REVIEW OF BASIC CHEMISTRY

Note: The material up until the start of Biochemistry on the next page is largely from the week 1 unit of 1103, and it is here for review purposes only. I will not DIRECTLY test on this material, but I thought that quite a few students would benefit from reviewing basic chemistry before tackling Biochemistry and several of the other units we cover over the next few weeks. If you want to try some of the more interactive material in the "Draft version" of a new 1103 unit, then go to my website: http://gerry3.coolchameleon.com

I. Atoms, Elements and Ions

- **matter** is anything which has mass and takes up space
- matter is made up of a number of building blocks called **chemical elements** which are substances that cannot be broken down into simpler substances by chemical means
- the 4 most abundant elements in the human body = **C, O, N, and H**
- **atoms** are the smallest units of an element that retain all the characteristics of the element
- each atom contains: Martini (8th ed.) Figs 2-1 & 2-2 OR Tortora (10-12th ed.) Figs 2.1 & 2.2
  - **(i) neutrons** = particles with no charge (**neutral**); found in a dense central region (nucleus)
  - **(ii) protons** = particles that each have a **+1** charge; also found in nucleus
  - **(iii) electrons** = particles that each have a **–1** charge; found electron shells around nucleus
- all atoms of a given element have the same number of protons (hydrogen = 1; oxygen = 8 ...)
- atoms have the same number of electrons as protons, so they have no net charge

II. Chemical Bonds, Molecules and Compounds

- **chemical bonds are attractions that hold atoms together to form:**
  - **(i) molecules** = two or more atoms joined together by chemical bonds
    - the atoms may be of the same element: oxygen gas = 2 oxygen atoms (written as O_2)
    - the atoms may also be different: water (H_2O) = 2 hydrogen atoms + 1 oxygen atom
  - **(ii) compounds** = molecules consisting of more than one element

- the only parts of atoms that become involved in bonds are electrons
- we can determine how many & what types of bonds an atom will form based on its electrons
- each electron shell can hold a maximum number of electrons: - the 1st shell holds up to 2 electrons
  - the 2nd shell hold up to 8 electrons
- innermost shells are filled before electrons are added to higher shells
- atoms are stable (chemically unreactive) when their outermost shells (**valence shells**) are "full" (note: the 3rd shell is also stable with 8 electrons)
- if the outermost shell is not full then atoms will **transfer OR share electrons** to fill their shell
  ⇒ produces two types of chemical bonds

A.) Ionic Bonds are formed following the transfer of electrons between atoms:

- first, atoms donate or accept 1-2 electrons to obtain a full valence shell Fig 2-3M OR 2.4T
- once the "atoms" are now charged they are called "ions"
  e.g. (i) a sodium atom (Na) can lose an electron to become a sodium ion (Na^+)
  (ii) a chlorine atom (Cl) can gain an electron to become a chloride ion (Cl^-)
- **ions with opposite charges may then be attracted to each other = ionic bonds**
- ionic bonds are common in inorganic (non C-based) compounds

B.) <u>Covalent Bonds</u> are formed by atoms sharing electrons: Fig 2-4M OR 2.5T

- in a covalent bond a full valence shell is obtained by the atoms **sharing** electrons
- a single covalent bond = 2 shared electrons
- atoms can also share more than two electrons : - 4 shared electrons = double cov. bonds
  - 6 shared electrons = triple cov. bonds
- covalent bonds are common in all organic (C-based) compounds

<u>Types of covalent bonds</u>:

- as a result of differences in the attraction that different atoms have for electrons, two different types of cabvalent bonds may be formed
- O & N have a high attraction for the e- (high "electronegativity"), H & C have a lower attraction

(i) non-polar covalent bonds $\Rightarrow$ **equal** sharing of e^-

- form when the 2 atoms being joined have about the same attraction for e- e.g. H_2, O_2, & CH_4

(ii) polar covalent bonds $\Rightarrow$ **unequal** sharing of e^- **Figs 2-5 & 2-6 (M) OR 2.5 & 2.6 (T)**

- form when the atoms have significantly different attraction for the electrons
- the shared e^- are pulled towards the atom with a stronger attraction creating partial (weak) + and - charges (called δ^+ and δ^-) e.g. H_2O
- the parts of two polar covalent molecules that have opposite charges can form weak interactions called hydrogen bonds between them e.g. between two water molecules
- polar molecules are therefore hydrophillic while non-polar molecules are hydrophobic!

III. <u>Chemical Reactions</u> - atoms combine with and/or break apart from other atoms
- bonds are made or broken but the number & types of atoms don't change

.