

Chemistry Department

University of Alberta

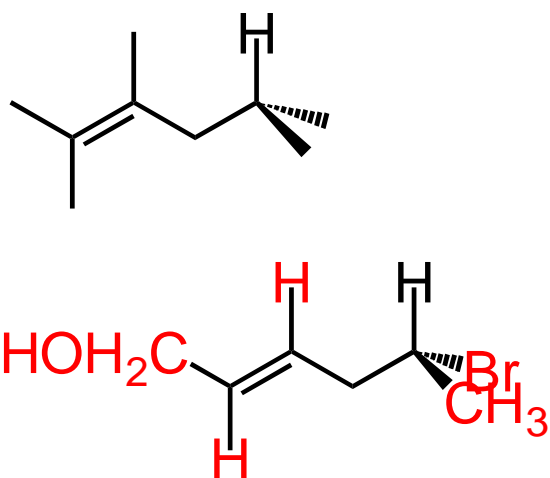
CHEM 161 A5

Final Exam

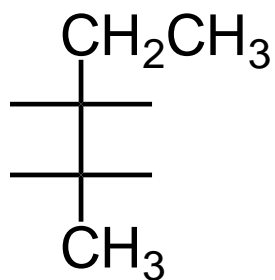
December 11, 2006

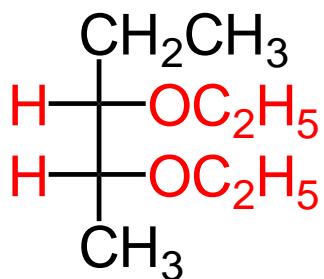
1.

a. Complete the following partial structure of (E,5R)-5-bromo-2-hexen-1-ol:



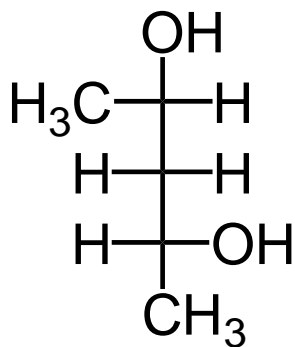
b. Complete the following partial Fischer structure of (2R,3S)-2,3-diethoxypentane:





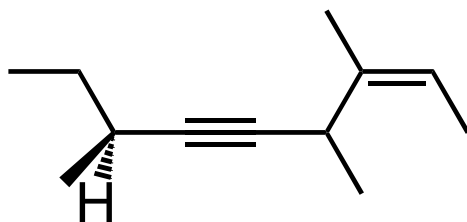
2. Name the following compounds by the IUPAC system. The name must indicate the stereochemistry of the compound.

a.



meso-2,4-pentanediol

b.



(Z,7S)-3,4,7-trimethyl-2-nonen-5-yne

3. Explain **three (3)** of the following terms:

a. Azeotropic mixture

A mixture whose liquid and vapour forms have the same composition.  
E.g. 95% C<sub>2</sub>H<sub>5</sub>OH and 5% water.

b. Racemic mixture

A mixture of equal amounts of the two enantiomeric forms of a chiral compound.

c. Meso compound

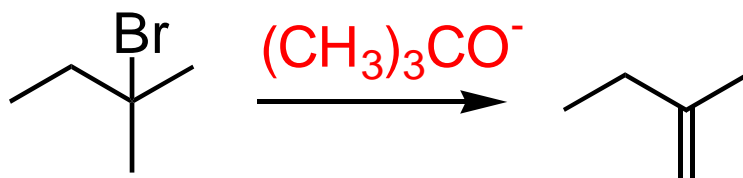
An achiral molecule that has tetrahedral stereogenic centres.

d. Conformational isomers

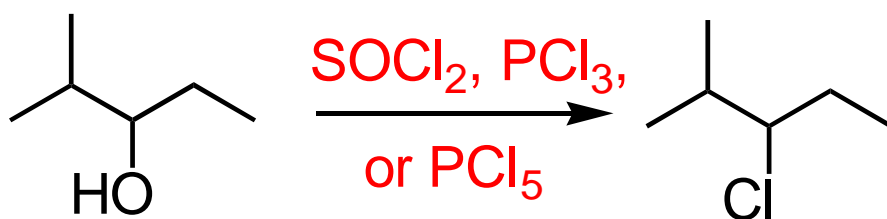
Isomers that are inter convertible by rotation about single bonds.

4. What reagents would you use to effect **five (5)** of the following conversions?

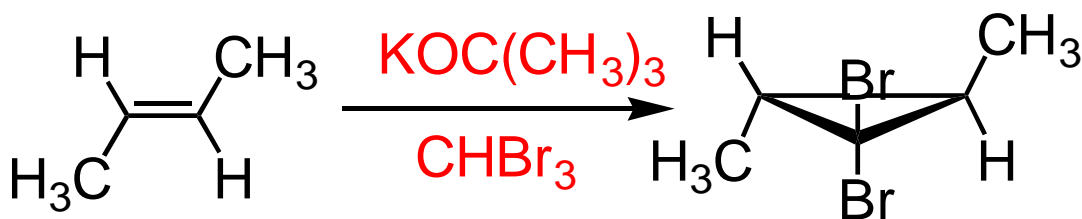
a.



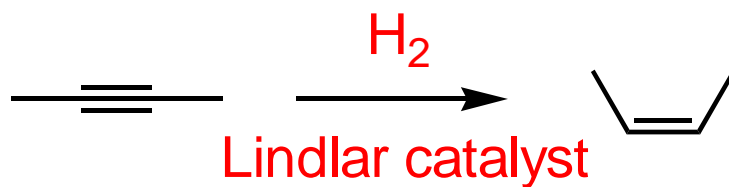
b.



