Name: ___________________________

Homework was checked against the key with wrong answers corrected.
Parent Signature: ______________________________

Chapter 16: Covalent Bonding

Each numbered question is worth 1 point except as noted. Total possible = 44 points

Section 16.1: The Nature of Covalent Bonding

1. Draw the electron dot structure for each molecule.

a. chlorine	b. bromine	c. iodine

What do you observe about the three structures?

2. The following molecules have single covalent bonds. Draw an electron dot structure for each.

a. H_2O_2	b. PCl_3

3. Draw the electron dot structure of the hydroxide ion (OH^-). (0.5)

4. Draw the electron dot structure of the polyatomic boron tetrafluoride anion (BF_4^-). (0.5)

5. Draw the electron dot structures for sulfate (SO_4^{2-}) and carbonate (CO_3^{2-}). Sulfur and carbon are the central atoms, respectively.

sulfate	carbonate

6. Draw the electron dot structure for the hydrogen carbonate ion (HCO_3^-). Carbon is the central atom, and hydrogen is attached to oxygen in this polyatomic anion. (0.5)

7. How are single, double, and triple bonds indicated in electron dot structures? (0.5)

8. Provide an example of each of the following. (Name a chemical; you do not need to draw the structure.)

a. coordinate covalent bonding

b. resonance structures

c. exceptions to the octet rule

9. What kinds of information does a structural formula reveal about the compound it represents? (0.5)

10. Draw electron dot structures for the following molecules, which have only single covalent bonds. (1.5)

a. H_2S	b. PH_3	c. ClF

11. Draw the resonance structures for sulfur dioxide (SO_2). Sulfur is the central atom.

12. How many kilojoules are required to dissociate all the C-H single bonds in 0.1 mol of methane (CH_4)? Assume that the bond dissociation energy is the same for each bond. (Hint: Use Table 16.3.)

Section 16.2: Bonding Theories

14. Explain how the VSEPR theory can be used to predict bond angles in the following covalently bonded molecules. (1.5)

a. methane

b. ammonia

c. water

18. The BF_3 molecule is planar. The attachment of a fluoride ion to the boron in BF_3, through a coordinate covalent bond, creates the BF_4^- ion. What is the geometric shape of this ion? Draw the Lewis structure.

Section 16.3: Polar Bonds and Molecules

19. Identify the bonds between atoms of each pair of elements as (1) nonpolar covalent, (2) moderately polar covalent, (3) very polar covalent, or (4) ionic. (Hint: Use Table 16.4 and Table 14.2 (p. 405).) (1.5)

a. H and Br

b. K and Cl

c. C and O

d. Cl and F

e. Li and O

f. Br and Br

20. Order the following covalent bonds from least to most polar: (0.5)

a. H-Cl b. H-Br c. H-S d. H-C e. F-F

21. Explain how you can use electronegativity values to classify a bond as nonpolar covalent, polar covalent, or ionic. (0.5)

22. Describe the three kinds of attractive forces that hold groups of molecules together. Rank these forces from weakest to strongest. (1.5)

23. Not every molecule with polar bonds is polar. Explain this statement, using CCl_4 as an example. (0.5)

24. Draw the electron dot structure for each molecule below. Identify polar covalent bonds by assigning slightly positive ($\delta +$) and slightly negative ($\delta -$) symbols to the appropriate atoms. (2)

a. HOOH	b. BrCl	c. HBr	d. H_2O

25. How does a network solid differ from most other covalent compounds?

26. Which of the following are characteristic of most covalent compounds?
   a. high melting points
   b. shared bonding electrons
   c. low water solubility
   d. existence as molecules
   e. composed of a metal and a nonmetal

Chapter 16 Review

28. Classify the following compounds as ionic or covalent. 16.1
   a. $MgCl_2$

   b. Na_2S

   c. H_2O

   d. H_2S

30. How many electrons do atoms in a double covalent bond share? How many in a triple bond? (0.5) 16.1

31. Based upon the examples provided in Section 16.1, state a general rule for determining which atom is the central one in a binary molecular compound. (0.5) 16.1

37. Draw resonance structures for the carbonate ion (CO_3^{2-}). Each oxygen is attached to the carbon. 16.1

39. How can you experimentally determine whether a substance is paramagnetic? 16.1

40. Predict whether the following species are diamagnetic or paramagnetic. (Explain your reasoning.) (2 points) 16.1

a. BF_3

b. O_2^-

c. NO_2

d. F_2

43. What is the relationship between the magnitude of a molecule's bond dissociation energy and its expected chemical reactivity? (0.5) 16.1

44. Explain what is meant by *bond dissociation energy*. (0.5) 16.1

45. Assume the total bond energy in a molecule is the sum of the individual bond energies. Calculate the total bond energy in a mole of ethyne (C_2H_2). (*Hint*: Write the electron dot structure to determine the kinds of bonds. Then refer to Table 16.3.) 16.1

51. What must always be true if a covalent bond is to be polar? (0.5) 16.3

52. The bonds between the following pairs of elements are covalent. Arrange them according to polarity, naming the most polar bond first. 16.3

a. H-Cl b. H-C c. H-F d. H-O e. H-H f. S-Cl

53. Arrange the following bonds in order of increasing ionic character. 16.3

a. Cl-F b. N-N c. K-O d. C-H e. S-O f. Li-F

55. Depict (with a drawing) the hydrogen bonding between two ammonia molecules; then depict the bonding between one ammonia and one water molecule. (2) 16.3

Between two ammonia molecules	Between one ammonia and one water molecule

56. Circle the compound in each pair that exhibits the stronger intermolecular hydrogen bonding. Explain your rationale behind your answer. (2) 16.3

a. H_2S, H_2O

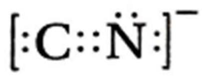
b. HCl, HF

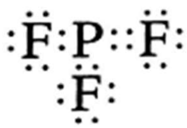
c. HBr, HCl

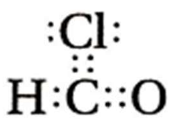
d. NH_3, H_2O

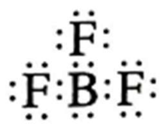
58. Explain why compounds with strong intermolecular attractive forces have higher boiling points than compounds with weak intermolecular attractive forces. (0.5) 16.3

62. Explain why each Lewis structure below is incorrect. Replace each structure with one that is more acceptable. (4 points)

a. 

b. 

c. 

d. 

63. Use VSEPR theory to predict the geometry of each of the following: (4 points)

a. $SiCl_4$

b. CO_3^{2-}

c. CCl_4

d. SCl_2