

Unit 2 – Chapters 8, 9

Name \_\_\_\_\_

Exercises

Period \_\_\_\_\_

1) What geometry do the following hybrid bonds possess?

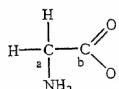
- |              |            |
|--------------|------------|
| a. sp        | c. $sp^3$  |
| b. $sp^2$    | d. $sp^3d$ |
| e. $sp^3d^2$ |            |

2) Predict the geometries of the following compounds:

- |           |            |
|-----------|------------|
| a. $SF_2$ | c. $XeF_2$ |
| b. $SF_4$ | d. $XeF_4$ |
| e. $IF_5$ | f. $ClF_3$ |

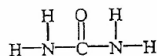
3) Predict the geometry about the indicated atom and identify the hybridization of each atom

a. the two carbon atoms and the nitrogen atom of glycine



- b. the carbon atom in  $CF_2Cl_2$   
 c. the phosphorous atom in  $PCl_5$   
 d. the nitrogen atom in  $NH_2^-$

4) The structure of urea is



- a. How many  $\sigma$  bonds are there?  
 b. How many  $\pi$  bonds are there?  
 c. What is the hybridization at the carbon?  
 d. How are the nitrogen atoms hybridized?  
 e. What is the N-C-N bond angle expected to be?  
 f. How many lone pairs of electrons are there?

\_\_\_\_\_ 5. What hybridization describes square planar geometry?

- |           |            |
|-----------|------------|
| a. $sp^3$ | c. $sp^2d$ |
| b. $spd$  | d. $sp^2$  |

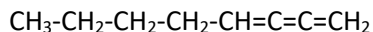
\_\_\_\_\_ 6. Formaldehyde is used as a preservative. In the presence of air, formaldehyde is oxidized to formic acid,  $HCOOH$ . What hybridization does the carbon atom have in formic acid?

- |           |          |
|-----------|----------|
| a. $sp^2$ | c. sp    |
| b. $sp^3$ | d. $spd$ |

\_\_\_\_\_ 7. Phosphorous pentachloride is produced upon reaction of phosphorous trichloride with chlorine. What hybridization is present in the phosphorus atom of  $\text{PCl}_3$  and  $\text{PCl}_5$  molecules, respectively?

- a.  $\text{sp}^3$ ,  $\text{sp}^3\text{d}^2$
- b.  $\text{sp}^3$ ,  $\text{sp}^3\text{d}$
- c.  $\text{sp}^3$ ,  $\text{sp}^3\text{d}^2$
- d.  $\text{sp}^3\text{d}^2$ ,  $\text{sp}^3\text{d}$

\_\_\_\_\_ 8. How many  $\sigma$ , and how many  $\pi$  bonds, respectively, are there in the following molecule:



(Remember that carbon needs to have four bonds to be satisfied.)

- a. 19, 3
- b. 16, 7
- c. 16, 3
- d. 20, 4

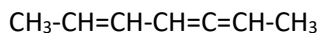
\_\_\_\_\_ 9. The following molecule  $\text{CH}_3\text{CH}_2\text{CHO}$ , is reduced to  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ . What orbital is most probably used in the reduction process?

- a.  $\pi$  orbital of one of the  $\text{sp}^3$  carbons
- b.  $\sigma$  orbital of one of the  $\text{sp}^2$  carbons
- c.  $\sigma$  orbital of one of the  $\text{sp}^3$  carbons
- d.  $\pi$  orbital of the  $\text{sp}^2$  carbons

\_\_\_\_\_ 10. What is the hybridization of phosphorus in  $\text{PCl}_6^-$ ?

- a.  $\text{d}^2\text{sp}^3$
- b.  $\text{dsp}^3$
- c.  $\text{sp}^3$
- d.  $\text{sp}^2$

\_\_\_\_\_ 11. How many  $\pi$  bonds are in the following molecule?



- a. 4
- b. 3
- c. 0
- d. 1

\_\_\_\_\_ 12. The bond in  $\text{RbF}$  is:

- a. Covalent
- b. Polar covalent
- c. Molecular
- d. Ionic

\_\_\_\_\_ 13. Which of the following bonds do you expect to be polar covalent?

