Pakistan Medical Commission (PMC) National MDCAT Syllabus-2020

(Biology, Chemistry, Physics & English)

Table of Contents

SUBJECT-WISE CONTENT, WEIGHTAGE &

DIFFICULTY INDEX

Total MCQs: 200

S.no	Subject	Weightage	
		Percentage	Questions
1.	Biology	40	80
2.	Chemistry	30	60
3.	Physics	20	40
4.	English	10	20
Total		100	200

Difficulty Index (%)

Easy	30
Moderate	50
Hard	20

Note: In Biology, Chemistry and Physics sections 70% questions will be recall (C1) and 30% at understanding level (C2).

BIOLOGY

Table of contents

Cell structure and function

- Cell wall,
- Cytoplasm and cell organelles
    - Nucleus,
    - Endoplasmic reticulum,
    - Mitochondria,
    - Golgi apparatus/Golgi complex/Golgi bodies,
    - Lysozyme,
    - Plastids/ Chloroplast,
    - Vacuoles,
- Prokaryote and eukaryote
- Fluid mosaic model

Learning Outcomes

- Compare the structure of typical animal and plant cell
- Compare and contrast the structure of Prokaryotic cell with Eukaryotic cells
- Outline the structure and function of the following organelles: Nucleus, Endoplasmic reticulum, Golgi apparatus, Mitochondria
- Discuss fluid mosaic model of cell membrane

Biological molecules

- Introduction to biological molecules
- Water
- Carbohydrates
- Proteins
- Lipids
- Nucleic acids (DNA/RNA)
- Conjugated molecules (Glycolipids, Glycoproteins)

Learning Outcomes

- Introduce biological molecules.
- Describe biologically important properties of water (Polarity, hydrolysis, specific heat, water as solvent and reagent, density, cohesion/ionization)
- Discuss carbohydrates: Monosaccharides (Glucose), Oligosaccharides (Cane sugar, sucrose, lactose), Polysaccharides (Starches, cellulose, glycogen)
- Describe Proteins: Amino acids, structure of proteins
- Describe Lipids: Phospholipids, Triglycerhides, alcohol and esters(Acyl glycerol)
- Describe the structure along its back bone composition and function of DNA as hereditary material, double helical model.
- Give an account of RNA
- Introduce and discuss conjugated molecules (glycolipids, glycoproteins)

Enzymes

- Introduction/Characteristics of enzymes
- Mechanism of action of enzymes
- Factors effecting rate of enzyme action
- Enzyme inhibition

Learning Outcomes

- Introduce and distinguish characteristics of enzymes
- Explain mechanism of action of enzymes
- Describe effects of factor on enzyme action (temperature, pH, concentration)
- Distinguish enzyme inhibitors

Bioenergetics

- Photosynthesis,
- Role of light, water, CO_2,/ Factors effecting photosynthesis
- Production of ATP,
- Electron transport chain
- Light dependent and light independent phases/reactions,
- Glycolysis/ Glycolytic pathway/Aerobic respiration
- Oxidative phosphorylation/Cyclic and non-cyclic phosphorylation,
- Anaerobic respiration (Respiration without oxygen)

Learning Outcomes

- Explain the process of Photosynthesis
- Distinguish the role of factors (light, water, CO_2) effecting photosynthesis
- Distinguish and explain light dependent and independent phases/reaction
- Explain ATP production process
- Differentiate and discuss Electron transport chain, phosphorylation, Glycolysis, Aerobic and Anaerobic respiration

Biodiversity (Acellular life/ Variety of life)

- Discovery of viruses,
- Structure of viruses,
- Classification of viruses,
- Viral disease (For example AIDS)

Learning Outcomes

- Trace the discovery of virus
- Classify viruses on basis of their structure/ no. of strands/diseases/host etc.
- Identify symptoms, mode of transmission and causes of viral disease (AIDS)

Prokaryotes (Kingdom Monera)

- Cellular Structure of bacteria

- Shape and size of bacteria
- Importance and control of bacteria

Learning Outcomes

- Describe cellular structures of bacteria
- Explain diversity in shape and size in bacteria
- Highlight the importance of bacteria and control of harmful bacteria

Protists and Fungi (Kingdom Protoctista and Kingdom Fungi)

- Major groups among Protists (Algae (Plant like protists), Protozoa (Animal like protists))
- Characteristics of Protists
- Characteristics of fungi

Learning Outcomes

- Describe salient features/characteristics of protists
- Differentiate among major group of protists with examples
- List the characteristic features of fungi

Diversity among Plants (The Kingdom Plantae)

- General introduction of plants,
- Characteristics/Features of plants

Learning Outcomes

- Outline and introduce the structure of plants
- List general characteristics/features of plants

Diversity among Animals (The Kingdom Animalia)

- Characteristics and diversity among the animals

Learning Outcomes

- Describe general characteristic of animals

Life processes in animals and plants (Nutrition/ Gaseous exchange/Transport)

