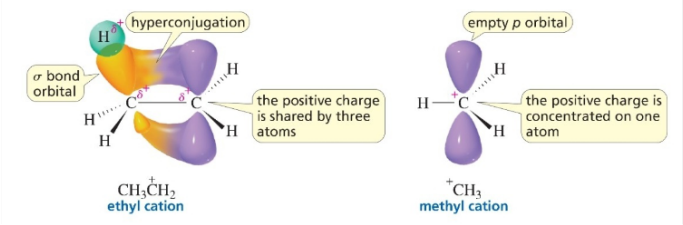
2b 1. Which is more stable: a methyl cation or the ethyl cation and why?

The ethyl cation is more stable since the carbon adjacent to the positively charged carbon has three sigma bond orbitals available for overlap with the vacant p orbital, whereas the methyl cation does not have any sigma bond orbitals available for overlap with the vacant p orbital.
In more simple terms, more carbons are better since there are more places for the electrons to go and delocalize.



4 2. Rank the following carbocations from most stable to least stable. 1 > 2 > 3

a. $CH_3CH_2\overset{\overset{CH_3}{|}}{\overset{+}{C}}CH_3$ (1) $CH_3CH_2\overset{+}{C}HCH_3$ (2) $CH_3CH_2CH_2\overset{+}{C}H_2$ (3)

b. $CH_3\overset{Cl}{\overset{|}{C}}HCH_2\overset{+}{C}H_2$ (2) $CH_3\overset{CH_3}{\overset{|}{C}}HCH_2\overset{+}{C}H_2$ (1) $CH_3\overset{F}{\overset{|}{C}}HCH_2\overset{+}{C}H_2$ (3)

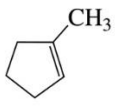
(A) The more R groups the cation is attached to the better.

(B) Halogens decrease the stability of the carbocation because they are electron withdrawing, meaning that the positive charge of the carbocation will become even more positive and very localized. In other words, the halogens withdraw electrons away from the positively charged carbon, increasing the concentration of positive charge on the carbocation which in turn makes the carbocation less stable.

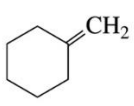
7 3. What is the major product obtained from the addition of HBr to each of the following compounds?

a. $CH_3CH_2CH{=}CH_2$

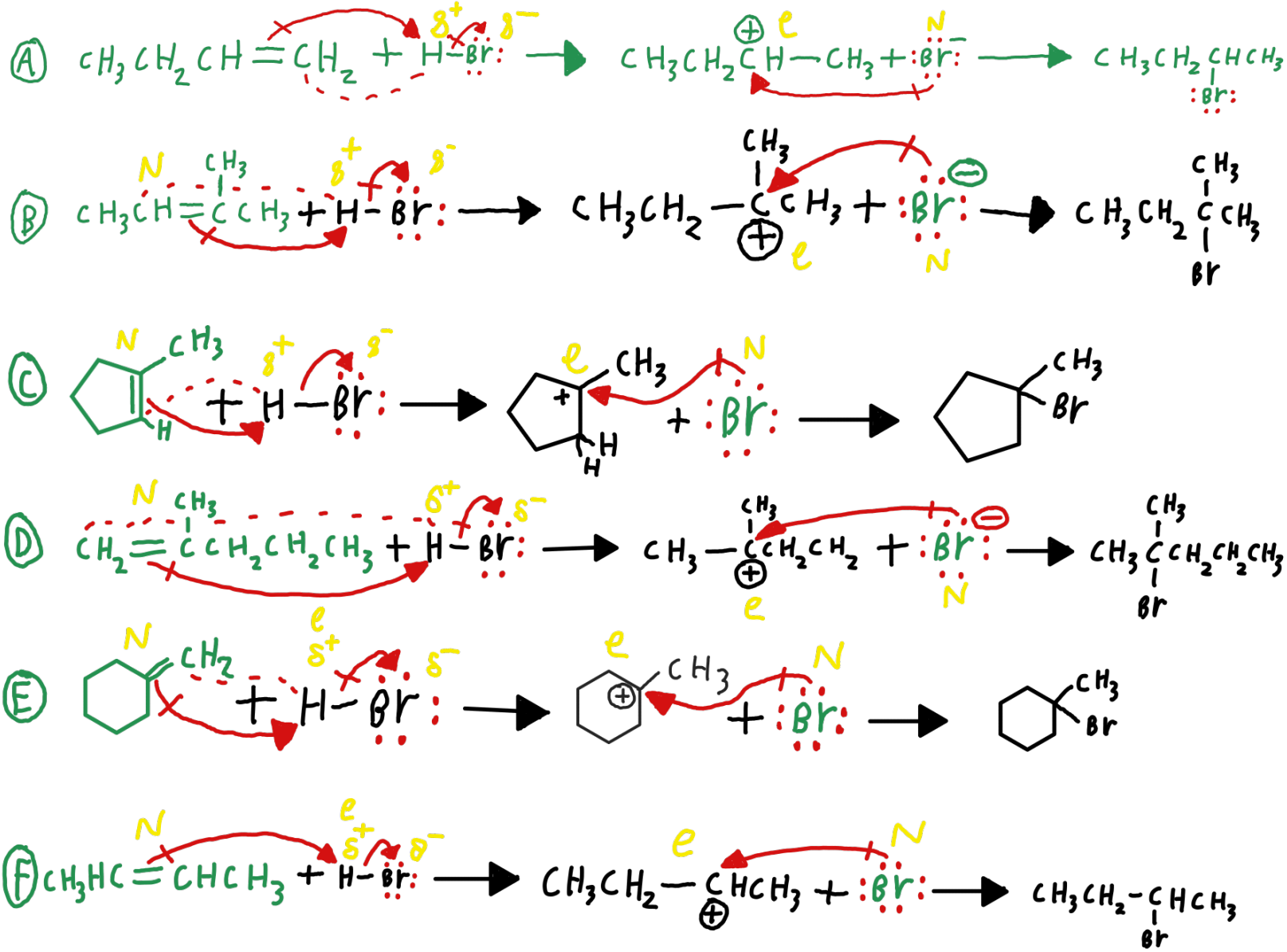
b. $CH_3CH{=}\overset{CH_3}{\overset{|}{C}}CH_3$

