GRADE 11 SYLLABUS

Content Area: General and Physical Chemistry (53)

1. Foundation and Fundamentals 2(3)

1.1 General introduction to chemistry
1.2 Importance and scope of Chemistry
1.3 Basic concepts of chemistry (atoms, molecules, relative masses of atoms and molecules, atomic mass unit (amu), radicals, molecular formula, empirical formula)
1.4 Percentage composition from molecular formula weight, atomic weight, and valency

2. Stoichiometry 8(10)

2.1 Dalton's atomic theory and its postulates
2.2 Laws of stoichiometry
2.3 Avogadro's law and some deductions
2.3.1 Molecular mass and vapour density
2.3.2 Molecular mass and volume of gas
2.3.3 Molecular mass and no. of particles
2.4 Mole and its relation with mass, volume, and number of particles
2.5 Calculations based on the mole concept
2.6 Limiting reactant and excess reactant
2.7 Theoretical yield, experimental yield, and % yield
2.8 Calculation of empirical and molecular formula from % composition (Solving related numerical problems)

3. Atomic Structure 8

3.1 Rutherford's atomic model
3.2 Limitations of Rutherford's atomic model
3.3 Postulates of Bohr's atomic model and its application
3.4 Spectrum of the hydrogen atom
3.5 Defects of Bohr's theory
3.6 Elementary idea of quantum mechanical model: de Broglie's wave equation
3.7 Heisenberg's Uncertainty Principle
3.8 Concept of probability
3.9 Quantum Numbers
3.10 Orbitals and shape of s and p orbitals only
3.11 Aufbau Principle
3.12 Pauli's exclusion principle
3.13 Hund's rule and electronic configurations of atoms and ions (up to atomic no. 30)

4. Classification of elements and Periodic Table 5

4.1 Modern periodic law and modern periodic table
4.1.1 Classification of elements into different groups, periods and blocks
4.2 IUPAC classification of elements
4.3 Nuclear charge and effective nuclear charge
4.4 Periodic trend and periodicity
4.4.1 Atomic radii
4.4.2 Ionic radii
4.4.3 Ionization energy
4.4.4 Electron affinity
4.4.5 Electronegativity
4.4.6 Metallic characters (General trend and explanation only)

5. Chemical Bonding and Shapes of Molecules 9

5.1 Valence shell, valence electron, and octet theory
5.2 Ionic bond and its properties
5.3 Covalent bond and coordinate covalent bond
5.4 Properties of covalent compounds
5.5 Lewis dot structure of some common compounds of s and p block elements
5.6 Resonance
5.7 VSEPR theory and shapes of some simple molecules (BeF_2, BF_3, CH_4, CH_3Cl, PCl_5, SF_6, H_2O, NH_3, CO_2, H_2S, PH_3)
5.8 Elementary idea of Valence Bond Theory
5.9 Hybridization involving s and p orbitals only
5.10 Bond characteristics:
5.10.1 Bond length
5.10.2 Ionic character
5.10.3 Dipole moment
5.11 Vander Waals' force and molecular solids
5.12 Hydrogen bonding and its application
5.13 Metallic bonding and properties of metallic solids

6. Oxidation and Reduction 5

6.1 General and electronic concept of oxidation and reduction
6.2 Oxidation number and rules for assigning oxidation number
6.3 Balancing redox reactions by oxidation number and ion-electron (half reaction) method
6.4 Electrolysis
6.4.1 Qualitative aspect
6.4.2 Quantitative aspects (Faraday's laws of electrolysis)

7. States of Matter 8(10)

7.1 Gaseous state

7.1.1 Kinetic theory of gas and its postulates
7.1.2 Gas laws
7.1.2.1 Boyle's law and Charles' law
7.1.2.2 Avogadro's law
7.1.2.3 Combined gas equation
7.1.2.4 Dalton's law of partial pressure
7.1.2.5 Graham's law of diffusion
7.1.3 Ideal gas and ideal gas equation
7.1.4 Universal gas constant and its significance
7.1.5 Deviation of real gas from ideality (Solving related numerical problems based on gas laws)

7.2 Liquid state

7.2.1 Physical properties of liquids
7.2.1.1 Evaporation and condensation
7.2.1.2 Vapour pressure and boiling point
7.2.1.3 Surface tension and viscosity (qualitative idea only)
7.2.2 Liquid crystals and their applications

7.3 Solid state

7.3.1 Types of solids
7.3.2 Amorphous and crystalline solids
7.3.3 Efflorescent, Deliquescent and Hygroscopic solids
7.3.4 Crystallization and crystal growth

7.3.5 Water of crystallization
7.3.6 Introduction to crystal lattice and unit cell

8. Chemical equilibrium 3

8.1 Physical and chemical equilibrium
8.2 Dynamic nature of chemical equilibrium
8.3 Law of mass action
8.4 Expression for equilibrium constant and its importance
8.5 Relationship between Kp and Kc
8.6 Le Chatelier's Principle (Numericals not required)

