

Government of Nepal

Teachers' Service Commission

Secondary Level Curriculum of Subjective Examination-2077

Subject: Chemistry

Marks: 100

Time: 3 Hours

Section A

Unit One: General Chemistry

- 1.1 Atomic Structure:** Rutherford's, Bohr's and wave mechanical model de Broglie's equation, Heisenberg's uncertainty principle, spectrum of hydrogen atom, quantum numbers, Aufbau and Pauli's exclusion principle, Hund's rule and electronic configurations
- 1.2 Stoichiometry:** Basic concepts of chemistry (atoms, molecules, relative masses of atoms and molecules, atomic mass unit, radicals, molecular formula, empirical formula, percentage composition from molecular formula, Dalton's atomic theory, Avogadro's law and mole)
- 1.3 Volumetric Analysis:** Gravimetric and volumetric analysis and equivalent weight, concentration, primary and secondary standard, law of equivalence and normality equation and titration
- 1.4 Oxidation and Reduction:** General and electronic concept, oxidation number and rules for assigning oxidation number and balancing chemical equation

Unit Two: Basic Inorganic Chemistry

- 2.1. Chemical Bonding and Shape of Molecules:** Ionic, covalent, coordinate covalent and metallic bond, Lewis dot structure of s and p block elements, VSEPR theory, valence bond theory, hybridization involving s and p orbitals and bond characteristics
- 2.2 Classification of Elements and Periodic Table:** Modern periodic table, ionization energy, electron affinity, electro negativity and metallic characters
- 2.3 Chemistry of Non-Metals:** Hydrogen, oxygen, nitrogen and halogens, carbon, phosphorus and sulphur
- 2.4. Chemistry of Metals:** **Alkali metal** (sodium, sodium hydroxide and sodium carbonate), **alkaline earth metals** (quick lime, bleaching powder, magnesia, plaster of paris and epsom salt), **chemistry of heavy metals** (copper, zinc and iron, blue vitriol, red oxide and black oxide of copper, white vitriol and manufacture of steel)

Unit Three: Basic Physical Chemistry

- 3.1 States of Matters: Gaseous States** (Boyle's law, Charles' law and combined gas equation, universal gas constant, real gases, deviation of real gas from ideality, van der Waals equation, kinetic theory of gas, derivation of kinetic gas equation, different types of velocities of gas molecules), **liquid state** (properties of liquids, surface tension and viscosity), **solid state** (crystal system and Bravais lattices and cubic crystals)
- 3.2 Ionic and Chemical Equilibrium:** Physical and chemical equilibrium, relationship between K_p and K_c , Le Chatelier's principle. Ostwald's dilution law, ionic product of water (K_w), dissociation constant of acid and base, (K_a & K_b), Concept of pK_a and pK_b ,
- 3.3 pH value:** pH of strong and weak acids and bases, solubility, common ion effect, Buffer solution, indicators, **acid, base and salts** (Arrhenius, Bronsted-Lowry, Lewis concept, conjugate acid-base pairs and hydrolysis of salts)
- 3.4 Electrochemistry:** Faradays laws of electrolysis, electrode potential and standard electrode potential, electrodes, electrochemical series, voltaic cell, commercial batteries and fuel cells

Unit Four: Organic Chemistry

- 4.1 Basic Concept and Fundamental Principles of Organic Chemistry:** Properties of carbon, classification of organic compounds, homologous series, cracking and reforming, quality of gasoline, octane number, cetane number and gasoline additive, isomerism homolytic and heterolytic fission, electrophile, nucleophiles and free radicals, inductive and resonance effect
- 4.2 Hydrocarbons: Aliphatic hydrocarbon** (hydrocarbons, preparation, properties of alkane, alkene and alkyne and unsaturation test -bromine water test and Baeyer's test), **aromatic hydrocarbons** (Huckel's rule, Kekule structure of benzene, resonance and orientation)
- 4.3 Aliphatic and Aromatic Halo Compounds:** Classification, isomerism, preparation and properties of haloalkane and haloarenes
- 4.4 Aliphatic and Aromatic Alcohol, Ether and Amines: Alcohol** (preparation, properties, isomerism and classification of alcohol, Victor Meyer's Method), **ether** (classification, properties and, preparation), **amines** (classification, isomerism, separation of amines by Hoffmann's method, preparation of primary amines and aniline properties)

4.5 Aliphatic and Aromatic Aldehyde, Ketone and Acids: Aldehyde and ketone (isomerism, preparation, properties, and uses-formalin, benzaldehyde and acetophenone), **carboxylic acids** (isomerism, preparation, properties of monocarboxylic acids and benzoic acid, acid derivatives - acid halides, amides, esters and anhydrides) and **heterocyclic compounds** (furan, pyridine and pyrrole)

Unit Five: Overview of Science Curriculum and Evaluation of Secondary Level

5.1 Curriculum and Text book: Comparative study of chemistry curriculum, text books and teacher manual of Grade 11 and 12

5.2 Teaching aids: Development and use of ICT (integrated communication technology) in teaching chemistry

5.3 Evaluation: Test items, marking scheme of chemistry of class 11 and 12 and specification grid

5.4 Assessment: Continuous assessment system, grade and grading system

5.5 Teaching Learning Science: Science process skills, scientific method, approaches of teaching science, science laboratory and safety measures

Section B

Unit Six: Applied Chemistry

6.1 Fundamentals of Applied Chemistry: Chemical industry, stages in producing a new product, continuous and batch processing and environmental impact of the chemical industry.

