

Primary	Secondary	Tertiary
Primary $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}-\text{C}-\text{Cl} \\ \\ \text{H} \end{array}$	Secondary $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}-\text{C}-\text{Cl} \\ \\ \text{CH}_3 \end{array}$	Tertiary $\begin{array}{c} \text{CH}_3 \\ \\ \text{H}_3\text{C}-\text{C}-\text{Cl} \\ \\ \text{CH}_3 \end{array}$
Undergoes SN2	SN1/2	SN1
Reasons: -No steric hindrance -Carbocation created is unstable -Intermediate is co-planar, both groups exist in same plane	Reasons: -Steric hindrance, resulting in high activation energy in SN2 reactions -Alkanes are electropositive, donate electron density, making resulting carbocation ion more stable -Energy to stabilize carbocation/anion provided by solvation energy -> solvent surrounds molecule in a sphere via hydrogen bonds, therefore releasing energy, lengthening/weakening bonds -> heterolytic fission	

Reactions include:

-Substitution to amino group -> 1°, 2°, 3° amines

-R-CN, creates nitrile, ascends homologous series

-Can be oxidized into carboxylic acid or reduced into primary amine

-Hydrolysis, OH subs for haloalkane, creates primary alcohol

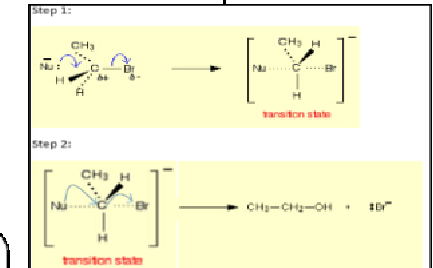
-Alcohols can also undergo nucleophilic substitution due to carbon donating electron density to oxygen, weakening OH bond, creates ester (R-O-R)

SN2

-Bimolecular RDS, nucleophilic substitution
 Since there exists a polar bond between the halogen and the carbon it is attached to, nucleophile is attracted to δ^+
 -Nucleophile forms coordinate dative bond with carbon while the halogen is still attached, resulting in coplanar transition state - this is the RDS

-Carbon donates electron pair to halogen, creating halide ion, nucleophile donates electron pair to carbon fast step

-Back attack results in lateral inversion of configuration



Note: Must be in a cold, dilute, aqueous alkali solution in order to undergo substitution

Haloalkanes

(By Edward Sun)

Physical Properties:

Higher melting/boiling point than alkanes, however, melting/boiling point still low

-increases as the molar mass of the halogen increases due to LDF
 -Can also increase going down homologous series (LDF as well)

Insoluble in water, dipoles are not polar enough for hydrogen bonding with water, water tends to hydrogen bond with itself

Soluble in other organic solvents

Structure/Bonding:

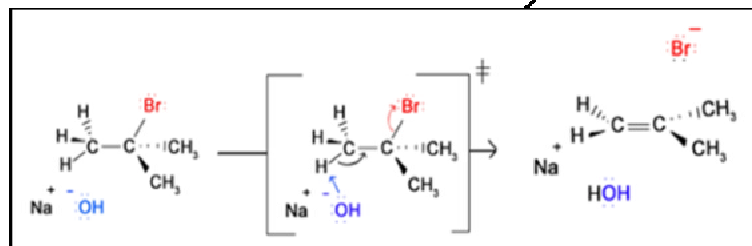
Sp³ hybridization, 109° bond angles

-Takes place in hot, concentrated alcoholic, aqueous solutions to form alkenes, (formation of cis and trans isomers), T > 100°, since E has higher E_a - Stronger the base, more likely for elimination

E2:

-OH donates electron pair to hydrogen atom on β-carbon, forms double bond by expulsion of halide ion, bimolecular RDS

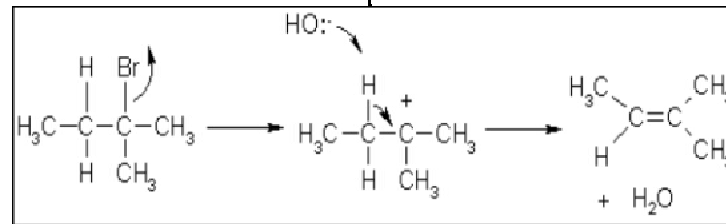
-Creates alkenes, halide ion, and water



E1:

-Unimolecular RDS, dependent on ionization of halogen atom

-OH donates electron pair to hydrogen on beta carbon, forms double bond (Like E2)



SN1

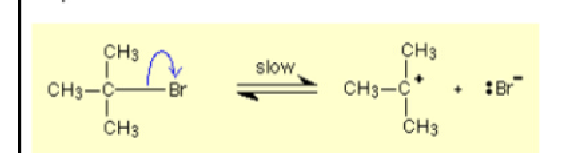
- Nucleophilic substitution with a unimolecular RDS

-Haloalkane ionizes, gives carbocation and halide ion (since carbocation is relatively stable, since alkyl groups are electropositive, therefore donating electron density to the carbocation)

-Once carbocation formed, will react immediately upon contact with nucleophile (could be CN⁻ or OH⁻)

-Reaction depends on how fast the halogenoalkane ionizes

Step 1



Step 2:

