**NAME (Print):** _____

**SIGNATURE:** _____

**EID:** _____

**Chemistry 320M/328M**
**Dr. Brent Iverson**
**1st Homework**
**August 25, 2022**

**Please print the first three letters of your last name in the three boxes**

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|---|---|---|
| | | |

(5 pts) Fill in the blank with the most appropriate word(s) or number(s).

1. The most important question in chemisty is: _____?

2. Atoms prefer a _____ valence shell of electrons. The vast majority of stable _____ in molecules takes place in such a way that this is accomplished.

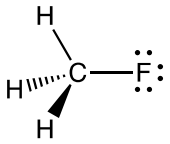
3. Neutral Oxygen atoms take part in _____ bond(s) and has _____ pair(s) of electrons.

4. An Oxygen atom with a negative 1 formal charge (-1) takes part in _____ bond(s) and has _____ pair(s) of electrons.

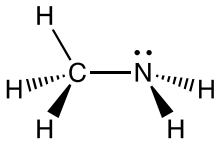
5. When two atoms of different electronegativities form a covalent bond, the majority of shared electron density is found around the _____ electronegative atom.

6. (4 pts) Use the  symbol to indicate on the structure the direction of the bond dipole moment of the bond listed.

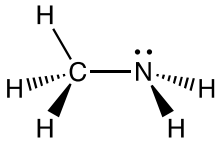
A. C-F



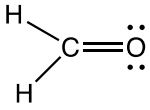
C. N-H



B. C-N



D. C=O



7. (1 pt) As I said in class, the most important thing is to find the most important thing. Well, here is for empahsis, one more time. What is the most important question in Chemistry?

8. (14 pts) For the following molecular formulas, draw complete Lewis structures in which all atom (even H atoms) are drawn, lines are used as bonds, and all lone pairs and formal charges are drawn.

A. $(CH_3)_2CHCH_2CH_2CH_2OCH_3$

B. $CH_3CH_2CH_2CH_2NH_3$

C. $(CH_3)_3CCH_2CHOHCH_2CN$

8 (cont.)

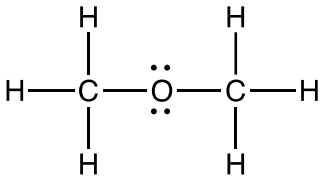
D. $CH_3CHOHCO_2CH_3$

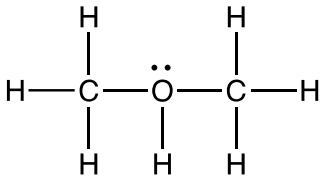
E. $CH_3CONH_2$

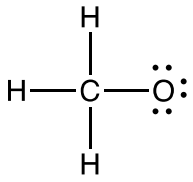
F. $(CH_3)_2CC(CH_3)_2$

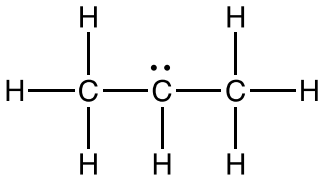
F. $NH_3CH_2CO_2$

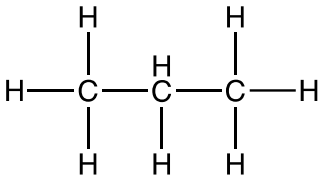
9. (8 pt) Put all appropriate formal charges on the following molecules.

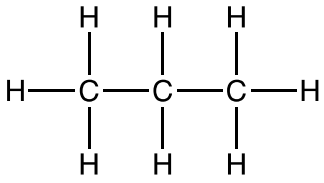


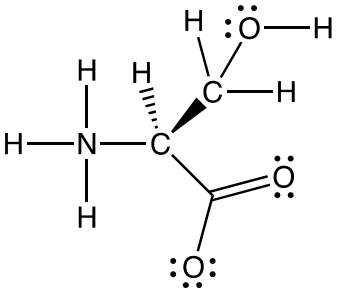












**10.** (1 pts each) Fill in each blank with the word or words that best completes the sentences.

**For organic chemistry, it is best to think of electrons as _____.**

**The electron density in molecules can be described mathematically by adding the wave functions of all the atomic orbitals for all the atoms in the entire molecule, an approach refered to as _____ _____ theory.**

**The wave functions for the valence atomic orbitals on each atom can be added together first, a process referred to as _____ , before looking for overlap with orbitals from other atoms. This aproach is called _____ _____ theory.**

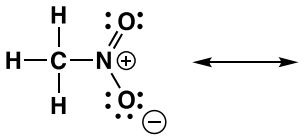
**You need to be able to think about all _____ bonding in molecules as being derived from the overlap of _____ orbitals and all pi bonding as being derived from overlap of unhybridized _____ orbitals.**

