SFCC: Winter 2009 Name:_____
Dr. Timm

1) What is the name of the chart that describes the atomic elements in ascending order of mass.

Periodic Table of elements

2) The atomic number describes the number of protons found in the nucleus. What other characteristic sub-atomic particle can the atomic number describe for a neutral atom?

By extension, a neutral atom has equal number of electrons (e^-) as protons (H^+)

3)When an atom receives an extra neutron, either by cosmic rays or nuclear furnace, thus, knocking a proton from the nucleus what is the resulting atom referred as **Radio Isotope**. These "heavy" atomic elements can now be used for what purposes?

A. ___ **Medical** _____

B. ___ **Metabolic tracer or**

C) **historical dating of artifacts**

4) Nitrogen ($^{7}N_{14}$) has _ **2** _ number electrons in its first energy shell along with ___ **5** ___ number of electrons in its 2nd energy shell.

5) The act of either giving up or gaining electrons causes an element to become an___ **ion** _____.

6) The unique properties of water stem from what type of bonds formed between hydrogen of one molecule of water and that of oxygen of an adjacent molecule of water

Hydrogen bonds

7) Does water form a covalent, polar covalent, an ionic or non ionic bond within a water molecules. And, how is the density of frozen water influence by this phenomenon?

Water forms a polar bonds. These bonds cause partial charge to form: δ^- for Oxygen and δ^+ for hydrogen atoms. The bonds between oxygen and hydrogen within a water molecule are polar in nature resulting in unshared electrons between the oxygen atom and hydrogen atoms.
Frozen water is less dense than liquid water because water expands as it freezes.. Solid water, ice, forms a crystalline structure with equal separation between adjacent water molecules.

8) At what temperature is water most dense?
3.94 or 4°C

b) How much energy is required to transform solid phase water at 0°C to liquid at 0°C
80 calories Or 334.9 J/gm
c) How much enery does each gram of water absorb to move that gram of water 1°C
1 calorie of energy or 4.186 J/gm
d) How much energy is absorbed by water to cause water to vaporize at 100°C
540 calories or 2260.4 J/gm

9) What does the pH scale measure? In your answer note the unit differences and give an example an acid verse a base in terms of these number units.

The pH scale measures the hydrogen ion activity of a solution such as H^+ resulting from the disassociation of hydrochloric acid in water.

Each pH number represents a 10 fold shift in hydrogen ions from its previous number. With each decreasing value the solution of H^+ ions become 10x more potent.

Example: pH 3 to pH 4 - - pH 3 is 10 times more acid than pH 4.
pH 3 to ph 7 - - pH 3 is 10^4 times (10,000) more acid than pH 7.

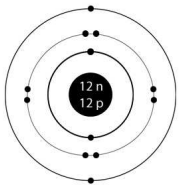
Neutral pH (7) has 1/10,000,000 number of hydrogen ions (acid) in a water solution. A pH of 3 has 1/1000 number of hydrogen ions in a water solution while that of a base (pH 11) has $1 \cdot 10^{-11}$ number of H^+ ions in solution. Thus, pH is the -log of H^+ ions.

10) What is the purpose of a chemical buffer?

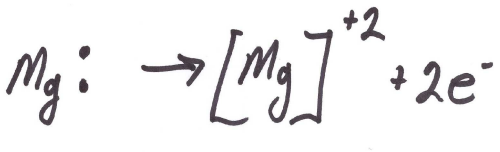
Buffers are chemical substances that resist pH changes. Buffer molecules combine with, or release, H^+ to prevent drastic changes in pH. Carbonic acid is the major buffer compound found in the human body. This buffer works in the pH range of 7.2 to 7.5.

11) First find Magnesium (Mg) on the periodic chart

A. Give Mg atomic number ____ **12** ____
B. Give Mg Atomic Mass: ____ **24.3** ____
C. Mg has ___**12** ___ protons and ____ **12** ____
D. Diagram an atom of Mg using the planetary projection (Lewis dot diagram showing the electon arrangement about the nucleus for the Neutral Mg atom:
give it its over all charge



Neutral Magnesium has charge



Valence charge of +2

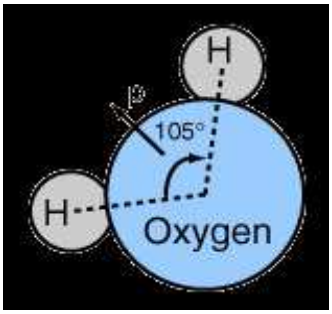
Describe the following giving an example in support of your description

12. What is an ionic bond?:

A chemical bond formed by electrostatic attraction between two oppositely charged atoms. Ex:. NaCl

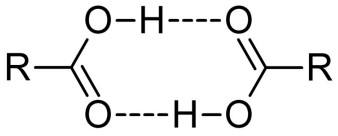
13. What is a polare covalent Bond:

Polar covalent bonds results from unequal sharing of electrons between atoms. This situation results when one atom is more electro negetive then the other contributing atom such as we find with oxygen and hydrogen in the water molecule. Ex.: H_sO



14. What is a Hydrogen bond?

A hydrogen bond is a special type of dipole-dipole force that exists between an partial electronegative oxygen atom and a partial electron positive hydrogen atom bonded to another oxygen atom between water molecules. The dotted lines represent these forces.



