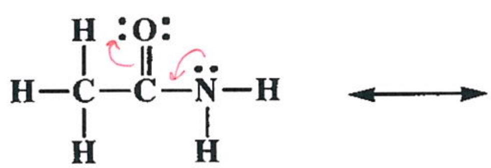
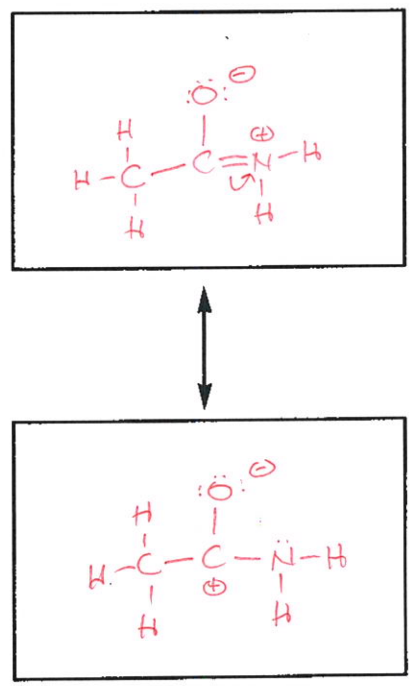
Signature____________________________ Pg 1 ____________(29)

1. (5 pts) What is the most important question in organic chemistry?

Where are the electrons?

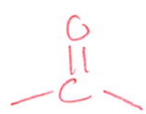
2. (10 pts) Amides are best represented as the hybrid of three contributing structures. Draw the second and third important contributing structures in the spaces provided, including all lone pairs and formal charges. For the two structures on the left in each problem, use arrows to indicate the movement of electrons to give the structures you drew. There is no need to draw any circles around any of these contributing strucures. You might want to read these directions again to make sure you know what we want



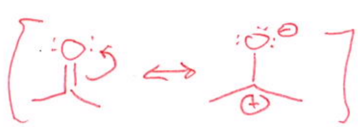


Valid!

Special for Amides!



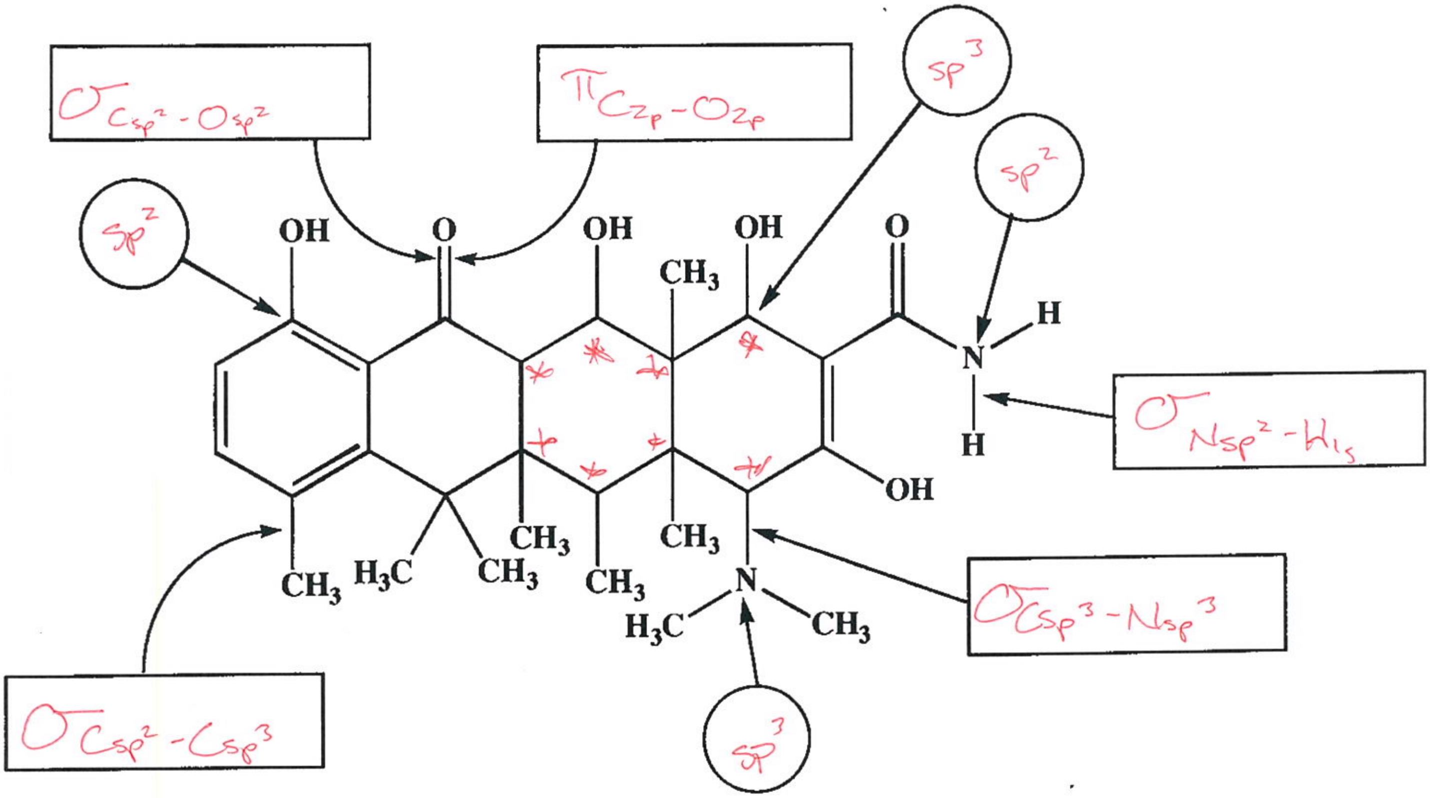
Know that this is a possible resonance structure