c. 

d. $CH_2{=}\overset{CH_3}{\overset{|}{C}}CH_2CH_2CH_3$

e. 

f. $CH_3CH{=}CHCH_3$



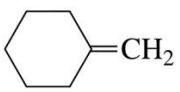
(1) In the 1st step the electrophile is the Hydrogen and the nucleophile is the Alkene.
(2) Remember Markovnikov's rule: The Hydrogen will go the carbon with the most Hydrogens. This rxn is a Markovnikov addition rxn.
(3) In the 2nd step the electrophile is the Alkane and the nucleophile is the Br.
(4) Always draw the electron arrows to justify the reaction.
(5) Show the intermediates and how the carbocation forms

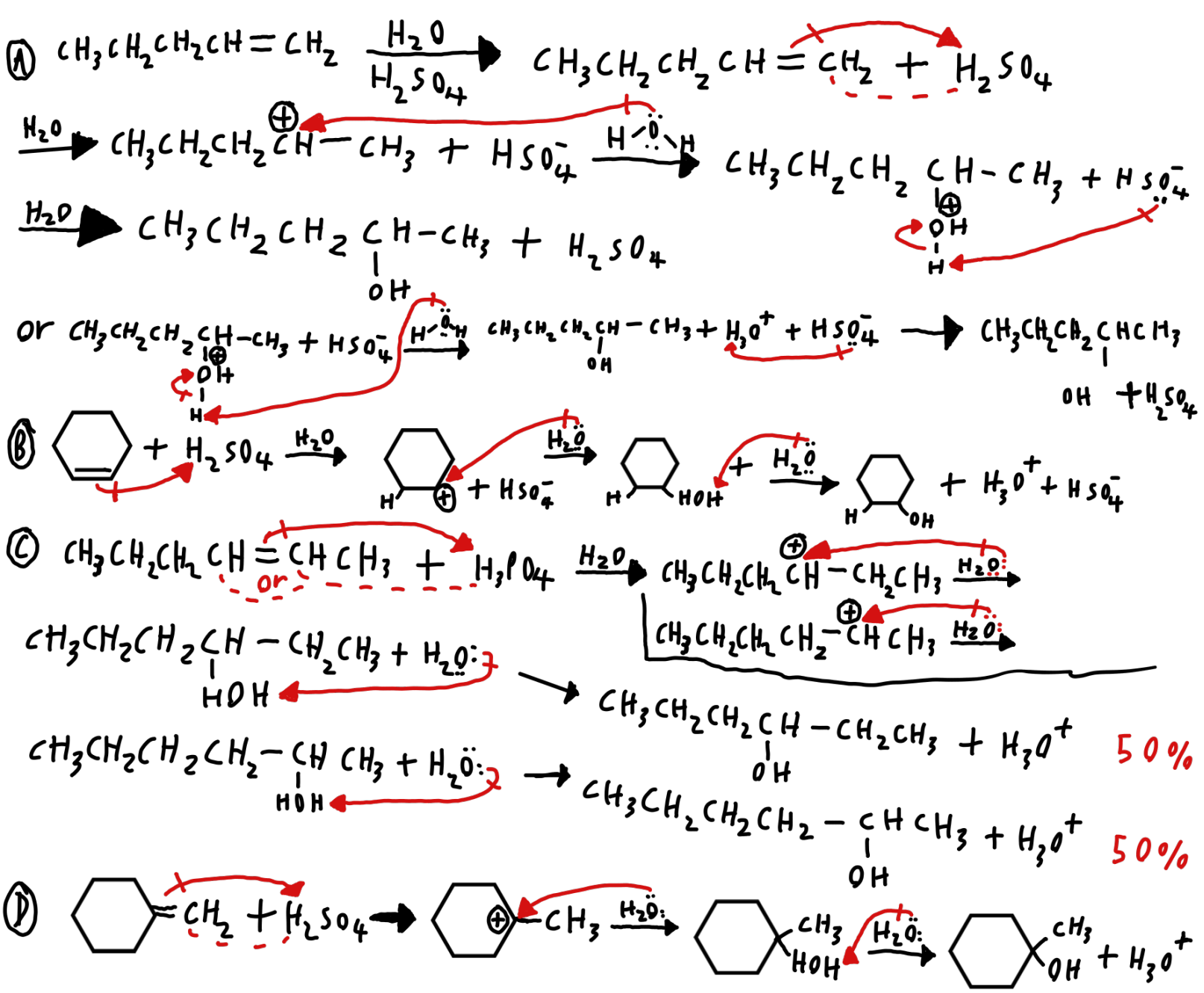
When you see HBr or HCl smile because you know it will be easy. Also, HF or HI will not be used since HF is too reactive and HI is too stable, therefore neither of these will form products. They will just stay in their original form.