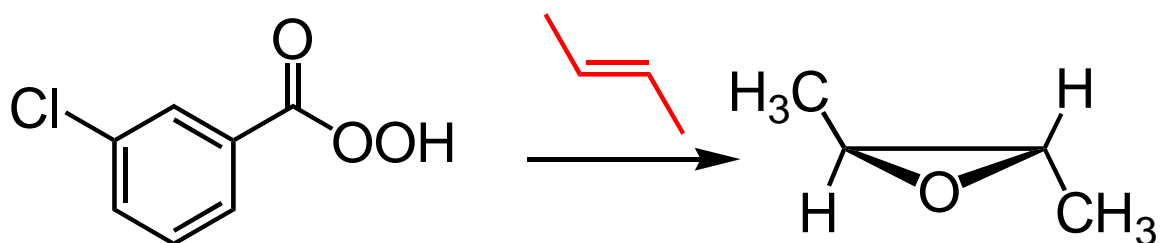
c.



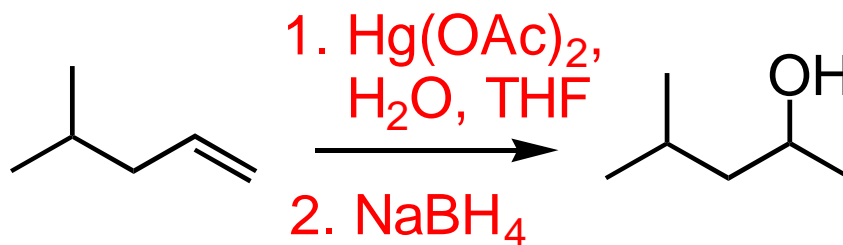
d.



e.

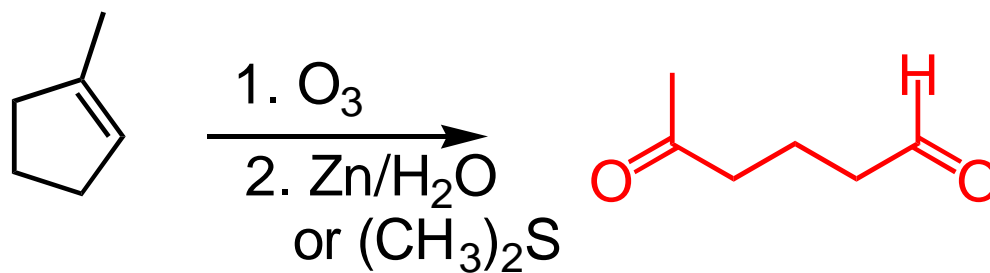


f.

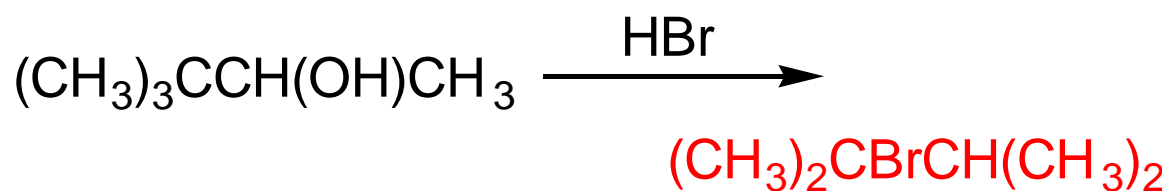


5. Give the structure(s) of the principle organic products of **five (5)** of the following reactions. Where appropriate the structures must indicate the stereochemistry of the compound:

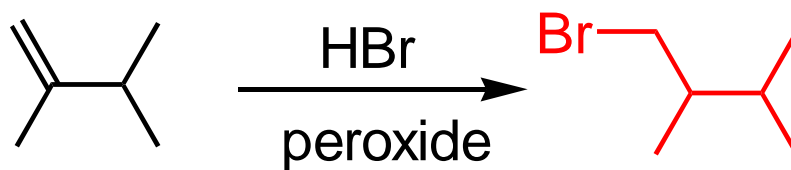
a.



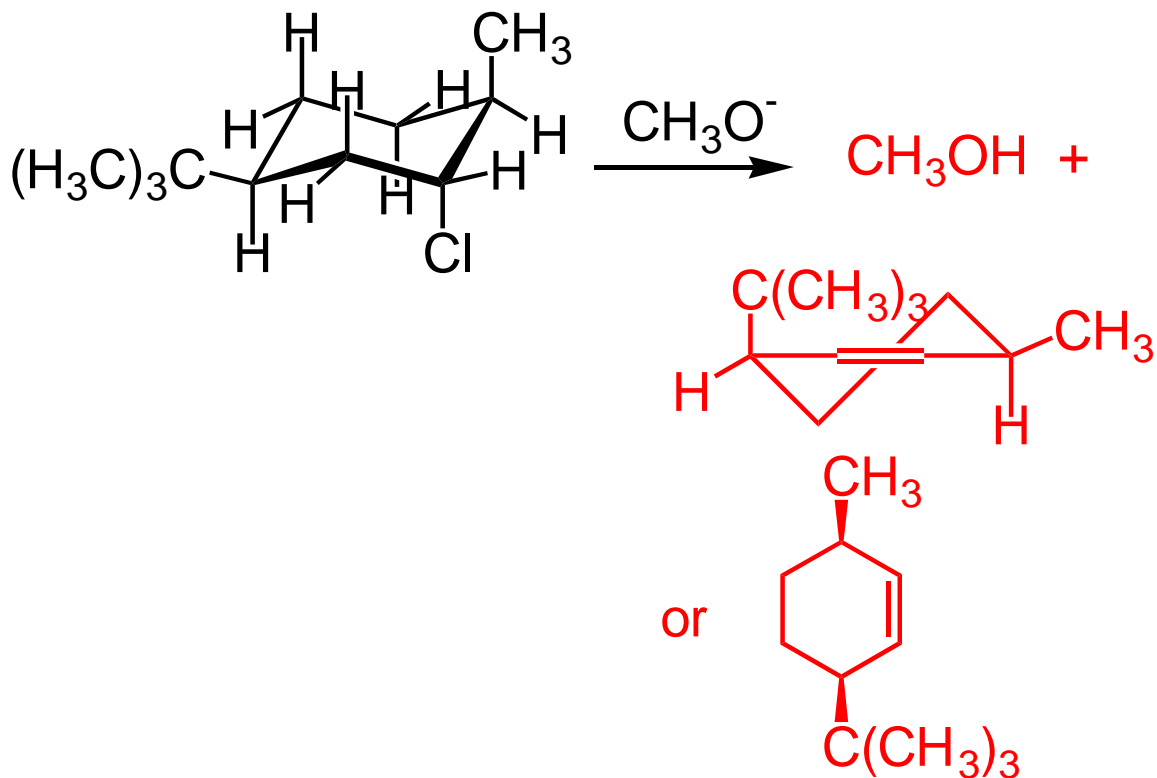
b.



