

NAME (Print): _____

SIGNATURE: _____

Chemistry 610A/618A
Dr. Brent Iverson
2nd Exam
Oct. 29, 2003

Please Note: This test may be a bit long, but there is a reason. I would like to give you a lot of little questions, so you can find ones you can answer and show me what you know, rather than just a few questions that may be testing the one thing you forgot. **I recommend you look the exam over and answer the questions you are sure of first**, then go back and try to figure out the rest. Also make sure to **look at the point totals** on the questions as a guide to help budget your time. **I recommend saving questions marked "challenge" until you are finished with all of the other questions.**

RELAX, TAKE A DEEP BREATH, THINK ABOUT SOMETHING PEACEFUL AND BEGIN. NERVES AND PANIC ONLY HURT YOU, JUST ASK A GUY ON THE BOMB SQUAD, A SUSPENSION BRIDGE PAINTER OR A BALD GUY SHAVING HIS HEAD !

Page	Points
1	(10)
2	(16)
3	(22)
4	(18)
5	(27)
6	(21)
7	(21)
8	(23)
9	(15)
10	(20)
11	(15)
Total	(208)
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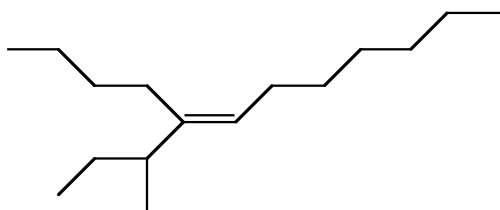
Pg 1 _____ (24)

1. (4 pts. each) Draw the structures indicated by each IUPAC name.

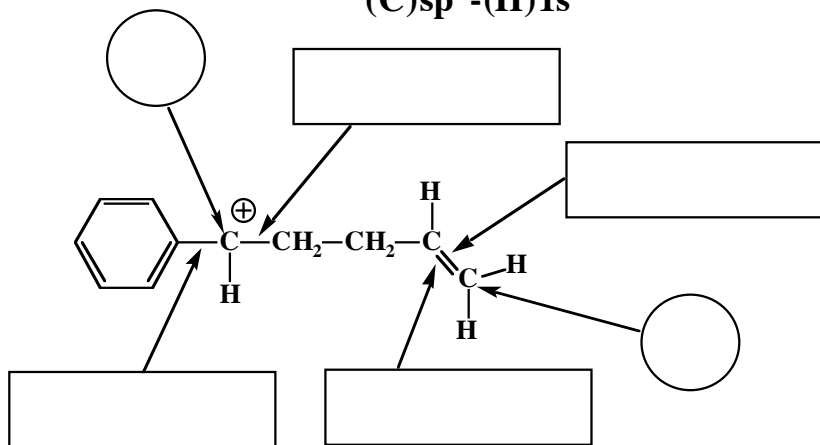
trans-2-methyl-3-hexene

(6*Z*)-2,6-dimethyl-2,6-nonadiene

2. (4 pts) For the structure, give an acceptable IUPAC name.

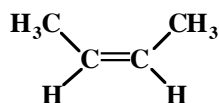


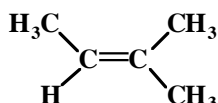
3. (2 pts each) For the following molecule, **in the circles** write the hybridization state of the indicated atom, and **in the boxes** describe the indicated bond in terms of overlap of hybridized orbitals. For example, a correct answer in a box will be of the form: $\sigma_{(\text{C})\text{sp}^3-(\text{H})1\text{s}}$

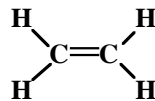


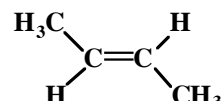
4. (15 pts. total) Rank the following species in terms of the stated property from 1 to 4 (or 3) as described, with intermediate numbers to rank the species of intermediate stability activity. **Please make sure you know what we want, as you will get no credit if you get the numbers backwards!**

Stability of alkene: Place a **1** under the most stable (i.e. least reactive to H_2/Pt) and a **4** under the least stable (i.e. most reactive to H_2/Pt)

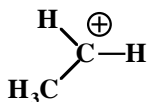


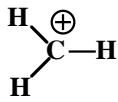


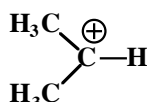


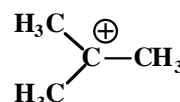


Stability of carbocations: Place a **1** under the most stable carbocation and a **4** under the least stable carbocation.

