

Grade XII CHEMISTRY NEW SYLLABUS (2077)

Scope of Contents

Content Area: General and Physical Chemistry

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1. Volumetric analysis

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- 1.1 Introduction to gravimetric analysis, volumetric analysis, and equivalent weight
- 1.2 Relationship between equivalent weight, atomic weight, and valency
- 1.3 Equivalent weight of compounds (acid, base, salt, oxidizing, and reducing agents)
- 1.4 Concentration of solution and its units in terms of: Percentage, g/L, molarity, molality, normality and formality, ppm, and ppb
- 1.5 Primary and secondary standard substances
- 1.6 Law of equivalence and normality equation
- 1.7 Titration and its types: Acid-base titration, redox titration (related numerical problems)

2. Ionic Equilibrium

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- 2.1. Limitations of Arrhenius concepts of acids and bases
- 2.2. Bronsted -Lowry definition of acids and bases
- 2.3. Relative strength of acids and bases
- 2.4. Conjugate acid -base pairs
- 2.5. Lewis' definition of acids and bases
- 2.6. Ionization of weak electrolytes (Ostwald's dilution law)
- 2.7. Ionic product of water(K_w)
- 2.8. Dissociation constant of acid and base (K_a & K_b)
- 2.9. Concept of pK_a and pK_b
- 2.10. pH value: pH of strong and weak acids, pH of strong and weak bases
- 2.11. Solubility and solubility product principle
- 2.12 Common Ion Effect
- 2.13 Application of the solubility product principle and the common ion effect in precipitation reactions
- 2.14 Buffer solution and its application
- 2.15 Indicators and selection of indicators in acid-base titration
- 2.16 Types of salts: Acidic salts, basic salts, simple salts, complex salts (introduction and examples)
- 2.17 Hydrolysis of salts
 - 2.17.1 Salts of strong acid and strong base
 - 2.17.2 Salts of weak acid and strong base
 - 2.17.3 Salts of weak bases and strong acids (solving related numerical problems)

3. Chemical Kinetics

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- 3.1 Introduction
- 3.2 Rate of reactions: Average and instantaneous rate of reactions
- 3.3 Rate law and its expressions
- 3.4 Rate constant and its unit and significance
- 3.5 Order and molecularity
- 3.6 Integrated rate equation for zero and first-order reactions
- 3.7 Half-life of zero and first-order reactions
- 3.8 Collision theory, concept of activation energy, and activated complex
- 3.9 Factors affecting the rate of reactions: Effect of concentration, temperature (Arrhenius Equation), and effect of catalyst (energy profile diagram)
- 3.10 Catalysis and types of catalysis: homogeneous, heterogeneous, and enzyme catalysis (solving related numerical problems based on rate, rate constant, and order of zero and first order reactions)

4. Thermodynamics

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- 4.1 Introduction
- 4.2 Energy in chemical reactions
- 4.3 Internal energy
- 4.4 First law of thermodynamics
- 4.5 Enthalpy and enthalpy changes: (Endothermic and exothermic processes)
- 4.6 Enthalpy of reaction, enthalpy of solution, enthalpy of formation, enthalpy of combustion
- 4.7 Laws of thermochemistry (Laplace Law and Hess's Law)
- 4.8 Entropy and spontaneity
- 4.9 Second law of thermodynamics
- 4.10 Gibbs' free energy and prediction of spontaneity
- 4.11 Relationship between ΔG and equilibrium constant (Solving related numerical problems)

5. Electrochemistry

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- 5.1 Electrode potential and standard electrode potential
- 5.2 Types of electrodes: Standard hydrogen electrode and calomel electrodes
- 5.3 Electrochemical series and its applications
- 5.4 Voltaic cell: Zn-Cu cell, Ag- Cu cell
- 5.5 Cell potential and standard cell potential
- 5.6 Relationship between cell potential and free energy
- 5.7 Commercial batteries and fuel cells (hydrogen/oxygen)

Content Area: Inorganic Chemistry 20

6. Transition Metals

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- 6.1 Introduction
 - 6.1.1 Characteristics of transition metals
 - 6.1.2 Oxidation states of transition metals
 - 6.1.3 Complex ions and metal complexes
 - 6.1.4 Shapes of complex ions
 - 6.1.5 d-orbitals in complex ions (simple explanation by crystal field theory) for an octahedral complex
 - 6.1.6 Reasons for the colour of transition metal compounds
 - 6.1.7 Catalytic properties of transition metals

7. Study of Heavy Metals

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7.1 Copper

- 7.1.1 Occurrence and extraction of copper from copper pyrite
- 7.1.2 Properties (with air, acids, aqueous ammonia and metal ions) and uses of copper
- 7.1.3 Chemistry (preparation, properties and uses) of blue vitriol

7.1.4 Other compounds of copper (red oxide and black oxide of copper) formula and uses only

7.2 Zinc

- 7.2.1 Occurrence and extraction of zinc from zinc blende
- 7.2.2 Properties (with air, acid, alkali, displacement reaction) and uses of zinc
- 7.2.3 Chemistry (preparation, properties, and uses) of white vitriol