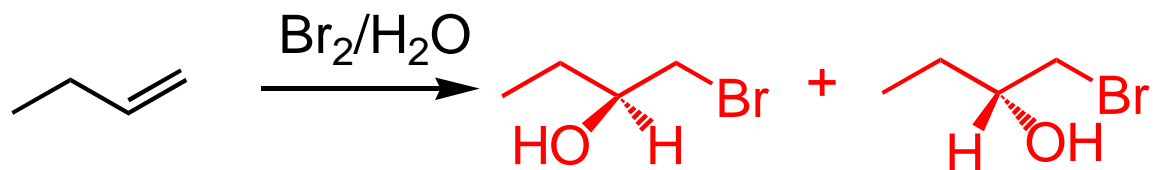
d.



e.

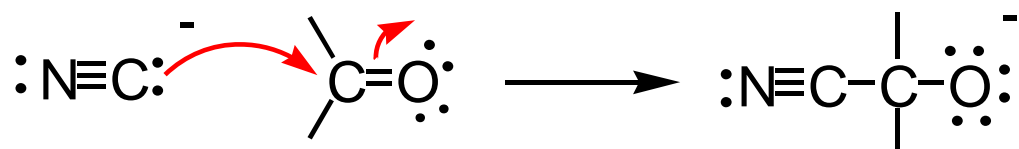


f.

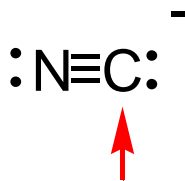


6.

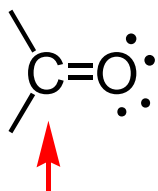
a. Draw a curved-arrow depiction of the flow of electrons in the following reaction:



b. Identify the nucleophilic site.



c. Identify the electrophilic site.



d. Which reagent in each pair would be the better nucleophile?

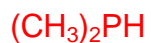
I.  $\text{CH}_3\text{SH}$  or  $\text{CH}_3\text{S}^-$ ?



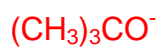
II.  $\text{P}(\text{CH}_3)_3$  or  $\text{S}(\text{CH}_3)_2$ ?



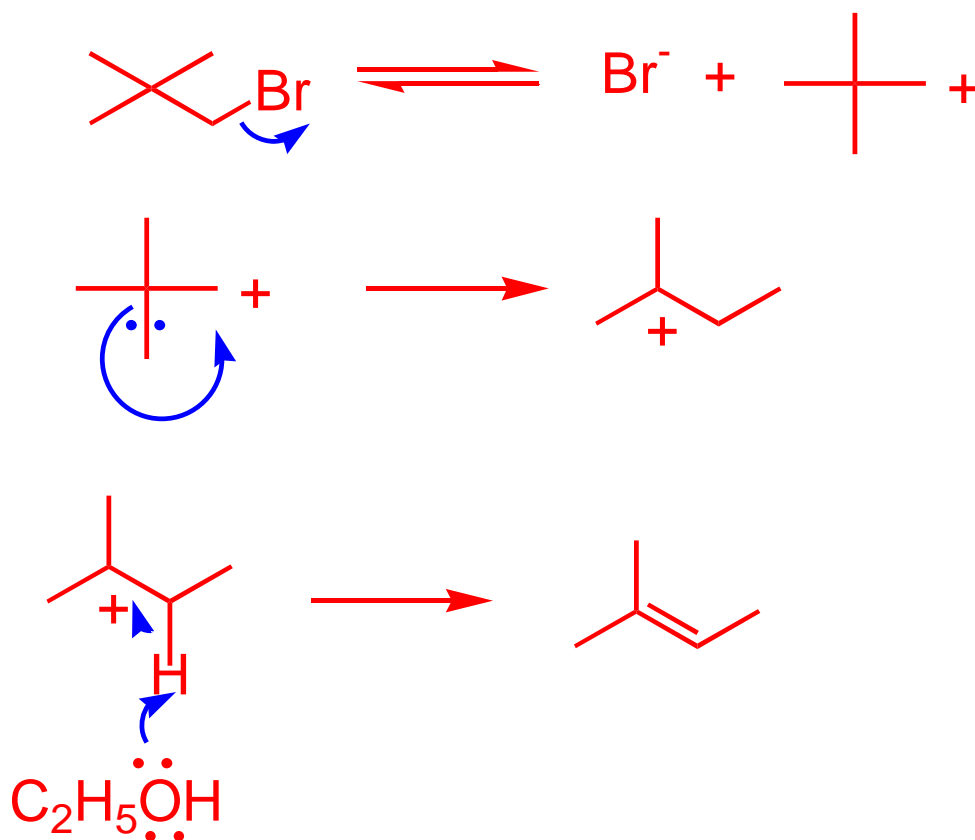
III.  $(\text{CH}_3)_2\text{NH}$  or  $(\text{CH}_3)_2\text{PH}$ ?