- Carnivorous plants/ parasitic nutrition (pitcher plant, Venus fly trap, sundew)
- Photosynthesis,
- Osmotic pressure/potential
- Water and mineral uptake by roots, Xylem and Phloem
- Human heart structure,
- Blood vessels,
- Lymphatic system,
- Immune system

Learning Outcomes

- Discuss the examples of carnivorous plants

- Explain the process of photosynthesis
- Describe water and minerals uptake by roots, xylem and phloem
- List down general structure of human heart
- List the differences and functions of capillaries, arteries and veins.
- Describe lymphatic system (organs, nodules, vessels)
- Define and introduce immune system (general definition, its need and importance)

Homeostasis

- Mechanism of Homeostasis
    - Receptors
    - Control center
    - Effector
    - Positive feedback
    - Negative feedback
- Various nitrogenous compounds excreted during the process of excretion.
- Excretory System of Human
- Structure and Function of Kidney
- Thermoregulation in Human

Learning Outcomes

- Describe the three elements i.e receptors, control center and effector
- Nature of excretory products.
- Explain kidney structure and function
- Define the thermoregulation and its need**.**

Support and Movement

- Muscles
- Types of muscles
    - Skeletal Muscles
    - Cardiac Muscles
    - Smooth Muscles
- Structure of Skeletal Muscles

Learning Outcomes

- Define muscle
- Compare smooth muscles, cardiac muscles and skeletal muscles
- Explain the Ultra-structure of Skeletal Muscles

Coordination and control/ Nervous & chemical coordination

- Nervous System of Man
    - Nerve Impulse
    - Steps involved in nervous coordination
    - Neurons (Structure and Types)
- Transmission of Action Potential between Cells – Synapse
    - Electrical synapses
    - Chemical synapses
    - Transmission of nerve impulse across synapse
- Hormones- The chemical messengers
- Endocrine glands
- Feedback Mechanism
    - Positive feedback Mechanism
    - Negative feedback Mechanism

Learning Outcomes

- Steps involved in nervous coordination
- Recognize receptors as transducers sensitive to various stimuli.
- Define Neurons and explain its structure (Cell body, dendrites, axon and myelin sheath and Schwann cells)
- Define nerve impulse.

Reproduction

- Menstrual cycle
- Sexually Transmitted Diseases- AIDS

Learning Outcomes

- Describe the menstrual cycle (Female reproductive Cycle) emphasizing the role of hormones.
- Explain AIDS as a worldwide sexually transmitted disease.

Variation and Genetics / Inheritance

- Mendel's law of inheritance
    - Gregor John Mendel and his worked
    - Mendel's experiment
    - Inheritance of single trait
    - Mendel's principles of inheritance
    - Inheritance of two traits
    - Law of independent assortment
    - Scope of independent assortment in variation
    - Statistics and probability relevant to genetics
- Complete dominance

- Co-dominance
- Multiple alleles
- Gene linkages and crossing over
- Sex linkages in drosophila
- Sex linkage in human
    - Genetics of Haemophilia

Learning Outcomes

- Associate inheritance with the laws of Mendel.
- Explain the law of independent assortment, using a suitable example.
- Describe the terms gene linkage and crossing over
- Explain how gene linkage counters independent assortment and crossing-over modifies the progeny
- Describe the concept of sex-linkage.
- Inheritance of sex-linked traits
- Analyze the inheritance of Haemophilia.

Chromosome and DNA/ Nucleic acid

- Chromosomes
    - Number of chromosomes
    - Structure of chromosomes
    - Composition and organization of chromosomes
- Concept of gene
- DNA as heredity material
- DNA replication
- Gene expression
- Gene Mutation

Learning Outcomes

- Annotate the detailed structure, composition and Organization of a chromosome.
- Describe the gene.
- Explain the concept of alleles as the alternative forms of a gene.
- Explain DNA as the hereditary material.
- Describe the process of DNA replication.
- Explain the mechanism of transcription
- Define gene and genetic code.
- Describe the mechanism of protein synthesis (Translation)
- Define and explain mutation

Evolution

- Concepts of Evolution
- Inheritance of acquired characteristics
- Darwinism's
    - Darwin's voyage of HMS beagle and his observations
    - Darwin's theory evolution

- Neo-Darwinism's
    - Evidence of evolution

Learning Outcomes

- Explain origin of life according to concept of evolution
- Describe the theory of inheritance of acquired characters, as proposed by Lamarck.
- Briefly describe the observations Darwin made during his voyage.
- Explain the theory of natural selection as proposed by Darwin

Biotechnology/ Genetic Technology

- Cloning of gene
    - Recombinant DNA technology
    - Selection and isolation of desired gene
    - Molecular scissors
    - Molecular carriers or vectors
    - Small size example of vectors
    - Molecular glue (DNA Ligase)
    - Expression system
- Procedure of recombinant DNA technology
- Polymerase chain reaction
    - Components of PCR technique
    - Mechanism of PCR reaction
    - Application of PCR
- DNA sequencing
    - Gel Electrophoresis
    - Automated DNA sequencing
- Transgenic organisms
- Biotechnology and healthcare

Learning Outcomes

- Define gene cloning and state the steps in gene cloning.
- Describe the techniques of gene cloning through recombinant DNA technology.
- Describe the steps involved in gene amplification through polymerase chain reaction.
- Describe the principles of Gel Electrophoresis as being used in gene sequencing.
- Define genetically modified/genetically engineered/transgenic organism
- State the objectives of the production of transgenic plants and transgenic animals.

