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**Chemistry 320M/328M  
Dr. Brent Iverson  
1st Homework  
August 26, 2024**

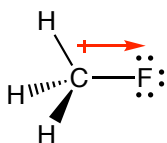
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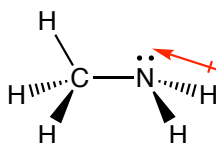
(5 pts) Fill in the blank with the most appropriate word(s) or number(s).

- The most important question in chemistry is: \_\_\_\_\_ **Where are the electrons** ?
- Atoms prefer a \_\_\_\_\_ **filled** \_\_\_\_\_ valence shell of electrons. The vast majority of stable \_\_\_\_\_ **bonding** \_\_\_\_\_ in molecules takes place in such a way that this is accomplished.
- Neutral Oxygen atoms take part in \_\_\_\_\_ **2** \_\_\_\_\_ bond(s) and has \_\_\_\_\_ **2** \_\_\_\_\_ pair(s) of electrons.
- An Oxygen atom with a negative 1 formal charge (-1) takes part in \_\_\_\_\_ **1** \_\_\_\_\_ bond(s) and has \_\_\_\_\_ **3** \_\_\_\_\_ pair(s) of electrons.
- When two atoms of different electronegativities form a covalent bond, the majority of shared electron density is found around the \_\_\_\_\_ **more** \_\_\_\_\_ electronegative atom.
- (4 pts) Use the  $\overset{+}{\longrightarrow}$  symbol to indicate on the structure the direction of the bond dipole moment of the bond listed.

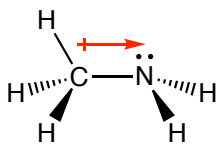
A. C-F



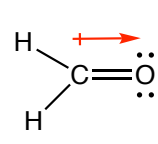
C. N-H



B. C-N



D. C=O

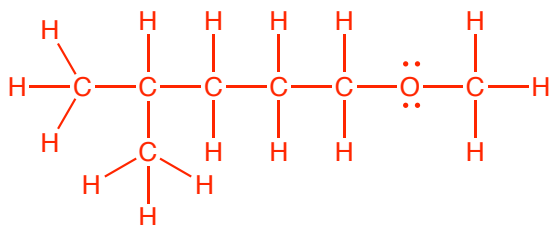


7. (1 pt) As I said in class, the most important thing is to find the most important thing. Well, here it is for emphasis, one more time. What is the most important question in Chemistry?

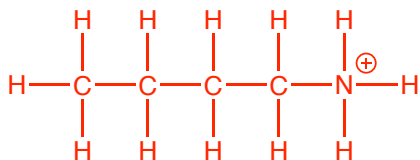
Where are the electrons?

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

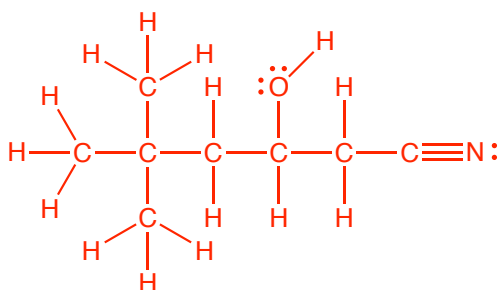
A.  $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_2\text{CH}_2\text{OCH}_3$



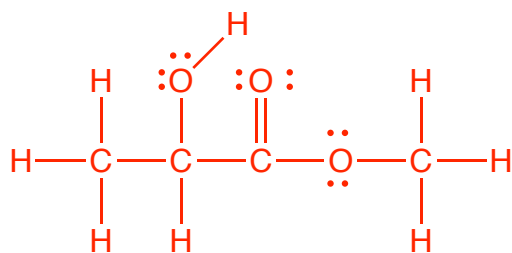
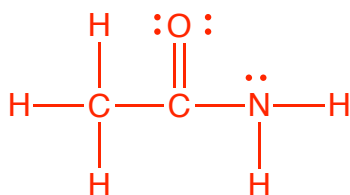
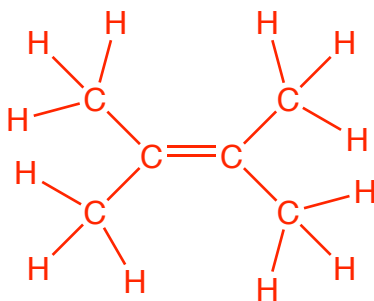
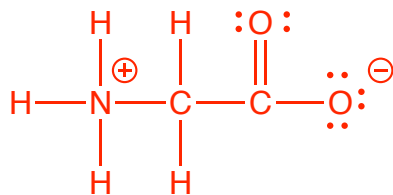
B.  $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{NH}_3^+$



