

Chapter 2 Basic Introductory Chemistry

Basic Chemical Organization

A Nature of Matter

- Anything that has mass and occupies space.
- Atoms - basic unit - element
 - 119 recognized - 92 found in nature
 - 26 elements in the human body
 - See Pg 31
- Molecules - 2 or more atoms O₂, H₂, H₂O, CO₂, C₆H₁₂O₆
- Compounds - two or more different elements - H₂O, C₆H₁₂O₆
- Molecules are chemically combined and do not separate easily.
- Mixtures - two or more substances physically combined. Easily separated. ex. air, water, saltwater
- Matter exists as solid, liquid, or gas.

B Structure of Atoms

- Atoms consist of two basic parts: nucleus and electron cloud
- Nucleus: Protons (positive charge and a mass of 1 AMU) and neutrons (no charge and also a mass of 1 AMU) Atomic mass = # of protons + # of neutrons
- electrons: negligible mass (0) and a negative charge. They are moving in energy levels around the nucleus.
- Atoms are neutrally charged (# of protons = # of electrons)
- Atoms with an unequal # of protons and electrons (charged) are called **IONS**
- Each atom has a specific # of protons known as the **ATOMIC NUMBER** which defines the element.
- Isotopes** are atoms of the same element with different atomic masses. EX. H¹, H² (protium, deuterium, tritium) Chemically each form of the isotope reacts the same.
- Some forms of isotopes are radioactive. Releasing energy in the form of rays.
 - Alpha, Beta, Gamma
 - α, β, γ
 - Radioactive isotopes are used in anatomy and physiology.
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Molecules and Compounds

- When atoms combine or compounds break apart, new substances with different chemical properties form. Chemical reaction
- Chemical reactions are the foundation of all life.
- Atoms reactivity is determined by electrons
 - Electrons in the 1st 3 levels
 - inert gases are non-reactive. All outer shells are filled
 - Valence number- the number of extra or deficient electron
- Ionic bonds
 - Some atoms either gain or donate electrons to form molecules.
 - When electrons are gained or lost atoms become charged and are known as **ions** or **electrolytes**.
 - Metals are electron donors and they form positive ions also known as **CATIONS**: Li⁺, Ca²⁺
 - Non-metals are electron acceptors and they form negative ions also known as **ANIONS** ex. Cl⁻
 - Ionic compounds include salts, acids, and bases. Ionic compounds are usually small simple molecules.
- Covalent Bonds
 - More common: more stable, usually larger and more complex.
 - formed when electron pairs are shared.
 - single bond, double bond, triple bond
 - Carbon always forms covalent bonds.
- Hydrogen bonds
 - hydrogen atoms of one molecule forms a bond with oxygen (nitrogen) of another molecule.
 - not as strong as other covalent bonds, they form and break easily
 - hydrogen bonds are found as bridges in various molecules such as proteins and DNA.

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II Biomolecules: Important molecules found in the body.

A Inorganic compounds. (Do Not contain Carbon)

1 Water - H₂O

a The most abundant compound in the body: 60% RBC's, 75% muscle

b Water is the universal solvent - most substances dissolve to form solutions in water. ex. nutrients and wastes are carried through the body in solution

c water is an important part of chemical reactions such as the synthesis of proteins and hormones

d Water absorbs and releases heat SLOWLY thus maintaining the temperature homeostasis of the body.

e Water acts as a lubricant for many body parts such as joints, mucus, and saliva.

f Water is a polar molecule and conducts electric current.

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2 Inorganic acids, bases, and salts

a When molecules of inorganic acids, bases, and salts dissolve in water they dissociate or ionize

b Acids form H⁺ ions

c Bases form OH⁻ ions

d pH measures the excess of H⁺ or OH⁻ ions

e pH scale 1-14

- pH 0-6 acid
- 8-14 base
- 7 is neutral. (H and OH are equal)
- there is a ten fold difference (power of 10)

f pH of body fluids is very important.

g Buffers are weak acids or bases that help maintain pH homeostasis

h Salts- the ions provide essential elements such as Ca, Na, K, Cl

I See Pg. 38 Table 2.4 for important inorganic compounds.

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J Chemical reactions: They occur when molecules are formed, broken, or changed,

- Synthesis: A + B → AB **Synthesis** generally involves an input of energy
- Decomposition: AB → A + B **Decomposition** generally releases energy.
- Replacement: A + BC → AC + B ex. K + NaCl → KCl + Na
AB + CD → CB + AD HCl + NaOH → NaCl + H₂O
- Oxidation/reduction: CH₄ + 2O₂ → CO₂ + 2H₂O Major energy producing reaction in living things.

3 Organic compounds: Carbon containing compounds

a Organic compounds are large complex molecules (polymers) composed of repeating smaller molecules called monomers.

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b Important Organic compounds

1 Carbohydrates

a Composed of C, H, O. There is a 2:1 ratio between H and O
CH₂O **C-H, O**

b Simple sugars or monosaccharides are the building blocks of more complex carbohydrates. Simple sugar contains 3-7 carbons. most common are the pentose (5C) and hexose (6 C)

c isomers are molecules with same formula but different structures.

d disaccharide are two monosaccharides ex. sucrose, lactose, maltose, levulose

e polysaccharides are many simple sugars ex. starch, glycogen, cellulose

f energy source. 4 cal/gram

2 Lipids

a C₂H₃O₂ but no 2:1 ratio between hydrogen and oxygen

b basic building block is glycerol and fatty acids (triglyceride)

c saturated fats vs unsaturated fats

d High energy storage molecule. 9 cal/gram

e not soluble in water - protection against water loss, makes up part of the cell membrane.

f Types of lipids include: fats, oils, waxes, phospholipids, cholesterol, and many hormones.

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3 Proteins
a CHON
b building blocks are amino acids (20)
c Held together by peptide bonds - form polymers
d Other structures
1 alpha helix and beta sheets- collagen, actin, myosin, elastin;
basically structural proteins
2 Globular proteins - 3 dimensional "globs" basically enzymes
e Lock and Key theory explains enzyme substrate complex.
f denatured proteins- shape is altered and can no longer function correctly.

4 Nucleic Acids
a basic unit is the nucleotide (sugar, phosphate, base)
b DNA and RNA
c DNA is double stranded while RNA is single stranded.
d About 1000 DNA bases compose a gene (code for a protein)
e Humans have about 100,000 functional genes that direct protein
formation.
f DNA can replicate and be passed on from one generation to the next by
mitosis or meiosis.

G ATP, Adenosine Triphosphate
living things.
1 Essential to the life of the cell and is found universally among all
living things.
2 Function is to store energy for immediate use by cells.

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