CHEMISTRY

Table of contents

Introduction to fundamental concepts of chemistry

- Atomic mass
- Empirical formula
- Molecular formula
- Concept of mole
- Construction of mole ratios as conversion factors in stoichiometry calculations
- Avogadro's number
- Important assumptions of stoichiometric calculations
- Stoichiometry
- Limiting reactant
- Percentage yield

Learning Outcomes

- Construct mole ratios from balanced equations for use as conversion factors in stoichiometric problems.
- Perform stoichiometric calculations with balanced equations using moles, representative particles, masses and volumes of gases (at STP).
- Knowing the limiting reagent in a reaction, calculate the maximum amount of product(s) produced and the amount of any unreacted excess reagent.
- Given information from which any two of the following may be determined, calculate the third: theoretical yield, actual yield, percentage yield.
- Calculate the theoretical yield and the percent yield when given the balanced equation, the amounts of reactants and the actual yield.

Atomic Structure

- Concept of orbitals
- Electronic configuration
- Discovery and properties of proton (positive Rays)
- Quantum numbers
- Shapes of orbitals

Learning Outcomes

- Describe discovery and properties of proton (positive rays)
- Define photon as a unit of radiation energy.
- Describe the concept of orbitals.
- Distinguish among principal energy levels, energy sub-levels, and atomic orbitals.
- Describe the general shapes of s, p, and d orbitals.
- Describe the hydrogen atom using the quantum theory.
- Use the Aufbau Principle, the Pauli Exclusion Principle, and Hund's Rule to write the electronic configuration of the atoms.
- Write electronic configuration of atoms.

Gases

- Properties of gases
- Gas laws
- Boyle's law

- Charles's law
- General gas equation
- Kinetic molecular theory of gases
- Kinetic interpretation of temperature
- Ideal gas equation

Learning Outcomes

- List the postulates of kinetic molecular theory.
- Describe the motion of particles of a gas according to kinetic theory.
- State the values of standard temperature and pressure (STP).
- Describe the effect of change in pressure on the volume of gas.
- Describe the effect of change in temperature on the volume of gas.
- Explain the significance of absolute zero, giving its value in degree Celsius and Kelvin.
- Derive ideal gas equation using Boyle's, Charles' and Avogadro's law.
- Explain the significance and different units of ideal gas constant.
- Distinguish between real and ideal gases.

Liquids

- Properties of liquids
- Intermolecular forces
- Dipole-dipole forces
- Dipole-induced dipole forces
- Hydrogen bonding
- Vapor pressure
- Boiling point and external pressure

Learning Outcomes

- Describe simple properties of liquids e.g; diffusion, compression, expansion, motion of molecules, spaces between them, intermolecular forces and kinetic energy based on kinetic molecular theory.
- Explain applications of dipole-dipole forces and dipole-induced dipole forces.
- Explain physical properties of liquids such as evaporation, vapor pressure, boiling point.
- Describe the hydrogen bonding in H_2O, NH_3 and HF molecules.
- Anomalous behavior of water when its density shows maximum at 4 degree centigrade

Solids

- Introduction
- Types of solids
- Ionic solids
- Molecular solids
- Crystal lattice

Learning Outcomes

- Describe crystalline solids.
- Name three factors that affect the shape of an ionic crystal.
- Give a brief description of ionic and molecular solids.

- Describe crystal lattice.
- Define lattice energy.

Chemical Equilibrium

- Reversible and irreversible reactions
- State of chemical equilibrium
- Equilibrium constant expression for important reaction
- Applications of equilibrium constant
- Solubility product
- The Le Chatelier's principle
- Applications of chemical equilibrium in industry
- Synthesis of ammonia by Haber's Process
- Common ion effect
- Buffer solutions
- Equilibria of slightly soluble ionic compounds (solubility product)

Learning Outcomes

- Define chemical equilibrium in terms of a reversible reaction.
- Write both forward and reverse reactions and describe the macroscopic characteristics of each.
- State Le Chatelier's Principle and be able to apply it to systems in equilibrium with changes in concentration, pressure, temperature, or the addition of catalyst.
- Explain industrial applications of Le Chatelier's Principle using Haber's process as an example.
- Define and explain solubility product.
- Define and explain the common ion effect giving suitable examples.
- Describe buffer solutions and explain types of buffers.
- Explain synthesis of ammonia by Haber's Process.

