M.Sc. (Med.) Entrance Examination

GROUP- B (B.Sc. chemistry/ zoology)

CHEMISTRY

50 QUESTIONS

Stereochemistry of Organic Compounds : Concept of isomerism. Types of isomerism.

Optical Isomerism : elements of symmetry, molecular chirality, enantiomers, stereogenic centre, optical activity, properties of enantiomers, chiral and achiral molecules with two stereogenic centres diastereomers, threo and erythro diastereomers, meso compounds resolution of enantiomers, inversion, retention and racemization.

Relative and absolute configuration, sequence rules, D & L and R & S systems of nomenclature.

Colloidal State : Definition of colloids, classification of colloids. Solids in liquids (sols) : properties-kinetic, optical and electrical; stability of colloids, protective action. Hardy-Schulze law, gold number. Liquids in solids (gels) : classification, preparation and properties, inhibition, general application of colloids. Liquids in liquids (emulsions): types of emulsions, preparation, Emulifier.

Bioinorganic Chemistry

Essential and trace elements to Biological processes, metalloporphyrins with special reference to haemoglobin and myoglobin.

Carbohydrates

Classification and nomenclature, Monosaccharides, mechanism of osazone formation, interconversion of glucose and fructose, chain lengthening and chain shortening of aldoses. Configuration of monosaccharides. Erythro and threo diastereomers. Conversion of glucose into mannose. Formation of glycosides, ethers and esters. Determination of ring size of monosaccharides. Cyclic structure of D(+)- glucose. Mechanism of mutarotation.

Structures of ribose and deoxyribose.

An introduction to disaccharides (maltose, sucrose and lactose) and polysaccharides (starch and cellulose) without involving structure determination.

Amino Acids, Peptides, Proteins and Nucleic Acids

Classification, structure and stereochemistry of amino acids. Acid-base behaviour, isoelectric point and electrophoresis. Preparation and reactions of α-amino acids.

Structure and nomenclature of peptides and proteins. Classification of proteins. Peptide structure determination, end group analysis, selective hydrolysis of peptides. Classical peptide synthesis, solid-phase peptide synthesis. Structures of peptides and proteins. Levels of protein structure. Protein denaturation/renaturation.

Nucleic acids : Introduction. Constituents of nucleic acids. Ribonucleosides and ribonucleotides. The double helical structure of DNA.

Fats, Oils and Detergents

Natural fats, edible and industrial oils of vegetable origin, common fatty acids, glycerides, hydrogenation of unsaturated oils. Saponification value, iodine value, acid value, soaps, synthetic detergents, alkyl and aryl sulphonates.

Coordination Compounds

Werner's coordination theory and its experimental verification, effective atomic number concept, chelates, nomenclature of coordination compounds, isomerism in coordination compounds, valence bond theory of transition metal complexes.

Chemistry of Lanthanide and Actinide Elements

Electronic structure, oxidation states and ionic radii and lanthanide contraction, complex formation, occurrence and isolation, lanthanide compounds.

General features and chemistry of actinides, chemistry of separation of Np, Pu and Am from U, similarities between the later actinides and the later lanthanides.

Oxidation and Reduction

Use of redox potential data-analysis of redox cycle, redox stability in water-Frost, latimer and Pourbaix diagrams, Principles involved in the extraction of the elements.

Acids and Bases

Arrhenius, Bronsted-Lowry, the Lux-Flood, solvent system and Lewis concepts of acids and bases.

Non-aqueous Solvents

Physical properties of a solvent, types of solvents and their general characteristics, reactions in non-aqueous solvents with reference to liquid NH_3 and liquid SO_2.

Electromagnetic Spectrum : An Introduction

Absorption Spectra

Ultraviolet (UV) absorption spectroscopy-absorption laws (Beer-Lambert Law) molar absorptivity, presentation and analysis of UV spectra, types of electronic transitions, effect of slovents on transitions, effect of conjugation, Concept of chromophore and auxochrome Bathochromic, hypsochromic and hyperchromic and hypochromic shifts, UV spectra of conjugated enes and enones..

Infrared IR absorption spectroscopy-molecular vibrations, Hook's law, selection rules, intensity and position of IR bands, measurement of IR spectrum, fingerprint region, characteristics absorption of various functional groups and interpretation of IR spectra of simple organic compounds.

Alcohols

Classification and nomenclature.

Monohydric alcohols-methods of formation by reduction of aldehydes, ketones, carboxylic acids and esters, Hydrogen bonding, Acidic nature, Reactions of alcohols.

Dihydric alcohols-methods of formation, chemical reactions of vicinal glycols, oxidative cleavage [$Pb(OAc)_4$ and HIO_4] and pinàcol-pinacolone rearrangement.

Trihydric alcohols-methods of formation, chemical reactions of glycerol.

