

Chemical Bonding

Name _____ Class _____ Date _____

Part I

Select the answer that best completes each statement. Write the letter of each answer in the space provided on the left.

- b 1. Between atoms in a covalent bond, _____
 a. the attractions are weaker than the repulsions
 b. electrons are shared
 c. no electrons are located
 d. the electronegativity difference is 1.7 or greater
- d 2. As two atoms approach each other to bond, _____
 a. electrons are repelled by protons
 b. attractive forces decrease in strength
 c. orbitals merge completely
 d. the potential energy is lowered
- a 3. A dipole occurs when _____
 a. two atoms with an electronegativity difference of between 0.3 and 1.6 bond
 b. electrons are transferred from one atom to another
 c. two atoms of the same electronegativity bond
 d. electrons are shared equally between two atoms
- a 4. In ionic bonding, _____
 a. the electronegativity difference between atoms is 1.7 or greater
 b. electrons are shared equally
 c. protons are transferred
 d. there are no more than two atoms
- b 5. Substances with polar molecules tend to exhibit _____
 a. less attraction than usual between the molecules
 b. higher boiling points than expected
 c. less solubility than expected
 d. lower bond energies than expected
- c 6. Which of the following would not have a molecular dipole?
 a. HCl
 b. H₂O
 c. BeH₂
 d. NH₃
- c 7. The CCl₄ molecule does not behave as a polar molecule because _____
 a. the C-Cl bonds are nonpolar
 b. the C-Cl bonds are ionic
 c. the bond dipoles cancel
 d. the shape of the molecule is linear
- d 8. Which of the following does not describe the growth of crystals?
 a. The potential energy of the system decreases.
 b. Ions form a lattice.
 c. Heat is removed.
 d. Melting temperature decreases.

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- c 9. Van der Waals forces include _____
 a. dipole-dipole forces
 b. London forces
 c. both a and b
 d. neither a nor b
- a 10. Noble gases liquefy because of _____
 a. momentary dipoles
 b. permanent dipoles
 c. hydrogen bonds
 d. ionic attractions
- b 11. Which of the following is the weakest?
 a. covalent bonds
 b. London forces
 c. hydrogen bonds
 d. dipole-dipole forces
- b 12. The valence shell electron pair repulsion theory (VSEPR) would account for the fact that _____
 a. all valence electrons must be involved in the bonding process
 b. the C-H bonds in the CH₄ molecule all have bond angles of 109.5°
 c. the carbon atom has four electrons available for bonding
 d. no two bond angles in the same molecule have equal measure
- c 13. Exceptions to the octet rule arise when _____
 a. a stable molecule possesses a central atom with fewer than eight electrons
 b. a stable molecule possesses a central atom surrounded by more than eight electrons
 c. both a and b
 d. neither a nor b

Part II

Select the answer that best completes each statement or fill in the blank with the correct answer.

- c 14. In which of the following are electrons shared unequally?
 a. H₂
 b. S₈
 c. HCl
 d. Cl₂
- d 15. The electron dot formula for atom X, which has the electron configuration 1s² 2s² 2p⁵, is _____
 a. $\cdot\ddot{X}\cdot$
 b. $\cdot\ddot{X}$
 c. $\cdot\ddot{X}\cdot$
 d. $\cdot\ddot{X}$
- b 16. The correct electron dot formula for C₃H₈ is _____
 a. $\begin{array}{c} \text{H H H} \\ | | | \\ \text{H} \cdot \text{C} \cdot \text{C} \cdot \text{C} \cdot \text{H} \cdot \text{H} \cdot \text{H} \\ | \\ \text{H} \end{array}$
 b. $\begin{array}{c} \text{H H H} \\ | | | \\ \text{H} \cdot \text{C} \cdot \text{C} \cdot \text{C} \cdot \text{H} \\ | | | \\ \text{H H H} \end{array}$
 c. $\begin{array}{c} \text{H} \cdot \text{C} \cdot \text{C} \cdot \text{C} \cdot \text{H} \\ | | | \\ \text{H H H} \end{array}$
 d. $\begin{array}{c} \text{H H} \\ | | \\ \text{H} \cdot \text{C} \cdot \text{C} \cdot \text{C} \cdot \text{H} \\ | | \\ \text{H H} \end{array}$
- c 17. In which of the following is the carbon-carbon bond distance the greatest?
 a. $\begin{array}{c} \text{H H} \\ | | \\ \text{C} \cdot \text{C} \\ | | \\ \text{H H} \end{array}$
 b. $\text{H} \cdot \text{C} \cdot \text{C} \cdot \text{H}$
 c. $\begin{array}{c} \text{H H} \\ | | \\ \text{H} \cdot \text{C} \cdot \text{C} \cdot \text{H} \\ | | \\ \text{H H} \end{array}$
 d. $\begin{array}{c} \text{H H H} \\ | | | \\ \text{C} \cdot \text{C} \cdot \text{C} \\ | | | \\ \text{H H H} \end{array}$

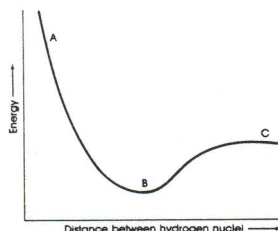
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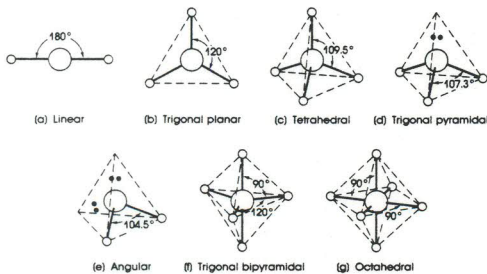
Questions 18 through 20 refer to the graph.

