

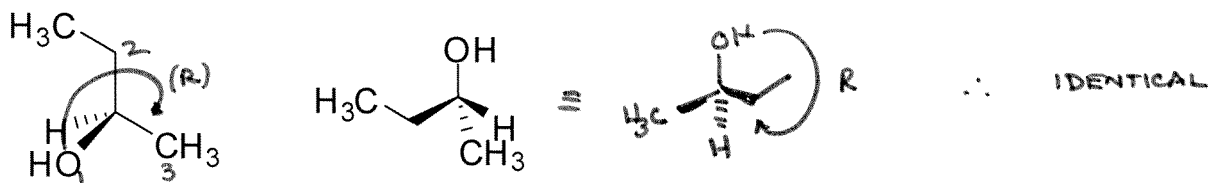
NAME \_\_\_\_\_ ID# \_\_\_\_\_

LAB SECTION (and TA) \_\_\_\_\_

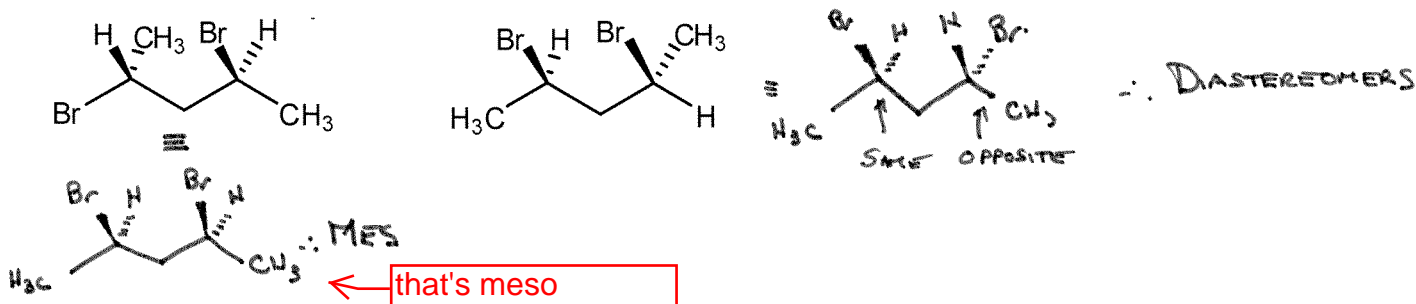
Note: **Please answer on the test paper.** There is an extra sheet for rough work at the back, but it will not be marked unless asked. Tests written in pencil will be marked, but cannot be returned for remarking.

1. Identify the relationship between each of the following pairs (i.e., enantiomers, diastereomers, identical, structural isomers). Are any of the compounds meso forms? If so, indicate which one(s). (total 14 marks)

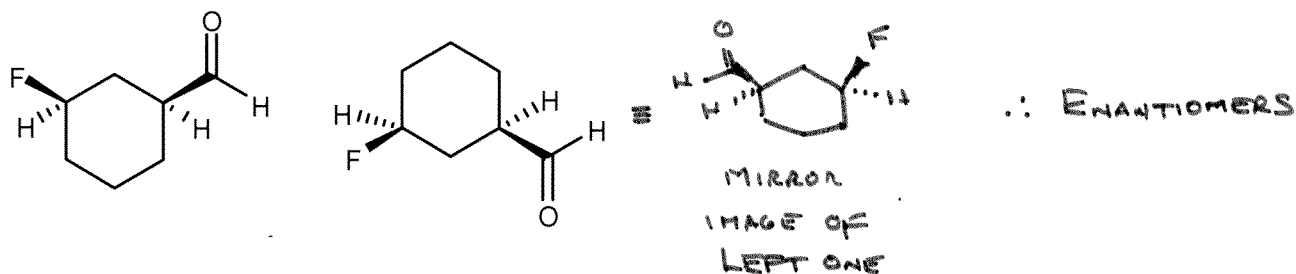
a.



b.

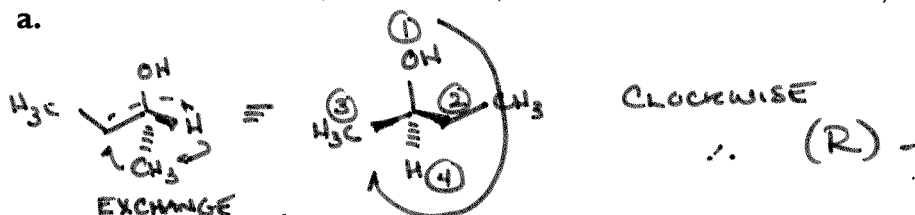


c.