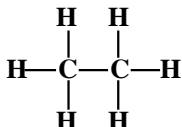


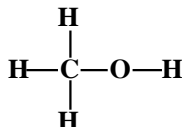


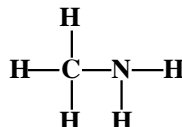


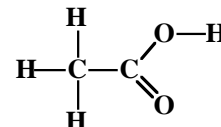


Relative Acidity: Place a **1** under the most acidic molecule and a **4** under the least acidic molecule.

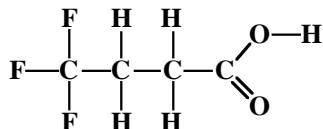


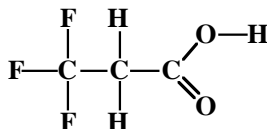


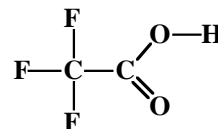




Relative Acidity: Place a **1** under the most acidic molecule and a **3** under the least acidic molecule.







4. (cont.) (8 pts. total) Rank the following species in terms of the stated property from 1 to 4 as described, with intermediate numbers to rank the species of intermediate stability activity. **Please make sure you know what we want, as you will get no credit if you get the numbers backwards!**

Relative Acidity: Place a **1** under the most acidic molecule and a **4** under the least acidic molecule.

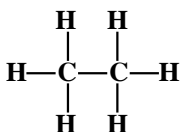


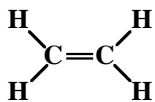


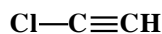


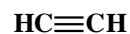


Relative Acidity: Place a **1** under the most acidic molecule and a **4** under the least acidic molecule.

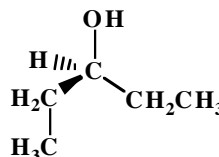
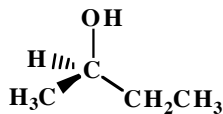
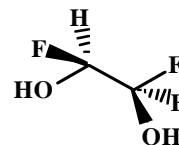
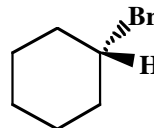
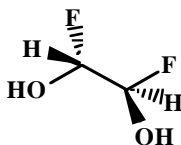
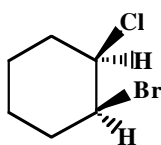
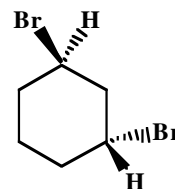
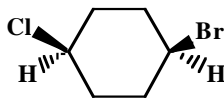
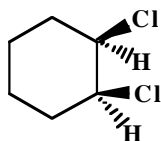








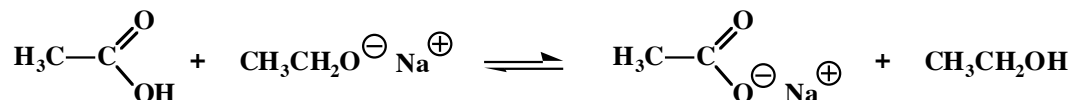
5. (9 pts total) Of the molecules shown below, circle the ones that are optically active, that is the ones for which a sample would rotate the plane of plane polarized light. In other words, circle the molecules that are chiral.



Signature _____

Pg 4 _____ (19)

6. (3 pts each) Use your understanding of relative acidities to predict the position of equilibrium in the following acid-base reactions. **Draw a circle around the side of each equation that predominates at equilibrium.** *These may seem difficult at first, but remember what you know about acid-base equilibria as well as relative acid strengths.*



Challenge! Think about this one!!!!

