

ASSESSMENT FRAMEWORK AND MODEL QUESTION PAPER

CHEMISTRY

Grade XI

NATIONAL CURRICULUM

2022-23



50% MCQs & 50% Descriptive
INCLUSIVE SCHEME OF STUDIES 2024



FEDERAL BOARD OF
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**ASSESSMENT FRAMEWORK
FOR
CHEMISTRY GRADE-XI
CURRICULUM 2022-23
SCHEME OF STUDIES 2024**

ACKNOWLEDGEMENT

It is a great honour that we, at the Federal Board of Intermediate and Secondary Education, have developed the Assessment Framework (AF) for the subject of Chemistry for Grade-XI. The primary objective of the AF is to optimize the current curriculum 2022-23. This comprehensive framework has been crafted meticulously by subject matter and assessment experts who conducted an in-depth review of all learning outcomes for Grade-XI Chemistry curriculum. They evaluated these outcomes in terms of their scope, cognitive level, and progression across the grade.

This significant undertaking was the result of a series of extensive meetings and collaborative efforts of the subject and assessment experts. Their dedication and expertise have been instrumental in bringing this framework to fruition.

The Assessment Framework will serve as a guiding document for students, teachers and paper setters. Students will receive clear directions for preparing themselves for the annual examination. Similarly, teachers will use it as a guide to understand what to teach in class and to prepare students for the final examinations accordingly. Similarly paper setters will also seek guidance from this document.

Following subject as well as assessment experts/committee members remained constantly engaged in the development of the AF:

1. Dr. Shaista Sabir, Associate Professor, PAEC Model College for Girls, Nilore, Islamabad
2. Mr. Naeem Mushtaq, Associate Professor, Islamabad Model College for Boys, G-10/4, Islamabad
3. Mr. Amir Muhammad, Assistant Professor, Islamabad Model College for Boys I-8/3, Islamabad
4. Ms. Javeria Gul, HOD Chemistry, Pak Turk Muaarif International School, Islamabad
5. Ms. Ambreen Tassawar, Subject Experts, APSAC Secretariat Rawalpindi

The whole work was successfully accomplished under the able supervision and guidance of Dr. Ikram Ali Malik, Chairman, FBISE and due to the hard work and dedication of the staff of Research Section of FBISE, in particular, Syed Zulfiqar Shah, Deputy Secretary, Research and Academics who played a pivotal and leading role in finalizing the Assessment Framework.

MIRZA ALI
Director
FBISE, Islamabad

ASSESSMENT FRAMEWORK FOR CHEMISTRY GRADE-XI, CURRICULUM 2022-23

To ensure clarity and precision in assessment, the learning outcomes have been categorized into two distinct groups: formative and summative. This classification helps in effectively measuring student progress and understanding. Each Student learning outcome (SLO) has been carefully marked as either formative or summative within the newly developed Assessment Framework. SLOs of Summative Assessment Format will be part of the Final Examination while SLOs of Formative Assessment will although be part of the teaching-learning activity but they will **NOT** be part of Final Examinations. Estimated cognitive levels i.e Knowledge (K), Understanding (U) and Application (A) of all the SLOs have also been indicated. It may be noted that all the higher cognitive levels have been collectively accumulated in the cognitive level of 'Application'. In subjects involving Practicals (Lab work), it has been mentioned categorically whether an SLO is summative for theory or summative for Practical Based Assessment (PBA). If an SLO is summative for PBA, it means that Laboratory work is required in the teaching-learning activity and it will be part of the Practical Examination/ Practical Based Assessment.

The Assessment Framework will act as a comprehensive guide for students, teachers and paper setters. Students will have clear instructions on how to prepare for the annual examinations. Teachers will use the framework to understand the curriculum and effectively prepare their students for the final examination. Additionally, paper setters will refer to this document for guidance in setting examination papers.

A model question paper has also been developed to provide a clear structure and format for upcoming examinations. The model question paper ensures consistency and fairness, offering students a comprehensive understanding of what to expect in their examinations. By aligning the paper with the Student Learning Outcomes (SLOs) of the curriculum, we ensured that the questions accurately reflect the skills and knowledge that students are expected to acquire.

A detailed Table of Specifications (ToS) has been created to ensure equitable coverage of cognitive levels and content domains in order to generate a balanced question paper. The ToS serves as drawing scale and action plan for the question paper, ensuring that all important areas of the curriculum are adequately and proportionately assessed.

FORMATIVE ASSESSMENT: AN ESSENTIAL COMPONENT OF EFFECTIVE LEARNING

Formative assessment is a pivotal element in the educational process, distinguished by its role in providing ongoing feedback to both students and educators. Unlike summative assessments, which evaluate student learning at the end of an instructional period, formative assessments are integrated into the learning process to monitor student understanding and guide instructional decisions.

The primary objective of formative assessment is to identify learning gaps and misunderstandings as they occur, enabling timely interventions. This dynamic approach allows teachers to adjust their teaching strategies to better meet the needs of their students. For instance, if a teacher notices through a quick quiz or class discussion that a significant portion of the class struggles with a particular concept, they can revisit that topic, providing additional explanations or alternative methods of instruction. This adaptability is crucial for fostering a deeper understanding of the material.

Formative assessments come in various forms, ranging from informal methods like classroom discussions, observations, and questioning, to more structured approaches such as quizzes, peer assessments, and self-reflections. These methods are not limited to paper-and-pencil tasks but can include digital tools that provide instant feedback. The versatility of formative assessments allows educators to cater to diverse learning styles and preferences, ensuring that all students are engaged and supported in their learning journey.

Formative assessment plays a significant role in creating a supportive classroom environment. It shifts the focus from merely achieving grades to understanding the learning process. This approach reduces the pressure on students, as they perceive assessments not as a final judgment of their abilities but as a part of their learning journey. Consequently, formative assessment can lead to increased student motivation and engagement.

In conclusion, formative assessment is a powerful tool that, when effectively implemented, can significantly enhance the learning experience. It provides invaluable insights for both teachers and students, promotes a growth-oriented learning environment, and supports the continuous development of essential skills. As education evolves, the role of formative assessment will undoubtedly continue to be central in fostering successful and meaningful learning experiences.

SUMMATIVE ASSESSMENT: EVALUATING LEARNING OUTCOMES IN THE FORM OF TERMINAL/FINAL EXAMINATION

Summative assessment is a fundamental component of the educational process, designed to evaluate student learning at the conclusion of an instructional period. Unlike formative assessment, which provides ongoing feedback during the learning process, summative assessment serves as a final measure of what students have learned. Typically administered at the end of a unit, course, or academic year. Summative assessment aims to determine the extent to which educational objectives have been achieved.

The primary purpose of summative assessment is to assess the overall effectiveness of instruction and learning. It provides a conclusive evaluation of student performance, often in the form of tests, final projects, or standardized exams. These assessments generate grades or scores that reflect a student's achievement in a given subject area over a specific period or time duration.

Summative assessment is often used to make critical decisions regarding student progression, certification, or placement in subsequent educational levels. Additionally, summative assessments provide valuable data that inform curriculum development and instructional strategies. By analyzing summative assessment results, educators can identify trends, strengths, and weaknesses within their instructional approaches, allowing for improvements in future teaching.

In conclusion, summative assessment plays a critical role in the educational process by providing a final evaluation of student learning. While it differs from formative assessment in its focus and application, it is an essential tool for measuring academic achievement. When balanced with formative assessments, summative assessments contribute to a well-rounded and effective approach to evaluating and supporting student learning.

National Curriculum of Pakistan 2022-2023

Assessment Framework CHEMISTRY (Theory)

Details of Content Areas/ SLOs Grade XI (11)

Domain	Content Area	SLO No.	SLO Description	Cognitive Level	Type of Assessment	Remarks	Time allocation (lectures)
A	Nature of Science in Chemistry	SLO:C-11-A-01	Describe how Al Ghazali's burning cotton thought experiment highlight the challenges of inductive reasoning examples of deductive reasoning with respect to chemistry.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	01
B	Atomic Structure	SLO: C-11-B-01	Describe that, each atomic shell and subshell are further divided into degenerate orbitals having the same energy.	Understanding	Summative	Question(s) will be asked in the annual examination.	10
		SLO: C-11-B-02	Describe protons, neutrons and electrons in terms of their relative charges and relative masses.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-03	Recognize that the terms atomic and proton number represent the same concept.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-04	Recognize the terms mass and nucleon number represent the same concept.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-05	Describe the behavior of beams of protons, neutrons and electrons moving at the same velocity in an electric field.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-07	Explain the change in atomic and ionic radius across a period and down a group.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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. $1s^2$, $2s^2$, $2p^6$, $3s^1$ c). Students should be able to determine both of these from the periodic table and are not required to memorize these. d) Students should understand that chemical properties of an atom are governed by valence electrons).	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-09	Define terms related to electronic configuration (Some examples include shells, subshells, orbitals, principal quantum number (n), ground state).	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-10	Relate Quantum Numbers to Electronic distribution of elements.	Understanding	Summative	Question(s) will be asked in the annual examination.	

	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.	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B- 12	Apply aufbau principle, pauli exclusion principle and hunds rule to write the electronic configuration of elements	Application	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-13	Describe the order of increasing energy of the subshells (s,p,d and f).	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-14	Describe the electronic configurations to include the number of electrons in each shell, subshell and orbital.	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-15	Explain the electronic configurations in terms of energy of the electrons and inter-electron repulsion.	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-16	Determine the electronic configuration of atoms and ions given the proton or electron number and charge,	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-17	Illustrate the importance of electronic configurations in the 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.)	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-18	Describe the shapes of s, p and d orbitals.	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-19	Describe a free radical as a species with one or more unpaired electrons.	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-20	Explain that ionization energies are due to the attraction between the nucleus and the outer electron.	Understanding	Summative	Question(s) will be asked in the annual examination.
	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.	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-22	Account for the variation in successive ionization energies of an element.	Understanding	Summative	Question(s) will be asked in the annual examination.
	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.	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-24	Deduce the electronic configurations of elements using successive ionization energy data.	Application	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-25	Deduce the position of an element in the Periodic Table using successive ionization energy data.	Application	Summative	Question(s) will be asked in the annual examination.
	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.	Understanding	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-27	Perform calculations involving non-integer relative atomic masses and abundance of isotopes from given data, including mass spectra	Application	Summative	Question(s) will be asked in the annual examination.
	SLO: C-11-B-28	Explain the concept of emission spectra. Use the concept of	Understanding	Formative	Question(s) will not be asked in

			emission spectra to deduce the electronic configuration of elements.			the annual examination, however it will be the part of class room teaching.	
Chemical Bonding	SLO: C-11-B-29	Define electronegativity as the power of an atom to attract electrons to itself.	Knowledge	Summative	Question(s) will be asked in the annual examination.	13	
	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.	Understanding	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-31	Explain the trends in electronegativity across a period and down a group of the Periodic Table.	Understanding	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-32	Use the differences in Pauling electronegativity values to predict the formation of ionic and covalent bonds.	Application	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-33	Describe covalent bonding in molecules using the concept of hybridization to describe sp, sp ² and sp ³ orbitals.	Understanding	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-34	Use bond energy values and the concept of bond length to compare the reactivity of covalent molecules	Application	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-35	Describe the shapes and bond angles in molecules using VSEPR theory (including describing by sketching)	Understanding	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-36	Predict the shapes, and bond angles in molecules and ions.	Understanding	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-37	Explain hybridization and types of hybridization.	Understanding	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-38	Explain valence bond theory.	Understanding	Summative	Question(s) will be asked in the annual examination.		
	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.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.		
	SLO: C-11-B-40	Explain the salient features of molecular orbital theory.	Understanding	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-41	Explain the paramagnetic nature of Oxygen molecule in the light of MOT.	Understanding	Summative	Question(s) will be asked in the annual examination.		
	SLO: C-11-B-42	Calculate Bond order of N ₂ , O ₂ , F ₂ & He	Understanding	Summative	Question(s) will be asked in the annual examination.		
	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).	Understanding	Summative	Question(s) will be asked in the annual examination.		
SLO: C-11-B-44	Describe hydrogen bonding, limited to molecules containing N–H, O–H and H–F groups, (including ammonia, water and	Understanding	Summative	Question(s) will be asked in the annual examination.			

