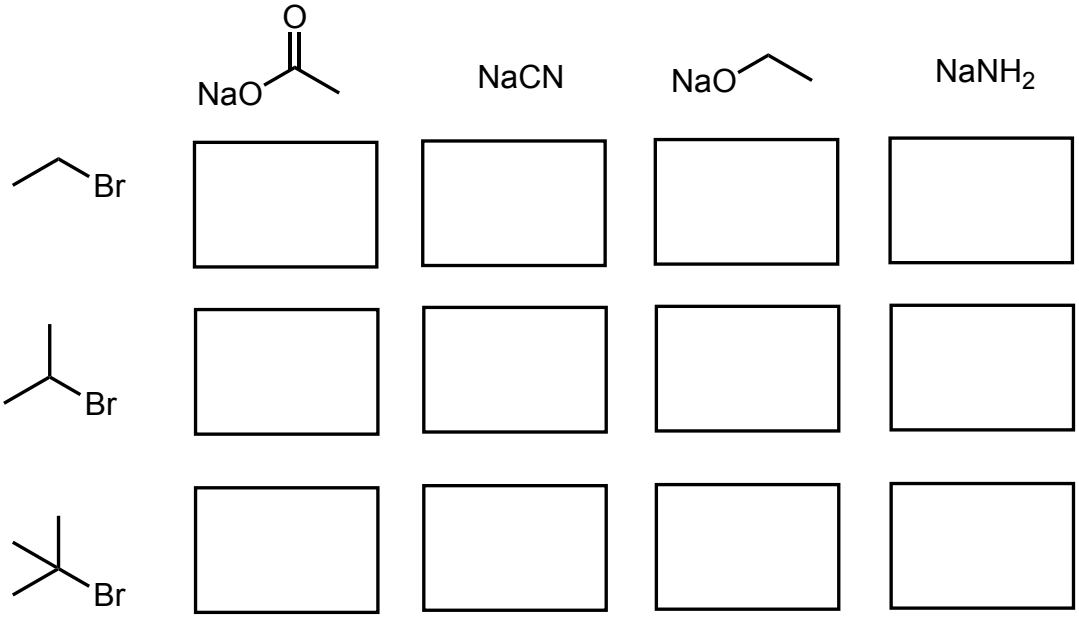
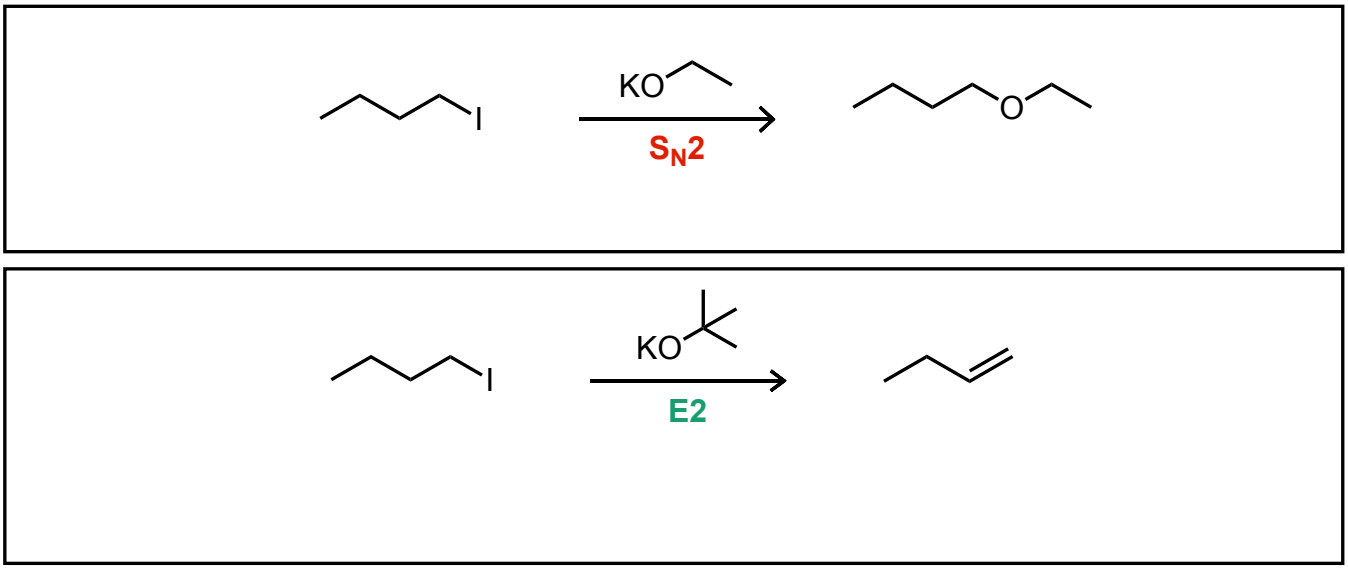
## *Substitution and Elimination*

