Class 8

Matter

Introduction to Matter
Definition: Matter is anything that has mass and occupies space, forming the basis of all physical substances. It exists in various forms, from simple elements to complex compounds, and is composed of tiny particles called atoms and molecules.
Importance: Understanding matter explains the composition of everything around us, from the air we breathe to the food we eat. In Nepal, it relates to natural resources like minerals and helps in agriculture and industry.
Deep Insight: Matter is classified into pure substances (elements and compounds) and mixtures. The study of matter involves chemistry, where properties and changes are key. Historically, alchemists sought to transform matter, leading to modern atomic theory.
Real-Life Examples: Water in rivers, metals in tools, gases in air—all are matter. In daily life, matter changes state (e.g., ice to water) or forms new substances (e.g., cooking).
Elements
Definition: An element is a pure substance that cannot be broken down into simpler substances by chemical means. It consists of only one type of atom. There are 118 known elements, each with unique properties.
Examples: Hydrogen (H), Oxygen (O), Iron (Fe). Elements are the building blocks of matter.
Deep Insight: Elements are represented by symbols (e.g., H for hydrogen). They combine to form compounds. In Nepal, elements like copper and zinc are mined for alloys.
Table of 20 Elements (with Atomic Number, Element Name, and Symbol):
Atomic Number 1: Hydrogen (H)
Atomic Number 2: Helium (He)
Atomic Number 3: Lithium (Li)
Atomic Number 4: Beryllium (Be)
Atomic Number 5: Boron (B)
Atomic Number 6: Carbon (C)
Atomic Number 7: Nitrogen (N)
Atomic Number 8: Oxygen (O)

Atomic Number 9: Fluorine (F)
Atomic Number 10: Neon (Ne)
Atomic Number 11: Sodium (Na)
Atomic Number 12: Magnesium (Mg)
Atomic Number 13: Aluminium (Al)
Atomic Number 14: Silicon (Si)
Atomic Number 15: Phosphorus (P)
Atomic Number 16: Sulfur (S)
Atomic Number 17: Chlorine (Cl)
Atomic Number 18: Argon (Ar)
Atomic Number 19: Potassium (K)
Atomic Number 20: Calcium (Ca)
Deep Insight: Atomic number increases sequentially. Elements are metals (e.g., iron), non-metals (e.g., oxygen), or metalloids (e.g., silicon). Memorize symbols for exams.
Compounds
Definition: A compound is a pure substance formed when two or more elements chemically combine in a fixed ratio. It has properties different from its constituent elements.
Examples: Water (H_2O: hydrogen + oxygen), Salt (NaCl: sodium + chlorine). Compounds can be broken down into elements by chemical reactions.
Deep Insight: Compounds have fixed composition; e.g., water is always 2H:1O. In Nepal, compounds like fertilizers (e.g., urea) are used in farming. They are represented by formulas showing elements and ratios.
Real-Life Examples: Baking soda ($NaHCO_3$), sugar ($C_{12}H_{22}O_{11}$). Compounds differ from mixtures, which are not chemically bonded.
Molecules
Definition: A molecule is the smallest unit of a compound or element that retains its chemical properties. It consists of two or more atoms bonded together.
Examples: Oxygen molecule (O_2: two oxygen atoms), Water molecule (H_2O: two hydrogen + one oxygen). Diatomic molecules (e.g., N_2) are common.
Deep Insight: Molecules form through chemical bonds. In elements, noble gases exist as single atoms (monatomic), while others form molecules. In Nepal, molecular oxygen supports respiration.
Real-Life Examples: Glucose ($C_6H_{12}O_6$) in fruits, carbon dioxide (CO_2) in air.
Atoms
Definition: An atom is the smallest unit of an element that retains its properties. It is the basic building block of matter.
Structure: Atoms consist of a nucleus (center) and electrons orbiting around it.

Deep Insight: Atoms are indivisible by chemical means but can be split in nuclear reactions. John Dalton's atomic theory states atoms are spherical and combine in ratios.
Real-Life Examples: Carbon atoms in diamond, hydrogen atoms in water.
Atomic Structure
Definition: The structure of an atom includes the nucleus and surrounding electrons. The nucleus contains protons and neutrons, while electrons orbit in shells.
Deep Insight: Atoms are mostly empty space; the nucleus is tiny but contains most mass. This model explains chemical behavior.
Real-Life Examples: Atomic structure determines element properties, like reactivity.
Subatomic Particles
Electron: Negatively charged particle (-1 charge) orbiting the nucleus. Mass: 1/1836 of proton. Discovered by J.J. Thomson.
Proton: Positively charged particle (+1 charge) in the nucleus. Mass: 1 atomic mass unit (amu). Discovered by Ernest Rutherford.
Neutron: Neutral particle (0 charge) in the nucleus. Mass: 1 amu. Discovered by James Chadwick.
Deep Insight: Protons and neutrons give mass; electrons determine chemical properties. In neutral atoms, protons = electrons.
Real-Life Examples: Electrons in electricity; protons in acidity.
Atomic Number, Mass Number, and Atomic Mass Unit
Atomic Number (Z): Number of protons in an atom's nucleus. It defines the element; e.g., Hydrogen Z=1.
Mass Number (A): Total protons + neutrons in the nucleus. E.g., Carbon-12 has A=12 (6p + 6n).
Atomic Mass Unit (amu): Unit of mass; 1 amu = 1/12 mass of carbon-12 atom. Protons/neutrons ≈ 1 amu; electrons negligible.
Deep Insight: Isotopes have same Z but different A (e.g., Carbon-12, Carbon-14). Atomic mass is average of isotopes.
Examples: Oxygen: Z=8, A=16 (8p + 8n), Mass ≈16 amu.
Electronic Structure of an Atom (Bohr-Bury Scheme)
Definition: Electrons are arranged in shells (energy levels) around the nucleus. Bohr's model: Electrons orbit in fixed paths; Bury's scheme: Maximum electrons per shell ($2n^2$, where n=shell number).
Shells: K (n=1, max $2e^-$), L (n=2, max $8e^-$), M (n=3, max $18e^-$), etc.
Deep Insight: Electrons fill inner shells first. This explains stability; full outer shells are inert.
Examples: Sodium (Na, Z=11): $2e^-$ in K, $8e^-$ in L, $1e^-$ in M.
Valency