11

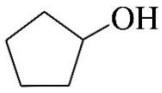
4. What is the major product obtained from the acid-catalyzed hydration of each of the following alkenes?

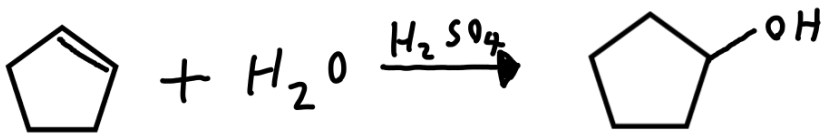
a. $CH_3CH_2CH_2CH{=}CH_2$ **c.** $CH_3CH_2CH_2CH{=}CHCH_3$

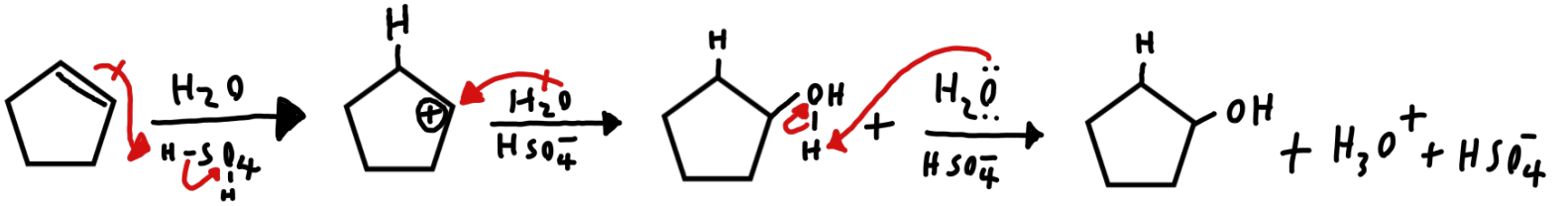
b.  **d.** 



5. How would the following compound be prepared using an alkene as one of the starting materials?



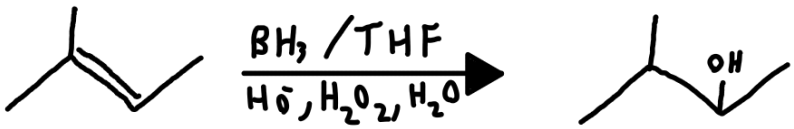




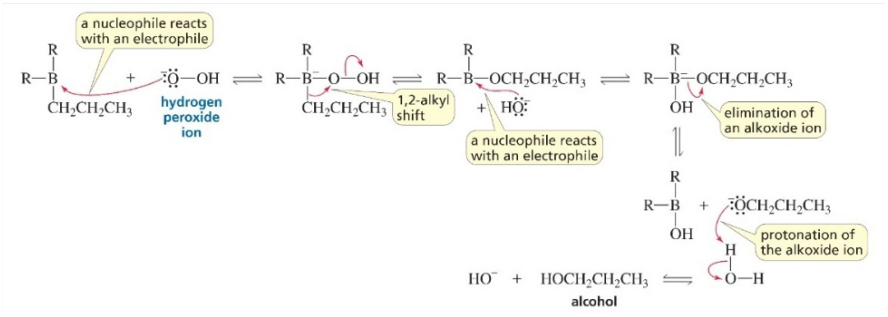
(1) Find an Alkene with the same parent chain and with the double bond in the correct position.
(2) See what substituents you will need to add to the parent hydrocarbon.
(3) Choose the correct Reactants and solvents and/or catalysts to complete the rxn.

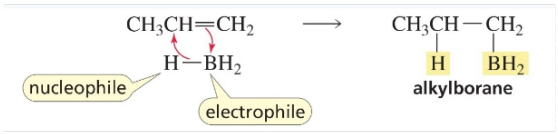
19 A

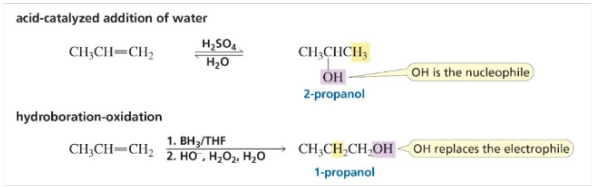
6. What is the major product obtained from the hydroboration-oxidation of 2-methyl-2-butene?