Phenols

Nomenclature, structure and bonding, Preparation of Phenols, physical properties and acidic character. Comparative acidic strength of alcohols and phenols, resonance stabilization of phenoxide ion. Reactions of phenols, electrophilic aromatic substitution, acylation and carboxylation. Mechanisms of Fries rearrangement, Claisen rearrangement. Gatterman synthesis, Hauben-Hoesch reaction, Lederer Manasse reaction and Reimer Tiemann reaction.

Ethers and Epoxides

Nomenclature of ethers and methods of their formation, physical properties, Chemical reactions-cleavage and autooxidation, Ziesel's method.

Synthesis of epoxides. Acid and base-catalyzed ring opening of epoxides, orientation of epoxide ring opening, reactions of Grignard and organolithium reagents with epoxides.

Aldehydes and Ketones

Nomenclature and structure of the carbonyl group. Synthesis of aldehydes and ketones with particular reference to the syntheses of aldehydes from acid chlorides, synthesis of aldehydes and ketones using 1,3-dithianes, synthesis of ketones from nitriles and from carboxylic acids. Physical properties.

Mechanism of nucleophilic additions to carbonyl group with particular emphasis on benzoin, aldol, Perkin and Knoevenagel condensations, Condensation with ammonia and its derivatives. Witting reaction, Mannich reaction.

Use of acetals as protecting group. Oxidation of aldehydes, Baeyer-Villiger oxidation of ketones, Cannizzaro reaction, MPV, Clemmensen, Wolff-Kishner, $LIAlH_4$ and $NaBH_4$ reductions, Halogenation of enolizable ketones.

Carboxylic Acids

Nomenclature, structure and bonding, physical properties, acidity of carboxylic acids, effects of substituents on acid strength. Preparation of carboxylic acids, Reactions of Cabroxylic acids Hell-Volhard-Zelinsky reaction. Synthesis of acid chlorides, esters and amides, Reduction of carboxylic acids, Mechanism of decarboxylation.

Methods of formation and chemical reactions of halo acids. Hydroxy acids; malic, tartaric and citric acids.

Methods of formation and chemical reactions of α, β-unsaturated monocarboxylic acids.

Dicarboxylic acids : methods of formation and effect of heat and dehydrating agents (succinic, glutaric and adipic acids).

Carboxylic Acid Derivatives

Structure and nomenclature of acid chlorides, esters, amides (urea) and acid anhydrides. Relative stability of acyl derivatives. Physical properties, interconversion of acid derivatives by nucleophilic acyl substitution.

Preparation of carboxylic acid derivatives, chemical reactions, Mechanisms of esterification and hydrolysis (acidic and basic).

Organic Compounds of Nitrogen

Preparation of nitroalkanes and nitroarenes. Chemical reactions of nitroalkanes, Mechanisms of nucleophilic substitution in nitroarenes and their reductions in acidic, neutral and alkaline media, Picric acid.

Halonitroarenes : reactivity. Structure and nomenclature of amines, physical properties, Stereochemistry of amines. Separation of a mixture of primary, secondary and tertiary amines. Structural

features effecting basicity of amines. Amine salts as phase-transfer catalysts. Preparation of alkyl, and aryl amines (reduction of nitro compounds, Nitriles), reductive amination of aldehydic and ketonic compounds. Gabriel-phthalimide reaction, Hofmann bromamide reaction.

Reactions of amines, electrophilic aromatic substitution in aryl amines, reactions of amines with nitrous acid. Diazotisation, mechanism. Synthetic transformations of aryl diazonium salts, azo coupling.

Thermodynamics-I

Definition of thermodynamic terms : system, surroundings etc. Types of systems intensive and extensive properties. State and path functions and their differentials. Thermodynamics process, concept of heat and work.

First Law of Thermodynamics : statement, definition of internal energy and enthalpy. Heat capacity, heat capacities at constant volume and pressure and their relationship. Joule's law-Joule-Thomson coefficient and inversion temperature, calculation of w,q, dU & dH for the expansion of ideal gases under isothermal and adiabatic condition for reversible process.

Thermochemistry : Standard state, standard enthalpy of formation-Hess's Law of heat summation and its applications, Heat of reaction at constant pressure and at constant volume. Enthalpy of neutralization. Bond dissociation energy and its calculation from thermo-chemical data, temperature dependence of enthalpy. kirchhoff's equation.

Thermodynamics-II

Second law of thermodynamics : **Need for the law, different statements of the law, Carnot cycle and its efficiency. Carnot theorem. Thermodynamic scale of temperature.**

Concept of entropy : **Entropy as a state function, entropy as a function of V & T, entropy as a function of P & T, entropy change in physical change, Clausius inequality, entropy as a criteria of sponteneity and equilibrium, Entropy change in ideal gases and mixing of gases.**

Third law of thermodynamics : Nernst heat theorem, statement and concept of residual entropy, evaluation of absolute entropy from heat capacity data. Gibbs and Helmholtz functions : Gibbs function (G) and Helmholtz function (A) as thermodynamic quantities, A & G as Criteria for thermodynamic equilibrium and spontancity, their advantage over entropy change, Variation of G and A with P, V and T.

