

Chemistry Department

University of Alberta

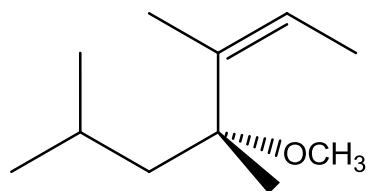
CHEM 261

Final Exam

April 18, 2008

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

a.



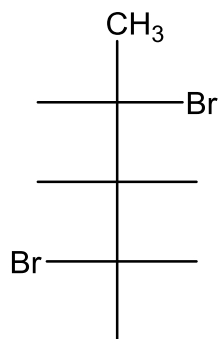
*(Z,4R)-4-methoxy-3,4,6-trimethyl-2-heptene*

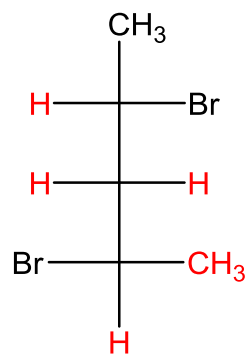
b.



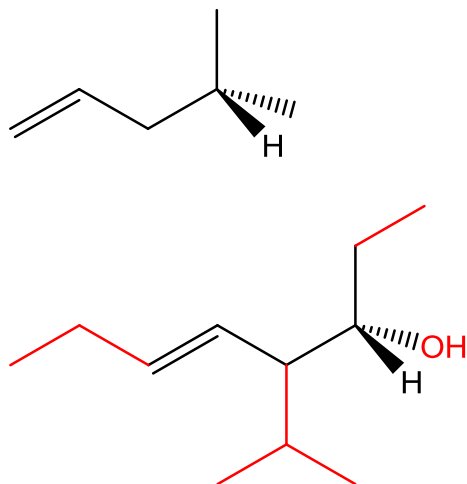
*cis-3-tert-butylcyclohexanol*

2. Complete the following partial Fischer structures meso-2,4-dibromopentane:



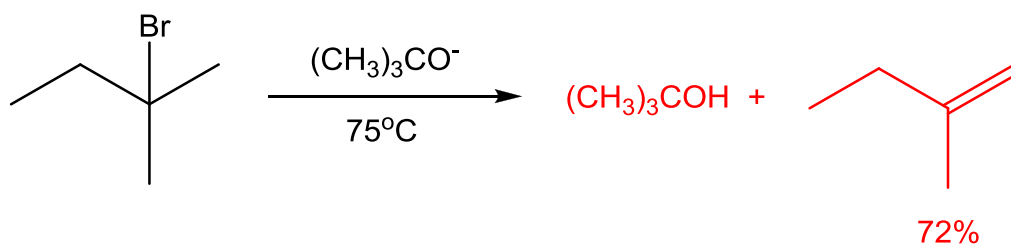


3. Complete the following partial structure of (E,3S)-4-isopropyl-5-octene-3-ol:

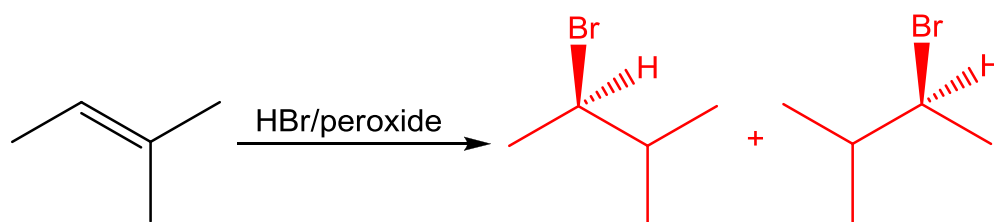


4. Give the structure(s) of the major organic products of **five (5)** of the following reactions:

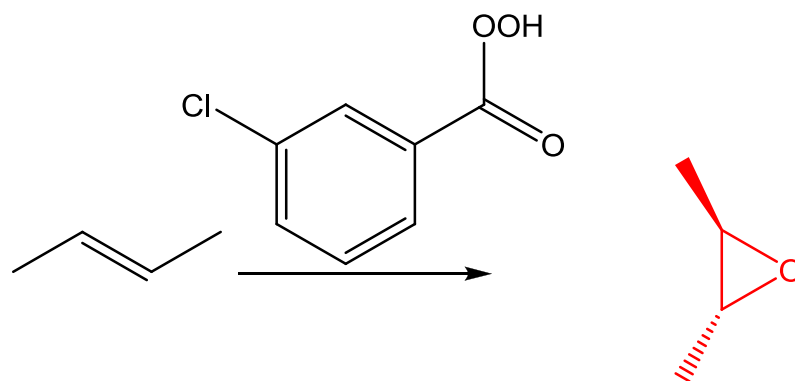
a.



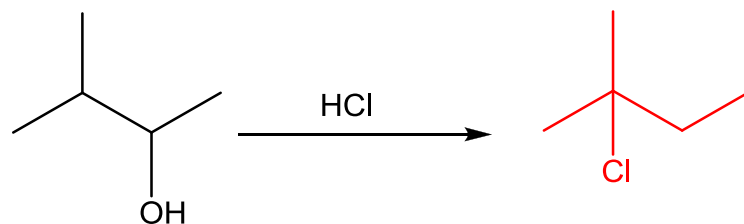
b.



