INORGANIC CHEMISTRY

TRANSITION ELEMENTS

d block elements – characteristics- metallic character, atomic volume and densities, melting and boiling points, atomic radii, ionization potential, variable oxidation states, reducing properties, formation of colored compounds, magnetic properties, catalytic properties, formation of alloys.


Coordination compounds- bonding of transition metal complexes,

Valence bond theory – assumptions, application of VBT to octahedral complexes crystal field theory – salient features, application of CFT, crystal field stabilization energy and John – Teller distortion application of CFT.

Chelation and application of chelate formation- magnetic properties of complexes

Isomerism, ionization isomerism, hydrate isomerism, linkage isomerism

NON TRANSITION ELEMENTS

Chemistry of non transition elements- general discussion on their properties , polymorphism of carbon, phosphorus and sulphur, synthesis, properties and structure of boranes, carbonates, borazines, silicates carbides , silicones and phosphazines. sPeroxo compounds of boron, carbon, and sulphur. Oxyacids of nitrogen, phosphorus and sulphur. Interhalogens , pseudohalogenes , noble gas compounds.

Homogeneous catalysis, mechanism, equilibrium treatment, steady state treatment, activation energies of catalyzed reactions.

Bioinorganic chemistry- essential and trace elements in biological system, transport and storage of di oxygen – the interaction between haeme and dioxygen , the bonding of dioxygen to myoglobin, physiology of haemoglobin and myoglobin, structure and function of haemoglobin, metalloporphyrins and respiration cytochromes.

Ionic bonding properties of ionic substances, efficiency of packing , hcp and ccp structures, radius ratio rule and its effect on the shape of ionic crystals. Classification of ionic crystals-AX and AX\(_2\) types. Structures of ZnS, NaCl, CsCl2 fluorite, rutile and • crystallalite structures . lattice energy Born – Lande equation, experimental determination of lattice energy by Born – Haber cycle covalent character in ionic bond Fajans rules of polarization power and polarizability

References

1. Selected Topics in Inorganic Chemistry wahid U mallik, D G Tuli R D Madan 2001
2. Advanced Inorganic Chemistry F A Cotton and Wilkinson John wiley and sons
3. Basic Inorganic Chemistry F A Cotton
4. Inorganic Chemistry J D Lee
5. Inorganic Chemistry principles, structure and reactivity James E Huheey
6. Inorganic Chemistry Puri, Sharma Khalia S Chand
7. Sathyaprakash modern Inorganic Chemistry R D Madan
Thermodynamics - 1st law, limitations, 2nd law spontaneous processes, cyclic processes, Carnot’s cycle and 3rd law – relation between $C_p$ and $C_v$, enthalpies of physical and chemical changes. Temperature dependence of enthalpies, entropy, Gibb’s – Helmholtz equation, calculation of entropies, entropy change in isothermal expansion of an ideal gas, in reversible and irreversible processes. Work and free energy functions, Maxwell’s relationships. Claperon equation, Claperon – Clausius equation.

Chemical Kinetics – methods of determining rate laws. Rate equation, order of a reaction, illustration of 1st, 2nd and zero order reactions, half life time, order and molecularity of a simple reaction, mechanism of a complex reaction, collision theory, effect of temperature and temperature on reaction rate, concept of energy of activation and its experimental determination, energy barrier, effect of catalyst, Arrhenius equation.


Catalysis – definition, types of homogeneous and heterogeneous catalysis, effect of temperature and diffusion limitation Michaelis – Menten kinetics.

Negative catalysis, characteristics of catalysis.


References

1. Physical chemistry Atkins ELBS, and Oxford University Press, 2005
2. Physical chemistry Puri, Sharma and Patania S. Chand
3. Advanced Physical chemistry Gurdeep Raj
7. Basic Physical chemistry W. J. Moore
8. Chemical Kinetics Leidler Harper and Row Delhi
9. Adsorption and catalysis chakravarthi
ORGANIC REACTION MECHANISMS

Fundamentals of reaction mechanism: homolytic and heterolytic cleavage, carbocations, carbanions, free radical-, generation and characteristic reactions, inductive and electromeric effects, resonance effect.

Addition reactions: addition reactions to aldehydes and ketones - hydrogen cyanide, alcohol, Grignard reagent.

Aliphatic nucleophilic substitutions- mechanism and scope, \( S^1_N \), \( S^2_N \) and \( S^i_N \) reactions, stereochemistry, allylic reactions, neighbouring group participation, factors influencing the substitution reactions - leaving group, substrate, nucleophile, solvents, on the rate of the nucleophilic substitution reactions, comparison between \( S^1_N \) and \( S^2_N \) reactions,

Elimination reactions: \( E_1^1 \) and \( E_2^2 \) reactions, mechanism, Saytzev rule, stereochemistry,

Aromatic electrophilic substitutions- mechanism of nitration, sulphonation, Friedel crafts alkylation and acylation,

Aromaticity – Hückel’s rule and its application to various systems.

Mechanism of Reformatsky, Knoevenagel, Perkin’s reactions, aldol condensation.

References:

5. Modern synthetic reactions H. O House Benjamin 1972
6. Organic Chemistry I L Finar Vol I and II
8. A guide Book to mechanism in organic chemistry by Peter Sykes Longman 2000
9. Reaction mechanisms and reagents in organic chemistry Chatwal , Himalaya Bombay 1989
10. Mechanism and theory in organic chemistry Lowry and Richardson Harper and Row 1987
Chromatography- classification, Theory – distribution coefficient, rate of travel, retention time, adjusted retention time, retention volume, net retention volume, specific retention volume, relative retention, Van Deemer equation, resolution. Gas chromatography – carrier gas, stationary phase, instrumentation, qualitative and quantitative analysis, effect of temperature on retention.

HPLC – Principle, Instrumentation, Detectors, Mobile phase selection, HPLC – MS chromatography.

V spectra -Chromophores and auxochromes, intensity of absorption bands – factors atnat affect the intensity, spectra of dienes, unsaturated carbonyl compounds.

Ir spectra – vibrational frequency, and factors that affect tem, finger print region and its significance, identification of functional groups and inter and intra molecular hydrogen bondsing. Importance of far infrared region.

\(^1\)H NMR spectra – coupling constants, - germinal, vicinal and long range coupling constants, chemical shifts – factors that influence the shift, proton coupling, Kaarplus equation, spin decoupling. Identification of structure of compounds based on the NMR.

\(^13\)C NMR Chemical shifts, use of INEPT and DEFT methods in assigning the signals. \(^13\)C NMR of some organic compounds.

References

1. Dyer J R Applications of absorption spectroscopy of organic compounds, Prentice Hall. 1978
5. Introduction to molecular spectroscopy C N Banwell, TMH edition, 1994
8. Principles of Instrumental analysis Skoog and West and Hollar Asia Pvt. Ltd.
9. Vogel’s text book of quantitative chemical analysis revised
10. Instrumental Methods of analysis Galen W Ewing
11. Basic concepts of analytical chemistry S M Kopkar