(1) Hydroboration and Oxidation is an Anti-Markovnikov addition reaction meaning the OH group will go on the carbon with the most Hydrogens.
(2) Other than that, the rxn proceeds as a hydration rxn



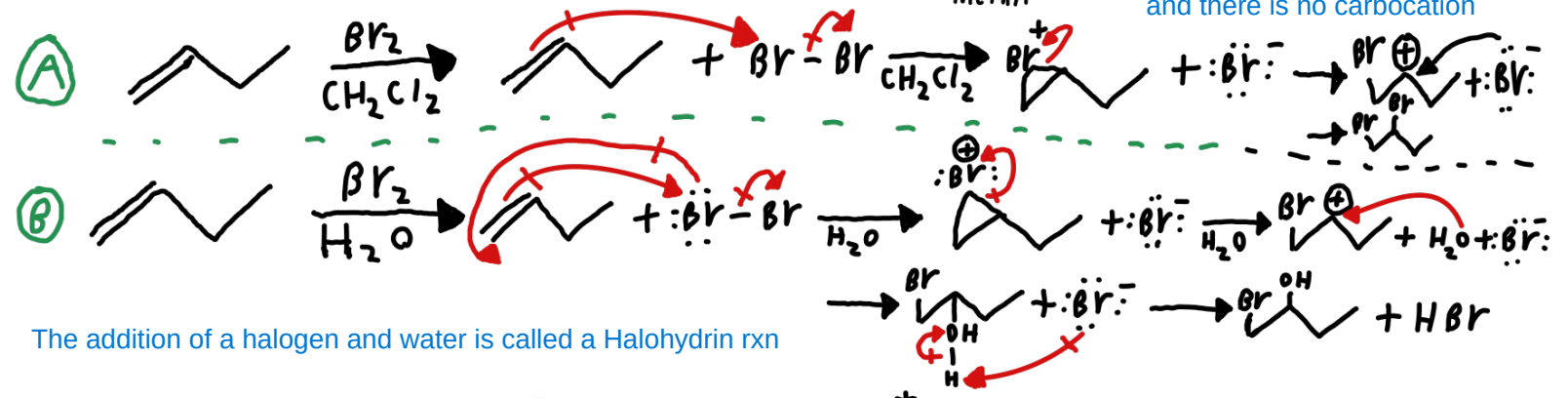




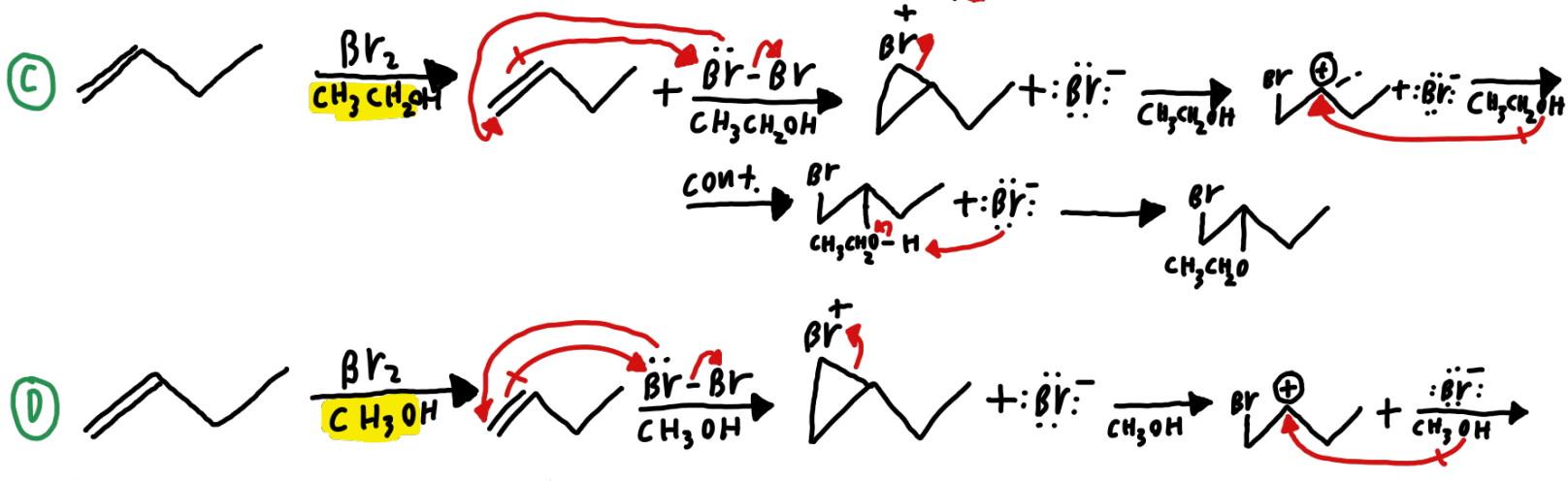
25

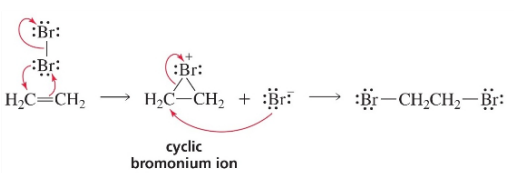
7. What is the major product obtained from the reaction of Br2 with 1-butene if the reaction is carried out in
   a) Dichloromethane b) water c) ethyl alcohol d) ~~ethyl~~ methyl alcohol