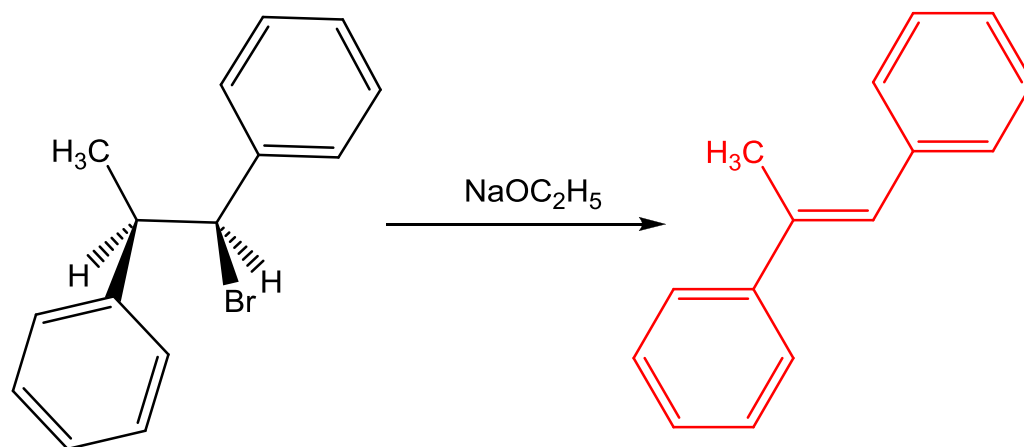
c.



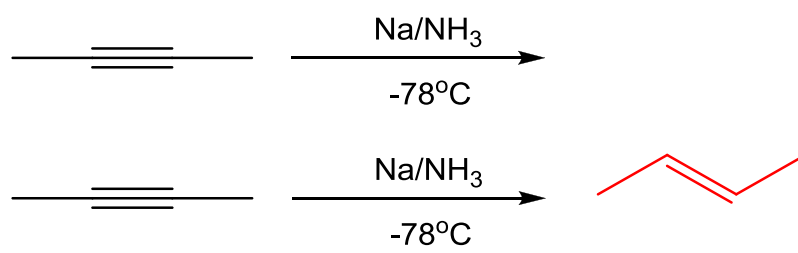
d.



e.

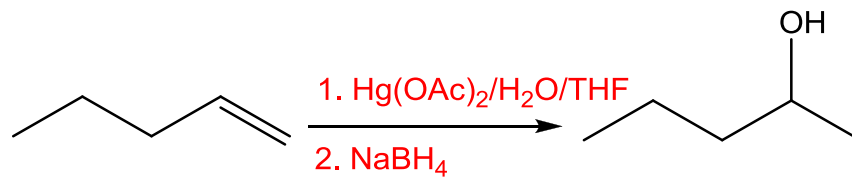


f.

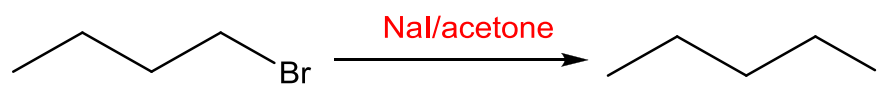


5. What reagents would you use to effect **five (5)** of the following conversions?

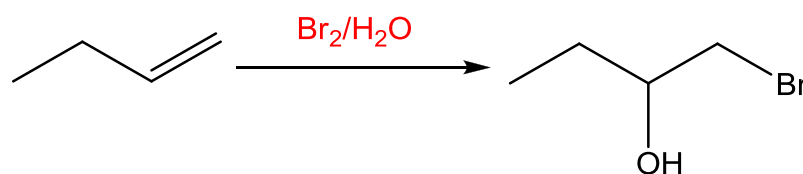
a.



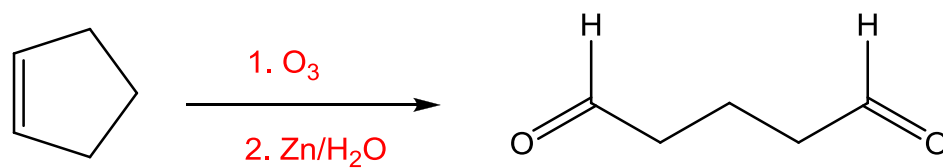
b.



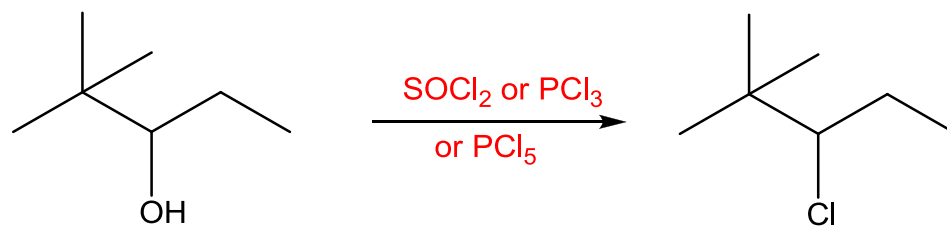
c.