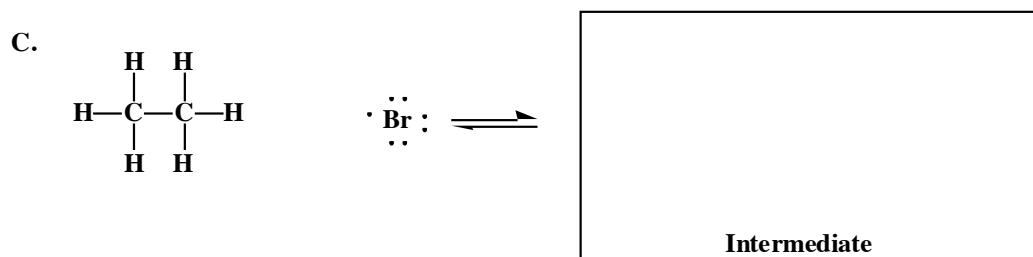
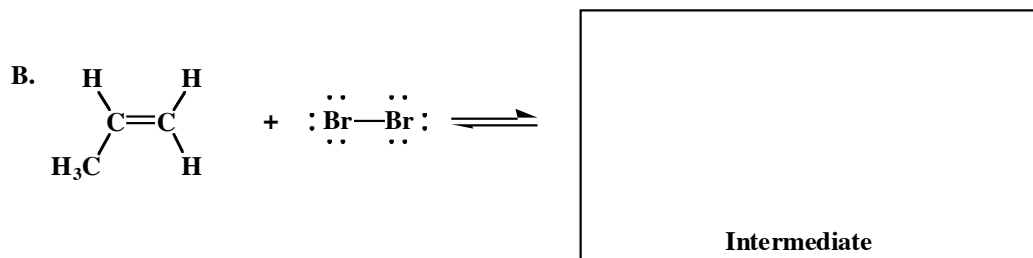
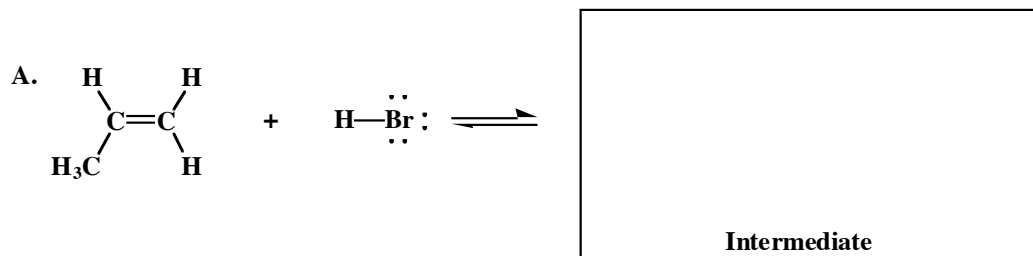


7. (5 pts each) In no more than two sentences, define the physical basis for the interactions defined by the following terms.