15. The hydrogen bonds that form between water impart specific characteristices to water. List and describe three of the properties.

A) Polarity of the water molecule (Adhesive affects) :

1) The electron arrangements in the water molecule, a polarity results that allow water to form hydrogen bonds with one another and other polar substances.

2) Polar substances are hydrophilic (water-loving); non-polar ones are hydrophobic (water- dreading) are repelled by water.

B) Water's temperature stabilizing effects

1) Water tends to stabilize temperature because it can absorb considerable heat before it temperature changes

2) This is an important property in evaporative and freezing processes.

C) Water cohesion

1) Hydrogen bonding of water molecules provides cohesion (capacity to resist rupturing).

2) Cohesion imparts surface tension and helps pull water through plants.

D) Water's solvent properties

1) Water is a great solvent because ions and polar molecules (solutes) dissolve in it.

2) The solvent properties of water are greatest with respect to polar molecules because 'spheres of hydration' are formed around the solute molecules.

16) Define and provide an example for each term:

a) Solvent (3)

A substance that dissolves another (the solute) and creates a soltion by dispersing the other substance. That is water dissovling ethanol or salt.

b) Solute (3)

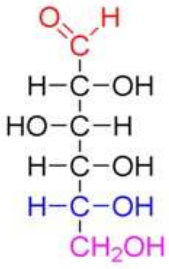
A substance that is dissolved by a solvent: such as ethanol (solute) into water (solvent) or salt into water.

17) List and describe the function of the four **major categories** of organic materials that make up life?

A) Carbohydrates

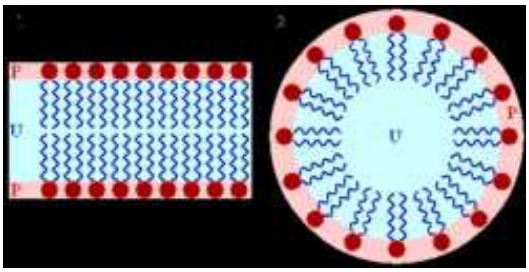
They fill numerous roles in living things, such as the storage and transport of energy (starch, glycogen) and structural components (cellulose in plants, chitin in animals). Additionally, carbohydrates and their derivatives play major roles in the working process of

the immune system, fertilization, pathogenesis and blood clotting. The -OH group conveys solubility in water. Remember hydrates mean water.



B) Lipids

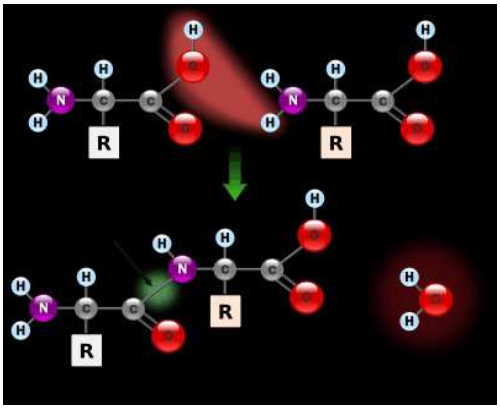
Lipids are a diverse and ubiquitous group of compounds which have many key biological functions, such as acting as structural components of cell membranes, serving as energy storage sources and participating in signaling pathways. Lipids may be broadly defined as hydrophobic or amphipathic small molecules that originate entirely or in part from two distinct types of biochemical subunits or "building blocks": ketoacyl and isoprene groups.



Phospholipids

C) Proteins

Proteins are large organic compounds made of amino acids arranged in a linear chain and joined together by peptide bonds between the carboxyl and amino groups of adjacent amino acid residues. The sequence of amino acids in a protein is defined by a gene and encoded in the genetic code. Although this genetic code specifies 20 "standard" amino acids.

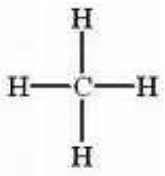


Amino Acid linked via peptide bonds to form protein.

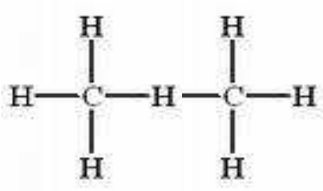
D) Nucleic acids

A nucleic acid is a macromolecule composed of nucleotide chains. In biochemistry these molecules carry genetic information or form structures within cells. The most common nucleic acids are deoxyribonucleic acid (DNA) and ribonucleic acid (RNA). Nucleic acids are universal in living things, as they are found in all cells and viruses. Each nucleotide consists of three components: a nitrogenous heterocyclic base, which is either a purine or a pyrimidine; a pentose sugar; and a phosphate group. Nucleic acid types differ in the structure of the sugar in their nucleotides - DNA contains 2-deoxyriboses while RNA contains ribose. Nucleotides also are involved in energy transduction - ATP, NADH, and NADPH.