			H–F as simple examples).				
		SLO: C-11-B-45	Use the concept of hydrogen bonding to explain the anomalous properties of H ₂ O (ice and water).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-46	Use the concept of electronegativity to explain bond polarity and dipole moments of molecules	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-47	State that, in general, ionic, covalent and metallic bonding are stronger than intermolecular forces	Understanding	Summative	Question(s) will be asked in the annual examination.	10
	Stoichiometry	SLO: C-11-B-50	Express balanced chemical equations in terms of moles, representative particles, masses, and volumes of gases (at STP).	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-51	Explain the concept of limiting reagents.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-52	Calculate the maximum amount of product and amount of any unreacted excess reagent.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-53	Calculate theoretical yield, actual yield, and percentage yield when given appropriate information.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-54	State the volume of one mole of a gas at STP.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-55	Use the volume of one mole of gas at STP to solve mole volume problem.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-56	Calculate the gram molecular mass of a gas from density measurements at STP.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-57	Derive measurements of mass, volume, and number of particles using moles.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-58	Calculate the quantities of reactants and products involved in a chemical reaction using stoichiometric principles (Some examples include calculations involving reacting masses, volumes of gasses, volumes, and concentrations of solutions, limiting reagent and excess reagent, percentage yield calculations).	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-59	Explain, with examples, the importance of stoichiometry in the production and dosage of medicine.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of class room teaching.	01
	Electrochemistry	SLO: C-11-B-60	Explain the merits of photovoltaic cells as sustainable ways of meeting energy demands by making reference to the photovoltaic principle.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of class room teaching.	
	States and phases of matter	SLO: C-11-B-61	Describe simple properties of liquids e.g., diffusion, compression, expansion, motion of molecules, spaces between them, intermolecular forces and kinetic energy based on kinetic molecular theory.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	08

		SLO: C-11-B-62	Describe types of intermolecular forces.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-63	Explain the strength and applications of dipole-dipole forces, hydrogen bonding and London forces.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-64	Describe physical properties of liquids such as evaporation, vapor pressure, boiling point, viscosity and surface tension.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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).	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-66	Define molar heat of fusion and molar heat of vaporization.	Knowledge	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-B-67	Describe how heat of fusion and heat of vaporization affect the particles that make up matter.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-69	Describe the physical properties of gases (including compressibility, expandability and pressure exerted by gases)	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-B-70	Describe liquid crystals and give their uses in daily life.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-B-71	Differentiate liquid crystals from pure liquids and crystalline solids.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-B-72	Describe simple properties of solids e.g. compression, expansion, motion of molecules, interparticle space, intermolecular forces and kinetic energy based on kinetic molecular theory.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-B-73	Differentiate between amorphous and crystalline solids.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-74	Describe properties of crystalline solids like geometrical shape, melting point, cleavage planes, habit of a crystal,	Understanding	Summative	Question(s) will be asked in the annual examination.	

			crystal growth.				
	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).	Understanding	Summative	Question(s) will be asked in the annual examination.	10
		SLO: C-11-B-76	Interpret a reaction pathway diagram, in terms of the enthalpy change of the reaction and of the activation energy.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-77	Define terms such as standard conditions, enthalpy change, reaction, formation, combustion, neutralization.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-78	Explain that energy transfer occurs during chemical reactions because of the breaking and making of bonds.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-79	Calculate the bond energies for the enthalpy change of reaction, ΔH .	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-80	Describe that some bond energies are exact, and some bond energies are approximate.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-81	Calculate enthalpy changes from appropriate experimental results, including the use of the relationships $q = mc\Delta T$ and $\Delta H = -mc\Delta T/n$	Application	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-B-82	Define terms such as enthalpy change of atomization, ΔH_{atm} , lattice energy, $\Delta H_{\text{Lattice}}$, first electron affinity, EA	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-83	Use terms such as enthalpy change of atomization, ΔH , lattice energy, ΔH , first electron affinity, EA.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-84	Explain the factors affecting the electron affinities of elements.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-85	Construct Born–Haber cycles for ionic solids.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-86	Perform calculations involving Born–Haber cycles.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-87	Explain the effect of ionic charge and ionic radius on the numerical magnitude of lattice energy.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-88	Apply enthalpy change with reference to hydration, and solution.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-89	Construct an energy cycle involving enthalpy change of solution, lattice energy and enthalpy change of hydration.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-90	Perform calculations involving the energy cycles.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-91	Explain the effect of ionic charge and ionic radius on the numerical magnitude of an enthalpy change of hydration.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-93	Explain the sign of the entropy changes that occur during a	Understanding	Summative	Question(s) will be asked in the	

			change in state, temperature change and a reaction in which there is a change in the number of gaseous molecules.			annual examination.	
		SLO: C-11-B-94	Calculate the entropy change for a reaction, ΔS , given the standard entropies, S , of the reactants and products.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-95	Explain the concept of heat as a form of energy.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-B-96	Explain the relationship between temperature and kinetic energy of particles.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-B-97	State that total energy is conserved in chemical reaction.	Knowledge	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-B-98	Explain the concept of standard conditions and standard states in measuring energy changes.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-99	Explain Hess's Law.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-100	Apply Hess's Law to calculate enthalpy changes in a reaction carried out in multiple steps.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-101	Explain the relationship between bond formation energy, and bond breaking energy.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-102	Explain Gibbs free energy.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-103	Apply the concept of Gibbs free energy to solve problems.	Application	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-B-104	Outline how enthalpy change relates to the calorie content of the food we eat.	Application	Summative	Question(s) will be asked in the annual examination.	
	Chemical Kinetics	SLO: C-11-B-105	Explain the rate of reaction and rate constant.	Understanding	Summative	Question(s) will be asked in the annual examination.	07
		SLO: C-11-B-106	Use experimental data to calculate the rate of a reaction.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-107	Explain the concept of activation energy and its role in chemical reactions.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-108	Use the Boltzmann distribution curve to explain the effect of temperature on the rate of a reaction.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-109	Explain the concept of catalyst and how they increase the rate	Understanding	Summative	Question(s) will be asked in the	

			of a reaction by lowering the activation energy.			annual examination.	
		SLO: C-11-B-110	Interpret reaction pathway diagrams, including in the presence and absence of catalysts.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-111	Explain the relationship between Gibbs free energy change, ΔG , and the feasibility of a reaction.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of class room teaching.	
		SLO: C-11-B-112	Use rate equations, including orders of reaction and rate constants.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-113	Calculate the numerical value of a rate constant using the initial rates and half-life method.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-114	Suggest a reaction mechanism that is consistent with a given rate equation and rate-determining step.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-115	Describe the effect of temperature change on the rate constant and rate of a reaction.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	Chemical Equilibrium	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.	Understanding	Summative	Question(s) will be asked in the annual examination.	10
		SLO: C-11-B-117	Define dynamic equilibrium between two physical states.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-118	State the necessary conditions for equilibrium and the ways that equilibrium can be recognized.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-119	Describe the microscopic events that occur when a chemical system is in equilibrium Define with examples.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-120	Deduce the equilibrium constant expression K_c from an equation for homogeneous reaction.	Understanding	Summative	Question(s) will be asked in the annual examination.	10
		SLO: C-11-B-121	Determine the relationship between different equilibrium constants (K_c) for the same reaction at the same temperature.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of class room teaching.	
		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.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-123	Differentiate between Microscopic and Macroscopic events in a chemical reaction.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of class room teaching.	
		SLO: C-11-B-124	Propose microscopic events that account for observed macroscopic changes that take place during a shift in equilibrium.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of class room teaching.	
		SLO: C-11-B-125	Determine if the equilibrium constant will increase or	Understanding	Summative	Question(s) will be asked in the	

			decrease when temperature is changed, given the equation for the reaction.			annual examination.	
		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.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-127	Explain industrial applications of Le Chatelier's Principle using Haber's process and the Contact Process as an example.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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 produc	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-129	Use the concept of hydrolysis to explain why aqueous solutions of some salts are acidic or basic.	Application	Summative	Question(s) will be asked in the annual examination.	
	Acids, Bases and Salts	SLO: C-11-B-130	Define conjugate acid-base pair.	Understanding	Summative	Question(s) will be asked in the annual examination.	08
		SLO: C-11-B-131	Identify conjugate acid-base pairs in reactions.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-132	Apply the concept of conjugate acid and conjugate base on salt hydrolysis.	Application	Summative	Question(s) will be asked in the annual examination.	
		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).	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-134	Calculate $[H^+]_{(aq)}$ and pH values for (a) strong acids (b) strong alkalis (c) weak acids (d) weak alkalis.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-135	Distinguish that Lewis acids accept lone pair, and Lewis bases donate lone pair to make a coordinate covalent bond.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-136	Calculate the pH of buffer solutions in given appropriate data.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-137	Demonstrate the ability to comprehend and effectively apply the concept of solubility product. (K_{sp})	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-138	Construct an expression for K_{sp} .	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-139	Calculate K_{sp} from concentrations and vice versa.	Application	Summative	Question(s) will be asked in the annual examination.	
		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.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-141	Perform calculations using K_{sp} values and concentration of a common ion.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-142	Use the concept of hydrolysis to explain why aqueous solutions of some salts are acidic or basic.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-143	Calculate the $[H_3O^+]$ given the K_a and molar concentration of weak acid.	Application	Summative	Question(s) will be asked in the annual examination.	

C		SLO: C-11-B-144	Calculate concentrations of ions of slightly soluble salts.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-B-145	Perform acid-base titrations to calculate molarity and strength of given sample solutions.	Application	Summative for Practical Based Assessment (PBA).	Lab Work, Question(s) will be asked in PBA.	
		SLO: C-11-B-146	Select suitable indicators for acid-alkali titrations, given appropriate data (pKa values will not be used).	Understanding	Summative for PBA	Lab Work, Question(s) will be asked in PBA.	
	Periodic Table	SLO: C-11-C-01	Explain the arrangement of elements in the periodic table.	Understanding	Summative	Question(s) will be asked in the annual examination.	10
		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-03	Recognize that the period number (n) is the outer energy level that is occupied by electrons.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-05	Identify the positions of metals, nonmetals and metalloids in the periodic table.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-07	Recognize that trends in metallic and non-metallic behavior are due to the trends in valence electrons.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-09	Write equations for, the reactions of Na and Mg with oxygen, chlorine and water.	Application	Summative	Question(s) will be asked in the annual examination.	
		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-13	Explain with equations for, the reactions of the chlorides with water including the likely pHs of the solutions obtained.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-14	Explain the variations and trends in terms of bonding and	Understanding	Summative	Question(s) will be asked in the	

			electronegativity.			annual examination.	
		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-16	Predict the characteristic properties of an element in a given group by using knowledge of chemical periodicity	Application	Summative	Question(s) will be asked in the annual examination.	
		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-18	Explain the trends in the ionization energies and electron affinities of the Group 1 and Group 17 elements.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	Group 17	SLO: C-11-C-19	Describe the colors and trend in volatility of chlorine, bromine and iodine.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	04
		SLO: C-11-C-20	Describe the trend in bond strength of halogen molecules.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-C-21	Interpret the volatility of the elements in terms of instantaneous dipole-induced dipole forces.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-C-22	Describe the relative reactivity of the halogen elements as oxidizing agents.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-23	Describe the reactions of the elements with hydrogen and explain their relative reactivity in these reactions.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-24	Describe the relative thermal stabilities of the hydrogen halides and explain these in terms of bond strengths.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-25	Describe the relative reactivity of halide ions as reducing agents.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-26	Explain the reactions of halide ions with aqueous silver ions and concentrated sulfuric acid.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-27	Describe the reaction of halides with aqueous silver ions followed by aqueous ammonia.	Understanding	Summative for Practical Based Assessment (PBA)	Lab Work, Question(s) will be asked in PBA.	
		SLO: C-11-C-28	Interpret the reaction of chlorine with cold and hot aqueous sodium hydroxide as disproportionation reactions.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	