Definition: Valency is the combining capacity of an element, determined by electrons in the outermost shell.
Types: Elements gain, lose, or share electrons to achieve stable 8e^- (octet rule).
Deep Insight: Metals lose electrons (positive valency); non-metals gain (negative). E.g., Sodium valency 1; Oxygen valency 2.
Examples: Hydrogen (1), Chlorine (1), Magnesium (2).
Periodic Classification of Elements
Definition: Elements are arranged in a table based on atomic number, showing patterns in properties.
Deep Insight: Classification by Mendeleev and modern periodic table groups similar elements.
Mendeleev's Periodic Table
Definition: Dmitri Mendeleev arranged 63 elements by atomic mass, predicting unknown ones. Properties repeat periodically.
Features: Rows (periods), columns (groups). Anomalies corrected by modern table.
Deep Insight: Predicted elements like gallium; basis for modern table.
Examples: Group 1: Alkali metals; Group 17: Halogens.
Variation of Properties
Across Periods: Atomic size decreases, valency increases from 1 to 7.
Down Groups: Atomic size increases, valency constant.
Deep Insight: Metallic to non-metallic left to right; reactivity varies.
Examples: Period 2: Li to Ne; Group 1: Li to Fr.
Molecular Formula
Definition: Chemical formula showing elements and atom ratios in a molecule. E.g., H_2O (2H:1O).
Deep Insight: Calculated from valency; e.g., NaCl (1:1).
Examples: CO_2, CH_4.
Chemical Equation
Definition: Symbolic representation of chemical reactions, showing reactants → products.
Balancing: Atoms must balance; e.g., $2H_2 + O_2 \rightarrow 2H_2O$.
Deep Insight: Indicates state (s, l, g) and conditions.
Examples: Photosynthesis: $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$.
Key Concepts and Applications
Importance: Atomic structure explains bonding; periodic table predicts properties. In Nepal, used in mining and medicine.
Deep Insight: Matter's study leads to innovations like plastics.
Key Formulas and Units
Atomic Mass: Average of isotopes.
Valency: Electrons needed for octet.
Deep Insight: Molecular mass = sum of atomic masses.

Important Diagrams and Concepts
Atomic model: Bohr's orbits.
Periodic table: Groups/periods.
Chemical equation: Balanced reaction.
Deep Insight: Electron configuration.
Exam Tips
Memorize elements, formulas; practice balancing equations.
Relate to Nepal; e.g., elements in soil.
Common mistakes: Confusing mass/atomic number; unbalanced equations.
Important Questions for Exams (Class 8 Level) – Based on BLE and Nepal's Board Exams
Very Short Answer Questions (1-2 words or simple phrases)
What is an element? (BLE: Definition focus)
Define atomic number. (Nepal Board: Atomic basics)
What is valency? (BLE: Chemical properties)
Name the subatomic particle with no charge. (Nepal Board: Particles)
What is a molecule? (BLE: Matter units)
Short Answer Questions (1-2 sentences)
Explain the difference between an atom and a molecule. (BLE: Basic distinction)
Describe Bohr's model of the atom. (Nepal Board: Structure)
How is atomic mass calculated? (BLE: Mass concepts)
What is the octet rule? (Nepal Board: Valency)
Give an example of a compound and its formula. (BLE: Compounds)
Long Answer Questions (Detailed explanations, 4-6 sentences)
Describe the structure of an atom, including subatomic particles and their properties. Explain the Bohr-Bury scheme with an example. (BLE: Atomic structure; Nepal Board: Electron arrangement)
Explain Mendeleev's periodic table and its significance. Discuss how properties vary across periods and groups. (Nepal Board: Classification; BLE: Periodic trends)
What is valency? How is it determined? Give examples of elements with different valencies and write their molecular formulas. (BLE: Valency; Nepal Board: Formulas)
Define a chemical equation and explain the steps to balance it. Provide an example of a balanced equation and its importance. (BLE: Equations; Nepal Board: Reactions)
List 10 elements from the table with their atomic numbers and symbols. Explain the difference between elements, compounds, and mixtures with examples. (Nepal Board: Elements; BLE: Classification)