Chapter 1--Structure and Bonding: Acids and Bases

Student: _____

1. Give the ground-state electron configuration for carbon (atomic number 6).

2. Give the ground-state electron configuration for nitrogen (atomic number 7).

3. Give the ground-state electron configuration for potassium (atomic number 19).

4. How many electrons does potassium have in its valence shell?

5. **Narrative 1-1**
Write valid Lewis (electron-dot) structures for each formula below. Show all electrons as dots and show all non-bonding electrons.

Refer to Narrative 1-1. C_2Cl_4 tetrachloroethylene

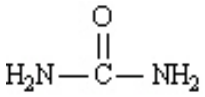
6. **Narrative 1-1**
Write valid Lewis (electron-dot) structures for each formula below. Show all electrons as dots and show all non-bonding electrons.

Refer to Narrative 1-1. CO_2 carbon dioxide

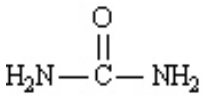
7. **Narrative 1-1**
Write valid Lewis (electron-dot) structures for each formula below. Show all electrons as dots and show all non-bonding electrons.

Refer to Narrative 1-1. CH_5N methylamine

8. The structure of urea is shown below. Fill in any non-bonding valence electrons that are missing from the line-bond structure.

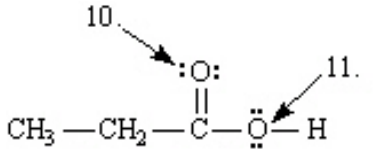


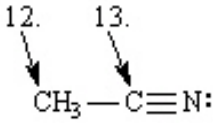
9. The structure of urea is shown below. The carbon atom in urea is:



a. sp^3 hybridized
b. sp^2 hybridized
c. *sp* hybridized
d. not hybridized

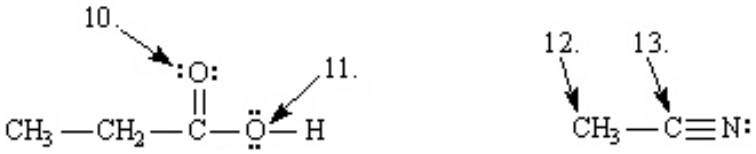
10. **Narrative 1-2**
Determine the hybridization for the indicated atoms in each structure below.





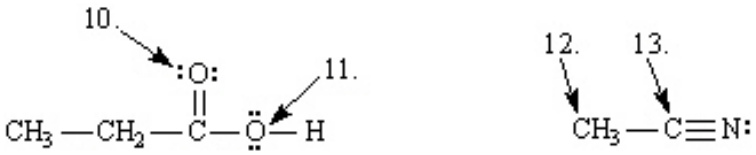
Refer to Narrative 1-2. The hybridization of this oxygen atom is _____.

11. **Narrative 1-2**
Determine the hybridization for the indicated atoms in each structure below.



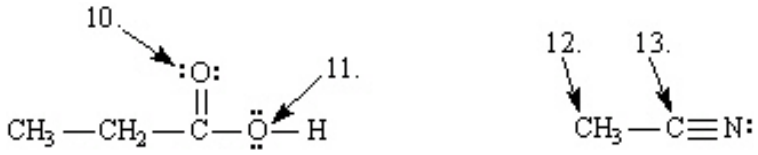
The hybridization of this oxygen atom is _____.

12. **Narrative 1-2**
Determine the hybridization for the indicated atoms in each structure below.



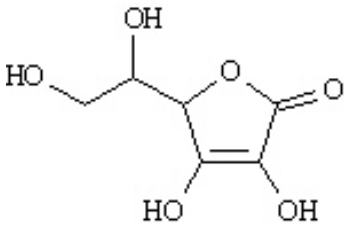
The hybridization of this carbon atom is _____.

13. **Narrative 1-2**
Determine the hybridization for the indicated atoms in each structure below.



The hybridization of this carbon atom is _____.

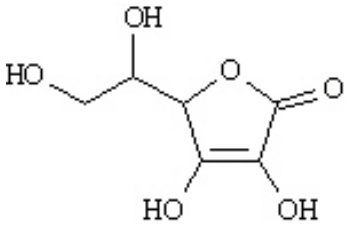
14. **Narrative 1-3**
Consider the structure of Vitamin C to answer the following questions.