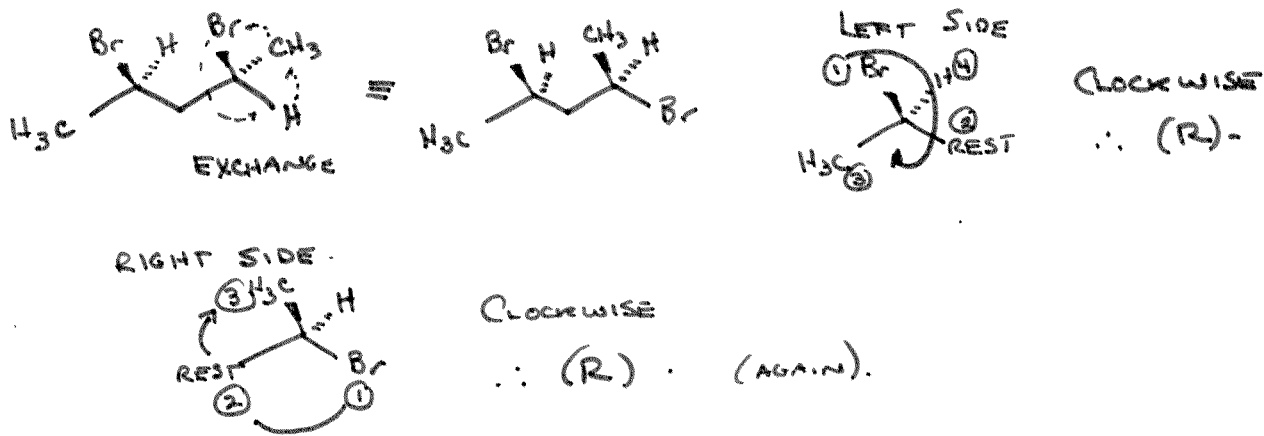


2. For the structures on the **right** side **1a** and **1b** only, identify each chiral centre as (R)- or (S)-. Show how you arrived at your answer (4 marks each centre, total 12)

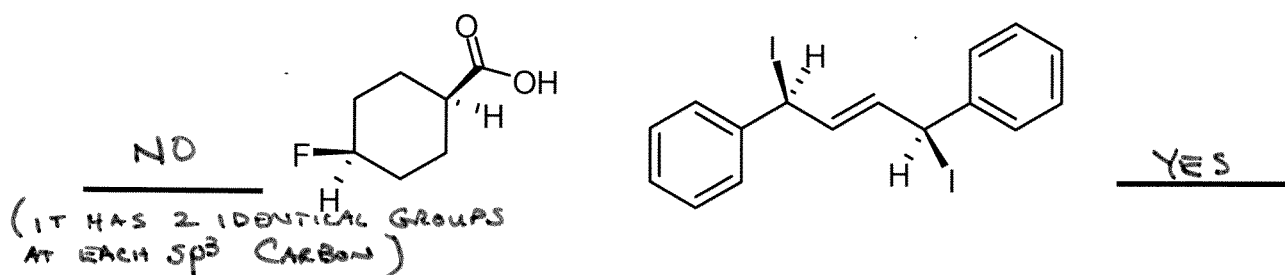
a.



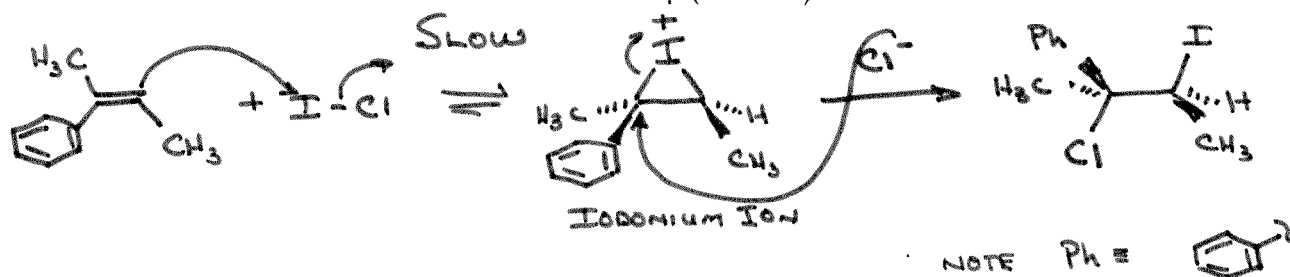
b. ON NEXT pg.



