

1. Consider the F atom in its ground state.

a. How many s orbitals are doubly occupied? \_\_\_\_

b. How many p orbitals are doubly occupied? \_\_\_\_

2. Consider  $\text{H}_3\text{C}-\underset{\text{H}}{\text{C}}=\underset{\text{H}}{\text{C}}-\text{C}\equiv\text{N}$  (geometry deliberately incorrect)

a. Indicate the hybridization at all C and N atoms.

b. Indicate the area of the molecule that is linear.

3. Consider  $\text{H}_3\text{C}-\overset{\text{O}}{\parallel}\text{C}-\underset{\text{CH}_3}{\text{N}}-\overset{\text{H}_2}{\text{C}}-\text{C}\equiv\text{C}-\text{CH}_3$  (again incorrect geometry)

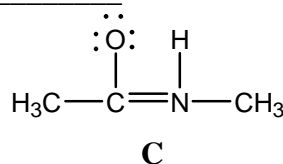
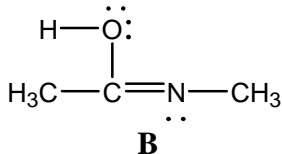
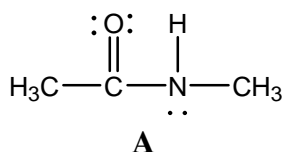
a. How many electrons are in nonbonding orbitals? \_\_\_\_

b. How many electrons are in the  $\pi$  bonds of the molecule? \_\_\_\_

c. What is the number of  $\pi$  bonds? \_\_\_\_

d. How many double bonds are present? \_\_\_\_

4. a. Which of the following are related by resonance? \_\_\_\_\_



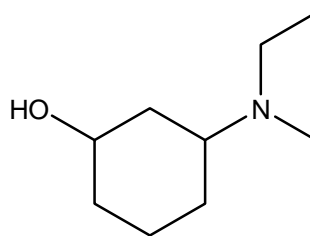
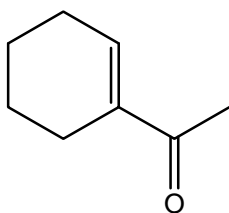
b. Select those that are related by resonance and indicate the resonance phenomenon by curved arrows.

c. Also show formal charges where present.

5. Give bond-line and molecular formulas for a. an ether, b. an ester and c. a ketone; each containing 4 carbon atoms.

6. Show two isomeric aldehydes with the formula  $\text{C}_4\text{H}_8\text{O}$ .

7. What are the molecular formulas for



8. Which one of the following is not a Lewis acid?

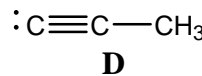
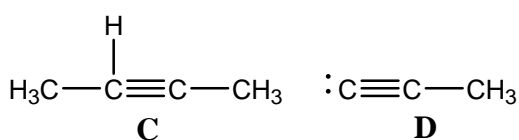
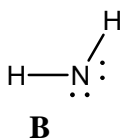
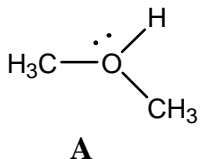


9. Formic acid ( $\text{HCOOH}$ ) has two(2) different conjugate acids.

Show them and indicate which is the more stable one.

10. Consider the terms :  $\text{e}^-$  donor,  $\text{H}^+$  acceptor, nucleophile, lone pair electrons, cation. Which one is out of place?

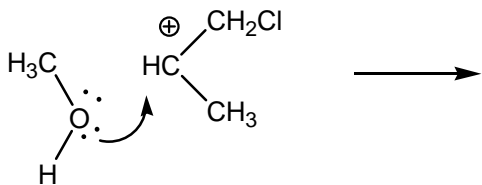
11. a. Which one of the following is not a valid Lewis structure?



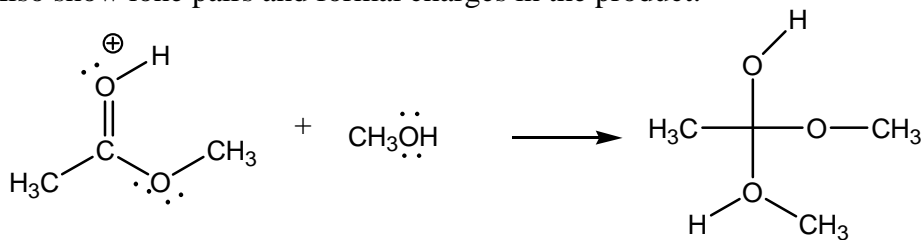
b. Indicate formal charges on any of the valid ones.

12. What will happen if 1 mole of  $\text{ROH}_2^+$  is mixed with 2 moles of  $\text{NH}_2^-$ ?

13. What structure will be formed if curved arrows are applied as follows. Show lone pairs and formal charges.



14. Place curved arrows to indicate the following transformation. Also show lone pairs and formal charges in the product.



15. Show a homolytic reaction involving ethane ( $\text{C}_2\text{H}_6$ ). Apply proper  $\text{e}^-$  flow arrows.

16. Which of the following bonds will give an IR peak at the lowest wavenumber.



a.



b.

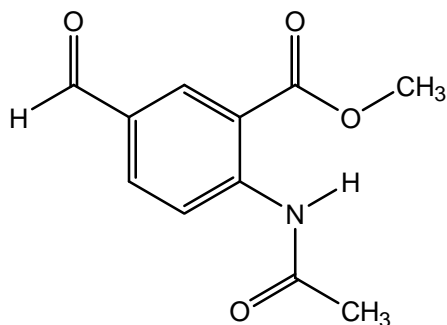


c.

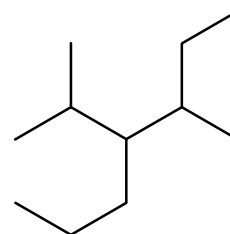
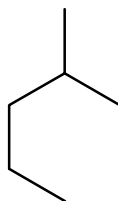
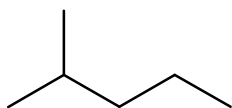


d.

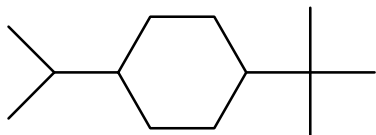
17. Identify the functional groups in the following structure.



18. Provide systematic names for the following.



19. a. Identify primary (p), secondary (s), tertiary (t) and quaternary (q) carbon atoms in



b. What is the number of secondary hydrogen atoms? \_\_\_\_

20. Give an example of a secondary alcohol.