7.3 Mercury

- 7.3.1 Occurrence and extraction of mercury from cinnabar
- 7.3.2 Properties of mercury
- 7.3.3 Chemistry (preparation, properties, and uses) of calomel and corrosive sublimate

7.4 Iron

- 7.4.1 Occurrence and extraction of iron
- 7.4.2 Properties and uses of iron
- 7.4.3 Manufacture of Steel by Basic Oxygen Method and Open Hearth Process
- 7.4.4 Corrosion of iron and its prevention

7.5 Silver

- 7.5.1 Occurrence and extraction of silver by the cyanide process
- 7.5.2 Preparation and uses of silver chloride and silver nitrate

8. Haloalkanes**8**

- 8.1 Introduction
- 8.2 Nomenclature, isomerism, and classification of monohaloalkanes
- 8.3 Preparation of monohaloalkanes from alkanes, alkenes, and alcohols
- 8.4 Physical properties of monohaloalkanes
- 8.5 Chemical properties, substitution reactions S_N1 and S_N2 reactions (basic concept only)
- 8.6 Formation of alcohol, nitrile, amine, ether, thioether, carbylamines, nitrite, and nitroalkane using haloalkanes
- 8.7 Elimination reaction (dehydrohalogenation- Saytzeff's rule), Reduction reactions, Wurtz reaction
- 8.8 Preparation of Trichloromethane from ethanol and propanone
- 8.9 Chemical properties of trichloromethane: oxidation, reduction, action on silver powder, conc. nitric acid, propanone, and aqueous alkali

9. Haloarenes**3**

- 9.1 Introduction
- 9.2 Nomenclature and isomerism of haloarenes
- 9.3 Preparation of chlorobenzene from benzene and benzene diazonium chloride
- 9.4 Physical properties
- 9.5 Chemical properties
 - 9.5.1 Low reactivity of haloarenes as compared to haloalkanes in terms of nucleophilic substitution reaction
 - 9.5.2 Reduction of chlorobenzene
 - 9.5.3 Electrophilic substitution reactions
 - 9.5.4 Action with Na (Fittig and Wurtz- Fittig reaction)
 - 9.5.5 Action with chloral
- 9.6 Uses of haloarenes

10. Alcohols**7**

- 10.1 Introduction
- 10.2 Nomenclature, isomerism, and classification of monohydric alcohol
- 10.3 Distinction of primary, secondary, and tertiary alcohols by Victor Meyer's Method
- 10.4 Preparation of monohydric alcohols from haloalkanes, primary amines, and esters
- 10.5 Industrial preparation of alcohol from: Oxo process, hydroboration-oxidation of ethene & fermentation of sugar
- 10.6 Definition of common terms: Absolute alcohol, power alcohol, denatured alcohol (methylated spirit), rectified spirit; alcoholic beverage
- 10.7 Physical properties of monohydric alcohols
- 10.8 Chemical properties of monohydric alcohols
 - 10.8.1 Reaction with HX , PX_3 , PCl_5 , $SOCl_2$
 - 10.8.2 Action with reactive metals like Na, K, Li
 - 10.8.3 Dehydration of alcohols
 - 10.8.4 Oxidation of primary, secondary, and tertiary alcohols with mild oxidizing agents like acidified $KMnO_4$ or $K_2Cr_2O_7$
 - 10.8.5 Catalytic dehydrogenation of 1° and 2° alcohol and dehydration of 3° alcohols
 - 10.8.6 Esterification reaction
 - 10.8.7 Test of Ethanol

11. Phenols**4**

- 11.1 Introduction and nomenclature
- 11.2 Preparation of phenol from i. chlorobenzene ii. Diazonium salt and iii. benzene sulphonic acid
- 11.3 Physical properties of phenol
- 11.4 Chemical properties
 - 11.4.1 Acidic nature of phenol (comparison with alcohol and water)
 - 11.4.2 Action with NH_3 , Zn, Na, benzene diazonium chloride, and phthalic anhydride
 - 11.4.3 Acylation reaction, Kolbe's reaction, Reimer-Tiemann's reaction
 - 11.4.4 Electrophilic substitution: nitration, sulphonation, bromination, and Friedel-Crafts alkylation
- 11.5 Test of phenol: ($FeCl_3$ test, aq. Bromine test & Libermann test)
- 11.6 Uses of phenol

12. Ethers

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12.1 Introduction

12.2 Nomenclature, classification, and isomerism of ethers

12.3 Preparation of aliphatic and aromatic ethers from Williamson's synthesis

12.4 Physical properties of ether

12.5 Chemical properties of ethoxyethane: action with HI, Conc. HCl, Conc. H₂SO₄, air and Cl₂

12.6 Uses of ethers

13.1 Aliphatic aldehydes and ketones

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13.1.1 Introduction, nomenclature, and isomerism

13.1.2 Preparation of aldehydes and ketones from: Dehydrogenation and oxidation of alcohol, Ozonolysis of alkenes, Acid chloride, Gem dihaloalkane, Catalytic hydration of alkynes