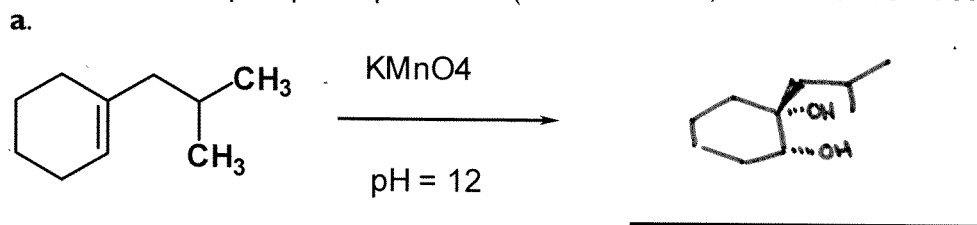
c) Do the following compounds rotate plane polarized light? Answer only yes or no. (4 marks)



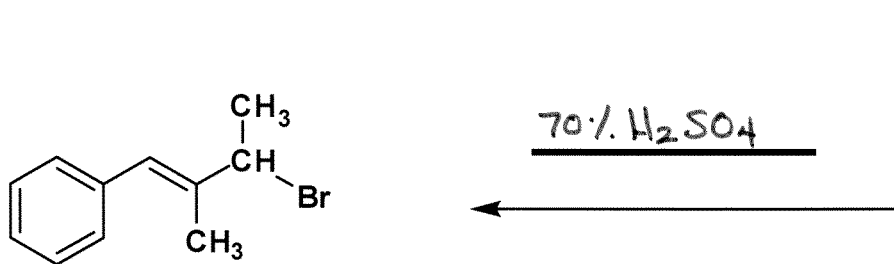
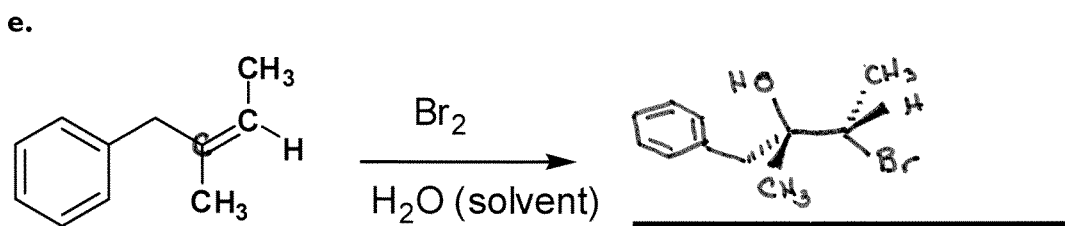
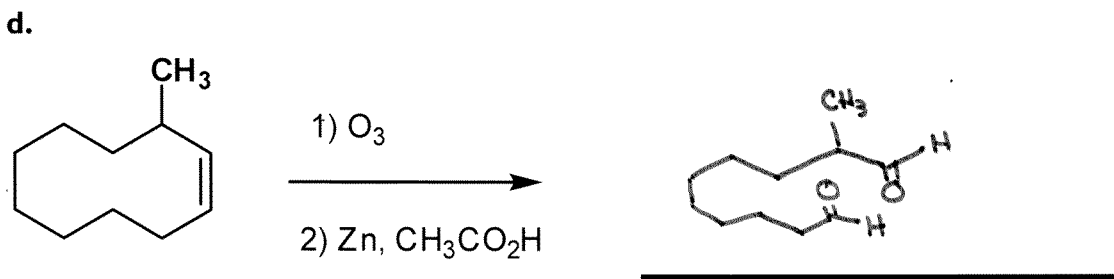
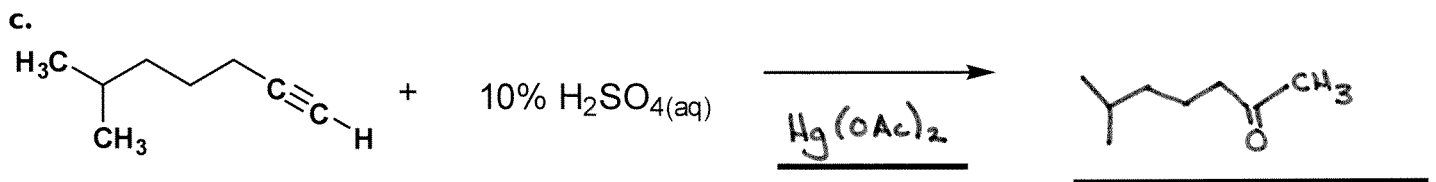
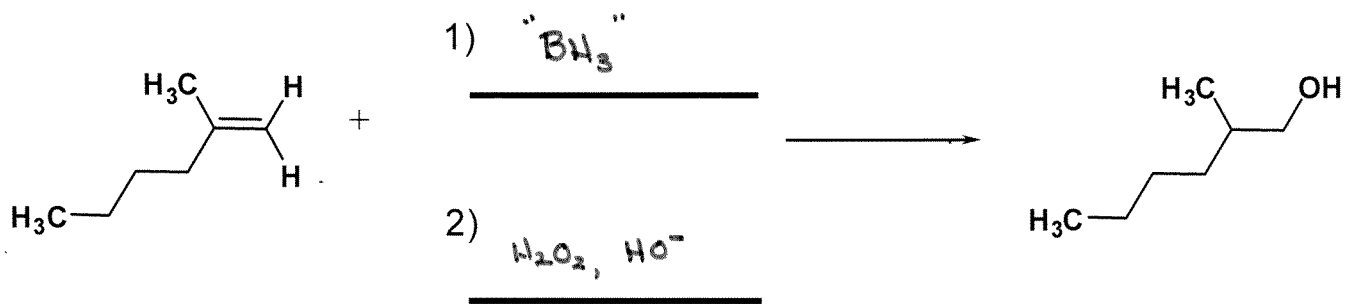
3. Draw the complete mechanism of the acid catalyzed addition of ICl (iodine monochloride) to (Z)-2-phenyl-2-butene. Indicate which is the slow step. (9 marks)