Reaction Kinetics

- Rate of reaction
- Determination of the rate of a chemical reaction
- Factors affecting rate of reaction
- Specific rate constant or velocity constant
- Units of rate constant
- Order of reaction and its determination

Learning Outcomes

- Define chemical kinetics.
- Explain the terms rate of reaction, rate equation, order of reaction, rate constant and rate determining step.
- Explain qualitatively factors affecting rate of reaction.
- Given the order with respect to each reactant, write the rate law for the reaction.
- Explain what is meant by the terms activation energy and activated complex.
- Relate the ideas of activation energy and the activated complex to the rate of a reaction.
- Explain effects of concentration, temperature and surface area on reaction rates.

- Describe the role of the rate constant in the theoretical determination of reaction rate.

Thermochemistry and Energetics of Chemical Reactions

- System, Surrounding and State function
- Definitions of terms used in thermodynamics
- Standard states and standard enthalpy changes
- Energy in chemical reactions
- First Law of thermodynamics
- Sign of ΔH
- Enthalpy of a reaction
- Born-Haber cycle
- Hess's law of constant heat summation

Learning Outcomes

- Define thermodynamics.
- Classify reactions as exothermic or endothermic.
- Define the terms system, surrounding, boundary, state function, heat, heat capacity, internal energy, work done and enthalpy of a substance.
- Name and define the units of thermal energy.
- Explain the first law of thermodynamics for energy conservation.
- Apply Hess's Law to construct simple energy cycles.
- Describe enthalpy of a reaction.
- Describe Born-Haber cycle.

Electrochemistry

- Oxidation number or state
- Explanation of electrolysis
- Electrode potential
- Balancing of redox equations by ion-electron method
- Balancing redox equations by oxidation number change method

Learning Outcomes

- Give the characteristics of a redox reaction.
- Define oxidation and reduction in terms of a change in oxidation number.
- Use the oxidation-number change method to identify atoms being oxidized or reduced in redox reactions.
- Define cathode, anode, electrode potential and S.H.E. (Standard Hydrogen Electrode).
- Define the standard electrode potential of an electrode.
- Use the ion-electron method/oxidation number method to balance chemical equations.

Chemical Bonding

- Energetics of bond formation
- Atomic sizes
- Atomic radii
- Ionic radii
- Covalent radii
- Ionization energy

- Electron affinity
- Electronegativity
- Bond energy
- Bond length
- Types of bonds
- Electrovalent or Ionic Bond
- Covalent bond
- Co-ordinate or dative covalent bond
- Ionic character of covalent bond
- Sigma and Pi bond
- Hybridization
- sp^3 - Hybridization
- sp^2 - Hybridization
- *sp*-hybridization
- The Valence Shell Electron Pair Repulsion theory
- Postulates of VSEPR theory
- Applications of VSEPR theory

Learning Outcomes

- Use VSEPR theory to describe the shapes of molecules.
- Describe the features of sigma and pi bonds.
- Describe the shapes of simple molecules using orbital hybridization.
- Determine the shapes of some molecules from the number of bonded pairs and lone pairs of electrons around the central atom.
- Predict the molecular polarity from the shapes of molecules.
- Explain what is meant by the term ionic character of a covalent bond.
- Describe how knowledge of molecular polarity can be used to explain some physical and chemical properties of molecules.
- Define bond energies and explain how they can be used to compare bond strengths of different chemical bonds.
- Define and explain the terms atomic radii, ionic radii, covalent radii, ionization energy, electron affinity, electronegativity, bond energy and bond length.

s and p Block Elements

- Electronic configuration
- Chemical properties of s-block elements
- Group 1 Elements (Alkali Metals)
- Atomic and Physical properties
- Trends in reactivity
- Group 2 Elements (Alkaline earth metals)
- Trends in reactivity
- Physical and chemical properties
- Group trends: atomic radii, ionic radii, electronegativity, ionization potential, electropositivity or metallic character, melting and boiling points

Learning Outcomes

- Recognize the demarcation of the periodic table into s block, p block, d block, and f block.
- Describe how physical properties like atomic radius, ionization energy, electronegativity, electrical conductivity and melting and boiling points of elements change within a group and within a period in the periodic table.
- Describe reactions of Group I elements with water, oxygen and chlorine.
- Describe reactions of Group II elements with water, oxygen and nitrogen.
- Describe reactions of Group III elements with water, oxygen and chlorine.

Transition Elements

- General characteristics

Learning Outcomes

- Describe electronic structures of elements and ions of d-block elements.

Fundamental Principles of Organic Chemistry

- Classification of organic compound
- Isomerism

Learning Outcomes

- Define organic chemistry and organic compounds.
- Classify organic compounds on structural basis.
- Explain that organic compounds are also synthesized in the laboratory.
- Define functional group.
- Explain isomerism and its types.

Chemistry of Hydrocarbons

- Open chain and closed chain hydrocarbons
- Nomenclature of alkanes, alkenes and alkynes
- Benzene: Properties, structure, modern representation, reactions, resonance method, electrophilic substitution,
- The molecular orbital treatment of benzene.

