

Chemical Bonding

Name _____

Class _____ Date _____

BONDING II / EXAM REVIEW

Part I

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

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

- _____ 9. Van der Waals forces include _____.
- a. dipole-dipole forces
b. London forces
c. both a and b
d. neither a nor b
- _____ 10. Noble gases liquefy because of _____.
- a. momentary dipoles
b. permanent dipoles
c. hydrogen bonds
d. ionic attractions
- _____ 11. Which of the following is the weakest?
- a. covalent bonds
b. London forces
c. hydrogen bonds
d. dipole-dipole forces
- _____ 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
- _____ 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

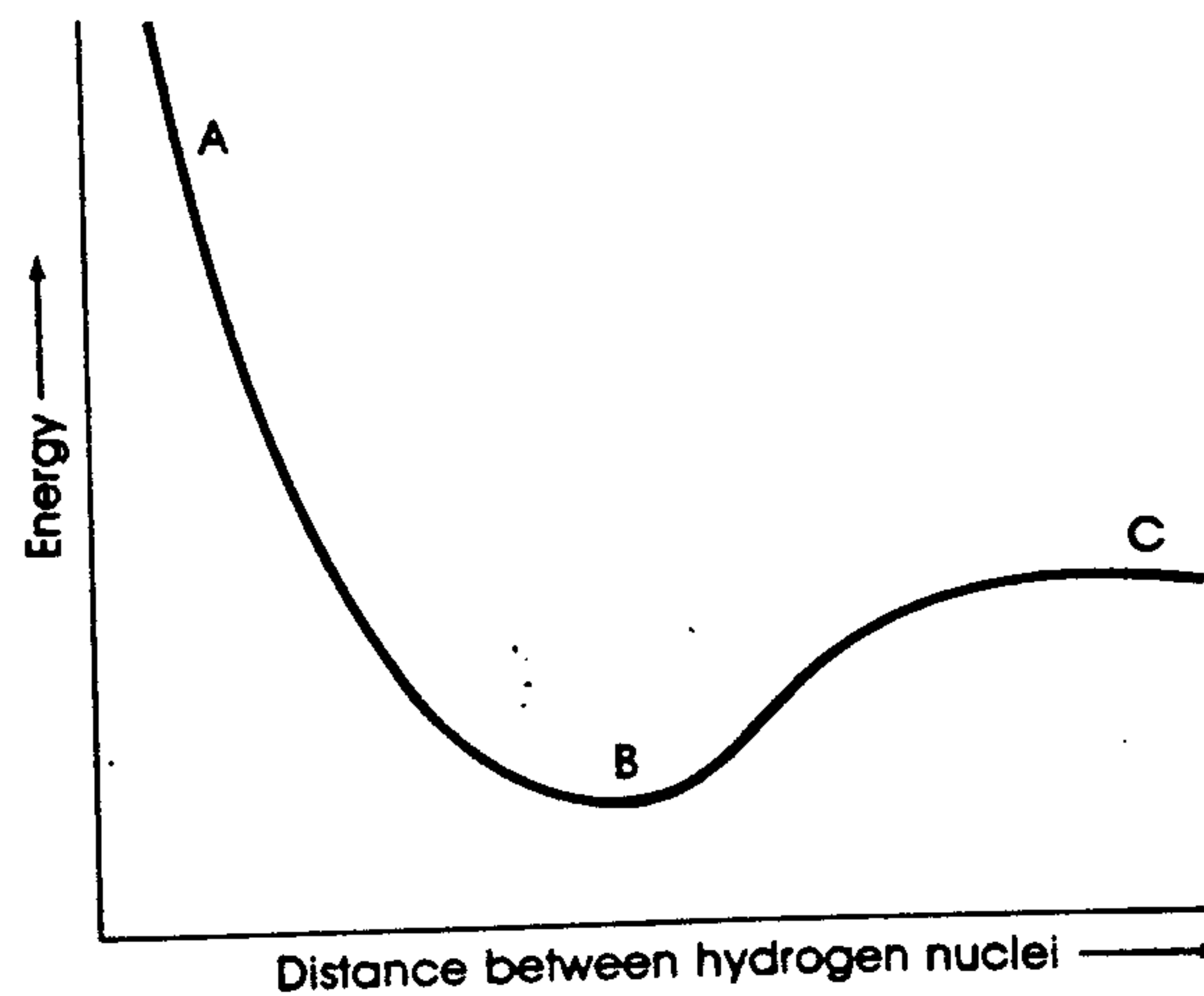
Part II

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