		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	Nitrogen and Sulphur	SLO: C-11-C-30	Explain the lack of reactivity of nitrogen due to its triple bond strength and lack of polarity.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	03
		SLO: C-11-C-31	Describe the basicity of ammonia using the Brønsted–Lowry theory.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-C-32	Identify the structure of the ammonium ion and explain how it is formed by an acid-base reaction.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-C-33	Describe how ammonia can be displaced from ammonium salts through acid-base reactions.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		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.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		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).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-C-36	Differentiate between nitrification and denitrification.	Knowledge	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-C-37	Explain the lack of reactivity of sulfur, with reference to its bonding and stability of its compounds.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-C-38	Describe the different oxidation states of sulfur and their relative stability.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-C-39	Describe the properties and uses of sulfuric acid, including its production and industrial applications.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-C-40	Describe the chemical reactions and processes involving	Understanding	Formative	Question(s) will not be asked in	

			sulfur, such as combustion and oxidation.			the annual examination, however it will be the part of classroom teaching.	
		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
D	Environmental Chemistry Air	SLO: C-11-D-01	Identify the properties and composition of the atmosphere. (Include the concepts of 4 layers of atmosphere and their composition).	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	03
		SLO: C-11-D-02	Describe the factors that affect air quality.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-D-03	Describe the sources and understand the effects of air pollution, (This can include both natural and human-caused pollutants including O ₃ , Pb, Hg, Polycyclic aromatic hydrocarbons, Persistent organic pollutants, Greenhouse gases (such as CO ₂ , CH ₄ and N ₂ O), CFCs and other ozone-depleting substances, Volatile organic compounds, Heavy metals (such as Pb, Hg, and Cd).	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-04	Familiarize with use of the methods and techniques to measure and monitor air quality.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-05	Describe the impact of human activities on the atmosphere, including the effects of burning fossil fuels and deforestation.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-06	Identify the chemical reactions and processes that occur in the atmosphere (some examples include the formation of smog and acid rain).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-D-07	Identify laws and regulations related to air quality and the measures used to control air pollution.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-08	Analyze data and interpret air quality measurements and trends.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the	

						part of class room teaching.	
		SLO: C-11-D-09	Explain the link between air quality and human health.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-10	Evaluate the potential health risks associated with air pollution.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-11	Explain the technologies and strategies used to reduce air pollution and improve air quality, such as emissions control and renewable energy sources.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-12	Design experiments and collect data to test hypotheses about air quality	Application	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-13	Identify the global scale problems of air pollution, such as global warming and the greenhouse effect.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-14	Analyze the economic, social and political issues related to air pollution and air quality management and demonstrate through answers.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
	Environmental Chemistry -Water	SLO: C-11-D-15	Identify different types of water pollution, (some examples include point source and nonpoint source pollution	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-16	Identify common water pollutants (Some examples include oil, pesticides, and heavy metals	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-17	Identify and explain the sources and effects of water pollution on human health and the environment.	Understanding	Formative	Question(s) will not be asked in the annual examination, since	

						already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-18	Identify and explain water treatment methods and technologies, such as filtration and purification.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-19	Explain the laws and regulations related to water pollution and conservation.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-20	Evaluate the impact of human activities on water resources, such as agriculture and industrial processes.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
		SLO: C-11-D-21	Explain conservation and management strategies for protecting and preserving water resources.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-D-22	Explain the chemical properties of water and how they relate to water quality and pollution.	Understanding	Formative	Question(s) will not be asked in the annual examination, since already covered in previous classes. However, it will be the part of class room teaching.	
E	Organic Chemistry	SLO: C-11-E-01	Recognize that hydrocarbons are compounds made up of C and H atoms only.	Understanding	Summative	Question(s) will be asked in the annual examination.	11
		SLO: C-11-E-02	Recognize that alkanes are simple hydrocarbons with no functional group.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-03	Recognize that compounds contain a functional group which dictates their physical and chemical properties.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-04	Interpret the general, structural, displayed, and skeletal formulae of the classes of compounds.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-05	Describe the use of systematic nomenclature of simple aliphatic organic molecules with functional groups.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-06	Deduce the molecular and/or empirical formula of a compound, given its structural, displayed, or skeletal formula.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-07	Describe terminology associated with the types of organic compounds and reactions (Some examples include: homologous series, saturated and unsaturated, homolytic and heterolytic fission, free radical, initiation, propagation, termination, nucleophile, electrophile, nucleophilic, electrophilic, addition, substitution, elimination, hydrolysis,	Understanding	Summative	Question(s) will be asked in the annual examination.	

			condensation, oxidation and reduction)				
		SLO: C-11-E-08	Define catenation and explain its importance in organic chemistry.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-09	Describe terminology associated with types of organic mechanisms (Some examples include: free-radical substitution, electrophilic addition, nucleophilic substitution, nucleophilic addition)	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-10	Draw the mechanism of a chemical reaction using curly arrows to represent the movement of a pair of electrons in at least three different types of reactions, including nucleophilic substitution, electrophilic addition, and elimination reactions.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-11	Apply the term 'planar' when describing the arrangement of atoms in organic molecules.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-12	Describe structural isomerism (in the context of organic molecules) and its division into chain, positional, functional group isomerism metamerism and tautomerism.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	Hydrocarbons	SLO: C-11-E-13	Classify hydrocarbons as aliphatic and aromatic.	Understanding	Summative	Question(s) will be asked in the annual examination.	10
		SLO: C-11-E-14	Describe nomenclature of alkanes and cycloalkanes.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-15	Explain the shapes of alkanes and cycloalkanes exemplified by ethane and cyclopropane.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-16	Explain unreactive nature of alkanes towards polar reagents.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-17	Define homolytic and heterolytic fission, free radical initiation, propagation, and termination.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-18	Describe the mechanism of free radical substitution in alkanes exemplified by methane and ethane.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-19	Identify organic redox reactions.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-20	Explain the nomenclature of alkenes.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-21	Explain shape of ethene molecule in terms of structure and bonding..	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-22	Describe the structure and reactivity of alkenes as exemplified by ethene.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-23	Explain with suitable examples the terms isomerism, stereoisomerism and structural isomerism.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be the part of classroom teaching.	
		SLO: C-11-E-24	Explain dehydration of alcohols and dehydrohalogenation of RX for the preparation of ethene.	Understanding	Summative	Question(s) will be asked in the annual examination.	

		SLO: C-11-E-25	Describe the chemistry of alkenes by the following reactions of ethene: hydrogenation, hydrohalogenation, hydration, halogenation, halohydrate, epoxidation, ozonolysis, polymerization.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-26	Explain the concept of conjugation in alkenes having alternate double bonds.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-27	Use the IUPAC naming system for alkenes.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-28	Describe the mechanism of electrophilic addition in alkenes, using bromine / ethene and hydrogen bromide /propene as examples.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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).	Understanding	Summative	Question(s) will be asked in the annual examination.	
	Halogeno alkanes	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.	Understanding	Summative	Question(s) will be asked in the annual examination.	05
		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).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-32	Describe nucleophilic substitution reactions (specifically: a. the reaction with NaOH(aq) and heat to produce an alcohol b. the reaction with KCN in ethanol and heat to produce a nitrile. c. the reaction with NH ₃ in ethanol heated under pressure to produce an amine. d. the reaction with aqueous silver nitrate in ethanol	Understanding	Summative	Question(s) will be asked in the annual examination.	

			as a method of identifying the halogen present as exemplified by bromoethane).				
		SLO: C-11-E-33	Describe the elimination reaction with NaOH in ethanol and heat to produce an alkene as exemplified by bromoethane.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	Hydroxy Compounds	SLO: C-11-E-34	State the reactions (reagents and conditions) by which alcohols can be produced: (a) electrophilic addition of steam to an alkene, $\text{H}_2\text{O(g)}$ and H_3PO_4 catalyst (b) reaction of alkenes with cold dilute acidified potassium manganate(VII) to form a diol (c) substitution of a halogenoalkane using NaOH (aq) and heat (d) reduction of an aldehyde or ketone using NaBH_4 or LiAlH_4 (e) reduction of a carboxylic acid using LiAlH_4 (f) hydrolysis of an ester using dilute acid or dilute alkali and heat describe the reaction with oxygen (combustion) of organic hydroxy compounds.	Knowledge	Summative	Question(s) will be asked in the annual examination.	07
		SLO: C-11-E-35	Describe substitution to halogenoalkanes, e.g. by reaction with HX or KBr with H_2SO_4 or H_3PO_4 ; or with PCl_3 and heat; or with PCl_5 ; or with SOCl_2 .	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-36	Describe the reaction of hydroxy organic compounds with Na(s).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-37	Describe the oxidation with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ 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).	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-38	Describe the dehydration of alcohols to alkenes by using a heated catalyst, e.g. Al_2O_3 or a concentrated acid.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-39	Describe the formation of esters by reaction with carboxylic acids and concentrated H_2SO_4 or H_3PO_4 as catalyst as exemplified by ethanol.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-40	Classify alcohols as primary, secondary and tertiary alcohols, to include examples with more than one alcohol group.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-41	State characteristic distinguishing reactions, e.g. mild oxidation with acidified $\text{K}_2\text{Cr}_2\text{O}_7$, colour change from orange to green.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-42	Deduce the presence of a $\text{CH}_3\text{CH(OH)-}$ group in an alcohol, $\text{CH}_3\text{CH(OH)-R}$, from its reaction with alkaline I_2 (aq) to form a yellow precipitate of tri-iodomethane and an ion, RCO_2^-	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-43	Explain the acidity of alcohols compared with water	Understanding	Summative	Question(s) will be asked in the annual examination.	
	Carbonyl	SLO: C-11-E-44	State the reactions (reagents and conditions) by which	Understanding	Summative	Question(s) will be asked in the	08

Compound		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			annual examination.	
	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	Understanding	Summative	Question(s) will be asked in the annual examination.	
	SLO: C-11-E-46	Describe the mechanism of the nucleophilic addition reactions of hydrogen cyanide with aldehydes and ketones.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	SLO: C-11-E-47	Describe the use of 2,4-dinitrophenylhydrazine (2,4-DNPH reagent) to detect the presence of carbonyl compounds.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	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)	Understanding	Summative	Question(s) will be asked in the annual examination.	
	SLO: C-11-E-49	Deduce the presence of a CH_3CO- group in an aldehyde or ketone, CH_3COR , from its reaction with alkaline $I_2(aq)$ to form a yellow precipitate of tri-iodomethane and an ion, RCO_2^- .	Application	Summative	Question(s) will be asked in the annual examination.	
	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	Knowledge	Summative	Question(s) will be asked in the annual examination.	
	SLO: C-11-E-51	Describe a. the redox reaction with reactive metals to produce a salt and $H_2(g)$ b. the neutralization reaction with alkalis to produce a salt and H_2O c. the acid-base reaction with carbonates to produce a salt and $H_2O(l)$ and $CO_2(g)$ d. esterification with alcohols with concentrated H_2SO_4 as catalyst e. reduction by $LiAlH_4$ to form a primary alcohol.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	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_2SO_4 as catalyst.	Knowledge	Summative	Question(s) will be asked in the annual examination.	
	SLO: C-11-E-53	Describe the hydrolysis of esters by dilute acid and by dilute alkali and heat	Understanding	Summative	Question(s) will be asked in the annual examination.	
Nitrogen Compound	SLO: C-11-E-54	Define primary and secondary amines, and explain their basic properties and reactivity.	Understanding	Summative	Question(s) will be asked in the annual examination.	03
	SLO: C-11-E-55	Identify the differences between primary and secondary amines in terms of their structure and chemical properties.	Understanding	Summative	Question(s) will be asked in the annual examination.	