Learning Outcomes

- Classify hydrocarbons as aliphatic and aromatic.
- Describe nomenclature of alkanes.
- Define free radical initiation, propagation and termination.
- Describe the mechanism of free radical substitution in alkanes exemplified by methane and ethane.
- Explain the IUPAC nomenclature of alkenes.
- Explain the shape of ethene molecule in terms of sigma and pi C-C bonds.
- Describe the structure and reactivity of alkenes as exemplified by ethene.
- Define and explain with suitable examples the terms isomerism and structural isomerism.
- Explain dehydration of alcohols and dehydrohalogenation of RX for the preparation of ethene.
- Describe the chemistry of alkenes by the following reactions of ethene:

Hydrogenation, hydrohalogenation, hydration, halogenation, halohydration, polymerization.

- Explain the shape of the benzene molecule (molecular orbital treatment).
- Define resonance, resonance energy and relative stability.
- Compare the reactivity of benzene with alkanes and alkenes.
- Describe addition reactions of benzene and methylbenzene.
- Describe the mechanism of electrophilic substitution in benzene.
- Discuss chemistry of benzene and methyl benzene by nitration, sulphonation, halogenation, Friedal Craft's alkylation and acylation.
- Apply the knowledge of positions of substituents in the electrophilic substitution of benzene.
- Use the IUPAC naming system for alkynes.
- Compare the reactivity of alkynes with alkanes, alkenes and arenes.
- Describe the preparation of alkynes using elimination reactions.
- Describe acidity of alkynes.
- Discuss chemistry of alkynes by hydrogenation, hydrohalogenation, and hydration.
- Describe and differentiate between substitution and addition reactions.

Alkyl Halides

- Classification of alkyl halides
- Nomenclature
- Reactions
- Mechanism of nucleophilic substitution reaction S_N1, S_N2, E1 and E2 reaction

Learning Outcomes

- Name alkyl halides using IUPAC system.
- Discuss the structure and reactivity of RX.
- Describe the mechanism and types of nucleophilic substitution reactions.
- Describe the mechanism and types of elimination reactions.

Alcohols and Phenols

- Alcohols:
  - Classification: Primary, secondary and tertiary alcohols
  - Nomenclature
  - Reactivity
- Phenols:
  - Physical properties
  - Nomenclature
  - Acidity
  - Reactivity

Learning Outcomes

- Explain nomenclature and structure of alcohols.
- Explain the reactivity of alcohols.
- Describe the chemistry of alcohols by preparation of ethers and esters.

- Explain the nomenclature and structure of phenols.
- Discuss the reactivity of phenol and their chemistry by electrophilic aromatic substitution.
- Differentiate between an alcohol and phenol.

Aldehydes and Ketones

- Nomenclature
- Preparation
- Reactions

Learning Outcomes

- Explain nomenclature and structure of aldehydes and ketones.
- Discuss the preparation of aldehydes and ketones.
- Describe reactivity of aldehydes and ketones and their comparison.
- Describe acid and base catalyzed nucleophilic addition reactions of aldehydes and ketones.
- Discuss the chemistry of aldehydes and ketones by their reduction to alcohols.
- Describe oxidation reactions of aldehydes and ketones.

Carboxylic Acids

- Nomenclature
- Classification
- Physical properties
- Preparations of carboxylic acids
- Reactivity

Learning Outcomes

- Describe nomenclature, chemistry and preparation of carboxylic acids.
- Discuss reactivity of carboxylic acids.
- Describe the chemistry of carboxylic acids by conversion to carboxylic acid derivatives: acyl halides, acid anhydrides, esters, amides and reactions involving interconversion of these.

Macromolecules

- Proteins
- Enzymes

Learning Outcomes

- Explain the basis of classification and structure-function relationship of proteins.
- Describe the role of various proteins in maintaining body functions and their nutritional importance.
- Describe the role of enzymes as biocatalysts.

TOS - CHEMISTRY

60 Questions

S.No.	Topic	No. of Questions
1	Introduction to Fundamental Concepts of Chemistry	3
2	Atomic Structure	4
3	Gases	2
4	Liquids	2
5	Solids	2
6	Chemical Equilibrium	4
7	Reaction Kinetics	4
8	Thermochemistry and Energetics of Chemical Reactions	3
9	Electrochemistry	3
10	Chemical Bonding	3
11	s and p Block Elements	3
12	Transition Elements	3
13	Fundamental Principles of Organic Chemistry	3
14	Chemistry of Hydrocarbons	6
15	Alkyl Halides	3
16	Alcohol and Phenols	3
17	Aldehydes and Ketones	3
18	Carboxylic Acids	3
19	Macromolecules	3
Total		**60**

PHYSICS

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PMC National MDCAT Syllabus for the Subject of Physics

Force and Motion

- Displacement
- Velocity
- Displacement-time graph
- Acceleration
- Uniform acceleration
- Variable acceleration
- Graphical representation of acceleration with velocity time graph
- Newton's laws of motion
- Newton's first law of motion
- Newton's second law of motion
- Newton's third law of motion
- Linear Momentum
- Law of conservation of momentum
- Collision
- Elastic collision
- Elastic collision in one dimension
- Elastic collision in one dimension under different cases
- Projectile motion
- Characteristics of projectile motion
- Time of flight
- maximum height
- Horizontal range

Learning Outcomes

- Describe displacement.
- Describe average velocity of objects.
- Interpret displacement-time graph of objects moving along the same straight line.
- Define uniform acceleration
- Distinguish between, uniform and variable acceleration.
- Explain that projectile motion is two-dimensional motion in a vertical plane.
- Communicate the ideas of a projectile in the absence of air resistance.
- Horizontal component (VH) of velocity is constant.
- Acceleration is in the vertical direction and is the same as that of a vertically free-falling object.
- The horizontal motion and vertical motion are independent of each other.
- Evaluate using equations of uniformly accelerated motion that for a given initial velocity of frictionless projectile.
- How higher does it go?
- How far would it go along the level land?

