

**SOLUTIONS TO THE STUDY GUIDE FOR MODULE #5**

1. a. Matter – Anything that has mass and takes up space
- b. Model – An explanation or representation of something that cannot be seen
- c. Element – A collection of atoms that all have the same number of protons
- d. Molecules – Chemicals that result from atoms linking together
- e. Physical change – A change that affects the appearance but not the chemical makeup of a substance
- f. Chemical change – A change that alters the makeup of the elements or molecules of a substance
- g. Phase – One of three forms - solid, liquid, or gas - which every substance is capable of attaining
- h. Diffusion – The random motion of molecules from an area of high concentration to an area of low concentration
- i. Concentration – A measurement of how much solute exists within a certain volume of solvent
- j. Semipermeable membrane – A membrane that allows some molecules to pass through but does not allow other molecules to pass through
- k. Osmosis – The tendency of a solvent to travel across a semipermeable membrane into areas of higher solute concentration
- l. Catalyst – A substance that alters the speed of a chemical reaction but is not used up in the process
- m. Organic molecule – A molecule that contains only carbon and any of the following: hydrogen, oxygen, nitrogen, sulfur, and/or phosphorous
- n. Biosynthesis – The process by which living organisms produce larger molecules from smaller ones
- o. Isomers – Two different molecules that have the same chemical formula
- p. Monosaccharides – Simple carbohydrates that contain 3 to 10 carbon atoms
- q. Disaccharides – Carbohydrates that are made up of two monosaccharides
- r. Polysaccharides – Carbohydrates that are made up of more than two monosaccharides
- s. Dehydration reaction – A chemical reaction in which molecules combine by removing water
- t. Hydrolysis – Breaking down complex molecules by the chemical addition of water
- u. Hydrophobic – Lacking any affinity to water

- v. Saturated fat – A lipid made from fatty acids that have no double bonds between carbon atoms
  - w. Unsaturated fat – A lipid made from fatty acids that have at least one double bond between carbon atoms
  - x. Peptide bond – A bond that links amino acids together in a protein
  - y. Hydrogen bond – A strong attraction between hydrogen atoms and certain other atoms (usually oxygen or nitrogen) in specific molecules
2. In an atom, protons and neutrons cluster together at the center, which is called the nucleus. Electrons orbit around the nucleus.
  3. The number of electrons (or protons) in an atom determines the vast majority of its characteristics.
  4. When a number appears after an atom's name, it tells you the sum of protons and neutrons in the atom's nucleus.
  5. An element contains all atoms that have the same number of protons (and therefore the same number of electrons), regardless of the number of neutrons. An atom is a single entity, determined by its number of protons, electrons, and neutrons.
  6. Since atoms have the same number of electrons and protons, there must be 32 electrons.
  7. The subscripts after the elemental abbreviations tell you how many of each atom is in the molecule. Thus, there are 3 carbons, 8 hydrogens, and 1 oxygen, for a grand total of 12 atoms.
  8. a. Molecule, because it has several atoms linked together  
b. Atom, because it specifies number of neutrons and protons  
c. Element, because it is by itself but does not specify the number of neutrons and protons
  9. Adding energy causes molecules to go from solid to liquid to gas. Thus, the liquid will turn into a gas. To turn it into a solid, you must take energy from it.
  10. A semipermeable membrane should not be used. For diffusion to work, both solute and solvent must be able to travel across the membrane. Semipermeable membranes typically allow only solvent molecules to pass.
  11. Since the water levels changed, that means solvent traveled from one side of the membrane to the other, but solute did not. This is osmosis, which requires a semipermeable membrane.
  12. a. Reactants appear to the left of the arrow. The number to the left of the chemical formulas, however, do not describe the reactants. Instead, they tell you how many of each reactant molecule. Thus, the reactants are N<sub>2</sub> and H<sub>2</sub>.  
b. Products appear on the right side of the arrow. The product is NH<sub>3</sub>.  
c. There are three H<sub>2</sub> molecules in the reaction, because of the "3" to the left of H<sub>2</sub>.

13. Photosynthesis is represented by:



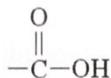
In order for a plant to carry out photosynthesis, it needs CO<sub>2</sub>, H<sub>2</sub>O, energy from sunlight, and a catalyst like chlorophyll.

14. Reactions can also be sped up by increasing temperature.

15. Carbohydrates have carbon, hydrogen, and oxygen and no other elements. In addition, like water, they must have twice as many H's as O's. Only molecule d fits that bill.

16. Dehydration reactions build up these molecules, and hydrolysis reactions can break them down, providing the proper enzyme exists.

17. An acid must contain an acid group, which looks like this:



Only molecule c has one.

18. The pH scale measures the acidity or alkalinity of a solution. On this scale, 7 is neutral. Lower than 7 pH's are acidic, and higher than 7 are alkaline. The lower the pH the more acidic, and the higher the pH the more alkaline.

19. Amino acids link together to make proteins, fatty acids link to glycerol to make lipids, and monosaccharides link together to make polysaccharides.

20. These two proteins will not have the same properties. Not only the number and type but also the order of amino acids determine a protein's structure and function.

21. Enzymes are a special class of proteins that are used as catalysts.

22. The "lock and key" theory of enzyme action says that an enzyme has an active site that is shaped especially for the molecule that it must work on. The action that the enzyme takes cannot happen until the molecule attaches to that active site. Since the active site is shaped for a specific molecule, such an enzyme cannot work on other molecules, unless it happens to have the same shape.

23. The three basic parts of a nucleotide are the phosphate group, the sugar, and the base.

24. DNA stores information as a sequence of nucleotide bases, much like all of the English language can be stored as a sequence of dots and dashes in Morse code.

25. Hydrogen bonds between the nucleotide bases hold the two helixes of DNA together.