	Amines	SLO: C-11-E-56	Describe the preparation methods of primary and secondary amines, including nucleophilic substitution reactions and reduction of nitro compounds.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-57	Explain the properties and reactivity of phenylamine and azo compounds, including their use as dyes and pigments.	Understanding	Summative	Question(s) will be asked in the annual examination.	
	Organic Synthesis	SLO: C-11-E-58	Explain the concept of organic synthesis and functional group interconversions.	Understanding	Summative	Question(s) will be asked in the annual examination.	03
		SLO: C-11-E-59	Identify organic functional groups using the reactions in this progression grid.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-60	Predict properties and reactions of organic molecules based on functional group presence.	Application	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-61	Devise multi-step synthetic routes for preparing organic molecules.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		SLO: C-11-E-63	Explain the concept of retrosynthesis and its application in organic synthesis.	Understanding	Formative	Question(s) will not be asked from 63, it needs more explanation. Could be possible in grade 12	
F	Energy	SLO: C-11-F-01	Differentiate between the difference between petrochemical and chemicals derived from them,	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	02
		SLO: C-11-F-02	Identify the various raw materials for the petrochemical industry.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	
		SLO: C-11-F-03	Explain the process of fractional distillation and refining of petroleum and identify the important fractions.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	
		SLO: C-11-F-04	Describe the basic building block processes in petrochemical technology and explain the petrochemical process technology.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	
		SLO: C-11-F-05	List some major petrochemicals and understand the importance of petrochemicals in the modern world.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	
		SLO: C-11-F-06	Distinguish between energy density and specific energy of different energy sources, and explain the efficiency of energy transfer.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom	

						teaching.	
		SLO: C-11-F-07	Explain the formation, properties, and uses of fossil fuels, and the importance of fossil fuels in the modern world.	Understanding	Summative	Question(s) will be asked in the annual examination.	
		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.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	
		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.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	
		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.	Understanding	Formative	Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	
		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.	Application		Question(s) will not be asked in the annual examination, however it will be part of classroom teaching.	
							Total Lectures for theory = 150
G	Practically perform chemical experiments	SLO: C-11-G-01	Identify the chemical hazards in the lab in context of the experiment being conducted.	Knowledge	Formative	Question will not be asked in PBA, however, it will be part of Lab work	02
		SLO: C-11-G-02	Test that the equipment is working properly without any potential risk of injury before conducting an experiment.	Knowledge	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
		SLO: C-11-G-03	Ensure that workspace for conducting the experiment is not crowded with apparatus as to be hazardous.	Knowledge	Formative	Question will not be asked in PBA, however, it will be part 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.	Knowledge	Formative	Question will not be asked in PBA, however, it will be part 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.	Knowledge	Formative	Question will not be asked in PBA, however, it will be part 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.	Knowledge	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
		SLO: C-11-G-07	Identify the proper waste disposal system for chemicals being used.	Knowledge	Formative	Question will not be asked in PBA, however, it will be part of	

Practically perform chemical experiments	SLO: C-11-G-08	Set up apparatus following instructions given in written or diagrammatic form.	Understanding	Formative	Lab work	
	SLO: C-11-G-09	Use apparatus to collect an appropriate quantity of data	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-10	Make observations, including subtle differences in colour, solubility or quantity of materials	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-11	Make measurements using pipettes, burettes, measuring cylinders, thermometers and other common laboratory apparatus.	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-12	Decide how many tests or observations to perform	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-13	Identify where repeated readings or observations are appropriate	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-14	Replicate readings or observations as necessary, including where an anomaly is suspected	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-15	Identify where confirmatory tests are appropriate and the nature of such tests	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-16	Select reagents to distinguish between given ions.	Knowledge	Formative	Question will not be asked in PBA, however, it will be part 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	Application	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-18	Describe an acid–base titration to include the use of a: a. burette b. volumetric pipette c. suitable indicator	Understanding	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	16
	SLO: C-11-G-19	Describe how to identify the endpoint of a titration using an indicator	Understanding	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
	SLO: C-11-G-20	Describe tests to identify the anions: a. CO_3^{2-} : By reaction with dilute acid and then testing	Understanding	Summative for Practical	Laboratory work- will be assessed in PBA.	

			for carbon dioxide gas. b. $\text{Cl}^{1-} / \text{Br}^{1-} / \text{I}^{1-}$: By acidifying with dilute nitric acid then adding aqueous silver nitrate. c. NO_3^{1-} : By reduction with aluminum foil and aqueous sodium hydroxide and then testing for ammonia gas. d. SO_4^{2-} : By acidifying with dilute nitric acid then adding aqueous barium nitrate. e. SO_3^{2-} : By reaction with acidified aqueous potassium manganate(VII).		Based Assessment (PBA).		
		SLO: C-11-G-21	Describe tests using aqueous sodium hydroxide and aqueous ammonia to identify the aqueous cations: a) aluminum, Al^{3+} b) ammonium, NH_4^{1+} c) calcium, Ca^{2+} d) chromium(III), Cr^{3+} e) copper(II), Cu^{2+} f) iron(II), Fe^{2+} g) iron(III), Fe^{3+} h) zinc, Zn^{2+}	Understanding	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		SLO: C-11-G-22	Present numerical data, values or observations in a single table of results with headings and units that conform to accepted scientific conventions.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
	Data representation and analysis	SLO: C-11-G-22	Record raw readings of a quantity to the same degree of precision and observations to the same level of detail.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	02
		SLO: C-11-G-23	Show working in calculations and key steps in reasoning.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		SLO: C-11-G-24	Use the correct number of significant figures for calculated quantities.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		SLO: C-11-G-25	Draw an appropriate table in advance of taking readings or making observations and record all data in the table.	Application	Summative for Practical	Laboratory work- will be assessed in PBA.	

					Based Assessment (PBA).		
		SLO: C-11-G-26	Use the appropriate presentation method to produce a clear presentation of the data.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		SLO: C-11-G-27	Plot appropriate variables on appropriate, clearly labelled x- and y-axes with carefully chosen scales.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		SLO: C-11-G-28	Draw straight lines or smooth curves of best fit to show the trend of a graph.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		SLO: C-11-G-29	Describe the patterns and trends shown by data in tables and graphs.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		SLO: C-11-G-30	Describe and summarize the key points of a set of observations.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		SLO: C-11-G-31	Determine the gradient of a straight-line graph and extrapolate the line of a graph.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
		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.	Application	Summative for Practical Based Assessment (PBA).	Laboratory work- will be assessed in PBA.	
	Suggest improvements based on	SLO: C-11-G-33	Draw conclusions from interpretations of observations, data and calculated values.	Application	Formative	Question will not be asked in PBA, however, it will be part of Lab work	02
		SLO: C-11-G-34	Make scientific explanations of data, observations and conclusions that they have described.	Application	Formative	Question will not be asked in PBA, however, it will be part	

validity, reliability and safety.					of Lab work	
	SLO: C-11-G-35	Analyse intrinsic errors in measuring device.	Application	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-36	Describe systematic errors.	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-37	Identify the most significant sources of error in an experiment	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	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	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-39	Analyse the limitations of the experimental design and propose appropriate modifications that will improve the accuracy of the experiment.	Application	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-40	Evaluate the validity of the methods used	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-41	Explain improvements or extensions to the methods used.	Understanding	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-42	Apply scientific language effectively.	Application	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-43	Document the work of others and sources of information used	Application	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-44	Suggest ways in which to extend the investigation to answer a new question.	Application	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
	SLO: C-11-G-45	Suggest alternate chemicals in experimental design which contribute to green chemistry.	Application	Formative	Question will not be asked in PBA, however, it will be part of Lab work	
			Total lectures for Practical's = 22 Total Lectures for Theory + practical's = 150 + 20 = 172			

Note: PBA STANDS FOR “PRACTICAL BASED ASSESSMENT”

FINAL CONCEPTUAL PATTERN OF HSSC-I & II

Physics, Chemistry, Biology and Computer Science

Total Marks: 80 Marks (Theory Paper)

Components	Detail
Marks Allocated to MCQs	40 marks
Total MCQs	80
Marks per MCQ	0.5
Objective Portion – MCQs (40 Marks)	Section-A (MCQs) 56 straight MCQs ($56 \times 0.5 = 28$ marks) 24 MCQs with (6-stimulus/situations/scenario) ($24 \times 0.5 = 12$ marks)
Subjective Portion – SRQs & ERQs Structure (40 Marks)	Section-B (SRQs) Section B having 7 questions. Each question has internal choice. Each question having 4 marks. ($7 \times 4 = 28$ marks) Section –C (ERQs) Section C having 2 questions. Each question has internal choice. Each question having 6 marks. ($2 \times 6 = 12$ marks)
Subjective Portion Structure	7 straight SRQs (with no sub parts) 2 straight ERQs (may having parts but with same concept)

Important Note:

- i) Summative SLOs of NCP Mathematics 2022-23 for grades XI or XII will only be included.
- ii) Ensure balanced domain coverage using the Table of Specifications (ToS).

PHY/CHEM/BIO/COMP HSSC-I

To be filled-in by the Candidate

PAPER VERSION	(A)	(B)	(C)	(D)	(E)
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CORRECTLY FILLED



WRONG METHOD

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Time Allowed: 1:40 Hours

Total Marks: 40

Candidate Sign. _____

Invigilator Sign. _____

Question Booklet No. _____

Roll No. _____

FILL ONLY ONE BUBBLE FOR EACH CORRECT ANSWER. USE BLACK BALL POINT/MARKER

1	(A)	(B)	(C)	(D)	21	(A)	(B)	(C)	(D)	41	(A)	(B)	(C)	(D)	61	(A)	(B)	(C)	(D)
2	(A)	(B)	(C)	(D)	22	(A)	(B)	(C)	(D)	42	(A)	(B)	(C)	(D)	62	(A)	(B)	(C)	(D)
3	(A)	(B)	(C)	(D)	23	(A)	(B)	(C)	(D)	43	(A)	(B)	(C)	(D)	63	(A)	(B)	(C)	(D)
4	(A)	(B)	(C)	(D)	24	(A)	(B)	(C)	(D)	44	(A)	(B)	(C)	(D)	64	(A)	(B)	(C)	(D)
5	(A)	(B)	(C)	(D)	25	(A)	(B)	(C)	(D)	45	(A)	(B)	(C)	(D)	65	(A)	(B)	(C)	(D)
6	(A)	(B)	(C)	(D)	26	(A)	(B)	(C)	(D)	46	(A)	(B)	(C)	(D)	66	(A)	(B)	(C)	(D)
7	(A)	(B)	(C)	(D)	27	(A)	(B)	(C)	(D)	47	(A)	(B)	(C)	(D)	67	(A)	(B)	(C)	(D)
8	(A)	(B)	(C)	(D)	28	(A)	(B)	(C)	(D)	48	(A)	(B)	(C)	(D)	68	(A)	(B)	(C)	(D)
9	(A)	(B)	(C)	(D)	29	(A)	(B)	(C)	(D)	49	(A)	(B)	(C)	(D)	69	(A)	(B)	(C)	(D)
10	(A)	(B)	(C)	(D)	30	(A)	(B)	(C)	(D)	50	(A)	(B)	(C)	(D)	70	(A)	(B)	(C)	(D)
11	(A)	(B)	(C)	(D)	31	(A)	(B)	(C)	(D)	51	(A)	(B)	(C)	(D)	71	(A)	(B)	(C)	(D)
12	(A)	(B)	(C)	(D)	32	(A)	(B)	(C)	(D)	52	(A)	(B)	(C)	(D)	72	(A)	(B)	(C)	(D)
13	(A)	(B)	(C)	(D)	33	(A)	(B)	(C)	(D)	53	(A)	(B)	(C)	(D)	73	(A)	(B)	(C)	(D)
14	(A)	(B)	(C)	(D)	34	(A)	(B)	(C)	(D)	54	(A)	(B)	(C)	(D)	74	(A)	(B)	(C)	(D)
15	(A)	(B)	(C)	(D)	35	(A)	(B)	(C)	(D)	55	(A)	(B)	(C)	(D)	75	(A)	(B)	(C)	(D)
16	(A)	(B)	(C)	(D)	36	(A)	(B)	(C)	(D)	56	(A)	(B)	(C)	(D)	76	(A)	(B)	(C)	(D)
17	(A)	(B)	(C)	(D)	37	(A)	(B)	(C)	(D)	57	(A)	(B)	(C)	(D)	77	(A)	(B)	(C)	(D)
18	(A)	(B)	(C)	(D)	38	(A)	(B)	(C)	(D)	58	(A)	(B)	(C)	(D)	78	(A)	(B)	(C)	(D)
19	(A)	(B)	(C)	(D)	39	(A)	(B)	(C)	(D)	59	(A)	(B)	(C)	(D)	79	(A)	(B)	(C)	(D)
20	(A)	(B)	(C)	(D)	40	(A)	(B)	(C)	(D)	60	(A)	(B)	(C)	(D)	80	(A)	(B)	(C)	(D)



Federal Board HSSC-I Examination

Chemistry Model Question Paper

National Curriculum 2022-2023 (Inclusive Scheme of Studies 2024)
(50% MCQs & 50% Descriptive)

SECTION - A (Marks 40)

Time Allowed: 1:40 hours

Section – A is compulsory. All parts of this section are to be answered on the OMR Sheet given in the E-Sheet and handed over to the Centre Superintendent.
Deleting/ overwriting is not allowed. Do not use lead pencil.