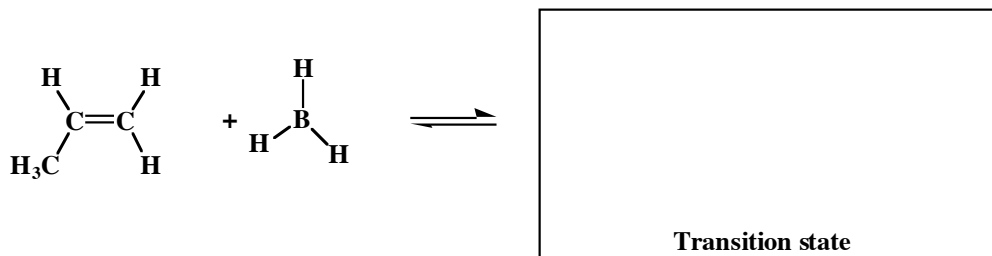
Hyperconjugation

The inductive effect

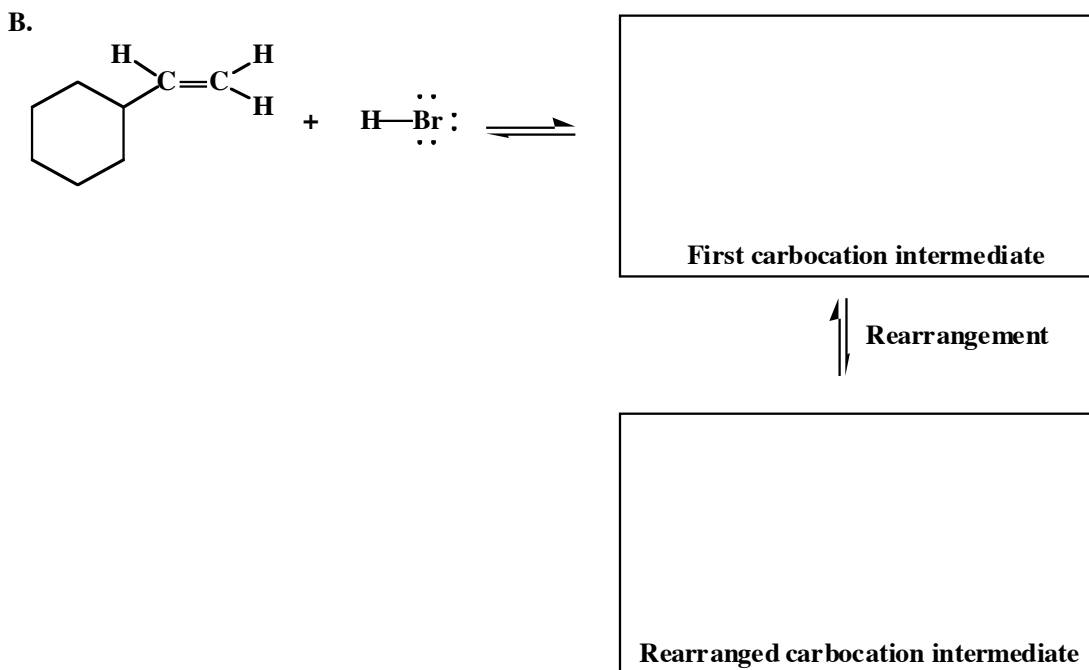
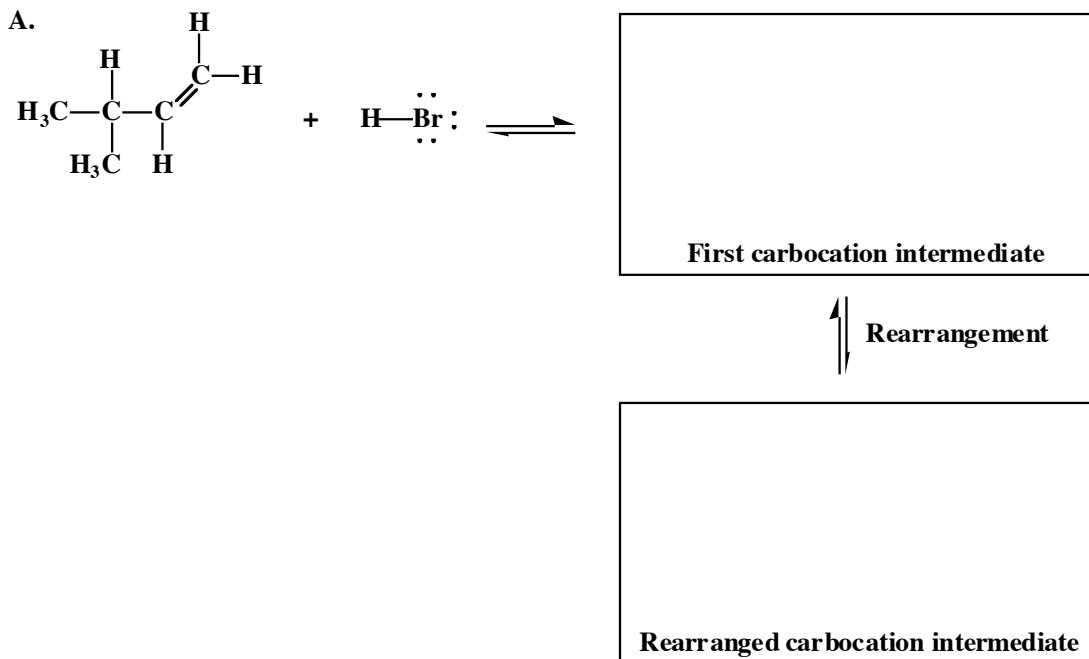
8. (6 pts each) For each set of reagents, draw the important intermediate or transition state that we discussed in lecture in the box provided. **You must show all lone pairs and formal charges on the structures you draw!!** Next, draw arrows (either normal arrows or single "fishhook" arrows as appropriate) on the starting material to indicate electron flow to generate the intermediate or transition state that you have drawn. Please read these directions again to make sure you know what we want. Note that we are only interested in the first step of the mechanism here, not the whole thing!