13.1.3 Physical properties of aldehydes and ketones

13.1.4 Chemical properties

13.1.4.1 Structure and nature of carbonyl group

13.1.4.2 Distinction between aldehyde and ketones by using 2,4- DNP reagent, Tollen's reagent, Fehling's solution

13.1.4.3 Addition reaction: addition of H₂, HCN and NaHSO₃

13.1.4.4 Action of aldehyde and ketone with ammonia derivatives; NH₂OH, NH₂-NH₂, phenyl hydrazine, semicarbazide,

13.1.4.5 Aldol condensation

13.1.4.6 Cannizzaro's reaction

13.1.4.7 Clemmensen's reduction

13.1.4.8 Wolf-Kishner reduction

13.1.4.9 Action with PCl₅ and action with LiAlH₄

13.1.4.10 Action of Methanal with ammonia and phenol

13.1.5 Formalin and its uses

13.2 Aromatic aldehydes and Ketones

13.2.1 Preparation of Benzaldehyde from toluene and Acetophenone from benzene

13.2.2 Properties of benzaldehyde

13.2.2.1 Perkin condensation

13.2.2.2 Benzoin condensation

13.2.2.3 Cannizzaro's reaction

13.2.2.4 Electrophilic substitution reactions

14. Carboxylic Acid and Its Derivatives

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14.1 Aliphatic and aromatic carboxylic acids

14.1.1 Introduction, nomenclature, and isomerism

14.1.2 Preparation of monocarboxylic acids from: aldehydes, nitriles, dicarboxylic acids, sodium alkoxide, and trihaloalkanes

14.1.3 Preparation of benzoic acid from alkyl benzene

14.1.4 Physical properties of monocarboxylic acids

14.1.5 Chemical properties: Action with alkalies, metal oxides, metal carbonates, metal bicarbonates, PCl₃, LiAlH₄, and dehydration of carboxylic acid

14.1.6 Hell-Volhard-Zelinsky reaction

14.1.7 Electrophilic substitution reaction of benzoic acid - bromination, nitration, and sulphonation)

14.1.8 Effect of constituents on the acidic strength of carboxylic acid

14.1.9 Abnormal behaviour of methanoic acid

14.2 Derivatives of Carboxylic acids (acid halides, amides, esters, and anhydrides)

14.2.1 Preparation of acid derivatives from carboxylic acid

14.2.2 Comparative physical properties of acid derivatives

14.2.3 Comparative chemical properties of acid derivatives (hydrolysis, ammonolysis, amines (RNH₂), alcoholysis, and reduction only)

14.2.4 Claisen condensation

14.2.5 Hofmann bromamide reaction

14.2.6 Amphoteric nature of amide

14.2.7 Relative reactivity of acid derivatives

15. Nitro Compounds

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15.1 Nitroalkanes

- 15.1.1 Introduction, nomenclature, and isomerism
- 15.1.2 Preparation from haloalkane and alkane
- 15.1.3 Physical properties
- 15.1.4 Chemical properties: Reduction

15.2 Nitrobenzene

- 15.2.1 Preparation from benzene
- 15.2.2 Physical properties
- 15.2.3 Chemical properties
- 15.2.4 Reduction in different media
- 15.2.5 Electrophilic substitution reactions (nitration, sulphonation & bromination)
- 15.2.6 Uses of nitro-compounds

16. Amines

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16.1 Aliphatic amines

- 16.1.1 Introduction, nomenclature, classification, and isomerism
- 16.1.2 Separation of primary, secondary, and tertiary amines by Hoffmann's method
- 16.1.3 Preparation of primary amines from haloalkanes, nitriles, nitroalkanes, and amides
- 16.1.4 Physical properties
- 16.1.5 Chemical properties: basicity of amines, comparative study of the basic nature of 1^o, 2^o, and 3^o amines
- 16.1.6 Reaction of primary amines with chloroform, conc. HCl, R-X, RCOX and nitrous acid (NaNO₂ / HCl)
- 16.1.7 Test of 1^o, 2^o, and 3^o amines (nitrous acid test)

16.2 Aromatic amine (Aniline)

- 16.2.1 Preparation of aniline from nitrobenzene, phenol
- 16.2.2 Physical properties
- 16.2.3 Chemical properties: basicity of aniline, comparison of basic nature of aniline with aliphatic amines and ammonia, alkylation, acylation, diazotization, carbylamines and coupling reaction, electrophilic substitution: Nitration, sulphonation, and bromination
- 16.2.4 Uses of aniline

17. Organometallic Compounds

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- 17.1 Introduction, general formula, and examples of organolithium, organocopper, and organocadmium compounds
- 17.2 Nature of Metal-Carbon bond
- 17.3 Grignard reagent
 - 17.3.1 Preparation (using haloalkane and haloarene)
 - 17.3.2 Reaction of Grignard reagent with water, aldehydes and ketones (preparation of primary, secondary and tertiary alcohols), carbon dioxide, HCN, RCN, ester and acid chloride

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