# RAMAN SPACE MANTHAN

DEPARTMENT OF NUCLEAR PHYSICS ISSI

**Grade 9 NCERT Science: Comprehensive Study Notes & Master Question Bank**

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Title

## CHAPTER 1: EXPLORING: ENTERING THE WORLD OF SECONDARY SCIENCE

**Key Concepts & Keywords:** Scientific Method, Hypothesis, Controlled Experiment, Variables (Independent, Dependent, Control), Empirical Evidence, Peer Review, Metric System, SI Units.

### COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Science is a systematic and organized body of knowledge acquired through scientific inquiry, meticulous observation, experimentation, and logical reasoning.
- The Scientific Method involves steps: (1) Observation & Problem Formulation, (2) Literature Review, (3) Formulating a Testable Hypothesis, (4) Designing and Conducting Controlled Experiments, (5) Data Collection & Analysis, and (6) Drawing Conclusions and Peer Communication.
- Variables in Scientific Testing: Independent Variable (manipulated by researcher), Dependent Variable (measured outcome/response), and Controlled Variables (kept constant to ensure internal validity).
- Measurement and SI Units: Standard international units ensure reproducibility. Mass in kg, Length in m, Time in s, Temperature in K, Electric Current in A, Amount of substance in mol.
- Scientific Integrity & Ethics: Replicability of experimental results, objective reporting of standard errors, and peer review validation before scientific acceptance.

### STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Which step directly follows hypothesis formulation in scientific method?**
A) Conclusion B) Designing & conducting experiment C) Literature review D) Theory publishing
**[Correct Answer: B]**

**Q2. The variable manipulated deliberately by an experimenter is called:**
A) Dependent variable B) Controlled variable C) Independent variable D) Extraneous variable
**[Correct Answer: C]**

**Q3. The SI base unit for measuring thermodynamic temperature is:**
A) Celsius B) Fahrenheit C) Kelvin D) Joule
**[Correct Answer: C]**

**Q4. To ensure a fair experiment, all variables except the independent variable must be:**
A) Changed continuously B) Kept constant C) Ignored D) Doubled
**[Correct Answer: B]**

**Q5. Empirical evidence is best defined as evidence derived from:**
A) Personal opinions B) Direct observation and experimentation C) Ancient legends D) Unverified assumptions
**[Correct Answer: B]**

**Q6. Which process helps ensure that research findings are valid before publication?**
A) Peer review B) Public voting C) Speculation D) Mass media advertising
**[Correct Answer: A]**

**Q7. An educated guess or tentative explanation that can be tested is a:**
A) Law B) Theory C) Hypothesis D) Axiom
**[Correct Answer: C]**

**Q8. SI unit of amount of substance is:**
A) Gram B) Mole C) Candela D) Ampere
**[Correct Answer: B]**

**Q9. A scientific law describes:**
A) Why a phenomenon occurs B) What happens consistently under specific conditions C) Unproven ideas D) Opinion-based facts
**[Correct Answer: B]**

**Q10. In an experiment testing fertilizer on plant growth, plant height is the:**
A) Independent variable B) Dependent variable C) Constant D) Control setup
**[Correct Answer: B]**

**Q11. Standard metric prefix 'kilo' represents a factor of:**
A) 10^2 B) 10^3 C) 10^6 D) 10^-3
**[Correct Answer: B]**

**Q12. Which instrument measures electric current precisely?**
A) Voltmeter B) Ammeter C) Barometer D) Thermometer
**[Correct Answer: B]**

**Q13. Scientific knowledge is considered dynamic because it:**
A) Never changes B) Is based on absolute faith C) Revises with new experimental evidence D) Is voted by politicians
**[Correct Answer: C]**

**Q14. Qualitative data differs from quantitative data in being:**
A) Numerical B) Descriptive and non-numerical C) Measured in meters D) Plotted on axes
**[Correct Answer: B]**

**Q15. Precision in scientific measurement refers to:**
A) Closeness to true value B) Closeness of repeated measurements to each other C) Speed of measurement D) Size of equipment
**[Correct Answer: B]**

**Q16. Accuracy refers to:**
A) Reproducibility B) Closeness of a measured value to the true/accepted value C) Number of decimals D) Machine age
**[Correct Answer: B]**

**Q17. Which unit is a derived SI unit?**
A) Meter B) Kilogram C) Newton D) Second
**[Correct Answer: C]**

**Q18. The baseline group in an experiment that does not receive experimental treatment is:**
A) Test group B) Control group C) Variable group D) Sample group
**[Correct Answer: B]**

**Q19. A graph where data points show trend of dependent vs independent variable is called:**
A) Pie chart B) Line/Scatter graph C) Flowchart D) Pictogram
**[Correct Answer: B]**

**Q20. Prefix 'milli' corresponds to:**
A) 10^-1 B) 10^-2 C) 10^-3 D) 10^-6
**[Correct Answer: C]**

**Q21. Science relies primarily on:**
A) Dogma B) Testable evidence and logical inference C) Intuition D) Popular vote
**[Correct Answer: B]**

**Q22. Which standard unit measures luminous intensity?**
A) Lumen B) Candela C) Lux D) Watt
**[Correct Answer: B]**

**Q23. Safety rule: When heating a test tube, always point the mouth:**
A) Towards yourself B) Towards your partner C) Away from everyone D) Directly at floor
**[Correct Answer: C]**

**Q24. Replicability means an experiment should:**
A) Give different results every time B) Produce consistent results when repeated by others C) Be performed once D) Never be documented
**[Correct Answer: B]**

**Q25. Micro prefix represents:**
A) 10^-3 B) 10^-6 C) 10^-9 D) 10^6
**[Correct Answer: B]**

**Q26. Scientific theories are:**
A) Pure guesses B) Well-substantiated explanations supported by vast evidence C) Inferior to laws D) Unchangeable facts
**[Correct Answer: B]**

**Q27. In SI system, length is measured in:**
A) Feet B) Inches C) Meters D) Centimeters
**[Correct Answer: C]**

**Q28. Mass is defined as:**
A) Weight force B) Amount of matter in an object C) Volume occupied D) Density x Gravity
**[Correct Answer: B]**

**Q29. Error that shifts all measurements in one systematic direction is:**
A) Random error B) Systematic error C) Human error D) Zero correction error
**[Correct Answer: B]**

**Q30. Systematic peer scrutiny before publishing scientific research ensures:**
A) Rapid profit B) High scientific rigor and validity C) Confidentiality D) Automatic awards
**[Correct Answer: B]**

# CHAPTER 2: CELL: THE BUILDING BLOCK OF LIFE

**Key Concepts & Keywords:** Cell Theory, Prokaryotes, Eukaryotes, Organelles, Cell Wall, Plasma Membrane, Nucleus, Mitochondria, Endoplasmic Reticulum, Golgi Apparatus, Lysosomes, Vacuoles, Plasmolysis, Osmosis.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Cell Theory formulated by Schleiden, Schwann, and Virchow: (1) All living organisms are composed of cells, (2) Cell is the fundamental structural and functional unit of life, (3) All cells arise from pre-existing cells (Omnis cellula-e-cellula).
- Prokaryotic vs Eukaryotic: Prokaryotes (e.g. Bacteria) lack a membrane-bound nucleus and organelles; Eukaryotes (Plants, Animals, Fungi) possess membrane-bound nucleus and complex organelles.
- Plasma Membrane: Fluid mosaic model, selectively permeable membrane composed of a phospholipid bilayer with embedded proteins. Regulates transport via diffusion, osmosis, and active transport.
- Cell Wall: Rigid outer layer present in plants (cellulose), fungi (chitin), and bacteria (peptidoglycan). Provides structural rigidity and protection against hypotonic burst.
- Key Organelles: Nucleus (contains chromatin/DNA, controls cell functions), Mitochondria ('Powerhouse of the cell', site of ATP production via cellular respiration, possesses its own circular DNA and 70S ribosomes), Ribosomes (site of protein synthesis), Endoplasmic Reticulum (RER with ribosomes synthesizes proteins; SER synthesizes lipids/steroids and detoxifies drugs), Golgi Apparatus (packages and modifies proteins), Lysosomes ('Suicide bags', rich in hydrolytic enzymes), Vacuoles (storage, turgidity in plant cells).

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Who proposed that all cells arise from pre-existing cells ('Omnis cellula-e-cellula')?**
A) Robert Hooke B) Anton van Leeuwenhoek C) Rudolf Virchow D) Robert Brown
**[Correct Answer: C]**

**Q2. Which organelle is known as the 'Powerhouse of the Cell'?**
A) Golgi apparatus B) Ribosome C) Mitochondrion D) Lysosome
**[Correct Answer: C]**

**Q3. Plant cell walls are primarily composed of:**
A) Chitin B) Peptidoglycan C) Cellulose D) Glycogen
**[Correct Answer: C]**

**Q4. Which organelle contains hydrolytic digestive enzymes and is termed 'suicide bag'?**
A) Peroxisome B) Lysosome C) Centrosome D) Endosome
**[Correct Answer: B]**

**Q5. Smooth Endoplasmic Reticulum (SER) is primarily involved in the synthesis of:**
A) Proteins B) Lipids and steroids C) Nucleic acids D) Carbohydrates
**[Correct Answer: B]**

**Q6. The semi-permeable nature of plasma membrane means it allows:**
A) All substances freely B) No substances at all C) Selective movement of solvent and specific solutes D) Only solids
**[Correct Answer: C]**

**Q7. Prokaryotic cells lack which of the following features?**
A) Plasma membrane B) Ribosomes C) Nuclear membrane D) Cytoplasm
**[Correct Answer: C]**

**Q8. Osmosis is the diffusion of water across a selectively permeable membrane from:**
A) High solute to low solute B) High water potential to low water potential C) Low water potential to high water potential D) Hypertonic to hypotonic solution
**[Correct Answer: B]**

**Q9. Plasmolysis in a plant cell occurs when it is placed in a:**
A) Isotonic solution B) Hypotonic solution C) Hypertonic solution D) Pure water
**[Correct Answer: C]**

**Q10. Which organelle has its own DNA and ribosomes?**
A) Golgi apparatus B) Lysosome C) Mitochondria D) Endoplasmic reticulum
**[Correct Answer: C]**

**Q11. Protein synthesis occurs at the site of:**
A) Lysosomes B) Ribosomes C) Nucleolus D) Vacuoles
**[Correct Answer: B]**

**Q12. Organelle responsible for packaging and dispatching cellular products:**
A) Mitochondria B) Golgi apparatus C) Centriole D) Peroxisome
**[Correct Answer: B]**

**Q13. The fluid content inside the plasma membrane is called:**
A) Nucleoplasm B) Cytoplasm C) Matrix D) Stroma
**[Correct Answer: B]**

**Q14. Chromosome consists of:**
A) DNA only B) Protein only C) DNA and Histone proteins D) RNA only
**[Correct Answer: C]**

**Q15. Who discovered cell for the first time in cork slice (1665)?**
A) Leeuwenhoek B) Robert Hooke C) Robert Brown D) Purkinje
**[Correct Answer: B]**

**Q16. Living cell was first observed by:**
A) Robert Hooke B) Anton van Leeuwenhoek C) Robert Brown D) Virchow
**[Correct Answer: B]**