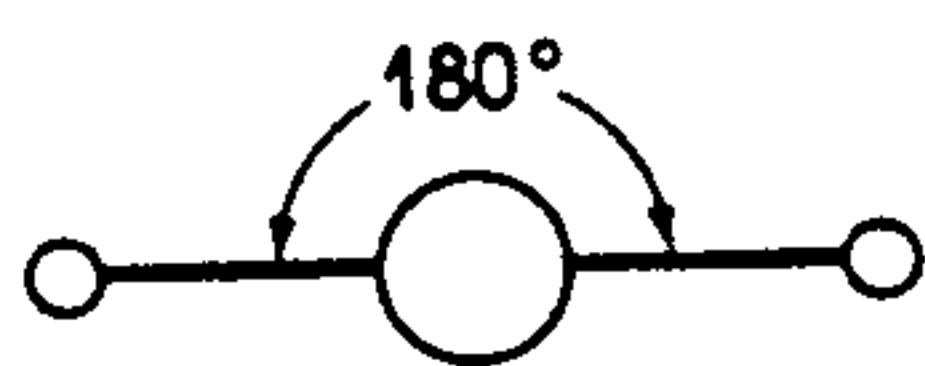
- _____ 14. In which of the following are electrons shared unequally?
- a. H₂
b. S₈
c. HCl
d. Cl₂
- _____ 15. The electron dot formula for atom X, which has the electron configuration 1s² 2s² 2p⁵, is _____.
- a. $\cdot\ddot{X}\cdot$
b. $\cdot\ddot{X}$
c. $\cdot\ddot{X}$
d. $\cdot\ddot{X}$
- _____ 16.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

Questions 18 through 20 refer to the graph.

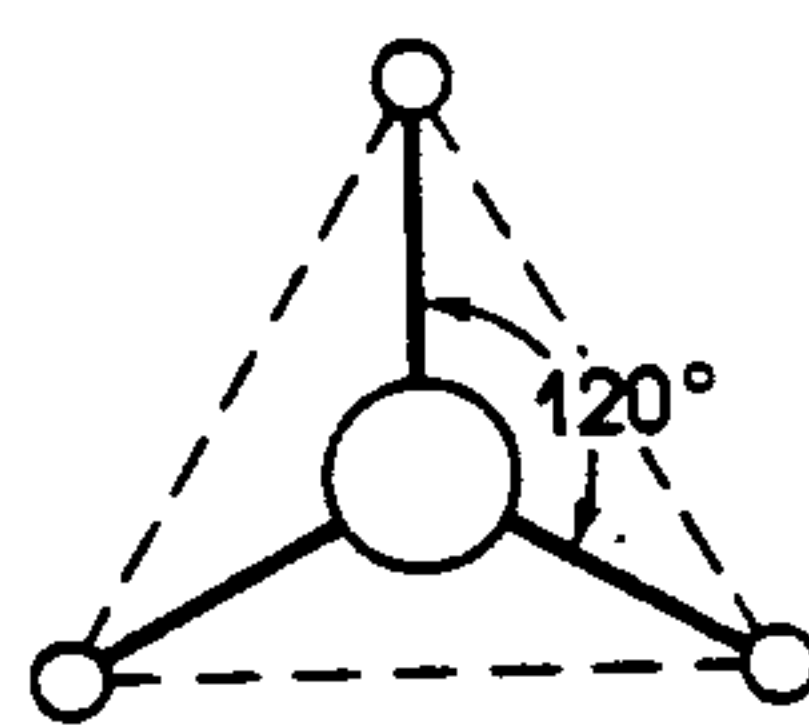
- _____ 18. For which of the lettered regions (A-C) are there no significant forces between the atoms?
- _____ 19. For which of the lettered regions are repulsive forces stronger than attractive forces?
- _____ 20. For which of the lettered regions are the atoms forming a chemical bond?



