Organic I

Alkynes

Lecture 7

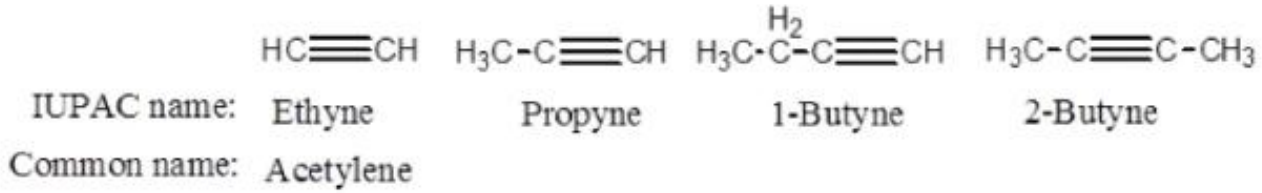
Dr: Fathallah A Khedr

Associate professor of Medicinal chemistry and drug design
Ashur university

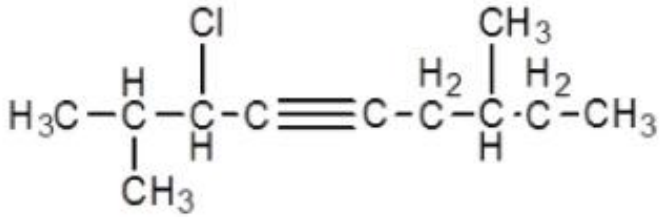
Nomenclature of Alkynes

- Named are derived from the corresponding alkanes by replacing the –ane ending by –yne.

- IUPAC rules as discussed for Alkenes .



- Example:

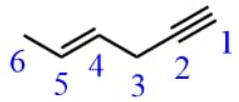


3-Chloro-2,7-dimethyl-4-nonyne

Naming a Compound Containing an Alkyne and Alkene

Doesn't matter which one - number such that the first group gets the lowest possible locant:

Alkyne can get position 1, so it does. Alkene cannot.



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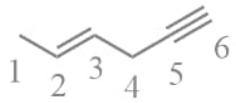
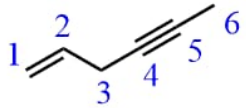


hex-4-en-1-yne

Correct

The first group is on position 2 - **wrong**

Alkene can get position 1, so it does. Alkyne cannot.



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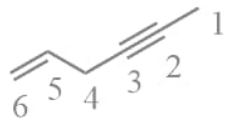


hex-1-en-4-yne

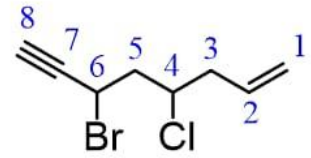
Correct

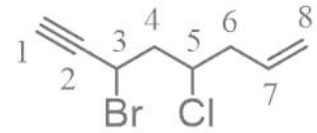
The first group is on position 2 - **wrong**

Simply choose the direction that gives the first group the lowest number - no priority.

Naming a Compound Containing an Alkyne and Alkene

Both directions give either the double or triple bond locant one:





6-bromo-4-chlorooct-1-en-7-yne

Correct

3-bromo-5-chlorooct-1-yne-7-ene

Incorrect

The alkene gets a lower locant even though the other substituents get higher numbers.

"terminal" alkynes have the triple bond at the end of the chain:

$CH_3CH_2C{\equiv}CH$

1-butyne

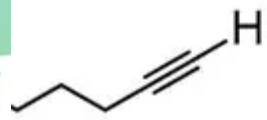
ethylacetylene

$HC{\equiv}CCHCH_2CH_3$ (with CH_3 branch)