- Where would it be after a given time?
- How long will it remain in air?
- Determine for a projectile launched from ground height.
- Launch angle that results in the maximum range.
- Relation between the launch angles that result in the same range.
- Apply Newton's laws to explain the motion of objects in a variety of context.
- Describe the Newton's second law of motion as rate of change of momentum.
- Correlate Newton's third law of motion and conservation of momentum.
- Solve different problems of elastic and inelastic collisions between two bodies in one dimension by using law of conservation of momentum.
- Describe that momentum is conserved in all situations.
- Identify that for a perfectly elastic collision, the relative speed of approach is equal to the relative speed of separation.

Work and Energy

- work
- Energy
- Kinetic energy
- Potential energy
- Gravitational potential energy
- Power

Learning Outcomes

- Describe the concept of work in terms of the product of force F and displacement d in the direction of force (Work as scalar product of F and d).
- Define Energy
- Explain Kinetic Energy
- Explain the Difference between Potential energy and gravitational Potential energy.
- Describe that the gravitational PE is measured from a reference level and can be positive or negative, to denote the orientation from the reference level.
- Express power as scalar product of force and velocity.
- Explain that work done against friction is dissipated as heat in the environment.
- State the implications of energy losses in practical devices

Rotational and Circular Motion

- Angular displacement
- Revolution
- Degree
- Radian
- Angular velocity
- Relation between linear and angular variables
- Relation between linear and angular displacements

- Relation between linear and angular velocities
- Relation between linear and angular accelerations
- Centripetal force
- Forces causing centripetal acceleration

Learning Outcomes

- Define angular displacement, express angular displacement in radians.
- Define Revolution, degree and Radian
- Define and Explain the term Angular Velocity
- Find out the relationship between the following:
- Relation between linear and angular variables
- Relation between linear and angular displacements
- Relation between linear and angular velocities
- Relation between linear and angular accelerations
- solve problems using centripetal force $F = mr\omega^2$, $F = mv^2/r$.

Waves

- Progressive waves
- Crest
- Trough
- Amplitude
- Wavelength
- Time period and frequency
- Types of progressive waves
- Transverse waves
- Longitudinal waves
- Periodic waves
- Transverse periodic waves
- Longitudinal periodic waves
- Speed of sound in air
- Principle of superposition/ superposition of sound waves
- Stationary waves/ standing waves
- Stationary waves in a stretched string/fundamental frequency and harmonics
- Doppler effect
- Observer is moving towards a stationary source
- Observer is moving away from a stationary source
- When the source is moving towards the stationary observer
- When the source is moving away from the stationary observer
- Simple harmonic motion (SHM)
- Characteristics of simple harmonic motion
- Instantaneous displacement
- Amplitude

- Vibration
- Time period
- Frequency
- Angular frequency

Learning Outcomes

- Describe what is meant by wave motion as illustrated by vibrations in ropes and springs.
- Demonstrate that mechanical waves require a medium for their propagation while electromagnetic waves do not.
- Define and apply the following terms to the wave model; medium, displacement, amplitude, period, compression, rarefaction, crest, trough, wavelength, velocity.
- Solve problems using the equation: v = fl.
- Describe that energy is transferred due to a progressive wave.
- Compare transverse and longitudinal waves.
- Explain that speed of sound depends on the properties of medium in which it propagates and describe Newton's formula of speed of waves.
- Describe the Laplace correction in Newton's formula for speed of sound in air.
- Identify the factors on which speed of sound in air depends.
- Describe the principle of superposition of two waves from coherent sources.
- Describe the phenomenon of interference of sound waves.
- Explain the formation of stationary waves using graphical method
- Define the terms, node and antinodes.
- Describe modes of vibration of strings.
- Describe formation of stationary waves in vibrating air columns.
- Explain the principle of Super position
- Explain S.H.M and explain the Characteristics of S.H.M.

Thermodynamics

- First law of thermodynamics
- Specific heat and Molar specific heat / specific heat capacity

Learning Outcomes

- Describe that thermal energy is transferred from a region of higher temperature to a region of lower temperature.
- Differentiate between Specific heat and Molar Specific Heat.
- Calculate work done by a thermodynamic system during a volume change.
- Describe the first law of thermodynamics expressed in terms of the change in internal energy, the heating of the system and work done on the system.
- Explain that first law of thermodynamics expresses the conservation of energy.
- Define the terms, specific heat and molar specific heats of a gas.
- Apply first law of thermodynamics to derive Cp – Cv = R.

