of oxidation and reduction, including the role of electrons in these processes.<br>**Describe** the process of electrolysis and its applications.<br>**Discuss** the relationship between electricity and chemical reactions, including the use of electrodes and electrolytes.<br>**Apply** the principles of electrochemistry to explain the behavior of batteries, fuel cells, and other electrochemical devices. | Benchmark 1:<br>Students should be able to **describe** the principles of electricity and electrochemistry, including redox reactions, oxidation and reduction, and the behavior of electrolytes. | **Electrochemistry** | SLO: C-10-B-16 | **Define** electrolysis as decomposition of ionic compound, in molten or aqueous solution, by passage of electric current | Modified(rephrased) SLO | | Remember |

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| | | | | SLO: C-10-B-17 | **Identify** and label in simple electrolytic cells, the anode (+), cathode (-), electrolyte and direction of flow of electrons in external circuit, | Modified (Split) SLO | | Remember |
| | | | | SLO: C-10-B-18 | **Describe** the transfer of charge in external circuit, movement of ions in the electrolyte and transfer of electrons at electrodes | Modified (Split) SLO | | Understand |
| | | | | SLO: C-10-B-19 | **Identify** the products formed at electrodes and describe the observations made during the electrolysis of molten lead(II) chloride, concentrated aqueous sodium chloride, dilute sulfuric acid using inert electrodes (platinum or carbon/graphite) | Modified (Split) SLO | | Understand |
| | | | | SLO: C-10-B-20 | **State** that hydrogen-oxygen fuel cell uses hydrogen and oxygen to produce electricity with water as the only chemical product | New SLO | | Remember |
| | | | | SLO: C-10-B-21 | **Describe** the advantages and disadvantages of using hydrogen–oxygen fuel cells in comparison with gasoline /petrol engines in vehicles | New SLO | | Understand |

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| | | Benchmark 2: 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 batteries, corrosion, and electroplating. | | SLO: C-10-B-22 | **Identify** the products formed at electrodes and describe the observations made during the electrolysis of dilute copper(II) sulfate using inert electrode or copper electrode | New SLO | | Understand |
| | | | | SLO: C-10-B-23 | **Predict** the identity of products of electrolysis of a halide compound in dilute or concentrated solution l | New SLO | | Analyse |
| | | | | SLO: C-10-B-24 | **Construct** ionic half-equations for reaction at either electrode. | New SLO | | Apply |
| | | | | SLO: C-10-B-25 | **Describe** electroplating and its **applications**. | New SLO | | Understand |
| | | | | SLO: C-10-B-26 | **Sketch** a schematic diagram for a voltaic cell e.g. Daniel cell | Matched SLO | | Apply |
| | | | | SLO: C-10-B-27 | **Use** the voltage data given for voltaic cells to **determine** order of reactivity of any two metals | Modified(rephrased) SLO | | Apply |
| | Standard:<br>Students should be able to:<br>**Describe** the nature of chemical reactions, including the activation energy and rate of reaction.<br>**Explain the factors** that affect the rate of reaction, including temperature, concentration, surface area, and catalysts.<br>**Discuss the mathematical models** used to describe reaction kinetics, including rate laws and rate constants. | Benchmark 1: Students should **apply** the principles of reaction kinetics to analyze and predict the rate of chemical reactions, including the effect of changing conditions on reaction rate. | Reaction Kinetics | SLO: C-10-B-28 | **Describe** collision theory in terms of number of particles per unit volume, frequency of collisions of particles, kinetic energy of particles and activation energy | New SLO | | Understand |
| | | | | SLO: C-10-B-29 | **State** that catalyst increases the rate of reaction, provides alternate pathway with lower activation energy, and remains unchanged at the end of a reaction | New SLO | | Remember |