**Q17. Nucleus was discovered by:**
A) Robert Brown B) Robert Hooke C) Purkinje D) Schleiden
**[Correct Answer: A]**

**Q18. Ribosomes in prokaryotes are of what type?**
A) 80S B) 70S C) 60S D) 50S
**[Correct Answer: B]**

**Q19. When a plant cell is placed in a hypotonic solution, it becomes:**
A) Plasmolyzed B) Flaccid C) Turgid D) Shrinked
**[Correct Answer: C]**

**Q20. The term 'Protoplasm' for the fluid substance of cell was coined by:**
A) Hooke B) Purkinje C) Brown D) Virchow
**[Correct Answer: B]**

**Q21. Foldings of inner mitochondrial membrane are called:**
A) Thylakoids B) Cristae C) Cisternae D) Grana
**[Correct Answer: B]**

**Q22. Chloroplasts contain green pigment called:**
A) Carotene B) Xanthophyll C) Chlorophyll D) Anthocyanin
**[Correct Answer: C]**

**Q23. Function of central vacuole in mature plant cell:**
A) Protein synthesis B) Providing turgidity and rigidity C) ATP synthesis D) Cell division
**[Correct Answer: B]**

**Q24. Cell wall of fungi is made of:**
A) Cellulose B) Chitin C) Suberin D) Lignin
**[Correct Answer: B]**

**Q25. Which organelle plays a key role in detoxifying poisons/drugs in liver cells?**
A) RER B) SER C) Golgi apparatus D) Lysosomes
**[Correct Answer: B]**

**Q26. Double membrane organelle absent in animal cells:**
A) Mitochondria B) Nucleus C) Plastid D) Endoplasmic reticulum
**[Correct Answer: C]**

**Q27. Chromatin material is composed of:**
A) DNA and RNA B) DNA and proteins C) RNA and lipid D) Protein only
**[Correct Answer: B]**

**Q28. Endocytosis is a process where cell engulfs material via:**
A) Cell wall B) Plasma membrane flexible infolding C) Nuclear membrane D) Vacuole expansion
**[Correct Answer: B]**

**Q29. Unspecialized cell capable of giving rise to differentiated cell types:**
A) Red blood cell B) Stem cell C) Neuron D) Muscle fiber
**[Correct Answer: B]**

**Q30. The functional unit of DNA that carries hereditary information:**
A) Chromosome B) Gene C) Nucleolus D) Histone
**[Correct Answer: B]**

# CHAPTER 3: TISSUE IN ACTION

**Key Concepts & Keywords:** Plant Tissues (Meristematic, Permanent), Apical/Lateral/Intercalary Meristems, Simple Permanent (Parenchyma, Collenchyma, Sclerenchyma), Complex Permanent (Xylem, Phloem), Animal Tissues (Epithelial, Connective, Muscular, Nervous).

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Tissues are groups of similar cells working together to perform a specific specialized function.

- Plant Tissues: Meristematic (actively dividing cells found in growing regions - Apical increases length, Lateral/ Cambium increases girth, Intercalary at nodes/internodes) and Permanent Tissues (cells lost division capacity).
- Simple Permanent Plant Tissues: Parenchyma (thin-walled living storage tissue, may contain chlorophyll - Chlorenchyma, or air cavities - Aerenchyma), Collenchyma (living cells with localized pectin thickenings providing flexibility), Sclerenchyma (dead, lignified thick-walled cells providing mechanical strength, e.g. husk of coconut).
- Complex Permanent Plant Tissues: Xylem (conducts water and minerals unidirectionally; consists of Tracheids, Vessels, Xylem Parenchyma, Xylem Fibers) and Phloem (translocates organic solutes bidirectionally; consists of Sieve tubes, Companion cells, Phloem Parenchyma, Phloem Fibers).
- Animal Tissues: Epithelial (protective covering: Squamous, Cuboidal, Columnar, Ciliated, Stratified), Connective (connects/supports: Bone, Cartilage, Areolar, Adipose, Blood, Ligament, Tendon), Muscular (contractile: Striated/ Skeletal/Voluntary, Unstriated/Smooth/Involuntary, Cardiac/Involuntary Heart), Nervous (neurons for signal transmission).

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Which tissue increases the girth/diameter of the stem in plants?**
A) Apical meristem B) Intercalary meristem C) Lateral meristem (Cambium) D) Parenchyma
**[Correct Answer: C]**

**Q2. Husk of coconut is made of which plant tissue?**
A) Parenchyma B) Collenchyma C) Sclerenchyma D) Aerenchyma
**[Correct Answer: C]**

**Q3. Flexibility in plants without breaking is provided by:**
A) Parenchyma B) Collenchyma C) Sclerenchyma D) Xylem
**[Correct Answer: B]**

**Q4. Water and mineral transport in plants takes place through:**
A) Phloem B) Xylem C) Cambium D) Cortex
**[Correct Answer: B]**

**Q5. Living element of xylem tissue is:**
A) Tracheid B) Vessel C) Xylem parenchyma D) Xylem fiber
**[Correct Answer: C]**

**Q6. Which phloem component lacks nucleus at maturity?**
A) Companion cell B) Sieve tube element C) Phloem parenchyma D) Phloem fiber
**[Correct Answer: B]**

**Q7. Tendon connects:**
A) Bone to bone B) Muscle to bone C) Muscle to muscle D) Cartilage to bone
**[Correct Answer: B]**

**Q8. Ligament connects:**
A) Bone to bone B) Muscle to bone C) Skin to muscle D) Nerve to muscle
**[Correct Answer: A]**

**Q9. Fat-storing tissue in human body is:**
A) Areolar tissue B) Adipose tissue C) Cartilage D) Epithelium
**[Correct Answer: B]**

**Q10. Involuntary, cylindrical, branched and uninucleate muscle fibers are:**
A) Skeletal muscle B) Smooth muscle C) Cardiac muscle D) Voluntary muscle
**[Correct Answer: C]**

**Q11. Voluntary, multinucleate, cylindrical and unbranched muscle fibers are:**
A) Striated/Skeletal muscle B) Smooth muscle C) Cardiac muscle D) Visceral muscle
**[Correct Answer: A]**

**Q12. Tissue present in lining of kidney tubules and ducts of salivary glands:**
A) Squamous epithelium B) Cuboidal epithelium C) Columnar epithelium D) Stratified epithelium
**[Correct Answer: B]**

**Q13. Fluid matrix of blood is called:**
A) Lymph B) Plasma C) Serum D) Platelets
**[Correct Answer: B]**

**Q14. Ciliated epithelium is found in:**
A) Digestive tract B) Respiratory tract C) Skin surface D) Bone marrow
**[Correct Answer: B]**

**Q15. Cell wall of sclerenchyma is uniformly thickened due to deposit of:**
A) Cellulose B) Suberin C) Lignin D) Pectin
**[Correct Answer: C]**

**Q16. Aerenchyma is helpful in aquatic plants for:**
A) Photosynthesis B) Buoyancy and floating C) Mechanical support D) Translocation
**[Correct Answer: B]**

**Q17. Which simple permanent tissue has intercellular spaces?**
A) Sclerenchyma B) Parenchyma C) Collenchyma D) Xylem vessels
**[Correct Answer: B]**

**Q18. Cartilage is NOT present in:**
A) Nose tip B) Ear pinna C) Kidney D) Larynx
**[Correct Answer: C]**

**Q19. Functional unit of nervous tissue is:**
A) Nephron B) Neuron C) Axon D) Dendrite
**[Correct Answer: B]**

**Q20. Axon and dendrites are parts of:**
A) Muscle cell B) Nerve cell C) Epithelial cell D) Blood cell
**[Correct Answer: B]**

**Q21. Matrix of bone tissue is rich in:**
A) Phosphorus and Sodium B) Calcium and Phosphorus C) Calcium and Iron D) Potassium and Sodium
**[Correct Answer: B]**

**Q22. Epithelium that protects skin against wear and tear (multilayered):**
A) Simple squamous B) Stratified squamous C) Cuboidal D) Columnar
**[Correct Answer: B]**

**Q23. Movement of esophagus during swallowing is controlled by:**
A) Voluntary muscles B) Smooth/Involuntary muscles C) Cardiac muscles D) Skeletal muscles
**[Correct Answer: B]**

**Q24. Intercalary meristem is located at:**
A) Growing tip of root B) Base of leaves or internodes C) Cambium D) Cork
**[Correct Answer: B]**

**Q25. Only dead cell component in phloem is:**
A) Sieve tube B) Companion cell C) Phloem fiber D) Phloem parenchyma
**[Correct Answer: C]**

**Q26. Companion cells are associated with:**
A) Tracheids B) Sieve tubes C) Vessels D) Xylem fibers
**[Correct Answer: B]**

**Q27. Glandular epithelium is modified:**
A) Connective tissue B) Epithelial tissue C) Muscle tissue D) Nervous tissue
**[Correct Answer: B]**

**Q28. Outer protective tissue of older stem transformed into:**
A) Epidermis B) Cork / Periderm C) Cortex D) Endodermis
**[Correct Answer: B]**

**Q29. Substance in cork cell wall that makes it impervious to gases and water:**
A) Lignin B) Suberin C) Pectin D) Cutin
**[Correct Answer: B]**

**Q30. Areolar connective tissue is found between:**
A) Skin and muscles B) Bone and bone C) Heart and lungs D) Blood and lymph
**[Correct Answer: A]**

# CHAPTER 4: DESCRIBING MOTION AROUND US

**Key Concepts & Keywords:** Distance, Displacement, Speed, Velocity, Acceleration, Uniform/Non-uniform Motion, Distance-Time Graph, Velocity-Time Graph, Equations of Motion, Uniform Circular Motion.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Distance is total path length traveled (scalar quantity). Displacement is shortest straight-line distance from initial to final position with direction (vector quantity).
- Speed = Distance / Time (m/s). Velocity = Displacement / Time (m/s, vector). Average Velocity = (u + v) / 2 for uniform acceleration.
- Acceleration (a) = Rate of change of velocity = $(v - u) / t$ (unit: m/s²). Negative acceleration is deceleration or retardation.
- Graphical Representation: Slope of Distance-Time graph gives Speed. Slope of Velocity-Time graph gives Acceleration. Area under Velocity-Time graph gives Displacement.
- Equations of Motion (for uniform acceleration):
- 1) $v = u + at$
- 2) $s = ut + \frac{1}{2} at^2$
- 3) $v^2 - u^2 = 2as$
- Uniform Circular Motion: Motion of an object along a circular path at constant speed. Since direction changes continuously, velocity changes continuously, making it an accelerated motion ($v = 2\pi r / T$).

### STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Distance traveled by an object in unit time is:**
A) Velocity B) Speed C) Acceleration D) Displacement
**[Correct Answer: B]**

**Q2. Numerical ratio of displacement to distance for a moving object is always:**
A) Greater than 1 B) Equal to 1 C) Less than or equal to 1 D) Less than 1
**[Correct Answer: C]**

**Q3. SI unit of acceleration is:**
A) m/s B) m·s C) m/s² D) km/h
**[Correct Answer: C]**

**Q4. Slope of velocity-time graph represents:**
A) Distance B) Speed C) Acceleration D) Displacement
**[Correct Answer: C]**

**Q5. Area under velocity-time graph represents:**
A) Speed B) Acceleration C) Displacement D) Time
**[Correct Answer: C]**

**Q6. An object moves along circular path of radius r. Displacement after completing one full revolution is:**
A) 2πr B) πr C) 2r D) Zero
**[Correct Answer: D]**

**Q7. If an object travels equal distances in equal intervals of time, its motion is:**
A) Non-uniform B) Uniform C) Accelerated D) Retarded
**[Correct Answer: B]**

**Q8. Slope of distance-time graph represents:**
A) Acceleration B) Speed C) Force D) Work
**[Correct Answer: B]**

**Q9. A car increases its speed from 18 km/h to 36 km/h in 5 s. Its acceleration is:**
A) 1 m/s² B) 2 m/s² C) 3.6 m/s² D) 0.5 m/s²
**[Correct Answer: A]**

**Q10. 18 km/h expressed in m/s is:**
A) 18 m/s B) 5 m/s C) 10 m/s D) 2.5 m/s
**[Correct Answer: B]**

**Q11. Which formula represents third equation of motion?**
A) $v = u + at$ B) $s = ut + \frac{1}{2} at^2$ C) $v^2 - u^2 = 2as$ D) $F = ma$
**[Correct Answer: C]**

**Q12. Uniform circular motion is an example of:**
A) Zero acceleration motion B) Accelerated motion with constant speed C) Non-accelerated motion D) Motion with constant velocity
**[Correct Answer: B]**

**Q13. When velocity of a body decreases with time, its acceleration is:**
A) Positive B) Zero C) Negative (Retardation) D) Infinite
**[Correct Answer: C]**

**Q14. Unit of displacement in SI system is:**
A) Kilometer B) Meter C) Centimeter D) Meter/second
**[Correct Answer: B]**

**Q15. A body starting from rest moves with uniform acceleration of 2 $m/s^2$. Distance covered in 4 s is:**
A) 8 m B) 16 m C) 32 m D) 4 m
**[Correct Answer: B]**

**Q16. A vector quantity has both:**
A) Magnitude and time B) Magnitude and direction C) Direction and mass D) Speed and velocity
**[Correct Answer: B]**

**Q17. Which of the following is a scalar quantity?**
A) Velocity B) Displacement C) Acceleration D) Distance
**[Correct Answer: D]**

**Q18. An athlete completes a circular track of radius 7m in 20s. Speed of athlete is:**
A) 2.2 m/s B) 4.4 m/s C) 1.1 m/s D) 7 m/s
**[Correct Answer: A]**

**Q19. If distance-time graph is parallel to time axis, the body is:**
A) In uniform motion B) At rest C) In accelerated motion D) Moving in circle
**[Correct Answer: B]**

**Q20. Area under acceleration-time graph gives change in:**
A) Distance B) Velocity C) Displacement D) Speed
**[Correct Answer: B]**

**Q21. A car travels first 30 km at 30 km/h and next 30 km at 60 km/h. Average speed is:**
A) 45 km/h B) 40 km/h C) 50 km/h D) 35 km/h
**[Correct Answer: B]**

**Q22. In uniform circular motion, direction of velocity vector at any point is:**
A) Along the radius B) Tangential to the circular path C) Opposite to motion D) Towards center
**[Correct Answer: B]**

**Q23. When an object falls freely under gravity, its acceleration is:**
A) Zero B) Variable C) Constant (9.8 $m/s^2$) D) Decreasing
**[Correct Answer: C]**

**Q24. Which equation relates initial velocity, final velocity, acceleration and time?**
A) $v = u + at$ B) $s = ut + \frac{1}{2} at^2$ C) $v^2 - u^2 = 2as$ D) $p = mv$
**[Correct Answer: A]**

**Q25. Can displacement be greater than distance?**
A) Yes, always B) Yes, sometimes C) No, never D) Depends on direction
**[Correct Answer: C]**

**Q26. In velocity-time graph, a straight line sloping upwards represents:**
A) Uniform positive acceleration B) Uniform velocity C) Zero acceleration D) Retardation
**[Correct Answer: A]**

**Q27. Displacement-time graph for non-uniform motion is a:**
A) Straight line parallel to time axis B) Straight line inclined to time axis C) Curved line D) Vertical line
**[Correct Answer: C]**

**Q28. Unit for rate of change of velocity:**
A) m/s B) m/s² C) m·s D) kg·m/s
**[Correct Answer: B]**

**Q29. A body travels half circle of radius R. Distance and displacement are:**
A) 2πR, 2R B) πR, 2R C) πR, 0 D) 2R, πR
**[Correct Answer: B]**

**Q30. An object moving with velocity v has acceleration a = 0. Its motion is:**
A) At rest B) Uniform velocity motion C) Circular motion D) Oscillatory motion
**[Correct Answer: B]**

# CHAPTER 5: EXPLORING MIXTURES AND THEIR SEPARATION

**Key Concepts & Keywords:** Pure Substances, Mixtures (Homogeneous, Heterogeneous), Solutions, Solute, Solvent, Concentration, Colloids, Suspensions, Tyndall Effect, Evaporation, Crystallization, Distillation, Fractional Distillation, Chromatography, Centrifugation.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Pure Substance: Consists of a single type of particle (Element or Compound). Mixture: Contains two or more pure substances physically combined in any ratio.
- Homogeneous Mixture: Uniform composition throughout (e.g. Salt solution, Air, Alloys). Heterogeneous Mixture: Non-uniform composition with visible boundaries (e.g. Chalk in water, Sand and salt).
- Solutions, Colloids, Suspensions:
- - Solution: Homogeneous, particle size < 1 nm, stable, does not scatter light, passes through filter paper.
- - Colloid: Heterogeneous looking homogeneous, particle size 1-100 nm, exhibits Tyndall Effect (scattering of light), stable (does not settle down), passes through filter paper.
- - Suspension: Heterogeneous, particle size > 100 nm, unstable (particles settle down), scatters light, retained on filter paper.
- Concentration of Solution = (Mass of Solute / Mass of Solution) × 100.
- Separation Techniques: Centrifugation (denser particles forced to bottom, lighter stay top), Chromatography (separation based on differential solubility in mobile phase), Simple Distillation (miscible liquids with boiling point difference > 25 K), Fractional Distillation (boiling point difference < 25 K, uses fractionating column), Crystallization (obtains pure solid in crystal form from solution).

### STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. A mixture of oil and water can be separated using:**
A) Filter paper B) Separating funnel C) Distillation column D) Centrifuge
**[Correct Answer: B]**

**Q2. The scattering of light by colloidal particles is called:**
A) Raman Effect B) Tyndall Effect C) Doppler Effect D) Photoelectric Effect
**[Correct Answer: B]**

**Q3. Air is considered a:**
A) Compound B) Element C) Homogeneous mixture D) Heterogeneous mixture
**[Correct Answer: C]**

**Q4. Tincture of iodine is prepared by dissolving iodine in:**
A) Water B) Alcohol C) Ether D) Acetone
**[Correct Answer: B]**

**Q5. Which technique is used to separate pigments from natural colors/dyes?**
A) Crystallization B) Sublimation C) Chromatography D) Distillation
**[Correct Answer: C]**

**Q6. Which of the following is a chemical change?**
A) Melting of ice B) Rusting of iron C) Dissolving salt in water D) Boiling of water
**[Correct Answer: B]**

**Q7. Boiling point difference required for simple distillation between two miscible liquids is at least:**
A) 5 K B) 10 K C) 25 K D) 50 K
**[Correct Answer: C]**

**Q8. Method used to separate cream from milk is:**
A) Filtration B) Centrifugation C) Evaporation D) Sublimation
**[Correct Answer: B]**

**Q9. Brass is an alloy (solid-in-solid solution) composed of:**
A) Copper and Zinc B) Copper and Tin C) Iron and Carbon D) Zinc and Lead
**[Correct Answer: A]**

**Q10. Particle size in a true solution is less than:**
A) 1 nm (10^-9 m) B) 100 nm C) 1 mm D) 1 cm
**[Correct Answer: A]**

**Q11. Which technique is best to purify copper sulfate containing soluble impurities?**
A) Evaporation B) Crystallization C) Simple filtration D) Centrifugation
**[Correct Answer: B]**

**Q12. Fog and clouds are examples of colloid where phase and medium are:**
A) Liquid in Gas B) Gas in Liquid C) Solid in Gas D) Liquid in Liquid
**[Correct Answer: A]**

**Q13. To separate components of petroleum, which process is used?**
A) Simple distillation B) Fractional distillation C) Sublimation D) Filtration
**[Correct Answer: B]**

**Q14. Which of the following is a heterogeneous mixture?**
A) Soda water B) Sugar solution C) Milk D) Salt solution
**[Correct Answer: C]**

**Q15. Camphor can be purified from salt mixture by:**
A) Evaporation B) Sublimation C) Crystallization D) Sedimentation
**[Correct Answer: B]**

**Q16. Mass percentage of solution formula:**
A) (Mass of solute / Mass of solvent) x 100 B) (Mass of solute / Mass of solution) x 100 C) (Mass of solvent / Mass of solution) x 100 D) (Volume of solute / Mass of solvent) x 100
**[Correct Answer: B]**

**Q17. Continuous phase in which colloidal particles are dispersed is called:**
A) Dispersed phase B) Dispersion medium C) Solute phase D) Solvent phase
**[Correct Answer: B]**

**Q18. Milk of Magnesia is an example of:**
A) Solution B) Gel C) Suspension D) Emulsion
**[Correct Answer: C]**

**Q19. Which of the following is an element?**
A) Water B) Carbon dioxide C) Oxygen D) Ammonia
**[Correct Answer: C]**

**Q20. Compound differs from a mixture in that a compound:**
A) Has variable composition B) Has fixed composition by mass C) Retains properties of constituents D) Can be separated physically
**[Correct Answer: B]**

**Q21. Shaving cream is a colloidal system of:**
A) Gas in Liquid B) Liquid in Gas C) Liquid in Liquid D) Solid in Gas
**[Correct Answer: A]**

**Q22. In blood, plasma acts as the:**
A) Solute B) Dispersion medium C) Dispersed phase D) Precipitate
**[Correct Answer: B]**

**Q23. Solubility of a solid solute in water generally:**
A) Decreases with increase in temperature B) Increases with increase in temperature C) Remains constant D) Becomes zero
**[Correct Answer: B]**

**Q24. Solution in which no more solute can be dissolved at a given temperature is:**
A) Unsaturated solution B) Saturated solution C) Supersaturated solution D) Concentrated solution
**[Correct Answer: B]**

**Q25. Naphthalene balls disappear over time without leaving liquid residue due to:**
A) Evaporation B) Sublimation C) Condensation D) Melting
**[Correct Answer: B]**

**Q26. Which of the following exhibits Tyndall Effect?**
A) Salt solution B) Sugar solution C) Starch solution / Milk D) Copper sulfate solution
**[Correct Answer: C]**

**Q27. Property used in separating iron filings from sulfur powder:**
A) Density difference B) Boiling point difference C) Magnetic attraction D) Solubility
**[Correct Answer: C]**

**Q28. Gaseous components of air are separated by:**
A) Simple distillation B) Fractional distillation of liquid air C) Filtration D) Chromatography
**[Correct Answer: B]**

**Q29. Which of the following is a physical change?**
A) Burning of paper B) Digestion of food C) Glowing of electric bulb D) Fermentation
**[Correct Answer: C]**

**Q30. Solder is an alloy of:**
A) Lead and Tin B) Copper and Zinc C) Iron and Nickel D) Aluminum and Copper
**[Correct Answer: A]**

# CHAPTER 6: HOW FORCES AFFECT MOTION

**Key Concepts & Keywords:** Balanced & Unbalanced Forces, Newton's First Law of Motion (Inertia), Newton's Second Law of Motion (F = ma, Momentum), Newton's Third Law of Motion (Action-Reaction), Conservation of Momentum, Friction.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Force is a push or pull that changes or tends to change state of rest, uniform motion, direction, or shape of an object (Vector quantity, SI unit: Newton, $1\ N = 1\ kg{\cdot}m/s^2$).
- Balanced forces produce zero net force and no change in velocity. Unbalanced forces produce non-zero net force and cause acceleration.
- Newton's First Law of Motion (Law of Inertia): An object remains in state of rest or uniform motion along a straight line unless acted upon by an external unbalanced force. Inertia is natural tendency to resist change in motion state; proportional to mass.
- Newton's Second Law of Motion: Rate of change of momentum of an object is directly proportional to applied unbalanced force and takes place in direction of force.
- - Momentum ($p$) = $m \times v$ (kg·m/s).
- - Force ($F$) = $m \times a = m(v - u) / t$.
- Newton's Third Law of Motion: To every action, there is an equal and opposite reaction acting simultaneously on two different bodies ($F_{12} = -F_{21}$).

