

Name _____

If you do not want your graded exam placed in the box outside my office, then please mark a cross here _____

(1 a-j) are TRUE/FALSE (10pts)

- a) Chiral molecules have non-superimposable mirror images.
- b) S_N1 and $E1$ reactions both proceed through carbocation intermediates.
- c) A triple bond has two π bonds and one σ bond.
- d) Cyclopropane has more ring strain than cyclobutane.
- e) Cahn, Ingold and Prelog created the rules for assigning R or S to a chiral center.
- f) Cyclohexanol is a cyclic, chiral molecule.
- g) An anion has a positive charge.
- h) The triple bond in an alkyne is between two sp^2 hybridized carbons.
- i) Unsaturated compounds have the maximum number of bonds to hydrogen.
- j) The conjugate base of Nitric Acid (HNO_3) is the NO_3^+ cation.

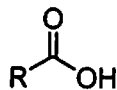
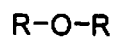
2) Define the following terms (3pts):

Anti Addition

Substitution reaction

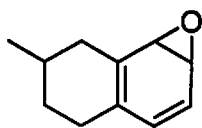
Racemic mixture

3) Name the classes of compound (functional groups) that the following molecules belong to (e.g. alkane, amide, etc.) (5pts)



4) Circle the above functional group that will likely be the most acidic. (1pt)

5) (4pts) For the below molecule:



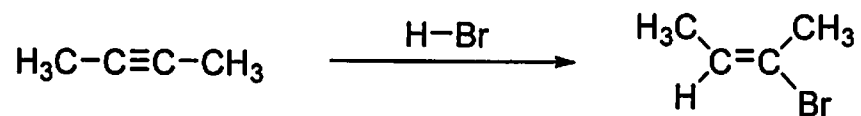
How many Hydrogens are there?

How many π bonds ?

How many sp^3 hybridized Carbons ?

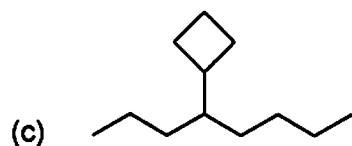
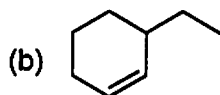
What is the hybridization of the Oxygen ?

6) Write a mechanism (i.e. curly arrows) for this electrophilic addition.
(5pts)

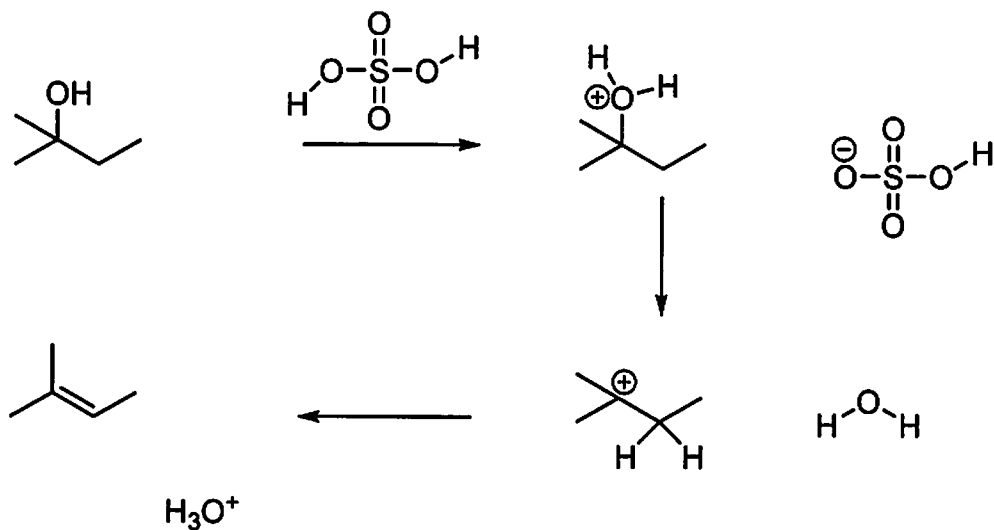


(1pt) In terms of *regiochemistry* (e.g. Markovnikov), how would you describe this reaction?