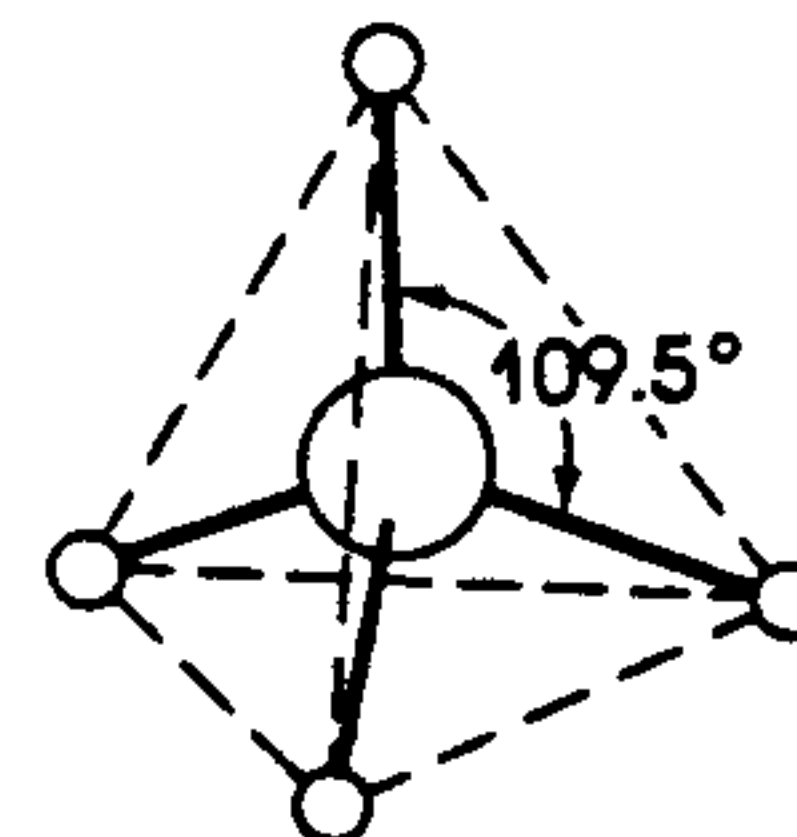
For each of the following, choose the letter of the drawing, below, that best represents its shape.