Vitamin C

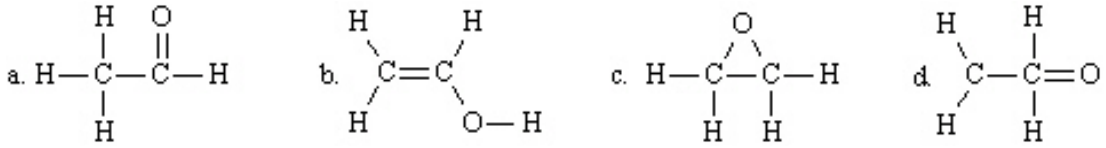
Refer to Narrative 1-3. Complete the Lewis electron-dot structure of Vitamin C, showing all lone-pair electrons.

15. **Narrative 1-3**
Consider the structure of Vitamin C to answer the following questions.

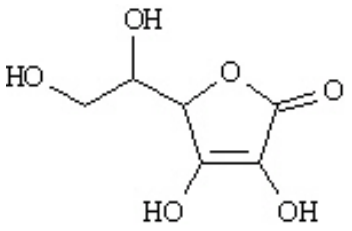


Vitamin C

Refer to Narrative 1-3. The molecular formula C_2H_4O can be converted into three-line bond (Kekulé) structures that are consistent with valence rules. Which one of the following Kekulé structures is ***not*** consistent with valence rules?



16. **Narrative 1-3**
Consider the structure of Vitamin C to answer the following questions.



Vitamin C

Refer to Narrative 1-3. Explain why the structure you chose in question **15.** is not consistent with valence rules.

17. Draw an orbital picture for acetylene, C_2H_2. Clearly label each bond type and indicate the type of orbitals involved in each bond.

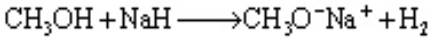
18. Propose a structure for a molecule that meets the following description.

    Contains two sp^3 hybridized carbons and two *sp* hybridized carbons.

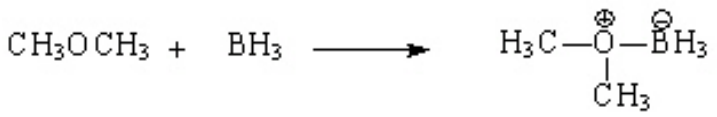
19. Propose a structure for a molecule that meets the following description.

    Contains one sp^3 hybridized carbon and two sp^2 hybridized carbons.

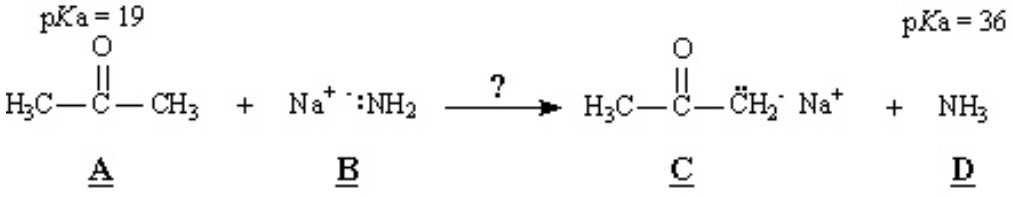
20. Label the acid and base in the reaction below.



21. Label the acid and base in the reaction below.

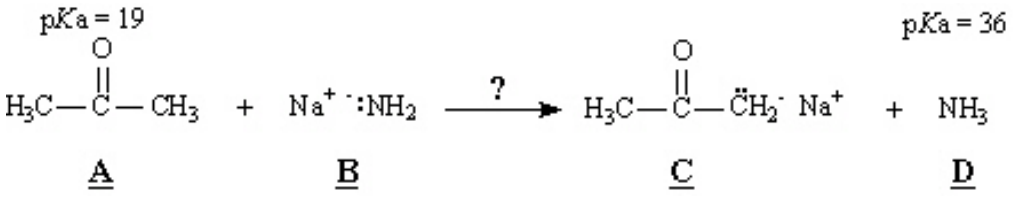


22. **Narrative 1-4**
Refer to the following equation to answer the questions below. Place the letter corresponding to the correct answer in the blank.



