**CHEM 3311** **Hour Exam #1** **Name** Key
**Dr. Minger** **June 7, 2022**

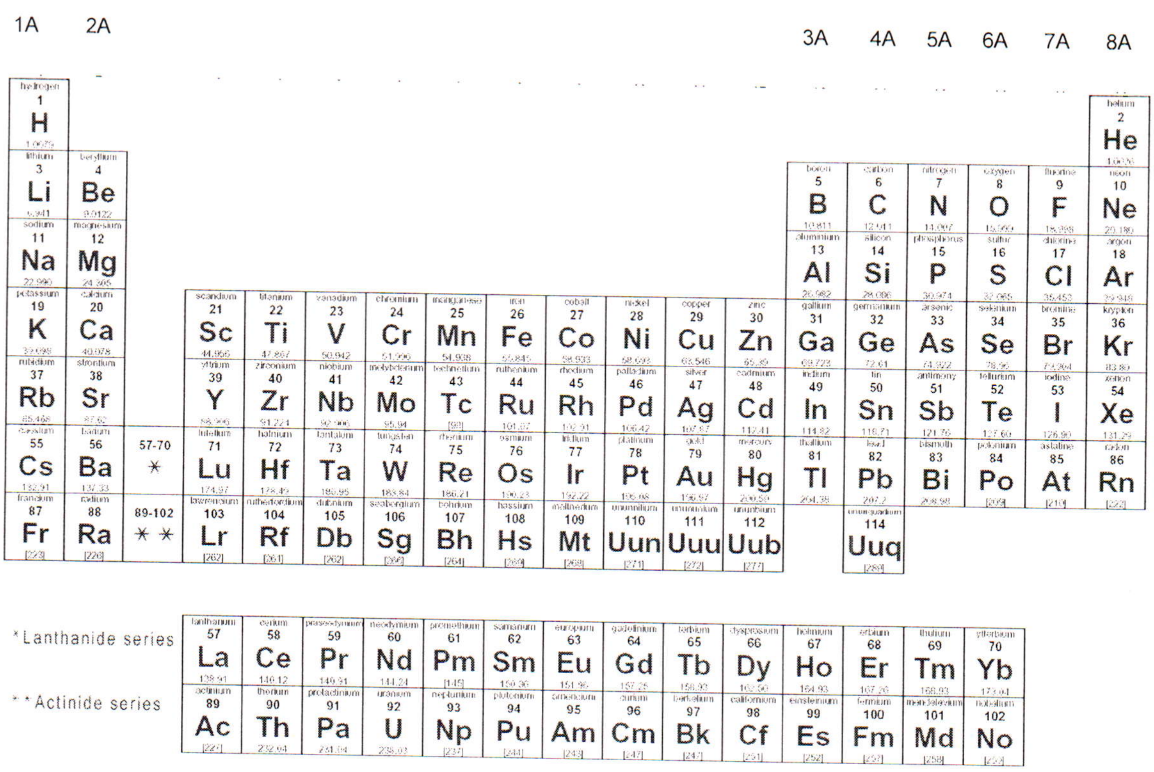
**Write your recitation section number:** _______ **and TA name:** _______________

**Sign the Honor Code pledge even though you've taken the quiz** ●

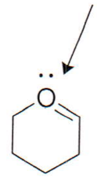
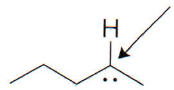
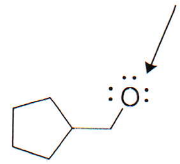
I pledge that on my honor, as a University of Colorado at Boulder student, I have neither given nor received unauthorized assistance on this exam.

_______________________________
Signature

**General Instructions:** There are 6 pages of questions plus this cover sheet. Be sure you have them all. Read each question carefully so that you know exactly what is being asked and what you need to write or draw. DO NOT USE COLORED INK. Your work on scratch pages will not be graded, so be sure everything you want graded is written on the exam itself.