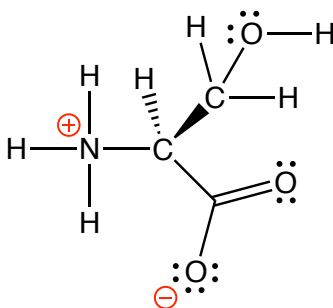
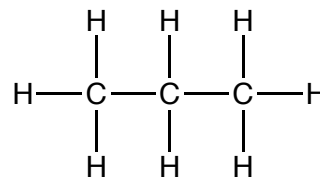
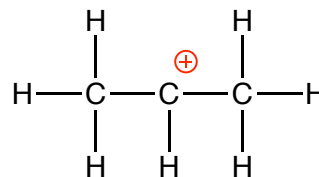
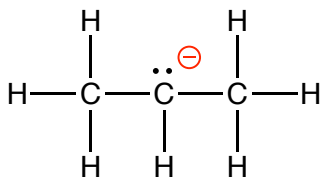
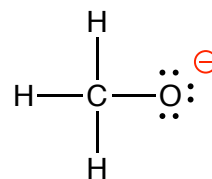
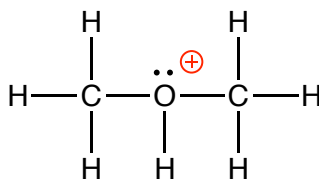
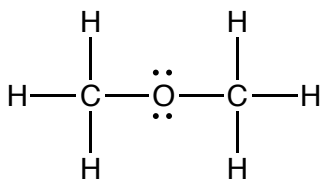
C.  $(\text{CH}_3)_3\text{CCH}_2\text{CHOHCH}_2\text{CN}$



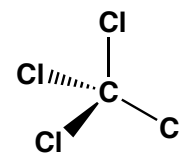
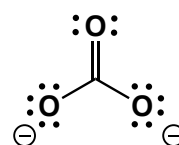
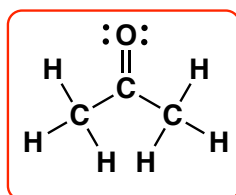
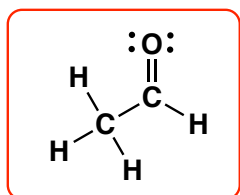
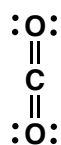
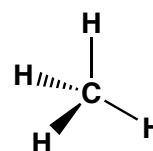
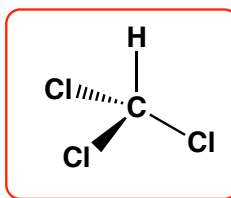
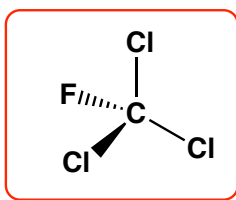
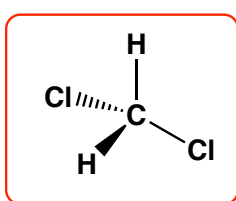
8 (cont.)

D.  $\text{CH}_3\text{CHOHCO}_2\text{CH}_3$ E.  $\text{CH}_3\text{CONH}_2$ F.  $(\text{CH}_3)_2\text{C}=\text{C}(\text{CH}_3)_2$ F.  $\text{NH}_3\text{CH}_2\text{CO}_2^-$ 

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



10. (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).



11. (3 pts) Write the first two “Golden Rules of Chemistry” that we have presented in this class (I want the first two I presented so far). Hint: These are not necessarily the first two listed the website, we jump around with the rules!

**1. In most stable molecules, all the atoms will have filled valence shells.** This means that C, N, O and the halogens will have 8 electrons in their valence shells, and H atoms will have 2 electrons in their valence shells. This simple yet powerful principle predicts the type of bonds created (single, double or triple) and how many lone pairs are found around the different atoms of a molecule. In general, an atom surrounded by 4 atoms/lone pairs will have a tetrahedral geometry, an atom surrounded by 3 atoms/lone pairs will have a trigonal planar geometry and an atom surrounded by two atoms/lone pairs will have a linear geometry. You will encounter a small number of molecules containing an atom such as a C atom with only 6 or 7 electrons in its valence shell. Atoms such as this with only a partially filled valence shell are noteworthy and highly reactive. Note, however, that you can never overfill the valence shell of any atom in a molecule such as placing more than 8 electrons in the valence shells of C, N, or O.

**4. The most important question in chemistry is "Where are the electrons?"**

The answer is that electrons are generally in higher amounts around the more electronegative atoms (*e.g.* F, Cl, O, N) of a molecule. The electronegative atoms pull electron density away from the less electronegative atoms (*e.g.* C, H) to which they are bonded. Thus, understanding electronegativities provides a simple method of deciding which portions of a molecule have a relatively high electron density, and which portions have a relatively low electron density. Molecules with areas of high and low electron density are referred to as ‘polar’ molecules. Molecules that have relatively uniform electron densities are referred to as ‘nonpolar’ molecules.

12. (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 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."

Of course, there is no single answer here, we want you to think up your own scenario. I took these intriguing sentences from a classic science fiction story by the writer Fredric Brown dating back to 1948. Here is a brief description of that full story taken from the Wikipedia summary:

"The Zan have killed off all life on Earth other than pairs of specimens for their zoo of exotic Earth fauna. Walter Phelan is the last man on Earth, but Grace Evans, the last woman, is not overly impressed with him and maintains her distance.

The Zan, who are ageless, become disturbed when, one by one, the other animals begin to die. They turn to Walter for advice. He tells them that the creatures have perished from lack of affection, suggesting that they pet the survivors regularly to keep them alive. He demonstrates with one of them. When the Zan begin to die, they depart the planet in fear. It is then revealed that the creature Walter advised them to pet was a poisonous snake.

Then Walter discusses the future of the human race with Grace. She is shocked by his proposal and leaves. The narrative then ends as it began:

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

I hope you came up with even better stories!!