D. For this one used dotted lines (••••) to indicate bonds being made or broken in the structure you draw.



9. (5 pts each structure) The following molecules undergo rearrangement. In each case, draw the first carbocation intermediate in the first box, then the rearranged carbocation intermediate in the second. Include all lone pairs and formal charges, but you do not need to draw arrows.

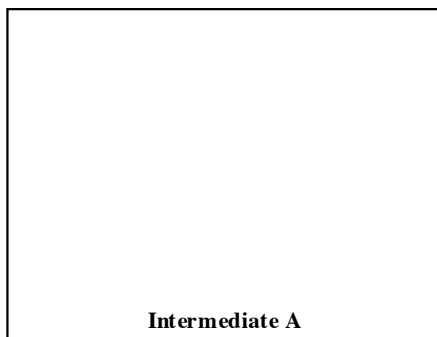
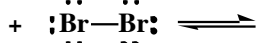
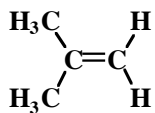


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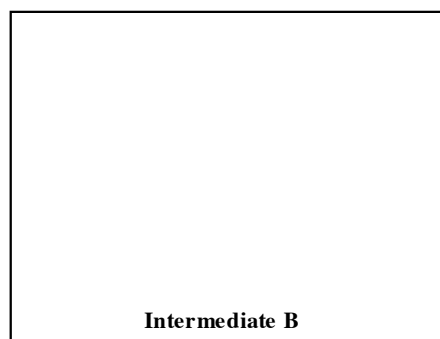
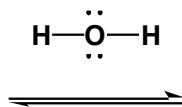
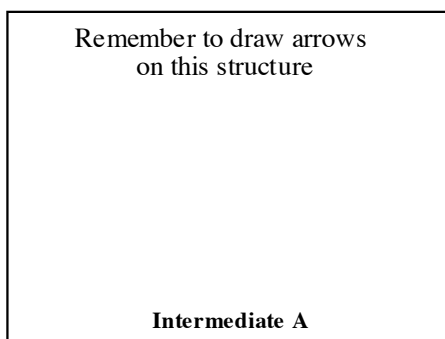
Pg. 7 _____ (20)

10. (18 pts.) Read these directions carefully. Read these directions carefully. (It was worth repeating) For the reaction shown below, fill in the details of the mechanism. Draw the appropriate chemical structures and draw arrows to show how pairs of electrons are moved to make and break bonds during the reaction of the indicated alkene with Br_2 in the presence of H_2O . Draw all non-bonded electrons as dots around the appropriate atoms and include all formal charges. Draw all products of each step and all products of the overall reaction. MAKE SURE TO FILL IN THE BLANK AT THE BOTTOM.

