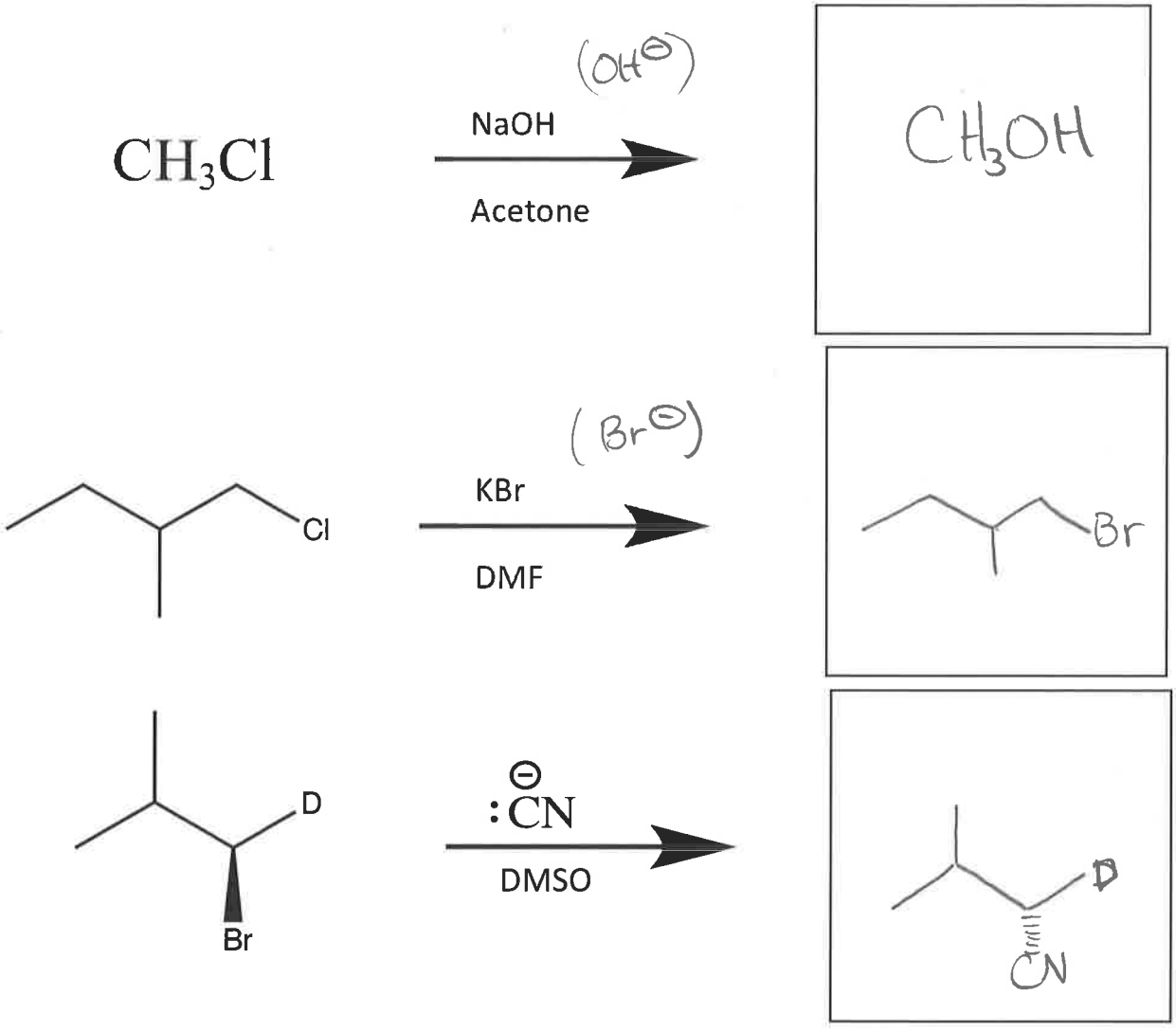
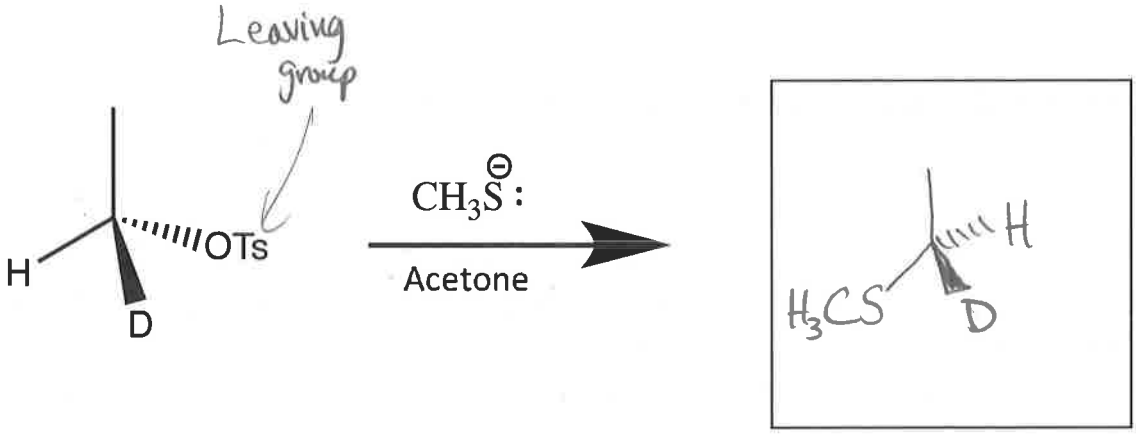
Substitution/Elimination #2: S_N2, E2, S_N1, E1 Practice