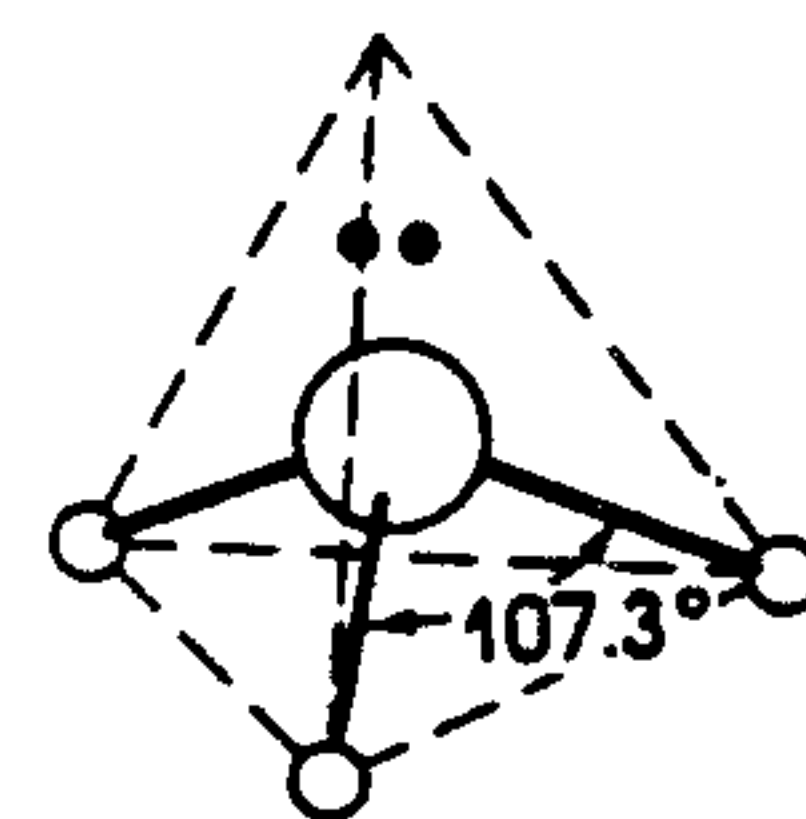
(a) Linear



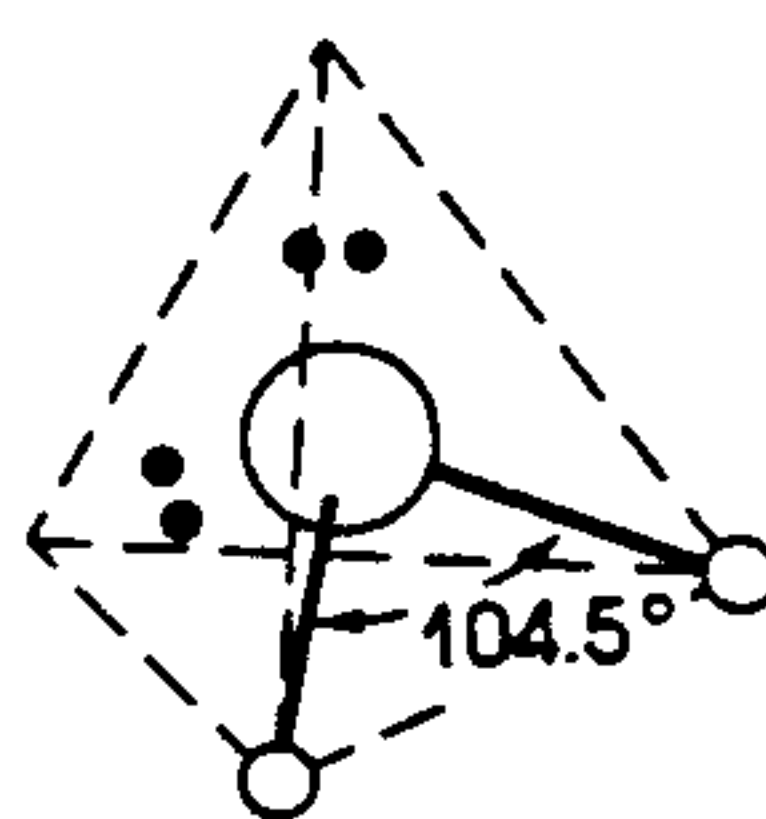
(b) Trigonal planar



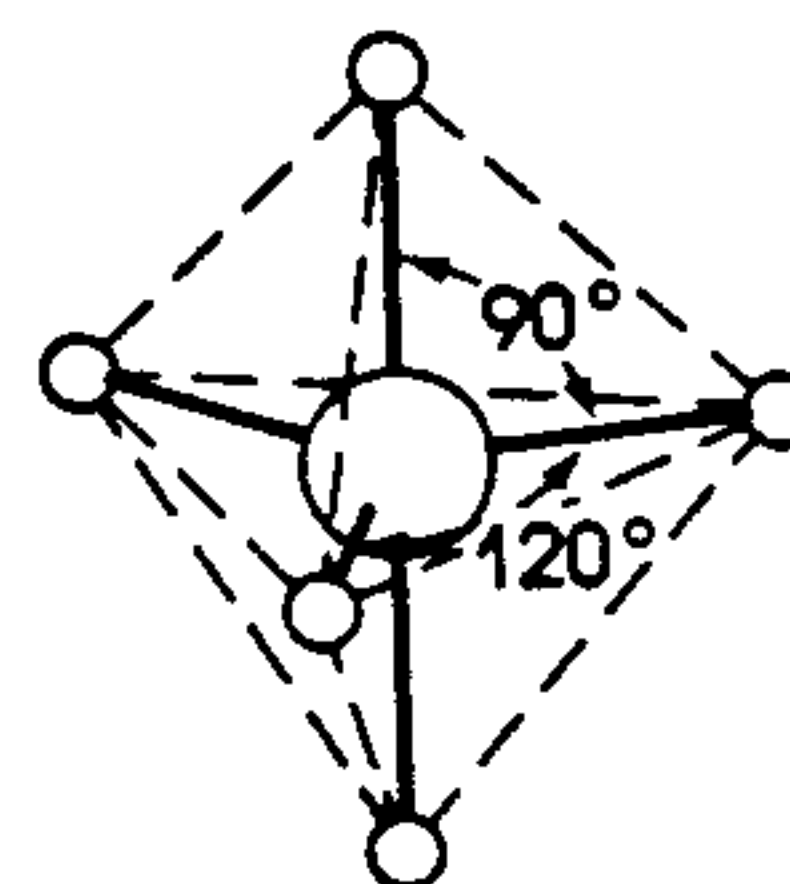
(c) Tetrahedral



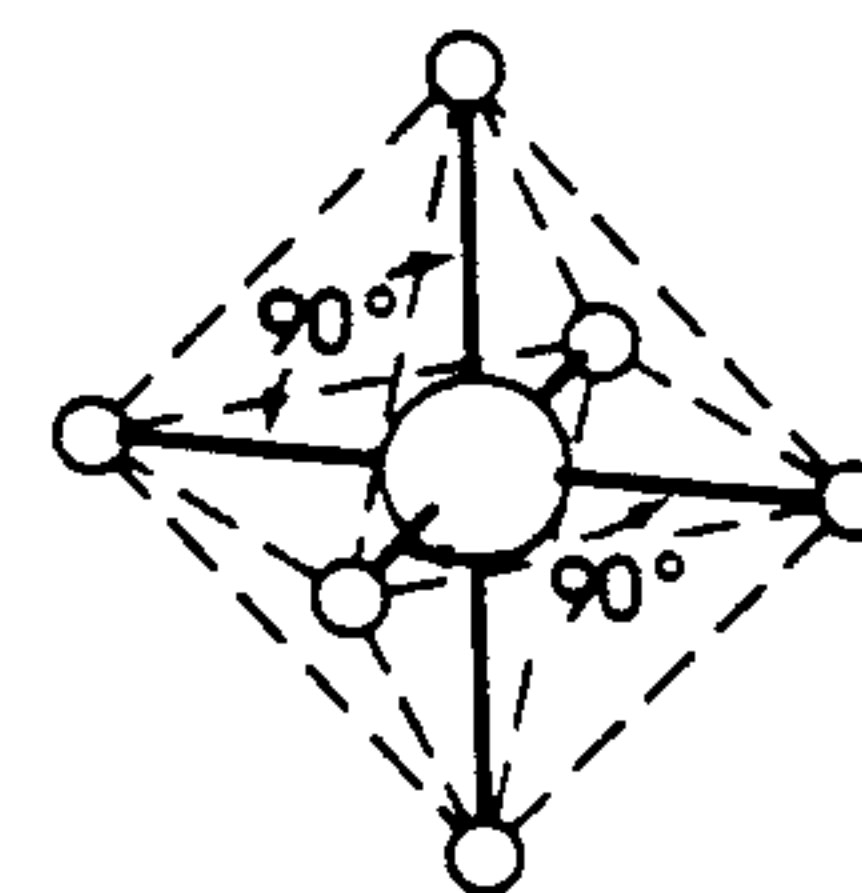
(d) Trigonal pyramidal



(e) Angular



(f) Trigonal bipyramidal



(g) Octahedral

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
Boron 2.0
Carbon 2.5
Oxygen 3.5
Fluorine 4.0

Sodium 0.9
Chlorine 3.0
Calcium 1.0
Bromine 2.8
Iodine 2.5

- _____ a. HBr
- _____ b. CaO
- _____ c. CO_2
- _____ d. CCl_4
- _____ e. I_2
- _____ f. NaBr
- _____ g. B_2H_6

Part III

Draw electron dot structures for the following compounds.

29. F_2

33. N_2H_2

30. H_2O_2

34. $SiCl_4$

31. CH_4

35. NCl_3

32. CO

11. Silicon compounds usually exhibit bonding which is primarily
 (A) covalent (C) electrovalent
 (B) ionic (D) coordinate 11. _____
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 12. _____
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 13. _____
14. Which compound exhibits bonds having the least ionic character?
 (A) CsCl (C) KF
 (B) RbBr (D) NaI 14. _____
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 15. _____
16. Which molecule is not a dipole?
 (A) HBr (B) H₂O (C) NH₃ (D) CCl₄ 16. _____
17. Experiment shows that H₂O is a dipole while CO₂ is not a dipole. The two structures that best illustrate this fact are
 (A) $\text{O}=\text{C}=\text{O}$ $\begin{array}{c} \text{H} \\ | \\ \text{O}-\text{H} \end{array}$ (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) $\begin{array}{c} \text{O} \\ || \\ \text{C}=\text{O} \end{array}$ $\begin{array}{c} \text{H} \\ | \\ \text{O}-\text{H} \end{array}$ 17. _____
18. Which molecule is a dipole?
 (A) H₂ (B) N₂ (C) CH₄ (D) HF 18. _____
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) $\begin{array}{c} \text{Cl} \\ | \\ \text{Cl}-\text{C}-\text{Cl} \\ | \\ \text{Cl} \end{array}$ 19. _____
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. 20. _____