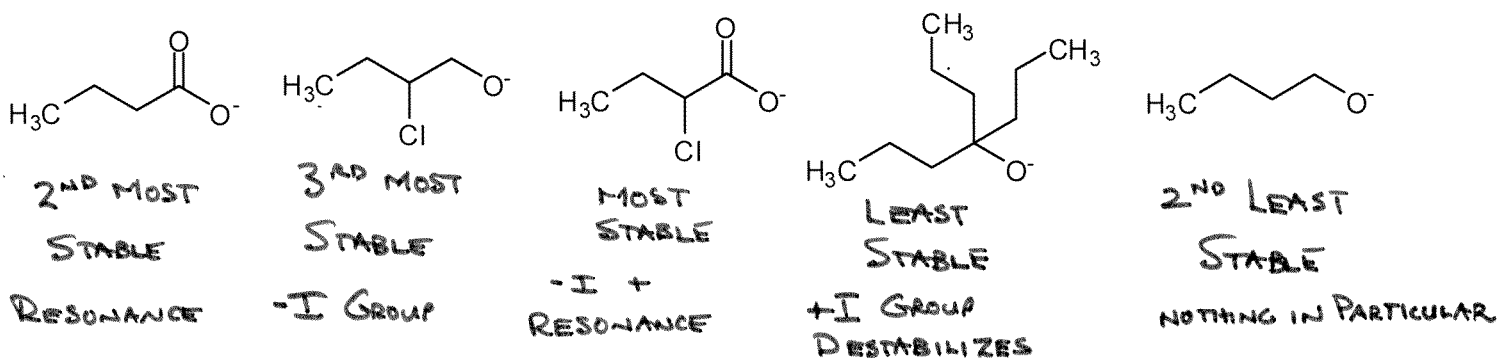
4. For each of the following reactions, fill in the blank with the structural formula of the required chemical. Show any required catalysts or additionally required reagents over the reaction arrow. Be sure to include stereochemistry where it is important. Note: There *may* be more than one reagent or more than one step required per blank. (a-d is worth 5; e is worth 10 - Total 30 marks)