6.2 Modern Chemical Manufactures: Manufacture of ammonia, nitric acid, sulphuric acid, sodium hydroxide and sodium carbonate

6.3 Fertilizers and Pesticides: Chemical fertilizers, insecticides, herbicides and fungicides

6.4 Chemistry in Service of Mankind : Polymers, dyes, drugs and medicine, cement, paper and pulp industry

Unit Seven: Coordination and Environmental Chemistry

7.1 Chemistry of d Block Elements: Properties characteristics and comparison of first (3d), second (4d) and third transition (5d) series

7.2 Co-ordination Compounds: Concept, characterizations, applications and isomerism, Werner's theory, Sidgwick theory, valence bond theory, chelates and polynuclear complexes, high spin and low spin complexes, inner and outer orbital complexes, stereochemistry with coordination number 4 and 6, substitution reactions and trans effect

7.3 Crystal Field Theory: Assumptions, splitting of d-orbitals, crystal field stabilization energy, spectrochemical series) nephelauxetic effect and Jahn Teller effect

7.4 Environmental Chemistry and Pollution: Type, sources and monitoring of air, water and soil pollution, BOD, COD, DO, TOC, acidity and basicity of soil, soil texture, green house effect and ozone layer

Unit Eight: Physical Chemistry

8.1 Chemical Kinetics: Rate of chemical reactions and integrated rate equation, order and molecularity of reaction, half life of a reaction, temperature dependence of the rate of reaction, effect of catalyst, Arrhenius equation, kinetic, simultaneous reaction, collision theory of a bimolecular and unimolecular reaction, transition state theory, chain reactions, methods of fast reaction kinetics and diffusion controlled reactions in solution

8.2 Thermodynamics: First law of thermodynamics, second law of thermodynamics, experimental determination of ΔE using bomb calorimeter, experimental determination of ΔH , enthalpy of physical changes, molar heat capacity at constant pressure and volume, relation between C_p and C_v , Kirchoff's equation, isothermal and adiabatic expansion, work done in reversible adiabatic expansion, Joule's Thomson effect

8.3 Photochemistry and Catalysis: Thermo-chemical and photochemical reactions, Grothus Draper law, Stark Einstein law, quantum yield, Lambert-Beer's law and photochemical processes

8.4 Chemistry of Surface: Adsorption types of physical adsorption isotherms, Freundlich adsorption isotherms and Langmuir adsorption isotherm and Brunauer-Emmett-Teller (BET) equation

8.5 Electrochemistry: Electrolytic conductance, Kohlraush law, ionic conductance and ionic mobility, conductivity of water, Hittorf's rule, transference number Nernst's equation, primary and secondary reference electrodes, measurements of standard electrode potential, electrochemical series, potentiometer and applications of emf measurements

Unit Nine: Reaction Mechanism, Structure Elucidation and Stereochemistry

- 9.1 Aliphatic and Aromatic Nucleophilic Substitution:** Mechanism, stereochemistry and factors affecting on reaction rate (SN_1 and SN_2), SET mechanism and benzyne mechanism
- 9.2 Aliphatic and Aromatic Electrophilic Substitution:** Mechanisms, factors affecting on reaction (SE_1 , SE_2 and SE_i) mechanism, electrophilic substitution accompanied by double bond shift and free radical substitution reaction mechanism
- 9.3 Addition and Elimination Reaction:** Electrophilic and nucleophilic reaction mechanism, Markonikov and Anti Markonikov rule, E_1 , E_2 and E_1CB mechanism, stereochemistry, Saytzeff rule and Hofmann's rule
- 9.4 Biomolecules:** Carbohydrates lipids and fats, proteins, vitamins and minerals
- 9.5 Isolation, Structure Elucidation and Synthesis:** Naphthalene, anthracene, citral, menthol nicotine, camphor and morphine

Unit Ten: Tools and Techniques

- 10.1 Separation Technology:** Solvent extraction, **chromatography** (paper, ion exchange, gas, HPLC, column and thin layer)
- 10.2 Spectroscopy:** Atomic absorption spectroscopy (AAS), Flame photometry, UV-visible spectrophotometry, Fourier- transforms infrared spectroscopy (FTIR), nuclear magnetic resonance spectroscopy (1H NMR, ^{13}C NMR) and mass spectroscopy (MS)
- 10.3 Surface Characterization Techniques:** X-Ray diffraction, imaging and microscopic techniques (scanning electron microscopy and transmission electron microscopy)
- 10.4 Thermal Analysis:** Thermo-gravimetric analysis (T.G.A) and differential thermal analysis (D.T.A)
- 10.5 Electro-Analytical Methods:** Voltammetry, amperometry, Karl Fisher titration, coulometry and ion-selective electrodes

Specification Grid

Subject: Chemistry

Level: Secondary

Unit	Section	Scope of Curriculum	Questions	Marks
1	A	General Chemistry	1	10
2		Basic Inorganic Chemistry	1	10
3		Basic Physical Chemistry	1	10
4		Organic Chemistry	1	10
5		Overview of Science Curriculum and Evaluation of Secondary Level	1	10
6	B	Applied Chemistry	1	10
7		Coordination and Environmental Chemistry	1	10
8		Physical Chemistry	1	10
9		Reaction Mechanism, Structure Elucidation and Stereochemistry	1	10
10		Tools and Techniques	1	10
Total			10	100

Notes:

1. This curriculum is divided into section A & section B.
2. Generally from section A, questions will be asked related to pedagogy.
3. From section B questions will be asked covering cognitive level.
4. Separate answer sheets will be used for each section.
5. The medium of the language in written test will be either Nepali or English or both.
6. This curriculum will be effective from 2077/03/ 25