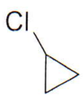


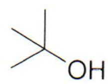
1) Calculate the formal charge on the indicated atom in each structure. All necessary lone pairs and hydrogen atoms are drawn for you. Write your answers in the boxes under the structures. (8 pts)

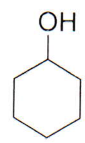





| +1 | +1 | −1 | −1 |
|---|---|---|---|

2) Classify each alkyl halide, alcohol, or amine as primary (1°), secondary (2°), or tertiary (3°). Write your answers in the boxes under the structures. (8 pts)

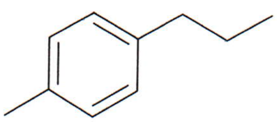
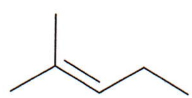







| 2° | 1° | 3° | 2° |
|---|---|---|---|

3) Indicate how many benzylic or allylic carbons there are in each structure by writing a number on the line below the structure. (4 pts)

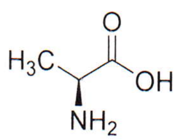



2 benzylic carbons

3 allylic carbons

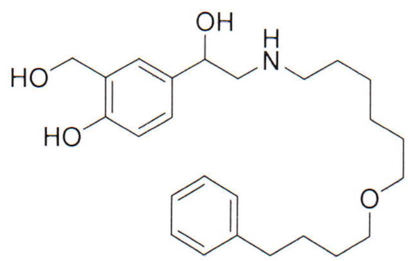
4) Using the labels (A, B, C, etc.) from the list of functional groups provided, identify the functional groups present in each of the molecules. Some choices may be used more than once, and some may not be used. Write your answers (**letters only, no names**) in the box under each compound. Use only these labels (i.e. if a group appears that is not on the list, you do not need to include it). (20 pts)

| | | | | | |
|---|---|---|---|---|---|
| **A** | Alkyne | **F** | Ketone | **K** | Amide |
| **B** | Alcohol | **G** | Carboxylic acid | **L** | Amine |
| **C** | Ether | **H** | Acid halide | **M** | Nitrile |
| **D** | Epoxide | **I** | Anhydride | **N** | Alkene |
| **E** | Aldehyde | **J** | Ester | **O** | Aromatic |



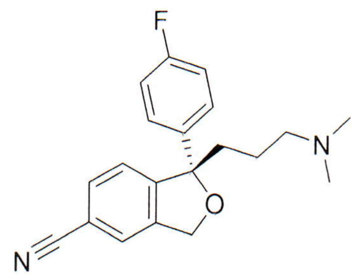
**Alanine**
an amino acid

G L



**Salmeterol (Advair)**
Treats airway constriction

B C L O



**Escilitopram (Lexapro)**
Anti-depressant

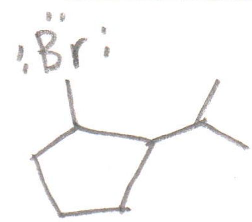
C L M O

5a) Draw the requested molecules in the boxes provided and circle the correct choice underneath each name to classify the compound. (8 pts)

**1-bromo-2-isopropylcyclopentane**

Classify this alkyl halide (circle one):

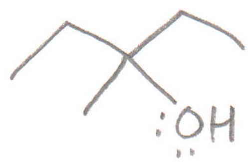
1° 2° 3°



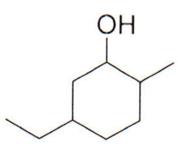
**3-methylpentan-3-ol**
**(3-methyl-3-pentanol)**

Classify this alcohol (circle one):

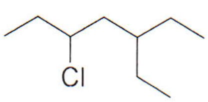
1° 2° 3°



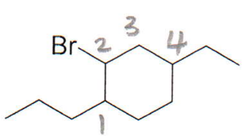
5b) Provide an acceptable IUPAC name for each of these compounds. (15 pts)