Content Area: Inorganic Chemistry

9. Chemistry of Non-metals

9.1 Hydrogen **1.5**
9.1.1 Chemistry of atomic and nascent hydrogen
9.1.2 Isotopes of hydrogen and their uses
9.1.3 Application of hydrogen as fuel
9.1.4 Heavy water and its applications

9.2 Allotropes of Oxygen **1.5**
9.2.1 Definition of allotropy and examples
9.2.2 Oxygen: Types of oxides (acidic, basic, neutral, amphoteric, peroxide and mixed oxides)
9.2.3 Applications of hydrogen peroxide
9.2.4 Medical and industrial applications of oxygen

9.3 Ozone **1(2)**
9.3.1 Occurrence
9.3.2 Preparation of ozone from oxygen
9.3.3 Structure of ozone
9.3.4 Test for ozone
9.3.5 Ozone layer depletion (causes, effects and control measures)
9.3.6 Uses of ozone

9.4 Nitrogen **5**
9.4.1 Reason for inertness of nitrogen and active nitrogen
9.4.2 Chemical properties of ammonia [Action with $CuSO_4$ solution, water, $FeCl_3$ solution, Conc. HCl, Mercurous nitrate paper, O_2]
9.4.3 Applications of ammonia
9.4.4 Harmful effects of ammonia
9.4.5 Oxy-acids of nitrogen (name and formula)
9.4.6 Chemical properties of nitric acid [HNO_3 as an acid and oxidizing agent (action with zinc, magnesium, iron, copper, sulphur, carbon, SO_2 and H_2S)
9.4.7 Ring test for nitrate ion

9.5 Halogens **5**
9.5.1 General characteristics of halogens

9.5.2 Comparative study on preparation (no diagram and description is required)
9.5.2.1 Chemical properties [with water, alkali, ammonia, oxidizing character, bleaching action] and uses of halogens (Cl_2, Br_2, and I_2)
9.5.3 Test for Cl_2, Br_2 and I_2
9.5.4 Comparative study on preparation (no diagram and description is required), properties (reducing strength, acidic nature, and solubility), and uses of haloacids (HCl, HBr, and HI)

9.6 Carbon 2

9.6.1 Allotropes of carbon (crystalline and amorphous), including fullerenes (structure, general properties, and uses only)
9.6.2 Properties (reducing action, reaction with metals and nonmetals) and uses of carbon monoxide

9.7 Phosphorus 1

9.7.1 Allotropes of phosphorus (name only)
9.7.2 Preparation (no diagram and description is required), properties (basic nature, reducing nature, action with halogens and oxygen), and uses of phosphine

9.8 Sulphur 5

9.8.1 Allotropes of sulphur (name only) and uses of sulphur
9.8.2 Hydrogen sulphide (preparation from Kipp's apparatus with diagram) properties (Acidic nature, reducing nature, analytical reagent) and uses
9.8.3 Sulphur dioxide: its properties (acidic nature, reducing nature, oxidising nature, and bleaching action) and uses
9.8.4 Sulphuric acid and its properties (acidic nature, oxidising nature, dehydrating nature) and uses
9.8.5 Sodium thiosulphate (formula and uses)

10. Chemistry of Metals

10.1 Metals and Metallurgical Principles 5

10.1.1 Definition of metallurgy and its types (hydrometallurgy, pyrometallurgy, electrometallurgy)
10.1.2 Introduction of ores
10.1.3 Gangue or matrix, flux and slag, alloy and amalgam
10.1.4 General principles of extraction of metals (different processes
involved in metallurgy) – concentration, calcination and roasting, smelting, carbon reduction, thermite, and electrochemical reduction
10.1.5 Refining of metals (poling and electro-refining)

10.2 Alkali Metals 3

10.2.1 General characteristics of alkali metals
10.2.2 Sodium [extraction from Down's process, properties (action with Oxygen, water, acids, nonmetals, and ammonia), and uses]
10.2.3 Properties (precipitation reaction and action with carbon monoxide) and uses of sodium hydroxide
10.2.4 Properties (action with CO_2, SO_2, water, precipitation reactions) and uses of sodium carbonate

10.3 Alkaline Earth Metals 2

10.3.1 General characteristics of alkaline earth metals
10.3.2 Molecular formula and uses of (quick lime, bleaching powder, magnesia, plaster of Paris, and Epsom salt)
10.3.3 Solubility of hydroxides, carbonates, and sulphates of
alkaline earth metals (general trend with explanation)