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| | | | | SLO: C-10-B-30 | **Describe** the physical parameters that may be **affected** by the rate of, reaction including change in mass, temperature, and formation of gas | New SLO | | Understand |
| | | | | SLO: C-10-B-31 | **Interpret** data, including graphs, for **investigating** rate of reaction | New SLO | | Understand |
| | | Benchmark 2: Students can **describe the factors** that influence the rate of chemical reactions, including concentration, temperature, and catalysts, and how these factors affect the activation energy. | | SLO: C-10-B-32 | **explain the effect** on rate of reaction of changing concentration of a reactant, pressure of gases, surface area of solids, temperature, presence of catalyst (including enzymes) using collision theory | New SLO | | Understand |
| | | | | SLO: C-10-B-33 | **Justify the importance** of chemical kinetics in the food industry to determine ideal harvesting and transportation times for produce. | New SLO | | Understand |
| | Standard:<br>Students should be able to:<br>**Describe** the nature of salts, including their formation from the reaction of acids and bases.<br>**Explain** the concept of ionic compounds, including the arrangement of ions in a crystal lattice.<br>**Discuss** the properties of salts, including solubility, conductivity, and melting point.<br>**Apply** the principles of chemical bonding to explain the behavior of salts in different physical states.<br>**Describe** the role of salts in chemical reactions, including their effect on acid-base equilibria. | Benchmark 1: Students will be able to **differentiate** between different types of salts based on their properties and solubility. | **Salts** | SLO: C-10-B-34 | **Explain** that salts are ionic compounds formed due to electrostatic attraction between oppositely charged ions (in which the positive ions come from bases and negative ions come from acids) | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-B-35 | **Explain** why at STP salts are solids with high melting points. | New SLO | | Understand |
| | | | | SLO: C-10-B-36 | **Describe** that under normal conditions, ionic compounds are usually solids with lattice structures. | New SLO | | Understand |
| | | | | SLO: C-10-B-37 | **Explain** why the molten and aqueous solutions of salts are good conductors of electricity by making reference to the idea of mobile ions | New SLO | | Understand |

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| | | | | SLO: C-10-B-38 | **Describe** the general solubility rules for salts.<br>(these are:<br>a. sodium, nitrate, potassium and ammonium salts are soluble<br>b. chlorides are soluble except lead and silver<br>c. carbonates are insoluble except sodium, potassium and ammonium<br>d. hydroxides are insoluble except sodium, potassium, ammonium and calcium (partially) ) | New SLO | | Understand |
| | | | | SLO: C-10-B-39 | **Describe** the preparation, separation and purification of soluble salts by reactions of acids with alkali (titration), excess metal, excess insoluble base, excess insoluble carbonate | New SLO | | Understand |
| **Domain C: Inorganic Chemistry** | Standard:<br>Students should be able to:<br>Describe the group properties of elements, including their electron configurations and reactivity.<br>Explain the trends in reactivity, size, and electronegativity of elements within a group.<br>Discuss the chemical behavior of elements in different oxidation states and their role in chemical reactions.<br>Apply the concepts of electron configuration and electron transfer to explain the reactivity of elements.<br>Describe the properties and applications of elements in different groups, including the alkali metals, alkaline earth metals, halogens, and noble gases. | Benchmark 1:<br>The students will be able to **explain the 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. | **Group Properties and Elements** | **Nitrogen and Sulfur**<br>SLO: C-10-C-01 | **Recognize** that atmospheric oxides of nitrogen (NO and NO2) can react with unburned hydrocarbons to form peroxyacetyl nitrate, PAN, which is a component of photochemical smog | New SLO | | Remember |
| | | | | SLO: C-10-C-02 | **Describe the role** of NO and NO2 in the formation of acid rain both directly and in their catalytic role in the oxidation of atmospheric sulfur dioxide | New SLO | | Understand |
| | | | | SLO: C-10-C-03 | **State** the symbol equation for the production of ammonia in the Haber process, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ | New SLO | | Remember |
| | | | | SLO: C-10-C-04 | **State** the sources of the hydrogen (methane) and nitrogen (air) in the Haber process | Modified(rephrased) SLO | | Remember |
| | | | | SLO: C-10-C-05 | **State** the typical conditions in the Haber process as 450°C, 20000kPa /20 atm and an iron catalyst | Modified(rephrased) SLO | | Remember |