Electrostatics

- Coulomb's Law
- Coulomb's law in material media
- Electric field and its intensity
- Electric field intensity due to an infinite sheet of charge
- Electric field intensity between two oppositely charged parallel plates
- Electric potential
- Capacitor
- Capacitance of a capacitor and its unit
- Capacitance of a parallel plate capacitor
- Energy Stored in a Capacitor
- Charging and Discharging a Capacitor

Learning Outcomes

- State Coulomb's law and explain that force between two-point charges is reduced in a medium other than free space using Coulomb's law.
- Describe the concept of an electric field as an example of a field of force.
- Calculate the magnitude and direction of the electric field at a point due to two charges with the same or opposite signs.
- Sketch the electric field lines for two-point charges of equal magnitude with same or opposite signs.
- Describe and draw the electric field due to an infinite size conducting plate of positive or negative charge.
- Define electric potential at a point in terms of the work done in bringing unit positive charge from infinity to that point.
- Define the unit of potential.
- Derive an expression for electric potential at a point due to a point charge.
- Explain polarization of dielectric of a capacitor.
- Demonstrate charging and discharging of a capacitor through a resistance.

Current Electricity

- OHM's Law
- Electrical resistance
- Specific resistance or resistivity
- Effect of temperature on resistance
- Temperature coefficient of resistance
- Variation of resistivity with temperature
- Internal resistance of a supply
- Electric power
- Unit of electric power
- Kilowatt-hours
- Kirchhoff's Rule
- Kirchhoff's current law

- Kirchhoff's voltage law
- Procedure of Kirchhoff's law for Problem solution
- Potentiometer

Learning Outcomes

- Describe the concept of steady current.
- State Ohm's law.
- Define resistivity and explain its dependence upon temperature.
- Explain the internal resistance of sources and its consequences for external circuits.
- Describe the conditions for maximum power transfer.
- Apply Kirchhoff's first law as conservation of charge to solve problem.
- Apply Kirchhoff's second law as conservation of energy to solve problem.

Electromagnetism

- Magnetic field
- Magnetic Flux
- Magnetic Flux Density

Learning outcome

- Define magnetic flux density and its units.
- Describe the concept of magnetic flux (Ø) as scalar product of magnetic field (B) and area (A) using the relation $ØB = B^{\perp} A = B.A$.
- Describe quantitatively the path followed by a charged particle shot into a magnetic field in a direction perpendicular to the field.
- Explain that a force may act on a charged particle in a uniform magnetic field.

Electromagnetic Induction

- Electromagnetic induction
- Faraday's Law
- Lenz's Law
- Lenz's Law and conservation of energy
- Generating electricity- Alternating Current Generator
- Transformers

Learning Outcomes

- State Faraday's law of electromagnetic induction.
- Account for Lenz's law to predict the direction of an induced current and relate to the principle of conservation of energy.
- Describe the construction of a transformer and explain how it works.
- Describe how set-up and step-down transformers can be used to ensure efficient transfer of electricity along cables.

Electronics

- Rectification

Learning Outcomes

- Define rectification and describe the use of diodes for half and full wave rectifications.

Dawn of Modern Physics

- The wave nature of particles
- The wave-particle duality

Learning Outcomes

- Explain the particle model of light in terms of photons with particular energy and frequency.
- Explain how the very short wavelength of electrons, and the ability to use electrons and magnetic fields to focus them, allows electron microscope to achieve very high resolution.
- Describe uncertainty principle.

Atomic Spectra

- Atomic Spectra/Line Spectrum

Learning Outcomes

- Describe and explain Atomic Spectra/Line Spectrum.
- Show an understanding of the existence of discrete electron energy levels in isolated atoms (e.g. atomic hydrogen) and deduce how this leads to spectral lines.

Nuclear Physics

- Spontaneous and random nuclear decay/ the Law of Radioactive Decay
- Half Life and rate of decay
- Biological effects of Radiation
- Biological and Medical Uses of Radiation

Learning Outcomes

- Describe a simple model for the atom to include protons, neutrons and electrons.
- Identify the spontaneous and random nature of nuclear decay.
- Describe the term half-life and solve problems using the equation
- Describe Biological effects of radiation state and explain the different medical uses of Radiation.

TOS- PHYSICS

40 Questions

S.No.	Topic	No. of Questions
1	Force and Motion	4
2	Work and Energy	4
3	Rotational and Circular Motion	4
4	Waves	4
5	Thermodynamics	2
6	Electro statistics	4
7	Current Electricity	4
8	Electromagnetism	2
9	Electromagnetic Induction	4
10	Electronics	2
11	Dawn of Modern Physics	2
12	Atomic Spectra	1
13	Nuclear Physics	3
Total		**40**

English

Aim

The aim of the English section of MDCAT is to measure the applicants' skills in English language and to evaluate how prepared they are for undertaking graduate studies in medicine in English. The test applies a common standard to everyone to be able to evaluate the preparation of the applicants from different sectors, regions and socio-economic backgrounds.