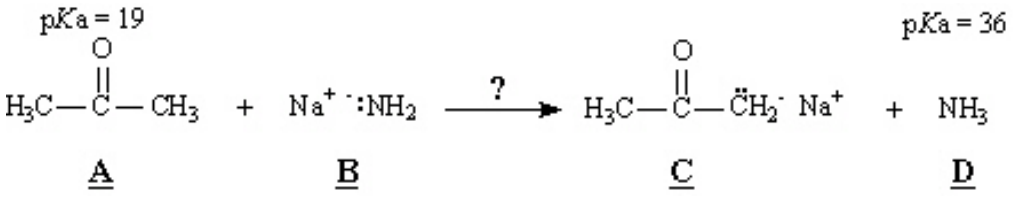
Refer to Narrative 1-4. The strongest Brønsted-Lowry acid in the equation is _____.

23. **Narrative 1-4**
Refer to the following equation to answer the questions below. Place the letter corresponding to the correct answer in the blank.



Refer to Narrative 1-4. The strongest Brønsted-Lowry base in the equation is _____.

24. **Narrative 1-4**
Refer to the following equation to answer the questions below. Place the letter corresponding to the correct answer in the blank.



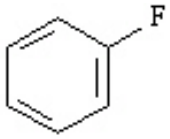
Refer to Narrative 1-4. The equilibrium for this reaction:

a. favors the reactants.
b. is approximately 1.
c. favors the products.
d. cannot be predicted.

25. An acid with a low pK_a:

a. is a weak acid
b. is a strong acid
c. has a weak conjugate base
d. both b and c

26. **Narrative 1-5**
Use the d-/d+ convention and the crossed arrow $(\overset{+}{\longrightarrow})$ to show the direction of the expected polarity of the indicated bonds in the following compounds.

Refer to Narrative 1-5. The C-F bond in fluorobenzene, 

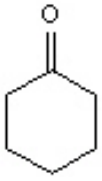
27. **Narrative 1-5**
Use the d-/d+ convention and the crossed arrow $(\overset{+}{\longrightarrow})$ to show the direction of the expected polarity of the indicated bonds in the following compounds.

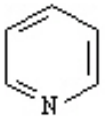
Refer to Narrative 1-5. The C-Si bond in tetramethylsilane, $(CH_3)_4Si$

28. **Narrative 1-5**
Use the d-/d+ convention and the crossed arrow $(\overset{+}{\longrightarrow})$ to show the direction of the expected polarity of the indicated bonds in the following compounds.

Refer to Narrative 1-5. The C-O bond in furan, 

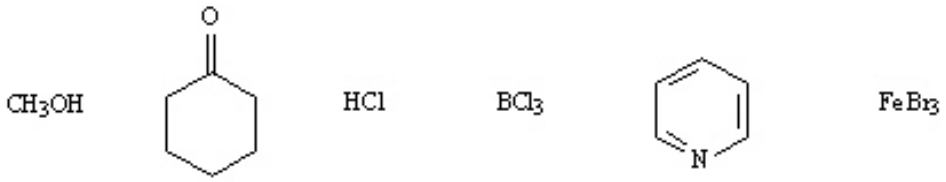
29. Circle all the Lewis bases in the group of compounds below.

CH_3OH 

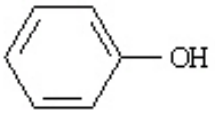
HCl BCl_3 

$FeBr_3$

30. Put a box around all the Lewis acids in the group of compounds below.

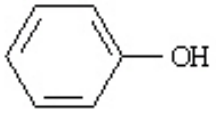


31. **Narrative 1-6**
Consider the acidity constants below to answer the questions.

ACID	STRUCTURE	pK_a
phenol		10.00
ethanol	CH_3CH_2OH	16.00
water	HOH	15.74

Refer to Narrative 1-6. Which acid above will be almost completely deprotonated by NaOH?

32. **Narrative 1-6**
Consider the acidity constants below to answer the questions.

ACID	STRUCTURE	pK_a
phenol		10.00
ethanol	CH_3CH_2OH	16.00
water	HOH	15.74

Refer to Narrative 1-6. Which acid has the *strongest* conjugate base?