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| | | | | SLO: C-10-C-06 | **State** the symbol equation for the conversion of sulfur dioxide to sulfur trioxide in the Contact process, $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ | New SLO | | Remember |
| | | | | SLO: C-10-C-07 | **State** the sources of the sulfur dioxide (burning sulfur or roasting sulfide ores) and oxygen (air) in the Contact process | New SLO | | Remember |
| | | | | SLO: C-10-C-08 | **State** the typical conditions for the conversion of sulfur dioxide to sulfur trioxide in the Contact process as 450°C, 200kPa /atm and a vanadium(V) oxide catalyst | New SLO | | Remember |
| | | | | **Oxides**<br>SLO: C-10-C-09 | **Describe** amphoteric oxides as oxides that react with acids and bases to produce a salt and water | New SLO | | Remember |
| | | | | SLO: C-10-C-10 | **Classify** oxides as acidic, including $SO_2$ and $CO_2$, basic, including CuO and CaO, or amphoteric, limited to $Al_2O_3$ and ZnO, related to metallic and non-metallic character | New SLO | | Understand |
| | | | | **Properties of Metals**<br>SLO: C-10-C-11 | **Identify** the general chemical properties of metals, limited to their reactions with dilute acids, coldwater,steam and oxygen. | New SLO | | Remember |
| | | | | SLO: C-10-C-12 | **Arrange** metals in order of reactivity given relevant information | New SLO | | Understand |
| **Domain E: Organic Chemistry** | Standard:<br>Students should be able to:<br>**Describe** the concept of catenation, including the ability of carbon atoms to bond with each other to form complex structures.<br>**Explain** the concept of isomerism in organic compounds, including structural and stereoisomers.<br>**Discuss** the systematic nomenclature of organic compounds, including IUPAC rules.<br>**Describe** the functional groups in organic compounds, including alcohols, carboxylic acids, amines, and aldehydes.<br>**Explain** the concept of homologous series, including the similarity in properties and reactivity among members of a series.<br>**Apply** the knowledge of the properties of organic | Benchmark 1:<br>**Recognize and classify** organic compounds based on their functional groups, nomenclature, isomerism, and homologous series. | **Basics of organic chemistry (catenation, isomerism, nomenclature, functional groups, homologous series)** | SLO: C-10-E-01 | **Name and draw** the structural and displayed formulae of unbranched alkanes, alkenes, alcohols, and carboxylic acids. (Include but-1-ene and but-2-ene, propan-1-ol, propan-2-ol, butan-1-ol and butan-2-ol) | Modified (Split) SLO | | Apply |
| | | | | SLO: C-10-E-02 | **State** the type of compound present given the chemical name ending in -ane, -ene, -yne, -ol, or -oic acid or from a molecular, structural or displayed formula | Modified (Split) SLO | | Remember |
| | | | | SLO: C-10-E-03 | **Name and draw** the displayed formulae of the unbranched esters which can be made from unbranched alcohols and carboxylic acids, each containing up to four carbon atoms | Modified (Split) SLO | | Remember |

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| | Standard:<br>Students should be able to:<br>**Describe** the structures and properties of alkanes, alkenes, and alkynes, including their classification as saturated and unsaturated hydrocarbons.<br>**Explain** the reaction mechanisms and products of alkane, alkene, and alkyne reactions, including combustion, addition, and substitution reactions.<br>**Discuss** the applications of hydrocarbons, including their use as fuels and starting materials for the synthesis of other organic compounds.<br>**Apply** the concepts of chemical bonding and reactivity to predict the products of hydrocarbon reactions (including aromatic compounds).<br>**Describe** the importance of hydrocarbons in organic | Benchmark 1:<br>**Classify and identify** different types of hydrocarbons (alkanes, alkenes, alkynes) based on their molecular structure, reactivity, and physical properties. | **Hydrocarbons** | **Alkanes**<br>**Alkenes**<br>SLO: C-10-E-04 | **State** that the bonding in alkenes includes a double carbon–carbon covalent bond and that alkenes are unsaturated hydrocarbons | Modified(rephrased) SLO | | Remember |
| | | | | SLO: C-10-E-05 | **Describe** the manufacture of alkenes by the cracking of large alkane molecules using a high temperature and a catalyst | Modified (Split) SLO | | Understand |
| | | | | SLO: C-10-E-06 | **Describe** the reasons for the cracking of large alkane molecules | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-E-07 | **Describe** the test to distinguish between saturated and unsaturated hydrocarbons by their reaction with aqueous bromine and KMnO4 | Modified(rephrased) SLO | | Understand |