4. (1 pts each) Below is the structure of the antibiotic tetracycline. **In the rectangles provided, indicate the type of bond** and the hybridized orbitals that overlap to form the bond. For example, one answer could be: $\sigma_{Csp^3\text{-}H1s}$

Next, in the circles provided, write the hybridization state of the atoms indicated with the arrows.

1s, 2s, $2p_x$, $2p_y$, $2p_z$



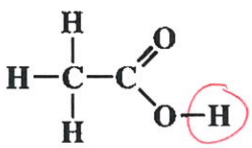
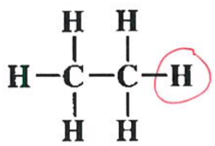
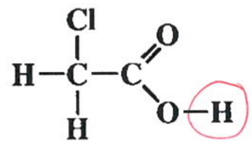
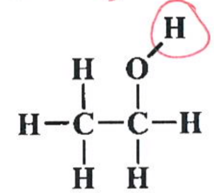
5. (1 pt each) On the above structure of tetraycline, the stereochemistry is not indicated. On the above structure indicate **EACH CHIRAL CENTER WITH AN ASTERISK (*).**

* any atom involved in a double bond (in drawing or in resonance must be sp² hybridized)

Acidic => wants to kick off

9. (4 pts) Rank the following with respect to relative acidity. Put a **1** under the molecule that is **most acidic**, and a **4** under the molecule that is **least acidic**. Remember, the **1 goes under the MOST acidic!**

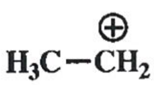
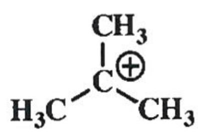
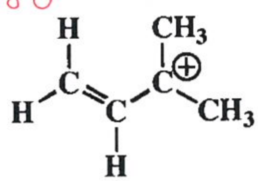
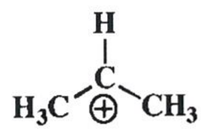
- Look at most acidic Hydrogen (probably unique one...)
- look for atom it's bonded to (character of that atom)

relative rank: 2   4   1   3

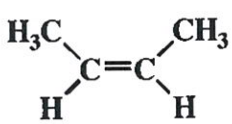
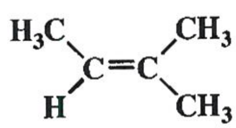
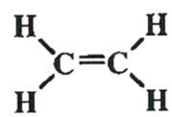
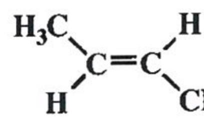
10. (4 pts total) For the following series of compounds, rank them in order of most to least stable cation by writing a **1** under the **most stable** all the way to a **4** under the **least stable.**

Stability of carbocation => -resonance -hyperconjugation!