• Law of Conservation of Linear Momentum: Total momentum of an isolated system remains constant provided no external force acts on it ($m_1u_1 + m_2u_2 = m_1v_1 + m_2v_2$).

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Inertia of an object depends directly on its:**
A) Velocity B) Acceleration C) Mass D) Volume
**[Correct Answer: C]**

**Q2. SI unit of momentum is:**
A) kg·m/s² B) kg·m/s C) N·m D) J/s
**[Correct Answer: B]**

**Q3. Newton's second law of motion gives a quantitative definition/measure of:**
A) Inertia B) Force C) Work D) Energy
**[Correct Answer: B]**

**Q4. A passenger in a moving bus tends to fall forward when driver applies sudden brakes due to:**
A) Inertia of rest B) Inertia of motion C) Inertia of direction D) Gravitational force
**[Correct Answer: B]**

**Q5. Action and reaction forces described in Newton's third law act:**
A) On the same body in opposite directions B) On different bodies in opposite directions C) On the same body in same direction D) On different bodies in same direction
**[Correct Answer: B]**

**Q6. Recoil of a gun when a bullet is fired is explained by:**
A) First law of motion B) Second law of motion C) Third law of motion / Conservation of momentum D) Law of gravitation
**[Correct Answer: C]**

**Q7. Force required to produce an acceleration of 2 m/s² in an object of mass 5 kg is:**
A) 2.5 N B) 7 N C) 10 N D) 0.4 N
**[Correct Answer: C]**

**Q8. When balanced forces act on a body, the body:**
A) Accelerates rapidly B) Must remain at rest or move with constant velocity C) Changes direction D) Stops completely
**[Correct Answer: B]**

**Q9. Which law of motion is also known as Law of Inertia?**
A) First law B) Second law C) Third law D) Law of gravitation
**[Correct Answer: A]**

**Q10. Dust particles come out of a carpet when beaten with a stick due to:**
A) Inertia of motion B) Inertia of rest C) Acceleration D) Friction
**[Correct Answer: B]**

**Q11. Rocket propulsion works on the principle of conservation of:**
A) Mass B) Energy C) Linear momentum D) Angular momentum
**[Correct Answer: C]**

**Q12. 1 Newton is equal to:**
A) 1 kg·m/s B) 1 kg·m/s² C) 1 g·cm/s² D) 1 kg·m²/s²
**[Correct Answer: B]**

**Q13. A fielder pulls his hands backward while catching a fast cricket ball to:**
A) Decrease catching time to increase force B) Increase catching time to decrease impact force C) Keep hands stationary D) Increase momentum
**[Correct Answer: B]**

**Q14. Momentum of a body of mass 2 kg moving with velocity 5 m/s is:**
A) 2.5 kg·m/s B) 10 kg·m/s C) 20 kg·m/s D) 7 kg·m/s
**[Correct Answer: B]**

**Q15. Frictional force always acts in a direction:**
A) Parallel to motion B) Opposite to relative motion C) Perpendicular to surface D) Downward
**[Correct Answer: B]**

**Q16. When a car takes a sharp turn, passengers are thrown outward due to:**
A) Inertia of direction B) Inertia of rest C) Centripetal acceleration D) Gravity
**[Correct Answer: A]**

**Q17. If force on a body is doubled and mass is halved, acceleration becomes:**
A) Same B) Doubled C) Four times D) Halved
**[Correct Answer: C]**

**Q18. An isolated system is one on which:**
A) External forces are non-zero B) Net external force is zero C) Gravity is infinite D) Internal forces are zero
**[Correct Answer: B]**

**Q19. Unit of impulse (Force x Time) is same as unit of:**
A) Force B) Acceleration C) Momentum D) Work
**[Correct Answer: C]**

**Q20. If a body is at rest, its momentum is:**
A) Infinite B) Zero C) Equal to its mass D) Dependent on gravity
**[Correct Answer: B]**

**Q21. To accelerate a 1000 kg car at 3 m/s², required force is:**
A) 300 N B) 3000 N C) 30000 N D) 333 N
**[Correct Answer: B]**

**Q22. Water droplets fly off wet umbrella when shaken due to:**
A) Inertia B) Friction C) Gravity D) Viscosity
**[Correct Answer: A]**

**Q23. Which of the following has maximum inertia?**
A) A rubber ball B) A stone of same size C) A 5 rupee coin D) A train
**[Correct Answer: D]**

**Q24. Force of friction can be reduced by using:**
A) Lubricants / Ball bearings B) Rough surfaces C) Increasing weight D) Sharp edges
**[Correct Answer: A]**

**Q25. A hammer hits a nail into wood. Force exerted by nail on hammer is:**
A) Zero B) Less than force by hammer C) Equal and opposite to force by hammer D) Greater than force by hammer
**[Correct Answer: C]**

**Q26. Conservation of linear momentum is derived from:**
A) Newton's first law only B) Newton's second and third laws C) Gravitational law D) Energy conservation only
**[Correct Answer: B]**

**Q27. Swimmer pushes water backward to move forward. This illustrates:**
A) Newton's 1st law B) Newton's 2nd law C) Newton's 3rd law D) Pascal's principle
**[Correct Answer: C]**

**Q28. If initial velocity is zero, distance moved under constant force F in time t is proportional to:**
A) $t$ B) $t^2$ C) $1/t$ D) $t^3$
**[Correct Answer: B]**

**Q29. When a bullet of mass m is fired with velocity v from gun of mass M, recoil velocity of gun is:**
A) -mv / M B) -Mv / m C) mvM D) -m / Mv
**[Correct Answer: A]**

**Q30. Net force on an object moving with constant velocity is:**
A) Equal to weight B) Zero C) Infinite D) Equal to momentum
**[Correct Answer: B]**

# CHAPTER 7: SOUND WAVES CHARACTERISTICS AND APPLICATIONS

**Key Concepts & Keywords:** Longitudinal Waves, Compression, Rarefaction, Frequency, Wavelength, Amplitude, Time Period, Velocity of Sound, Reflection of Sound, Echo, Reverberation, Ultrasound, SONAR, Human Ear.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Sound is a form of energy produced by vibrating objects and travels as mechanical longitudinal waves requiring a material medium (Solid > Liquid > Gas; cannot travel in vacuum).
- Wave Characteristics: Wavelength ($\lambda$, distance between consecutive compressions/rarefactions, meters), Frequency ($v$, vibrations per second, Hertz - Hz), Time Period ($T = 1 / v$), Amplitude ($A$, determines loudness), Speed ($v = v \times \lambda$).
- Pitch depends on frequency; Loudness depends on amplitude squared.
- Audible Range of Human Hearing: 20 Hz to 20,000 Hz (20 kHz). Infrasound < 20 Hz (whales, elephants, earthquakes); Ultrasound > 20 kHz (bats, dolphins, medical ultrasonography).
- Echo: Reflection of sound. Minimum distance to hear distinct echo in air at 22°C = 17.2 m (persistence of hearing is 0.1 s).
- Reverberation: Persistence of sound due to repeated reflections. Reduced using sound-absorbent materials (fiberboard, heavy curtains).
- SONAR (Sound Navigation and Ranging): Uses ultrasonic waves to measure depth of sea/underwater objects ($2d = v \times t$).

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Sound waves in air are:**
A) Transverse waves B) Electromagnetic waves C) Longitudinal mechanical waves D) Torsional waves
**[Correct Answer: C]**

**Q2. Audible range of frequency for normal human hearing is:**
A) 0 to 20 Hz B) 20 Hz to 20,000 Hz C) Above 20,000 Hz D) 100 Hz to 5,000 Hz
**[Correct Answer: B]**

**Q3. Sound cannot travel through:**
A) Water B) Steel C) Air D) Vacuum
**[Correct Answer: D]**

**Q4. Relationship between speed (v), frequency (v) and wavelength (λ) of sound is:**
A) v = v / λ B) v = v × λ C) v = λ / v D) v = 1 / (v × λ)
**[Correct Answer: B]**

**Q5. Loudness of sound depends primarily on its:**
A) Frequency B) Amplitude C) Wavelength D) Speed
**[Correct Answer: B]**

**Q6. Pitch of sound depends on its:**
A) Amplitude B) Frequency C) Speed D) Wave phase
**[Correct Answer: B]**

**Q7. SI unit of frequency is:**
A) Decibel B) Meter C) Hertz (Hz) D) Second
**[Correct Answer: C]**

**Q8. Minimum distance required between source and reflector to hear clear echo in air at room temperature is approximately:**
A) 34.4 m B) 17.2 m C) 51.2 m D) 8.6 m
**[Correct Answer: B]**

**Q9. Persistence of hearing for human ear is approximately:**
A) 1 second B) 0.1 second C) 0.01 second D) 0.5 second
**[Correct Answer: B]**

**Q10. Persistence of sound in a big hall due to repeated reflections is called:**
A) Echo B) Resonance C) Reverberation D) Diffraction
**[Correct Answer: C]**

**Q11. Ultrasound waves have frequencies:**
A) Below 20 Hz B) Between 20 Hz and 20 kHz C) Above 20 kHz (20,000 Hz) D) Exactly 100 Hz
**[Correct Answer: C]**

**Q12. SONAR stands for:**
A) Sound Navigation and Ranging B) Solar Navigation and Radiation C) Sound Operation and Radar D) System of Naval Radio
**[Correct Answer: A]**

**Q13. Technique used by bats to navigate and locate prey in dark:**
A) Refraction B) Echolocation / Ultrasound C) Infrared detection D) Polarization
**[Correct Answer: B]**

**Q14. Medical technique using ultrasonic sound to image internal organs:**
A) Electrocardiogram B) Ultrasonography (USG) C) X-ray radiography D) Endoscopy
**[Correct Answer: B]**

**Q15. In which medium does sound travel fastest?**
A) Air B) Water C) Iron/Steel D) Vacuum
**[Correct Answer: C]**

**Q16. Time taken to complete one full oscillation is called:**
A) Frequency B) Wavelength C) Time period D) Amplitude
**[Correct Answer: C]**

**Q17. Sound waves consist of alternating regions of high and low pressure called:**
A) Crests and troughs B) Compressions and rarefactions C) Nodes and antinodes D) Peaks and valleys
**[Correct Answer: B]**

**Q18. If frequency of wave is 50 Hz, its time period is:**
A) 0.02 s B) 0.2 s C) 50 s D) 0.5 s
**[Correct Answer: A]**

**Q19. Infrasonic sound is produced by:**
A) Bats B) Dolphins C) Elephants and Whales D) Dogs
**[Correct Answer: C]**

**Q20. Speed of sound in air at 20°C is approximately:**
A) 300,000 km/s B) 343 m/s C) 1500 m/s D) 5000 m/s
**[Correct Answer: B]**