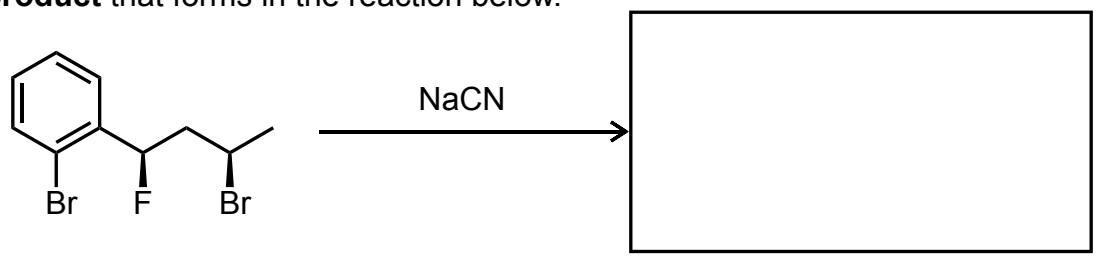
1. A. **Classify each alkyl halide** as being primary, secondary, or tertiary
   B. **Identify the weakest Lewis base** and **strongest Lewis base**
   C. In the boxes provided, **predict** if a **$S_N2$, E2,** or **no reaction** will proceed between each alkyl halide and Lewis base pair



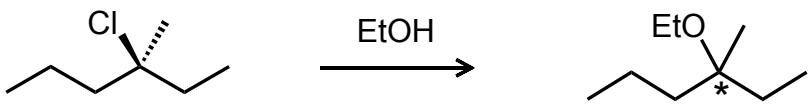

2. A. Draw the curved arrow mechanism for each reaction below.
   B. Explain why $S_N2$ occurs in the top reaction, but E2 occurs in the bottom reaction.




3. **Draw the product** that forms in the reaction below.



4. The reaction below is deliberately excluded from the Core Concept's flowchart. Answer the questions below to help you classify the reaction as $S_N2$, E2, $S_N1$, or E1.

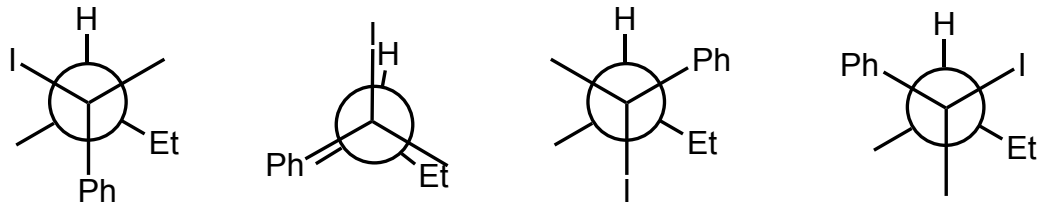



A. **Do we observe inversion, retention, or racemization of chirality** when comparing the product to the starting material?

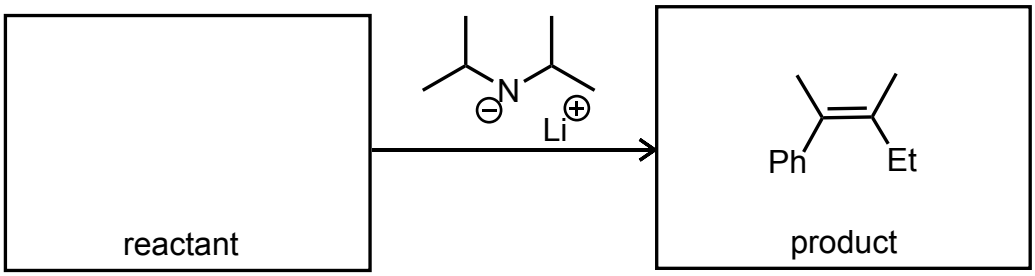
B. Is this process **stepwise** or **concerted**? Consider the reagents used in stepwise reactions versus the types of Lewis bases used in concerted reactions.

