1. The hydroxylic proton (-OH) of phenols is acidic (pKₐ ~ 10) compared to “regular” alcohols like methanol and ethanol (pKₐ ~ 16-18). Rank phenols 1-3 below in order of increasing acidity (weakest acid first) and explain why. (HINT: Resonance pictures will help.)

   ![Resonance pictures]

   1  2  3

2. Provide the product for the reactions below. Be sure to indicate stereochemistry.

   (a) Z-3-methyl-3-hexene \( \xrightarrow{\text{HBr}} \) 
   (b) cis-2-butene \( \xrightarrow{\text{I₂}} \) 
   (c) bicyclo[2.2.1]-2-heptane \( \xrightarrow{1. \text{O}_₃ \text{, Zn, H}_₂\text{O}^+} \) 
   (d) (2R)-1-chloro-2-phenylbutane \( \xrightarrow{\text{NaOCH₃}} \) 
   (e) (2R)-1-chloro-2-phenylbutane \( \xrightarrow{\text{NaOC(CH₃)₃}} \) 

3. Draw (using electron pushing arrows) the mechanism:

   ![Mechanism]

4. Ethyl bromide and isobutyl bromide are both primary alkyl halides, yet ethyl bromide undergoes \( S_N2 \) reactions more than 10 times faster than does isobutyl bromide. When each of these is treated with a strong base/nucleophile (\( \text{CH₃CH₂O}^- \)), isobutyl bromide gives more elimination products than substitution products; this behavior is reversed for ethyl bromide. Explain these observations.

5. Show the mechanism for the following reaction:

   ![Reaction mechanism]
6. Provide reagents and conditions for the following transformations. More than one step may be required.

(a) $(3R)$-3-methyl-3-hexanol $\xrightarrow{}$ $(3R)$-3-methyl-3-methoxyhexane

(b) methylenecyclopentane $\xrightarrow{}$ trans-2-methylcyclopentanol