**Q21. Unit used to measure sound intensity level is:**
A) Hertz B) Meter C) Decibel (dB) D) Watt
**[Correct Answer: C]**

**Q22. Part of human ear that converts pressure vibrations into electrical signals:**
A) Pinna B) Ear drum (Tympanum) C) Cochlea D) Ear ossicles
**[Correct Answer: C]**

**Q23. Three small bones in middle ear are Malleus, Incus and:**
A) Stapes B) Femur C) Tibia D) Radius
**[Correct Answer: A]**

**Q24. Distance between two consecutive compressions in a sound wave is:**
A) Amplitude B) Time period C) Wavelength D) Frequency
**[Correct Answer: C]**

**Q25. When sound wave goes from air into water, which property remains UNCHANGED?**
A) Speed B) Wavelength C) Frequency D) Amplitude
**[Correct Answer: C]**

**Q26. Curved ceilings of concert halls are designed to:**
A) Absorb sound B) Reflect sound uniformly to all parts of hall C) Block echo D) Increase frequency
**[Correct Answer: B]**

**Q27. Stethoscope works on the principle of:**
A) Single reflection of sound B) Multiple reflection of sound C) Refraction of sound D) Diffraction of sound
**[Correct Answer: B]**

**Q28. Ultrasonic waves are used in industry to:**
A) Clean hard-to-reach parts and detect flaws in metal blocks B) Heat water C) Produce electricity D) Sterilize air
**[Correct Answer: A]**

**Q29. A sound wave has frequency 2 kHz and wavelength 35 cm. Speed of sound is:**
A) 70 m/s B) 700 m/s C) 7000 m/s D) 350 m/s
**[Correct Answer: B]**

**Q30. Quality or timber of sound enables us to distinguish between:**
A) Two sounds of same pitch and loudness from different sources B) High and low loudness C) High and low pitch D) Loud and soft noise
**[Correct Answer: A]**

# CHAPTER 8: EARTH AS SYSTEM: ENERGY, MATTER AND LIFE

**Key Concepts & Keywords:** Biosphere, Hydrosphere, Atmosphere, Lithosphere, Biogeochemical Cycles (Water, Carbon, Nitrogen, Oxygen), Greenhouse Effect, Ozone Layer Depletion, Soil Erosion, Ecosystem Equilibrium.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Earth operates as an integrated open system for energy (solar input and thermal loss) and closed system for matter.
- Earth's Spheres: Atmosphere (gaseous envelope), Hydrosphere (water bodies), Lithosphere (crust and soil), Biosphere (zone of life where all spheres interact).
- Biogeochemical Cycles:
- - Water Cycle: Evaporation, transpiration, condensation, precipitation, surface runoff.
- - Carbon Cycle: Photosynthesis fixates $CO_2$ into biomass; respiration, combustion, decomposition release $CO_2$ back to atmosphere.
- - Nitrogen Cycle: Nitrogen Fixation (atmospheric, biological by Rhizobium/Azotobacter, industrial) → Nitrification (Nitrosomonas, Nitrobacter) → Assimilation → Ammonification → Denitrification (Pseudomonas returning $N_2$ to air).
- - Oxygen Cycle: Photosynthesis releases $O_2$; respiration and combustion consume $O_2$.
- Environmental Issues: Greenhouse Effect & Global Warming (trapping of heat by $CO_2$, $CH_4$, $N_2O$); Ozone Layer Depletion in Stratosphere by Chlorofluorocarbons (CFCs) allowing harmful UV rays; Soil Erosion caused by deforestation and overgrazing.

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Which bacteria fix atmospheric nitrogen in root nodules of leguminous plants?**
A) Nitrosomonas B) Rhizobium C) Pseudomonas D) Nitrobacter
**[Correct Answer: B]**

**Q2. Percentage of nitrogen gas in Earth's atmosphere by volume is approximately:**
A) 21% B) 0.03% C) 78% D) 50%
**[Correct Answer: C]**

**Q3. Ozone layer is located in which atmospheric layer?**
A) Troposphere B) Stratosphere C) Mesosphere D) Thermosphere
**[Correct Answer: B]**

**Q4. Main chemical responsible for ozone layer depletion is:**
A) Carbon dioxide B) Methane C) Chlorofluorocarbons (CFCs) D) Sulfur dioxide
**[Correct Answer: C]**

**Q5. Ozone molecules consist of how many oxygen atoms?**
A) One B) Two C) Three ($O_3$) D) Four
**[Correct Answer: C]**

**Q6. Which cycle involves processes like Nitrification, Ammonification and Denitrification?**
A) Carbon cycle B) Nitrogen cycle C) Water cycle D) Oxygen cycle
**[Correct Answer: B]**

**Q7. Which gas is primarily responsible for enhanced Greenhouse Effect and Global Warming?**
A) Oxygen B) Nitrogen C) Carbon dioxide ($CO_2$) D) Argon
**[Correct Answer: C]**

**Q8. Process by which plants return water vapor to atmosphere is called:**
A) Respiration B) Transpiration C) Condensation D) Precipitation
**[Correct Answer: B]**

**Q9. Denitrifying bacteria convert nitrates into:**
A) Ammonia B) Nitrites C) Free Nitrogen gas ($N_2$) D) Amino acids
**[Correct Answer: C]**

**Q10. Top layer of soil containing humus and living organisms is known as:**
A) A-horizon (Topsoil) B) B-horizon C) Bedrock D) Subsoil
**[Correct Answer: A]**

**Q11. Conversion of ammonia into nitrites and nitrates by soil bacteria is called:**
A) Nitrogen fixation B) Nitrification C) Ammonification D) Denitrification
**[Correct Answer: B]**

**Q12. Which organism acts as a major biological indicator of air pollution ($SO_2$ pollution)?**
A) Algae B) Lichens C) Ferns D) Fungi
**[Correct Answer: B]**

**Q13. Primary source of energy driving all biogeochemical cycles on Earth is:**
A) Geothermal energy B) Solar radiation C) Tidal energy D) Nuclear energy
**[Correct Answer: B]**

**Q14. Oxygen is returned to atmosphere mainly through process of:**
A) Combustion B) Respiration C) Photosynthesis D) Weathering
**[Correct Answer: C]**

**Q15. Humus in soil provides:**
A) Sand particles B) Organic matter and fertility C) Toxic minerals D) Acidic salts
**[Correct Answer: B]**

**Q16. Acid rain is caused by atmospheric pollution due to oxides of:**
A) Carbon and Hydrogen B) Nitrogen and Sulfur C) Sodium and Calcium D) Helium and Argon
**[Correct Answer: B]**

**Q17. Process of soil formation from rocks through physical, chemical and biological agents is:**
A) Erosion B) Weathering C) Deposition D) Leaching
**[Correct Answer: B]**

**Q18. Greenhouse gas produced in anaerobic condition of paddy fields and cattle gut:**
A) Carbon monoxide B) Methane ($CH_4$) C) Ozone D) Sulfur dioxide
**[Correct Answer: B]**

**Q19. The biological process that removes $CO_2$ from atmosphere is:**
A) Respiration B) Burning fossil fuels C) Photosynthesis D) Volcanic eruption
**[Correct Answer: C]**

**Q20. Microorganisms that decompose dead organic matter are called:**
A) Producers B) Primary consumers C) Decomposers / Saprotrophs D) Herbivores
**[Correct Answer: C]**

**Q21. Which sphere of Earth includes all liquid, frozen and underground water?**
A) Lithosphere B) Atmosphere C) Hydrosphere D) Biosphere
**[Correct Answer: C]**

**Q22. Harmful radiation blocked by stratosphere ozone layer:**
A) Infrared rays B) Ultraviolet (UV) rays C) X-rays D) Gamma rays
**[Correct Answer: B]**

**Q23. Excessive enrichment of nutrients in water body leading to algal bloom is:**
A) Eutrophication B) Biomagnification C) Bioaccumulation D) Salinization
**[Correct Answer: A]**

**Q24. Free-living nitrogen fixing bacteria found in soil is:**
A) Rhizobium B) Azotobacter C) Nitrosomonas D) E. coli
**[Correct Answer: B]**

**Q25. Atmospheric component that prevents extreme temperature variation between day and night on Earth:**
A) Soil B) Oceans and atmosphere C) Mountains D) Forests
**[Correct Answer: B]**

**Q26. Carbon is stored in Earth's crust primarily as:**
A) Coal, Petroleum and Carbonate rocks B) Pure Diamond C) Carbon monoxide gas D) Methane hydrates only
**[Correct Answer: A]**

**Q27. Prevention of soil erosion can be achieved by:**
A) Deforestation B) Afforestation / Cover cropping C) Overgrazing D) Tilling slope vertically
**[Correct Answer: B]**

**Q28. Water cycle is also known as:**
A) Carbon cycle B) Hydrological cycle C) Geothermal cycle D) Atmospheric cycle
**[Correct Answer: B]**

**Q29. Organisms at first trophic level in food chain are:**
A) Herbivores B) Autotrophs / Producers C) Carnivores D) Decomposers
**[Correct Answer: B]**

**Q30. Interconnected networks of multiple food chains in an ecosystem form a:**
A) Trophic pyramid B) Food web C) Ecological niche D) Biomass index
**[Correct Answer: B]**

# CHAPTER 9: PATTERN IN LIFE DIVERSITY AND CLASSIFICATION

**Key Concepts & Keywords:** Taxonomy, Binomial Nomenclature, Linnaeus, Five Kingdom Classification (Whittaker - Monera, Protista, Fungi, Plantae, Animalia), Plant Kingdom (Thallophyta, Bryophyta, Pteridophyta, Gymnosperms, Angiosperms), Animal Kingdom (Invertebrates, Vertebrates).

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Taxonomy is science of identification, naming, and classification of organisms. Carl Linnaeus introduced Binomial Nomenclature (Generic name + Specific epithet, e.g. Homo sapiens).
- Hierarchy of Categories: Kingdom → Phylum/Division → Class → Order → Family → Genus → Species.
- R.H. Whittaker's Five Kingdom Classification (1969):
- 1. Monera: Unicellular prokaryotes (Bacteria, Cyanobacteria).
- 2. Protista: Unicellular eukaryotes (Amoeba, Paramecium, Euglena).
- 3. Fungi: Multicellular saprophytic eukaryotes with chitin cell wall (Yeast, Rhizopus, Mushroom).
- 4. Plantae: Multicellular autotrophic eukaryotes with cellulose cell wall.
- - Thallophyta (Algae): Undifferentiated thallus.
- - Bryophyta: Amphibians of plant kingdom (Moss, Marchantia).
- - Pteridophyta: First vascular plants (Ferns).
- - Gymnosperms: Naked seeds (Pinus, Cycas).
- - Angiosperms: Flowering plants with enclosed seeds (Monocots, Dicots).
- 5. Animalia: Multicellular heterotrophic eukaryotes without cell wall.
- - Non-Chordates: Porifera, Coelenterata, Platyhelminthes, Nematoda, Annelida, Arthropoda (largest phylum), Mollusca, Echinodermata.
- - Chordates: Vertebrates (Pisces, Amphibia, Reptilia, Aves, Mammalia).

