Class - 7

Matter

Introduction to matter

Definition: Matter is anything that has mass and occupies space. It exists in three states: solid, liquid, and gas. All substances around us, like air, water, and rocks, are made of matter.
Composition: Matter is made up of tiny particles called atoms and molecules. These particles are in constant motion, and their arrangement determines the state of matter.
Deep Insight: Matter cannot be created or destroyed (Law of Conservation of Mass). It can change form but the total mass remains the same, as per Antoine Lavoisier's principle.
States of Matter
Solid: Fixed shape and volume; particles are closely packed in a regular arrangement, vibrating in place. Examples: Ice, wood, metal. They have high density and low compressibility.
Liquid: Definite volume but no fixed shape; particles are close but can slide past each other. Examples: Water, oil, milk. They flow and take the shape of the container.
Gas: No fixed shape or volume; particles are far apart and move freely. Examples: Air, oxygen, steam. Gases are highly compressible and expand to fill the container.
Deep Insight: Plasma (ionized gas) and Bose-Einstein condensate (super-cooled state) exist but are not covered in Class 7; focus on the three main states. The kinetic theory explains states based on particle energy and attraction.
Properties of Matter
Physical Properties: Characteristics like color, odor, density, melting point, boiling point, solubility, and conductivity. These can be observed without changing the substance.
Chemical Properties: How matter reacts with other substances, e.g., flammability or reactivity. These involve changes in composition.
Mass and Volume: Mass is the amount of matter (measured in grams/kg); volume is the space occupied (measured in cm^3 or m^3). Density = Mass/Volume (g/cm^3 or kg/m^3).
Deep Insight: Density determines if an object floats or sinks in a fluid (Archimedes' Principle). Pure substances have fixed properties, while mixtures vary.
Changes of State
Melting: Solid to liquid (e.g., ice to water) at melting point; absorbs heat.
Freezing: Liquid to solid (e.g., water to ice) at freezing point; releases heat.
Evaporation: Liquid to gas at any temperature (surface process); boiling is at boiling point (whole liquid).

Condensation: Gas to liquid (e.g., steam to water); releases heat.
Sublimation: Solid to gas without liquid state (e.g., dry ice).
Deep Insight: These are physical changes; energy is involved (latent heat). Temperature remains constant during phase changes at equilibrium.
Particle Model of Matter
Basic Idea: Matter consists of particles (atoms/molecules) with spaces between them. Particles attract each other (intermolecular forces).
In Solids: Strong forces, fixed positions.
In Liquids: Weaker forces, can move.
In Gases: Very weak forces, free movement.
Diffusion: Mixing of particles, faster in gases (e.g., perfume smell spreading).
Deep Insight: Brownian motion (random movement of particles) supports this model. Pressure in gases is due to particle collisions with container walls.
Mixtures and Solutions
Mixtures: Combination of two or more substances not chemically bonded; can be separated physically. Types: Homogeneous (uniform, e.g., salt water) and Heterogeneous (non-uniform, e.g., sand in water).
Solutions: Homogeneous mixtures; solute dissolves in solvent (e.g., sugar in water). Solubility depends on temperature and nature of substances.
Separation Techniques: Filtration (for solids), evaporation (for solvents), distillation (for liquids), chromatography.
Deep Insight: Alloys (e.g., brass) are solid solutions. Concentration affects properties like boiling point (elevation) and freezing point (depression).
Elements and Atomic Structure
Elements: Pure substances made of only one type of atom. There are 118 known elements; they are the building blocks of matter.
Atoms: The smallest unit of an element, consisting of protons (positively charged), neutrons (neutral), and electrons (negatively charged). Protons and neutrons are in the nucleus; electrons orbit around it.
Atomic Number and Mass: Atomic number (Z) = number of protons = number of electrons in a neutral atom. Atomic mass ≈ protons + neutrons.
Deep Insight: Elements are arranged in the periodic table by atomic number. Isotopes have the same protons but different neutrons. This structure explains chemical bonding and reactivity.
20 Common Elements with Protons and Electrons (for neutral atoms, protons = electrons = atomic number):
Hydrogen (H): Protons: 1, Electrons: 1
Helium (He): Protons: 2, Electrons: 2
Lithium (Li): Protons: 3, Electrons: 3
Beryllium (Be): Protons: 4, Electrons: 4
Boron (B): Protons: 5, Electrons: 5
Carbon (C): Protons: 6, Electrons: 6
Nitrogen (N): Protons: 7, Electrons: 7
Oxygen (O): Protons: 8, Electrons: 8
Fluorine (F): Protons: 9, Electrons: 9

Neon (Ne): Protons: 10, Electrons: 10
Sodium (Na): Protons: 11, Electrons: 11
Magnesium (Mg): Protons: 12, Electrons: 12
Aluminium (Al): Protons: 13, Electrons: 13
Silicon (Si): Protons: 14, Electrons: 14
Phosphorus (P): Protons: 15, Electrons: 15
Sulfur (S): Protons: 16, Electrons: 16
Chlorine (Cl): Protons: 17, Electrons: 17
Argon (Ar): Protons: 18, Electrons: 18
Potassium (K): Protons: 19, Electrons: 19
Calcium (Ca): Protons: 20, Electrons: 20
Key Concepts and Applications
Density and Flotation: Objects with density less than water float; used in ships and submarines.
Importance of Matter: Understanding matter helps in cooking, medicine, and environmental science (e.g., water cycle involves state changes).
Deep Insight: Matter's behavior explains weather (gas expansion), cooking (heat transfer), and pollution (particulate matter in air).
Key Formulas and Units
Density: $\rho = m/v$ (g/cm^3 or kg/m^3)
Volume of irregular solids: Displacement method (water level rise).
Mass: Measured on balance (g or kg).
Deep Insight: Specific gravity = Density of substance / Density of water (dimensionless).
Important Diagrams and Concepts
Particle arrangements: Dots for solids (tight), liquids (loose), gases (scattered).
Heating curve: Shows temperature vs. time during state changes.
Density experiment: Eureka can for volume measurement.
Atomic model: Bohr's model with nucleus and electron shells.
Deep Insight: Phase diagrams illustrate state changes with pressure and temperature.
Exam Tips
Memorize definitions, examples, and the 20 elements' details; relate to daily life.
Practice calculations for density and volume.
Draw labeled diagrams for states, changes, and atomic structure.
Common mistakes: Confusing physical and chemical changes; forgetting units or atomic numbers.
Important Questions for Exams (Class 7 Level)
Very Short Answer Questions (1-2 words or simple phrases)
What is matter?
Name the three states of matter.
What is density?
Define evaporation.
What is a mixture?
Short Answer Questions (1-2 sentences)
Explain the difference between a solid and a liquid with an example.
What is the particle model of matter?

How does diffusion occur in gases?
Describe one method to separate a mixture.
What happens during melting of a solid?
Long Answer Questions (Detailed explanations, 4-6 sentences)
Describe the three states of matter in detail, including particle arrangement and examples. Explain how the kinetic theory applies to them.
Explain the changes of state with examples. Discuss the role of heat energy and why temperature remains constant during phase changes.
What are the physical and chemical properties of matter? Give examples and explain why density is an important property.
Discuss mixtures and solutions. How are they different? Describe separation techniques for mixtures with real-life applications.
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