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| | | | | SLO: C-10-E-08 | **Describe** the properties of alkenes in terms of addition reactions with:<br>a. bromine or aqueous bromine<br>b. hydrogen in the presence of a nickel catalyst<br>c. steam in the presence of an acid catalyst and draw the structural or displayed formulae of the products | Modified (Split) SLO | | Understand |
| | | | | SLO: C-10-E-09 | **Describe**, using symbol equations, preparation of alkenes by elimination reaction in halogeno alkanes and alcohols | Modified (Split) SLO | | Understand |
| | | | | **Alkynes**<br>SLO: C-10-E-10 | **Identify** alkynes as hydrocarbons containing triple carbon-carbon covalent bond and that alkynes are unsaturated hydrocarbons | Modified(rephrased) SLO | | Remember |
| | | | | SLO: C-10-E-11 | **Describe** the use of ethyne as fuel for welding and in artificially ripening fruits | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-E-12 | **Describe** separation of petroleum into useful fraction by fractional distillation | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-E-13 | **Describe** how the properties of fractions obtained from petroleum change from the bottom to the top of the fractionating column, limited to:<br>a. decreasing chain length<br>b. higher volatility<br>c. lower boiling points<br>d. lower viscosity | New SLO | | Understand |
| | | | | SLO: C-10-E-14 | **Name the uses** of the fractions as:<br>a. refinery gas fraction for gas used in heating and cooking<br>b. gasoline /petrol fraction for fuel used in cars<br>c. naphtha fraction as a chemical feedstock<br>d. kerosene /paraffin fraction for jet fuel<br>e. diesel oil/ gas oil fraction for fuel used in diesel engines<br>f. fuel oil fraction for fuel used in ships and home heating systems<br>g. lubricating oil fraction for lubricants, waxes and polishes<br>h. bitumen fraction for making roads | Modified (Split) SLO | | Understand |

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| | Standard:<br>Students should be able to:<br>**Describe** the structure and properties of alcohols, including primary, secondary, and tertiary alcohols.<br>**Explain** the reaction mechanisms and products of alcohol reactions, including oxidation, esterification, and dehydration.<br>**Discuss** the applications of alcohols, including their use as solvents, fuels, and starting materials for organic synthesis.<br>**Apply** the concepts of chemical bonding and reactivity to predict the products of alcohol reactions.<br>**Describe** the importance of alcohols in organic chemistry and their role in industry and daily life. | Benchmark 1:<br>**Identify** the processes for manufacturing ethanol and its uses and effects. | **Hydroxy Compounds** | SLO: C-10-E-15 | **Describe** the manufacture of ethanol<br>(This can be done by discussing<br>- fermentation of aqueous glucose at 25–35°C in the presence of yeast and in the absence of oxygen<br>- catalytic addition of steam to ethene at 300°C and 6000kPa /6 atm in the presence of an acid catalyst including a comparison of the advantages and disadvantages of the two methods) | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-E-16 | **Describe** the combustion of alcohols | New SLO | | Understand |
| | | | | SLO: C-10-E-17 | **Discuss the applications** of alcohols as fuels, including their advantages and disadvantages over fossil fuels. | New SLO | | Understand |
| | | | | SLO: C-10-E-18 | **Explain the role** of alcohols in various industries such as pharmaceuticals, cosmetics, and fuel production. | New SLO | | Remember |
| | | | | SLO: C-10-E-19 | **Discuss** the impact of alcohols on daily life, including their use as solvents and disinfectants. | New SLO | | Understand |

