

THE CHEMICAL CONTEXT OF LIFE

Chapter 2

Objectives

- Be familiar with the chemical vocabulary discussed in class
- Know the basic parts of an Atom and its properties
- Understand the relationship between energy level and electron orbit
- Be familiar with the kinds of chemical bonds formed between **atoms**. Understand what causes their formation.
- Be familiar with the kinds of chemical bonds formed between **molecules**. Understand what causes their formation.

Chemical Elements and Compounds

- Matter: anything that takes up space and has mass
- Element: substance that cannot be broken down to other substances by chemical reactions
 - CHNOPS, Ca, K, Na, Cl, Mg
 - Trace elements: Fe, I
- Compound: substance made of 2 or more elements

ATOMS AND MOLECULES.

- Atom: smallest chemical unit
- Atomic structure determines the behavior of an element
- Atoms usually consist of 3 subatomic particles
 - Proton
 - Neutron
 - Electron

ATOMS AND MOLECULES

- Atomic number
 - equivalent to the # of Protons
 - electrically neutral so equal to # of electrons
- Atomic Mass
 - measured in Daltons; proton and neutron = 1 Dalton, electrons = 0 Daltons
 - calculated as sum of protons, neutrons, and electrons
- Molecule: substance composed of two or more Atoms:

ISOTOPES

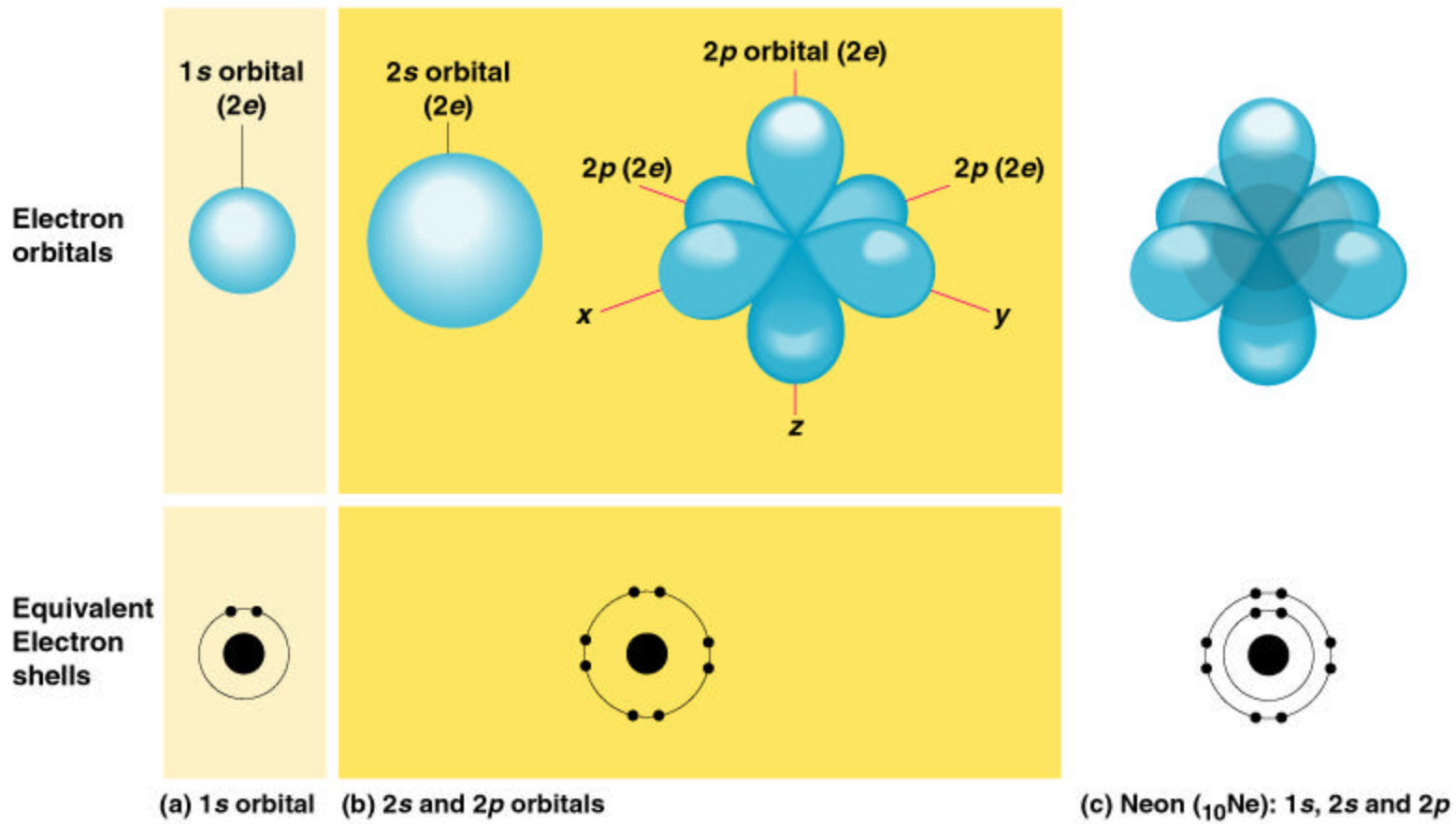
- Isotope: an atom with a greater number of neutrons than other atoms of the same element
- Radioactive Isotopes: Atomic nuclei that are unstable may lose a proton (decay) and energy (radiation).
- Applications of radioactive isotope: dating of objects, diagnosing disease

