

Grade XI Chemistry NEB New Syllabus (2077)

Scope of Contents

Content Area: General and Physical Chemistry

1. Volumetric Analysis

- 1.1 Define and explain the terms volumetric and gravimetric analysis.
- 1.2 Express the concentration of solutions in terms of percentage, g/l, molarity, molality, normality, ppm, ppb
- 1.3 Define and calculate the equivalent weight of (elements, acids, bases, salts, oxidising and reducing agents).
- 1.4 Express the concentration of the solution in terms of normality.
- 1.5 Explain and apply the concept of the law of equivalence in chemical calculation.
- 1.6 Define and explain primary and secondary standard substances.
- 1.7 Explain different types of titration and their applications.

2. Ionic equilibrium

- state and explain different concepts of acids and bases
- define and use the term degree of ionization
 - explain autoionization of water and pH
 - state and explain the solubility product and the common ion effect
 - Describe the use of the solubility product principle and the common ion effect in the qualitative analysis of salts
 - classify salts and explain the hydrolysis of salts
 - solve numericals related to the above topics
 - explain the selection of indicators for acid-base titration

3. Chemical Kinetics

- 3.1 Define chemical kinetics.
- 3.2 Explain and use the terms rate of reaction, rate equation, and rate constant.
- 3.3 Explain qualitatively the factors affecting the rate of reaction.
- 3.4 Use collision theory to explain how the rate of chemical reaction is influenced by temperature, concentration, and particle size.
- 3.5 Explain the meaning of the term activation energy and activated complex.
- 3.6 Derive and explain the integrated rate equation and half-life for zero- and first-order reactions.
- 3.7 Construct and use rate equations, calculating an initial rate using concentration data.
- 3.8 Explain the significance of the Arrhenius equation and solve the related problems.
- 3.9 Explain and use the terms catalyst and catalysis (homogeneous, heterogeneous).
- 3.10 Describe enzymes as biological catalysts.
- 3.11 Explain the role of a catalyst in the reaction mechanism.
- 3.12 Solve related numerical problems based on rate, rate constant, and order of zero and first-order reactions.

4. Thermodynamics

- 4.1 Define thermodynamics.
- 4.2 Explain the energy change in chemical reactions.
- 4.3 Define the terms internal energy and state function. (enthalpy of solution, enthalpy of formation,

enthalpy of combustion, and enthalpy of reaction).

4.4 State and explain the first law of thermodynamics.

4.5 State and explain enthalpy and enthalpy changes in various processes

4.6 Explain endothermic and exothermic processes with the help of an energy profile diagram.

4.7 State laws of thermochemistry and solve numerical problems related to the Hess law.

4.8 Define the term entropy and spontaneity.

4.9 State and explain the second law of thermodynamics.

4.10 Define standard Gibbs free energy change of reaction by means of the equation $\Delta G = \Delta H - T\Delta S$.

4.11 Calculate ΔG for a reaction using the equation $\Delta G = \Delta H - T\Delta S$.

4.12 State whether a reaction or process will be spontaneous by using the sign of ΔG .

4.13 Explain the relationship between ΔG and the equilibrium constant.

5. Electrochemistry

5.1 Define the terms: standard electrode (redox) potential.

5.2 Explain the standard hydrogen electrode and calomel electrodes.

5.3 Calculate a standard cell potential by combining two standard electrode potentials.

5.4 Describe the applications of the electrochemical series.

5.5 Define and explain standard cell potential with reference to a voltaic cell: Zn-Cu cell, Ag-Cu cell

5.6 Use standard cell potentials to: explain/deduce the direction of electron flow in a simple cell and predict the feasibility of a reaction.

5.7 Explain the relationship between cell potential and free energy change.

5.8 State the possible advantages of developing other types of cells, e.g., the hydrogen/oxygen fuel cell and lithium-ion, rechargeable batteries.

Content Area: Inorganic Chemistry

6. Transition Metals

6.1 Explain the characteristics of transition metals.

6.2 Explain oxidation states of transition metals.

6.3 Describe complex ions and metal complexes.

6.4 Show shapes of complex ions.

6.5 Describe d-orbitals in complex ions (simple explanation by the crystal field theory) for the octahedral complex.

6.6 Explain reasons for the colour of transition metal compounds.

6.7 Explain the catalytic properties of transition metals.

7. Studies of Heavy Metals

7.1 Explain the occurrence of heavy metals.

7.2 Describe the extraction of heavy metals.

7.3 Describe properties (with air, acids, aqueous ammonia, and metal ions) and uses of copper.

7.4 Explain the chemistry (preparation, properties, and uses) of blue vitriol.

7.5 Write the formula and use red and black oxide of copper.

7.6 Describe properties (with air, acid, alkali, displacement reaction) and uses of zinc.

7.7 Explain the chemistry (preparation, properties, and uses) of white vitriol.

7.8 State properties of mercury.

7.9 Explain the chemistry (preparation, properties, and uses) of calomel and corrosive sublimate.

7.10 Explain properties and uses of iron.

7.11 Explain the manufacture of steel by the basic oxygen method and the open hearth process.

7.12 Explain corrosion of iron and its prevention.

7.13 Explain the preparation and uses of silver chloride and silver nitrate.

Content Area: Organic Chemistry

8. Haloalkanes

8.1 Describe the nomenclature, isomerism, and classification of monohaloalkanes.

8.2 Show the preparation of monohaloalkanes from alkanes, alkenes, and alcohols

8.3 State physical properties of monohaloalkanes.

Show the formations of alcohol, nitrile amine, ether, thioether, carbylamines, nitrite, and nitroalkane using haloalkanes.