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| | Standard:<br>Students should be able to:<br>**Describe** the structure and properties of carbonyl Compounds , including their characteristic functional groups.<br>**Explain** the reaction mechanisms and products of carboxylic acid reactions, including decarboxylation, esterification, and acid-base reactions.<br>**Discuss the applications** of carboxylic acids and esters, including their use as fragrances, flavors, and starting materials for organic synthesis.<br>**Apply the concepts** of chemical bonding and reactivity to predict the products of carboxylic acid reactions. | Benchmark 1:<br>**Identify and explain** the properties and reactions of carboxylic acids and esters, including their preparation, structure, and use in industry and daily life. | **Carbonyl Compounds** | SLO: C-10-E-20 | **Describe** the reactions of carboxylic acids with metals, bases and carbonates including names and formulae of the salts produced. | New SLO | | Understand |
| | | | | SLO: C-10-E-21 | **Describe** the formation of ethanoic acid by the oxidation of ethanol: with acidified aqueous potassium manganate(VII) & by bacterial oxidation during vinegar production | New SLO | | Understand |
| | | | | SLO: C-10-E-22 | **Describe** the reaction of a carboxylic acid with an alcohol using an acid catalyst to form an ester | New SLO | | Understand |
| | | | | SLO: C-10-E-23 | **Describe** the industrial applications of carboxylic acids and esters, including their use as solvents, flavors, fragrances, and plastics. | New SLO | | Understand |
| | | | | SLO: C-10-E-24 | **Explain the role** of carboxylic acids and esters in daily life, including their use in food preservation, cosmetics, and pharmaceuticals. | New SLO | | Remember |

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| | Standard:<br>Students should be able to:<br>**Describe** the structure and properties of polymers, including homopolymers and copolymers.<br>**Explain** the formation and synthesis of polymers, including addition polymerization and condensation polymerization.<br>**Discuss** the applications of polymers, including their use in various industries such as plastics, textiles, and biomedicine.<br>**Apply** the concepts of chemical bonding and reactivity to predict the properties and reactivity of polymers.<br>**Describe** the importance of polymers in materials science and their impact on society and the environment. | Benchmark 1:<br>**Identify and describe** the structure, properties, reactions and applications of various polymers, including natural and synthetic types. | **(Polymer)** | SLO: C-10-E-25 | **Define** polymers as large molecules built up from many smaller molecules called monomers | New SLO | | Remember |
| | | | | SLO: C-10-E-26 | **Identify** the repeating units and/or linkages in addition polymers and in condensation polymers | New SLO | | Understand |
| | | | | SLO: C-10-E-27 | **Deduce** the structure or repeat unit of an addition polymer from a given alkene and vice versa | New SLO | | Understand |
| | | | | SLO: C-10-E-28 | **Deduce** the structure or repeating unit of a condensation polymer from given monomers and vice versa, limited to:<br>a. polyamides from a dicarboxylic acid and a diamine<br>b. polyesters from a dicarboxylic acid and a diol | New SLO | | Understand |
| | | | | SLO: C-10-E-29 | **Describe the differences** between addition and condensation polymerisation | New SLO | | Understand |
| | | | | SLO: C-10-E-30 | **State** that plastics are made from polymers | New SLO | | Remember |
| | | | | SLO: C-10-E-31 | **Describe** how the properties of plastics have implications for their disposal | New SLO | | Understand |
| | | | | SLO: C-10-E-32 | **Describe** the environmental challenges caused by plastics, limited to:<br>a. disposal in landfill sites<br>b. accumulation in oceans<br>c. formation of toxic gases from burning | New SLO | | Analyse |
| | | | | SLO: C-10-E-33 | **Describe** the structure of:<br>a. Nylon, a polyamide<br>b. PET, a polyester<br>The full name for PET, polyethylene terephthalate, is not required | New SLO | | Remember |
| | | | | SLO: C-10-E-34 | **State** that PET can be converted back into monomers and re-polymerised | New SLO | | Remember |
| | | | | SLO: C-10-E-35 | **Outline** the importance of polymers in the textile industry. (Examples for polymers being used may be given along with their specific properties) | New SLO | | Remember |