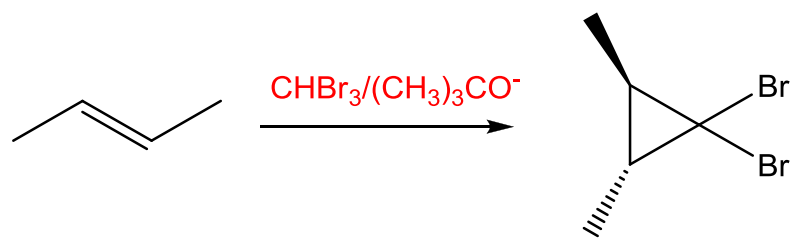
d.



e.

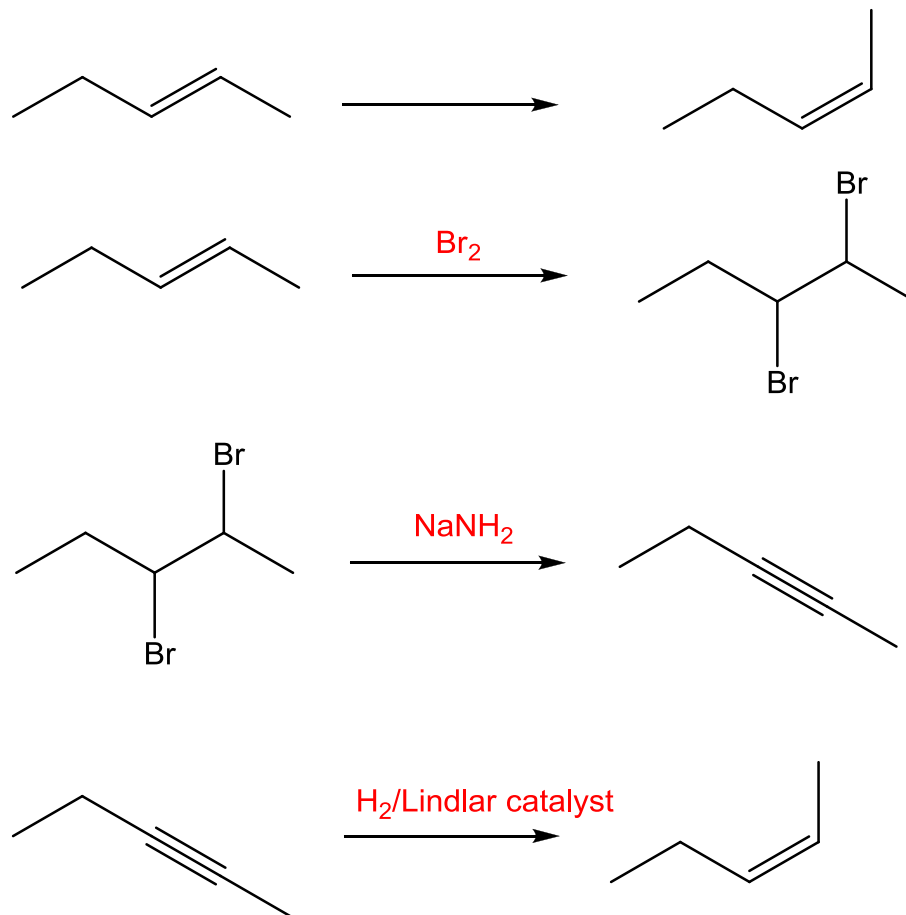


f.

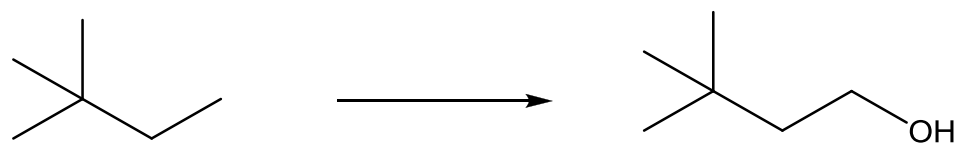


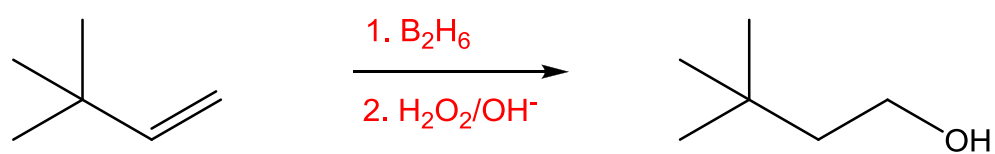
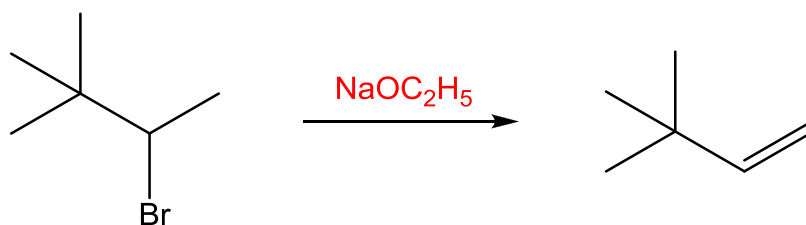
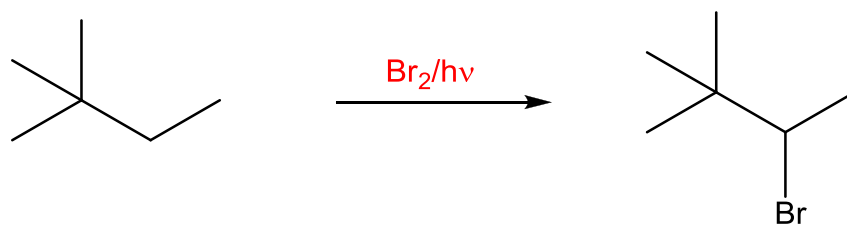
6. Provide a synthetic pathway for the following transformations. Begin your synthesis with the indicated starting material.

a.