C. What **type of reaction** occured above? $S_N2$, E2, $S_N1$, or E1?

5. A. Shown below are various conformations of the same molecule (conformers). **Place a box around the Newman projection** that is in a **reactive conformation** for an **E2 elimination reaction.**

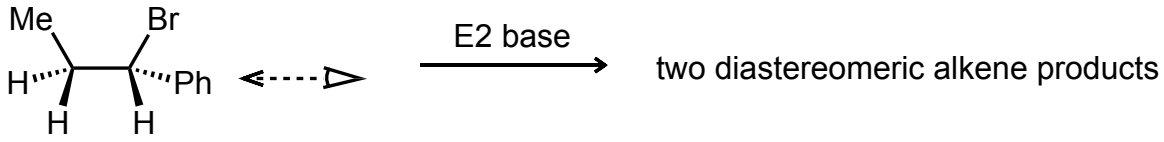



B. **Draw the bond line structure of the boxed conformation from part A** in the reactant space below. Then, show the curved-arrow mechanism and product for its subsequent E2 reaction with the shown base.



6. The alkyl halide below can participate in an **E2 reaction** in the presence of a suitable base **to yield two diastereomeric alkene products**.

A. **Label the α carbon and β carbon(s)** relative to the leaving group in the molecule below.




B. **Draw the Newman projection** of the molecule above **given the indicated perspective.**

unreactive for E2

In the Newman projection you drew to the left, the **molecule is not in a reactive conformation for** an **E2** elimination reaction. **Why not**?

C. **Rotate the front carbon** of the Newman projection in part B **to provide two different Newman projections that are in a reactive conformation for an E2 reaction.**

rotate front C

reactive Newman projection 1

rotate front C

reactive Newman projection 2

D. **Draw the alkene product** that would result f**rom each of the reactive Newman projections** from part C. Then **assign them** as ***E*** or ***Z*** and **circle the major product.**

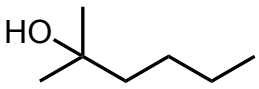
**product from reactive Newman projection 1**

***E*** or ***Z***

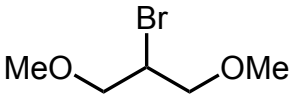
**product from reactive Newman projection 2**

***E*** or ***Z***

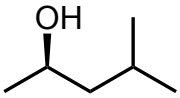
7. **Identify the reaction taking place** ($S_N1$, $S_N2$, E1, or E2). Then, **provide the missing starting material, reactant, or product**.
Consider that carbocation rearrangements are possible in SN1 and E1 reactions if the shift results in a more stable carbocation.

A. 

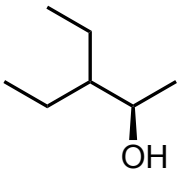
$H_2SO_4$, $H_2O$ → [ ] + $H_2O$

B. 

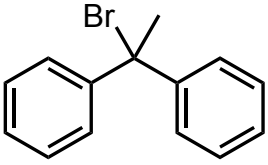
Na ⊕ ⊖ S-Me, DMSO → [ ] + NaBr

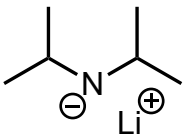
C. 

HCl → [ ] + $H_2O$

D. 

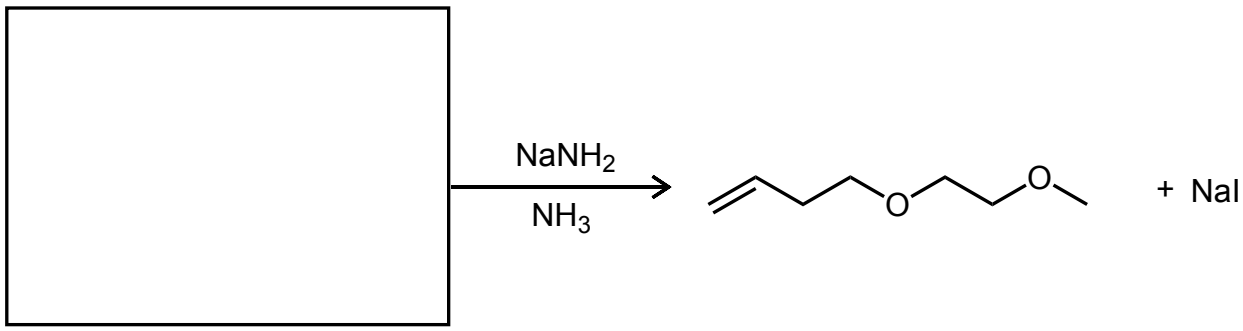
HCl → [ ] + $H_2O$

E. 