DiHalogen rxns form in one step and there is no carbocation



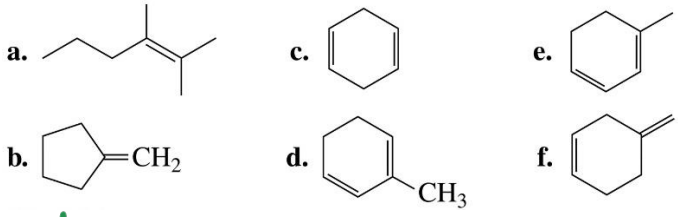
The addition of a halogen and water is called a Halohydrin rxn

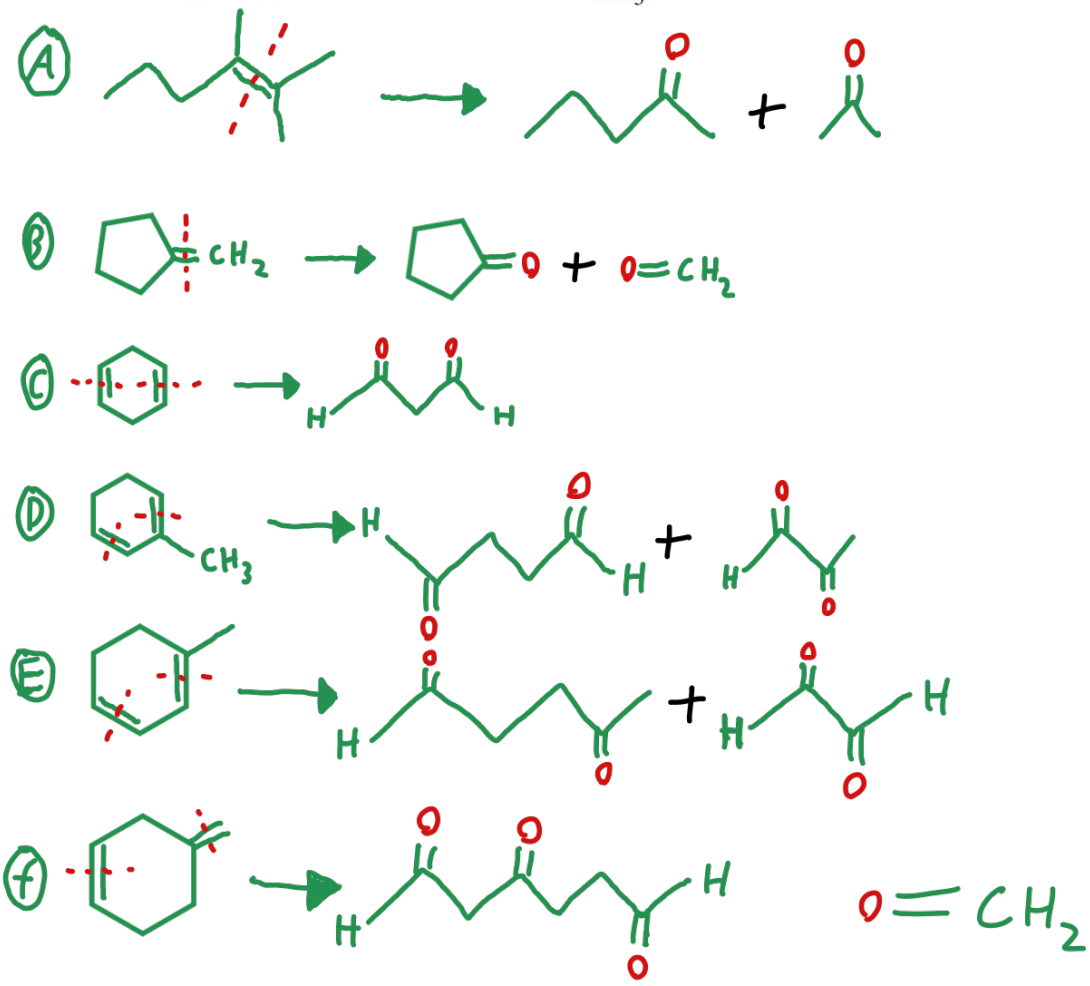




30

8. What products are formed when the following react with ozone and then with $(CH_3)_2SO$?



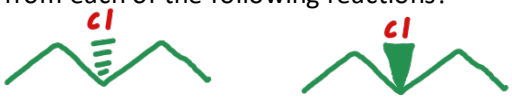


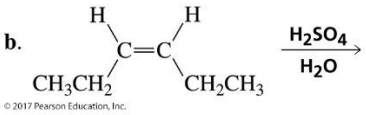
(1) Cut the double bonds in half
(2) Replace the double bonds that are split in half with double bonded Oxygens