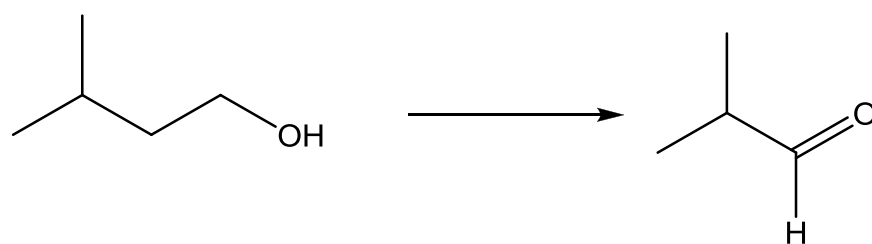


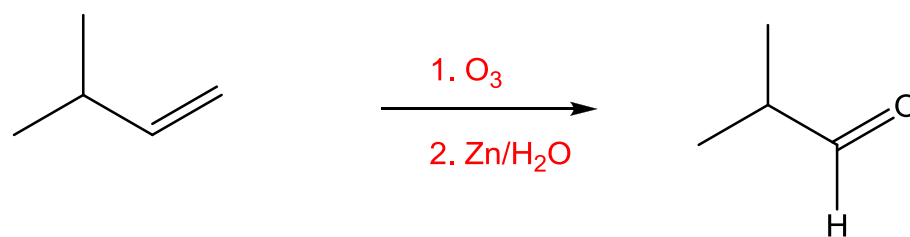
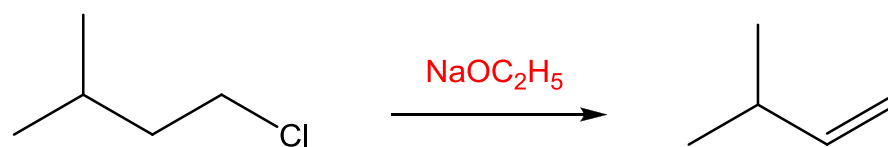
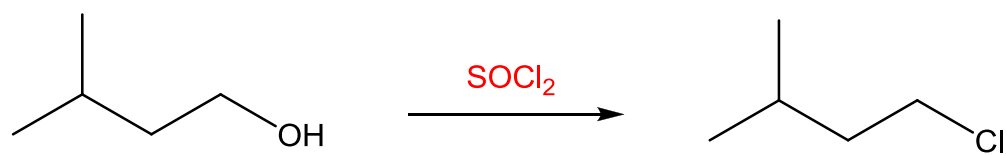
b.





c.

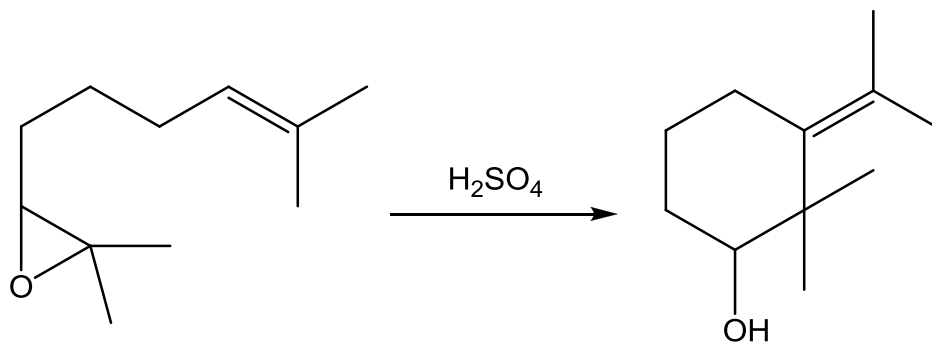


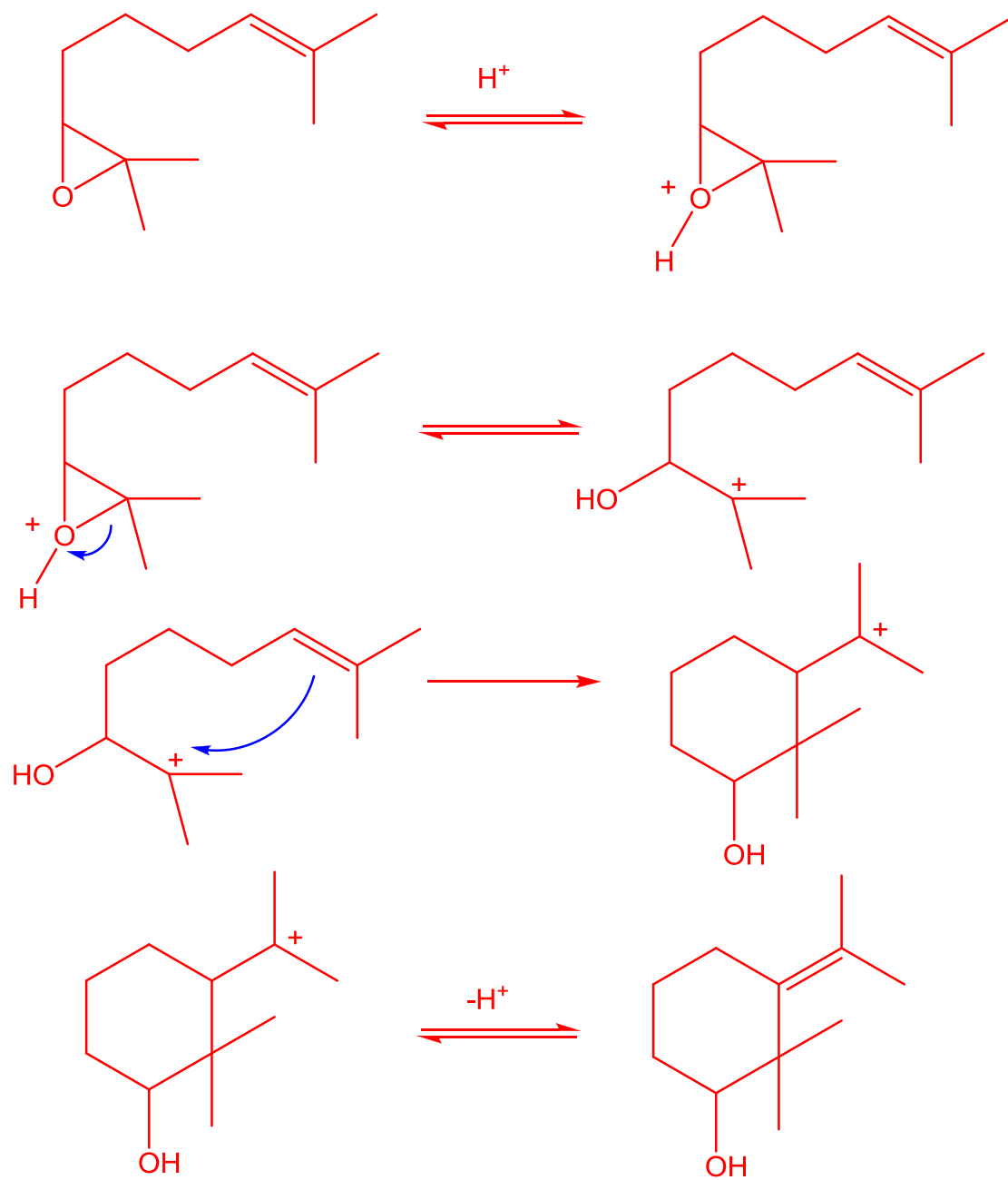


7. The following questions deal with substitution and elimination reactions:
- a. Predict the most likely mechanism which will occur when 1-chloro-4,4-dimethylcyclohexane is heated in water:
- $S_N1$
  - $S_N2$
  - E1
  - E2
  - None of the above
- b. Predict the two most likely mechanisms which occur when 2-iodohexane is heated in ethanol:
- $S_N1$  and  $S_N2$
  - $S_N2$  and E2
  - E1 and E2
  - E2 and  $S_N1$
  - E1 and  $S_N1$**
- c. Which of the following compounds is the most nucleophilic?
- $B_2H_6$
  - $CH_3SH$**
  - $CH_3OH$
  - $H_2O$
  - $CH_3CO_2H$
- d. When 3-iodo-3-ethylpentane is treated with sodium methoxide in methanol, the major organic product is an \_\_\_\_\_ that is generated through an \_\_\_\_\_ mechanism.
- Ether,  $S_N1$
  - Ether,  $S_N2$
  - Ether, E1
  - Alkene, E2**
  - Alkene, E1
- e. Which of the following chloroalkanes will undergo  $S_N2$  reaction most readily?
- 1-chloro-4-methylpentane**
  - 2-chloro-4-methylpentane

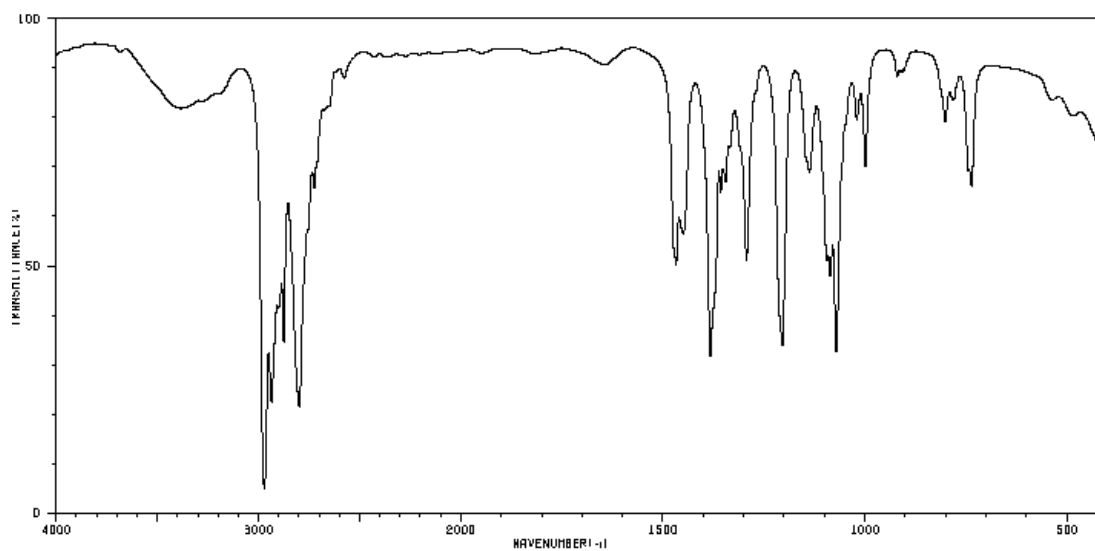
- iii. 2-chloro-3-methylpentane
- iv. 3-chloro-2-methylpentane
- v. 2-chloro-2-methylpentane