10.3.4 Stability of carbonate and nitrate of alkaline earth metals (general trend with explanation)

11. Bioinorganic Chemistry 3

11. Introduction to Bioinorganic Chemistry
11.1 Introduction
11.2 Micro and macro nutrients
11.3 Importance of metal ions in biological systems (ions of Na, K, Mg, Ca, Fe, Cu, Zn, Ni, Co, Cr)
11.4 Ion pumps (sodium-potassium and sodium-glucose pump)
11.5 Metal toxicity (toxicity due to iron, arsenic, mercury, lead, and cadmium)

Content Area: Organic Chemistry

12 Basic Concept of Organic Chemistry 6

12.1 Introduction to organic chemistry and organic compounds
12.2 Reasons for the separate study of organic compounds from inorganic compounds
12.3 Tetra-covalency and catenation properties of carbon
12.4 Classification of organic compounds
12.5 Alkyl groups, functional groups, and homologous series
12.6 Idea of structural formula, contracted formula, and bond line structural formula
12.7 Preliminary idea of cracking and reforming, quality of gasoline, octane number, cetane number, and gasoline additive alcohols

13 Fundamental Principles of Organic Chemistry 8

13.1 IUPAC Nomenclature of Organic Compounds (up to a chain having 6-carbon atoms)
13.2 Qualitative analysis of organic compounds (detection of N, S, and halogens by Lassaigne's test)
13.3 Isomerism in Organic Compounds
13.4 Definition and classification of isomerism
13.5 Structural isomerism and its types: chain isomerism, position isomerism, functional isomerism, metamerism, and tautomerism
13.6 Concept of geometrical isomerism (cis & trans) & optical isomerism (d & l form)

13.7 Preliminary Idea of Reaction Mechanism 2

13.7.1 Homolytic and heterolytic fission
13.7.2 Electrophiles, nucleophiles, and free radicals
13.7.3 Inductive effect: +I and –I effect
13.7.4 Resonance effect: +R and –R effect

14. Hydrocarbons 8

14.1 Saturated Hydrocarbons (Alkanes)

14.1.1 Alkanes: Preparation from haloalkanes (Reduction and Wurtz reaction), Decarboxylation, Catalytic hydrogenation of alkene and alkyne
14.1.2 Chemical properties: Substitution reactions (halogenation, nitration & sulphonation only), oxidation of ethane

14.2 Unsaturated hydrocarbons (Alkenes & Alkynes)

14.2.1 Alkenes: Preparation by Dehydration of alcohol, Dehydrohalogenation, Catalytic hydrogenation of alkyne
14.2.1.1 Chemical properties: Addition reaction with HX (Markovnikov's addition and peroxide effect), H_2O, O_3, H_2SO_4 only
14.3 Alkynes:

Preparation from carbon and hydrogen, 1,2-dibromoethane, chloroform/iodoform only
14.3.1 Chemical properties: Addition reaction with (H_2, HX, H_2O),
Acidic nature (action with Sodium, ammonical $AgNO_3$, and ammonical Cu_2Cl_2)
14.4 Test of unsaturation (ethene & ethyne): bromine water test and Baeyer's test
14.5 Comparative studies of physical properties of alkane, alkene, and alkyne
14.6 Kolbe's electrolysis methods for the preparation of alkane, alkene, and alkynes

15. Aromatic Hydrocarbons 6

15.1 Introduction and characteristics of aromatic compounds
15.2 Huckel's rule of aromaticity
15.3 Kekulé structure of benzene
15.4 Resonance and isomerism
15.5 Preparation of benzene from decarboxylation of Sodium benzoate, Phenol, and Ethyne only
15.6 Physical properties of Benzene
15.7 Chemical properties of benzene: Addition reaction: hydrogen, halogen, Electrophilic substitution reactions: orientation of benzene derivatives (o, m & p), nitration, sulphonation, halogenation, Friedel-Craft's reaction (alkylation and acylation), combustion of benzene (free combustion only) and uses

Content Area: Applied Chemistry

16 Fundamentals of Applied Chemistry 4

16.1 Fundamentals of Applied Chemistry
16.1.2 Chemical industry and its importance
16.1.3 Stages in producing a new product
16.1.4 Economics of production
16.1.5 Cash flow in the production cycle
16.1.6 Running a chemical plant
16.1.7 Designing a chemical plant
16.1.7 Continuous and batch processing
16.1.8 Environmental impact of the chemical industry

Unit: 17 Modern Chemical Manufactures 11(9)

17.1 Modern Chemical Manufactures (principle and flow sheet diagram only)

17.1.1 Manufacture of ammonia by Haber's process,
17.1.2 Manufacture of nitric acid by Ostwald's process,
17.1.3 Manufacture of sulphuric acid by contact process,
17.1.4 Manufacture of Sodium Hydroxide by Diaphragm Cell
17.1.5 Manufacture of sodium carbonate by ammonia soda or Solvay process

17.2 Fertilisers (Chemical fertilisers, types of chemical fertilisers, production of urea with flow-sheet diagram)