Name _____ Date _____ Class _____

CHAPTER 9 STUDY GUIDE FOR CONTENT MASTERY

Covalent Bonding

Section 9.1 The Covalent Bond

In your textbook, read about the nature of covalent bonds.

Use each of the terms below just once to complete the passage.

covalent bond	molecule	sigma bond	exothermic	pi bond

When sharing of electrons occurs, the attachment between atoms that results is called a(n) **(1)**_____. When such an attachment is formed, bond dissociation energy is released, and the process is **(2)**_____. When two or more atoms bond by means of electron sharing, the resulting particle is called a(n) **(3)**_____. If the electrons shared are centered between the two atoms, the attachment is called a(n) **(4)**_____. If the sharing involves the overlap of parallel orbitals, the attachment is called a(n) **(5)**_____.

In your textbook, read about single and multiple bonds and bond strength.

Circle the letter of the choice that best completes the statement or answers the question.

6. In what form do elements such as hydrogen, nitrogen, and oxygen normally occur?
- **a.** as single atoms
- **b.** as molecules containing two atoms
- **c.** as molecules containing three atoms
- **d.** as molecules containing four atoms

7. How many electrons are shared in a double covalent bond?
- **a.** none
- **b.** one
- **c.** two
- **d.** four

8. Bond length is the distance between
- **a.** two molecules of the same substance.
- **b.** the electrons in two attached atoms.
- **c.** the nuclei of two attached atoms.
- **d.** the orbitals of two attached atoms.

9. Which of the following relationships relating to bond length is generally correct?
- **a.** the shorter the bond, the stronger the bond
- **b.** the shorter the bond, the weaker the bond
- **c.** the shorter the bond, the fewer the electrons in it
- **d.** the shorter the bond, the lower the bond dissociation energy

Section 9.2 Naming Molecules

In your textbook, read about how binary compounds and acids are named from their formulas.

For each statement below, write *true* or *false*.

_____ **1.** Binary molecular compounds are generally composed of a metal and a nonmetal.

_____ **2.** The second element in the formula of a binary compound is named using the suffix *-ite*.

_____ **3.** The prefix *tetra-* indicates three atoms.

_____ **4.** The prefix *hexa-* indicates six atoms.

_____ **5.** In naming the first element in a formula, the prefix *mono-* is not used.

_____ **6.** For binary acids, the hydrogen part of the compound is named using the prefix *hydro-*.

_____ **7.** An oxyacid contains only two elements.

_____ **8.** If the name of the anion of an oxyacid ends in *-ate*, the acid name contains the suffix *-ous*.

In your textbook, read about naming molecular compounds and oxyacids.

For each item in Column A, write the letter of the matching item in Column B.

Column A	Column B
_____ **9.** CO	**a.** hydrobromic acid
_____ **10.** CO_2	**b.** dinitrogen tetroxide
_____ **11.** H_2CO_3	**c.** carbon monoxide
_____ **12.** NH_3	**d.** nitrous acid
_____ **13.** N_2O_4	**e.** ammonia
_____ **14.** HNO_2	**f.** nitric acid
_____ **15.** HNO_3	**g.** carbonic acid
_____ **16.** HBr	**h.** bromic acid
_____ **17.** $HBrO_3$	**i.** carbon dioxide

Section 9.3 Molecular Structures

In your textbook, read about Lewis structures.

For each statement below, write *true* or *false*.

_____ **1.** A structural formula shows the arrangement of the atoms in a molecule.

_____ **2.** The central atom in a molecule is the one with the highest electron affinity.

_____ **3.** In molecules, hydrogen is always a terminal atom.

_____ **4.** The number of bonding pairs in a molecule is equal to the number of electrons.

_____ **5.** To find the total number of electrons available for bonding in a positive ion, you should add the ion charge to the total number of valence electrons of the atoms present.

_____ **6.** The electrons in a coordinate covalent bond are donated by both the bonded atoms.

_____ **7.** Resonance occurs when more than one valid Lewis structure can be written for a molecule.

_____ **8.** Nitrate is an example of an ion that forms resonance structures.

_____ **9.** The carbon dioxide molecule contains two double bonds.

_____ **10.** All electrons in an atom are available for bonding.

_____ **11.** In the sulfate ion (SO_4^{2-}), 32 electrons are available for bonding.

_____ **12.** When carbon and oxygen bond, the molecule contains ten pairs of bonding electrons.

In your textbook, read about resonance structures and exceptions to the octet rule.

For each item in Column A, write the letter of the matching item in Column B.

Column A	Column B
_____ **13.** Odd number of valence electrons	**a.** O_3
_____ **14.** Fewer than 8 electrons around an atom	**b.** BF_3
_____ **15.** More than 8 electrons around central atom	**c.** NO
_____ **16.** More than one valid Lewis structure	**d.** SF_6

Section 9.4 Molecular Shape

In your textbook, read about the VSEPR model.

Circle the letter of the choice that best completes the statement.

1. The VSEPR model is used mainly to
- **a.** determine molecular shape.
- **b.** write resonance structures.
- **c.** determine ionic charge.
- **d.** measure intermolecular distances.

2. The bond angle is the angle between
- **a.** the sigma and pi bonds in a double bond.
- **b.** the nucleus and the bonding electrons.
- **c.** two terminal atoms and the central atom.
- **d.** the orbitals of a bonding atom.

3. The VSEPR model is based on the idea that
- **a.** there is always an octet of electrons around an atom in a molecule.
- **b.** electrons are attracted to the nucleus.
- **c.** molecules repel one another.
- **d.** shared and unshared electron pairs repel each other as much as possible.

4. The shape of a molecule whose central atom has four pairs of bonding electrons is
a. tetrahedral. **b.** trigonal planar. **c.** trigonal pyramidal. **d.** linear.