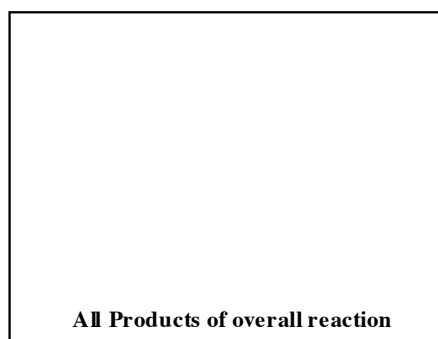
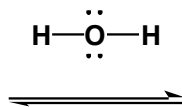
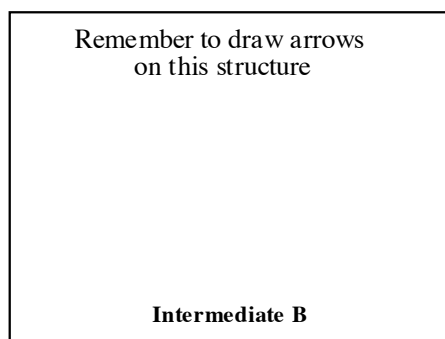
STEP 1



STEP 2



STEP 3

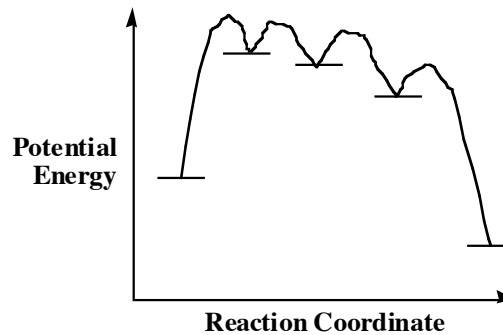
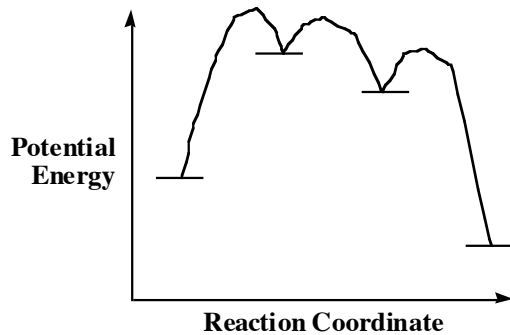
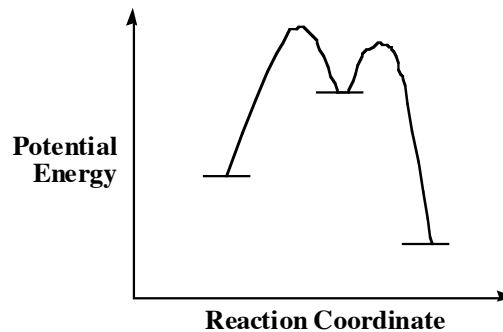
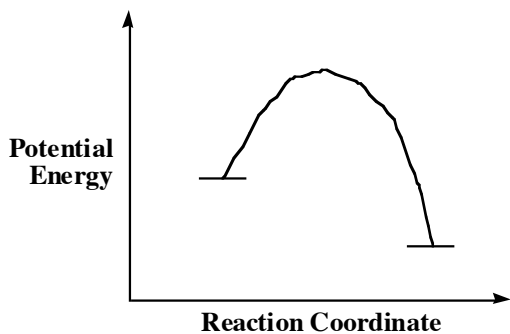


(2 pts) During the reaction described by the above mechanism, say what happens to the pH of the solution _____

Signature _____

Pg. 8 _____ (8)

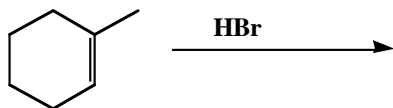
10 (cont.) (8 pts.) **A.** For the reaction mechanism you drew on the previous page, **circle the energy diagram that best describes your mechanism.** Sorry about the lame curves, imagine they are smoother!



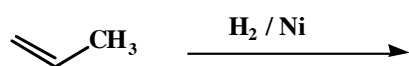
B. Now draw an **X** through the energy diagram that best describes the reaction of an alkene with Cl_2 (with no water in the reaction).