**Three (or more) atom "pi-ways" are the situation resonance _____ structures are usually trying to describe. Individual _____ structures can only describe pi bonding between _____atoms, not _____or more, explaining why the _____ structures are needed for these situations.**

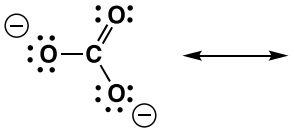
**For pi bonding and therefore pi delocalization to occur over more than _____ atoms (i.e. pi-ways), parallel _____ orbitals are needed on ALL of the adjacent atoms involved, explaining why ALL of these atoms must be _____(or _____) hybridized and why these sytems are planar.**

**11.** (1 or 2 pts each) The following molecules are best represented as the hybrid of contributing structures. **Draw the most important contributing structures** in the spaces provided, including all lone pairs and formal charges. **For all but the structures on the right in each problem, use arrows to indicate the movement of electrons to give the structures you drew.** You might want to read these directions again to make sure you know what we want.

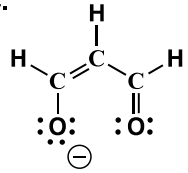
**A.**



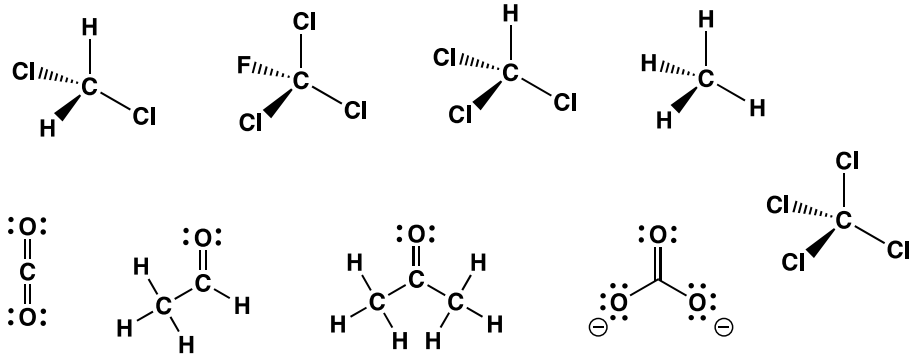
**B.**



**C.**

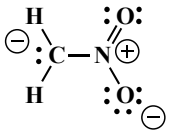


**12.** (1 pt each) Circle any molecule that has an overall molecular dipole moment (this one might be considered pretty hard, there is a lot to think about).

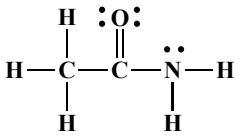


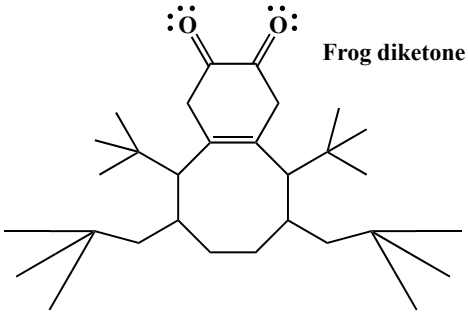
**13.** (2 pts each) The following molecules are best represented as the hybrid of three contributing structures. **Draw the second and third important contributing structures** in the spaces provided, including all lone pairs and formal charges. **For the two structures on the left in each problem, use arrows to indicate the movement of electrons to give the structures you drew.** You might want to read these directions again to make sure you know what we want.

**A**



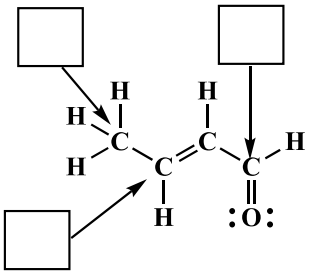
**B.**

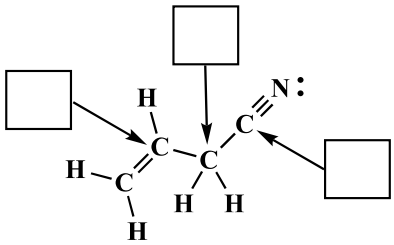


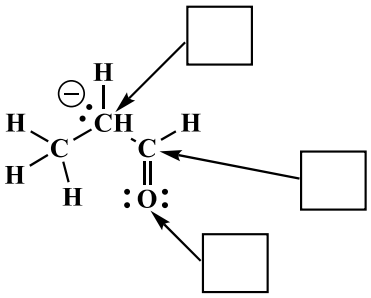


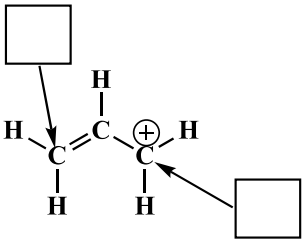
**Frog diketone**

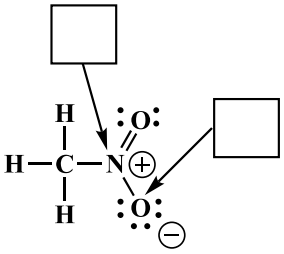
**14.** (20 pts) For the following molecules, write the hybridization state of each atom indicated by the arrow.

