CHEMISTRY SYLLABUS

Physical-Chemistry{

1 Some basics concepts in chemistry

Matter and its nature, Dalton's atomic theory: Concept of atom, molecule, elements and compound, Physical quantities and their measurements in Chemistry, Precision and accuracy, significant figures and S.I.Units

dimensional analysis: Laws of chemical combination, Atomic and molecular masses, mole concept, molar mass, empirical and molecular formulae, Chemical equations and stoichiometry

2 States of matter

Topics are classified in three parts

Solid Classification of solids: molecular, ionic, covalent and metallic solids, amorphous and crystalline solids (elementary idea),

Bragg's Law and its applications, Unit cell and lattices, packing in solids,voids, calculations involving unit cell parameters, an imperfection in solids, Electrical and magnetic properties

Liquid Properties of liquids-vapor pressure, viscosity and surface tension, effect of temperature on them

Gaseous Measurable properties of gasses: Gas laws - Boyle's law, Charle's law, Graham's law of diffusion, Avogadro's law,

Dalton's law of partial pressure, Concept of Absolute scale of temperature, Ideal gas equation, Kinetic theory of gasses,

Concept of average, root mean square and most probable velocities, Real gasses, deviation from Ideal behavior,

compressibility factor, and van der Waals equation

3 Atomic structure

Thomson and Rutherford atomic models and their limitations, Nature of electromagnetic radiation, photoelectric effect;

Spectrum of the hydrogen atom, Bohr model of a hydrogen atom and its postulates, derivation of the relations for the energy of the electron and radii of the different orbits,

limitations of Bohr's model, Dual nature of matter, De Broglie's relationship. Heisenberg uncertainty principle,

Elementary ideas of quantum mechanics, quantum mechanics, the quantum mechanical model of the atom and its important features,

Concept of atomic orbitals as one-electron wave functions, variations in various quantum numbers and their significance,shapes of s, p, and d - orbitals,

electron spin and spin quantum number, Rules for filling electrons in orbitals - Aufbau principle. Pauli's exclusion principle and Hund's rule,

electronic configuration of elements, extra stability of half filled and completely filled orbitals

4 Chemical bonding and Molecular structure

Kosse and Lewis approach chemical bond formation, ionic and covalent bonds, Ionic Bonding, formation of ionic bonds,

factors affecting the formation of ionic bonds, calculation of lattice enthalpy, Covalent Bonding, Concept of electronegativity,

Fajan's rule, dipole moment, Valence Shell Electron Pair Repulsion (VSEPR) theory and shapes of simple molecules,

Quantum mechanical approach to covalent bonding, Valence bond theory and its important features,

the concept of hybridization involving s, p, and d orbitals; Resonance

Molecular orbital theory types of molecular orbitals (bonding, antibonding), sigma and pi-bonds,

molecular orbital electronic configurations of homonuclear diatomic molecules, the concept of bond order, bond length, and bond energy.

5 Chemical thermodynamics
First law of thermodynamics

Concept of work, heat internal energy and enthalpy, heat capacity, molar heat capacity,
Hess's law of constant heat summation, Enthalpies of bond dissociation, combustion, formation, atomization,
sublimation, phase transition, hydration, ionization, and solution. Second law of thermodynamics:- Spontaneity of processes; ΔS of the universe and ΔG of the system as criteria for spontaneity. G0 (Standard Gibbs energy change) and equilibrium constant.

6 Solutions
Different methods for expressing the concentration of solution (molality, molarity, mole fraction, percentage) by volume and mass both, the vapor pressure of solutions and Raoult's Law :Ideal and non-ideal solutions,
vapor pressure: composition, plots for ideal and non-ideal solutions, Colligative properties of dilute solutions a relative
lowering of vapor pressure, depression of freezing point, the elevation of boiling point and osmotic pressure,
Determination of molecular mass using colligative properties, Abnormal value of molar mass, van't Hoff factor and its significance

7 Chemical equilibrium
Equilibrium in physical process solid-liquid, liquid-gas and solid-gas equilibria, Henry's law, General characteristics of equilibrium involving physical processes.
Equilibrium in chemical process Concept of chemical equilibrium, equilibrium constants (Kp and Kc) and their significance, the significance of G and t.G0 in chemical equilibrium, factors affecting equilibrium concentration, pressure, temperature, the effect of catalyst, Le Chatelier's principle
Ionic equilibrium Weak and strong electrolytes, ionization of electrolytes, various concepts of acids and bases (Bronsted and and lowry) their ionization, acid-base equilibria and ionization constants, ionization of water, pH scale, common ion effect, hydrolysis of salts and pH of their solutions, the solubility of sparingly soluble salts and solubility products, buffer solutions

8 Electrochemistry and redox reaction
Electronic concepts of oxidation and reduction, redox reactions, oxidation number, rules for assigning oxidation number,
balancing of redox reactions, Electrolytic and metallic conduction,conductance in electrolytic solutions, molar conductivities and their variation with concentration- Kohlrausch's law and its applications.
Electrochemical cells,
Electrolytic and Galvanic cells, different types of electrodes, electrode potentials including standard electrode potential,
half cell and cell reactions, emf of a Galvanic cell and its measurement, Nernst equation and its applications,
Relation between cell potential and Gibbs' energy change, Dry cell and lead accumulator, Fuel cells

9 Chemical kinetics
Rate of a chemical reaction, factors affecting the rate of reactions- concentration, temperature, pressure and catalyst, elementary and complex reactions, order and molecularity of reactions, rate law, rate constant and its units,
differential and integral forms of zero and first-order reactions, their characteristics and half-lives, the effect of temperature on the rate of reactions,
Arrhenius theory, activation energy and its calculation, collision theory of bimolecular gaseous reactions (no derivation)

10 Surface chemistry
Physisorption, chemisorption and their characteristics, factors affecting adsorption of gasses in solids Freundlich and Langmuir adsorption isotherms, adsorption from solutions. Catalysis- Homogeneous and heterogeneous, activity and selectivity of solid catalysts,
enzyme catalysis, and its mechanism Distinction among true solutions, colloids, and suspensions, classification of colloids- lyophilic.
lyophobic, multi-molecular, macromolecular and associated colloids, preparation and properties of colloids,
Tyndall effect, Brownian movement, electrophoresis, dialysis, coagulation, and flocculation, Emulsions and their characteristics.
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