Roll Number						Paper Version
						A

Candidate Sign. _____

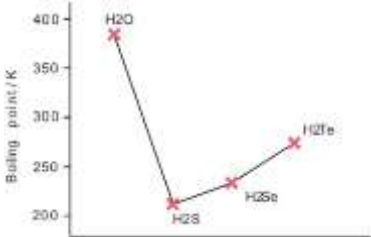
Invigilator Sign. _____

Note: Fill the correct bubble for each question on OMR Sheet given in the E-Sheet. Each question carries 0.5 mark.

S #	Question	(A)	(B)	(C)	(D)																				
1.	Which halide ion is the strongest reducing agent?	Cl ⁻	Br ⁻	I ⁻	F ⁻																				
2.	The carbonate ion, CO ₃ ²⁻ , has a total of 30 protons. How many neutrons and electrons are there in this ion?	<table><tr><td>neutrons</td><td>electrons</td></tr><tr><td>30</td><td>30</td></tr></table>	neutrons	electrons	30	30	<table><tr><td>neutrons</td><td>electrons</td></tr><tr><td>32</td><td>32</td></tr></table>	neutrons	electrons	32	32	<table><tr><td>neutrons</td><td>electrons</td></tr><tr><td>30</td><td>32</td></tr></table>	neutrons	electrons	30	32	<table><tr><td>neutrons</td><td>electrons</td></tr><tr><td>32</td><td>28</td></tr></table>	neutrons	electrons	32	28				
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neutrons	electrons																								
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neutrons	electrons																								
30	32																								
neutrons	electrons																								
32	28																								
3.	A sample of Magnesium contains the following isotopes. Isotope Percentage abundance ²⁴ Mg 81.21% ²⁵ Mg 14.10% ²⁶ Mg 4.69% What is the relative atomic mass of magnesium, to one decimal place, in this sample?	24.10	24.23	25.09	25.83																				
4.	Which is the electronic configuration of a Nitrogen atom in its ground state?	<table><tr><td>↑</td><td>↑↓</td><td>↑↓</td><td>↑</td><td>↑</td></tr></table>	↑	↑↓	↑↓	↑	↑	<table><tr><td>↑</td><td>↑↑</td><td>↑↑</td><td>↑</td><td>↑</td></tr></table>	↑	↑↑	↑↑	↑	↑	<table><tr><td>↑↓</td><td>↑↓</td><td>↑↓</td><td>↑</td><td>↑</td></tr></table>	↑↓	↑↓	↑↓	↑	↑	<table><tr><td>↑↓</td><td>↑↓</td><td>↑</td><td>↑</td><td>↑</td></tr></table>	↑↓	↑↓	↑	↑	↑
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5.	The first six ionisation energies of an element, in <i>kJ mol⁻¹</i> , are shown. 578 1817 2745 11578 14831 18378 Which group of the Periodic Table includes this element?	Group 2	Group 3	Group 4	Group 5																				
6.	The conversion of a nitrile into a carboxylic acid involves which type of reaction, and which reagent/conditions are required?	Hydrolysis using dilute acid or dilute alkali followed by acidification	Oxidation with acidified <i>K₂Cr₂O₇</i> under reflux	Reduction with LiAlH ₄	Neutralization with NaOH solution																				

7.	Which reagent is used to convert butanone to butan-2-ol?	HI in the presence of phosphorous	Water in the presence of mercuric sulphate	LiAlH ₄ in the presence of ether	KMnO ₄ in the presence of Concentrated H ₂ SO ₄												
8.	Which species is not tetrahedral?	<i>CCl₄</i>	<i>CH₄</i>	<i>NH¹⁺₄</i>	<i>ICl¹⁻₄</i>												
9.	Number of moles present in 50 cm ³ of a 0.0800 <i>mol</i> dm ⁻³ solution of sodium carbonate is:	4 moles	0.4 moles	0.004 moles	0.04 moles												
10.	What volume will be occupied by 2 moles of oxygen gas at STP?	11.2 <i>dm</i> ³	22.4 <i>dm</i> ³	44.8 <i>dm</i> ³	2.24 <i>dm</i> ³												
11.	How many orbitals are there in total in the first four quantum shells of an atom?	7	10	16	30												
12.	Which element is in the p-block and has two unpaired electrons in the ground state?	sodium	silicon	chlorine	aluminium												
13.	Which of these molecules is polar?	<i>CO₂</i>	<i>BF₃</i>	<i>CH₄</i>	<i>NH₃</i>												
14.	Which type of isomerism is exhibited by the following pair of compounds A and B? A: CH ₃ –O–CH ₂ –CH ₂ –CH ₃ B: CH ₃ –CH ₂ –O–CH ₂ –CH ₃	Chain isomerism	Position isomerism	Functional group isomerism	Metamerism												
15.	There are 6.02 × 10 ²³ atoms in 0.25 mol of:	He	<i>H₂O</i>	<i>BH₃</i>	<i>CH₄</i>												
16.	What is the electron arrangement of the nitrogen ion in magnesium nitride?	1s ² 2s ²	1s ² 2s ² 2p ³	1s ² 2s ² 2p ⁴	1s ² 2s ² 2p ⁶												
17.	Which one of the following compounds has the same empirical formula and molecular formula?	<i>C₆H₁₂O₆</i>	<i>C₆H₆</i>	<i>CH₃COOH</i>	<i>CH₃CH₂OH</i>												
18.	In a series of experiments, the initial rate of a reaction was measured at different concentrations of reactant A (with all other conditions constant): <table border="1"><thead><tr><th>Experiment</th><th>[A] / mol dm⁻³</th><th>Initial Rate / mol dm⁻³ s⁻¹</th></tr></thead><tbody><tr><td>1</td><td>0.10</td><td>0.020</td></tr><tr><td>2</td><td>0.20</td><td>0.080</td></tr><tr><td>3</td><td>0.40</td><td>0.320</td></tr></tbody></table> Based on the experimental data, what is the correct rate equation for the reaction with respect to reactant A?	Experiment	[A] / mol dm ⁻³	Initial Rate / mol dm ⁻³ s ⁻¹	1	0.10	0.020	2	0.20	0.080	3	0.40	0.320	Rate = k[A]	Rate = k[A] ²	Rate = k[A] ³	Rate = k
Experiment	[A] / mol dm ⁻³	Initial Rate / mol dm ⁻³ s ⁻¹															
1	0.10	0.020															
2	0.20	0.080															
3	0.40	0.320															
19.	Chlorine reacts with methane in the presence of ultraviolet light, what happens first in the reaction mechanism?	The Cl–Cl bond is split homiletically.	The Cl–Cl bond is split heterolytically.	The C–H bond is split homiletically.	The C–H bond is split heterolytically.												
20.	At higher temperature, the Boltzmann distribution curve becomes:	Narrower and taller	Broader and flatter	Unchanged	Discontinuous												
21.	In a reaction pathway diagram, activation energy is best described as:	Energy difference between reactants and products	Energy required to break bonds of products	Energy barrier between reactants and transition state	Total enthalpy change of reaction												

22.	Which compound will undergo nucleophilic addition reaction with HCN?	Propane	Propene	Propanone	Propanol
23.	Which of the following defines lattice energy?	Energy released when gaseous ions form a solid ionic compound	Energy required to melt a solid	Energy of electron gain by atoms	Energy released in combustion
24.	Which factor increases electron affinity (makes it more negative)?	Larger atomic size	Higher nuclear charge	Increased shielding only	Lower electronegativity
25.	Which process results in a positive entropy change?	Freezing of water	Melting of ice	Condensation of steam	Formation of NaCl(s) from ions in solution
26.	Given: $S^\circ(\text{H}_2\text{O}) = 213 \text{ J K}^{-1} \text{ mol}^{-1}$, $S^\circ(\text{O}_2) = 205 \text{ J K}^{-1} \text{ mol}^{-1}$, $S^\circ(\text{H}_2) = 424 \text{ J K}^{-1} \text{ mol}^{-1}$. Calculate ΔS° for: $2\text{H}_2(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{H}_2\text{O}(\text{g})$.	$-416 \text{ J K}^{-1} \text{ mol}^{-1}$	$+416 \text{ J K}^{-1} \text{ mol}^{-1}$	$+627 \text{ J K}^{-1} \text{ mol}^{-1}$	$-627 \text{ J K}^{-1} \text{ mol}^{-1}$
27.	A student studies the decomposition of a substance A. The reaction is found to be first order, with a half-life of 10 minutes at a fixed temperature. The value of the rate constant (k) is:	0.0693 min^{-1}	0.693 min^{-1}	14.43 min^{-1}	1.443 min^{-1}
28.	According to Le Chatelier's Principle, increasing pressure favors the side with:	More moles of gas	Fewer moles of gas	Equal moles of gas	No gaseous molecules
29.	Which reagent is used to convert an alkene into a diol?	NaOH	Acidified KMnO_4 (cold)	HBr	NaBH_4
30.	Which of the following reactions represents oxidation in organic chemistry?	$\text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{CH}_3$	$\text{CH}_3\text{CH}_2\text{OH} \rightarrow \text{CH}_3\text{CHO}$	$\text{CH}_3\text{CH}_2\text{CH}_3 \rightarrow \text{CH}_2=\text{CHCH}_3$	$\text{C}_6\text{H}_6 \rightarrow \text{C}_6\text{H}_{12}$
31.	Which observation would provide the strongest evidence for catenation	Carbon forms four bonds with Hydrogen to form CH_4	Carbon forms double bond with oxygen to form CO_2	Carbon atoms linked together to form C_5H_{12}	Carbon forms triple bond with Nitrogen to form HCN
32.	Which reaction occurs most vigorously at room temperature even in the darkness?	$\text{Cl}_2 + \text{H}_2 \rightarrow 2\text{HCl}$	$\text{Br}_2 + \text{H}_2 \rightarrow 2\text{HBr}$	$\text{I}_2 + \text{H}_2 \rightarrow 2\text{HI}$	$\text{F}_2 + \text{H}_2 \rightarrow 2\text{HF}$
33.	The number of principal energy levels in an atom is equal to its:	Group number	Period number	Atomic number	Valence electrons
34.	Which of the following correctly represents an important industrial use of sulfur compounds?	Used only in making plastics and glass	Used to neutralize acids in water treatment	Used as a fuel in automobiles	Used in fertilizers & gunpowder
35.	Which of these ions has the greatest ionic radius?	N^{3-}	F^{1-}	Na^+	Al^{3+}