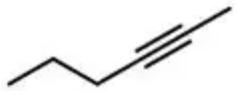
3-methyl-1-pentyne

sec-butylacetylene

s are classified as Terminal and Int



Terminal

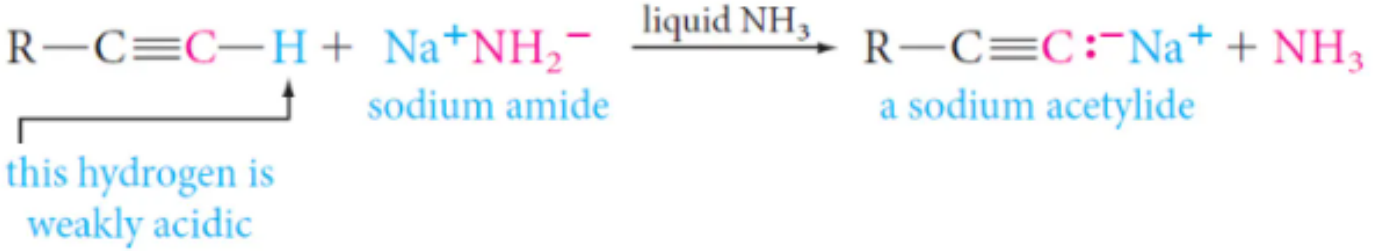


Internal

Internal: triple bond located between two carbon atoms in the chain

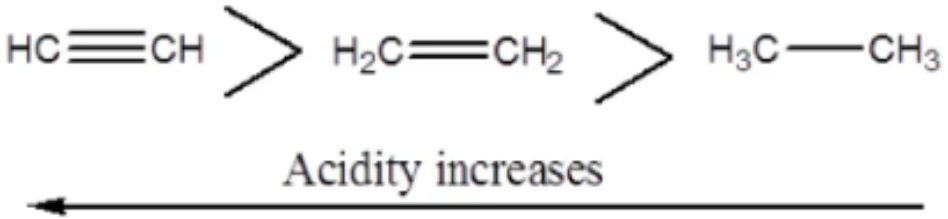
Acidity of Alkynes

- A hydrogen atom on a triply bonded carbon (Terminal Alkyne) is weakly acidic and can be removed by a very strong base (as Sodium amide).



- Internal alkynes (Non-Terminal Alkyne) have no exceptionally acidic hydrogens.

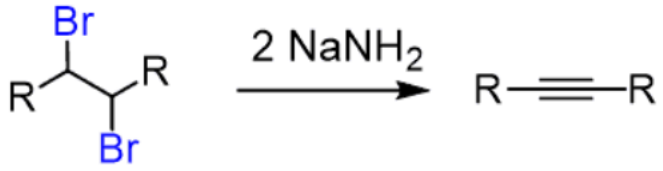
- Relative Acidity of the Hydrocarbon.

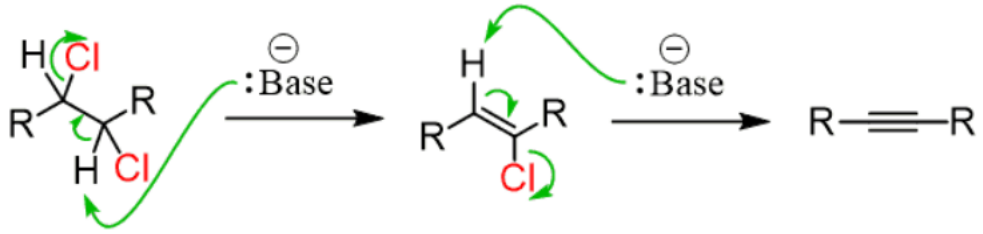


Preparation of Alkynes

1) Dehydrohalogenation of Alkyl dihalides

The reaction goes by E2 mechanism and is similar to how alkenes are prepared. The difference here is that two halogen atoms are needed because the triple bond id formed by two consecutive elimination reactions:

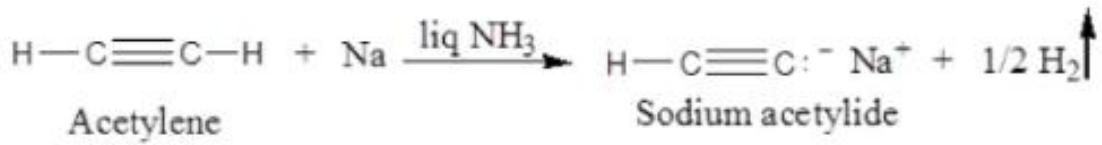


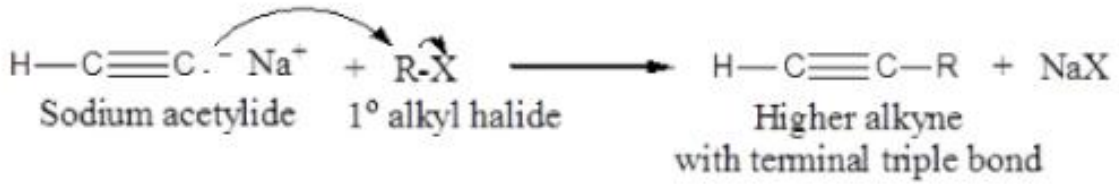


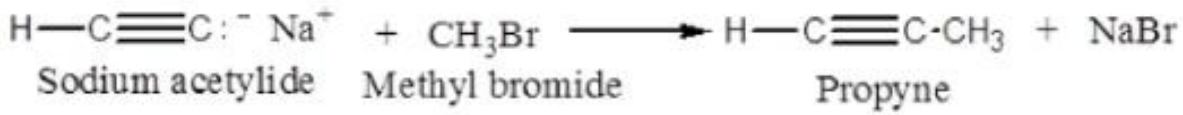
Preparation of Alkynes

2) Reaction of Sodium Acetylide with Primary Alkyl Halides

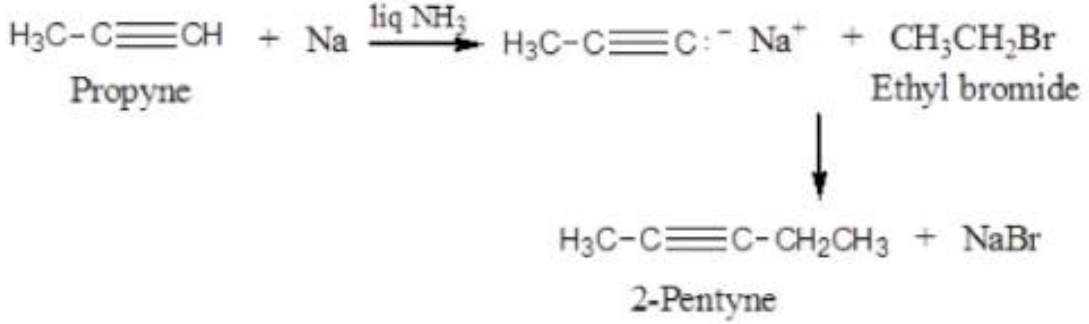
Acetylene







Monosubstituted Acetylenes

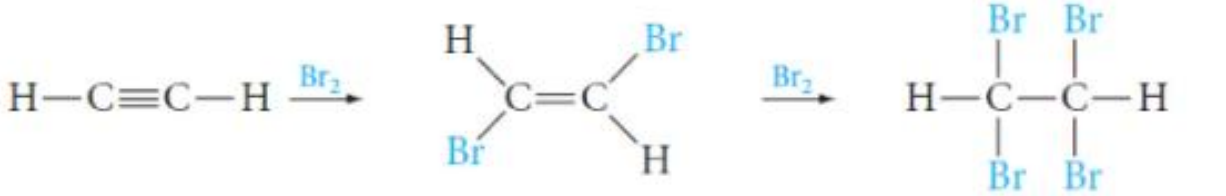


1- Reduction of alkynes



2- Addition of Br2

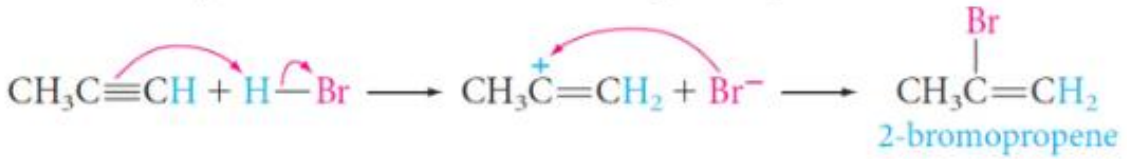
- Bromine adds as follows; In the first step, the addition occurs mainly *trans*.



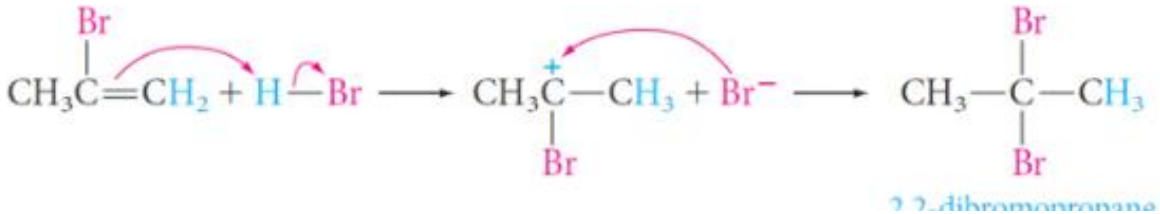
ethyne — *trans*-1,2-dibromoethene — 1,1,2,2-tetrabromoethane

3- Addition of HBr

- With unsymmetric triple bonds and unsymmetric reagents, Markovnikov's Rule is followed in each step, as shown in the following example:



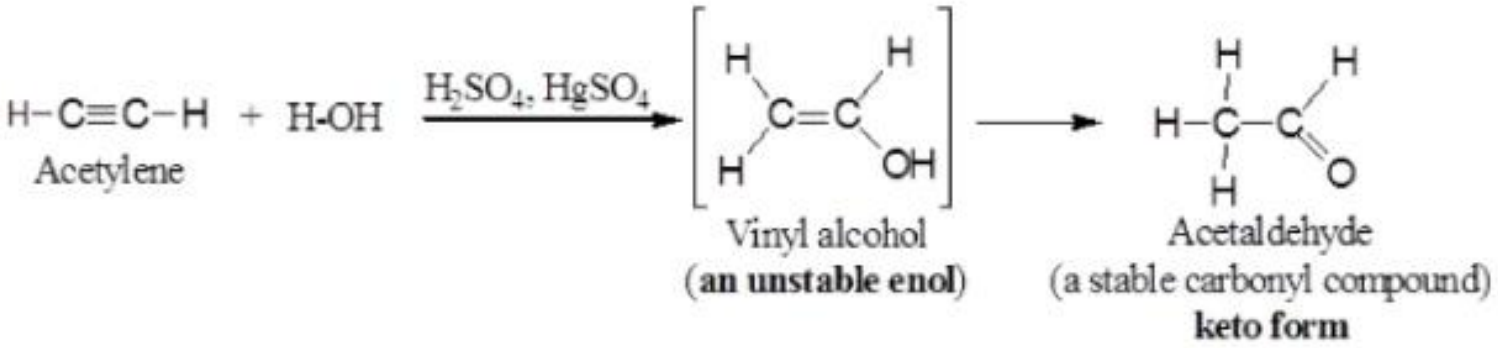
2-bromopropene

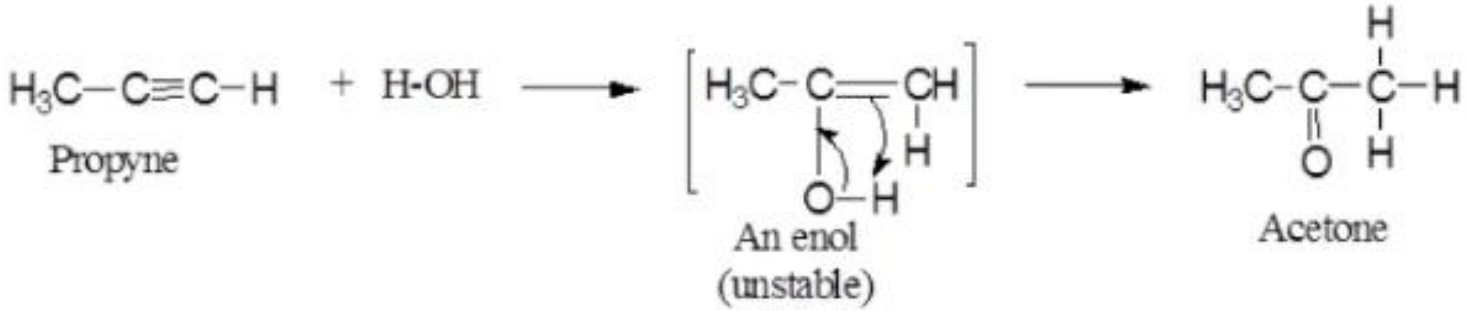


2,2-dibromopropane

4- Addition of H2O

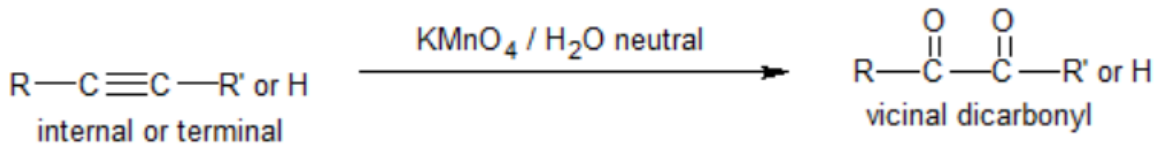
- Addition of water to alkynes requires not only an acid catalyst but mercuric ion as well.
- The mercuric ion forms a complex with the triple bond and activates it for addition.
- Although the reaction is similar to that of alkenes, the initial product—a **vinyl alcohol** or **enol**—rearranges to a carbonyl compound.