8. Propose a mechanism to explain the following reaction:





9. The IR spectrum of a compound of molecular formula  $C_6H_{15}N$  is given below. Identify the functional group.

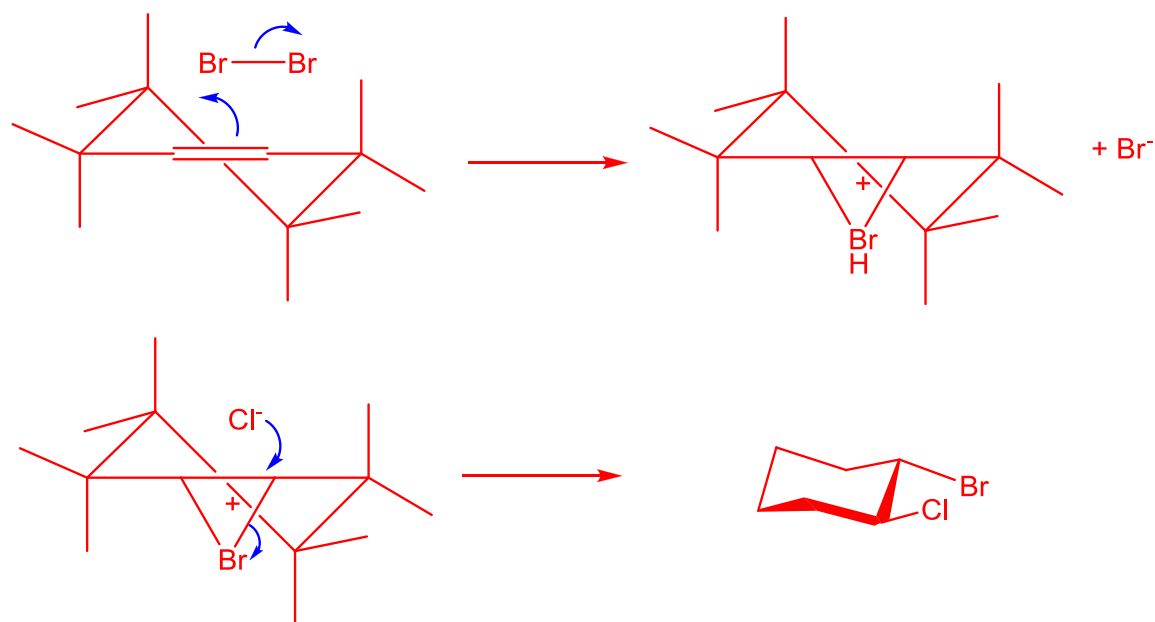


Tertiary amine

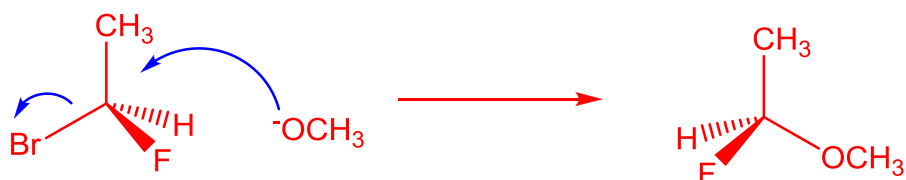
10. Cyclohexene reacts with bromine in saturated aqueous sodium chloride to yield *trans*-1-bromo-2-chlorocyclohexane and other products.
- Draw a structural formula that specifies the stereochemistry of *trans*-1-bromo-2-chlorocyclohexane.



- Propose a mechanism that explains the formation of the *trans*-1-bromo-2-chlorocyclohexane.



11. Under appropriate conditions, (S)-1-bromo-1-fluoroethane reacts with sodium methoxide to give (S)-1-fluoro-1-methoxyethane. Draw a mechanism to account for this reaction.



12. Bisabolene,  $C_{15}H_{24}$ , is a terpene that is found in myrrh and oil of bergamot. There is no peak between  $2100$  and  $2300\text{ cm}^{-1}$  in its IR spectrum. Catalytic hydrogenation gives a compound of formula  $C_{15}H_{30}$ .

a. How many units of unsaturation are present in bisabolene?

$$(2 \times 15 - 24 + 2)/2 = 4$$

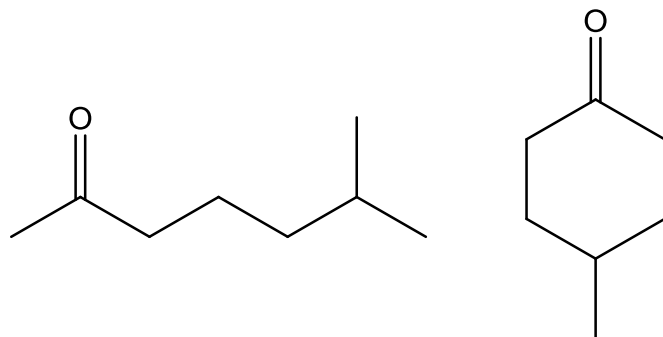
b. How many double bonds are present in bisabolene?