7) Name the following molecules in IUPAC form. (12pts)

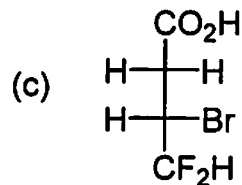
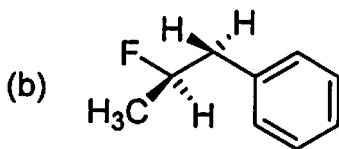
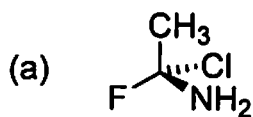


8) (i) Draw in the curly arrows for this acid catalyzed elimination. (6pts)

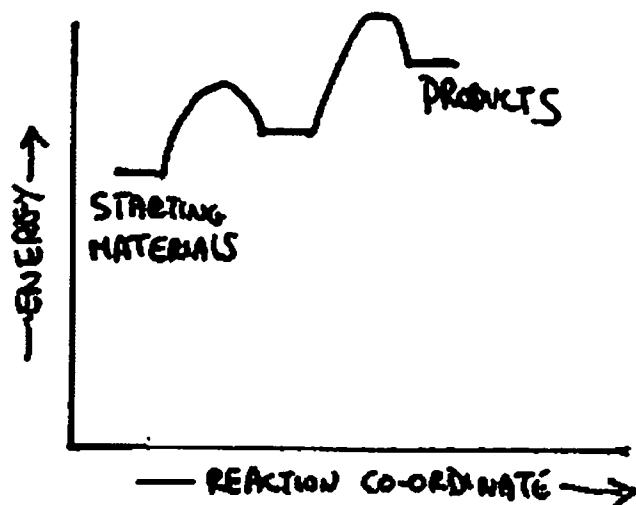


ii) Provide the specific name of the above reaction mechanism type – it should involve at least one letter, and a number. (1pt)

9) Assign **R** or **S** to each chiral center in these molecules. (6pts)

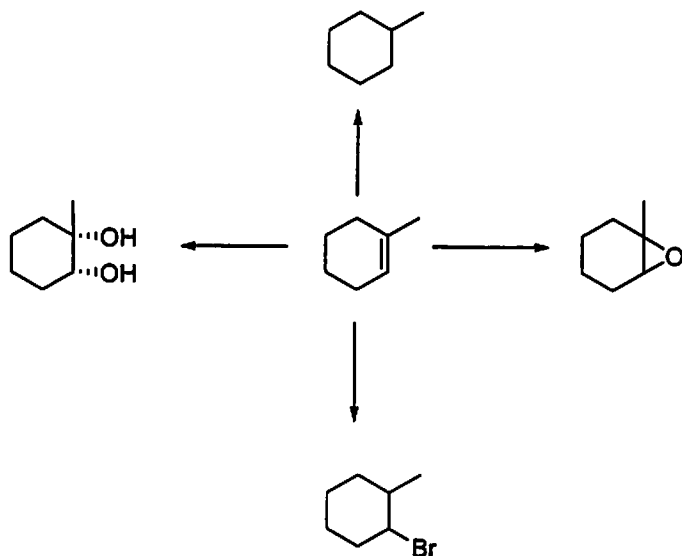


10) (6 pts) For the below energy level diagram...

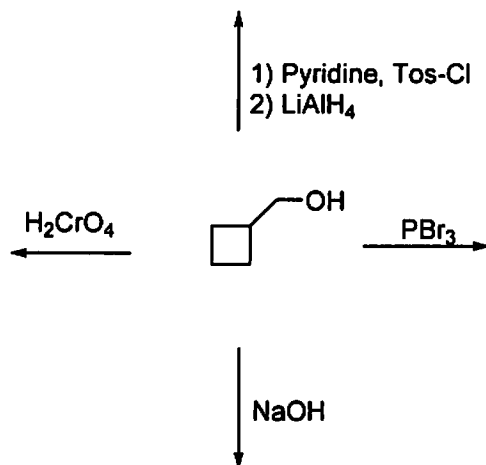


- is this reaction *exothermic* or *endothermic* ?
- Will the Equilibrium constant (K_{eq}) be *greater* or *less* than 1.00 ?
- how many transition states are there ?
- how many steps is this multistep reaction ?
- which step is the rate determining step ?
- which is the fastest step ?