11. (3 or 5 pts each) The following reactions all involve chemistry of alkenes. Fill in the box with the product(s) that are missing from the chemical reaction equations. **Draw only the predominant regioisomer product or products (i.e. Markovnikov or non-Markovnikov products)** and please remember that **you must draw the structures of all the product stereoisomers using wedges and dashes to indicate stereochemistry**. When a racemic mixture is formed, **you must write "racemic"** under both structures **EVEN THOUGH YOU DREW BOTH STRUCTURES**.

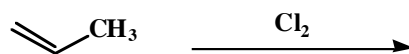
A.



B.

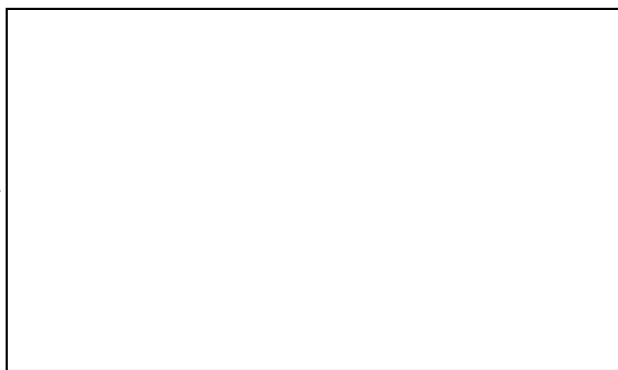
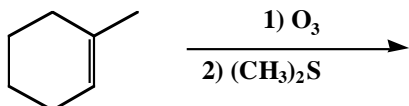


C.

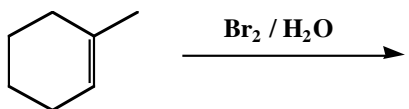


11 (cont.) (3 or 5 pts each) The following reactions all involve chemistry of alkenes. Fill in the box with the product(s) that are missing from the chemical reaction equations. **Draw only the predominant regioisomer product or products (i.e. Markovnikov or non-Markovnikov products)** and please remember that **you must draw the structures of all the product stereoisomers using wedges and dashes to indicate stereochemistry**. When a racemic mixture is formed, **you must write "racemic"** under both structures **EVEN THOUGH YOU DREW BOTH STRUCTURES**.

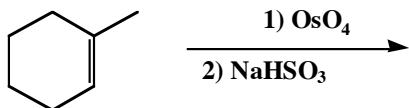
D.



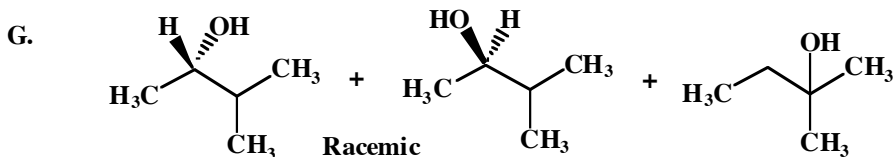
E.



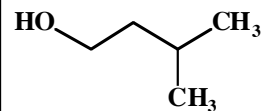
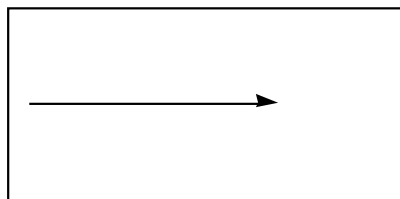
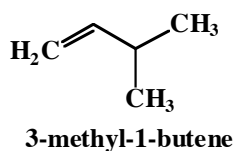
F.



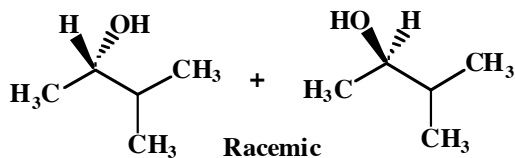
11 (cont.) (11 pts total) When making an alcohol from an alkene it may be important (for physical properties of a desired material or for biological activity of a desired drug) to insert the OH group at a specific carbon with a specific stereochemistry. For instance 3-methyl-1-butene, shown below, can be converted into several types of alcohols depending on what hydration reagent(s) a chemist uses. **In the three boxes below write the reagent(s) that will produce the products shown.** Some boxes may require two steps.