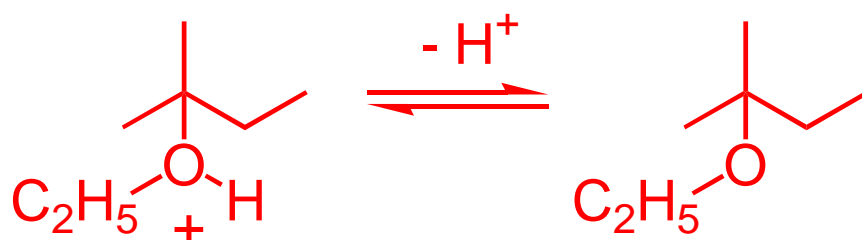
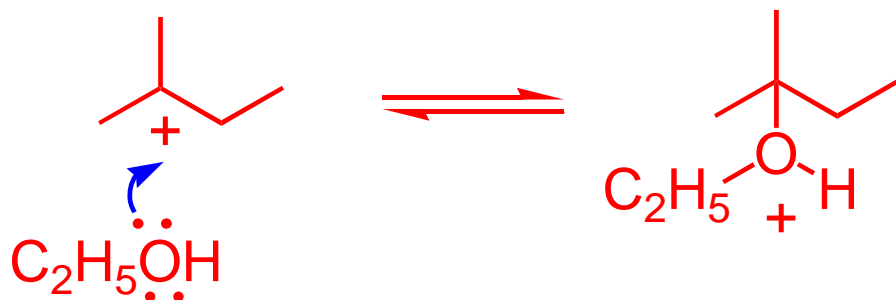


IV.  $(\text{CH}_3)_3\text{CO}^-$  or  $\text{CH}_3\text{O}^-$ ?

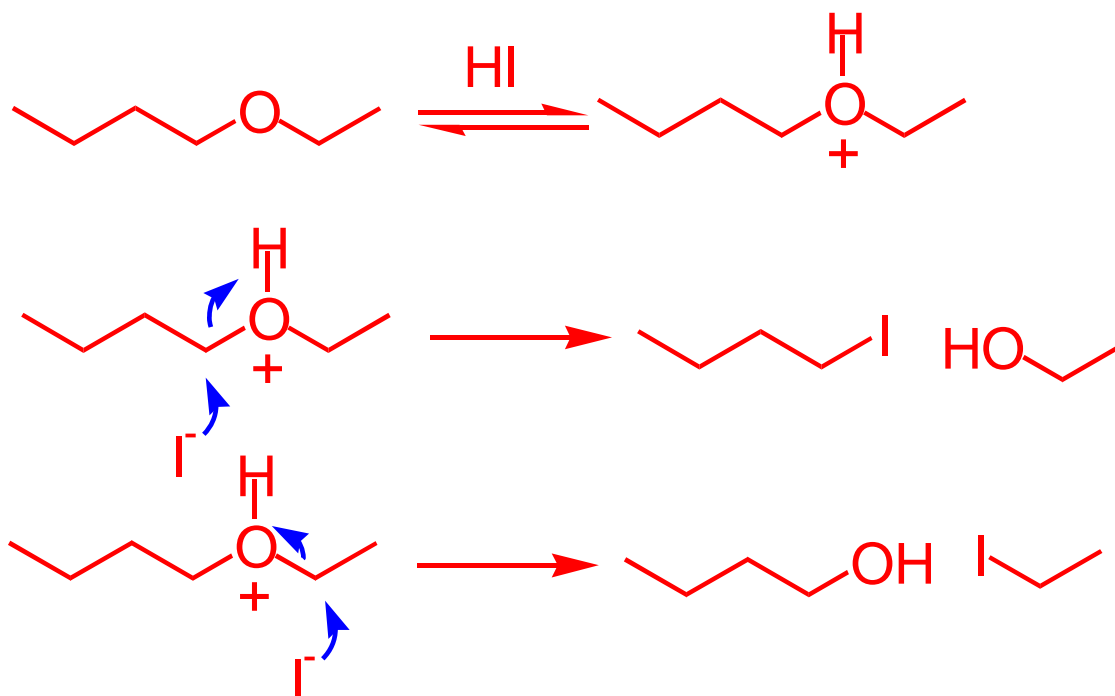


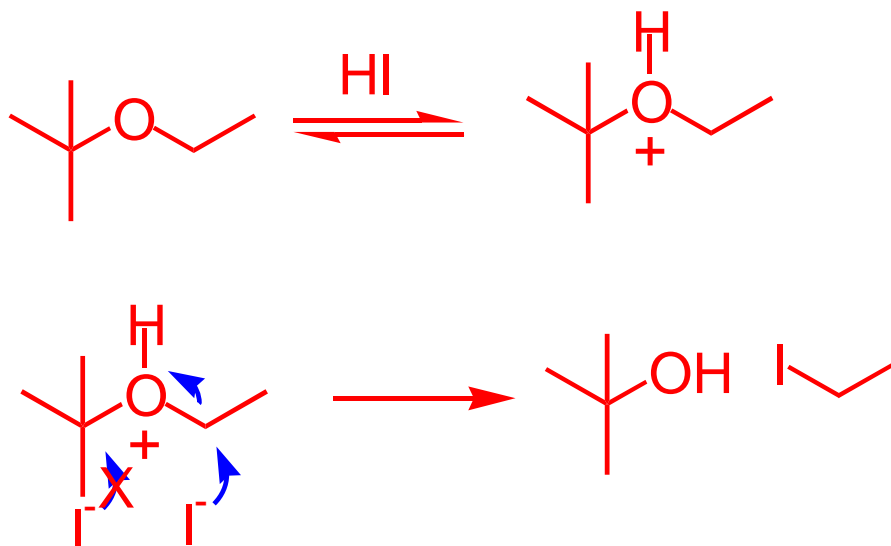
- e. Propose a mechanistic explanation to account for the fact that  $(\text{CH}_3)_3\text{CCH}_2\text{Br}$  reacts with ethanol to yield 2-ethoxy-2-methylbutane and 2-methyl-2-butene.