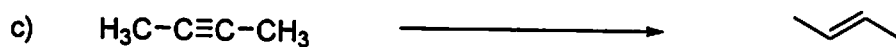
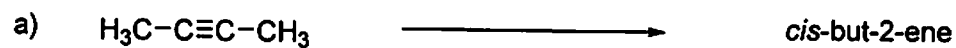
11) Give the **reagents** for the following alkene reactions. (8pts)



12) Give the **products** for the following alcohol transformations. (8pts)



13) Give the reagents (for a & c), and the products (for b & d). (8pts)



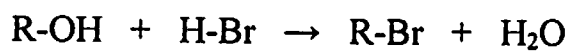
14) (2+2+1+1=6pts) Draw two molecules that are *structural isomers*.

Draw two molecules that are *stereoisomers*.

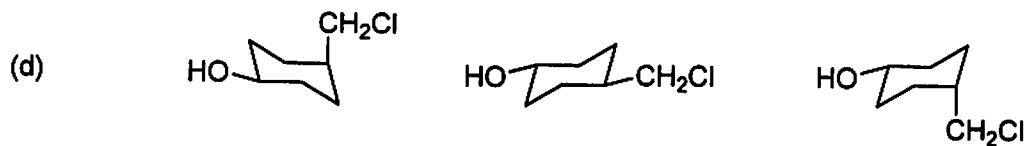
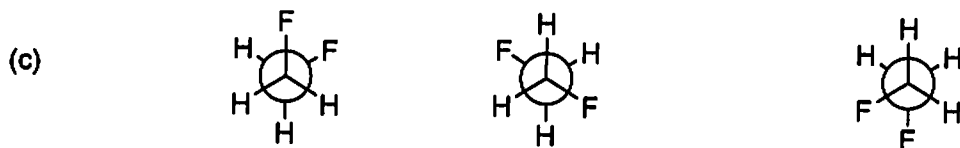
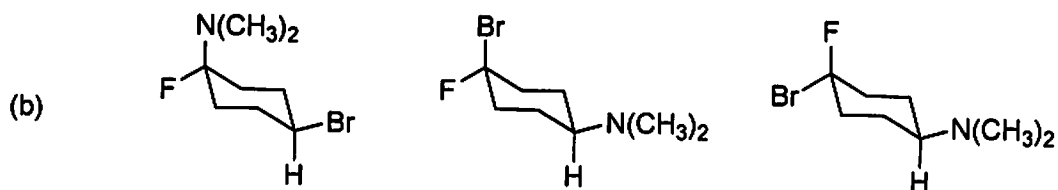
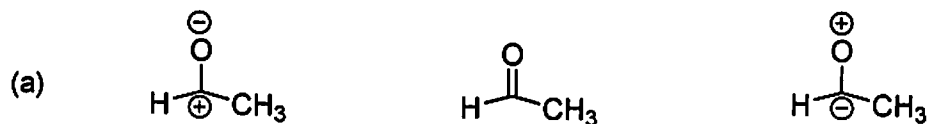
What is meant by a *diastereomer* ?

What are *tautomers* ?

15) Write the mechanism (i.e. curly arrows) for the following S_N2 transformation: (6pts)



16) Circle the *lowest energy* member of each threesome. (4pts)



****BONUS POINTS (up to TWO)****

Draw a *meso* compound, and state what makes it “meso”.

Name ETHEL GROOM

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(1 a-j) are TRUE/FALSE (10pts)

- a) Chiral molecules have non-superimposable mirror images. **T**
- b) S_N1 and E1 reactions both proceed through carbocation intermediates. **T**
- c) A triple bond has two π bonds and one σ bond. **T**
- d) Cyclopropane has more ring strain than cyclobutane. **T**
- e) Cahn, Ingold and Prelog created the rules for assigning R or S to a chiral center. **T**
- f) Cyclohexanol is a cyclic, chiral molecule. **false**
- g) An anion has a positive charge. **false**
- h) The triple bond in an alkyne is between two sp^2 hybridized carbons. **false**
- i) Unsaturated compounds have the maximum number of bonds to hydrogen. **false**
- j) The conjugate base of Nitric Acid (HNO_3) is the NO_3^+ cation. **false**

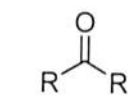
2) Define the following terms (3pts):

Anti Addition The addition of 2 atoms or groups to the opposite faces (sides) of a molecule.