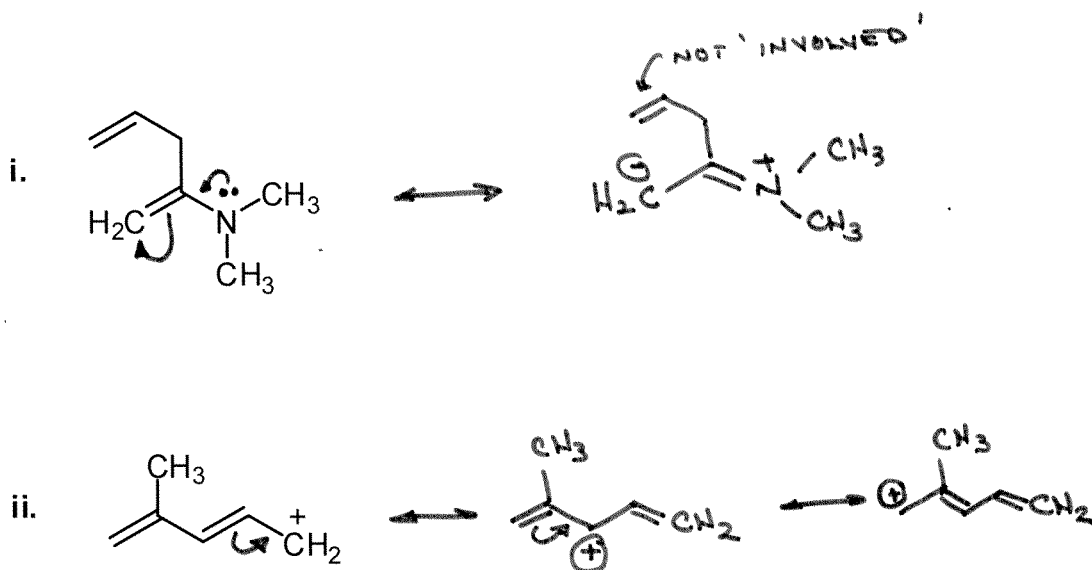
b.



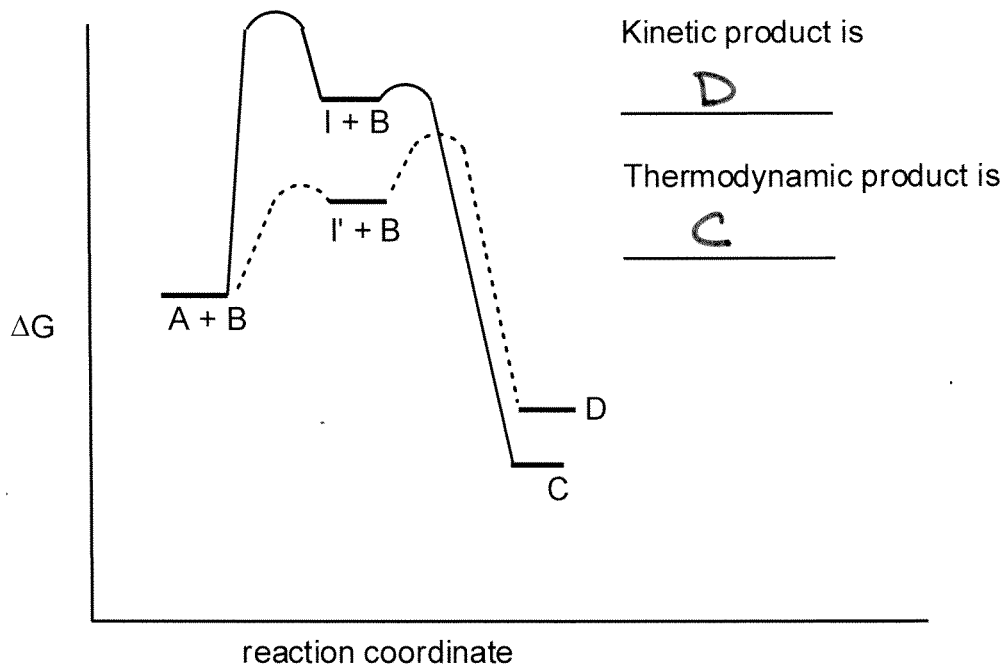
5a) Rank the following anions in terms stability, going from the most to least stable. (4 marks)



b) Draw all reasonable resonance forms for the following structures. For each of these, show the appropriate use of curved arrows demonstrating the electron movement leading to the other resonance forms (9 marks).



6. The following is the energy profile for the two step reaction of  $A + B$  to give  $C$  or  $D$ , competitively. Which product is the kinetic product? Which product is the thermodynamic product? Assuming  $A$  is in each case consumed in the 1<sup>st</sup> step, and  $B$  in each case is consumed in the 2<sup>nd</sup> step, draw the rate equation for the formation of  $C$  and the rate equation for the formation of  $D$ . (8 marks)



form of D rate ( $v$ ) =  $k [A] [B]$

form of C rate ( $v'$ ) =  $k' [A]$

**Bonus.** Instead of an addition reaction, carbonyl compounds such as ketones do a substitution reaction, as long as there is a trace amount of acid to act as a catalyst to get it started. Can you propose a reasonable mechanism for the following? (Up to 5 additional marks... you can continue the answer on the back or an extra sheet)