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| | Standard:<br>Students should be able to:<br>**Describe** the structure and properties of carbohydrates, proteins, and lipids, including their classification as monosaccharides, disaccharides, polysaccharides, amino acids, peptides, and fatty acids.<br>**Explain** the metabolic pathways and functions of carbohydrates, proteins, and lipids in living organisms, including energy storage and transfer, structural support, and regulatory roles.<br>**Describe** the structure and function of DNA and RNA, including the role of DNA in genetics and the mechanism of transcription and translation.<br>**Discuss** the importance of vitamins and minerals in human nutrition, including their role in metabolic | Benchmark 1:<br>**Identify** the importance of carbohydrates, proteins, fats, DNA and vitamins in biological systems. | **Biochemistry (carbohydrates, proteins, fats, DNA, vitamins)** | SLO: C-10-E-36 | **Describe** proteins as natural polyamides and that they are formed from amino acid monomers with the general structure | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-E-37 | **draw** the general structure of proteins | Modified(rephrased) SLO | | Remember |
| | | | | SLO: C-10-E-38 | **Explain** the sources, use and structure of proteins, lipids and carbohydrates | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-E-39 | **Describe** the importance of nucleic acids | Matched SLO | | Understand |
| | | | | SLO: C-10-E-40 | **explain** vitamins, their sources and their importance to health | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-E-41 | **Identify** applications of biochemistry in testing (blood test, pregnancy test, cancer screening, parental genetic testing), genetic engineering, gene therapy and cloning | New SLO | **Ambiguous** | Analyse |

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| **Domain F: Empirical Data Collection and Analysis** | Standard:<br>The students will be able to:<br>**Compare and contrast** the different energy sources based on their availability, efficiency, and environmental impact.<br>**Analyze** the extraction, processing, and utilization of fossil fuels, including their effects on the environment and human health.<br>**Evaluate** the advantages and disadvantages of nuclear energy, including the impact on the environment and safety concerns.<br>**Evaluate** the potential of solar energy as a sustainable source of energy and analyze the feasibility of its implementation.<br>**Analyze** energy consumption patterns and develop strategies to reduce energy waste and increase energy | Benchmark 1:<br>Describe the composition and properties of various energy fuels, such as coal, oil, natural gas, and biofuels and explain the chemical reactions involved in the combustion of energy fuels. | **(Energy)** | SLO: C-10-F-01 | **Name** fossil fuels; coal, natural gas and petroleum | Modified(rephrased) SLO | | Remember |
| | | | | SLO: C-10-F-02 | **Name** methane as main constituent of natural gas | Modified(rephrased) SLO | | Understand |
| | | | | SLO: C-10-F-03 | **State** that petroleum is a mixture of hydrocarbons, compounds containing hydrogen and carbon only | Modified(rephrased) SLO | | Understand |

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| **Domain G: Lab and Practical Skills** | Standard: Students should be able to **demonstrate knowledge** of how to select and safely use techniques, apparatus and materials | Benchmark I: Students should be able to follow **provided safety instructions** in general lab settings while using appropriate apparatus, equipment and methods. | | SLO: C-09-10-G-01 | **Explain**, with examples, the types of chemical hazards in the lab and suggest safety precautions.<br>(Types of chemical hazards to be identified: flammable or explosive hazards, corrosive hazards, toxic hazards, reactive hazards, radiation hazards and asphyxiation hazards) | | | Understand |
| | | | | SLO: C-09-10-G-02 | **Recognize** the meaning of different chemical hazard signs in the lab and on chemicals. | | | Remember |
| | | | | SLO: C-09-10-G-03 | **Recognize** the importance of personal protective equipment (PPE) by correctly identifying the types of PPE needed for different lab activities | | | Remember |
| | | | | SLO: C-09-10-G-04 | locate the nearest fire extinguisher and emergency shower. | | | Understand |
| | | | | SLO: C-09-10-G-05 | **show** awareness of emergency procedures in the event of an emergency in the lab | | | Remember |
| | | | | SLO: C-09-10-G-06 | **identify** apparatus from diagrams or descriptions | | | Remember |
| | | | | SLO: C-09-10-G-07 | **draw, complete or label** diagrams of apparatus | | | Understand |
| | | | | SLO: C-09-10-G-08 | **Explain the use** of, common techniques, apparatus and materials | | | Understand |
| | | | | SLO: C-09-10-G-09 | **select** the most appropriate apparatus or method for the task and justify the choice made | | | Analyse |
| | | | | SLO: C-09-10-G-10 | **describe** tests (qualitative, gas tests, other tests) | | | Understand |
| | | | | SLO: C-09-10-G-11 | **describe and explain** techniques used to ensure the accuracy of observations and data | | | Understand |
| | Standard: Students should be able to plan and carry out experiments and investigations.<br>Students should be able to make and record observations and measurements. | Benchmark I:Students should be able to **apply** scientific knowledge to conduct simple experiments using appropriate apparatus. | | SLO: C-09-10-G-12 | Carry out the following tests under supervision:<br>- identification of metal ions, non-metal ions and gases<br>- chemical test for water<br>- test-tube reactions of dilute acids, including ethanoic acid<br>- tests for oxidising and reducing agents<br>- melting points and boiling points<br>- displacement reactions of metals and halogens<br>- temperature changes during reactions | | | Apply |
| | | | | SLO: C-09-10-G-13 | Carry out separation and purification techniques<br>(This may include:<br>- filtration<br>- crystallisation<br>- simple distillation<br>- fractional distillation<br>- chromatography<br>- electrolysis) | | | Apply |
| | | | | SLO: C-09-10-G-14 | **suggest** the most appropriate apparatus or technique and justify the choice made | | | Analyse |
| | | | | SLO: C-09-10-G-15 | – **describe** experimental procedures | | | Understand |
| | | | | SLO: C-09-10-G-16 | **take readings** from apparatus (analogue and digital) or from diagrams of apparatus with appropriate precision, | | | Understand |
| | | | | SLO: C-09-10-G-17 | – **take sufficient observations or measurements**, including repeats where appropriate | | | Understand |
| | | | | SLO: C-09-10-G-18 | – **record** qualitative observations from chemical tests and other tests | | | Understand |