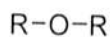
Substitution reaction A reaction where an atom or group is substituted for another atom or group.

Racemic mixture An equal amount of both enantiomers of a chiral species.

3) Name the classes of compound (functional groups) that the following molecules belong to (e.g. alkane, amide, etc.) (5pts)



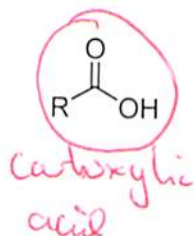
Ketone



Ether



Alcohol

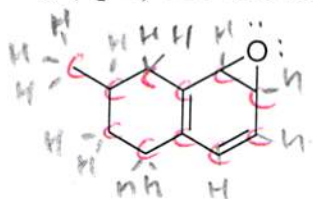


Thiol

4) Circle the above functional group that will likely be the most acidic. (1pt)

✓

5) (4pts) For the below molecule:



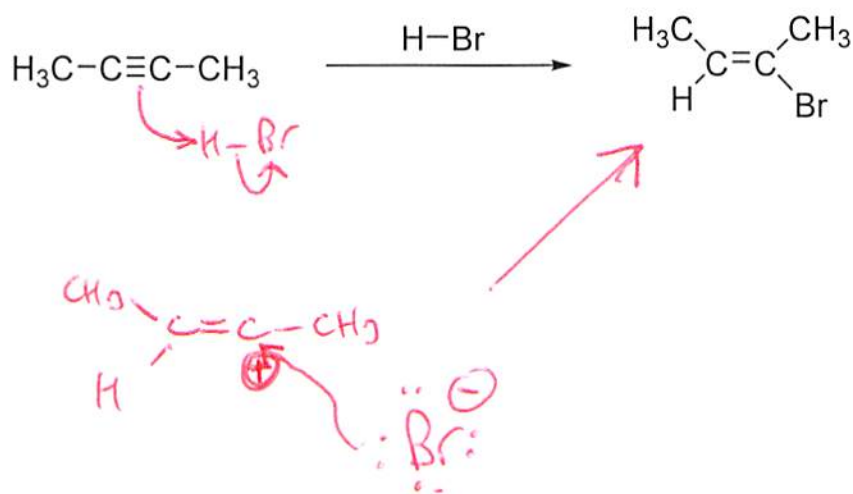
How many Hydrogens are there? 14

How many π bonds? 2

How many sp^3 hybridized Carbons? 7

What is the hybridization of the Oxygen? sp^3

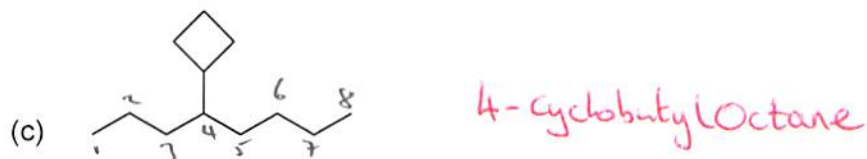
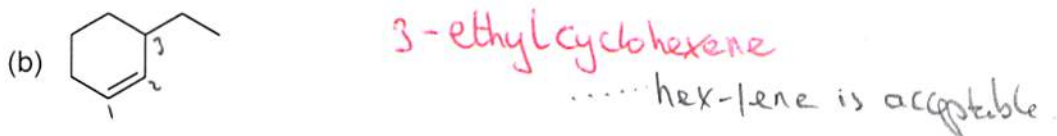
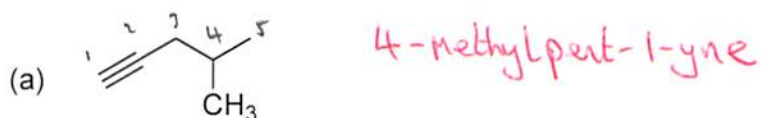
