

ADMISSIONS TO MEDICINE, DENTISTRY, PHARMACY & PHYSIOTHERAPY PROGRAMS

TOPICS TO PREPARE FOR WRITTEN TEST AND INTERVIEW

BIOLOGY

1. The Structure and Function of Large Biological Molecules.

The diversity of polymers. Carbohydrates. Proteins. Nucleic acids. Lipids.

2. Prokaryotic cell structure and function.

Cell surface structures. Motility. Internal organization and DNA (nucleoid, plasmids). Binary fission and conjugation in bacteria.

3. Eukaryotic cell structure and function.

Plasma Membrane. Compartmentalization. Cytoskeleton. Endomembrane system: endoplasmic reticulum, Golgi Apparatus and lysosomes. The Nucleus. Ribosomes. Mitochondria.

4. Cell communication.

Cell junctions. Local and long distant signaling. Chemical messengers. Receptors. The stages of cell signaling.

5. Cell cycle.

Mitosis and meiosis. Cellular organization of genetic material. Phases of cell cycle. The mitotic spindle. Cytokinesis. Cellular organization of genetic material. The stages of mitosis and meiosis. A comparison of Mitosis and Meiosis. Origins of genetic variation among offspring.

6. Cellular respiration and fermentation.

Catabolic pathways and production of ATP. The stages of cellular respiration (glycolysis, oxidation of pyruvate, citric acid cycle, oxidative phosphorylation). Anaerobic respiration. Types of fermentation.

7. Viruses.

Structure of viruses. General features of viral replication cycles. Viroids and prions. Viral diseases. Emerging viruses.

8. Bacteria and Archaea.

Cell surface structures. Motility. Internal organization. Reproduction and adaptation. Diverse nutritional and metabolic adaptation – oxygen and nitrogen metabolism, cooperation. The role in the biosphere (chemical recycling, ecological interactions). Beneficial and harmful impacts of Prokaryotes on humans.

9. Protists

Structural and functional diversity in Protists. Role of Protists in ecological communities.

10. Fungi.

Nutrition and Ecology. Body structure. Sexual and asexual reproduction. Fungi as pathogens. Practical uses of fungi.

11. Chromosomal and Molecular Basis of Inheritance.

The chromosomal basis of sex. Inheritance of X- and Y-linked genes. Alternation of chromosome number and structure. Human disorders due to chromosomal alternation. Inheritance of organelle genes. DNA as genetic material. Structural model of DNA. Chromosomes' structure.

12. Genetic mechanisms.

The flow of genetic information. Replication: base pairing to a template strand, synthesis of new DNA strands. Transcription: molecular components of transcription, posttranscriptional modifications (alternation of mRNA ends, RNA splicing). Translation: molecular components of the process. Building of polypeptide. Genetic code. Type of mutations. Regulation of Gene Expression (promoters, transcription factors).

13. Tissues and body membranes.

Structure and physiology of: connective, muscle, epithelial and nervous tissue; serous, mucous, synovial and cutaneous membranes.

14. Senses.

Hearing and equilibrium. Visual perception. Taste. Smell. Types of sensory receptors.

15. Nervous system.

Organization of nervous system. The central nervous system. The organization of human brain. Peripheral nervous system: motor and autonomic nervous system. Glia. Blood-brain barrier. Nervous system disorders.

16. Neurons, synapses and signaling.

Neurons structure and function. Resting and action potential. Conduction of action potentials. Postsynaptic potential. Neurotransmitters.

17. Hormones and endocrine system.

Intercellular communication. Endocrine tissues and organs. Chemical classes of hormones. Multiple effects of hormones. Simple hormone pathways. Feedback regulation.

18. Immune system. Innate and adaptive immunity.

Antigen. Antibody. The humoral immune response. The cell-mediated immune response. Inflammatory response. Immunological memory. Allergies. Immunization (vaccination).

19. Cardiovascular system.

Organization of human circulatory system. Heart and heart's rhythmic beat. Blood vessels structure and function. Blood pressure. Blood composition and function.

20. Respiratory system.

Organization of human respiratory system. Negative pressure breathing. Hemoglobin.

21. Digestive system and nutrition.

Essential nutrients. Dietary deficiencies. Organization of human digestive system. Chemical digestion in the human digestive system. Dental adaptation.

22. Human reproduction and development.

Female and male reproductive anatomy. Hormonal control of reproductive system. Gametogenesis. Conception. Embryonic development. Birth.

23. Osmoregulation and excretion.

Excretory organs. Kidney structure. Nephron organization and function. Kidney function, water balance and blood pressure.