8.4 Describe chemical properties of haloalkanes: substitution reactions SN1 and SN2 reactions (basic concept only).

8.6 Describe elimination reaction (dehydrohalogenation- Saytzeff's rule), Reduction reactions, Wurtz reaction.

8.7 Show the preparation of trichloromethane from ethanol and propanone.

8.8 Explain the chemical properties of trichloromethane: oxidation, reduction, action on silver powder, conc. nitric acid

9. Haloarenes

9.1 Describe briefly the nomenclature and isomerism of haloarenes.

9.2 Show the preparation of chlorobenzene from benzene and benzene diazonium chloride.

9.3 State physical properties of haloarenes.

9.4 Describe the low reactivity of haloarenes as compared to haloalkanes in terms of nucleophilic substitution reaction.

9.5 Explain the chemical properties of haloarenes: reduction of chlorobenzene, electrophilic substitution reactions, action with Na (Fittig and Wurtz- Fittig reaction), and action with chloral.

9.6 Describe uses of haloarenes

10 Alcohols

Describe briefly the nomenclature, isomerism, and classification of monohydric alcohol.

10.2 Distinguish primary, secondary, and tertiary alcohols by Victor Meyer's Method.

10.3 Show the preparation of monohydric alcohols from Haloalkane, primary amines and esters.

10.4 Explain the industrial preparation of alcohol from: Oxo process, hydroboration-oxidation of ethane & fermentation of sugar.

10.5 Define absolute alcohol, power alcohol, denatured alcohol (methylated spirit), rectified spirit, and alcoholic beverage.

10.6 State physical properties of monohydric alcohols.

10.7 Explain the chemical properties of monohydric alcohols

- with HX, PX₃, PCl₅, and SOCl₂.
- Action with reactive metals like Na, K and Li. Dehydration of alcohols.
- Oxidation of primary, secondary, and tertiary alcohols with mild oxidizing agents like acidified KMnO₄ or K₂Cr₂O₇.
- Catalytic dehydrogenation of 1° and 2° alcohol and dehydration of 3° alcohol, Esterification reaction and test of ethanol.

11. Phenols

11.1 Describe the nomenclature of phenols briefly.

11.2 Show the preparation of phenol from chlorobenzene, Diazonium salt and benzene sulphonic acid

11.3 State physical properties of phenol.

- 11.4 Describe the acidic nature of phenol (comparison with alcohol and water).
11.5 Explain the chemical properties of phenol
- with NH_3 ,
- Zn ,
- Na ,
- benzene diazonium chloride and
- phthalic anhydride,
- Acylation reaction,
- Kolbe's reaction and
- Reimer-Tiemann's reaction
Electrophilic substitution (nitration, sulphonation, bromination, and Friedel-Crafts alkylation).
11.6 Describe the test of phenol (FeCl_3 test, aq. Bromine test & Libermann test).
11.7 State important uses of phenol.

12. Ethers

- 12.1 Describe the nomenclature, classification, and isomerism of ethers.
12.2 Show the preparation of aliphatic and aromatic ethers from Williamson's synthesis.
12.3 State physical properties of ether.
12.4 Explain the chemical properties of ethoxyethane with HI , Conc. HCl , Conc. H_2SO_4 , air and Cl_2
12.5 State important uses of ethers.

13. Aldehydes and Ketones

(A) Aliphatic aldehydes and ketones

- 13.1 Describe briefly the nomenclature and isomerism of aliphatic aldehydes and ketones.
13.2 Show the preparation of aldehydes and ketones from dehydrogenation, oxidation of alcohol, ozonolysis of alkenes, acid chloride, gem dihaloalkane, and catalytic hydration of alkynes
13.3 State physical properties of aldehydes and ketones.
13.4 Describe the structure and nature of the carbonyl group.
13.5 Explain chemical properties of aliphatic aldehydes and ketones, i.e., addition of H_2 , HCN and NaHSO_3 .
action of aldehyde and ketone with ammonia derivatives, i.e., NH_2OH , $\text{NH}_2\text{-NH}_2$, phenyl hydrazine, and semicarbazide. Aldol condensation, Cannizzaro's reaction, Clemmensen's reduction, and Wolf-Kishner reduction. Action with PCl_5 and action with LiAlH_4 .
Action of methanal with ammonia and phenol.
13.6 Distinguish between aliphatic aldehydes and ketones by using 2,4- DNP reagent, Tollen's reagent and Fehling's solution.
13.7 Define formalin and state its uses.