6) Write a mechanism (i.e. curly arrows) for this electrophilic addition.
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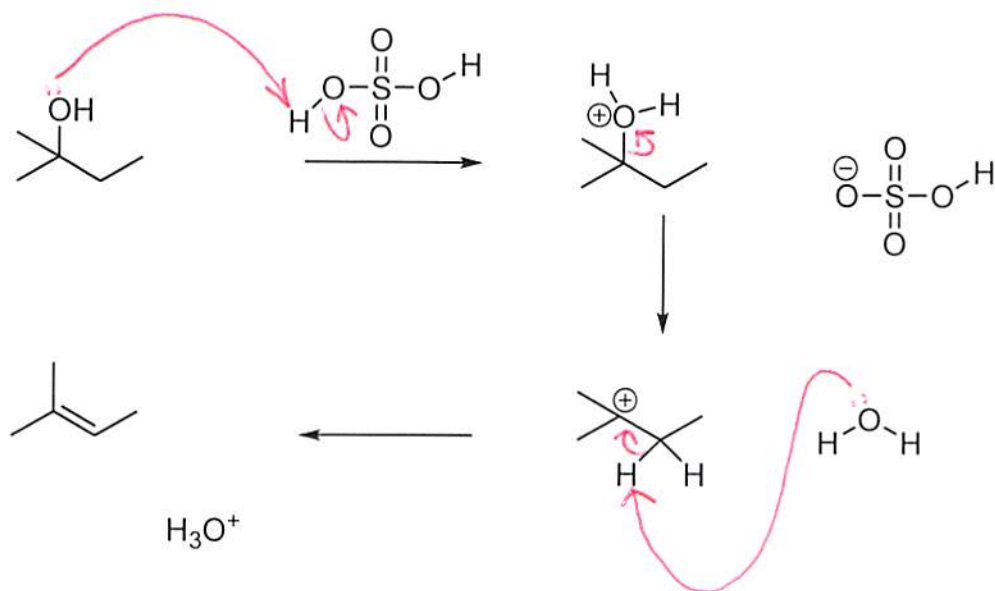
(1pt) In terms of *regiochemistry* (e.g. Markovnikov), how would you describe this reaction?

Neither Markovnikov nor Anti-Markovnikov.

7) Name the following molecules in IUPAC form. (12pts)



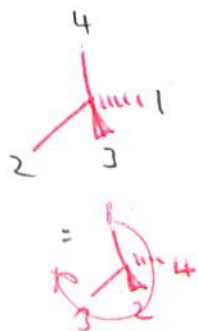
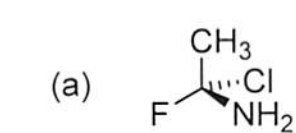
8) (i) Draw in the curly arrows for this acid catalyzed elimination. (6pts)



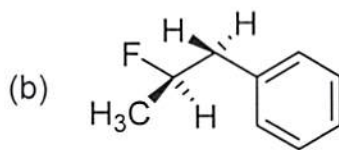
ii) Provide the specific name of the above reaction mechanism type – it should involve at least one letter, and a number. (1pt)

E1

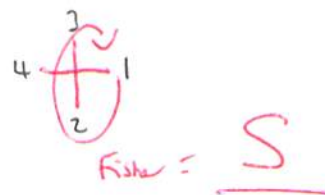
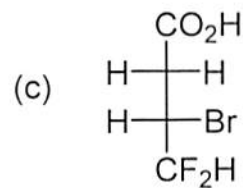
9) Assign **R** or **S** to each chiral center in these molecules. (6pts)