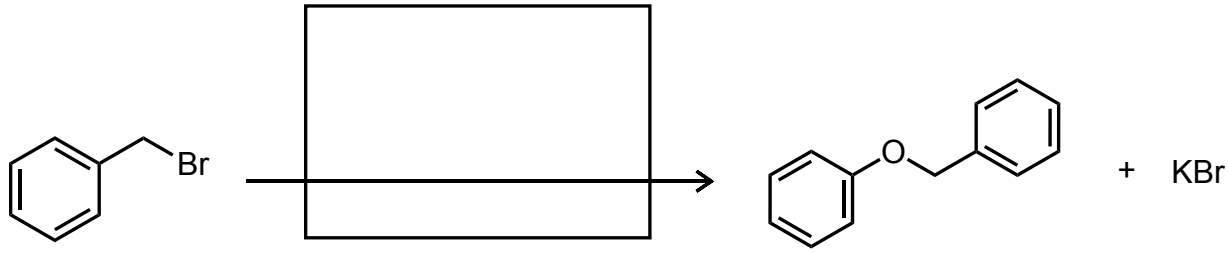


→ [ ] + LiBr

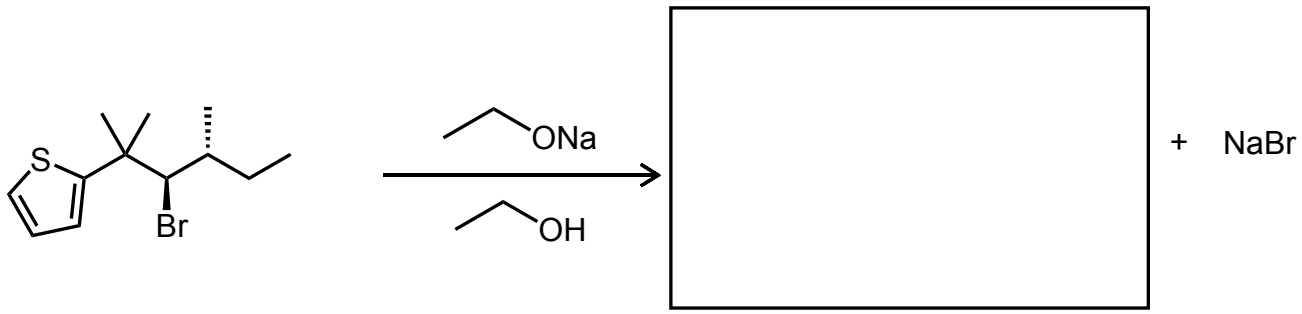
F.


NaNH2
NH3
O
O
+ NaI

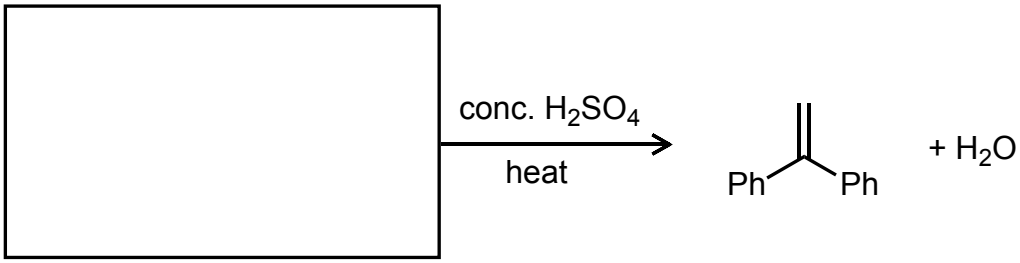
G.


Br
O
+ KBr

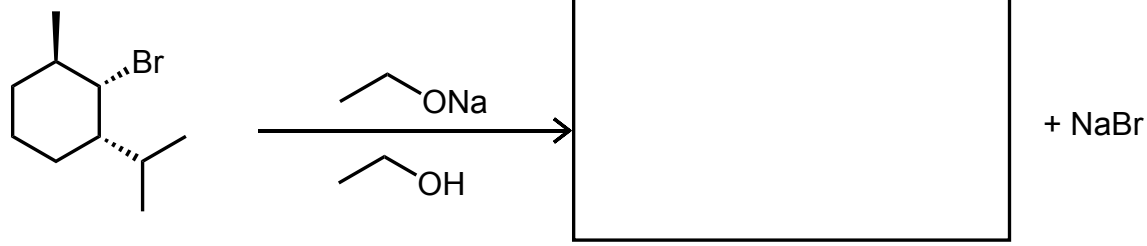
H.


S
Br
ONa
OH
+ NaBr

I.


conc. H2SO4
heat
Ph
Ph
+ H2O

J.


Br
ONa
OH
+ NaBr