5-ethyl-2-methylcyclohexanol

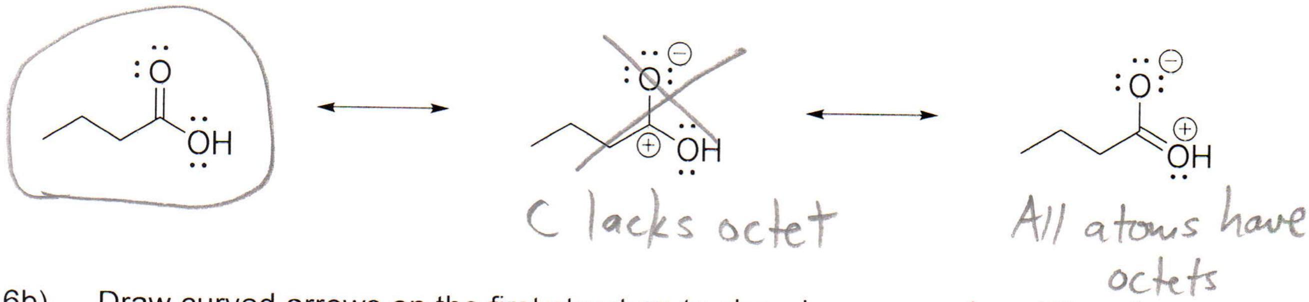


3-chloro-5-ethylheptane

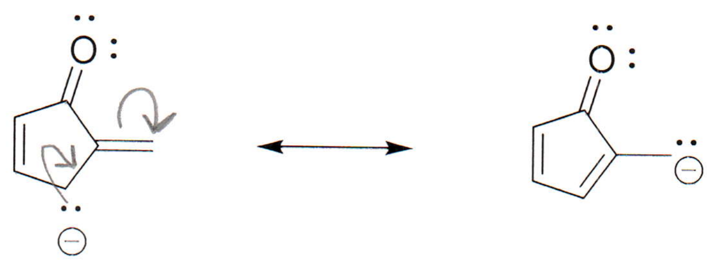


2-bromo-4-ethyl-1-propylcyclohexane

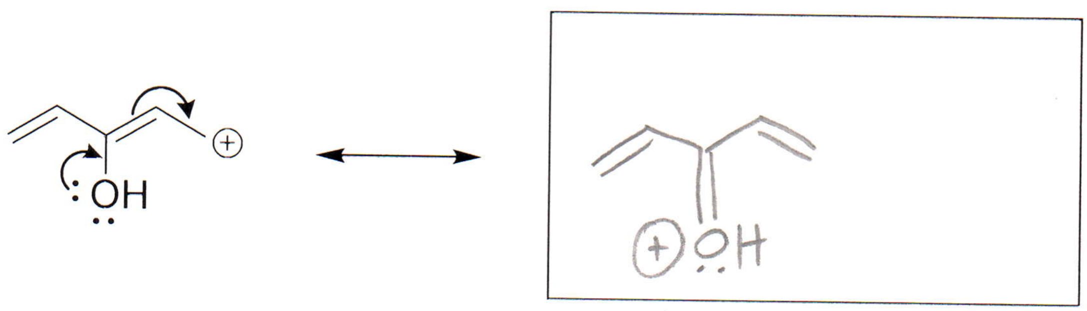
6a) Here is a set of resonance contributors. Put a circle around the major (most important) contributor. Put an X through the most minor (least important) contributor. (2 pts)