These are the three possible products

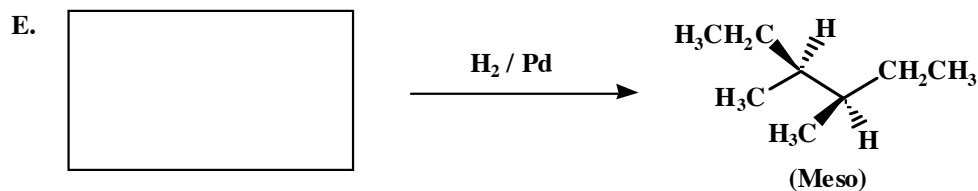
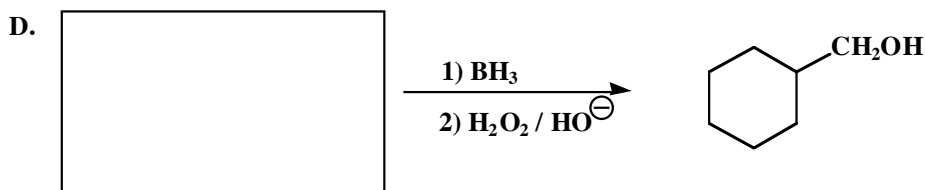
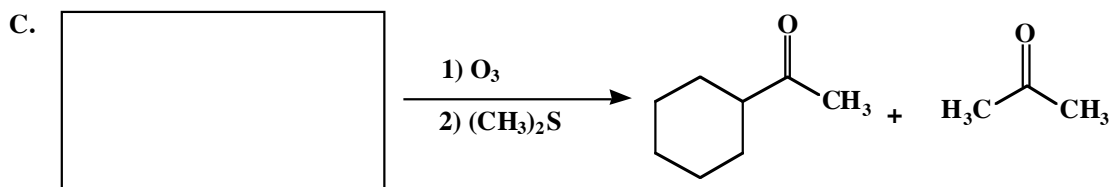
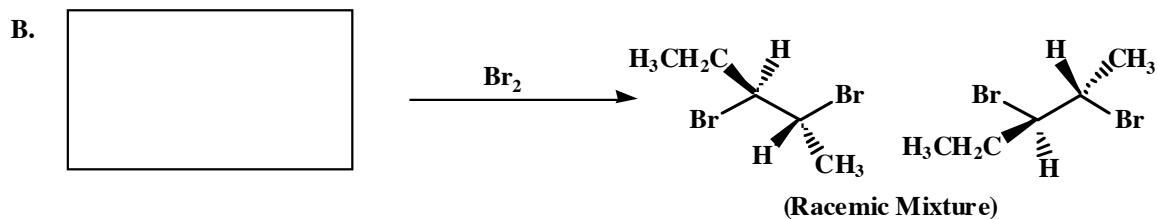
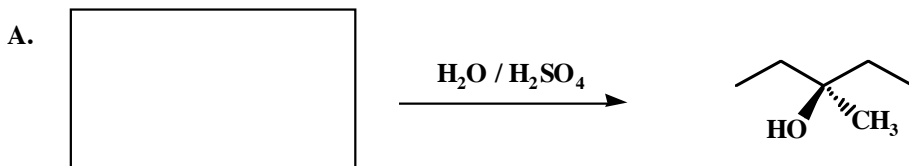


This is the only product



These are the only products

12. (4 pts each) The following problems are a new format. We turn the tables and give you the product. In the space provided show the starting material required to make that product using the given reagents.



Signature _____

Pg 13 _____ (24)

13. (24 pts.) Take your time on this. Use the back of the previous page for scratch paper if that helps. For the following reactions, draw ALL of the stereoisomers of the constitutional isomers produced (i.e. all the different product molecules). If your answer ends up being a little messy, circle all the final structures you want graded.

