

Module 2: Basic Chemistry

Keys to Success & Study Guide

Learning Objectives

By the end of this module, you should be able to:

1. **Describe** the structure of an atom and the properties of its subatomic particles.
2. **Compare** and **contrast** ionic, covalent, and hydrogen bonds.
3. **Explain** the unique life-supporting properties of water resulting from its polarity.
4. **Interpret** the pH scale and explain the importance of buffers in maintaining homeostasis.

Key Terminology Checklist

Define these terms in your own words to ensure mastery.

- [] **Matter:** Anything that has mass and occupies space.
- [] **Isotope:** Atoms of the same element with different numbers of neutrons.
- [] **Valence Shell:** The outermost electron shell, which determines an atom's reactivity.
- [] **Cation vs. Anion:** A positively charged ion (lost electrons) vs. a negatively charged ion (gained electrons).
- [] **Electronegativity:** A measure of an atom's ability to attract shared electrons in a bond.
- [] **Solute vs. Solvent:** The substance being dissolved vs. the dissolving medium.
- [] **Hydrophilic vs. Hydrophobic:** Water-attracting vs. water-repelling.

Concept Check

1. Atomic Structure

- **Question:** How are Atomic Number and Mass Number determined?

- **Key Answer:** Atomic Number = number of protons (defines the element). Mass Number = protons + neutrons.
- **Application:** Carbon-12 has 6 protons and 6 neutrons. Carbon-14 (an isotope) has 6 protons and 8 neutrons.

2. Chemical Bonding

- **Question:** How do ionic and covalent bonds differ?
- **Key Answer:** In **ionic bonds**, electrons are transferred (e.g., NaCl). In **covalent bonds**, electrons are shared (e.g., H₂O). Hydrogen bonds are weak attractions between polar molecules.

3. Properties of Water

- **Question:** Why is water essential for life?
- **Key Answer:** Water's polarity leads to hydrogen bonding, which gives it high specific heat, cohesion, adhesion, and solvent properties. Ice floats because water expands upon freezing.

4. pH and Buffers

- **Question:** What is the pH scale and why do buffers matter?
- **Key Answer:** pH measures hydrogen ion concentration (0-14 scale; 7 is neutral). Buffers resist pH changes by absorbing or releasing H⁺ ions, critical for enzyme function.