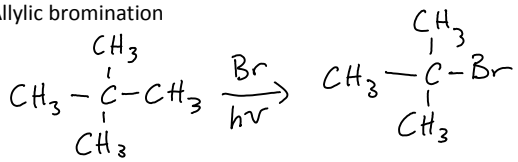
Notes 2-27

Tuesday, March 27, 2007
5:35 PM

Last Time: Allylic bromination

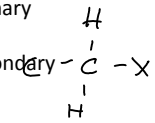


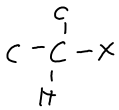
Today: Nucleophilic Substitution Reactions

SN1
SN2

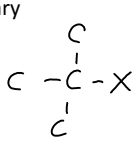
- Substitution vs. Elimination
  - Elimination
    - ◇ Favored when Nu:⁻ is a strong base
    - ◇ Favored at high tempratures
    - ◇ Major product ha smost substituted C=C
    - ◇ Can occur by E_1 or E_2 mechanisms
  - □ Substitution
    - ◇ Favored when Nu:⁻ is a good nucleophile but a weak base
    - ◇ Can occur by S_N1 or S_N2 mechanisms

- Substitution of Alkyl Halides:
  - Primary
  - Secondary

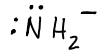




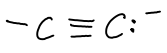
  - Tertiary



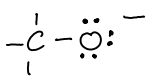
- Strong Bases: (memorize all these)
  - Amide
    - ◇ Elimination with 1°, 2°, 3° alkyl halides
    - ◇ Formula:



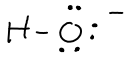
  - Acetylide anion
    - ◇ Substitution with 1° alkyl halides; elimination with 2° and 3° alkyl halides
    - ◇ Formula:



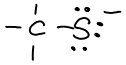
  - Alkoxide
    - ◇ Substitution with 1° alkyl halides; elimination with 2° and 3° alkyl halides
    - ◇ Formula:



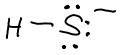
  - Hydroxide
    - ◇ Substitution with 1° alkyl halides; elimination with 2° and 3° alkyl halides
    - ◇ Formula:



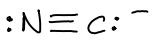
- How to determine strength of base/acid
  - K is large = strong acid
  - Small pKa = strong acid
  - Conjugate base of a strong acid = weak base
- Weak Bases:
  - Thiolate



  - Hydrosulfide

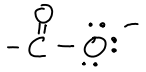


  - Cyanide

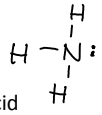


  - Iodide

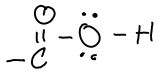
  - Carboxylate



  - Amine

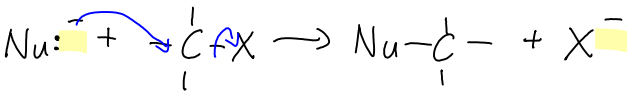


  - acid

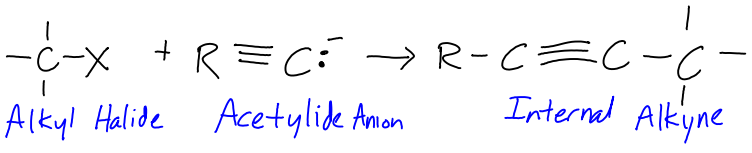


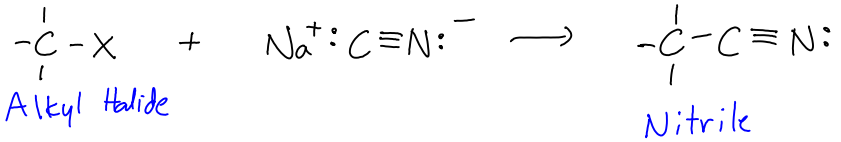
- Basicity:

- Nucleophicity:

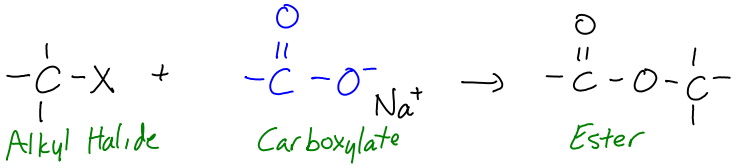


- Product Structure (C=Nu)





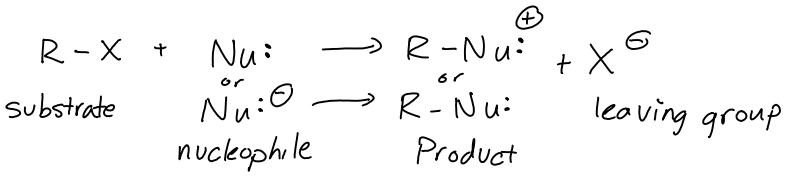
- Product Structure (O=Nu)



- See hand out for rest of structures

- Reactivity of Alkyl Substrate
  - The weaker the basicity of X^-, the better the leaving group and the more reactive the alkyl halide
  - Order of basicity $I^- > Br^- > Cl^- > F^-$.
  - So, the order of reactivity RI > RBr > RCl > RF

- Equilibrium
  - Equilibrium will favor side with weaker Bronsted base

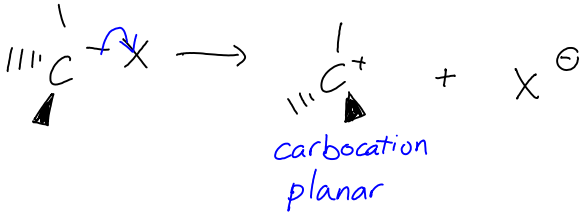


    - Why? Because stronger Bronsted base displaces the weaker Bronsted base.

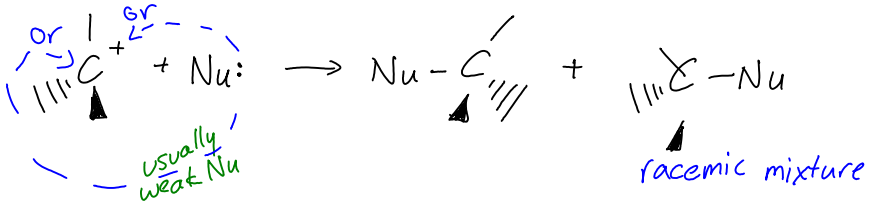
- Rate of displacement on the carbon substrate depends on nucleophilicity of the attacking base.

- Two Mechanisms for Nucleophilic Substitution Reactions.
  - SN1
    - First order kinetics
    - Two step mechanism - forms carbocation intermediate
    - Stereochemistry: racemic mixtures due to Nu attack at either face of carbocation

    - Mechanism
      - Step 1: Rate Determining Step r=k[R-X]



      - Step 2: fast step



- Carbocation stability 3° > 2° > 1° > CH_3^+