37

9. What stereoisomers are obtained from each of the following reactions?

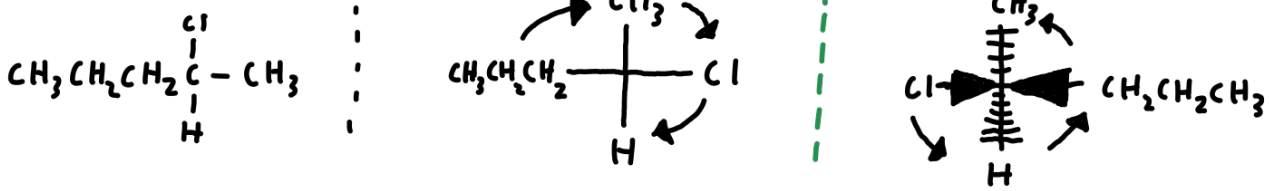
a. $CH_3CH_2CH_2CH{=}CH_2 \xrightarrow{HCl}$

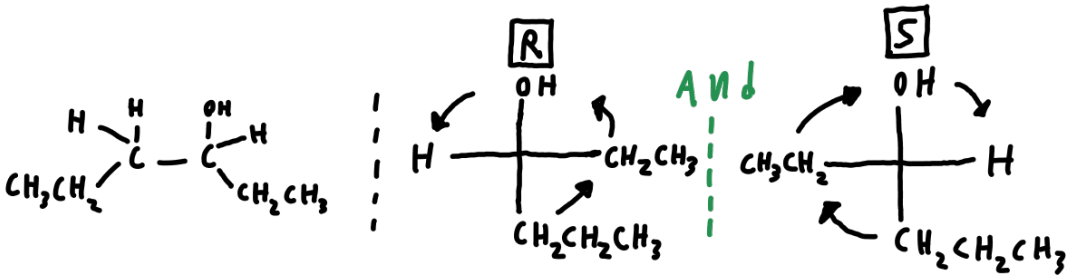


b. 

$\xrightarrow[H_2O]{H_2SO_4}$

Both these reactions will form racemic mixtures of 2 stereoisomers

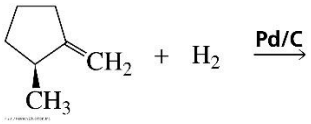
(A) 

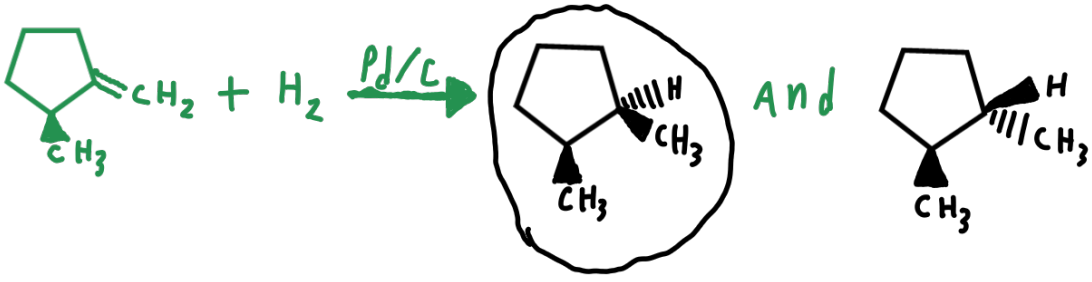
(B) 

These reactions will form a racemic mixture which contains equal amounts of a pair of enantiomers.
A racemic mixture is formed by any reaction that forms a product with an asymmetric center forma reactant that does not have an asymmetric center. (Note: both of these reactants have asymmetric centers, therefore they will form a Racemic mixture.)
(1) To draw both enantiomers simply draw the mirror image using a Ficher projection or a
(2) Use the 2^n where n is the number of asymmetric centers. That will give you the number of stereoisomers that can form.
If a reaction is Regioselective it means it prefers one constitutional Isomer over the other.
If a reaction is Stereoselective it means it prefers one steroisomer over the other.

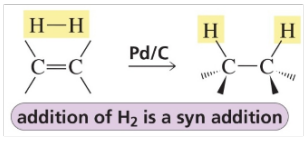
40

10. What stereoisomer is formed in greater yield?



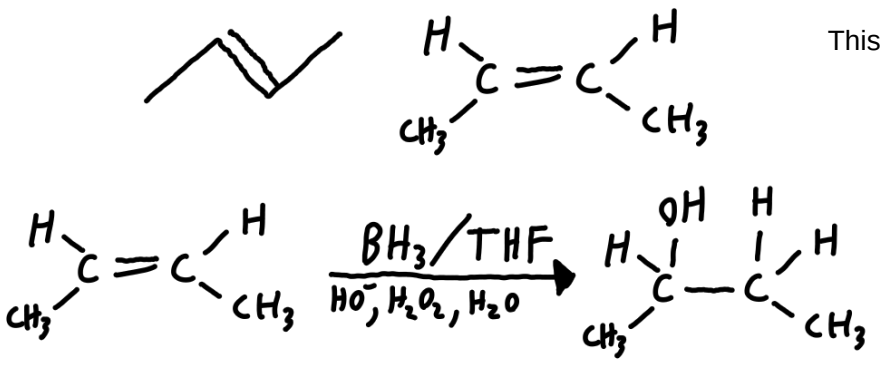


(1) Replace the double bonds with Hydrogens
(2) Apply Stereochemistry by switching the ways the groups go in or out of the page
(3) Draw the enantiomers if possible