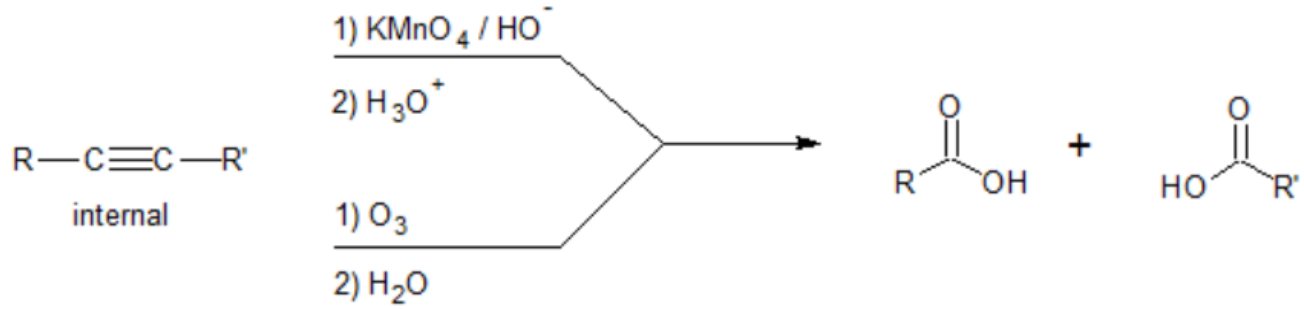


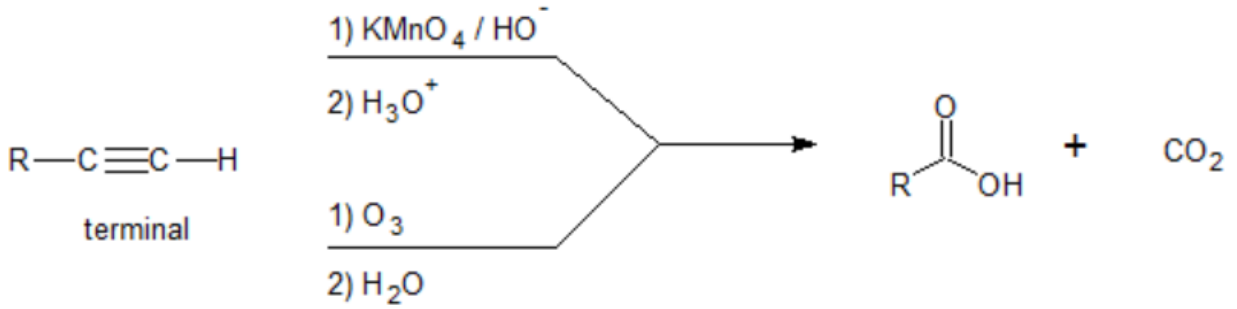
Oxidation of alkynes

Gentle Alkyne Oxidation



Strong Alkyne Oxidation - Oxidative Cleavage



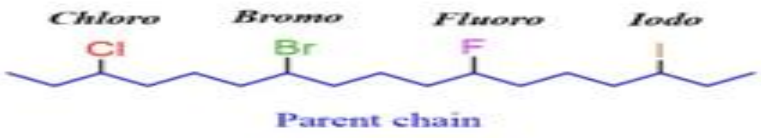


Alkyl halides

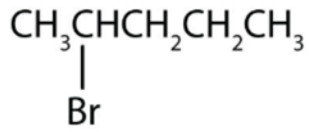
Nomenclature

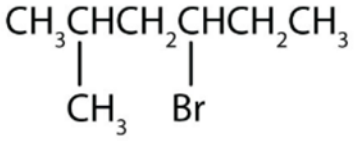
The halogen in alkyl halides is treated just like any alkyl substituent, meaning it has no priority over the carbon atoms. The parent chain is still numbered in a way to give the lowest possible number(s) for the substituents.

The only difference in naming alkyl halides is the change of the suffix "**ine**" to "**o**". For example, 2-bromo, 4-chloro, 3-iodo, 5-fluoro:



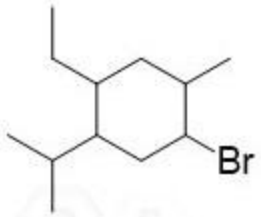
ive the IUPAC name for each compound.

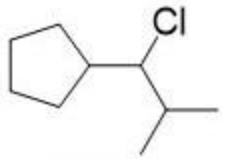


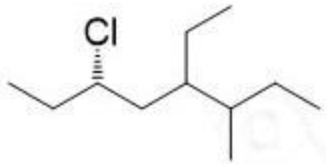


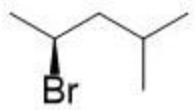
Give IUPAC name for each of the following:

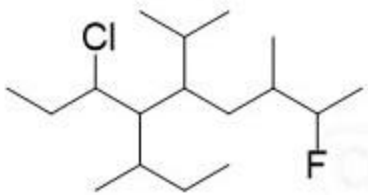
a) 

b) 

c) 

d) 

e) 

f) 