THE ENERGY LEVELS OF ELECTRONS

- Electrons are the only particles involved in chemical reactions
- An atom's electrons vary in their energy level
 - Energy: ability to do work
- Potential energy: amount of energy stored as a result of position or location

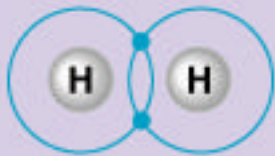
Electron Orbitals

- Potential energy of an atom \uparrow as electrons move farther from the atomic nucleus
- Electrons reside in orbitals (3D space) around the atomic nucleus within energy shells
 - orbitals can be spherical (s) or dumbbell shaped (p)
- The number of electrons in the outermost shell of an atom determine its reactivity in chemical reactions

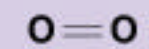
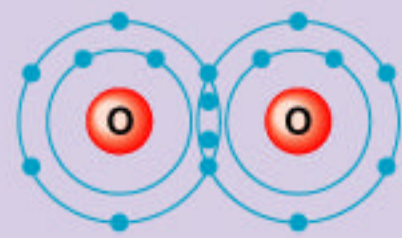


ATOMS COMBINE BY CHEMICAL BONDING TO FORM MOLECULES.

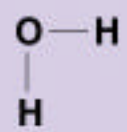
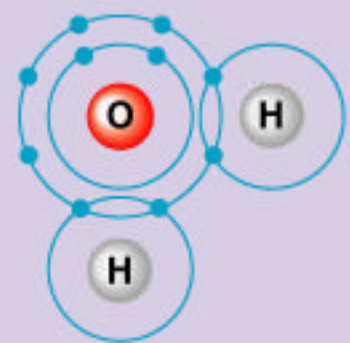
- Chemical bonds: attractions between atoms as a result of electron interactions
- Covalent bonds: result from the sharing of valence electrons, influenced by the pulling power of an atom (electronegativity)
 - Nonpolar covalent bonds
 - Polar covalent bonds



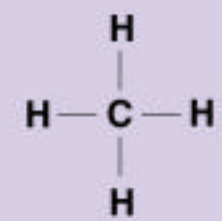
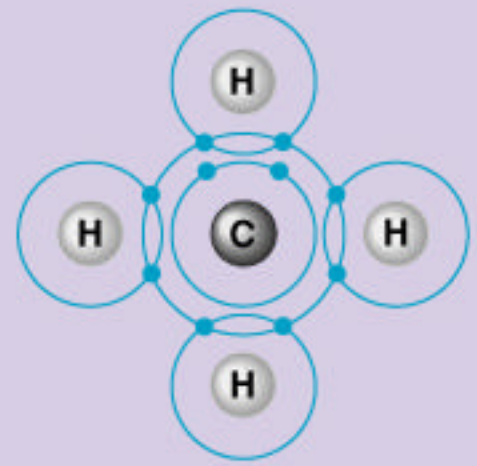
(a) H₂



(b) O₂



(c) H₂O



(d) CH₄



Hydrogen (H)



Hydrogen (H)

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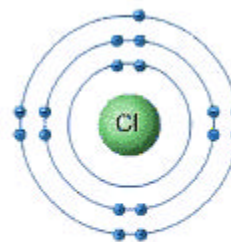
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CHEMICAL BONDS Continued

- Ionic bonds: transfer of electrons between atoms as a result of a large difference in electronegativity; may be strong or weak
- Ion: is a positively or negatively charged atom or molecule
 - Cation: +
 - Anion: -



Sodium (Na)



Chlorine (Cl)

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Chemical Bonds Between Molecules

- Hydrogen Bonds: weak attraction of a hydrogen atom on one molecule for an electronegative atom of another molecule
 - protein structure
- van der Waals interactions: changing “hot spots” of positive and negative charges due to the random non-symmetrical distribution of electrons in molecules