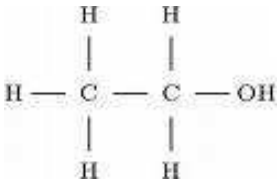
18) Draw a structural form of a methane molecule: (2)



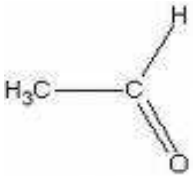
19) Of a structural form a ethane molecule:(2)



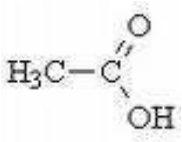
20) Of a ethyl alcohol molecule:(2)



21) Of a acetyl aldehyde: (2)



22) Of a acetic acid molecule:(2)

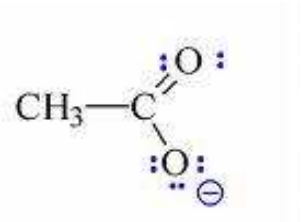


23) Which ones (questions 18 - 22) are soluble in water and why (3) :

Ethanol, acetyl aldehyde, and acetic acid are soluble in water because of their hydrogen bonding ability between the -OH groups (=O) and -O or -Hyrogen δ^+ charges of water.

24) Which ones (questions 18 - 22) ionize in water and what are the ionized produces (draw a diagram):

Only acetic acid ionizes in water forming an acetate ion releasing a +H ion into the water solution.



\+ H^+

Acetate ion Hydrogen ion

25) Provide an example of a monomer type molecule (1) _ **Amino Acids** _____

of a polymer type molecule (1) ____ **Proteins** _____

26) What type of chemical reaction describes the removal of water between monomers to produce a polymer compound. (1)?

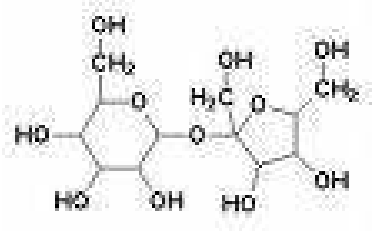
Condensation reaction removes water between monomer units.

27) Explain why waxes float on water while sucrose (a disaccharide) dissolves in water. Provide an example drawing (4) Key words: **Hydrophobic Hydrophilic molecular structural shapes**

Waxes are categorized as lipids. Waxes are insolubility in water due to a lack of hydrogen bonds formed between lipids and water. Waxes are made up of repeating units of -(CH_2)- . Therefore, waxes are hydrophobic molecules are less dense than water and float.

Beeswax
CH3(CH2)29O-CO-(CH2)14CH3

On the other hand, sucrose (table sugar) has 8 [-OH] groups associated with the carbon backbone. Each -OH group has a degree of polar nature resulting in partial (δ) charges. These partial charge create hydrogen bond permitting sucrose solubility in water. Sucrose <u>does not</u> break down in water.

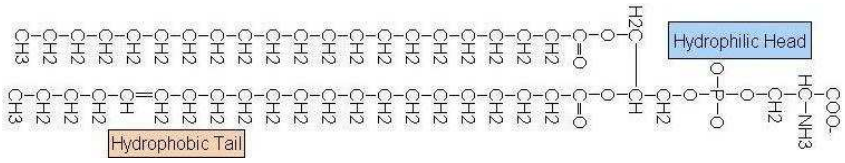


27b) Why does salt dissolve in water but not in gasoline? (4 pts)

NaCl ionizes in water resulting in sodium and chloride ions as a result of water's polar nature. Gasoline, on the other hand, is composed of ($-CH_2$) units which are hydrocarbon (hydrogen carbons) without any polar molecules. Gasoline like other petroleum products are non-polar molecules with any partial charges. Therefore, salt will not disassociate in gasoline.

28) What unique properties does the class of phospholipids possess? Where would we most likely find a phospho-lipid in a biological system? Draw out a phospholipid. (4)

_ **Phospholipids are unique in that they have a hydrophilic head consisting of a positive nitrogen group covalently bonded to a negatively charged phosphate group. The hydrophilic head is covalently bonded to glycerol backbone in turn covalently bonded to a hydrophobic group made up of two fatty acid tails. These fatty acid tails do not provide any water soluble points. These molecules are the foundation molecules of the plasma membrane bi-layers system.**



29) Enzymes digest proteins breaking proteins down into simple amino acids.
Name this type of chemical reaction? (1) **Hydrolysis reation**

List and describe three (3) function of a protein (6)

A) **Proteins function as enzymes regulating cell functions**

B) **Proteins function immunization pathways in defense of the human body**

C) **Protein form a cable like net-work within the cell providing structural support for the cell**

D) **Subcellular proteins fulfill transport needs across the cell nuclear and vacuole membranes; And, contractile proteins behavioral characteristics like rubber bands mediating muscle movement**

30) Name the three subunit that make up a Nucleotide (3)

A) _ **pentose ribose sugar** ____ B)__**Nitrogen Base** C) ___ **Phosphate group** _____

31) What are the four bases that make up DNA (4)

Adenine, Guanine, Cytosine, Thymine

32) What are the four bases that make up RNA (4)

Adenine, Guanine, Cytosine, Uracil

33) What type of bond holds the two opposing strips of DNA held together? (1)

_____**Hydrogen bonds** _____

34) What type of bonds hold RNA together? (2 pts)

Covalent bonds holds RNA molecules together