- f. Butyl ethyl ether reacts with HI to give a mixture of 1-iodobutane, iodoethane, ethanol, and 1-butanol whereas *tert*-butyl ethyl ether yields only 2-methyl-2-propanol and iodoethane. Explain.

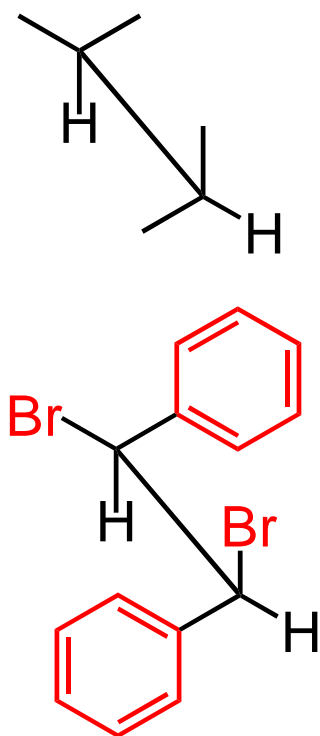




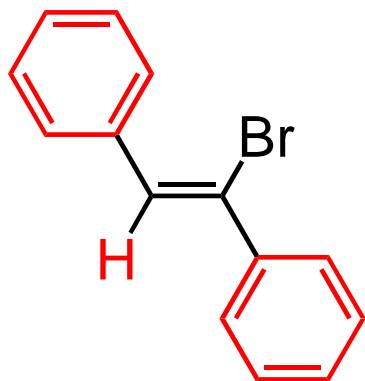
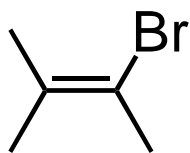
There is only one possible S<sub>N</sub>2 cleavage in the case of the *tert*-butyl ether.

7. (1S,2S)-1,2-Dibromo-1,2-diphenylethane gives (Z)-1-bromo-1,2-diphenylethane on treatment with sodium methoxide.

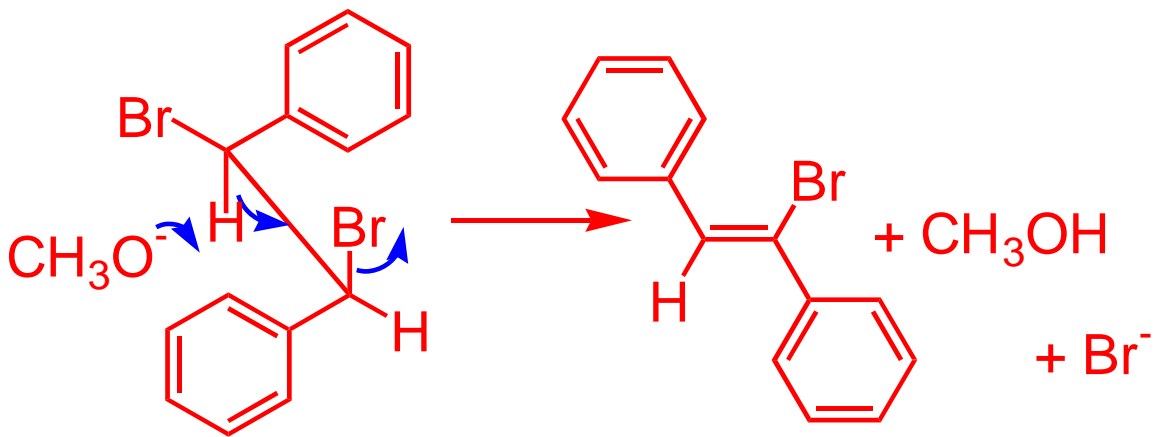
- a. Complete the following partial structure of (1S,2S)-1,2-dibromo-1,2-diphenylethane:



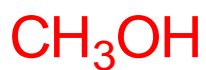
- b. Complete the following partial structure of (Z)-1-bromo-1,2-diphenylethane:



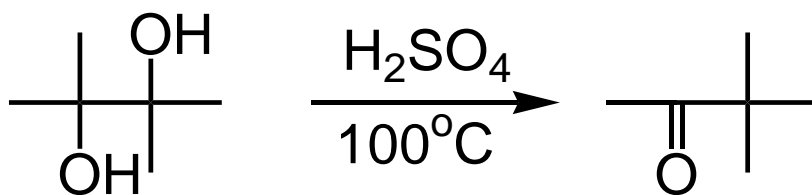
- c. Propose a mechanism that explains the formation of (Z)-1-bromo-1,2-diphenylethene.



- d. What other organic compound is formed?



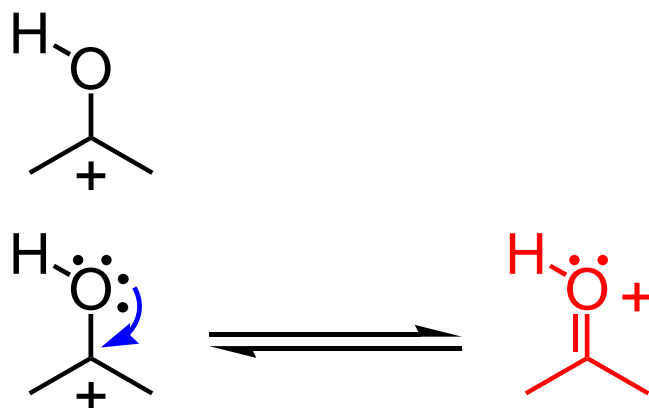
8. The following dehydration is an example of the pinacol rearrangement:



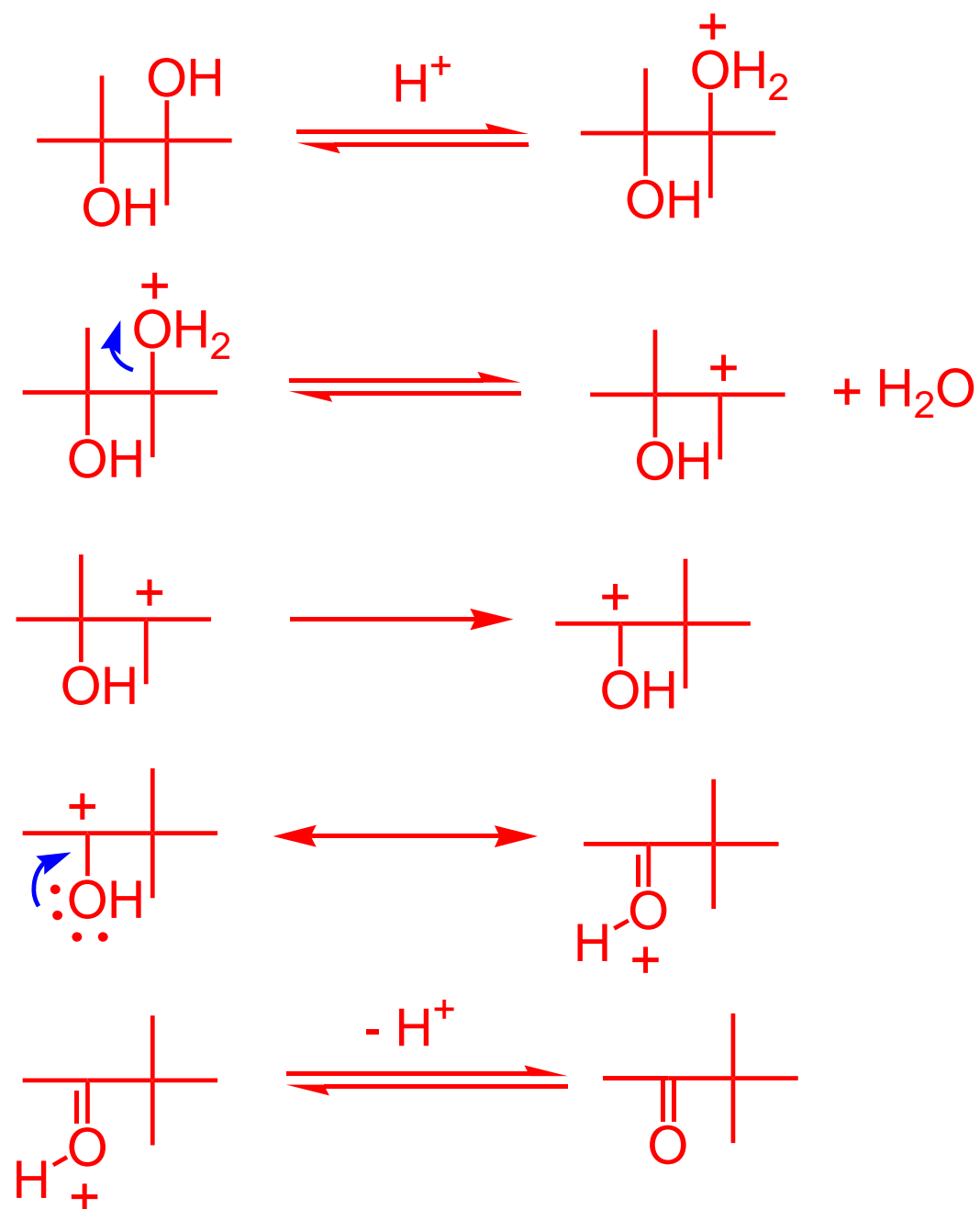
a. Name the functional group in the organic product.

ketone

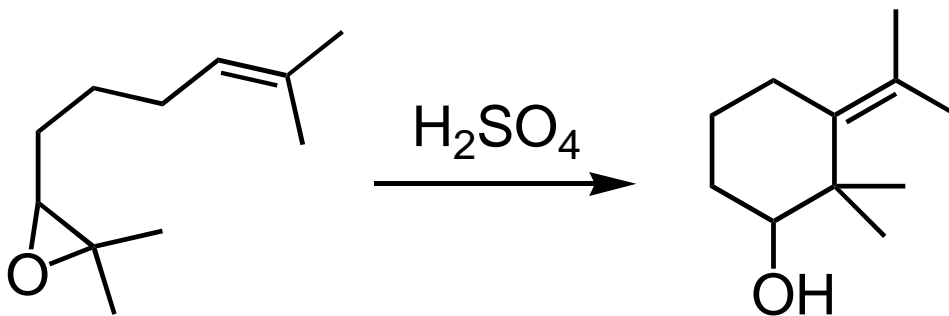
b. Draw another resonance structure of the following cation:

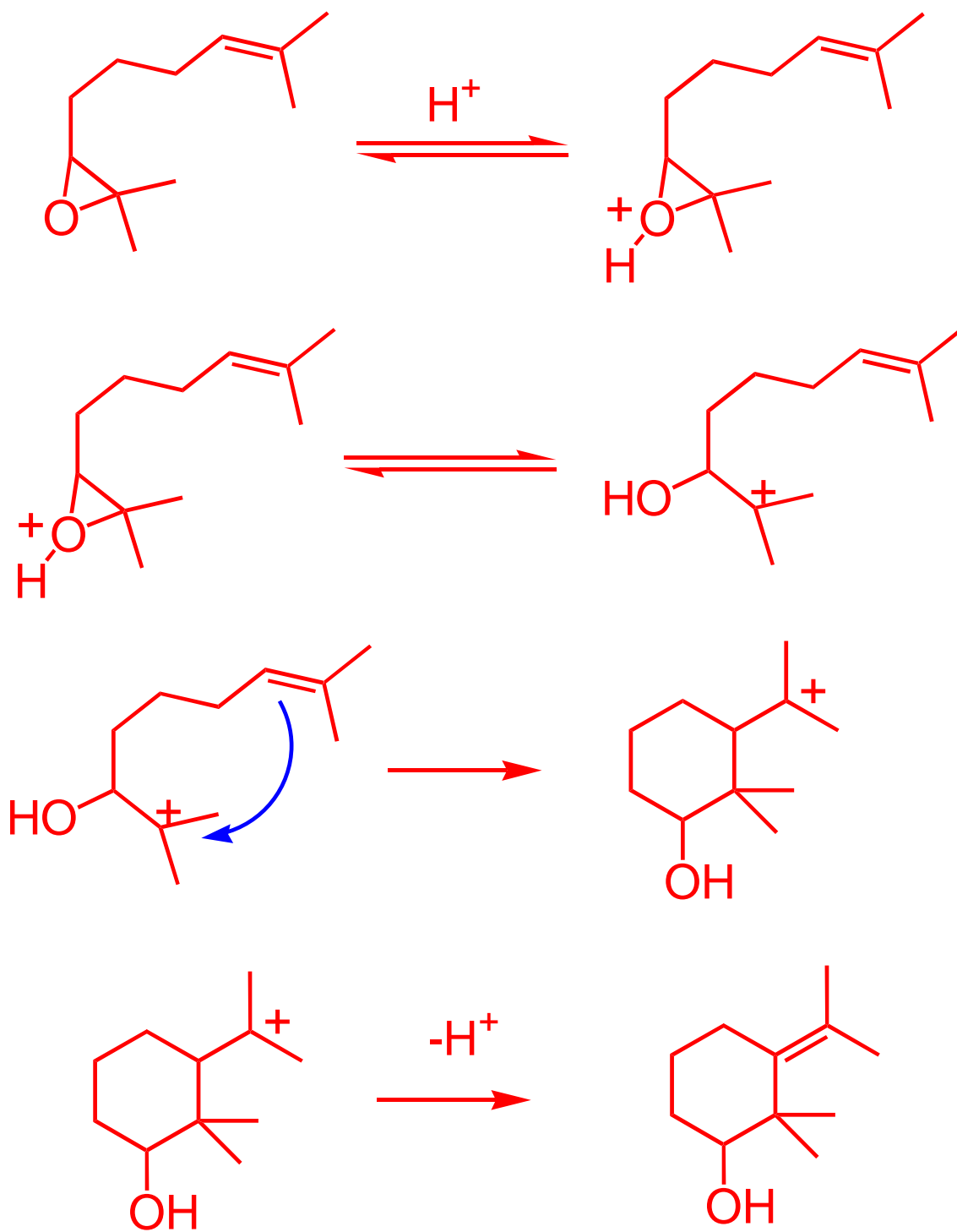


c. Propose a mechanism for the reaction.

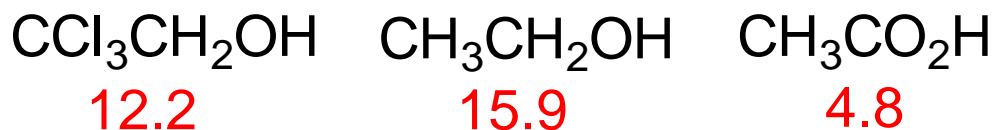


9. Propose a mechanism for the following reaction:



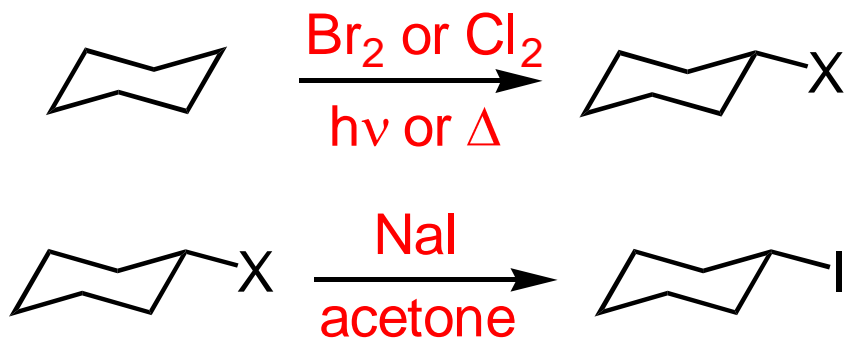


10. Match the  $pK_a$  values, 4.8, 12.2, 14.3 and 15.9, to the appropriate structure:

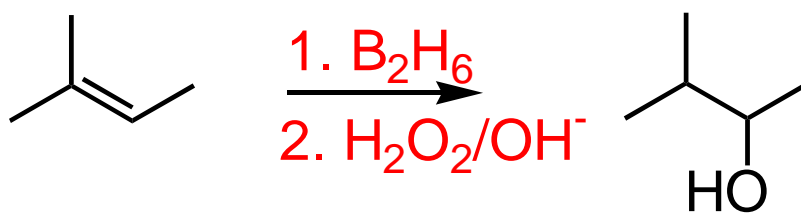
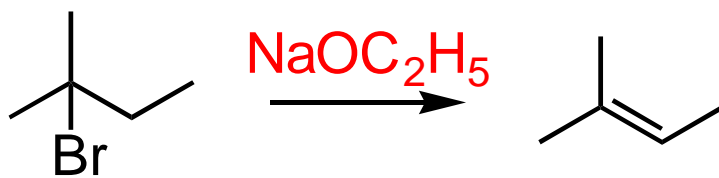
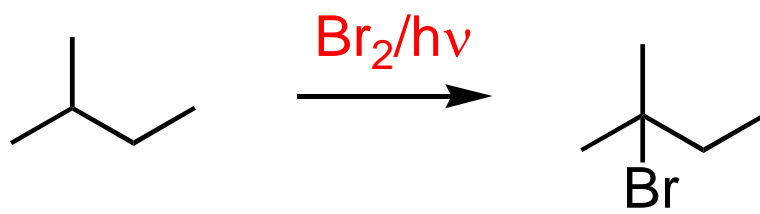


11. Provide a synthetic pathway for **three (3)** of the following transformations. Begin your synthesis with the indicated starting material.