Electro chemistry-II

Types of reversible electrodes-gas-metal ion, metal-metal ion, metal-insoluble salt-anion and redox electrodes, Electrode reactions, Nernst equation, derivation of cell E.M.F. and single electrode potential, standard hydrogen electrode, reference electrodes, standard electrode potential, sign conventions, electrochemical series and its significance.

Definition of pH and pK_a, determination of pH using hydrogen quinhydrone and glass electrodes, by potentiometric methods.

ZOOLOGY

50 QUESTIONS

1. Introduction to cell: Morphology, size, shape and characteristics of Prokaryotic, Eukaryotic and Animal cells; basic idea of virus and cell-theory.
2. Cell membrane: Characteristics of cell membrane molecules, fluid-mosaic model of Singer and Nicholson, concept of unit membrane.
3. Cell membrane transport: Passive (diffusion and osmosis, facilitated, mediated) and active transport.
4. Cytoplasmic organelles:
   i. Structure and biogenesis of mitochondria; electron transport chain and generation of ATP molecules.
   ii. Structure and function of endoplasmic reticulum, ribosome (Prokayotic and Eukaryotic) and Golgi complex.
   iii. Structure and function of lysosome, microbodies and centrioles.
   iv. Structure and functions of cilia, flagella, microvilli and cytoskeletal elements.

1. Nucleus:

   i. Structure and function of nuclear envelope, nuclear matrix and nucleolus.
   ii. Chromosomes: Morphology, chromonema, chromomeres, telomeres, primary and secondary constrictions, chromatids; prokaryotic chromosome.
   iii. Giant chromosome types : Polytene and Lampbrush.
   iv. Chromosomal organization: Euchromatin, heterochromatin and folded fibre model and nucleosome concept.

2. **Nucleic Acids:**
   i. DNA structure, polymorphism (A, B and Z type) and replication (semi conservative mechanism), experiments of Messelson and Stahl: elementary idea about polymerases, topoisomerase, single strand binding protein, replication forks (both unidirectional and bidirectional), leading and lagging strands, RNA primers and Okazaki fragments; elementary idea about DNA repairs.

   ii. RNA structure and type (mRNA, rRNA and tRNA) and transcription (brief idea about polymerase, exon and introns)
3. Genetic code and translation,: triplet code, characteristics of triplet code; protein synthesis (translation)
4. Cell in Reproduction:
   i. Interphase nucleus and cell cycle : S, G-l, G-2 and M-phase.
   ii. Mitosis: Phases and process of mitosis, structure and function of spindle apparatus; anaphasic movement.
   iii. Meiosis: Phases and process of meiosis, synapses and synaptonemal complex, formation and fate of chiasmata and significance of the crossing over.

1. Mendelism: Brief history of genetics and mendel's work; Mendelian laws, their significance and current status; chromosomal theory of inheritance.
2. Chromosomal mutations: Classification of chromosomal mutations, translocation, inversion, deletion and duplication. Variations in chromosome numbers; haploidy, diploidy, polyploidy, aneuploidy, euploidy and polysomy.

3. Linkage and crossing over, elementary idea of chromosome mapping.

4. Genetic interaction :Supplementary genes, complementary genes, duplicate genes, epistasis, inhibitory and polymorphic genes multiple gene inheritance; ABO blood groups and Rh factor and their significance.
5. Cytoplasmic inheritance.

Developmental Biology-Scope and Early Events

1. Historical review and types and scope of embryology
2. Gametogenesis:
   i. Formation of egg and sperm.
   ii. Vitellogenesis
3. Fertilization: Activation of ovum, essence of activation: changes in the organization of the egg cytoplasm.
4. Parthenogensis

Developmental Biology-Pattern and Processes

1. Cleavage: Definition, planes and patterns among non-chordates and chordates, significance of cleavage, blastulation and morulation.
2. Fate maps, morphogenetic cell movements, significance of gastrulation.
3. Embryonic induction; primary organizer, differentiation and competence;
4. Development of chick up to 96 hours stage.
5. Embryonic adaptations:
   i. Extra-embryonic membranes in chick, their development and functions.
   ii. Placentation in Mammals: Definition, types, classification on the basis of morphology and histology; functions of placenta.