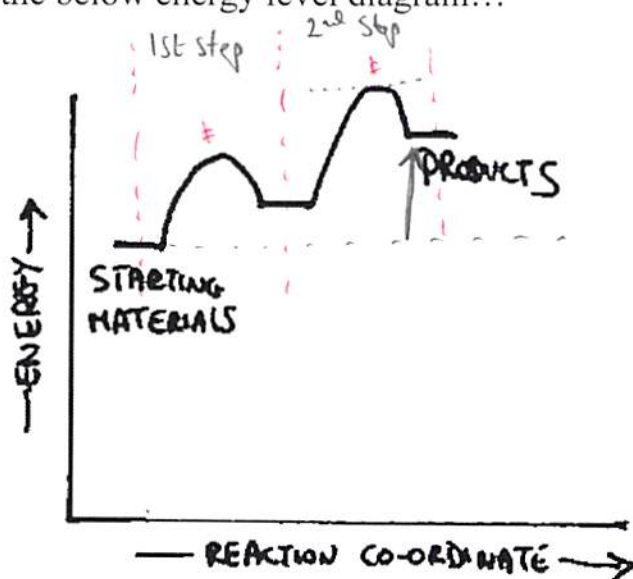
R



R



10) (6 pts) For the below energy level diagram...



a) is this reaction *exothermic* or *endothermic*?

b) Will the Equilibrium constant (K_{eq}) be *greater* or *less* than 1.00?

c) how many transition states are there? 2

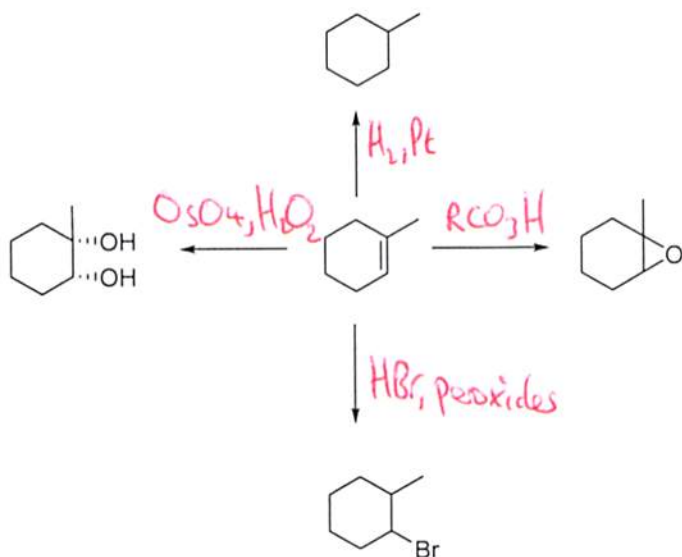
d) how many steps is this multistep reaction? 2

e) which step is the rate determining step? 2nd

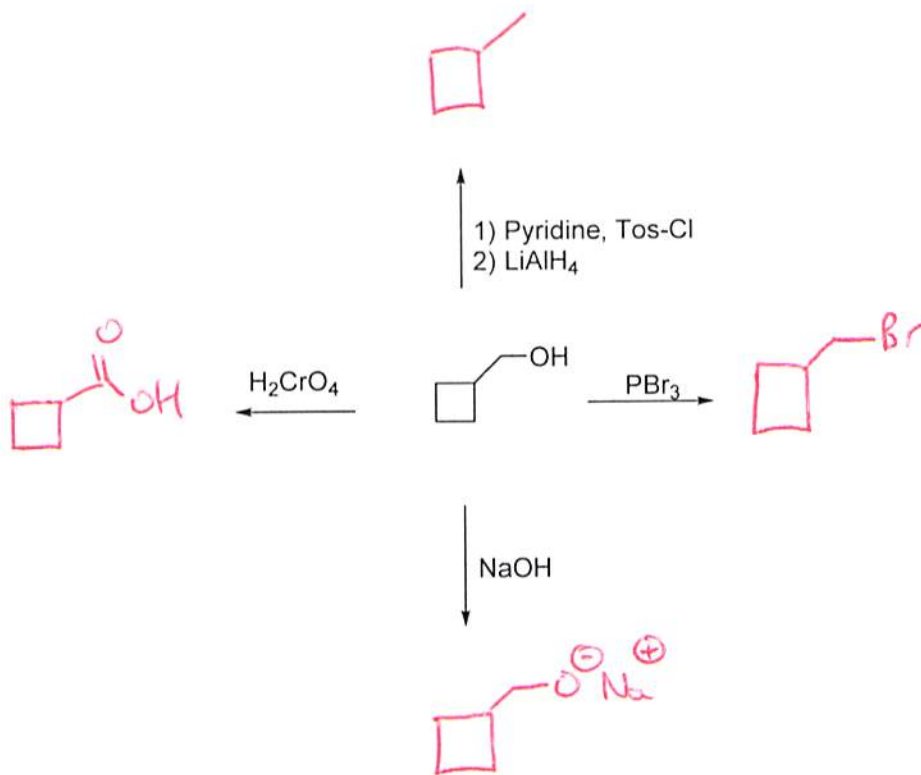
f) which is the fastest step?