24. Evolution.

Evolution of population. Evolution of human being. The Origin and Evolution of Vertebrates. Phylogeny and the Tree of Life.

25. Ecology

Biotic and abiotic factors, habitats, niches, levels of organization, symbiosis, mutualism, parasitism, commensalism, trophic levels, nutrient cycles (water, carbon and nitrogen), food chains, primary producers, types of consumers, energy and biomass pyramids, limiting factors, tolerance, carrying capacity, adaptation, succession, climax community, pioneer species, biomes.

26. Genetics of population.

Genetic drift and effective population size, bottleneck effect, adaptation and phenotypic variance, Hardy-Weinberg equilibrium, maximum likelihood and Bayesian analysis.

CHEMISTRY

1. Atoms

Atomic theory
Elements and atomic number
Isotopes and atomic weight

2. The Periodic Table

The periodic table and some characteristics of different groups
Electronic structure of atoms and electron configurations
Electron configurations and the periodic table
Electron-dot symbols

3. Ionic Compounds

The octet rule ions and ionic bonds
Periodic properties, ion formation formulas, naming ionic compounds
Some properties of ionic compounds
 H^+ and OH^- ions: an introduction to acids and bases

4. Molecular Compounds

Covalent bonds and the periodic table
Multiple covalent bonds and coordinate covalent bonds
Characteristics of molecular compounds
Molecular formulas and Lewis structures
Polar covalent bonds and electronegativity, polar molecules
Naming binary molecular compounds

5. Classification and Balancing of Chemical Reactions

Classes of chemical reactions
Chemical equations and balancing chemical equations
Acids, bases, and neutralization reactions
Redox reactions

6. Mole and Mass Relationships

The mole and Avogadro's number
Gram-mole conversions

7. Reaction Rates and Chemical Equilibria.

Endothermic and exothermic chemical reactions
Factors that influence chemical reaction rates
Chemical equilibrium
Equilibrium constants

8. Nuclear Chemistry

Radioactivity
Radioactive half-life

9. Physical quantities

Metric system of units
Metric units of length
Metric units of mass
Metric units of volume
Significant figures

10. Fundamental Chemical Laws

Law of conservation of mass
Law of definite proportions
Law of multiple proportions

11. Chemical Calculations

Mole concept and chemical formulas
Calculations involving chemical equations
Calculations involving volume and concentration

12. Solutions

Mixtures and solutions
Units of concentration
Dilution
Ions in solution: electrolytes

13. Acids and Bases

Acids and bases in aqueous solution, some common acids and bases
The Brønsted-Lowry definition of acids and bases
Acid dissociation constants. Acid and base strength
Some common acid-base reactions

Acidity and basicity of salt solutions

14. Buffers

Measuring acidity in aqueous solution: pH

Buffer solutions

Titration

15. Introduction to Organic Chemistry: Alkanes

The nature of organic molecules

The structure of organic molecules: alkanes and their isomers

Drawing organic structures

The shapes of organic molecules

Naming alkanes

Properties of alkanes

Reactions of alkanes

16. Cycloalkanes

Drawing and naming cycloalkanes

17. Alkenes and Alkynes

Alkenes and alkynes

Naming alkenes and alkynes

The structure of alkenes: cis-trans isomerism

Properties of alkenes and alkynes

Types of organic reactions

Reactions of alkenes and alkynes

18. Aromatic Compounds

Alkene polymers

Aromatic compounds and the structure of benzene

Naming aromatic compounds

Reactions of aromatic compounds

19. Alcohols

Some common alcohols

Naming alcohols

Properties of alcohols, acidity of alcohols

Reactions of alcohols

20. Phenols

Some common phenols

Acidity of phenols

21. Some Compounds with Oxygen, Sulfur, or a Halogen

Ethers

Thiols and disulfides

Halogen-containing compounds

22. Amines

Amines

Properties of amines

Heterocyclic nitrogen compounds

Basicity of amines

Amine salts

23. Aldehydes

The carbonyl group

Naming aldehydes

Properties of aldehydes

Some Common aldehydes

Oxidation of aldehydes

Reduction of aldehydes

24. Ketones

Naming ketones
Properties of ketones
Some Common ketones
Reduction of ketones

25. Carboxylic Acids and their Derivatives

Carboxylic acids and their derivatives: properties and names
Some common carboxylic acids
Acidity of carboxylic acids
Reactions of carboxylic acids: ester and amide formation
Hydrolysis of esters and amides