Hey, gang. To date, we've discussed the two types of both substitution and elimination reactions and their corresponding mechanisms. Now, this worksheet will aim to help you get more comfortable with drawing the reaction mechanisms as well as recognizing and completing these reactions. In the future, you will have to identify whether a reaction is either S_N2, E2, S_N1, or E1, but for now I'm going to tell you what the reaction type is.

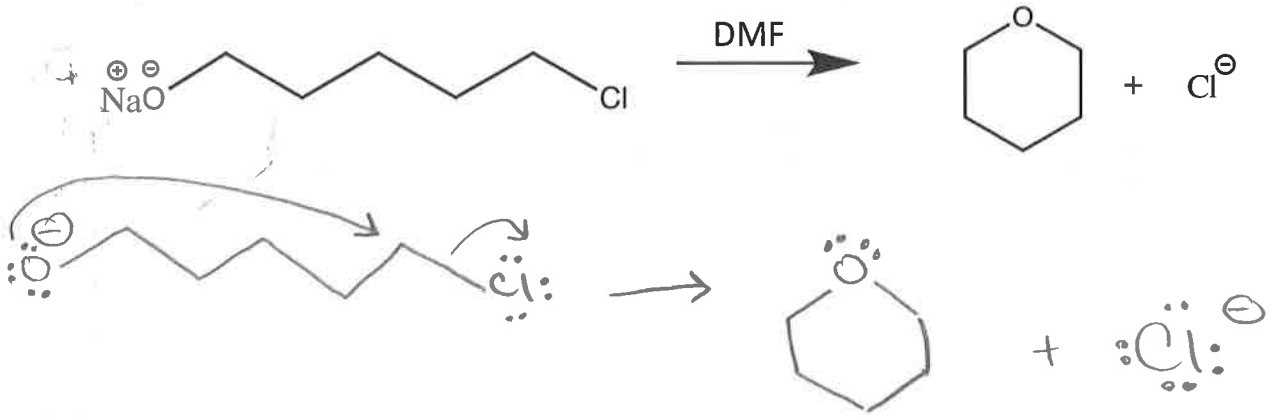
S_N2

Given the S_N2 reaction below, predict the product. If stereochemistry is present on the atom being attacked, remember to correctly invert the stereocenter in the product.