36.	Which property is characteristic of crystalline solids but not amorphous solids?	They have irregular shapes	They show cleavage along definite planes	They soften gradually when heated	They possess isotropic physical properties
37.	The standard enthalpy change for the reaction is $\Delta H^\circ = +1668 \text{ kJ}$ $2\text{NF}_3(\text{g}) \rightarrow 2\text{N}(\text{g}) + 6\text{F}(\text{g})$ What is the bond energy of the N–F bond?	-556 kJ mol^{-1}	-278 kJ mol^{-1}	$+278 \text{ kJ mol}^{-1}$	$+556 \text{ kJ mol}^{-1}$
38.	Which observation indicates that a system has reached equilibrium?	Concentrations of reactants and products keep changing	Concentrations of reactants and products become constant	Concentrations of reactants and products are the same	The forward and backward reactions stop completely
39.	The diagram shows the variation of the boiling points of the Group VI hydrides  What explains the much higher boiling point of water compared to the other hydrides?	Strong OH bond energy	Polarity of OH bonds	High electronegativity of oxygen	Hydrogen bonding between H_2O molecules
40.	The correct K_{sp} expression for AgCl is:	$[\text{AgCl}]$	$[\text{Ag}^+][\text{Cl}^-]$	$[\text{Ag}^+] + [\text{Cl}^-]$	$[\text{Ag}^+]^2[\text{Cl}^-]$
41.	A buffer solution is prepared by mixing $0.1 \text{ M CH}_3\text{COOH}$ and $0.1 \text{ M CH}_3\text{COONa}$. If K_a of acetic acid is 1.8×10^{-5} , the pH of the buffer will be approximately:	3.7	4.7	6.7	5
42.	An element in Period 3, Group 2 of the periodic table has:	3 principal energy levels and 2 valence electrons	2 principal energy levels and 3 valence electrons	3 valence electrons and 2 principal energy levels	2 valence electrons and 2 principal energy levels
43.	What is the correct IUPAC name of the following compound? $\text{CH}_3\text{CH}(\text{CH}_3)\text{CH}_2\text{CH}(\text{CH}_3)\text{CH}_3$	2,4-dimethylpentane	3,3-dimethylpentane	2,3-dimethylpentane	Hexane
44.	An organic compound X has the molecular formula C_5H_{10} . On ozonolysis, followed by treatment with water in the presence of zinc, it produces two different compounds: propanone and ethanal. What is the correct name of compound X?	Pent-1-ene	Pent-2-ene	2-Methylbut-1-ene	2-Methylbut-2-ene
45.	Carboxylic acids react with alcohols to form esters. Which acid and alcohol react together to form the following ester? $\text{CH}_3\text{CH}_2\text{COOCH}_3$	propanoic acid and ethanol	propanoic acid and methanol	ethanoic acid and ethanol	ethanoic acid and methanol

46.	What intermediate compound is formed when ethanal is converting to lactic acid?	Ethanol	Ethanoic acid	Cyanohydrin	Ethene
47.	What is produced when propan-2-ol is heated with an excess of potassium dichromate in the presence of sulfuric acid?	propane	propanoic acid	propene	propanone
48.	What is the structure of the product of the reaction between but-1-ene and bromine, Br ₂ ?	CH ₂ Br–CH ₂ –CH ₂ –CH ₂ Br	CH ₂ Br–CH ₂ –CHBr–CH ₃	CH ₃ –CHBr–CH ₂ –CH ₂ Br	CH ₃ –CH ₂ –CHBr–CH ₂ Br
49.	When propene (CH ₃ –CH=CH ₂) undergoes hydrohalogenation with HBr, the major product is 2-bromopropane. Why does this major product form?	Because a primary carbocation is formed, which is more stable	Because a secondary carbocation is formed, which is more stable than a primary carbocation	Because hydrogen always attaches to the carbon with fewer hydrogens	Because the reaction avoids carbocation formation altogether
50.	Which reagent could best be used to distinguish between propanal and propanone?	Ag(NH ₃) ₂ ⁺	Br ₂ in CCl ₄	2,4-dinitrophenyl hydrazine (2,4-DNPH)	NaBH ₄ in CH ₃ OH
51.	Compound X is an organic compound. It gives a precipitate with aqueous silver nitrate. All of this precipitate remains undissolved when an excess of dilute or concentrated aqueous ammonia is added. Which of the following could be the identity of X?	1-Chlorobutane	2-Chlorobutane	2-Bromobutane	Iodomethane
52.	In the formation of photochemical smog, Peroxyacetyl Nitrate (PAN) is produced when:	NO reacts directly with ozone	Hydrocarbon s react with NO to form PAN	Peroxyacetyl radicals formed from hydrocarbons combine with NO ₂	Sunlight directly converts NO ₂ into PAN
53.	Which statement correctly describes a secondary amine?	Nitrogen bonded to one alkyl group and two hydrogens	Nitrogen bonded to two alkyl groups and one hydrogen	Nitrogen bonded to three alkyl groups	Nitrogen bonded only to hydrogen atoms
54.	The solubility of AgCl decreases in NaCl solution because of:	Neutralization	Hydrolysis	Common ion effect	Buffer action
55.	Which of the following represents a propagation step in the chlorination of methane?	$2Cl \cdot \rightarrow$	$Cl \cdot + CH_4 \rightarrow HCl + CH_3 \cdot$	$Cl \cdot + Cl \cdot \rightarrow Cl_2$	$CH_3 \cdot + CH_3 \cdot \rightarrow C_2H_6$
56.	Which reaction has an enthalpy change equal to the standard enthalpy change of formation of propane?	$3C(g) + 4H_2(g) \rightarrow C_3H_8(g)$	$3C(g) + 8H(g) \rightarrow C_3H_8(g)$	$3C(s) + 4H_2(g) \rightarrow C_3H_8(g)$	$3C(s) + 4H_2(g) \rightarrow C_3H_8(l)$

	STIMULUS/SITUATION/SCENARIO BASED MCQs					
Scenario for MCQ 57 to 60			A chemist compares the molecules BF_3 , NF_3 , and NH_3 , noting that BF_3 has no dipole moment despite having polar B–F bonds, that NF_3 and NH_3 are both polar but differ in bond angles and boiling points, and that NH_3 has an unusually high boiling point compared to similar-sized molecules, leading her to apply VSEPR theory, Valence Bond Theory, orbital hybridization, and intermolecular force concepts to explain these observations.			
57.	Why does BF_3 have zero net dipole moment despite having polar B–F bonds?	The B–F bonds are non-polar because fluorine and boron have the same electronegativity	BF_3 is trigonal planar; the three bond dipoles are symmetrically arranged and cancel out exactly	BF_3 is trigonal pyramidal and dipoles cancel due to lone pair	The bond dipoles in BF_3 are too weak to create a net dipole	
58.	Using VSEPR theory, what is the correct geometry and bond angle of NH_3 ?	Trigonal planar, 120°	Tetrahedral, 109.5°	Trigonal pyramidal, 107°	Bent, 104.5°	
59.	Which of the following orbitals overlap in the ammonia (NH_3) molecule to form the N–H bonds?	p–p	sp^2 –p	sp^3 –s	s–s	
60.	Which type of intermolecular force is mainly responsible for the unusually high boiling point of NH_3 compared to PH_3 ?	London dispersion forces	Dipole–dipole interactions	Hydrogen bonding	van der Waals forces only	
Scenario for MCQ 61 to 64			A student in a chemistry laboratory prepared different aqueous solutions including HCl , NH_4Cl and CH_3COOH . During the experiment, the student measured pH values and studied acid-base behavior of different substances.			
61.	In the reaction: $\text{CH}_3\text{COOH} + \text{H}_2\text{O}$; $\text{CH}_3\text{COO}^- + \text{H}_3\text{O}^+$ the conjugate base of acetic acid is:	H_3O^+	H_2O	CH_3COO^-	CH_3COOH	
62.	A $0.001 \text{ mol dm}^{-3}$ HCl solution has pH equal to:	1	3	11	7	
63.	The aqueous solution of NH_4Cl is acidic because:	NH_4^+ undergoes hydrolysis producing H_3O^+	Cl^- produces OH^-	NH_4Cl is insoluble	Water acts as Lewis acid	
64.	Which species acts as a Lewis base in the formation of coordinate bond with H^+ ?	BF_3	AlCl_3	NH_3	H^+	

Scenario for MCQ 65 to 68		In a laboratory experiment, 1.0 g of ammonium nitrate (NH ₄ NO ₃) is added to 0.8 g of sodium hydroxide (NaOH). The reaction proceeds according to the equation: NH ₄ NO ₃ + NaOH → NaNO ₃ + NH ₃ + H ₂ O values: NH ₄ NO ₃ = 80.0, NaOH = 40.0, NaNO ₃ = 85.0, NH ₃ = 17.0, H ₂ O = 18.0									
65.	Which reagent is the limiting reagent in this reaction, and why?	NaOH, because it has a low mass	NaOH, because it has fewer moles compared to NH ₄ NO ₃	NH ₄ NO ₃ , because it has fewer moles compared to NaOH	NH ₄ NO ₃ , because it produces less moles of product						
66.	What is the maximum mass of NaNO ₃ that could be produced in this reaction?	0.425 g	1.06 g	0.850 g	2.12 g						
67.	What volume of NH ₃ gas is formed at STP?	0.28 dm ³	1.12 dm ³	2.24 dm ³	22.4 dm ³						
68.	If the actual mass of NaNO ₃ obtained is 0.80 g, what is the percentage yield of the reaction?	75.5 %	85.0%	50.0%	100%						
Scenario for MCQ 69 to 72		Use the diagram to answer the questions.									
		Group →	1 IA	2 IIA		13 III A	14 IV A	15 VA	16 VIA	17 VII A	18 VIII A
		1	A							B	
		2	C	D						E	
		3	F	G		H	I	J	K	L	M
69.	Which labeled element belongs to the p-block?	D	G	J	F						
70.	Which element has the greatest number of occupied energy levels?	C	D	F	L						
71.	Which labeled element is most likely a metalloid?	H	I	J	K						
72.	Which element is expected to have the highest ionization energy?	F	H	L	M						
Scenario for MCQ 73 to 76		A chemical engineer investigates the Haber process: N ₂ (g) + 3H ₂ (g) ⇌ 2NH ₃ (g) + heat The goal is to maximize ammonia production by adjusting reaction conditions.									
73.	To increase ammonia yield, the engineer should use:	Low pressure	High pressure	Low concentration of reactants	Open container						
74.	Since the forward reaction is exothermic, lowering the temperature will:	Favor ammonia formation	Favor reactants	Stop equilibrium completely	Reduce the effect of pressure						
75.	The equilibrium constant (K _c) for the Haber process depends only on:	Concentration of nitrogen	Pressure applied	Temperature	Amount of catalyst						

76.	The addition of a catalyst in the Haber process will:	Permanently increase ammonia yield	Shift equilibrium to the right	Decrease the reverse reaction rate	Allow equilibrium to be reached faster	
Scenario for MCQ 77 to 80		A research chemist is analyzing four unlabelled liquid samples (A, B, C and D), each containing a different pure alcohol. To identify them, the chemist subjects each sample to a series of diagnostic chemical tests, including mild oxidation using acidified potassium dichromate (VI) ($K_2Cr_2O_7$) and an iodoform test using alkaline aqueous iodine ($NaOH + I_2$).				
77.	Sample A is identified as propane-1,2-diol. How are the two hydroxyl groups in this molecule classified?	One primary and one secondary	Two primary	Two secondary	One secondary and one tertiary	
78.	When Sample B is warmed with acidified $K_2Cr_2O_7$, the solution rapidly changes from orange to green. Which alcohol could not be Sample B?	Ethanol	Propan-2-ol	2-Methylpropan-2-ol	Butan-1-ol	
79.	Sample C gives a positive iodoform test, producing a yellow precipitate. Which structural feature must be present in Sample C?	$-CH_2OH$	$-CH(OH)CH_3$	$-C(OH)(CH_3)_2$	$-CH_2CH_2OH$	
80.	Sample D has molecular formula $C_4H_{10}O$. It decolorizes acidified $K_2Cr_2O_7$ and gives a positive iodoform test. What is the exact identity of Sample D?	Butan-1-ol	Butan-2-ol	2-Methylpropan-1-ol	2-Methylpropan-2-ol	



Federal Board HSSC-I Examination

Model Question Paper Chemistry

National Curriculum 2022-2023 (Inclusive Scheme of Studies 2024)
(50% MCQs & 50% Descriptive)

Time allowed: 1 hour 20 Minutes

Total Marks: 40

Note: Answer all parts from Section 'B' and all questions from Section 'C' on the **E-sheet**.
Write your answers on the allotted /given spaces.