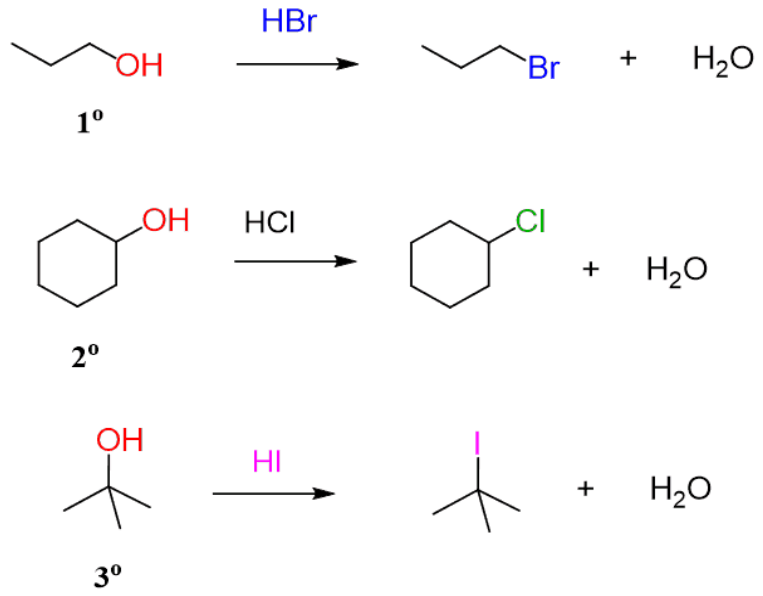
Preparation of alkyl halides

1- free radical substitution reaction of alkanes

2- halogenation of alkenes

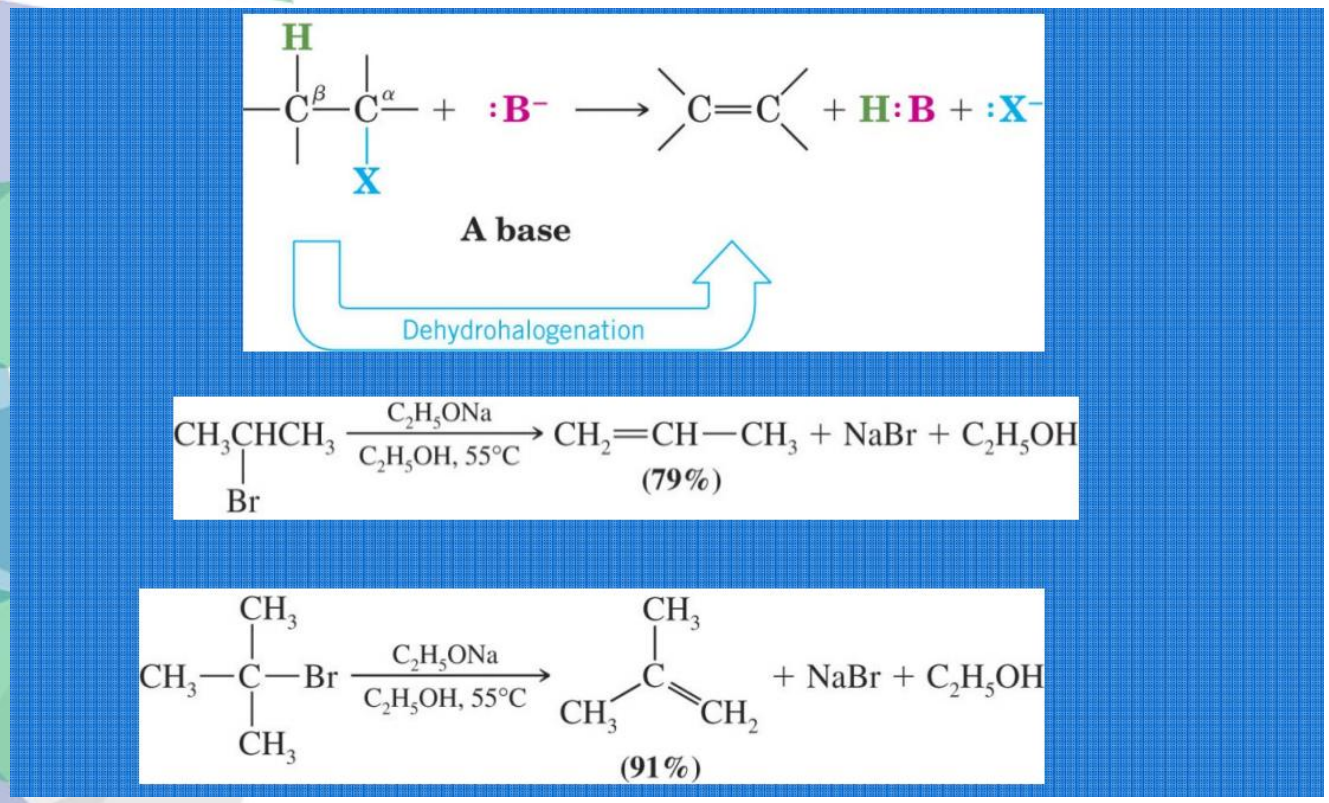
3- reaction of alcohols with HBr

Alcohols can be converted to Alkyl Halides with HX acids



Reaction of alkylhalides

1- Elimination reaction (dehydrohalogenation of alkyl halides give alkenes) E2



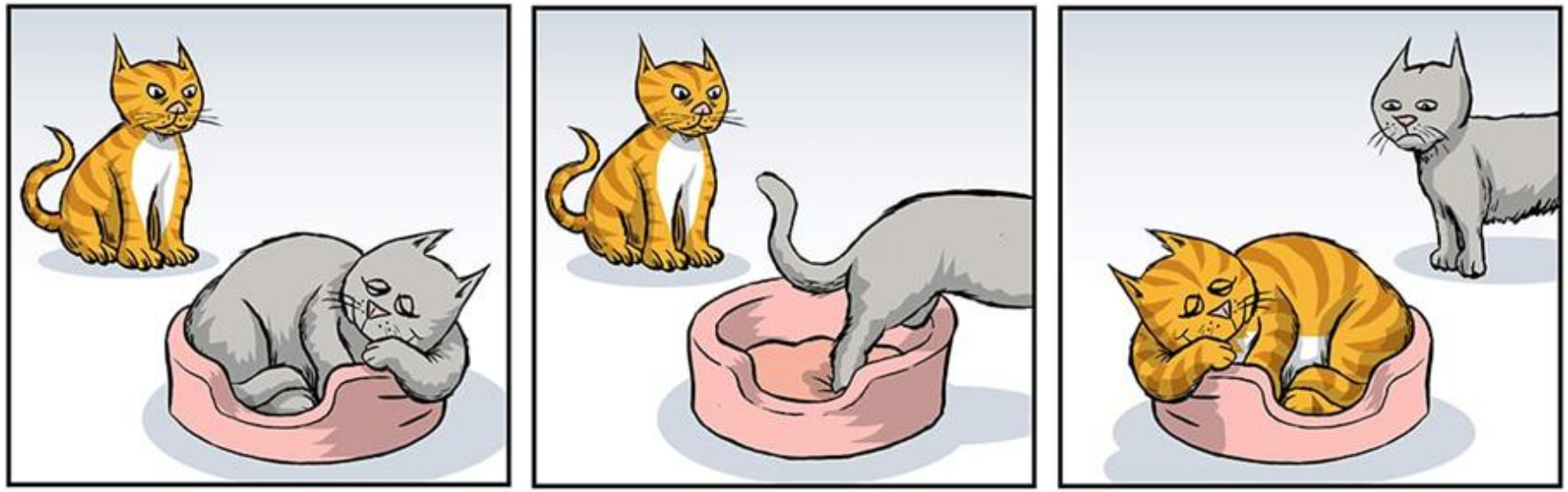
2- Nucleophilic substitution reaction SN1 and SN2