1st step

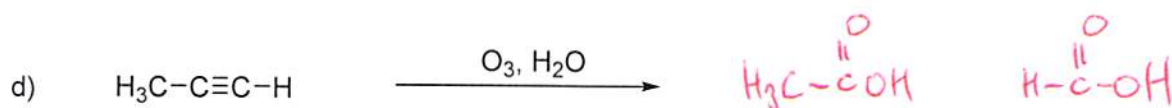
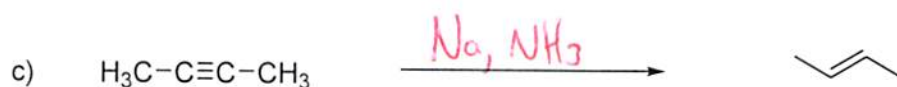
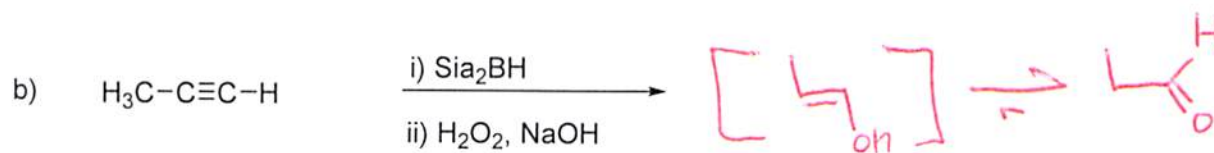
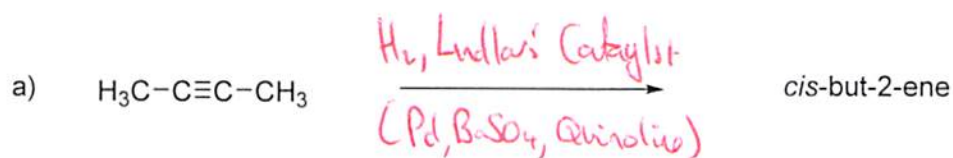
11) Give the **reagents** for the following alkene reactions. (8pts)



12) Give the products for the following alcohol transformations. (8pts)



13) Give the reagents (for a & c), and the products (for b & d). (8pts)



14) (2+2+1+1=6pts) Draw two molecules that are *structural isomers*.



Draw two molecules that are *stereoisomers*.



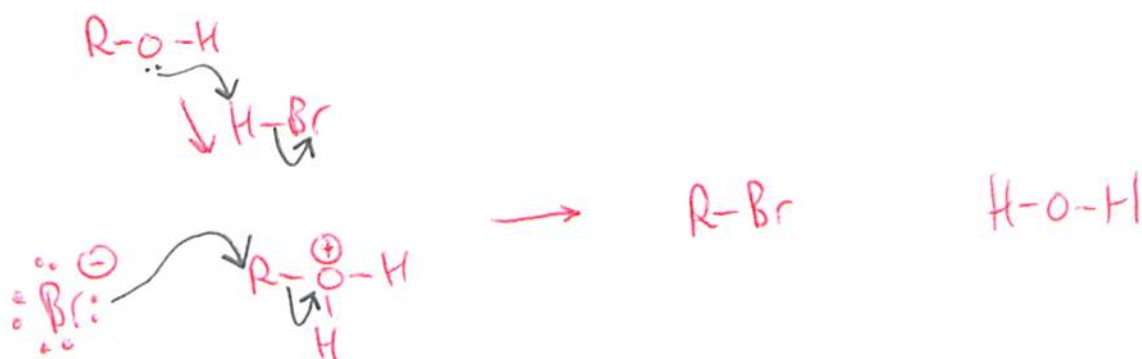
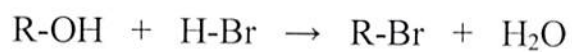
What is meant by a *diastereomer*?