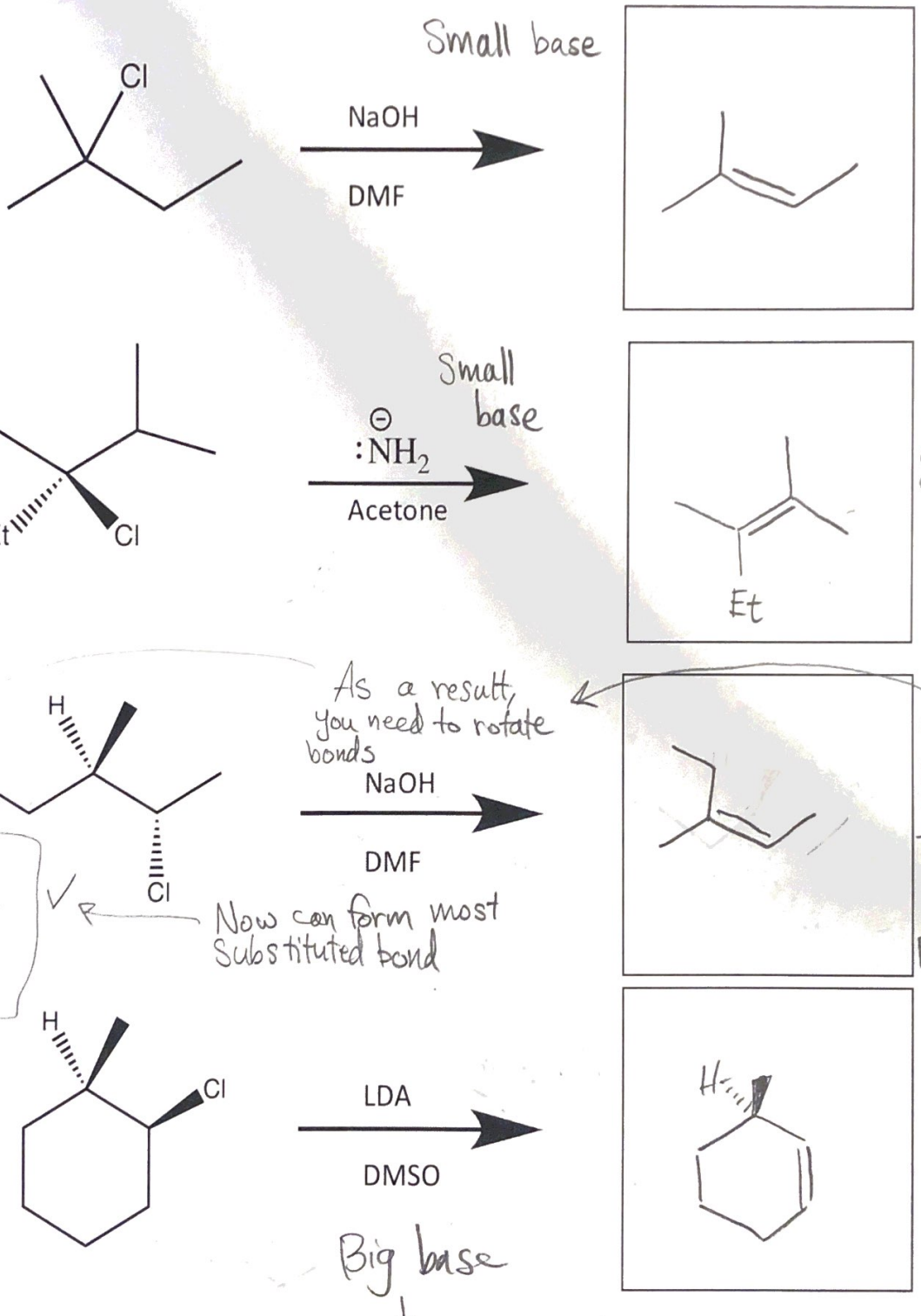
Given the following S_N2 reaction, draw the correct arrow-pushing mechanism ***AND*** reaction energy diagram that illustrates the chemistry.