SECTION-B (7x4 = 28 Marks)

Q1	In a laboratory experiment, 12.0 g of magnesium reacts with 14.0 g of hydrochloric acid according to the equation: $\text{Mg} + 2\text{HCl} \rightarrow \text{MgCl}_2 + \text{H}_2$ Identify the reactant which is in excess and explain your answer. Calculate the maximum volume of hydrogen gas produced at room temperature and pressure (RTP).	2+2	OR	A chemist tests three different fertilizer salt solutions and records their pH values: Ammonium chloride (NH_4Cl): pH = 5 (Acidic) Sodium carbonate (Na_2CO_3): pH = 11 (Basic) Sodium chloride (NaCl): pH = 7 (Neutral) Using the concept of salt hydrolysis, answer the following: why each salt solution shows acidic, basic, or neutral behaviour. Identify the ions responsible for hydrolysis in each case. Name the parent acid and parent base for each salt, and explain how their strengths determine the final pH of the solution.	2+2
Q2	During the electrophilic reaction of propene with hydrogen bromide, two carbocations can be formed. Explain why the secondary carbocation is more stable than the primary carbocation. Name the major product and write the name and statement of the rule involved.	2+2	OR	During a sunny day, nitrogen oxides and hydrocarbons released from vehicles react in the atmosphere to produce photochemical smog. Explain why sunlight is necessary for this process and the role of nitrogen oxides (NO_x) in the reactions. Write two effects of photochemical smog on living organisms.	2+2
Q3	Using the Boltzmann distribution curve of molecular energies, explain briefly why a higher temperature increases the rate of reaction. Explain how the use of a catalyst increases the rate of a reaction.	2+2	OR	Use the rules of systematic nomenclature (IUPAC) to write the name of the following structures. $\text{CH}_2=\text{C}(\text{CH}_3)-\text{CH}_2-\text{CH}(\text{CH}_3)-\text{CH}_3$ $(\text{CH}_3)_2\text{CH}-\text{CH}(\text{CH}_3)-\text{CH}_2-\text{OH}$ $\text{CH}_3-\text{C}(\text{O})-\text{CH}(\text{CH}_3)-\text{CH}_2-\text{CH}_3$ $\text{CH}_3-\text{C}(\text{CH}_3)_2-\text{COOH}$	2+2
Q4	Describe the trend in the relative reactivity of halide ions as reducing agents down Group 17 Describe how the behavior of a silver halide precipitate in aqueous ammonia (NH_3) can be used to distinguish between bromide (Br^-) and iodide (I^-) ions.	2+2	OR	Explain how nitroethane $\text{C}_2\text{H}_5\text{NH}_2$ is converted into aminoethane by reduction. Also give four other methods to obtain the same product?	04
Q5	Define halogenoalkanes. Classify halogenoalkanes based on the position of the halogen-bearing carbon atom, also write example of halogenoalkane in each type.	1+3	OR	Describe dynamic equilibrium in terms of reversible physical changes. Why no apparent change is observed even though changes continue at the molecular level.	2+2
Q6	State the required reagents and specific conditions needed to convert an alkene into a diol. State the required reagents and	2+2	OR	Consider the reaction network below, where Compound B is a nitrile and Compound C is an ester. All three pathways yield the same carboxylic acid, Compound A .	2+2

	experimental conditions for both the acid-catalyzed and alkali-catalyzed hydrolysis of an ester		[Primary Alcohol] ↓ CrO₃ / H₂SO₄ ↓ [Compound A] ← [Compound B] (Nitrile) H₂O + dilute H₂SO₄ ↑ Dilute H₂SO₄, Heat [Compound C] (Ester) If Compound A is ethanoic acid (CH₃COOH), draw the structural formulas for the starting materials Compound B and Compound C. Explain why the conversion of Compound B to Compound A requires a two-step treatment (base followed by acid).	
Q7	Define the first electron affinity (EA) and Lattice Energy. Why is the electron affinity of chlorine more negative than that of fluorine, despite fluorine being more electronegative?	2+2	OR An element X has an electron configuration ending in 3s ¹ . Answer the following: a) State the group, period, and block of element X. b) Explain how its position in the periodic table helps in determining its chemical properties.	3+1

SECTION C (2x6=12)

Q8	Using Le Chatelier's principle, explain how operating conditions are used to increase the yield in (a) The Haber process for the manufacture of ammonia. (b) The Contact process for the oxidation of sulfur dioxide to sulfur trioxide.	3+3	OR	Predict the shapes and bond angles of methane, ammonia and water using VSEPR theory, and explain the type of hybridization of the central atom in each molecule.	6
Q9	Silver chromate (Ag_2CrO_4) is a sparingly soluble salt. (a) Construct the expression for the solubility product constant, K_{sp} , of Ag_2CrO_4 and calculate its value if the solubility is $1.3 \times 10^{-4} \text{ mol dm}^{-3}$. (b) A solution of Ag_2CrO_4 is prepared in $0.10 \text{ mol dm}^{-3} \text{ AgNO}_3$. Calculate the new solubility of Ag_2CrO_4 in this solution and explain briefly the reason for the decrease in solubility.	3+3	OR	For the formation of potassium fluoride, the following data are given: - Enthalpy of atomization of K = $+89 \text{ kJ mol}^{-1}$ - Enthalpy of atomization of F_2 = $+79 \text{ kJ mol}^{-1}$ - Ionization energy of K = $+419 \text{ kJ mol}^{-1}$ - Electron affinity of F = -328 kJ mol^{-1} - Enthalpy of formation of KF = -567 kJ mol^{-1} (a) Draw a Born-Haber cycle for KF formation. (b) Calculate the lattice energy of KF. (c) Explain how ionic size affects lattice energy in KF.	2+2+2

Federal Board HSSC-I Examination
Chemistry Model Question Paper
National Curriculum 2022-2023 (Inclusive Scheme of Studies 2024)
(50% MCQs & 50% Descriptive)
Alignment of Questions with Student Learning Outcomes

Section: Q. No. (Part no.)	SLOs	Cognitive Domain	Allocated Marks in Model Paper
A: 1	SLO: C-11-C-25 Describe the relative reactivity of halide ions as reducing agents	U	0.5
A: 2	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.	K	0.5
A: 3	SLO: C-11-B-27 Perform calculations involving non-integer relative atomic masses and abundance of isotopes from given data, including mass spectra.	A	0.5
A: 4	SLO: C-11-B-12 Apply Aufbau principle, Pauli exclusion principle and Hunds rule to write the electronic configuration of elements	A	0.5
A: 5	SLO: C-11-B-24 Deduce the electronic configurations of elements using successive ionization energy data.	U	0.5
A: 6	SLO: C-11-E-50 Recall the reactions by which carboxylic acids can be produced: b) hydrolysis of nitriles with dilute acid or dilute alkali followed by acidification	K	0.5
A: 7	SLO: C-11-E-34 State the reactions (reagents and conditions) by which alcohols can be produced: (d) reduction of an aldehyde or ketone using NaBH ₄ or LiAlH ₄	K	0.5
A: 8	SLO: C-11-B-36 Predict the shapes, and bond angles in molecules and ions.	U	0.5
A: 9	SLO: C-11-B-58 Calculate the quantities of reactants and products involved in a chemical reaction using stoichiometric principles (Some examples include calculations involving reacting masses, volumes of gasses, volumes, and concentrations of solutions, limiting reagent and excess reagent, percentage yield calculations).	U	0.5
A: 10	SLO: C-11-B-54 State the volume of one mole of a gas at STP.	K	0.5
A: 11	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.	K	0.5
A: 12	SLO: C-11-B-14 Describe the electronic configurations to include the number of electrons in each shell, subshell and orbital.	U	0.5
A: 13	SLO: C-11-B-46 Use the concept of electronegativity to explain bond polarity and dipole moments of molecules	K	0.5
A: 14	SLO: C-11-E-12 Describe structural isomerism (in the context of organic molecules) and its division into chain, positional, functional group isomerism metamerism and tautomerism	U	0.5
A: 15	SLO: C-11-B-57 Derive measurements of mass, volume, and number of particles using Moles.	U	0.5
A: 16	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 , 3s ¹ c). Students should be able to determine both of these from the periodic table and are not required to memorize these. d. students should understand that chemical properties of an atom are governed by valence electrons).	K	0.5
A: 17	SLO: C-11-E-06 Deduce the molecular and/or empirical formula of a compound, given its structural, displayed, or skeletal formula.	U	0.5

A: 18	SLO: C-11-B-106 Use experimental data to calculate the rate of a reaction.	A	0.5
A: 19	SLO: C-11-E-17 Define homolytic and heterolytic fission, free radical initiation, propagation, and termination.	U	0.5
A: 20	SLO: C-11-B-108 Use the Boltzmann distribution curve to explain the effect of temperature on the rate of a reaction.	U	0.5
A: 21	SLO: C-11-B-76 Interpret a reaction pathway diagram, in terms of the enthalpy change of the reaction and of the activation energy.	K	0.5
A: 22	SLO: C-11-E-60 Predict properties and reactions of organic molecules based on functional group presence.	A	0.5
A: 23	SLO: C-11-B-82 Define terms such as enthalpy change of atomization, ΔH_{atm} , lattice energy, $\Delta H_{\text{Lattice}}$, first electron affinity, EA	K	0.5
A: 24	SLO: C-11-B-84 Explain the factors affecting the electron affinities of elements.	U	0.5
A: 25	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.	U	0.5
A: 26	SLO: C-11-B-94 Calculate the entropy change for a reaction, ΔS , given the standard entropies, S , of the reactants and products.	A	0.5
A: 27	SLO: C-11-B-113 Calculate the numerical value of a rate constant using the initial rates and half-life method.	A	0.5
A: 28	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.	K	0.5
A: 29	SLO: C-11-E-34 State the reactions (reagents and conditions) by which alcohols can be produced: (b) reaction of alkenes with cold dilute acidified potassium manganate(VII) to form a diol.	K	0.5
A: 30	SLO: C-11-E-19 Identify organic redox reactions.	U	0.5
A: 31	SLO: C-11-E-08 Define catenation and explain its importance in organic chemistry.	K	0.5
A: 32	SLO: C-11-C-23 Describe the reactions of the halogen elements with hydrogen and explain their relative reactivity in these reactions.	U	0.5
A: 33	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.	K	0.5
A: 34	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.	U	0.5
A: 35	SLO: C-11-B-07 Explain the change in atomic and ionic radius across a period and down a group.	U	0.5
A: 36	SLO: C-11-B-73 Differentiate between amorphous and crystalline solids.	K	0.5
A: 37	SLO: C-11-B-79 Calculate the bond energies for the enthalpy change of reaction, ΔH .	A	0.5
A: 38	SLO: C-11-B-118 State the necessary conditions for equilibrium and the ways that equilibrium can be recognized.	K	0.5
A: 39	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).	A	0.5