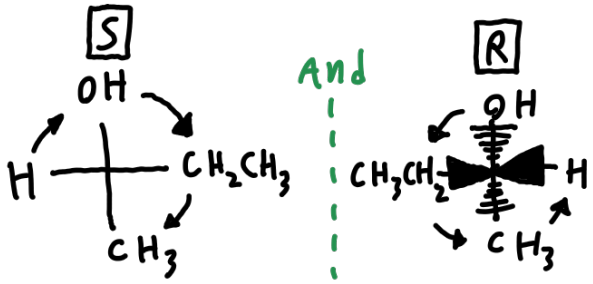


4.2 C

11. What stereoisomers are obtained from the hydroboration-oxidation of cis-2-butene? Assign an R or S configuration to each asymmetric center.



This will for a racemic mixture of 2 stereoisomers



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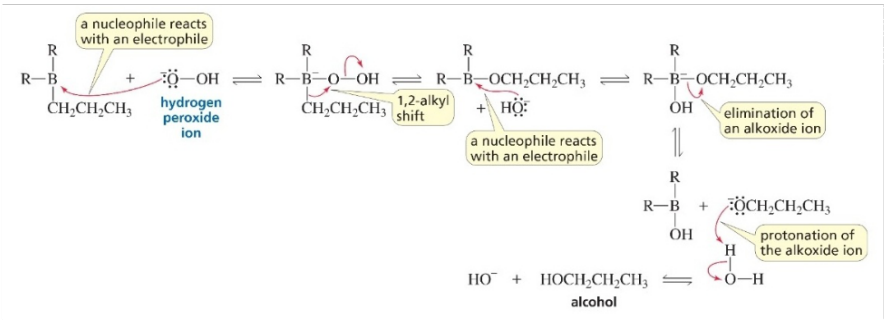
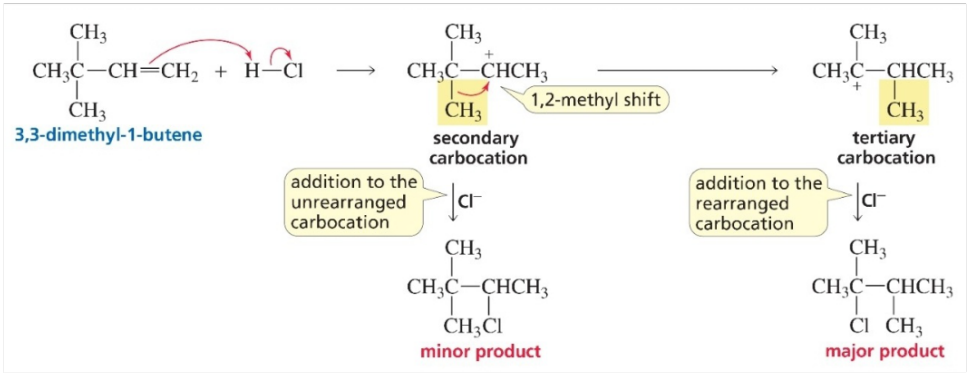
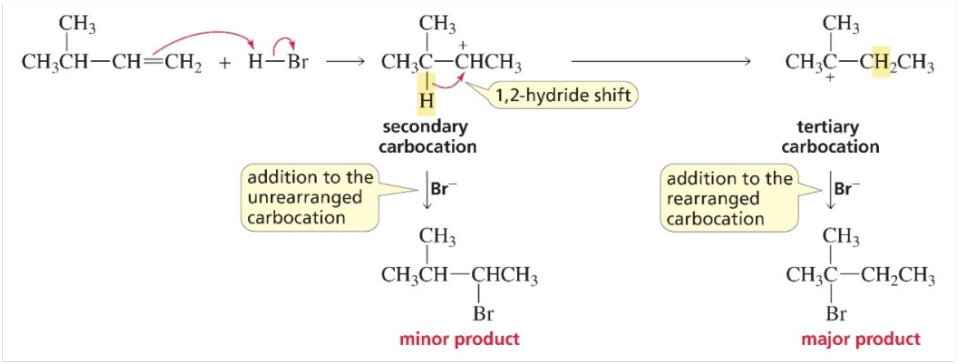