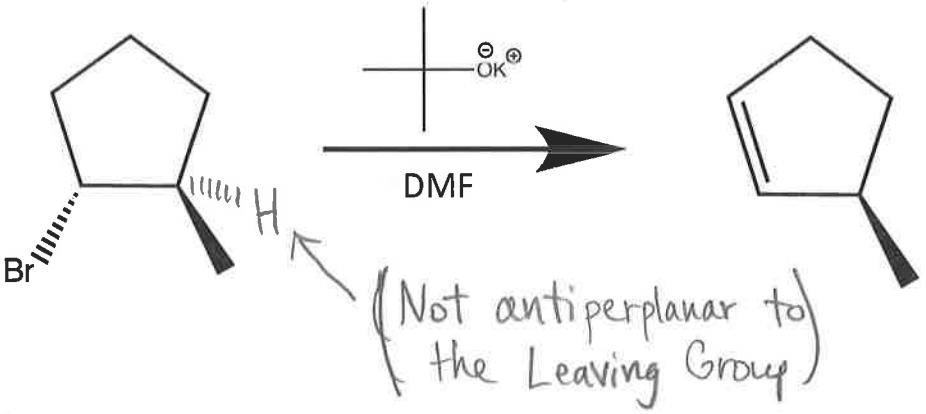
* Concerted Mechanism (1 step)
  - One "bump" on the E-diagram
  - Exothermic

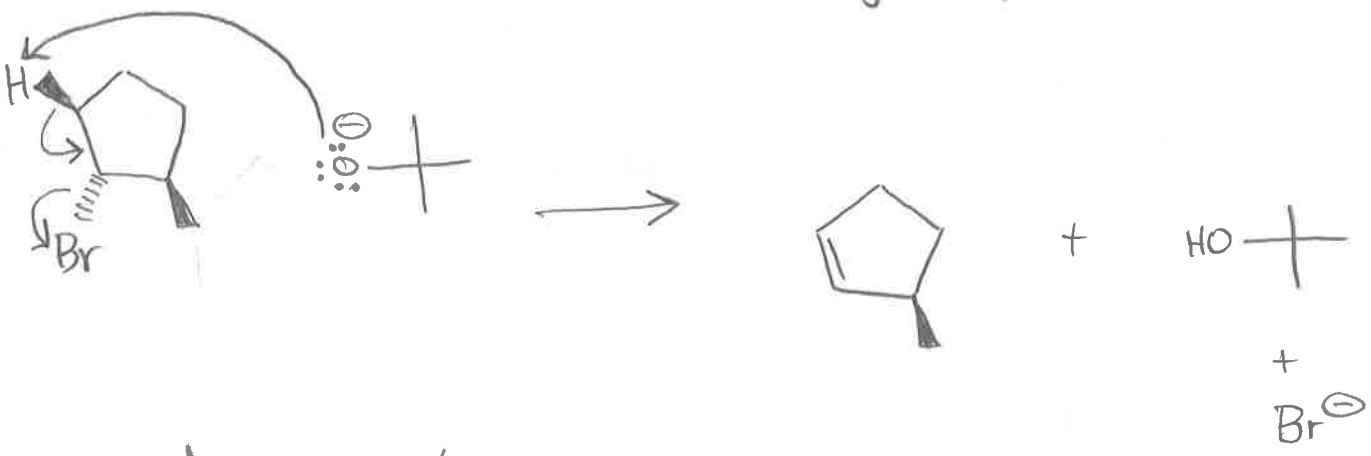
E2

Given the E2 reaction below, predict the product. *Remember how the size of the strong base affects the placement of the double bond in the favored product*