21. Hydrogen bonds are formed between molecules in which hydrogen is covalently bonded to an element whose atomic radius and electronegativity, respectively, are
(A) large and low (C) large and high
(B) small and low (D) small and high 21. _____
22. Multiple covalent bonds exist in a molecule of
(A) F₂ (B) H₂ (C) N₂ (D) Cl₂ 22. _____
23. Which is an example of a nonpolar molecule that contains polar covalent bonds?
(A) CCl₄ (B) N₂ (C) H₂O (D) NH₃ 23. _____
24. As the distance between molecules decreases, the effect of the van der Waals forces between the molecules
(A) decreases (B) increases (C) remains the same 24. _____
25. Which molecule is nonpolar?
(A) H₂O (B) HF (C) NF₃ (D) CF₄ 25. _____
26. Which reaction would require the greatest amount of energy?
(A) Na + energy → Na⁺ + e⁻
(B) Mg + energy → Mg⁺ + e⁻
(C) Al + energy → Al⁺ + e⁻
(D) Si + energy → Si⁺ + e⁻ 26. _____
27. In which noble gas are the van der Waals forces the greatest?
(A) Ne (B) Ar (C) Kr (D) Xe 27. _____
28. What is the nature of the bond in ICl?
(A) ionic (C) polar covalent
(B) nonpolar (D) coordinate covalent 28. _____
29. The attraction that nonpolar molecules have for each other is primarily caused by
(A) hydrogen bonding
(B) high ionization
(C) electronegativity differences
(D) van der Waals forces 29. _____
30. Xenon has a higher boiling point than neon because xenon has
(A) smaller molecules
(B) weaker van der Waals forces
(C) a smaller molecular mass
(D) more electrons per atom 30. _____
31. The major attractive force between polar molecules is usually
(A) dipole attraction (C) hydrogen bonding
(B) electrostatic bonding (D) van der Waals forces 31. _____
32. Which type of bonding accounts for the high boiling point of H₂O as compared with the relatively low boiling point of H₂S?
(A) van der Waals forces (C) covalent bonds
(B) hydrogen bonds (D) electrovalent bonds 32. _____

Self Test 4-C

Bonding II - TEST REVIEW

From the list A-F below, select the bond or attractive force that is most closely associated with each of the following phrases, and write its letter in the space at the right.

- (A) ionic bonds (C) coordinate covalent bonds (E) van der Waals forces
(B) hydrogen bonds (D) metallic bonds (F) covalent bonds

1. Hold the iodine atoms together in a molecule of I₂. 1. _____
2. Hold the many molecules of I₂ together in a crystal of iodine. 2. _____
3. Account for the relatively high boiling and freezing points of pure water. 3. _____
4. Are illustrated by the compounds formed when fluorine reacts with active metals. 4. _____
5. Hold magnesium atoms in a crystal lattice. 5. _____
6. Mobile electrons in the crystal that permit electrical conductivity in the solid state. 6. _____
7. Responsible for the extremely high melting point of diamond (above 3500°C). 7. _____
8. Permit helium and hydrogen to exist in liquid or solid phases under conditions of low temperature and high pressure. 8. _____
9. Link water molecules to neighboring water molecules. 9. _____
10. Produce substances that are nonconductors in the solid phase and conductors in the liquid phase. 10. _____
11. Are weak enough to permit solid iodine to sublime readily upon heating. 11. _____
12. Cause the boiling point of hydrogen fluoride to be much higher than that of hydrogen chloride, hydrogen bromide, or hydrogen iodide. 12. _____
13. Link the atoms within a molecule of a diatomic gaseous element. 13. _____
14. Bond noble gas atoms in the liquid phase. 14. _____
15. Account for the attraction between gas molecules in a nonideal gas. 15. _____
16. Responsible for the formation of ice crystals. 16. _____

Select the best answer and write its letter in the space at the right.

17. Among the following, the compound that has the highest degree of ionic bonding is
(A) CCl₄ (B) MgCl₂ (C) H₂O (D) CO₂ 17. _____
18. A compound that has polar molecules is
(A) CCl₄ (B) MgCl₂ (C) H₂O (D) CO₂ 18. _____
19. When compared to hydrogen chloride (HCl), hydrogen fluoride (HF) has an unusually high boiling point. This is due to the magnitude of the
(A) hydrogen bonds (C) van der Waals forces
(B) coordinate covalent bonds (D) nonpolar covalent bonds 19. _____