The benchmarks for the test have been developed in the light of the Syllabus used in HSSC and CIE. Since the students who take the MDCAT come from a wide range of educational contexts, the test comprises items that may be applied to a broadband of language competencies that are not exclusive to one particular type of Syllabus.

Objectives

i. To ensure complete alignment between the English Syllabus used in various sectors at the HSSC and CIE level and the test items

ii. To create a balance of items from different benchmarks of the English Syllabus outlined for MDCAT

iii. To make sure that difficult and ambiguous items beyond the scope of high school education are not included

iv. To design the test specifications

v. To design, select, and arrange test task items

3 **Objective**	**Benchmark**	**Contents**
1. Comprehend key vocabulary	Use one or more of the following strategies to determine meaning of key vocabulary: 1.1 contextual clues and illustrations 1.2 background or prior knowledge 1.3 morphology, syntax, phonics, knowledge of word relationships 1.4 knowledge of synonyms, antonyms, homophones	High and low frequency words from the course book or to be selected from similar contexts or the contexts the HSSC and CIE students may be familiar with

2. Demonstrate control of tenses and sentence structure	2.1 Use correct tenses and sentence structure in writing 2.2 Identify mistakes in the use of tenses and sentence structure in written texts	▯ All the present tenses ▯ All the past tenses ▯ Four types of sentences ▯ Conditionals ▯ Types of clauses ▯ Fragments
3. Demonstrate correct use of subject-verb agreement	3.1 use correct subject-verb agreement in written texts 3.2 Identify mistakes in the use of subject verb-agreement in written texts	Use the texts prescribed/ used in HSSC or CIE for selecting test items as well as determining the degree of their complexity
4. Demonstrate correct use of articles and prepositions	4.1 Use appropriate articles and prepositions in different written contexts 4.2 Identify mistakes in the use of articles and prepositions in sentences or short texts 4.3 Select the appropriate article or preposition for a particular Context	The test items to be selected from the contexts common to the texts at HSSC and CIE level
5. Demonstrate correct use of writing conventions of spelling, capitalization and punctuation to clarify meaning	5.1 Use capitalization and punctuation such as semi colons, commas in a series, apostrophes in possessives, proper nouns, and abbreviations 5.2 Avoid and identify the following punctuation	The test items to be selected from the type of texts written by HSSC and CIE students and from the contexts common to both the streams

Vocabulary

A
appalling astounded
apparently attached to
appraised alas abruptly
accentuated anxieties

B
boon bewilderment
briskly
bead brimming baffling
bashful beckoned

C
coveted credentials
capacious collided with
crudely confront
compelled crudely
coaxed
comprehension curious
casually
confining crammed
confirm
cautioned captivated
condescended compelled
criteria

D
daintily
dispensing
dispute
distract
drummed dilapidated
disconsolately delicately
dank
dilapidated disguise
definite

E
enchanted encouraged
fringed
exude
eccentric excursion
elaborate exasperation
expansive exaggeration
evaluates

F
fatality flicked flawlessly
friction fluttered

G
gingerly glistening glared
groggy

H
heap
hideous
habitat
haggard haphazardly
harmony haughty
havoc
hearsay

I
intended
in vain
illumination invariably
irritable insinuated
intently industry
intolerable
imperceptibly

J
judgment judicial
junction juvenile jeopardy jealousy
jubilant

K
Kindred
Knack
knickers
knick
knack

L
likelihood labyrinth
ludicrous limp

M
menaced mustered
mean
mass
mounting
minimum
mayhem
miniature
mumbled meditated
moulded
menacing

N
nuisance naïve
native nauseous
negate negligence
nemesis neutral niggle

O
opted for
on the wrong foot
occasionally operation

P
plopped presume precautions
panting purchase persisted
pensively
prime
placidly
peered propelling passion
promptly practically prone to
paraphernalia prerogative path
precision pizzazz potential

Q
qualitative qualm
quantitative quarrel
quench query
queue
quirk
quiver quizzical
quotation

R
rituals
reinforce reprimanded
riot
refuge
regret
rarely
reproachful
ragged
revolving
resonant

S
swarmed up
scenario swathe
subsequently struck up
string
sternly
solemnly succulent
shuffled sailed stunt
sauntered
splendour sagged off
speckled with stable

T
tentatively
tackle
tumultuous
tomfoolery
tangle
troughs
tangled

U
urge
unburdened
unprovoked

V
ventured vulnerable

W
whipped
weighing up
writhing
waft

Y
Yearning Yelp yield

Z
zealous zenith zest

TOS - ENGLISH

20 Questions

S.No.	Topic	No. of Questions
1	Vocabulary	04
2	Tenses	04
3	Structure of Sentence	03
4	Correct use of Subject Verb Agreement	03
5	Correct use of articles and prepositions	02
6	Use of writing conventions of spelling, capitalization and punctuation	02
7	Mistakes in Sentences or short written texts	02
	Total	**20**