5. The shape of a molecule that has two covalent single bonds and no lone pairs on the central atom is
a. tetrahedral. **b.** trigonal planar. **c.** trigonal pyramidal. **d.** linear.

6. The shape of a molecule that has three single covalent bonds and one lone pair on the central atom is
a. tetrahedral. **b.** trigonal planar. **c.** trigonal pyramidal. **d.** linear.

In your textbook, read about hybridization.

Use each of the terms below just once to complete the passage.

carbon	hybridization	sp^3	identical	methane

The formation of new orbitals from a combination or rearrangement of valence electrons is called **(7)**_____. The orbitals that are produced in this way are **(8)**_____ to one another. An example of an element that commonly undergoes such formation is **(9)**_____. When this atom combines its three p orbitals and its one s orbital, the orbitals that result are called **(10)**_____ orbitals. An example of a molecule that has this type of orbital is **(11)**_____.

Section 9.5 Electronegativity and Polarity

In your textbook, read about electronegativity.

Use the table of electronegativities below to answer the following questions.

Electronegativities of Some Elements

1 H 2.20																
3 Li 0.98	4 Be 1.57											5 B 2.04	6 C 2.55	7 N 3.04	8 O 3.44	9 F 3.98
11 Na 0.93	12 Mg 1.31											13 Al 1.61	14 Si 1.90	15 P 2.19	16 S 2.58	17 Cl 3.16
19 K 0.82	20 Ca 1.00	21 Sc 1.36	22 Ti 1.54	23 V 1.63	24 Cr 1.66	25 Mn 1.55	26 Fe 1.83	27 Co 1.88	28 Ni 1.91	29 Cu 1.90	30 Zn 1.65	31 Ga 1.81	32 Ge 2.01	33 As 2.18	34 Se 2.55	35 Br 2.96
37 Rb 0.82	38 Sr 0.95	39 Y 1.22	40 Zr 1.33	41 Nb 1.6	42 Mo 2.16	43 Tc 2.10	44 Ru 2.2	45 Rh 2.28	46 Pd 2.20	47 Ag 1.93	48 Cd 1.69	49 In 1.78	50 Sn 1.96	51 Sb 2.05	52 Te 2.1	53 I 2.66
55 Cs 0.79	56 Ba 0.89	57 La 1.10	72 Hf 1.3	73 Ta 1.5	74 W 1.7	75 Re 1.9	76 Os 2.2	77 Ir 2.2	78 Pt 2.2	79 Au 2.4	80 Hg 1.9	81 Tl 1.8	82 Pb 1.8	83 Bi 1.9	84 Po 2.0	85 At 2.2
87 Fr 0.7	88 Ra 0.9	89 Ac 1.1														

Metal
Metalloid
Nonmetal

1. What is the meaning of the term *electronegativity*?

_____

2. Which element has the highest electronegativity? What is the numerical value? What are the name and group number of the chemical family that has the highest overall electronegativities?

_____

3. Which element has the lowest electronegativity? What is the numerical value? What are the name and group number of the chemical family that has the lowest overall electronegativities?

_____

4. What general trend in electronegativity do you note going down a group? Across a period?

_____

5. How are the electronegativity values used to determine the type of bond that exists between two atoms?

_____

In your textbook, read about the properties of covalent compounds.

For each statement below, write *true* or *false*.

_____ **6.** Ionic compounds are usually soluble in polar substances.

_____ **7.** In a covalent molecular compound, the attraction between molecules tends to be strong.

Section 9.5 *continued*

In your textbook, read about bond polarity.

Using the table of electronegativities on the preceding page, circle the letter of the choice that best completes the statement or answers the question.

8. Unequal sharing of electrons between two bonded atoms always indicates
- **a.** a nonpolar covalent bond.
- **b.** an ionic bond.
- **c.** a polar covalent bond.
- **d.** a polar molecule.

9. When electronegativities of two bonded atoms differ greatly, the bond is
- **a.** polar covalent.
- **b.** coordinate covalent.
- **c.** polar covalent.
- **d.** ionic.

10. What is the electronegativity difference that usually is the dividing line between covalent and ionic bonds?
- **a.** 1.0
- **b.** 1.7
- **c.** 2.7
- **d.** 4.0

11. The symbol δ^+ is placed next to which of the following?
- **a.** the less electronegative atom in a polar covalent bond
- **b.** the more electronegative atom in a polar covalent bond
- **c.** a positive ion
- **d.** the nucleus

12. A nonpolar covalent bond is one in which
- **a.** electrons are transferred.
- **b.** electrons are shared unequally.
- **c.** electrons are shared equally.
- **d.** both electrons are provided by the same atom.

13. Molecules containing only polar covalent bonds
- **a.** are always polar.
- **b.** may or may not be polar.
- **c.** are always ionic.
- **d.** are always nonpolar.

14. What factor other than electronegativity determines whether a molecule as a whole is polar or not?
- **a.** temperature
- **b.** its geometry
- **c.** its physical state
- **d.** its mass

15. Which of the following correctly describes the compound water, H_2O?
- **a.** ionic
- **b.** nonpolar overall, with polar covalent bonds
- **c.** polar overall, with nonpolar covalent bonds
- **d.** polar overall, with polar covalent bonds

16. Which of the following correctly describes the compound carbon tetrachloride, CCl_4?
- **a.** ionic
- **b.** nonpolar overall, with polar covalent bonds
- **c.** polar overall, with nonpolar covalent bonds
- **d.** polar overall, with polar covalent bonds

17. A molecule of ammonia, NH_3, is
- **a.** nonpolar because it is linear.
- **b.** polar because it is linear.
- **c.** nonpolar because there is no electronegativity difference.
- **d.** polar because there is an electronegativity difference and the molecule is trigonal pyramidal.