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Who proposed the Five Kingdom System of Classification?**
A) Carl Linnaeus B) R.H. Whittaker C) Ernst Haeckel D) Robert Brown
**[Correct Answer: B]**

**Q2. Father of Taxonomy who introduced Binomial Nomenclature:**
A) Aristotle B) Carl Linnaeus C) Charles Darwin D) Gregor Mendel
**[Correct Answer: B]**

**Q3. Unicellular prokaryotic organisms are placed in Kingdom:**
A) Protista B) Monera C) Fungi D) Plantae
**[Correct Answer: B]**

**Q4. Unicellular eukaryotic organisms like Amoeba and Paramecium belong to:**
A) Monera B) Protista C) Fungi D) Animalia
**[Correct Answer: B]**

**Q5. Which group of plants is called 'Amphibians of Plant Kingdom'?**
A) Thallophyta B) Bryophyta C) Pteridophyta D) Gymnosperms
**[Correct Answer: B]**

**Q6. Largest phylum in animal kingdom with jointed appendages is:**
A) Mollusca B) Annelida C) Arthropoda D) Nematoda
**[Correct Answer: C]**

**Q7. Naked seed-bearing plants belong to:**
A) Angiosperms B) Gymnosperms C) Pteridophytes D) Bryophytes
**[Correct Answer: B]**

**Q8. Flowering plants with seeds enclosed inside fruits are:**
A) Gymnosperms B) Angiosperms C) Bryophytes D) Algae
**[Correct Answer: B]**

**Q9. Correct sequence of taxonomic hierarchy from top to bottom is:**
A) Kingdom -> Phylum -> Class -> Order -> Family -> Genus -> Species B) Kingdom -> Order -> Class -> Phylum -> Family -> Genus -> Species C) Species -> Genus -> Family -> Order -> Class -> Phylum -> Kingdom D) Phylum -> Kingdom -> Class -> Order -> Family -> Genus -> Species
**[Correct Answer: A]**

**Q10. Fungi have cell walls made up of tough complex sugar called:**
A) Cellulose B) Chitin C) Pectin D) Lignin
**[Correct Answer: B]**

**Q11. Plants lacking well-differentiated body structure (thallus) belong to:**
A) Bryophyta B) Thallophyta (Algae) C) Pteridophyta D) Gymnosperms
**[Correct Answer: B]**

**Q12. Which animal phylum has pore-bearing bodies (sponges)?**
A) Porifera B) Coelenterata C) Platyhelminthes D) Annelida
**[Correct Answer: A]**

**Q13. Earthworm and Leech belong to Phylum:**
A) Arthropoda B) Annelida C) Mollusca D) Nematoda
**[Correct Answer: B]**

**Q14. Water vascular system is characteristic feature of Phylum:**
A) Porifera B) Echinodermata C) Mollusca D) Cnidaria
**[Correct Answer: B]**

**Q15. Cold-blooded animals with three-chambered heart and dual life (land & water):**
A) Pisces B) Amphibia C) Reptilia D) Aves
**[Correct Answer: B]**

**Q16. Warm-blooded vertebrates with four-chambered heart and feathers:**
A) Reptilia B) Amphibia C) Aves D) Pisces
**[Correct Answer: C]**

**Q17. Mammals are characterized by presence of:**
A) Feathers B) Mammary glands and hair C) Scales and gills D) Soft unsegmented bodies
**[Correct Answer: B]**

**Q18. First vascular plants on land were:**
A) Bryophytes B) Pteridophytes C) Thallophytes D) Gymnosperms
**[Correct Answer: B]**

**Q19. Binomial scientific name consists of two terms:**
A) Order and Family B) Genus and Species C) Class and Order D) Phylum and Class
**[Correct Answer: B]**

**Q20. In scientific name Homo sapiens, 'sapiens' represents:**
A) Genus B) Species epithet C) Family D) Order
**[Correct Answer: B]**

**Q21. Soft-bodied animals usually enclosed in hard calcareous shell belong to:**
A) Arthropoda B) Mollusca C) Echinodermata D) Annelida
**[Correct Answer: B]**

**Q22. Flatworms having bilateral symmetry and acoelomate body belong to:**
A) Platyhelminthes B) Nematoda C) Annelida D) Porifera
**[Correct Answer: A]**

**Q23. Pseudocoelom (false body cavity) is characteristic of:**
A) Annelids B) Nematodes (Aschelminthes) C) Platyhelminthes D) Arthropods
**[Correct Answer: B]**

**Q24. Reptiles breathe through:**
A) Skin B) Gills C) Lungs D) Trachea
**[Correct Answer: C]**

**Q25. Example of egg-laying mammal (Monotreme):**
A) Kangaroo B) Platypus C) Whale D) Bat
**[Correct Answer: B]**

**Q26. Sea anemone and Hydra belong to Phylum:**
A) Porifera B) Coelenterata (Cnidaria) C) Platyhelminthes D) Mollusca
**[Correct Answer: B]**

**Q27. Heart of fishes has how many chambers?**
A) Two B) Three C) Four D) Single
**[Correct Answer: A]**

**Q28. Pines and Deodar are examples of:**
A) Angiosperms B) Gymnosperms C) Pteridophytes D) Bryophytes
**[Correct Answer: B]**

**Q29. Monocotyledons plants are characterized by:**
A) Parallel venation in leaves and fibrous roots B) Reticulate venation and tap root C) Two cotyledons in seeds D) Naked seeds
**[Correct Answer: A]**

**Q30. Notochord is present in all organisms during some stage of development in Phylum:**
A) Non-Chordata B) Chordata C) Arthropoda D) Echinodermata
**[Correct Answer: B]**

# CHAPTER 10: REPRODUCTION: HOW LIFE CONTINUES

**Key Concepts & Keywords:** Asexual Reproduction (Fission, Budding, Fragmentation, Regeneration, Spore Formation, Vegetative Propagation), Sexual Reproduction, Flowers (Stamen, Pistil), Fertilization, Zygote, Seed Formation, Human Reproductive System, Puberty, Contraception.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Reproduction is biological process by which organisms produce offspring of their own kind, ensuring species continuity.
- Asexual Reproduction: Single parent involvement, no gamete fusion, offspring genetically identical clones.
- - Binary Fission: Amoeba, Leishmania.
- - Multiple Fission: Plasmodium.
- - Budding: Yeast, Hydra.
- - Regeneration: Planaria.
- - Fragmentation: Spirogyra.
- - Spore Formation: Rhizopus.
- - Vegetative Propagation: Bryophyllum (leaf buds), Potato (tuber eyes), Rose (stem cutting).
- Sexual Reproduction in Flowering Plants: Flower reproductive organs - Stamen (Male: Anther, Filament) produces pollen grains; Pistil/Carpel (Female: Stigma, Style, Ovary) contains ovule/egg. Pollination (Self/Cross) followed by double fertilization forming Zygote (2n) and Endosperm (3n). Ovule develops into Seed; Ovary develops into Fruit.
- Human Reproduction: Male gamete (Sperm produced in Testes), Female gamete (Ovum produced in Ovary). Fertilization occurs in Fallopian tube (Oviduct). Zygote implants in Uterus wall. Placenta provides nourishment/ oxygen to fetus.
- Reproductive Health: STDs (Syphilis, Gonorrhea, HIV-AIDS). Contraceptive methods: Barrier (Condoms), Chemical (Oral pills), Intrauterine (IUDs - Copper-T), Surgical (Vasectomy in males, Tubectomy in females).

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Asexual reproduction in Amoeba occurs through:**
A) Budding B) Binary fission C) Spore formation D) Fragmentation
**[Correct Answer: B]**

**Q2. Hydra reproduces asexually by:**
A) Binary fission B) Budding and Regeneration C) Multiple fission D) Spore formation
**[Correct Answer: B]**

**Q3. Vegetative propagation in Bryophyllum takes place through buds present on:**
A) Stem B) Root C) Leaf margins D) Flower
**[Correct Answer: C]**

**Q4. Malaria parasite (Plasmodium) reproduces inside red blood cells by:**
A) Binary fission B) Multiple fission C) Regeneration D) Budding
**[Correct Answer: B]**

**Q5. Male reproductive organ in a flower is:**
A) Sepal B) Petal C) Stamen D) Carpel
**[Correct Answer: C]**

**Q6. Female reproductive part of a flower consists of:**
A) Anther, Filament B) Stigma, Style, Ovary C) Sepal, Petal D) Pollen, Filament
**[Correct Answer: B]**

**Q7. Transfer of pollen grains from anther to stigma of a flower is known as:**
A) Fertilization B) Pollination C) Germination D) Transpiration
**[Correct Answer: B]**

**Q8. In human females, fertilization of egg by sperm takes place in:**
A) Uterus B) Ovary C) Fallopian tube (Oviduct) D) Vagina
**[Correct Answer: C]**

**Q9. After fertilization, ovary of flower develops into:**
A) Seed B) Fruit C) Embryo D) Endosperm
**[Correct Answer: B]**

**Q10. After fertilization, ovule of flower develops into:**
A) Fruit B) Seed C) Pericarp D) Flower
**[Correct Answer: B]**

**Q11. Specialized tissue through which embryo receives nutrition and oxygen from mother's blood:**
A) Amnion B) Placenta C) Umbilical cord D) Oviduct
**[Correct Answer: B]**

**Q12. Surgical method of contraception in human males is called:**
A) Tubectomy B) Vasectomy C) Hysterectomy D) Mastectomy
**[Correct Answer: B]**

**Q13. Surgical contraception method performed in females by blocking fallopian tubes:**
A) Vasectomy B) Tubectomy C) Copper-T D) Oral pill
**[Correct Answer: B]**

**Q14. Planaria exhibits remarkable ability to regenerate whole organism from body cut parts called:**
A) Fragmentation B) Regeneration C) Budding D) Fission
**[Correct Answer: B]**

**Q15. Organism that reproduces asexually by Spore Formation is:**
A) Rhizopus (Bread mold) B) Amoeba C) Spirogyra D) Hydra
**[Correct Answer: A]**

**Q16. Green filamentous alga that reproduces by Fragmentation is:**
A) Chlamydomonas B) Spirogyra C) Volvox D) Fucus
**[Correct Answer: B]**

**Q17. Primary male sex hormone produced by testes is:**
A) Estrogen B) Progesterone C) Testosterone D) Insulin
**[Correct Answer: C]**

**Q18. Primary female sex hormones produced by ovaries are:**
A) Testosterone and Aldosterone B) Estrogen and Progesterone C) Thyroxine and Insulin D) Adrenaline and Prolactin
**[Correct Answer: B]**

**Q19. Which of the following is an Intrauterine Contraceptive Device (IUCD)?**
A) Oral pill B) Condom C) Copper-T D) Diaphragm
**[Correct Answer: C]**

**Q20. Bacterial sexually transmitted disease includes:**
A) HIV-AIDS B) Gonorrhea and Syphilis C) Hepatitis B D) Genital Warts
**[Correct Answer: B]**

**Q21. Viral sexually transmitted disease includes:**
A) Syphilis B) Gonorrhea C) HIV-AIDS and Warts D) Cholera
**[Correct Answer: C]**

**Q22. Period during adolescence when reproductive organs mature and become functional:**
A) Menopause B) Puberty C) Gestation D) Lactation
**[Correct Answer: B]**