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| | Standard:<br>The students will be able to:<br>**Interpret** mass spectra and identify isotopes based on their m/e values and relative abundances<br>**Determine** the atomic mass of an element from its isotopic composition and mass spectrum<br>**Analyze** the molecular mass of organic compounds by analyzing the molecular ion peak in a mass spectrum<br>**Predict** the identity of fragmented molecules in a given mass spectrum<br>**Determine** the number of carbon atoms in a compound using the M 1 peak and the formula n=/(1.1 × abundance of M + ion) | Benchmark I:<br>Students should be able to **present data** in a tabulated or graphical form. | | SLO: C-09-10-G-19 | **record** observations and measurements systematically (in a suitable table, to an appropriate degree of precision and using appropriate units) | | | Understand |
| | | | | SLO: C-09-10-G-20 | **record** the results of an experiment | | | Understand |
| | | | | SLO: C-09-10-G-21 | **process** the results of an experiment to form a conclusion or to evaluate a prediction | | | Analyse |
| | | | | SLO: C-09-10-G-22 | **Predict** expected results | | | Analyse |
| | | | | SLO: C-09-10-G-23 | **Interpret and evaluate** experimental observation and data. | | | Apply |
| | | | | SLO: C-09-10-G-24 | **process data**, including for use in further calculations or for graph plotting. | | | Apply |
| | | | | SLO: C-09-10-G-25 | **present** data graphically, including the use of best-fit lines where appropriate | | | Apply |
| | | | | SLO: C-09-10-G-26 | – **analyse and interpret** observations and data, including data presented graphically | | | Analyse |
| | | | | SLO: C-09-10-G-27 | — **form conclusions** justified by reference to observations and data and with appropriate explanation | | | Analyse |
| | Standard: Students should be able to **evaluate** methods and **suggest** possible improvements. | Benchmark I:<br>Students should be able to **suggest improvements** in the experimental design | | SLO: C-09-10-G-28 | – **evaluate** the quality of observations and data, identifying any anomalous results | | | Analyse |
| | | | | SLO: C-09-10-G-29 | **identify** potential sources of error in an experimental design | | | Analyse |
| | | | | SLO: C-09-10-G-30 | **assess** the limitations of an experimental design | | | Analyse |
| | | | | SLO: C-09-10-G-31 | **evaluate** experimental arrangements, methods and techniques, including the control of variables | | **Not assessable in summative** | Understand |
| | | | | SLO: C-09-10-G-32 | **suggest** possible improvements to the apparatus, experimental arrangements, methods or techniques | | **Not assessable in summative** | Understand |