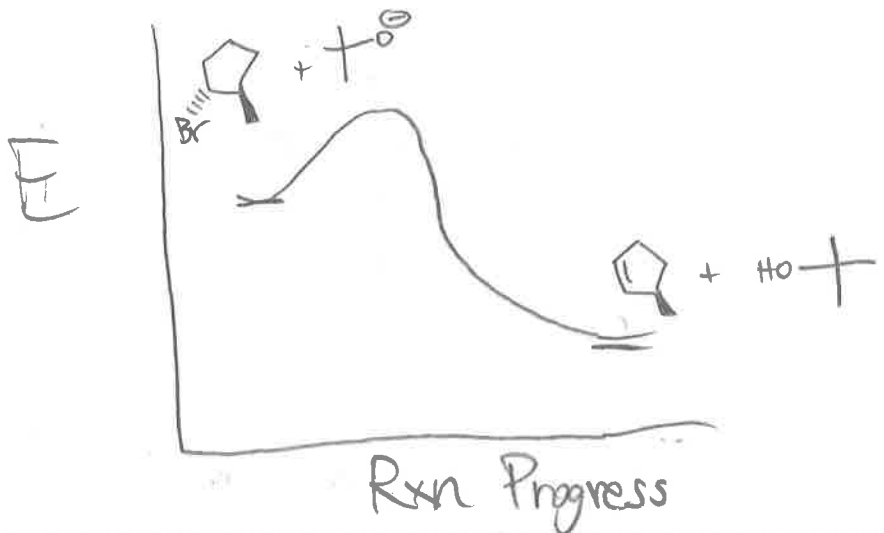


Given the following E2 reaction, draw the correct arrow-pushing mechanism ***AND*** reaction energy diagram that illustrates the chemistry. Explain why the double bond that forms, forms (hint: this condition must always be satisfied when performing E2).



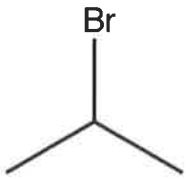


- Concerted Mech. (one step)
  - One "bump" on the E-diagram
  - Exothermic

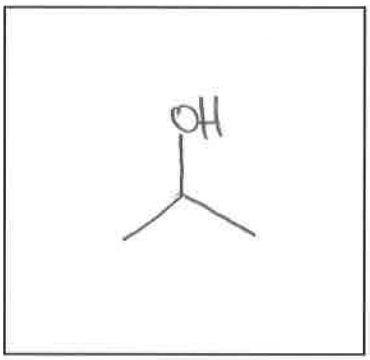


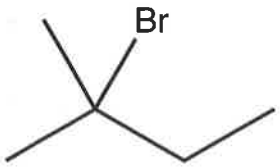
S_N1

Given the S_N1 reaction below, predict the product. If a racemic mixture would be produced in the reaction, indicate that by use of a squiggly line (remember, we discussed this?).