The hydrogenated product has  $(2 \times 15 - 30 + 2)/2 = 1$  degree of unsaturation. Therefore there are 3 double bonds as there is no triple bond.

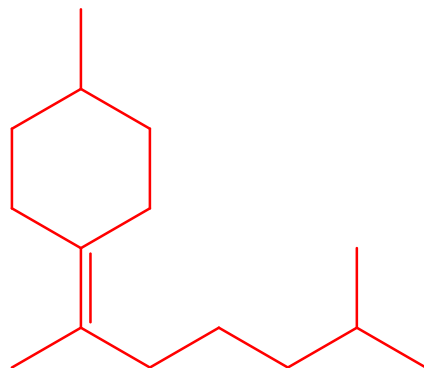
c. How many rings are present in bisabolene?

1

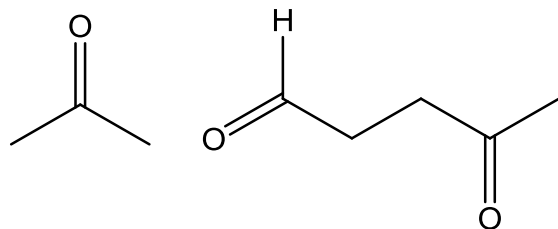
d. Partial hydrogenation of bisabolene gives compound "X",  $C_{15}H_{28}$ . Ozonolysis of compound "X" gives the following two compounds:



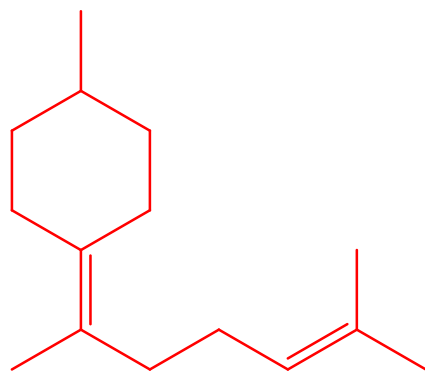
Draw the structure of compound "X".



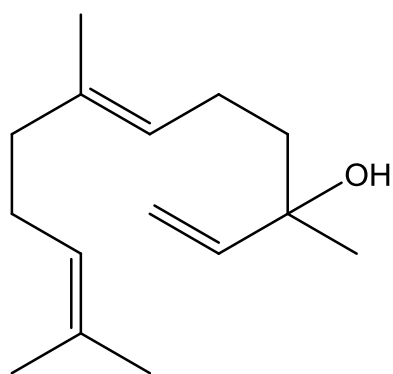
- e. Ozonolysis of bisabolene that has NOT been hydrogenated gives, among other products, the following two compounds:



Compound "X" provides the carbon skeleton of bisabolene. This new ozonolysis data allows you to locate another double bond. Draw a structure which shows its position.

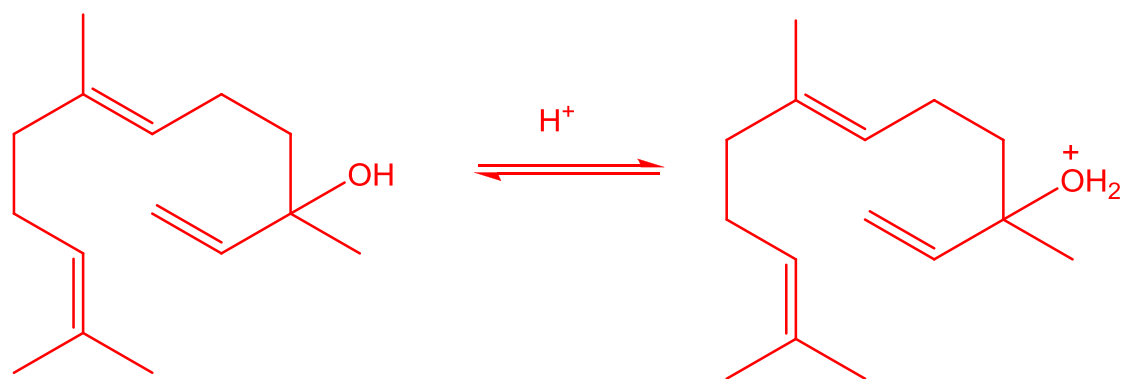


- f. Nerolidol, obtained from the flowers of bitter orange, undergoes acid-catalyzed cyclization to yield bisabolene.