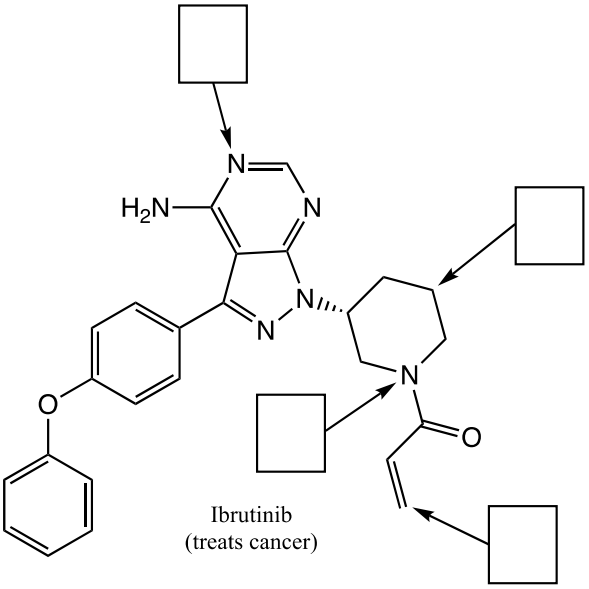




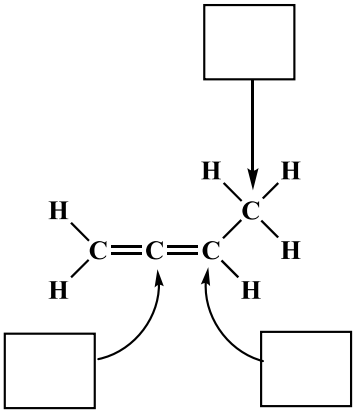




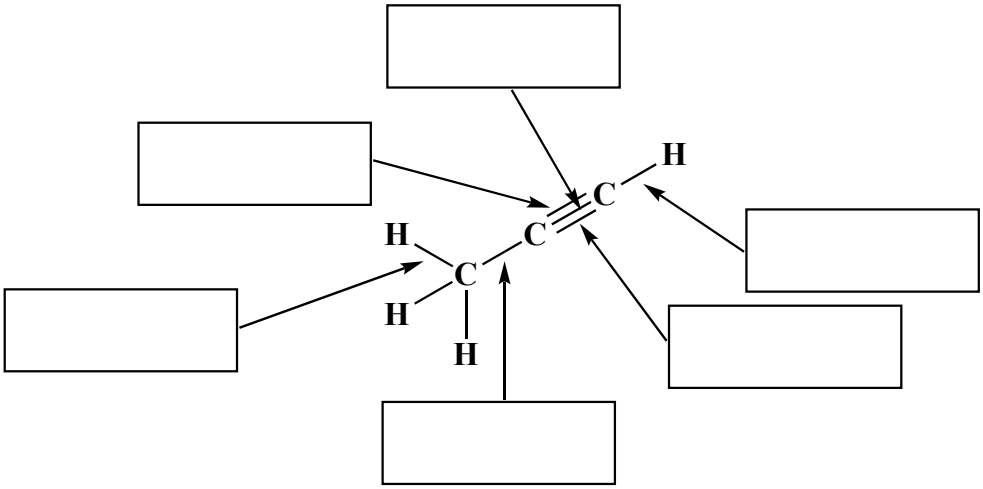


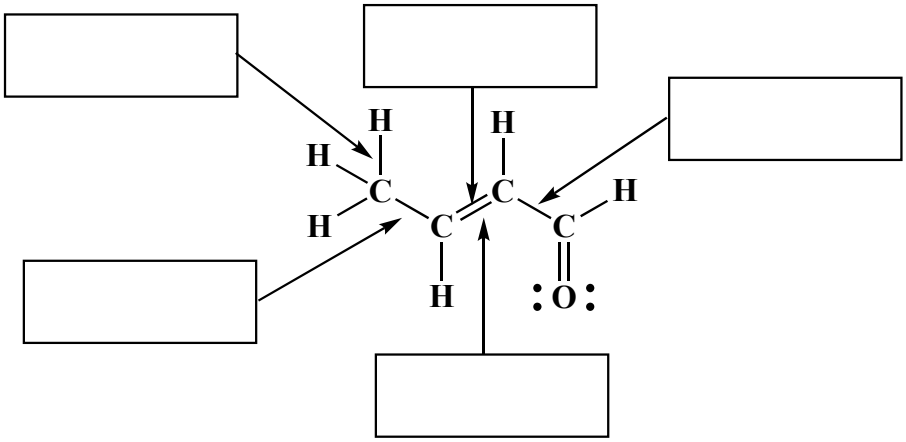


Ibrutinib
(treats cancer)