- a. H-N
- b. H-H
- c. Cs-F
- d. H-O

\_\_\_\_\_ 14. In a polar bond, electrons:

- a. spend equal time around both nuclei
- b. are localized between both nuclei
- c. spend more time around the bigger nucleus
- d. spend more time around one of the nuclei than the other one

\_\_\_\_\_ 15. What is the electronegativity difference between At and H?

- a. 0.1
- b. -0.1
- c. 4.3
- d. 0.0



- \_\_\_\_\_ 25. Select the crystal that would have the largest lattice energy. Assume that the internuclear distance is the same in all these crystals.
- a. NaCl
  - b. KCl
  - c.  $K_2S$
  - d. CaO
- \_\_\_\_\_ 26. Chemical bonds between two atoms result because:
- a. The atoms can thus achieve a state of higher energy
  - b. The atoms can thus achieve a state of lower energy
  - c. The atoms fit together nicely
  - d. The atoms can react better when bonded
- \_\_\_\_\_ 27. Two bonded atoms:
- a. React more readily with other substances.
  - b. Are less reactive compared to when free.
  - c. Share all their electrons.
  - d. Behave in unpredictable ways.
- \_\_\_\_\_ 28. The reaction of hydrogen with fluorine gas is highly exothermic (releases a high degree of energy). Calculate the F-F bond energy knowing that: H-H = 432 kJ/mol, H-F = 565 kJ/mol, and  $\Delta H = -543$  kJ.
- a. 155 kJ/mol
  - b. 543 kJ/mol
  - c. 698 kJ/mol
  - d. 1019 kJ/mol
- \_\_\_\_\_ 29. A truck uses propane ( $C_3H_8$ ) to power its engine. Calculate how much heat will be released when 5 moles of propane are burned, knowing that the reaction of propane with oxygen gas produces carbon dioxide and water.
- a. 7330 kJ
  - b. 75 kJ
  - c. 10,000 kJ
  - d. 4784 kJ
- \_\_\_\_\_ 30. Chlorine trifluoride is prepared by reacting chlorine gas with fluorine gas. The heat of the reaction is -803 kJ/mol of chlorine reacted. Calculate the Cl-Cl bond energy.
- a. 1091 kJ/mol
  - b. 155 kJ/mol
  - c. 238 kJ/mol
  - d. 50 kJ/mol
- \_\_\_\_\_ 31. How many valence electrons does selenium have?
- a. 6
  - b. 4
  - c. 3
  - d. 5
- \_\_\_\_\_ 32. How many of the 6 valence electrons in sulfur are used in covalent bonding in sulfur tetrachloride and disulfur difluoride?
- a. 4 and 2
  - b. 3 and 2
  - c. 6 and 1
  - d. 2 and 2

- \_\_\_\_\_ 33. How many of the 6 valence electrons in oxygen are usually used in covalent bonding?
- a. 4
  - b. 3
  - c. 6
  - d. 2
- \_\_\_\_\_ 34. In the  $\text{POCl}_3$  molecule, how many double bonds are there? How about single bonds?
- a. 1 and 3
  - b. 4 and 1
  - c. 2 and 1
  - d. 1 and 2
- \_\_\_\_\_ 35. Which one of the following molecules possesses a triple bond?
- a.  $\text{SF}_4$
  - b.  $\text{PCl}_5$
  - c.  $\text{C}_2\text{H}_2$
  - d.  $\text{C}_2\text{H}_6$
- \_\_\_\_\_ 36. Which one of the following molecules does not possess a double bond?
- a.  $\text{C}_2\text{F}_4$
  - b.  $\text{C}_2\text{H}_4\text{F}_2$
  - c.  $\text{OCH}_2$
  - d.  $\text{HOCOCl}$
- \_\_\_\_\_ 37. Which one of the following molecules contains a central atom that violates the octet rule?
- a.  $\text{SF}_4$
  - b.  $\text{COF}_2$
  - c.  $\text{Si}(\text{OH})_4$
  - d.  $\text{PBr}_3$
- \_\_\_\_\_ 38. Calculate the formal charge on chlorine in  $\text{ClO}_4^-$
- a. 1-
  - b. 3+
  - c. 6+
  - d. 4+