relative rank: 4   2   1   3

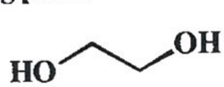
11. (4 pts) **Stability of alkenes:** Place a **1** under the most stable (i.e. most favored Zaitzev product) and a **4** under the least stable (least stable Zaitzev product) alkene

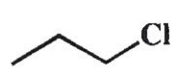
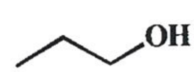





relative rank: 3 (cis)   1   4   2 (trans)

-Most substituted due to hyperconjugation, trans vs cis if a tie.
Zaitsev's rule => most stable alkene

12. (4 pts total) For the following compounds, rank them in order of highest to lowest boiling point, with a **1 under the molecule with the highest boiling point** and a **4 under the molecule with the lowest boiling point.**



relative rank: 1   4   3   2

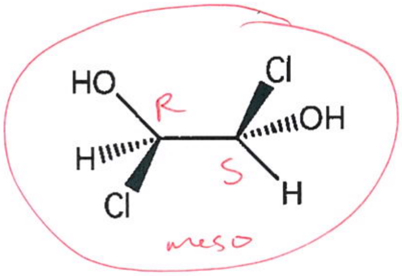
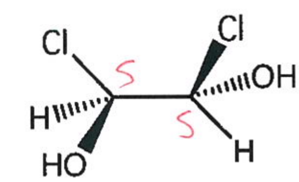
Strongest intermolecular interaction!

Are you sure you ranked them in the correct order according to the directions????

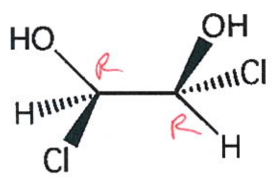
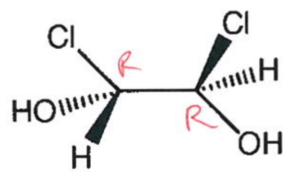
16. (8 pts) On the line provided, state the stereochemical relationship between each pair of molecules: **enantiomers, diastereomers, or the same molecule**. I recommend you assign R and S to each chiral center to help answer this question. **Circle all meso compounds.**

But don't need to.

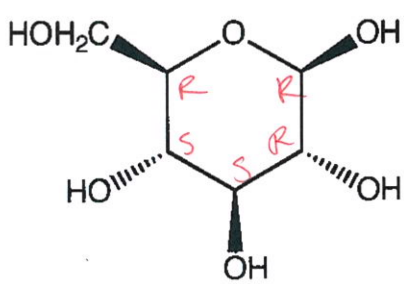
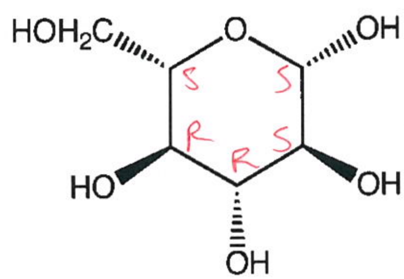
Relationship

Diastereomers

Same molecule

enantiomers

1. look at atoms (all same?)
2. Try to rotate: super impose
3) - both flipped, is enantiomer
- one flipped diastereomer
- both same => same molecule

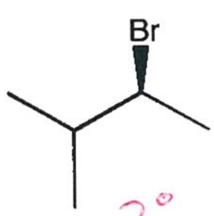
meso => don't have enantiomers

17. (13 pts) For the following reactions, draw the predominant product(s), and in the box over the arrow, write the predominant mechanism(s) (S_N2, E2 or S_N1/E1)

