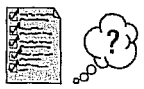
Name _____ Course/Section _____

Date _____ Professor/TA _____



Activity 2.1 A Quick Review of Elements and Compounds

1. Table 2.1 (page 31) lists the chemical elements that occur naturally in the human body. Similar percentages of these elements are found in most living organisms.

a. In what abiotic (nonlife) chemical forms are these elements often found in nature?	b. In what chemical form(s) do animals need to obtain these elements?	c. In what chemical form(s) do plants need to obtain these elements?

2. A chemical element cannot be broken down to other forms by chemical reactions. Each element has a specific number of protons, neutrons, and electrons.

a. What is the name of the following element, and how many protons, neutrons, and electrons does it have?

11
Na
23

Name	Number of protons	Number of neutrons	Number of electrons

b. What information do you need to calculate or determine the following?

The atomic number of an element	The mass number of an element	The weight in daltons of one atom of an element

c. What are the atomic number, mass number, and weight in daltons of the element shown in part a?

Atomic number	Mass number	Weight in daltons

3. One mole of an element or compound contains 6.02×10^{23} atoms or molecules of the element or compound. One mole of an element or compound has a mass equal to its mass number (or molecular weight) in grams. For example, 1 mol of hydrogen gas (H_2) contains 6.02×10^{23} molecules and weighs 2 g.

a. What is the weight of 1 mole of pure sodium (Na)?	b. How many molecules of Na are in 1 mole of Na?

c. How would you determine how many grams are in a mole of any chemical element or compound?

4. One atom of Na can combine with one atom of Cl (chlorine) to produce one molecule of NaCl (table salt).

a. If Cl has 17 electrons, 17 protons, and 18 neutrons, what is its mass number?	b. What is the mass number of NaCl?	c. How many grams of NaCl equal a mole of NaCl?

d. If you wanted to combine equal numbers of Na and Cl atoms in a flask, how much Cl would you have to add if you added 23 g of Na? (Include an explanation of the reasoning behind your answer.)

e. To make a one-molar (1 *M*) solution of NaCl, you need to add 1 mol of NaCl to distilled water to make a final volume of 1 L (1,000 ml). A 1 *M* solution is said to have a molarity of 1. If you added 2 mole of NaCl to 1 L of distilled water, you would make a 2 *M* solution and its molarity would equal 2.
You make up a 1 *M* solution of NaCl.

How many molecules of NaCl are in the 1 *M* NaCl solution?	How many molecules of NaCl are there per ml of the solution?

f. Next, you divide this 1 *M* solution of NaCl into four separate flasks, putting 250 ml into each flask.

How many grams of NaCl are in each flask?	How many molecules of NaCl are in each flask?	How many molecules of NaCl are there per ml of distilled water?	What is the molarity of NaCl in each of the four flasks?

5. The summary formula for photosynthesis is

$$6\ CO_2 + 6\ H_20 \rightarrow C_6H_{12}O_6 + 6\ O_2$$

a. How many molecules of carbon dioxide and water would a plant have to use to produce three molecules of glucose ($C_6H_{12}O_6$)?	b. How many moles of carbon dioxide and water would a plant have to use to produce 2 mole of glucose?

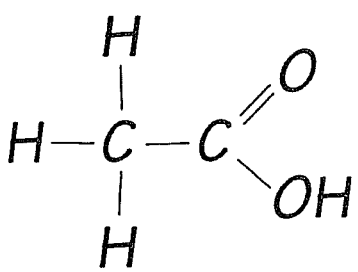
c. Refer to the summary formula for photosynthesis. If you know the number of molecules or moles of any of the reactants used (or products produced), how would you calculate the number of molecules or moles of all of the other reactants needed and products produced?

6. A biologist places a plant in a closed chamber. A sensor in the chamber maintains the carbon dioxide level at the normal atmospheric concentration of 0.03%. Another sensor allows the biologist to measure the amount of oxygen produced by the plant over time. If the plant produces 0.001 mole of oxygen in an hour, how much carbon dioxide had to be added to the chamber during that hour to maintain the atmospheric concentration of 0.03%?

7. O_2 and NH_3 are both small covalent molecules found in cells. NH_3 is extremely soluble in the aqueous environment of the cell, while O_2 is relatively insoluble. What is the basis for this difference in solubility between the two molecules? In reaching your answer, draw the structures of the molecules as valence shell diagrams (as in Figure 2.11, page 38). Given these diagrams, consider the types of interactions each molecule could have with water.

8. Refer to pages 37–41 of *Biology,* 7th edition, which describe these types of chemical bonds: nonpolar and polar covalent bonds, ionic bonds, hydrogen bonds, and van der Waals interactions.

The molecule diagrammed here can also be represented by the formula CH_3COOH.



Explain how you could determine which of the bonds between elements in this molecule are polar or nonpolar covalent bonds, ionic bonds, hydrogen bonds, and van der Waals interactions.