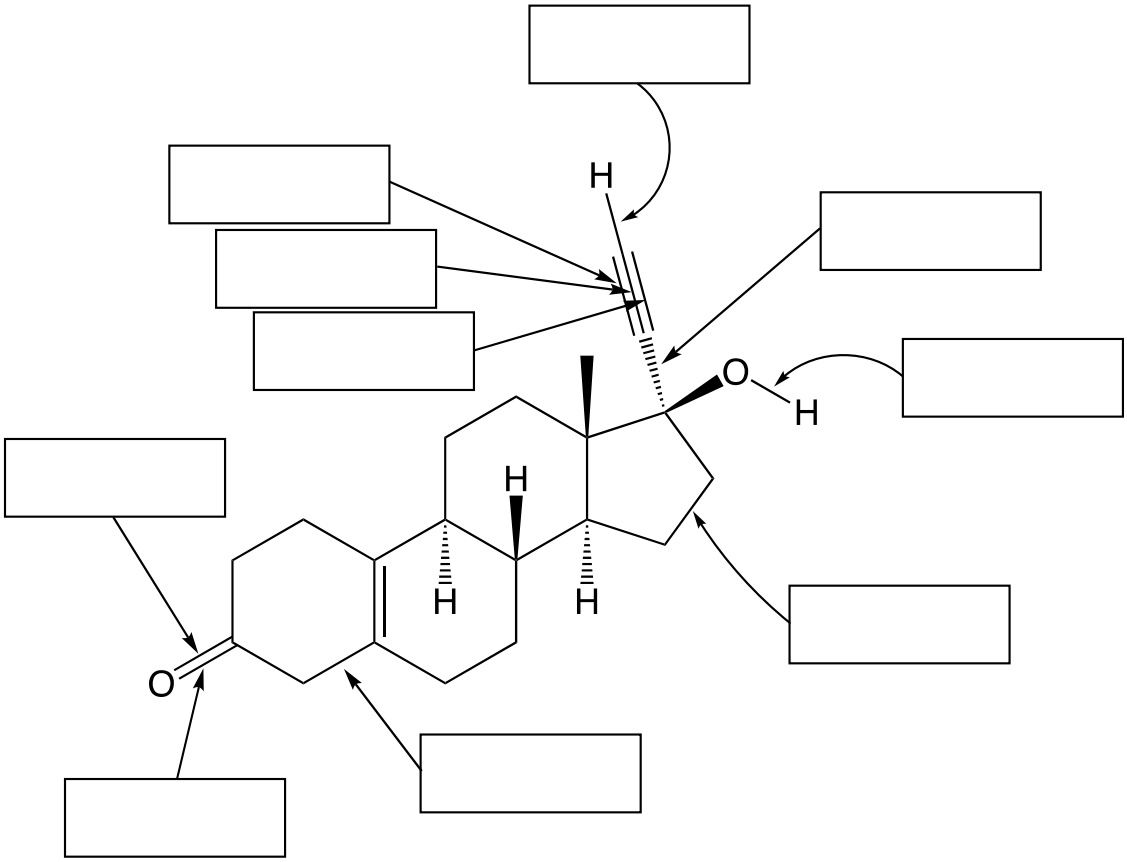


**15.** (11 pts) Describe each bond indicated with an arrow as the overlap of orbitals. For example, an answer might be S **$Csp^3$-$Csp^3$.**



**15 (cont).** (10 pts)




Noretynodrel (a contraceptive)

16. (3 pts) Write the first three "Golden Rules of Chemistry" that we have presented in this class (I want the first three I presented so far). Hint: These are not the first three listed the website, we jump around with the rules!

17. (5 pts) One of the most difficult aspects of organic chemistry is learning how to think creatively about synthesis, which is the construction of valuable complex molecules from cheap simpler ones. To be successful, one must be able to look at a final molecule, recognize the right details, then work backwards using known reactions until reaching the beginning, namely a simpler starting molecule. This type of thinking is new to most students and many find it very difficult to master at first. Based on conversations with previous students, we are trying something new this year in an attempt to prepare you long before we hit actual synthesis problems. What we are going to do is provide a brief situation for you to analyze. We want you think about ways that scenario could have come about, working backwards to the beginning.

The following is a two-sentence description of a specific scenario. Think creatively, then provide a brief description of a sequence of events that could have lead to the situation described in the scenario.

"The last man on Earth sat alone in a room. There was a knock on the door."