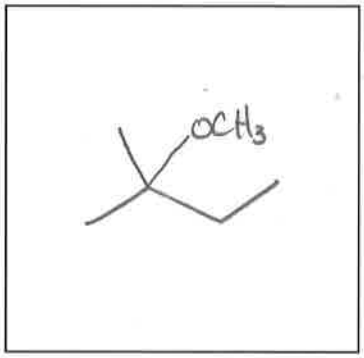


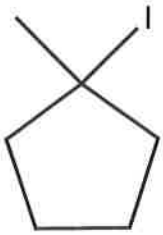
H_2O

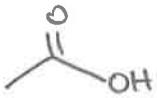




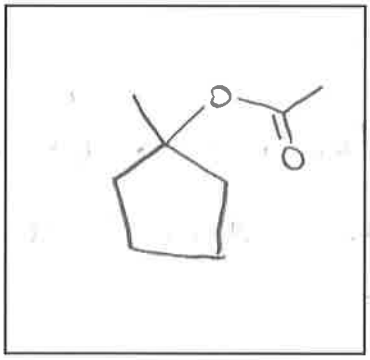
CH_3OH

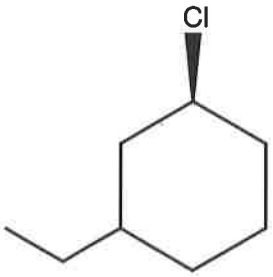




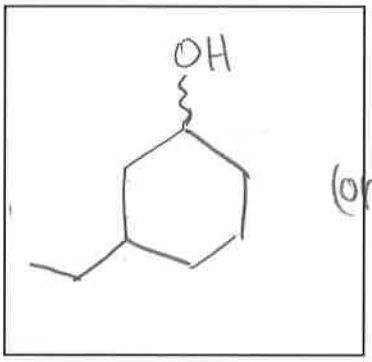


CH_3COOH

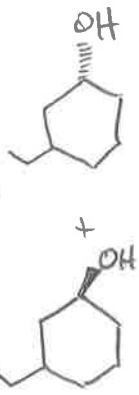


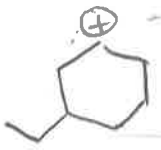


H_2O



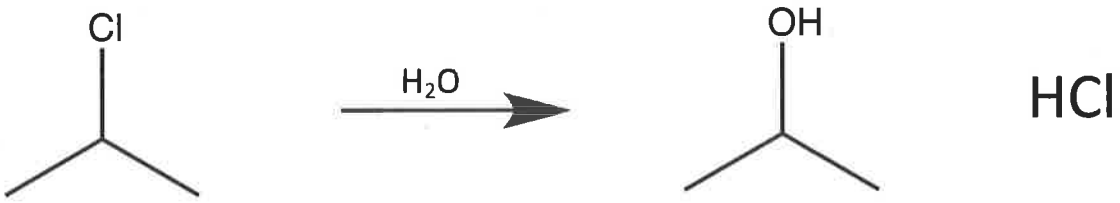
(or)