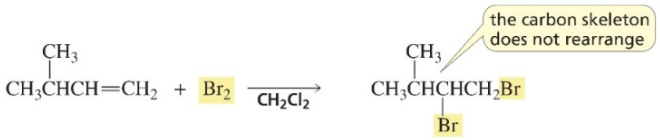
Problem 4 explanation

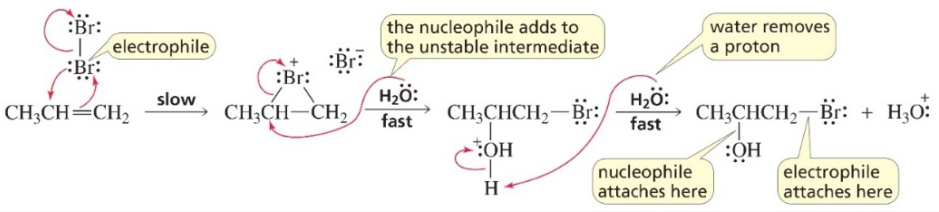
(1) For acid catalyzed rxns, remember that they CANNOT proceed without an acid catalyst.
(2) The acid catalyst always donates the proton and is the electrophile while the Alkene is the nucleophile
(3) The electrophile intermediate formed will then be attached by the H2O
(4) One of the protons on the H2O will be grabbed by the acid catalyst or another H2O molecule to make H3O+. Either way the acid catalyst MUST be regenerated in the end of the reaction.



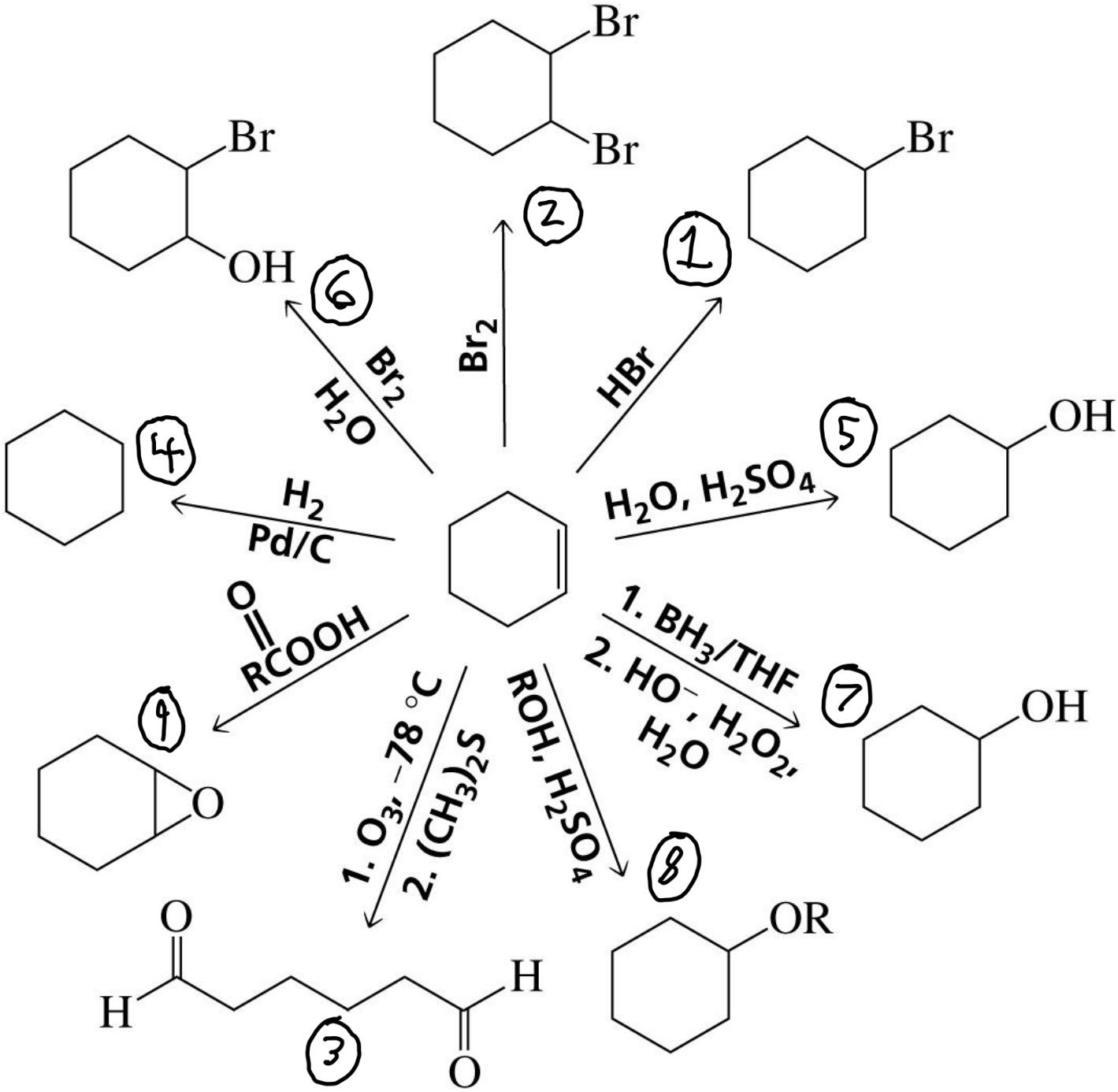


Because a carbocation is not formed when Br_2 or Cl_2 adds to an alkene, carbocation rearrangements do not occur in these reactions.





Summary of reactions WITHOUT stereochemistry



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