(B) Aromatic aldehydes and Ketones

- 13.8 Show the preparation of benzaldehyde from toluene and acetophenone from benzene.
13.9 Explain chemical properties of benzaldehyde, i.e. Perkin condensation, Benzoin condensation, Cannizzaro's reaction and electrophilic substitution reaction.

- Show the preparation of acid derivatives from carboxylic acid.
- Explain the comparative physical properties of acid derivatives.
- Explain the comparative chemical properties of acid derivatives (hydrolysis, ammonolysis, amines- RNH_2), alcoholysis, and reduction only. Claisen condensation and hofmannbromamide reaction.

- Describe the amphoteric nature of amide and the relative reactivity of acid derivatives.

15. Nitro compounds

- Describe briefly the nomenclature and isomerism of nitro compounds.
- Show the preparation from haloalkane and alkane.
- State the physical properties of nitro compounds.
- Explain the chemical properties of nitro compounds, i.e., reduction.

15.5 Show preparation of nitrobenzene from benzene.

15.6 State physical properties of nitrobenzene.

15.7 Explain chemical properties of nitrobenzene, i.e., reduction in different media and electrophilic substitution reactions (nitration, sulphonation & bromination).

15.8 State important uses of nitrocompounds.

16. Amines

(A) Aliphatic amines

16.1 Describe the nomenclature, classification and isomerism of amines.

16.2 Show the separation of primary, secondary, and tertiary amines by Hoffmann's method.

16.3 Show preparation of primary amines from haloalkanes, nitriles, nitroalkanes and amides.

16.4 State physical properties of aliphatic amines.

16.5 Explain the chemical properties of aliphatic amines, i.e. basicity of amines, comparative study of the basic nature of 1^o, 2^o and 3^o amines.

Reaction of primary amines with chloroform, conc. HCl, R-X, RCOX and nitrous acid (NaNO₂ / HCl) and test of 1^o, 2^o and 3^o amines (nitrous acid test).

(B) Aromatic amine (Aniline)

16.6 Show preparation of aniline from nitrobenzene and phenol.

16.7 State the physical properties of aromatic amine.

16.8 Explain chemical properties of aromatic amine, i.e., basicity of aniline, comparison of basic nature of aniline with aliphatic amines and ammonia, alkylation, acylation, diazotization, carbylamines, coupling reaction, and electrophilic substitution (Nitration, sulphonation, and bromination).

16.9 State important uses of aniline.

17. Organometallic Compounds

17.1 Describe the general formula and examples of organolithium, organocopper, and organocadmium compounds.

17.2 Explain the nature of the Metal-Carbon bond.

17.3 Define Grignard reagent.

17.4 Show the preparation of the Grignard reagent (using haloalkane and haloarene).

17.5 Explain the reaction of Grignard reagent with water, aldehydes, and ketones (preparation of primary, secondary, and tertiary alcohols), carbon dioxide, HCN, RCN, ester, and acid chloride.

18. Chemistry in the Service of Mankind

- 18.1 Explain addition and condensation polymers.
- 18.2 Explain elastomers and fibres.
- 18.3 Describe natural and synthetic polymers.
- 18.4 Explain some synthetic polymers (polythene, PVC, Teflon, polystyrene, nylon, and bakelite).
- 18.5 Explain types of dyes based on structure and method of application.
- 18.6 Describe characteristics of drugs.
- 18.7 Differentiate natural and synthetic drugs.
- 18.8 Classify some common drugs.
- 18.9 Be aware of the adverse effects of drug addiction.
- 18.10 Explain insecticides, herbicides, and fungicides.

19. Cement

- 19.1 Explain the introduction and raw materials for cement production.
- 19.2 Give the main steps in cement production (crushing and grinding, strong heating, and final grinding).
- 19.3 Explain OPC and PPC cement.
- 19.4 Explain the Portland cement process with a flow-sheet diagram.
- 19.5 Explain the cement Industry in Nepal.

20. Paper and Pulp

- 20.1 Explain raw materials, sources of raw materials, and stages in the production of paper.
- 20.2 Give a flow-sheet diagram for paper production.
- 20.3 Describe the quality of paper.

21. Nuclear Chemistry and Applications of Radioactivity

- 21.1 Describe natural and artificial radioactivity.
- 21.2 Give units of radioactivity.
- 21.3 Explain nuclear reactions.
- 21.4 Distinguish between nuclear fission and fusion reactions.
- 21.5 Describe nuclear power and nuclear weapons.
- 21.6 Explain industrial uses of radioactivity.
- 21.7 State the medical uses of radioactivity.
- 21.8 Explain radiocarbon dating.
- 21.9 Describe the harmful effects of nuclear radiations