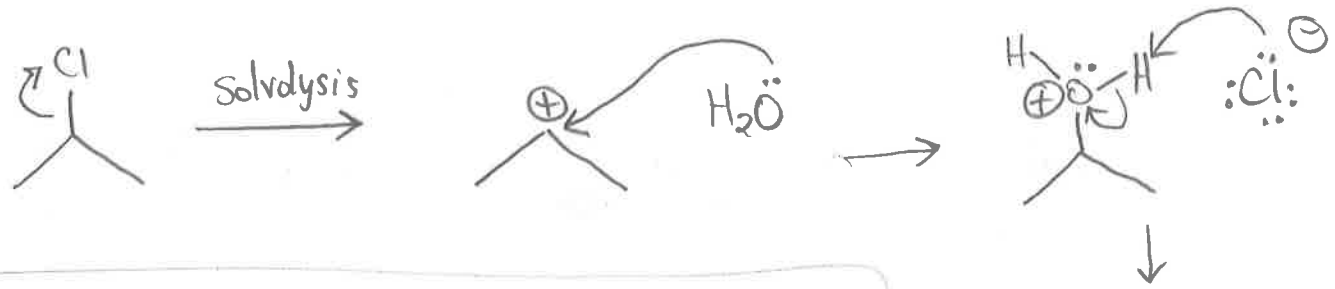




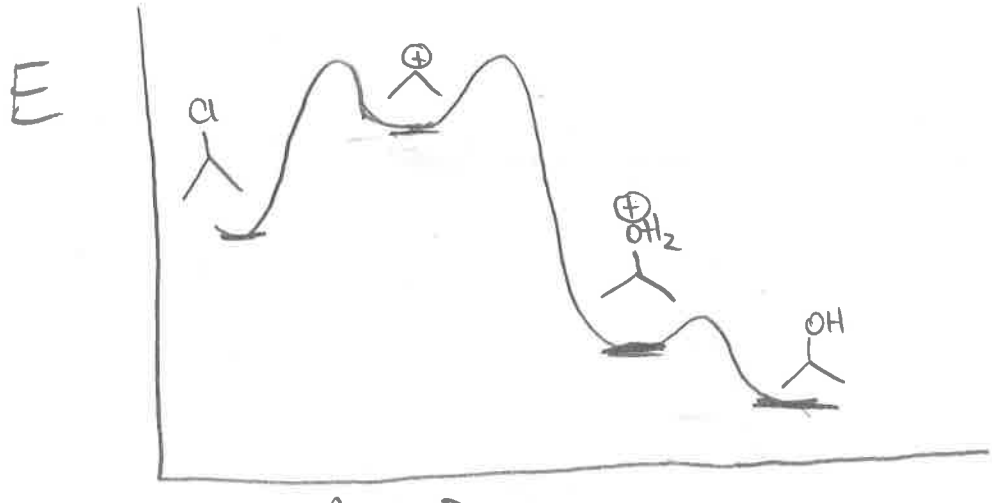
Flat, so attack happens on top & bottom (racemic)

Given the following S_N1 reaction, draw the correct arrow-pushing mechanism ***AND*** reaction energy diagram that illustrates the chemistry. Explain why the energy diagram differs from the typical shape of an S_N2 reaction diagram.



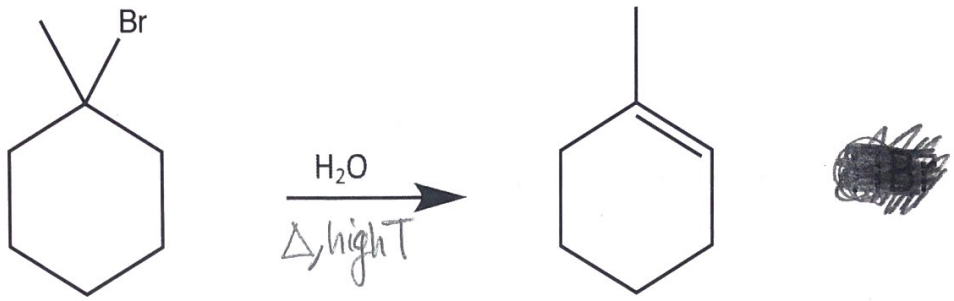


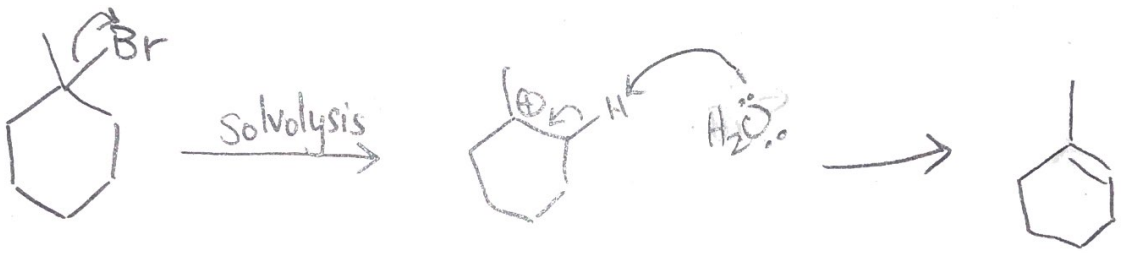
- 3 "bumps"
  - Endothermic step: solvolysis
  - Exothermic step: nucleophilic attack
  - Small Exothermic step: Acid-Base clean up



E1

As we discussed in the video regarding S_N1, there is always a small amount of E1 product made during the course of an S_N1 reaction. Understanding that the reaction below favors S_N1, ***draw*** the E1 mechanism responsible for producing the minor product listed below. In addition, draw a reaction diagram illustrating the E1 mechanism in this reaction.





- 2 "Bumps"
  - Endothermic step: Solvolysis
  - Exothermic step: Elimination/proton abstraction