A stereoisomer which is not an enantiomer.

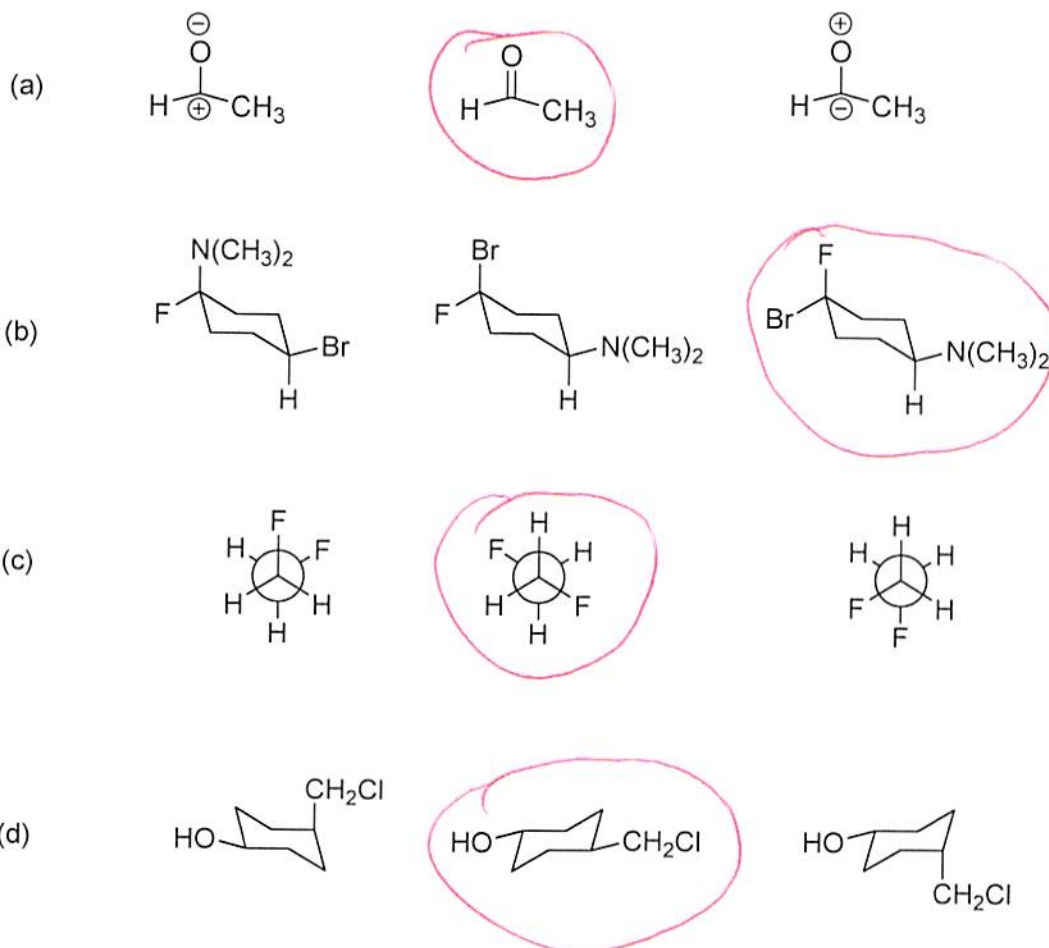
What are *tautomers*?

Structural isomers that are in equilibrium with each other.

15) Write the mechanism (i.e. curly arrows) for the following S_N2 transformation: (6pts)



16) Circle the *lowest energy* member of each threesome. (4pts)



****BONUS POINTS (up to TWO)****

Draw a *meso* compound, and state what makes it “meso”.

“Meso” means achiral, but contains chiral centers or elements.