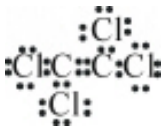
Chapter 1--Structure and Bonding: Acids and Bases Key

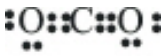
1. $1s^2 2s^2 2p_x 2p_y$ or $1s^2 2s^2 2p^2$

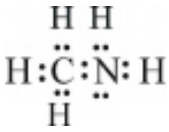
2. $1s^2 2s^2 2p_x 2p_y 2p_z$ or $1s^2 2s^2 2p^3$

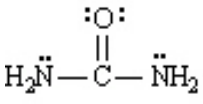
3. $1s^2 2s^2 2p^6 3s^2 3p^6 4s^1$

4. one

5. 

6. 

7. 

8. 

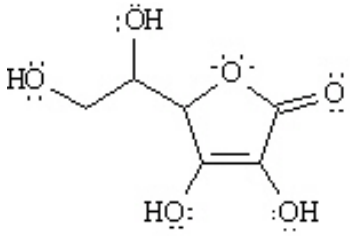
9. b. sp^2 hybridized

10. sp^2

11. sp^3

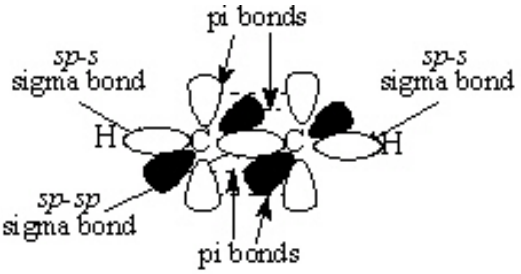
12. sp^3

13. *sp*

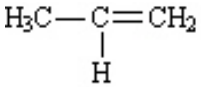
14. 
Vitamin C

15. d

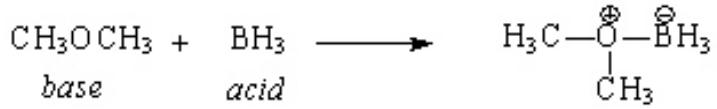
16. The carbon bonded to the oxygen atom in structure d is pentavalent; it has 10 valence electrons. Carbon can only have eight valence electrons. In addition, the other carbon has only six valence electrons when it would prefer to have eight.

17. 

18. $H_3C—C\equiv C—CH_3$

19. 

20. $CH_3OH + NaH \longrightarrow CH_3O^-Na^+ + H_2$
acid base conjugate base conjugate acid

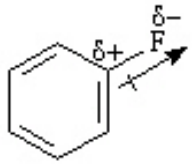
21. 

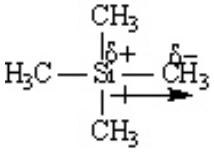
22. **A**

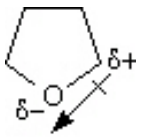
23. **B**

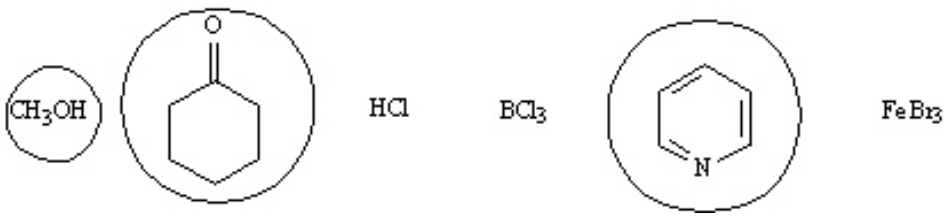
24. C

25. D

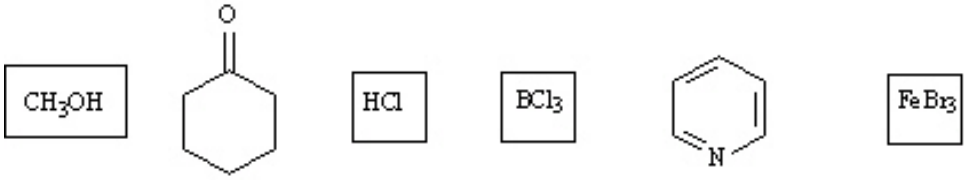
26. 

27. 

28. 

29. 

30.



31. phenol

32. Ethanol is the weakest acid (largest pK_a) so its conjugate base, ethoxide, $CH_3CH_2O^-$, will be the strongest base.