Dimensions in Developmental Biology

1. Regeneration
2. Various types of stem cells and their applications
3. Cloning of animals :
   i. Nuclear transfer technique. ii. Embryo transfer technique.
4. Teratology- (elementary idea).
5. Biology of aging (brief account)

Animal Physiology with special reference to mammals

1. Osmoregulation, Membrane Permeability : active and passive transport across membrane.
2. Physiology of Digestion : Nature of food-stuff, various types of digestive enzymes and their digestive action in the alimentary canal.
3. Physiology of Circulation : Composition and function of blood : mechanism of blood clotting; heart beat; cardiac cycle; blood pressure; body temperature regulation.
4. Physiology of respiration : Mechanism of breathing : exchange of gases : transportation of oxygen and carbon dioxide in blood; regulation of respiration.
5. Physiology of Excretion : Kinds of nitrogenous excretory endoproducts (ammonotelic, uricotelic and ureotelic); role of liver in the formation of these end products. functional architecture of mammalian kidney tubule and formation of urine; hormonal regulation of water and electrolyte balance.

Regulatory aspect of animals Physiology

1. Physiology of Nerve Impulse and Reflex Action : Functional architecture of a neuron, origin and propagation of nerve impulse, synaptic transmission; spinal reflex arc; central control of reflex action.
2. Physiology of Muscle Contraction : Functional architecture of skeletal muscles; chemical and biophysical events during contraction and relaxation of muscle fibers.
3. Types of Endocrine Glands, their secretions and functions : Pituitary, adrenal, thyroid, islets of Langerhans, testis and ovary.

Biochemistry

1. Carbohydrates : Structure, function and significance, oxidation of glucose through glycolysis, Kreb's cycle and oxidative phosphorylation; elementary knowledge of interconversion of glycogen and glucose in liver, role of insulin.
2. Proteins : Structure, function and significance. Essential and non-essential amino acids, transformation of amino acids, deamination, transamination, decarboyxlation, synthesis of protein and urea, fate of ammonia (Ornithine cycle) : fate of carbon skeleton.
3. Lipids : Structure, function and significance, Beta-oxidative pathway of fatty acids; brief account of biosynthesis of triglycerides. cholesterol and its metabolism.
4. Catabolism and biosynthesis of nucleotides.
5. Mineral Metabolism : Iodine, Iron, Calcium and Zinc.

Immunology

1. Immunology : Definition, types of immunity; innate and acquired : humoral and cell mediated.
2. Antigen and Antibody : Antigenicity of molecules, haptens, antibody types.
3. Antigen-Antibody Reactions : Precipitation reaction, agglutination reaction, neutralizing reaction, complement and lytic reactions and phagocytosis.
4. Immunity Regulating Cells : Macrophages, lymphocytes (B- and T- types) T- helper cells. T-killer cells, plasma cells and memory cells.
5. Mechanism of Humoral or Antibody Mediated Immunity.

Microbiology

1. Brief introduction to the History of Microbiology : Work of Anatony Van Leeuwenhock; theory of spontaneous generation : germ theory of fermentation and disease : work of Louis Pasteur, John Tynadal, Robert-Koch and Jenner.
2. The Prokaryota (Bacteria) : Structural organization :
   i. Size, shapes and patterns of arrangement

ii. Structural organization : Slime layer (capsule) : cell envelopes : cytoplasmic membrane (inner membrane). cell wall (outer membrane) of Gram negative and Gram-positive bacteria; mesosomes; cytoplasmic organization; cell projection : flagella and cilia.

3. Genetic Material of Bacteria : (i) Chromosome (ii) Replication of bacterial DNA
4. Reproduction in Bacteria : Asexual reproduction binary fission, budding, endospore formation, exospore and cyst formation; Sexual reproduction, conjugation.
5. Microbial Nutrition : Culture of Bacteria
   a. Carbon and energy source
   b. Nitrogen and minerals
   c. Organic growth factors
   d. Environmental factors : Temperature and pH
6. Bacteria of Medical Importance :
   (i) Gram-Positive :
   a. Cocci : Staphylococci, Streptococci
   b. Bacilli : Diptheria, Tetanus.
   (ii) Gram-Negative :
      a. Cocci : Gonnorrhea, Meningitis
      b. Bacilli : Diarrohea
   (iii) Mycobacteria : Tuberculosis, Leprosy
7. AIDS and Hepatitis. The causative agents, transmission, pathogenecity, laboratory diagnosis, treatment and prevention (elementary idea only).

Biotechnology

5. Recombinant DNA technology and hybridomas and their applications.
6. Monoclonal antibodies and their applications.
7. Genetic Engineering (outline idea only) : Applications of genetic engineering, hazards and regulations.
8. Transgenic animals, their uses in biotechnology.
9. Brief account of cloning, its advantages and disadvantages.
10. Biotechnology in Medicine (outline idea only) : P.C.R., antibiotics. vaccines, enzymes, vitamins, hormones, artificial blood.