26. Amino Acids and Proteins

Amino acids structures
Acid–base properties of amino acids
Chemical properties of proteins

27. Enzymes and Vitamins

Catalysis by enzymes
How enzymes work
Vitamins and minerals

28. Carbohydrates

Classification of carbohydrates
The D and L families of sugars: drawing sugar molecules
Structure of glucose
Disaccharides, structure of maltose
Some important polysaccharides
Properties of carbohydrates

29. Lipids

Structure and classification of lipids
Fatty acids and their esters
Properties of fats and oils

30. Nucleic Acids and Protein Synthesis

DNA, chromosomes, and genes
Composition of nucleic acids
The structure of nucleic acid chains
Base pairing in DNA: the Watson–Crick model

PHYSICS

1. Dynamics

Force, mass, Newton's 1st, 2nd and 3rd law
Free-body diagrams
Contact forces: normal force and friction force
Linear momentum, impulse, conservation of momentum
Elastic and inelastic collisions, center of mass, translational motion

2. Electric currents

Electric current,
Ohm's law, electrical resistance and resistors
Electric power
EMF and terminal voltage.
Resistors in series and parallel, Kirchhoff's rules

3. Electric field

Electric charge, static electricity, induced charge, electric field, field lines, electric potential, equipotential lines, voltage,

Coulomb's law

Electric field, conductors and dielectrics, charge distribution

Capacitance, storage of electric energy, capacitors in series and in parallel

4. Elements of kinematics and dynamics of circular and rotational motion

Angular velocity, angular acceleration, torque and rotational inertia

Angular momentum, conservation of angular momentum

Period, frequency, centripetal acceleration, centripetal force

Condition of equilibrium

Stability and balance

5. Elements of modern Physics: early quantum theory and models of the atom

Photon theory of light, photon energy, Planck's constant

Photoelectric effect

Early models of the atoms, atomic spectra, the Bohr model: energy levels, transitions, absorption and emission

Wave-particle duality: the de Broglie hypothesis

6. Fluids and solids

Mass and weight, specific density and specific gravity

Pascal's principle, pressure, hydraulic lift

Archimedes' principle, buoyancy and buoyant force

Elasticity, stress, strain, Hooke's law and Young's modulus

7. Geometrical optics and wave nature of light

The ray model of light

Reflection of light, formation of image by plane mirrors and spherical mirrors, total internal reflection, fibre optics

Refraction, Snell's law index of refraction

Thin lenses, focal point, focal length, optical power, ray tracing: converging and diverging lenses

The thin lenses equation; magnification, combination of lenses, lensmaker's equation,

Magnifying glass, eye and corrective lenses

Huygens principle, diffraction, diffraction grating, interference, polarization

8. Kinematics

Vectors and scalars, vector components, addition of vectors

Frames of reference and displacement

Velocity and acceleration

Motion at a constant acceleration; falling objects

Projectile motion

9. Magnetism and electromagnetic induction, electromagnetic waves

Magnets and magnetic fields.

Magnetic field of straight wires and coils supplied with electric current

Force on an electric current in a magnetic field and on electric charge moving in a magnetic field

Faraday's law of induction; Lenz's law, electric generators, transformers and transmission of power

Electromagnetic waves and the electromagnetic spectrum, production of electromagnetic waves

10. Nuclear Physics and radioactivity

Structure and properties on the nucleus, nuclear size

Binding energy and nuclear forces

Radioactivity: alpha, beta and gamma decay; conservation of nucleon number and charge

The law of radioactive decay; the half-life time

Nuclear reactions and transmutation of elements

Nuclear fission and fusion, nuclear reactors

11. Sounds

Characteristics of sound

Sound intensity and intensity level, ear, sound loudness

Doppler effect

Sources of sound: vibrating strings and air columns, standing waves

12. Temperature and kinetic theory of gases

Temperature, kinetic theory of gases and molecular interpretation of temperature

Thermal Equilibrium and the Zero-the Law of Thermodynamics

The Ideal Gas Law

Heat and internal energy, First Law of Thermodynamics

Specific heat and latent heat

Heat engines, Second Law of Thermodynamics

13. Vibration and waves

Simple harmonic motion (SHL), energy in the SHL, conservation of energy in the SHL,

Simple pendulum, resonance, forced vibration

Wave motion, transverse and longitudinal waves

Energy transported by waves

Propagation of waves: reflection, refraction and diffraction

14. Work, power and energy

Work, kinetic energy, potential energy, power

Conservative and non-conservative forces

Conversion of mechanical energy, energy transformations

Work-energy principle