**Q23. Normal human diploid chromosome number in zygote is:**
A) 23 B) 46 (23 pairs) C) 44 D) 48
**[Correct Answer: B]**

**Q24. Number of chromosomes in human gamete (sperm/egg) is:**
A) 46 B) 23 C) 22 D) 44
**[Correct Answer: B]**

**Q25. Cessation of menstrual cycle in women around age 45-50 is termed:**
A) Menarche B) Menopause C) Puberty D) Ovulation
**[Correct Answer: B]**

**Q26. First occurrence of menstruation at puberty is called:**
A) Menopause B) Menarche C) Gestation D) Parturition
**[Correct Answer: B]**

**Q27. Anther contains:**
A) Sepals B) Ovules C) Carpels D) Pollen grains
**[Correct Answer: D]**

**Q28. Fusion of male and female gametes produces a single cell called:**
A) Embryo B) Zygote C) Foetus D) Gametophyte
**[Correct Answer: B]**

**Q29. Time duration from fertilization to childbirth in humans (Gestation period) is approx:**
A) 280 days (9 months) B) 150 days C) 365 days D) 200 days
**[Correct Answer: A]**

**Q30. Which part of male reproductive system serves as common pathway for urine and sperm?**
A) Ureter B) Vas deferens C) Urethra D) Seminal vesicle
**[Correct Answer: C]**

# CHAPTER 11: ATOMIC FOUNDATION OF MATTER

**Key Concepts & Keywords:** Laws of Chemical Combination, Law of Conservation of Mass, Law of Constant Proportions, Dalton's Atomic Theory, Atoms, Molecules, Atomic Mass, Molecular Mass, Mole Concept, Molar Mass, Avogadro's Number.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Laws of Chemical Combination:
- 1. Law of Conservation of Mass (Lavoisier): Mass can neither be created nor destroyed in a chemical reaction. Total mass of reactants = Total mass of products.
- 2. Law of Constant/Definite Proportions (Proust): In a chemical compound, elements are always present in definite proportions by mass (e.g. Water $H_2O$ is always 1:8 H:O mass ratio).
- Dalton's Atomic Theory: Matter made of indivisible atoms; atoms of same element identical in mass/properties; compounds formed by simple whole-number ratio combinations.
- Atoms and Atomic Mass: Atomic Mass Unit (u) defined as exactly 1/12th mass of one Carbon-12 atom.
- Mole Concept:
- - 1 Mole of any substance = $6.022 \times 10^{23}$ particles (Avogadro Constant, $N_A$).
- - Number of Moles ($n$) = Given Mass ($m$) / Molar Mass ($M$) = Number of Particles ($N$) / Avogadro Number ($N_A$).
- - Molar Mass of compound = Sum of atomic masses of constituent atoms.

### STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Who formulated the Law of Conservation of Mass?**
A) Joseph Proust B) Antoine Lavoisier C) John Dalton D) Amedeo Avogadro
**[Correct Answer: B]**

**Q2. Law of Constant Proportions was stated by:**
A) Lavoisier B) Proust C) Dalton D) Thomson
**[Correct Answer: B]**

**Q3. Atomic mass unit (u) is defined as mass equal to exactly 1/12th mass of one atom of:**
A) Hydrogen-1 B) Oxygen-16 C) Carbon-12 D) Nitrogen-14
**[Correct Answer: C]**

**Q4. Value of Avogadro Constant is:**
A) 6.022 x 10^23 mol^-1 B) 3.0 × 10^8 m/s C) 1.6 × 10^-19 C D) 9.8 m/s²
**[Correct Answer: A]**

**Q5. Mass of 1 mole of nitrogen atoms (Atomic mass = 14 u) is:**
A) 14 g B) 28 g C) 1.4 g D) 6.022 g
**[Correct Answer: A]**

**Q6. Mass of 1 mole of nitrogen gas molecules ($N_2$) is:**
A) 14 g B) 28 g C) 56 g D) 7 g
**[Correct Answer: B]**

**Q7. Molecular mass of Water ($H_2O$) is: (H=1, O=16)**
A) 16 u B) 18 u C) 20 u D) 32 u
**[Correct Answer: B]**

**Q8. Number of moles present in 52 g of Helium (He, Atomic mass = 4 u) is:**
A) 13 B) 26 C) 4 D) 52
**[Correct Answer: A]**

**Q9. Chemical formula of quicklime (Calcium oxide) is:**
A) $CaCO_3$ B) CaO C) $Ca(OH)_2$ D) $CaCl_2$
**[Correct Answer: B]**

**Q10. In water ($H_2O$), ratio of hydrogen to oxygen mass is always:**
A) 1:2 B) 1:8 C) 2:1 D) 8:1
**[Correct Answer: B]**

**Q11. In ammonia ($NH_3$), mass ratio of Nitrogen to Hydrogen is: (N=14, H=1)**
A) 14:3 B) 3:14 C) 1:3 D) 14:1
**[Correct Answer: A]**

**Q12. Symbol for element Sodium derived from Latin name Natrium is:**
A) So B) Na C) Sd D) Nu
**[Correct Answer: B]**

**Q13. Valency of Carbon atom is:**
A) 2 B) 4 C) 3 D) 1
**[Correct Answer: B]**

**Q14. Which of the following is a polyatomic ion?**
A) $Cl^-$ B) $Na^+$ C) $NH_4^+$ / $SO_4^{2-}$ D) $Mg^{2+}$
**[Correct Answer: C]**

**Q15. Formula unit mass of NaCl is: (Na=23, Cl=35.5)**
A) 58.5 u B) 50 u C) 60 u D) 71 u
**[Correct Answer: A]**

**Q16. Number of atoms present in 1 mole of $CO_2$ gas is:**
A) 6.022 x 10^23 B) 1.806 x 10^24 C) 1.204 x 10^24 D) 3.011 x 10^23
**[Correct Answer: B]**

**Q17. Formula of Aluminum oxide is:**
A) AlO B) $Al_2O_3$ C) $Al_3O_2$ D) $AlO_2$
**[Correct Answer: B]**

**Q18. Which scientist proposed indivisible atom hypothesis in 1808?**
A) J.J. Thomson B) John Dalton C) Niels Bohr D) Ernest Rutherford
**[Correct Answer: B]**

**Q19. Molar mass of carbon dioxide ($CO_2$) is: (C=12, O=16)**
A) 28 g/mol B) 44 g/mol C) 32 g/mol D) 12 g/mol
**[Correct Answer: B]**

**Q20. Symbol for Iron is derived from Latin name Ferrum:**
A) Ir B) Fe C) Fr D) In
**[Correct Answer: B]**

**Q21. A collection of 6.022 x 10^23 particles is called one:**
A) Gram B) Mole C) Atomic mass unit D) Equivalent
**[Correct Answer: B]**

**Q22. Which ion has valency 3+?**
A) Calcium B) Aluminum C) Sodium D) Zinc
**[Correct Answer: B]**

**Q23. Mass of 0.5 mole of oxygen gas ($O_2$) is: (O=16)**
A) 16 g B) 32 g C) 8 g D) 64 g
**[Correct Answer: A]**

**Q24. Diatomic gas molecule among following is:**
A) Helium B) Argon C) Oxygen ($O_2$) D) Ozone ($O_3$)
**[Correct Answer: C]**

**Q25. Atomicity of Ozone ($O_3$) is:**
A) 1 B) 2 C) 3 D) 4
**[Correct Answer: C]**

**Q26. Atomicity of Phosphorus ($P_4$) is:**
A) 2 B) 4 C) 8 D) 1
**[Correct Answer: B]**

**Q27. Law of Conservation of Mass states that in chemical reaction, total mass:**
A) Increases B) Decreases C) Remains unchanged D) Becomes zero
**[Correct Answer: C]**

**Q28. Chemical formula of Calcium carbonate is:**
A) CaO B) $CaCO_3$ C) $CaHCO_3$ D) $CaCl_2$
**[Correct Answer: B]**

**Q29. Number of water molecules in 18 g of water is:**
A) 6.022 x 10^23 B) 1.204 x 10^24 C) 3.011 x 10^23 D) 18
**[Correct Answer: A]**

**Q30. Symbol for Potassium is derived from Latin name Kalium:**
A) Po B) K C) Pt D) Pm
**[Correct Answer: B]**

# CHAPTER 12: JOURNEY INSIDE THE ATOM

**Key Concepts & Keywords:** Subatomic Particles (Electrons, Protons, Neutrons), J.J. Thomson Model, Rutherford's Gold Foil Experiment, Bohr's Atomic Model, Atomic Number (Z), Mass Number (A), Electronic Configuration, Valency, Isotopes, Isobars.

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Discovery of Subatomic Particles: Electron (J.J. Thomson, cathode ray experiment), Proton (E. Goldstein, canal rays / Rutherford), Neutron (James Chadwick, 1932).
- Atomic Models:
- - J.J. Thomson's Plum Pudding Model: Positively charged sphere with electrons embedded.
- - Rutherford's α-particle Gold Foil Experiment: Discovered small, dense, positively charged nucleus at center of atom. Drawback: Could not explain stability of revoling electrons.
- - Bohr's Atomic Model: Electrons revolve in discrete non-radiating orbits (shells K, L, M, N with energy levels $n = 1, 2, 3, 4$). Maximum electrons in a shell = $2n^2$.
- Atomic Number ($Z$) = Number of protons in nucleus = Number of electrons in neutral atom.
- Mass Number ($A$) = Protons + Neutrons (Nucleons).
- Valency: Combining capacity of an atom (Outermost electrons if ≤ 4; or $8 - outermost\ electrons$ if > 4).
- Isotopes: Atoms of same element with same Atomic Number ($Z$) but different Mass Number ($A$) (e.g. Protium, Deuterium, Tritium; Carbon-12 and Carbon-14). Applications: Cobalt-60 in cancer treatment, Uranium-235 in nuclear reactor fuel, Iodine-131 in goiter treatment.
- Isobars: Atoms of different elements with different Atomic Number ($Z$) but same Mass Number ($A$) (e.g. Argon-40 and Calcium-40).