1°

+ $NaOCH_2CH_3$ $\xrightarrow{\boxed{S_N2}}$

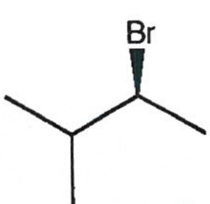
- strong base
- strong nucleophile



2°

+ NaOH $\xrightarrow{\boxed{E2}}$

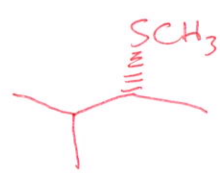
- strong base
- strong nucleophile



2°

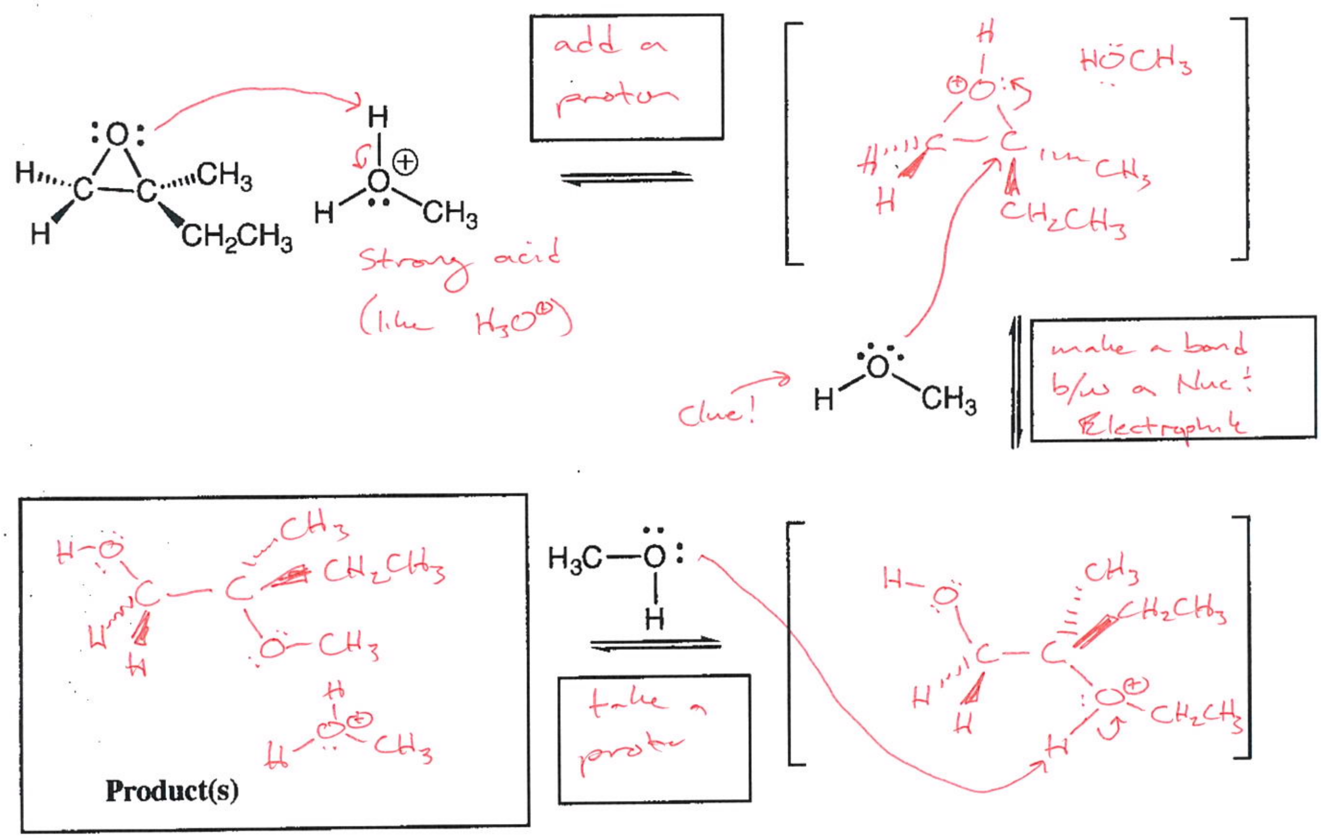
+ CH_3SNa $\xrightarrow{\boxed{S_N2}}$

good nucleophile



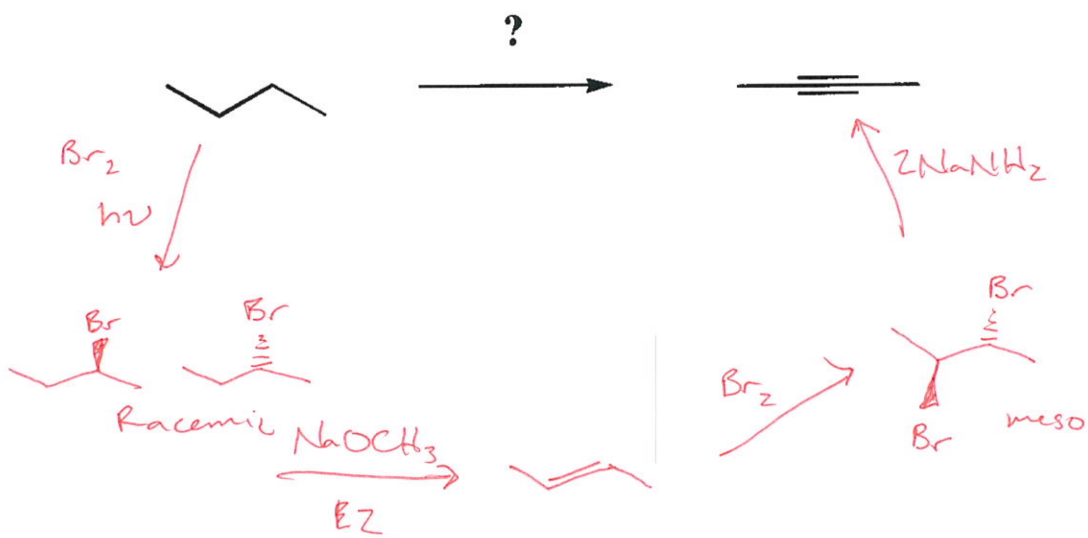
Signature ______________________________ Pg.13 ______ (25)

20. (25 pts.) **For the reaction of this epoxide with methanol in acid, fill in the details of the mechanism. Draw the appropriate chemical structures and use arrows to show how pairs of electrons are moved to** make and break bonds during the reaction. **For this question, you must draw all molecules produced in each step (yes, these equations need to be balanced!). Finally, fill in the boxes adjacent to the arrows with the type of step involved, such as "Make a bond" or "Take a proton away". MAKE SURE TO NOTICE THE QUESTIONS AT THE BOTTOM. Use wedges and dashes to indicate stereochemistry where appropriate, BUT if an intermediate or product is really a racemic mixture, you only need to draw one enantiomer for this problem (we are making this easier for you).**

