12.1 Chemical Bonding
Chemistry PS

Name _____ Date _____ Per. _____
Directions: Answer all open-ended questions in complete sentences, using evidence to support your answers. For math questions, show all of your work and include appropriate units and significant figures in your final answer to receive **FULL** credit.

A. Types of Chemical Bonds

1. Define a chemical bond.

2. What types of elements react to form ionic compounds? Give an example of the formation of an ionic compound from its elements.

3. a. What type of bonding requires the complete transfer of an electron from one atom to another?

b. What type of bonding involves the sharing (either equally or unequally) of electrons between atoms?

4. Describe the type of chemical bonding that exists between the atoms in the hydrogen molecule, H_2 .

5. Describe the type of chemical bonding that exists between the atoms in the hydrogen fluoride molecule, HF.

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B. Electronegativity

6. What do chemists mean by the term electronegativity? What does its electronegativity tell us about the atom?

7. What does it mean to say that a bond is polar? What are the conditions that give rise to a bond being polar?

8. For each of the following sets of elements, identify the element expected to be most electronegative and that expected to be least electronegative.

a. K, Sc, Ca b. Br, F, At c. C, O, N

9. Calculate the electronegativity difference between the atoms listed below. On the basis of the electronegativity values given in Figure 12.4, indicate whether each of the following bonds would be expected to be ionic, covalent, or polar covalent.

a. S—S b. S—O

c. S—H d. S—K

10. Which of the following molecules contain polar covalent bonds? Draw the structure of the molecule (use internet)

a. phosphorus, P_4 b. oxygen, O_2

c. ozone, O_3 d. hydrogen fluoride, HF

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11.Calculate the electronegativity difference between the atoms listed. On the basis of the electronegativity values given in Figure 12.4, indicate which is the more polar bond in each of the following pairs.

a. H—O or H—N

b. H—N or H—F

c. H—O or H—F

d. H—O or H—Cl

12. Calculate the electronegativity difference between the atoms listed. On the basis of the electronegativity values given in Figure 12.4, indicate which bond of the following pairs has a more ionic character.

a. Na—O or Na—N

b. K—S or K—P

c. Na—Cl or K—Cl

d. Na—Cl or Mg—Cl

C. Bond Polarity and Dipole Moments

13. What is a dipole moment? Give four examples of molecules that possess dipole moments, and draw the direction of the dipole as shown in this section.

14. Why is the presence of a dipole moment in the water molecule so important? What are some properties of water that are determined by its polarity?

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15. In each of the following diatomic molecules, which end of the molecule is positive relative to the other end? Draw the molecule and show the dipole moment by placing an appropriate arrow above the molecule.

a. hydrogen fluoride, HF

b. chlorine monofluoride, ClF

c. iodine monochloride, ICl

16. For each of the following bonds, draw a figure indicating the direction of the bond dipole, including which end of the bond is positive and which is negative.

a. P—F

b. P—O

c. P—C

d. P—H

17. For each of the following bonds, draw a figure indicating the direction of the bond dipole, including which end of the bond is positive and which is negative.

a. S—P

b. S—O

c. S—N

d. S—Cl

18. In each case, which of the following pairs of bonded elements forms the more polar bond? Explain your answer.

a. S—F or S—Cl

b. N—O or P—O

c. C—H or Si—H

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19. For each of the following pairs of elements, identify which element would be expected to be more electronegative. It should not be necessary to look at a table of actual electronegativity values. Explain your answer.

a. Be or Ba

b. N or P

c. F or Cl

20. In each of the following molecules, which end of the molecule is negative relative to the other end? Draw each molecule and include the dipole moment arrow.

a. carbon monoxide, CO

b. iodine monobromide, IBr

c. hydrogen iodide, HI

21. Explain the difference between a covalent bond formed between two atoms of the same element and a covalent bond formed between atoms of two different elements.

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D. Bond dissociation Energy

22. What do we mean by the bond energy of a chemical bond?

22. Use bond energies to estimate the enthalpy change for the combustion of butane.

$2\ C_4H_{10}(g) + 13\ O_2(g) \rightarrow 8\ CO_2(g) + 10\ H_2O(g)$

23. Use bond energies to estimate the enthalpy change for: $N_2(g) + 3\ H_2(g) \rightarrow 2\ NH_3(g)$

24. One reaction that methane undergoes with chlorine is: $CH_4(g) + 3\ Cl_2(g) \rightarrow CHCl_3(g) + 3\ HCl(g)$
Using average bond energies to calculate the enthalpy change for this reaction.