A: 40	SLO: C-11-B-138 Construct an expression for K_{sp} .	A	0.5
A: 41	SLO: C-11-B-136 Calculate the pH of buffer solutions in given appropriate data.	A	0.5
A: 42	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.	K	0.5
A: 43	SLO: C-11-E-05 Describe the use of systematic nomenclature of simple aliphatic organic molecules with functional groups.	U	0.5
A: 44	SLO: C-11-E-25 Describe the chemistry of alkenes by the following reactions of ethene: hydrogenation, hydrohalogenation, hydration, halogenation, halohydration, epoxidation, ozonolysis, polymerization.	U	0.5
A: 45	SLO: C-11-E-39 Describe the formation of esters by reaction with carboxylic acids and concentrated H_2SO_4 or H_3PO_4 as catalyst as exemplified by ethanol.	U	0.5
A: 46	SLO: C-11-E-59 Identify organic functional groups using the reactions in this progression grid.	K	0.5
A: 47	SLO: C-11-E-37 Describe the oxidation with acidified $K_2Cr_2O_7$ 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).	U	0.5
A: 48	SLO: C-11-E-25 Describe the chemistry of alkenes by the following reactions of ethene: hydrogenation, hydrohalogenation, hydration, halogenation, halohydration, epoxidation, ozonolysis, polymerization.	U	0.5
A: 49	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).	U	0.5
A: 50	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)	U	0.5
A: 51	SLO: C-11-E-32 Describe nucleophilic substitution reactions (specifically: d. the reaction with aqueous silver nitrate in ethanol as a method of identifying the halogen present as exemplified by bromoethane).	U	0.5
A: 52	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).	U	0.5
A: 53	SLO: C-11-E-55 Identify the differences between primary and secondary amines in terms of their structure and chemical properties.	K	0.5
A: 54	SLO: C-11-B-140 Apply the concept of common ion effect to describe why solubility changes in presence of common ion	U	0.5
A: 55	SLO: C-11-E-18 Describe the mechanism of free radical substitution in alkanes exemplified by methane and ethane.	U	0.5
A: 56	SLO: C-11-B-82 Define terms such as enthalpy change of atomization, ΔH_{atm} , lattice energy, $\Delta H_{Lattice}$, first electron affinity, EA	K	0.5
A: 57	SLO: C-11-B-46 Use the concept of electronegativity to explain bond polarity and dipole moments of molecules	U	0.5
A: 58	SLO: C-11-B-35 Describe the shapes and bond angles in molecules using VSEPR theory (including describing by sketching)	U	0.5
A: 59	SLO: C-11-B-37 Explain hybridization and types of hybridization	U	0.5
A: 60	SLO: C-11-B-44 Describe hydrogen bonding, limited to molecules containing N-H, O-H	U	0.5

	and H-F groups, (including ammonia, water and H-F as simple examples).		
A: 61	SLO: C-11-B-131 Identify conjugate acid-base pairs in reactions.	U	0.5
A: 62	SLO: C-11-B-134 Calculate $[H^+]$ and pH values for strong acids	A	0.5
A: 63	SLO: C-11-B-129 Use the concept of hydrolysis to explain why aqueous solutions of some salts are acidic or basic.	U	0.5
A: 64	SLO: C-11-B-135 Distinguish that Lewis acids accept lone pair, and Lewis bases donate lone pair	U	0.5
A: 65	SLO: C-11-B-51 Explain the concept of limiting reagents.	U	0.5
A: 66	SLO: C-11-B-52 Calculate the maximum amount of product and amount of any unreacted excess reagent.	A	0.5
A: 67	SLO: C-11-B-58 Calculate the quantities of reactants and products involved in a chemical reaction using stoichiometric principles (Some examples include calculations involving reacting masses, volumes of gasses, volumes, and concentrations of solutions, limiting reagent and excess reagent, percentage yield calculations).	A	0.5
A: 68	SLO: C-11-B-53 Calculate theoretical yield, actual yield, and percentage yield when given appropriate information.	A	0.5
A: 69	SLO: C-11-C-02 Explain that the periodic table is arranged into four blocks associated with s, p, d and f sublevels.	U	0.5
A: 70	SLO: C-11-C-03 Recognize that the period number is the outer occupied energy level.	U	0.5
A: 71	SLO: C-11-C-05 Identify the positions of metals, nonmetals and metalloids in the periodic table.	U	0.5
A: 72	SLO: C-11-C-18 Explain the trends in the ionization energies and electron affinities of the Group 1 and Group 17 elements.	U	0.5
A: 73	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.	K	0.5
A: 74	SLO: C-11-B-125 Determine if the equilibrium constant will increase or decrease when temperature is changed, given the equation for the reaction.	U	0.5
A: 75	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.	A	0.5
A: 76	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.	K	0.5
A: 77	SLO: C-11-E-40 Classify alcohols as primary, secondary and tertiary alcohols, to include examples with more than one alcohol group.	K	0.5
A: 78	SLO: C-11-E-41 State characteristic distinguishing reactions, e.g. mild oxidation with acidified $K_2Cr_2O_7$, colour change from orange to green	U	0.5
A: 79	SLO: C-11-E-42 Deduce the presence of a $CH_3CH(OH)-$ group in an alcohol, $CH_3CH(OH)-R$, from its reaction with alkaline I_2 (aq) to form a yellow precipitate of triiodomethane and an ion, RCO_2^-	U	0.5
A: 80	SLO: C-11-E-41 State characteristic distinguishing reactions, e.g. mild oxidation with acidified $K_2Cr_2O_7$, colour change from orange to green SLO: C-11-E-42 Deduce the presence of a $CH_3CH(OH)-$ group in an alcohol, $CH_3CH(OH)-R$, from its reaction with alkaline I_2 (aq) to form a yellow precipitate of triiodomethane and an ion, RCO_2^-	A	0.5

SECTION – B +C (Marks 40)

Sr No	SLO	Domain	Cognitive level		SLO	Domain	Cognitive level
Q1	SLO: C-11-B-58 Calculate the quantities of reactants and products involved in a chemical reaction using stoichiometric principles (Some examples include calculations involving reacting masses, volumes of gasses, volumes, and concentrations of solutions, limiting reagent and excess reagent, percentage yield calculations).	B	A	OR	SLO: C-11-B-129 Use the concept of hydrolysis to explain why aqueous solutions of some salts are acidic or basic.	B	A
Q2	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).	E	U	OR	SLO: C-11-D-06 Identify the chemical reactions and processes that occur in the atmosphere (some examples include the formation of smog and acid rain).	D	U
Q3	SLO: C-11-B-108 Use the Boltzmann distribution curve to explain the effect of temperature on the rate of a reaction. SLO: C-11-B-109 Explain the concept of catalyst and how they increase the rate of a reaction by lowering the activation energy.	B	U	OR	SLO: C-11-E-05 Describe the use of systematic nomenclature of simple aliphatic organic molecules with functional groups.	E	U
Q4	SLO: C-11-C-25 Describe the relative reactivity of halide ions as reducing agents SLO: C-11-C-26 Explain the reactions of halide ions with aqueous silver ions and concentrated sulfuric acid.	C	U	OR	SLO: C-11-E-56 Describe the preparation methods of primary and secondary amines, including nucleophilic substitution reactions and reduction of nitro compounds.	E	U
Q5	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.	E	K	OR	SLO: C-11-B-117 (K) Define dynamic equilibrium between two physical states. SLO: C-11-B-118 (K) State the necessary conditions for equilibrium and the ways that equilibrium can be recognized.	B	K
Q6	SLO: C-11-E-34 State the reactions (reagents and conditions) by which alcohols can be produced: (a) electrophilic addition of steam to an alkene, $\text{H}_2\text{O(g)}$ and H_3PO_4 catalyst(b) reaction of alkenes with cold dilute acidified potassium manganate(VII) to form a diol(c) substitution of a halogenoalkane using NaOH (aq) and heat(d) reduction of an	E	K	OR	SLO: C-11-E-50 Recall the reactions by which carboxylic acids can be produced: a) oxidation of primary alcohols and aldehydes with acidified $\text{K}_2\text{Cr}_2\text{O}_7$ or acidified KMnO_4 and refluxing b) hydrolysis of nitriles with dilute acid or dilute alkali followed by acidification c)	E	K

	aldehyde or ketone using NaBH_4 or LiAlH_4 (e) reduction of a carboxylic acid using LiAlH_4 (f) hydrolysis of an ester using dilute acid or dilute alkali and heat describe the reaction with oxygen (combustion) of organic hydroxy compounds.				hydrolysis of esters with dilute acid or dilute alkali and heat followed by acidification		
Q7	SLO: C-11-B-82 Define terms such as enthalpy change of atomization, ΔH_{atm}, lattice energy, $\Delta H_{\text{Lattice}}$, first electron affinity, EA SLO: C-11-B-84 Explain the factors affecting the electron affinities of elements.	B	K+ U	OR	C-11-C-02 Explain that the periodic table is arranged into four blocks associated with the four sub-levels -s, p, d, and f. C-11-C-03 Recognize that the period number (n) is the outer energy level that is occupied by electrons (U). 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 (K). C-11-C-08 Deduce the electron configuration of an atom from the element's position on the periodic table, and vice versa (U).	C	K + U
Q8	SLO: C-11-B-127 Explain industrial applications of Le Chatelier's Principle using Haber's process and the Contact Process as an example	B	U	OR	SLO: C-11-B-36 Predict the shapes, and bond angles in molecules and ions. SLO: C-11-B-37 Explain hybridization and types of hybridization.	B	U
Q9	SLO: C-11-B-138 Construct an expression for K_{sp}. SLO: C-11-B-139 Calculate K_{sp} from concentrations and vice versa. 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. SLO: C-11-B-141 Perform calculations using K_{sp} values and concentration of a common ion.	B	A	OR	SLO: C-11-B-85 Construct Born-Haber cycles for ionic solids. SLO: C-11-B-86 Perform calculations involving Born-Haber cycles.	B	A

Table of specifications (TOS) Model Paper Chemistry (50% MCQs Pattern) Grade XI (HSSC I)

Domains	A	B									C		
Assessment Objectives	History of Chemistry	Atomic Structure	Chemical Bonding	Stoichiometry	Electrochemistry	States and Phases of Matter	Energetics	Chemical Kinetics	Chemical Equilibrium	Acids, Bases and Salts	Periodic Table	Group 17	Nitrogen and Sulphur
K (Knowledge)		A (2) 0.5 A (16) 0.5 A (11) 0.5	A (13) 0.5	A (10) 0.5		A (36) 0.5	A (21) 0.5 A (23) 0.5 A (56) 0.5 Q7(f)2		A (38) 0.5 A (28) 0.5 A (73) 0.5 A (76) 0.5 Q5(s)4		A (33) 0.5 A (42) 0.5 Q7(s)3		
U (Understanding)		A (5) 0.5 A (12) 0.5 A (35) 0.5	A (8) 0.5 A (57) 0.5 A (58) 0.5 A (59) 0.5 A (60) 0.5 Q8(s)6	A (9) 0.5 A (15) 0.5 A (65) 0.5			A (24) 0.5 A (25) 0.5 Q7(f)2	A (20) 0.5 Q3(f) 4	A (63) 0.5 A (74) 0.5 Q8(f) 6	A (54) 0.5 A (61) 0.5 A (64) 0.5	A (69) 0.5 A (70) 0.5 A (71) 0.5 A (72) 0.5 Q7(s)1	A (1) 0.5 A (32) 0.5 Q4(f)4	A (34) 0.5 A (52) 0.5
A (Application)		A (3) 0.5 A (4) 0.5		A (66) 0.5 A (67) 0.5 A (68) 0.5 Q1(f)4		A (39) 0.5	A (26) 0.5 A (37) 0.5 Q9(s)6	A (18) 0.5 A (27) 0.5	A (75) 0.5	A (40) 0.5 A (41) 0.5 A (62) 0.5 Q1(s)4 Q9(f)6			
Total Marks		04	09	7.5		01	13.5	5.5	13.5	13	07	05	01

Domains	D		E							F		
Assessment Objectives	Environmental Chemistry-Air	Environmental Chemistry-Water	Organic Chemistry	Hydrocarbons	Halogenoalkanes	Hydroxy Compounds	Carbonyl Compounds	Amines	Organic Synthesis	Energy	Total Marks	% Age
K (Knowledge)			A (31) 0.5		Q5(f)4	A (7)0.5 A (29) 0.5 A (77) 0.5 Q6(f)4	A (6) 0.5 Q6(s)4	A (53) 0.5	A (46) 0.5		32	26.66 %
U (Understanding)	Q2(s)4		A (14) 0.5 A (17) 0.5 A (43) 0.5 Q3(s)4	A (19) 0.5 A (30) 0.5 A (44) 0.5 A (48) 0.5 A (49) 0.5 A (55) 0.5 Q2(f)4	A (51) 0.5	A (45) 0.5 A (47) 0.5 A (78) 0.5 A (79) 0.5	A (50) 0.5	Q4(s)4			60	50 %
A (Application)						A (80) 0.5			A (22) 0.5		28	23.33 %
Total Marks	4		06	07	4.5	08	05	4.5	1		120	100

Note:

- 1 This ToS does not reflect policy, but it is particular to this model question paper.
- 2 Proportionate / equitable representation of the content areas may be ensured.
- 3 The percentage of cognitive level is 30%, 50%, and 20% for knowledge, understanding, and application, respectively with $\pm 5\%$ variation. The domain of Application also contains all other higher order Cognitive Levels of Bloom's Taxonomy.
- 4 While selecting alternative questions for SRQs and ERQs, it must be kept in mind that:
 - Difficulty levels of the two alternative questions of the internal choice will be same
 - SLOs of the two alternative questions of the internal choice must be different

Key: Question Number (part/ first choice) marks example: Q2 (i / f)3 ,
Question Number (part/ second choice) marks Q2 (i / s) 3



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