SN1	SN2
Nucleophilic substitution reaction unimolecular	Nucleophilic substitution reaction bimolecular
two steps Depends on concentration of alkyl halide only	**One Step** Depends on concentration of both alkyl halide and nucleophile
Weak nucleophile (H_2O- C_2H_5OH)	Strong nucleophile (KOH, NaCN, C_2H_5ONa
Good leaving group	Bad leaving group
Formation of carbocation	No carbocation
Solvent: Polar protic solvent (H2O, C2H5OH)	Polar a protic solvent (acetone, dimethylformamide)
Rearrangement occurs	No Rearrangement

3° > 2° (1° & methyl don't usually react)
carbocation stability is the key factor

methyl > 1° > 2° (3° don't react)
steric hindrance is the key factor

SN1



SN2



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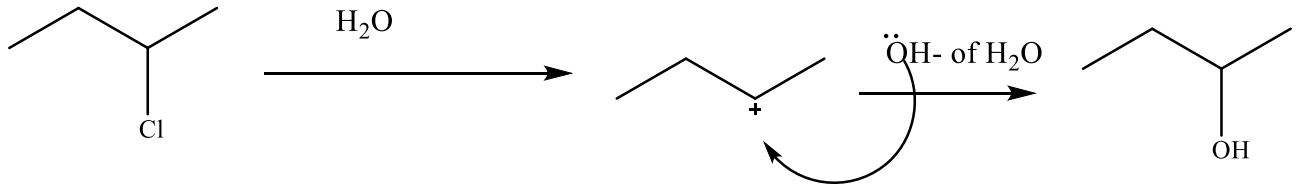
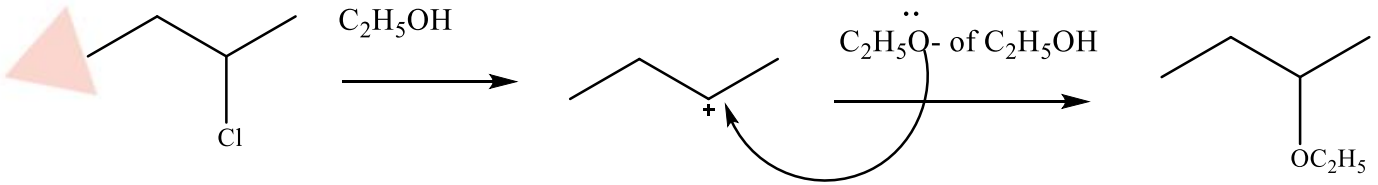
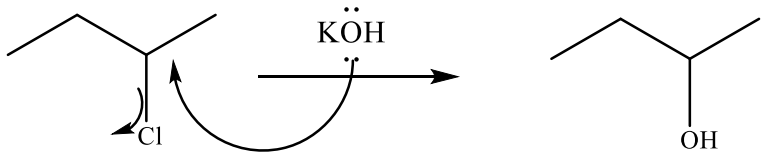
Secondary alkyl halides