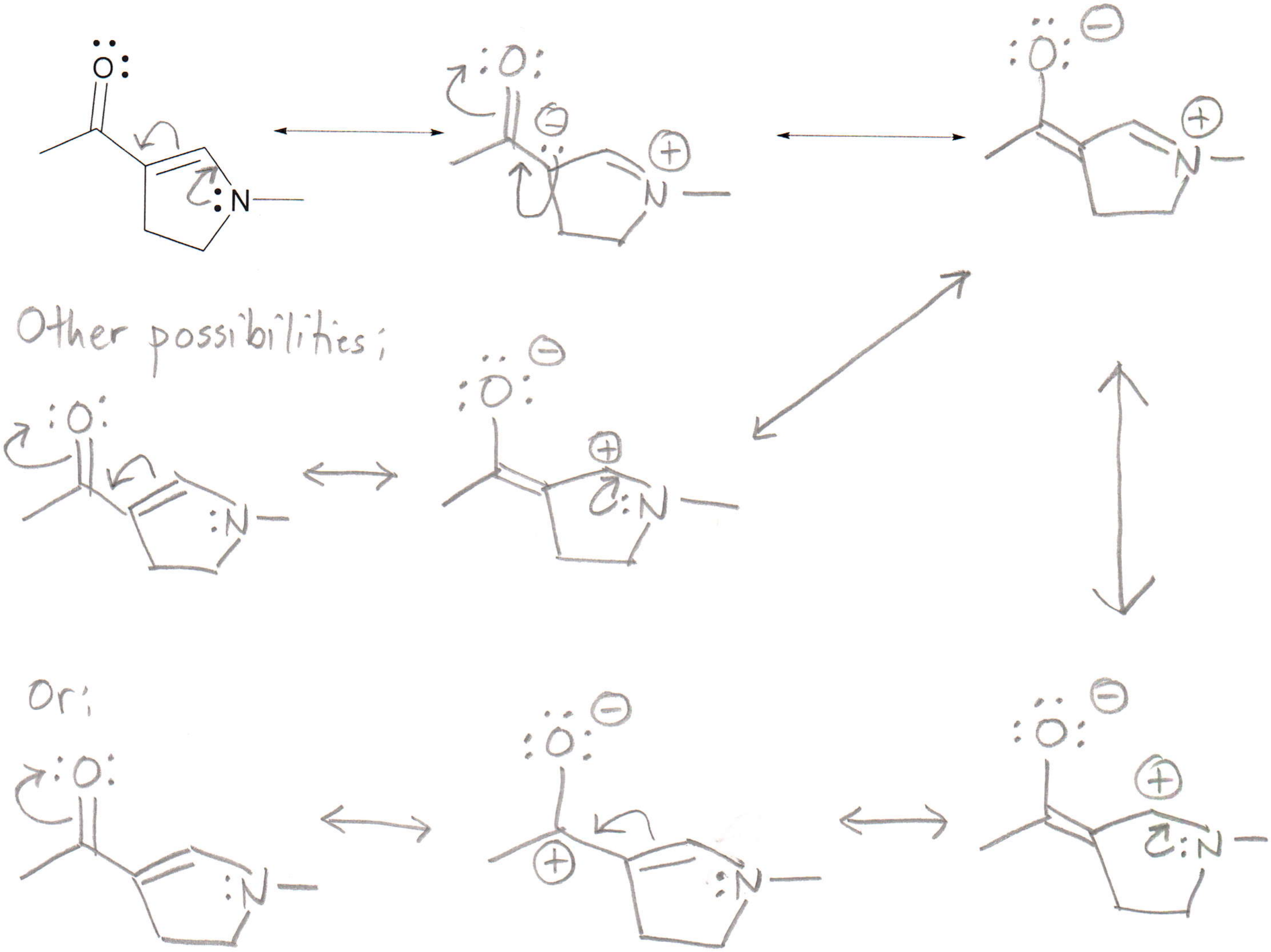

6b) Draw curved arrows on the first structure to show how you arrive at the other resonance contributor. (4 pts)



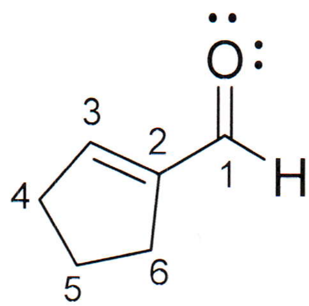
6c) Draw the resonance structure that is the result of the curved arrows shown. Include all lone pair electrons and nonzero formal charges in your structure. (4 pts)



7) Draw two additional *reasonable* resonance structures for the compound shown. Include in your drawings all necessary curved arrows, lone pair electrons and nonzero formal charges for full credit. (Be sure to draw curved arrows on the original structure to show how to get to your first new structure.) (14 pts)



8) Indicate the orbitals that are overlapping to create each of the indicated bonds according to valence bond theory. The carbon atoms are numbered for reference. (10 pts)




C1 – C2 σ: $sp^2$ on C1 and $sp^2$ on C2

C2 – C3 π: p on C2 and p on C3

C4 – H σ: $sp^3$ on C4 and s on H

C1 – O σ: $sp^2$ on C1 and $sp^2$ on O

C5 – C6 σ: $sp^3$ on C5 and $sp^3$ on C6

What are the valence orbitals on C2? List them on the line. (4 pts)

$sp^2$, $sp^2$, $sp^2$, p