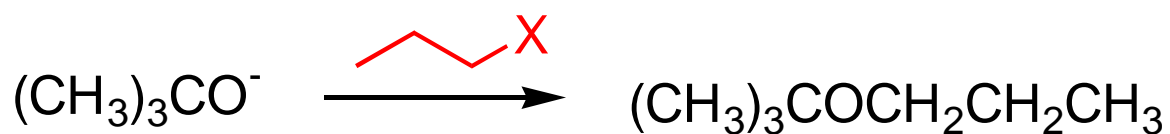
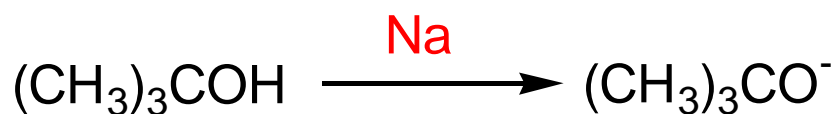
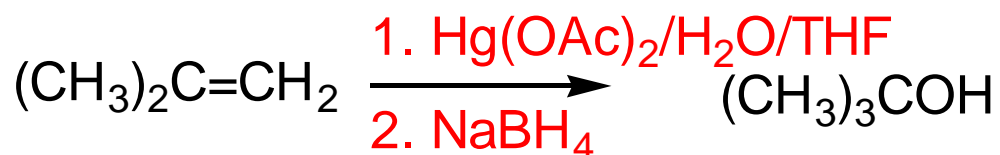
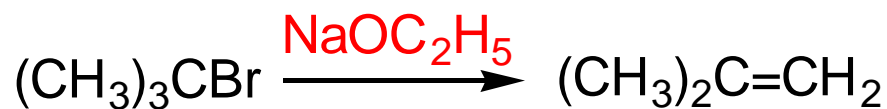
a.



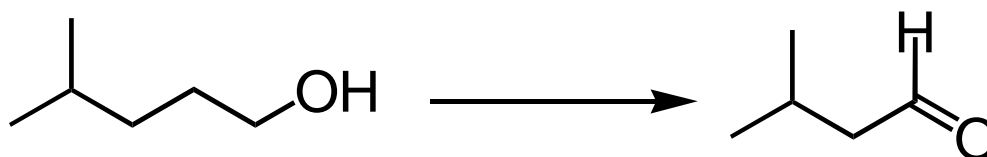
b.

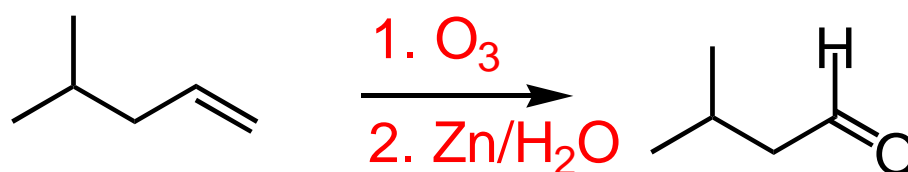
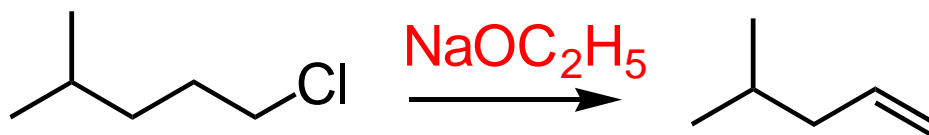


c.



d.





12. Give an example of **three (3)** of the following:

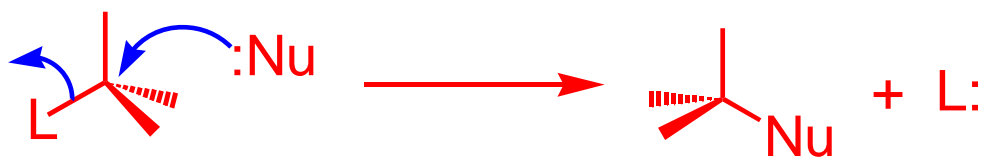
a. A Gilman reagent.



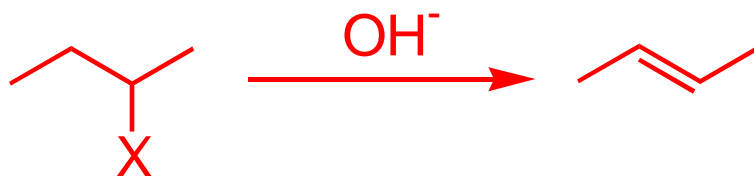
b. A Williamson synthesis.



c. A Walden inversion.

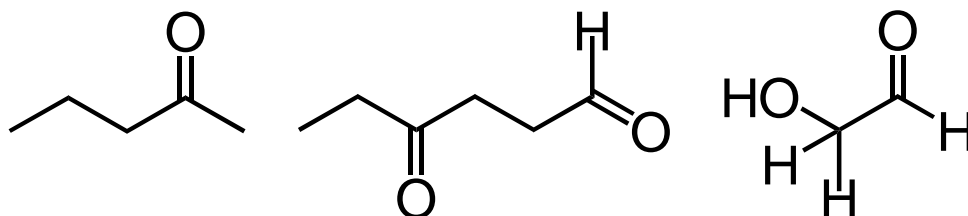


d. A Zaitsev elimination.



13. Pheromones are substances secreted by animals that produce a specific behavioral response in other members of the same species. Pheromones are effective at very low concentrations and include sex attractants, warning substances and "aggregation" compounds.

The sex attractant pheromone of the codling moth has molecular formula  $C_{13}H_{24}O$ . Catalytic hydrogenation converts this pheromone to 3-ethyl-7-methyl-1-decanol. On treatment with ozone followed by treatment with zinc and water the pheromone produces the following products:



- a. Neglecting the stereochemistry of the double bonds, write a general structure for this pheromone.



- b. The double bonds are known to be (2Z,6E). Write a stereochemical formula for the codling moth sex attractant.