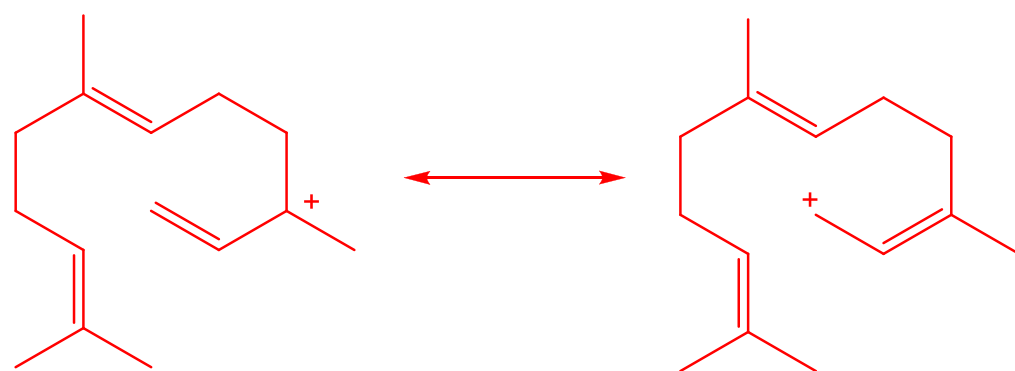
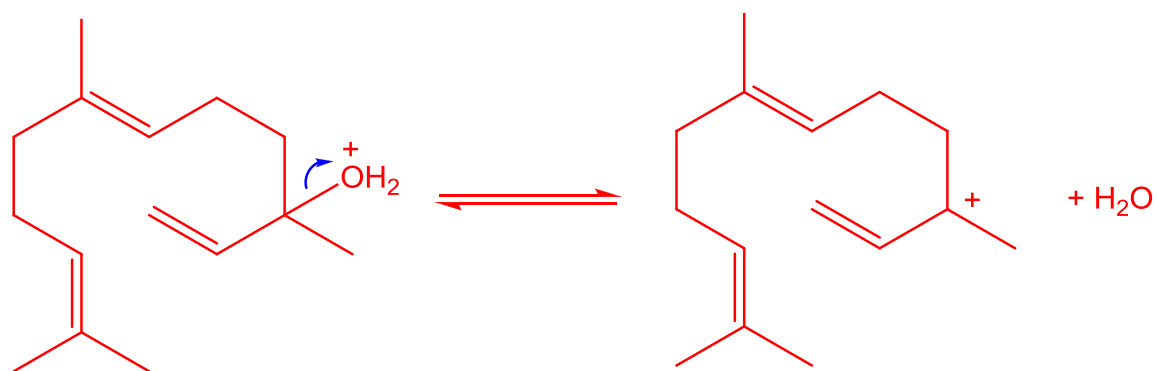


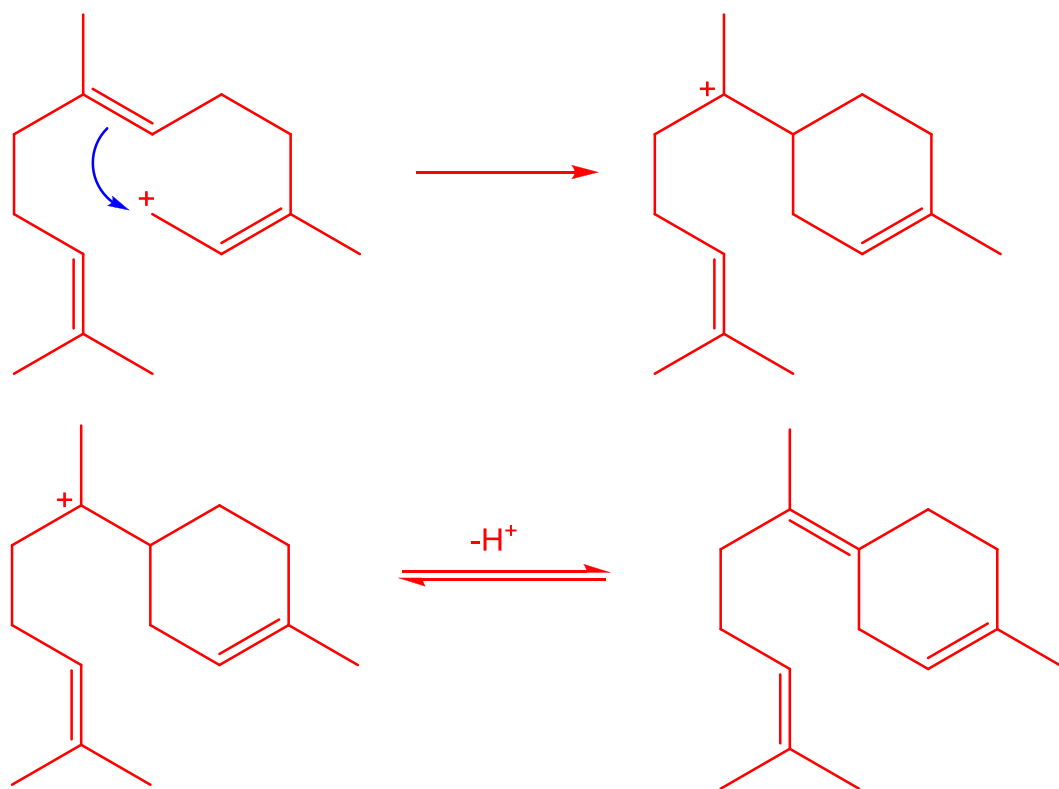
nerolidol

Draw the first step in the mechanism.



g. Complete the mechanism.





h. Draw the structure of bisabolene.

