

Unit 2 – Chapters 8,9: Bonding & Hybridization

Name _____

Exercises

Period _____

1) What geometry do the following hybrid bonds possess?

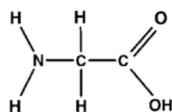
- | | |
|--------------|------------|
| a. sp | c. sp^3 |
| b. sp^2 | d. sp^3d |
| e. sp^3d^2 | |

2) Predict the geometries of the following compounds:

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

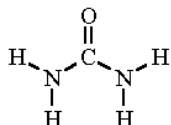
3) Predict the geometry about the indicated atom and identify the hybridization of each atom

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 σ bonds are there?
b. How many π 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?

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

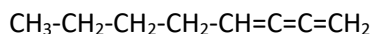
_____ 6. Formaldehyde is used as a preservative. In the presence of air, formaldehyde is oxidized to formic acid, $HCOOH$. What hybridization does the carbon atom have in formic acid?

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|-----------|----------|
| 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 PCl_3 and PCl_5 molecules, respectively?

- a. sp^2 , sp^3d^2
- b. sp^3 , sp^3d
- c. sp^3 , sp^3d^2
- d. sp^3d^2 , sp^3d

_____ 8. How many σ , and how many π 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

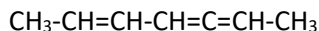
_____ 9. The following molecule $\text{CH}_3\text{CH}_2\text{CHO}$, is reduced to $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$. What orbital is most probably used in the reduction process?

- a. π orbital of one of the sp^3 carbons
- b. σ orbital of one of the sp^2 carbons
- c. σ orbital of one of the sp^3 carbons
- d. π orbital of the sp^2 carbons

_____ 10. What is the hybridization of phosphorus in PCl_6^- ?

- a. d^2sp^3
- b. dsp^3
- c. sp^3
- d. sp^2

_____ 11. How many π bonds are in the following molecule?



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

_____ 12. The bond in 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

_____ 16. Which of the following bonds is the most polar one?

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| a. H-O | c. N-O |
| b. Cs-Cl | d. C-H |

_____ 17. Order the following bonds in order of increasing bond polarity:

H-F, Se-Cl, C-O, C-At

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|-----------------------|-----------------------|
| a. C-At<Se-Cl<C-O<H-F | c. H-F<C-O<Se-Cl<C-At |
| b. C-O<Se-Cl<H-F<C-At | d. C-At<C-O<Se-Cl<H-F |

_____ 18. Order the following bonds in order of decreasing bond polarity (**Use 2.0 for boron, not 1.5**):

Ca-O, Ca-Cl, P-Cl, Fe-O, B-O, N-O

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|---------------------------------|---------------------------------|
| a. N-O>P-Cl>B-O>Fe-O>Ca-Cl>Ca-O | c. Ca-O>Ca-Cl>Fe-O>B-O>P-Cl>N-O |
| b. Ca-Cl>P-Cl>Ca-O>Fe-O>B-O>N-O | d. Fe-O>Ca-O>B-O>N-O>Ca-Cl>P-Cl |

_____ 19. Which of the following molecules would exhibit the greatest polarity? All molecules are tetrahedral in shape.

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| a. CHCl ₃ | c. CCl ₄ |
| b. CH ₄ | d. CH ₃ Cl |

_____ 20. Which of the following molecules has a dipole moment equal to 0?

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|-----------------------------------|---|
| a. SiO ₄ (tetrahedral) | c. C ₂ H ₂ F ₂ (tetrahedral) |
| b. H ₂ O (bent) | d. CBrCl ₂ F |

_____ 21. Which ion could the following electron configuration describe? $1s^2 2s^2 2p^6 3s^2 3p^4$

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|--------------------|---------------------|
| a. K ⁺ | c. S ²⁻ |
| b. Cl ⁺ | d. Ca ²⁺ |

_____ 22. Which of the following ions does not have the following configuration? $1s^2 2s^2 2p^6 3s^2 3p^4$

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|---------------------|---------------------|
| a. V ⁺ | c. Mn ²⁺ |
| b. Nb ³⁺ | d. all of them |

_____ 23. Place the following species in order of increasing size: Ne, B³⁺, O²⁻, and Be²⁺

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| a. B ³⁺ <Be ²⁺ <Ne<O ²⁻ | c. O ²⁻ <Ne<Be ²⁺ <B ³⁺ |
| b. Ne<B ³⁺ <Be ²⁺ <O ²⁻ | d. Ne<O ²⁻ <B ³⁺ <Be ²⁺ |

_____ 24. Determine the formula for the following sets of atoms when they combine to form binary compounds: Cs and F, Al and O, B and F, Ag and Cl

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|---|--|
| a. Cs ₂ F, Al ₂ O ₃ , BF, AgCl | c. CsF ₂ , AlO, B ₃ F, AgCl ₂ |
| b. CsF, Al ₂ O ₃ , BF ₃ , AgCl | d. Cs ₂ F ₂ , Al ₃ O ₅ , B ₂ F ₂ , Ag ₂ Cl 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 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. SF_4
 - b. PCl_5
 - c. C_2H_2
 - d. C_2H_6
- _____ 36. Which one of the following molecules does not possess a double bond?
- a. C_2F_4
 - b. $\text{C}_2\text{H}_4\text{F}_2$
 - c. OCH_2
 - d. HOCOCI
- _____ 37. Which one of the following molecules contains a central atom that violates the octet rule?
- a. SF_4
 - b. COF_2
 - c. $\text{Si}(\text{OH})_4$
 - d. PBr_3
- _____ 38. Calculate the formal charge on chlorine in ClO_4^-
- a. 1-
 - b. 3+
 - c. 6+
 - d. 4+