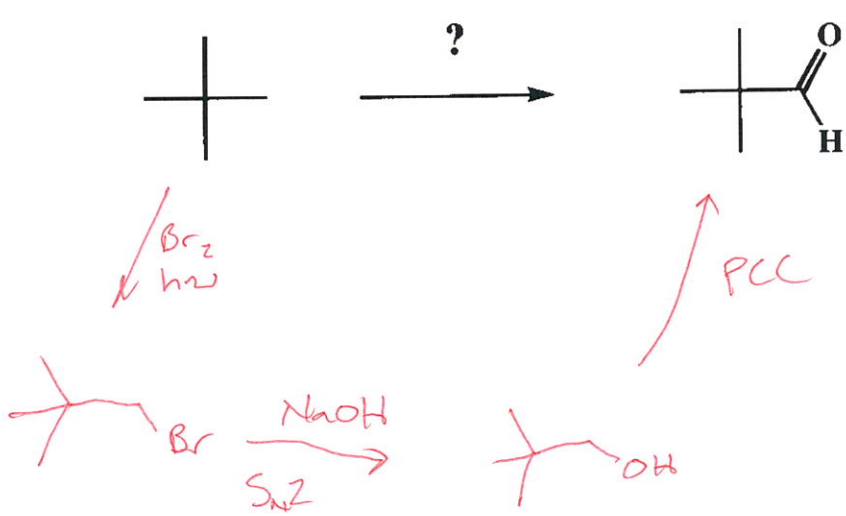


24. These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned provided that the product(s) you draw for each step is/are the predominant one(s). Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction. You must draw all stereoisomers formed, and use wedges and dashes to indicate chirality at each chiral center. Write racemic when appropriate.

A) (10 pts)



B) (7 pts)



24 (cont).) These are synthesis questions. You need to show how the starting material can be converted into the product(s) shown. You may use any reactions we have learned provided that the product(s) you draw for each step is/are the predominant one(s). Show all the reagents you need. Show each molecule synthesized along the way and be sure to pay attention to the regiochemistry and stereochemistry preferences for each reaction. You must draw all stereoisomers formed, and use wedges and dashes to indicate chirality at each chiral center. Write racemic when appropriate. **All the carbons of the product must come from carbons of the starting material.**

D) (16 pts)