- c 18. For which of the lettered regions (A-C) there are no significant forces between the atoms?
a 19. For which of the lettered regions are repulsive forces stronger than attractive forces?
b 20. For which of the lettered regions are the atoms forming a chemical bond?



For each of the following, choose the letter of the drawing, below, that best represents its shape.

- c 21. NH₄⁺
f 22. AsF₅
e 23. H₂O
a 24. BeH₂
b 25. BF₃
g 26. SF₆
d 27. AsCl₃



28. Indicate whether the bonds in each of the following molecules are ionic (I), polar covalent (P), or nonpolar covalent (C). Electronegativities are given in the chart below.

ELECTRONEGATIVITIES	
Hydrogen 2.1	Sodium 0.9
Boron 2.0	Chlorine 3.0
Carbon 2.5	Calcium 1.0
Oxygen 3.5	Bromine 2.8
Fluorine 4.0	Iodine 2.5

- P a. HBr
I b. CaO
P c. CO₂
P d. CCl₄
C e. I₂
I f. NaBr
C g. B₂H₆

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Part III

Draw electron dot structures for the following compounds.

29. F₂
 $\cdot\ddot{F}\cdot\ddot{F}\cdot$
30. H₂O₂
 $\text{H} \cdot \ddot{\text{O}} \cdot \ddot{\text{O}} \cdot \text{H}$
31. CH₄
 $\begin{array}{c} \text{H} \\ | \\ \text{H} \cdot \text{C} \cdot \text{H} \\ | \\ \text{H} \end{array}$
32. CO
 $\cdot\text{C}::\ddot{\text{O}}\cdot$
33. N₂H₂
 $\text{H} \cdot \text{N} :: \text{N} \cdot \text{H}$
34. SiCl₄
 $\begin{array}{c} \cdot\ddot{\text{Cl}}\cdot \\ | \\ \cdot\ddot{\text{Si}}\cdot \\ | \\ \cdot\ddot{\text{Cl}}\cdot \end{array}$
35. NCl₃
 $\begin{array}{c} \cdot\ddot{\text{Cl}}\cdot \\ | \\ \cdot\ddot{\text{N}}\cdot \\ | \\ \cdot\ddot{\text{Cl}}\cdot \end{array}$

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KEY

11. Silicon compounds usually exhibit bonding which is primarily
 (A) covalent (C) electrovalent
 (B) ionic (D) coordinate
12. Which of the following in its solid phase contains positive ions immersed in a sea of mobile electrons?
 (A) O₂ (C) Cu
 (B) SiO₂ (D) CuO
13. If a pure substance is a good conductor of electricity in both its solid and its liquid phases, then the bonding in the substance is predominantly
 (A) ionic (C) polar covalent
 (B) metallic (D) nonpolar covalent
14. Which compound exhibits bonds having the least ionic character?
 (A) CsCl (C) KF
 (B) RbBr (D) NaI
15. A pure substance melts at 38°C and does not conduct electricity in either the solid or liquid phase. The substance is classified as
 (A) ionic (C) electrovalent
 (B) metallic (D) molecular
16. Which molecule is not a dipole? ← polar molecule
 (A) HBr (B) H₂O (C) NH₃ (D) CCl₄
17. Experiment shows that H₂O is a dipole while CO₂ is not a dipole. The two structures that best illustrate this fact are
 (A) $\begin{array}{c} \text{O}=\text{C}=\text{O} \\ \text{linear} \end{array}$ $\begin{array}{c} \text{H} \\ | \\ \text{O}-\text{H} \\ \text{bent} \end{array}$ (C) $\text{O}=\text{C}=\text{O}$ $\text{H}-\text{O}-\text{H}$
 (B) $\begin{array}{c} \text{O} \\ | \\ \text{C}=\text{O} \end{array}$ $\text{H}-\text{H}-\text{O}$ (D) $\begin{array}{c} \text{O} \\ || \\ \text{C}=\text{O} \end{array}$ $\begin{array}{c} \text{H} \\ | \\ \text{O}-\text{H} \end{array}$
18. Which molecule is a dipole?
 (A) H₂ (B) N₂ (C) CH₄ (D) HF
19. Which molecule is polar?
 (A) $\begin{array}{c} \text{H}-\text{O} \\ | \\ \text{H} \end{array}$ (C) $\text{O}=\text{C}=\text{O}$
 (B) $\text{H}-\text{H}$ (D) $\begin{array}{c} \text{Cl} \\ | \\ \text{Cl}-\text{C}-\text{Cl} \\ | \\ \text{Cl} \end{array}$
20. Which best explains why a methane (CH₄) molecule is nonpolar?
 (A) Each carbon-hydrogen bond is polar.
 (B) Carbon and hydrogen are both nonmetals.
 (C) Methane is an organic compound.
 (D) The methane molecule is symmetrical.

11. A
12. C
13. B
14. D
15. D
16. D
17. A
18. D
19. A
20. D