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Who discovered the electron?**
A) Ernest Rutherford B) J.J. Thomson C) James Chadwick D) Niels Bohr
**[Correct Answer: B]**

**Q2. Neutron was discovered in 1932 by:**
A) J.J. Thomson B) Goldstein C) James Chadwick D) Bohr
**[Correct Answer: C]**

**Q3. Rutherford's α-particle scattering experiment led to discovery of:**
A) Electron B) Proton C) Atomic Nucleus D) Neutron
**[Correct Answer: C]**

**Q4. Maximum number of electrons that can be accommodated in M-shell (n=3) is:**
A) 8 B) 18 C) 32 D) 2
**[Correct Answer: B]**

**Q5. Formula for maximum electron capacity of a shell with principal quantum number n is:**
A) 2n B) $2n^2$ C) $n^2$ D) $4n^2$
**[Correct Answer: B]**

**Q6. Atomic number (Z) of an element is equal to number of:**
A) Neutrons B) Protons in nucleus C) Protons + Neutrons D) Nucleons
**[Correct Answer: B]**

**Q7. Mass number (A) of an atom is sum of:**
A) Protons + Electrons B) Protons + Neutrons C) Neutrons + Electrons D) Only Protons
**[Correct Answer: B]**

**Q8. Isotopes are atoms of same element having:**
A) Same mass number, different atomic number B) Same atomic number, different mass number C) Same number of neutrons D) Different atomic number and mass number
**[Correct Answer: B]**

**Q9. Isobars are atoms of different chemical elements having:**
A) Same atomic number B) Same mass number C) Same number of protons D) Same electronic configuration
**[Correct Answer: B]**

**Q10. Isotope used in treatment of goiter (thyroid swelling) is:**
A) Cobalt-60 B) Iodine-131 C) Uranium-235 D) Carbon-14
**[Correct Answer: B]**

**Q11. Isotope of Cobalt used in cancer radiotherapy treatment is:**
A) Cobalt-60 B) Cobalt-59 C) Iodine-131 D) Sodium-24
**[Correct Answer: A]**

**Q12. Which isotope is used as nuclear fuel in nuclear reactors?**
A) Carbon-14 B) Uranium-235 C) Iodine-131 D) Deuterium
**[Correct Answer: B]**

**Q13. Electronic configuration of Sodium (Atomic number Z = 11) is:**
A) 2,8,1 B) 2,9 C) 8,2,1 D) 2,8,2
**[Correct Answer: A]**

**Q14. Valency of Chlorine (Atomic number Z = 17, configuration 2,8,7) is:**
A) 7 B) 1 C) 8 D) 2
**[Correct Answer: B]**

**Q15. Valency of Argon (Atomic number Z = 18, configuration 2,8,8) is:**
A) 8 B) 0 C) 1 D) 2
**[Correct Answer: B]**

**Q16. Alpha (α) particles used in Rutherford's experiment are doubly charged:**
A) Hydrogen ions B) Helium nuclei ($He^{2+}$) C) Lithium ions D) Electrons
**[Correct Answer: B]**

**Q17. Which subatomic particle carries no electric charge (neutral)?**
A) Electron B) Proton C) Neutron D) Alpha particle
**[Correct Answer: C]**

**Q18. Hydrogen isotope with mass number 2 (1 proton, 1 neutron) is:**
A) Protium B) Deuterium C) Tritium D) Hydron
**[Correct Answer: B]**

**Q19. Radioactive isotope of hydrogen with mass number 3 is:**
A) Protium B) Deuterium C) Tritium D) Hydronium
**[Correct Answer: C]**

**Q20. Canal rays discovered by E. Goldstein in 1886 led to discovery of:**
A) Electron B) Proton C) Neutron D) Positron
**[Correct Answer: B]**

**Q21. K-shell (n=1) can hold maximum of how many electrons?**
A) 2 B) 8 C) 18 D) 32
**[Correct Answer: A]**

**Q22. Element with atomic number 14 has valence electrons equal to:**
A) 2 B) 4 C) 6 D) 8
**[Correct Answer: B]**

**Q23. In an atom with Z = 8 and A = 16 (Oxygen), number of neutrons is:**
A) 8 B) 16 C) 24 D) 0
**[Correct Answer: A]**

**Q24. Who proposed discrete stationary energy orbits for revolving electrons?**
A) Rutherford B) J.J. Thomson C) Niels Bohr D) Dalton
**[Correct Answer: C]**

**Q25. Which isotope is used in carbon dating of ancient fossils?**
A) Carbon-12 B) Carbon-13 C) Carbon-14 D) Uranium-238
**[Correct Answer: C]**

**Q26. Charge on an electron is:**
A) +1.6 x 10^-19 C B) -1.6 x 10^-19 C C) Zero D) -9.1 x 10^-31 C
**[Correct Answer: B]**

**Q27. Particles located inside atomic nucleus (Nucleons) are:**
A) Electrons and Protons B) Protons and Neutrons C) Electrons and Neutrons D) Only Electrons
**[Correct Answer: B]**

**Q28. Argon (Z=18, A=40) and Calcium (Z=20, A=40) are classic examples of:**
A) Isotopes B) Isobars C) Isotones D) Allotropes
**[Correct Answer: B]**

**Q29. An atom with configuration 2,8,3 has atomic number:**
A) 11 B) 13 (Aluminum) C) 15 D) 10
**[Correct Answer: B]**

**Q30. Subatomic particle with negligible mass (~1/1836 of proton mass):**
A) Proton B) Neutron C) Electron D) Alpha particle
**[Correct Answer: C]**

# CHAPTER 13: WORK ENERGY AND SIMPLE MACHINES

**Key Concepts & Keywords:** Work Done (W = F × s), Kinetic Energy (KE = ½ mv²), Potential Energy (PE = mgh), Law of Conservation of Energy, Power (P = W / t), Commercial Unit of Energy (kWh), Simple Machines (Levers, Pulleys, Inclined Plane, Mechanical Advantage).

## COMPREHENSIVE STUDY NOTES & CORE PRINCIPLES

- Work Done: Work is said to be done when a force applied on an object displaces it in the direction of force.
- - Formula: $W = F \times s \times \cos(\theta)$. (When force and displacement are in same direction: $W = F \times s$).
- - SI Unit: Joule (J). $1\ J = 1\ N \times 1\ m$.
- - Work can be Positive (0°), Zero (90°, e.g. satellite orbiting Earth, carrying load on head standing still), or Negative (180°, friction force).
- Energy: Capacity to do work (SI unit: Joule).
- - Kinetic Energy ($E_k$): Energy possessed by body due to motion. $E_k = \frac{1}{2} m v^2$.
- - Potential Energy ($E_p$): Energy possessed due to position or shape. Gravitational PE $E_p = m g h$.

- Law of Conservation of Energy: Energy can neither be created nor destroyed; it only transforms from one form to another. Total mechanical energy ($E_k + E_p$) remains constant.
- Power: Rate of doing work. $Power\ (P) = Work / Time = Energy / Time$. SI Unit: Watt (W). $1\ W = 1\ J/s$. Commercial unit: kilowatt-hour ($1\ kWh = 3.6 \times 10^6\ J$).
- Simple Machines: Devices that change direction or magnitude of force to make work easier (Lever, Pulley, Inclined Plane, Wheel & Axle, Wedge, Screw). Mechanical Advantage ($MA$) = Load / Effort.

## STANDARD MULTIPLE CHOICE QUESTION BANK (30 QUESTIONS)

**Q1. Work done on an object is zero when angle between force and displacement vectors is:**
A) 0° B) 45° C) 90° D) 180°
**[Correct Answer: C]**

**Q2. SI unit of work done and energy is:**
A) Watt B) Newton C) Joule D) Pascal
**[Correct Answer: C]**

**Q3. Kinetic energy of a body of mass m moving with velocity v is given by:**
A) mgh B) ½ mv² C) mv² D) ½ m²v
**[Correct Answer: B]**

**Q4. Gravitational potential energy of a body of mass m at height h above ground is:**
A) ½ mv² B) mgh C) mg/h D) m/gh
**[Correct Answer: B]**

**Q5. If mass of a moving object is doubled keeping velocity constant, its kinetic energy becomes:**
A) Same B) Doubled C) Four times D) Halved
**[Correct Answer: B]**

**Q6. If velocity of a moving object is doubled keeping mass constant, its kinetic energy becomes:**
A) Doubled B) Three times C) Four times D) Halved
**[Correct Answer: C]**

**Q7. Law of Conservation of Energy states that total energy of an isolated system:**
A) Increases continuously B) Decreases continuously C) Remains constant D) Fluctuates randomly
**[Correct Answer: C]**

**Q8. SI unit of power is:**
A) Joule B) Watt (W) C) Newton D) Kilowatt-hour
**[Correct Answer: B]**

**Q9. 1 Watt is defined as rate of work done equal to:**
A) 1 Joule per second B) 1 Newton per meter C) 1 Joule per minute D) 10 Joules per second
**[Correct Answer: A]**

**Q10. Commercial unit of electrical energy (1 Unit) is equal to:**
A) 1 Watt-second B) 1 kilowatt-hour (kWh) C) 1 Joule D) 1000 Joules
**[Correct Answer: B]**

**Q11. 1 kilowatt-hour (1 kWh) in standard Joules is equal to:**
A) 3.6 x 10^5 J B) 3.6 x 10^6 J C) 1000 J D) 3600 J
**[Correct Answer: B]**

**Q12. Work done by friction force on a sliding object is always:**
A) Positive B) Zero C) Negative D) Infinite
**[Correct Answer: C]**

**Q13. A coolie carries a heavy load on his head and stands still on platform for 10 minutes. Work done by him is:**
A) Positive B) Negative C) Zero D) Maximum
**[Correct Answer: C]**

**Q14. Mechanical Advantage (MA) of a simple machine is ratio of:**
A) Effort / Load B) Load / Effort C) Work Output / Work Input D) Distance / Time
**[Correct Answer: B]**

**Q15. Efficiency of an ideal frictionless simple machine is:**
A) 50% B) 100% C) 0% D) 200%
**[Correct Answer: B]**

**Q16. A body of mass 2 kg is raised to height 5 m. ($g = 9.8\ m/s^2$). Gravitational potential energy gained is:**
A) 10 J B) 98 J C) 49 J D) 19.6 J
**[Correct Answer: B]**

**Q17. An electric bulb of 100 W is used for 5 hours daily. Energy consumed in one day is:**
A) 500 kWh B) 0.5 kWh (units) C) 5 kWh D) 0.05 kWh
**[Correct Answer: B]**

**Q18. Class 1 Lever has which component located between Load and Effort?**
A) Load B) Effort C) Fulcrum D) Resistance arm
**[Correct Answer: C]**

**Q19. Crowbar, pair of scissors and see-saw are examples of:**
A) Class 1 Lever B) Class 2 Lever C) Class 3 Lever D) Inclined plane
**[Correct Answer: A]**

**Q20. Wheelbarrow and nutcracker are examples of:**
A) Class 1 Lever B) Class 2 Lever (Load in middle) C) Class 3 Lever D) Pulley
**[Correct Answer: B]**

**Q21. Pair of sugar tongs, tweezers and human forearm are examples of:**
A) Class 1 Lever B) Class 2 Lever C) Class 3 Lever (Effort in middle) D) Fixed Pulley
**[Correct Answer: C]**

**Q22. When a ball is thrown vertically upwards, at highest point its:**
A) Kinetic energy is maximum B) Potential energy is maximum, Kinetic energy is zero C) Both KE and PE are zero D) PE is zero, KE is maximum
**[Correct Answer: B]**

**Q23. When a freely falling object hits the ground, its potential energy is converted into:**
A) Chemical energy B) Kinetic energy, heat and sound C) Nuclear energy D) Solar energy
**[Correct Answer: B]**

**Q24. Power of an engine doing 3000 J work in 10 seconds is:**
A) 300 W B) 30000 W C) 30 W D) 3000 W
**[Correct Answer: A]**

**Q25. Work-Energy Theorem states that work done by net force on an object equals change in its:**
A) Potential energy B) Kinetic energy C) Momentum D) Acceleration
**[Correct Answer: B]**

**Q26. Energy possessed by a stretched rubber band or compressed spring is:**
A) Kinetic energy B) Elastic Potential energy C) Thermal energy D) Electrical energy
**[Correct Answer: B]**

**Q27. A fixed pulley makes work easier primarily by:**
A) Reducing required effort force by half B) Changing direction of applied effort force C) Increasing total distance D) Eliminating friction
**[Correct Answer: B]**

**Q28. Rate at which energy is transferred or consumed is defined as:**
A) Work B) Force C) Power D) Momentum
**[Correct Answer: C]**

**Q29. If force applied is 20 N and displacement is 4 m in direction of force, work done is:**
A) 5 J B) 80 J C) 16 J D) 24 J
**[Correct Answer: B]**

**Q30. Commercial electric power generator converts:**
A) Electrical energy to mechanical B) Mechanical energy into electrical energy C) Heat energy into mass D) Light energy into sound
**[Correct Answer: B]**

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