

Introduction to Chemistry

Introduction to Chemistry – Study Notes

1. What Is Chemistry?

- **Definition:** The scientific study of matter, its properties, how it changes, and the energy involved in those changes.
 - **Scope:**
 - Composition of substances (atoms, molecules, ions)
 - Structure (how atoms are arranged)
 - Reactivity (how substances interact)
 - Energy changes (heat, light, electrical)
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2. Key Concepts & Terminology

Term	Meaning	Example
Matter	Anything that has mass and occupies space	Water, air, metal
Element	Pure substance consisting of only one type of atom	Oxygen (O), Gold (Au)
Compound	Substance formed when two or more elements chemically combine	NaCl (table salt)
Mixture	Physical combination of two or more substances; components retain identity	Sand and sugar
Atom	Smallest unit of an element that retains its chemical properties	Hydrogen atom (H)
Molecule	Two or more atoms bonded together	H ₂ O (water)
Ion	Atom or molecule with a net electric charge	Na ⁺ , Cl ⁻
Chemical Reaction	Process where substances (reactants) transform into new substances (products)	Combustion of methane: CH ₄ + 2O ₂ → CO ₂ + 2H ₂ O
Law of Conservation of Mass	Mass cannot be created or destroyed in a chemical reaction	Mass of reactants = mass of products

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3. The Scientific Method in Chemistry

1. **Observation** – Notice a phenomenon (e.g., metal rusts).
 2. **Question** – Formulate a specific question (Why does rust form?).
 3. **Hypothesis** – Propose an explanation (Rust forms due to oxidation).
 4. **Experiment** – Design and conduct tests, collect data.
 5. **Analysis** – Interpret results, compare with hypothesis.
 6. **Conclusion** – Accept, modify, or reject the hypothesis.
 7. **Communication** – Share findings (papers, presentations).
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4. States of Matter

State	Characteristics	Typical Examples
Solid	Fixed shape & volume; particles vibrate in place	Ice, iron
Liquid	Fixed volume, no fixed shape; particles slide past each other	Water, ethanol
Gas	No fixed shape or volume; particles move freely	Oxygen, carbon dioxide
Plasma	Ionized gas; high energy; electrons separated from nuclei	Fluorescent lights, stars

5. Basic Quantitative Concepts

Concept	Symbol	Unit	Note
Mole	mol	6.022×10^{23} entities	Avogadro's number
Molar Mass	M	g mol^{-1}	Mass of one mole of a substance
Concentration	c	mol L^{-1} (M)	Amount of solute per unit volume
Stoichiometry	–	–	Uses balanced equations to relate moles of reactants/products

Example: $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$

- 2 mol H_2 react with 1 mol O_2 to produce 2 mol H_2O .
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6. Energy in Chemical Change

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Type	Description	Typical Example
Exothermic	Releases energy (usually heat) to surroundings	