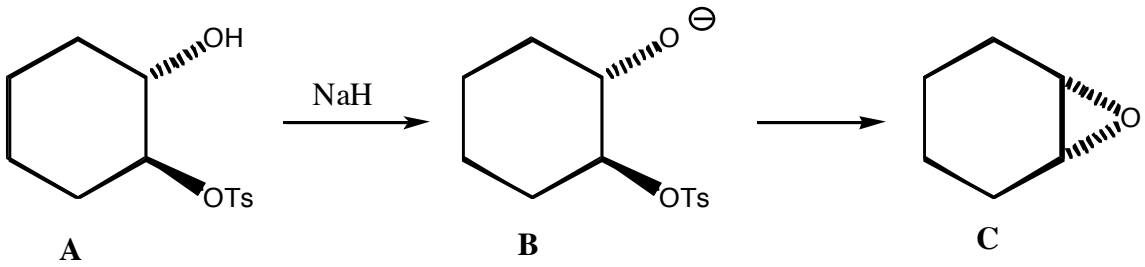
Problem 65, Chemistry 301X - 2006

Let's revisit problem 1a from Exam 2, 2004 and analyze the energetics of the reaction.

(a) We first added sodium hydride to alcohol **A** in order to deprotonate the alcohol. This process is highly exothermic. Write a full mechanism for this process (**A**→**B**) showing ALL products and sketch an energy vs. reaction progress diagram for the reaction.



A **B** **C**

(b) When sodium hydride deprotonates something, it does so irreversibly. Eexplain why this reaction is irreversable. What is the difference between deprotonation by NaH and KOH?

(c) In the next step of the reaction, the alkoxide B displaced the tosylate to form epoxide **C** in another exothermic reaction. Looking at gloriously detailed 3-D drawings of the chair forms of **B**, you no doubt observed that for the reaction to proceed by an S_N2 mechanism, **B** had to adopt its less stable chair conformation. On a new energy vs. reaction progress diagram, depict the dynamic equilibrium between these two chairs. Now amend this diagram to include the highly exothermic reaction that forms epoxide **C**.

(d) Using your diagram from part (c), explain why this reaction "works" even though you never have very much of the reactive chair in the flask relative to the unreactive chair. This is a Fundamental Concept in chemistry. Call a TA to your table before you move to the next question. Make sure a randomly selected member of your group will be able to explain this concept to the TA.