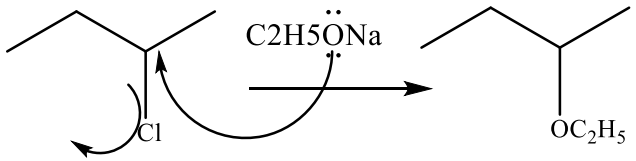
SN1





SN2

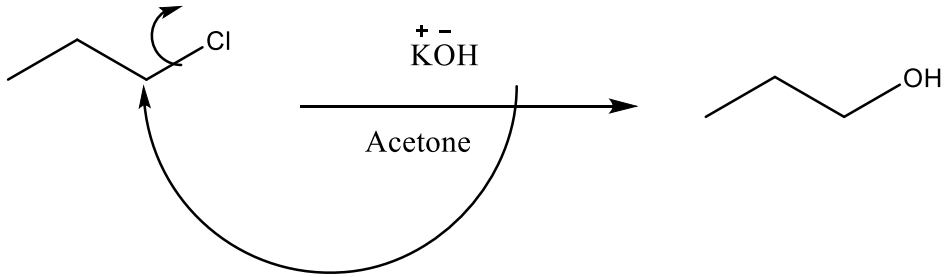


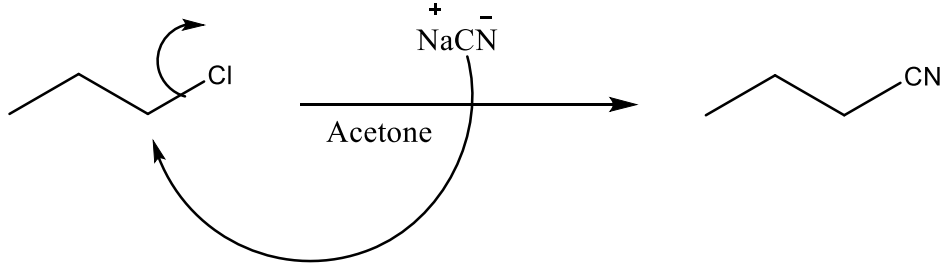


Primary alkyl halides

Reacts by SN2 only

WHY??????????

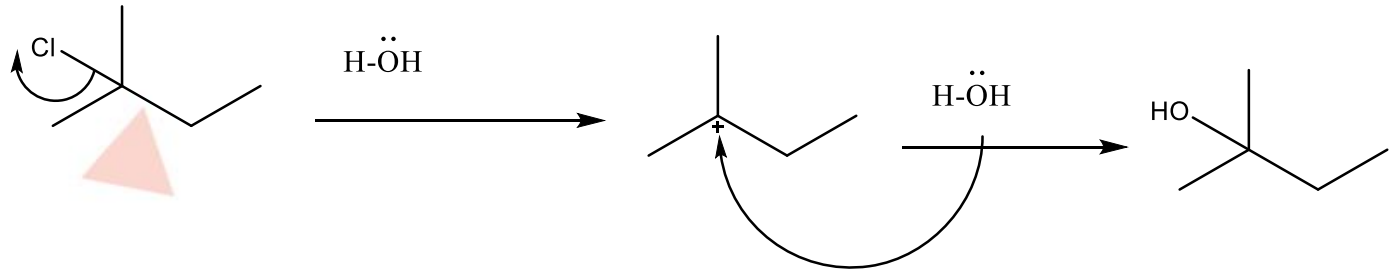




Tertiary alkyl halides

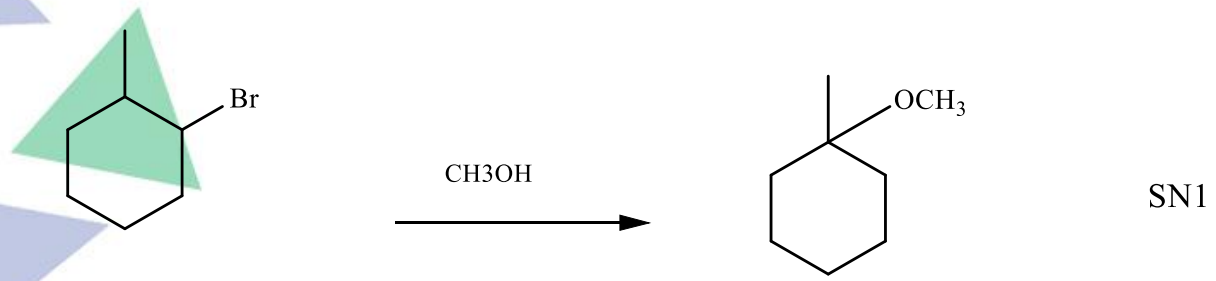
Reacts by SN1 only

WHY?????

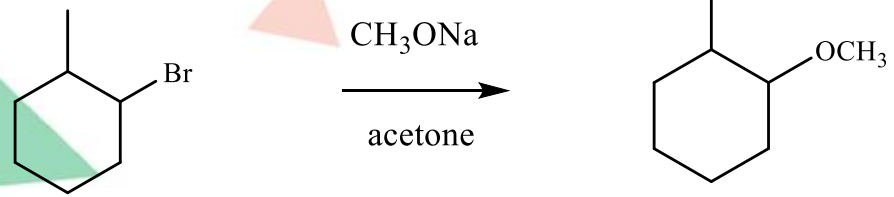


Practice problem

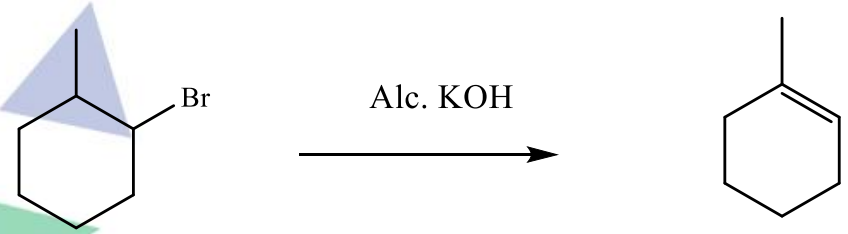
Mention type of the following reactions and outline the mechanism for each.



SN1



SN2



E2