Amines

Here are some important reactions related to *Amines*:

1. **Reduction of Nitro Compounds**:
   - Nitro compounds (R–NO_2) are reduced to primary amines (R–NH_2) using hydrogen gas and catalysts like Ni, Pt, or Pd.
   - Example:
     $C_6H_5NO_2 \xrightarrow{H_2/Ni} C_6H_5NH_2$
2. **Ammonolysis of Alkyl Halides**:
   - Alkyl halides (R–X) react with ammonia to form primary, secondary, or tertiary amines and quaternary ammonium salts.
   - Example:
     $RX + NH_3 \rightarrow RNH_2 + HX\ RNH_2 + RX \rightarrow R_2NH + HX$
3. **Gabriel Phthalimide Synthesis**:
   - A method for preparing primary amines by reacting phthalimide with alkyl halides followed by hydrolysis.
   - Example:
     $C_6H_4(CO)_2N^-K^+ \xrightarrow{R–X} C_6H_4(CO)_2NR \xrightarrow{H_2O/OH^-} RNH_2$
4. **Hoffmann Bromamide Degradation Reaction**:
   - Conversion of an amide (RCONH_2) into a primary amine (RNH_2) by treating with bromine and aqueous sodium hydroxide.
   - Example:
     $RCONH_2 + Br_2 + 4NaOH \rightarrow RNH_2 + Na_2CO_3 + 2NaBr + 2H_2O$
5. **Reduction of Nitriles**:
   - Nitriles (R–C≡N) are reduced to primary amines (R–CH_2NH_2) using hydrogen gas and a catalyst or by lithium aluminium hydride ($LiAlH_4$).
   - Example:
     $R–C \equiv N \xrightarrow{LiAlH_4} R–CH_2NH_2$
6. **Acylation Reaction**:
   - Amines react with acid chlorides or anhydrides to form amides.
   - Example:
     $RNH_2 + R'COCl \rightarrow R–NH–COR' + HCl$
7. **Alkylation Reaction**:
   - Amines react with alkyl halides to form higher amines or quaternary ammonium salts.
   - Example:
     $RNH_2 + RX \rightarrow R_2NH\ R_2NH + RX \rightarrow R_3N$
8. **Carbylamine Reaction**:
   - Primary amines react with chloroform ($CHCl_3$) and alcoholic KOH to form isocyanides (R–NC), a foul-smelling compound.
   - Example:
     $RNH_2 + CHCl_3 + 3KOH \rightarrow RNC + 3KCl + 3H_2O$
9. **Reaction with Nitrous Acid**:
   - Primary aliphatic amines react with nitrous acid (HNO_2) to form alcohols, and aromatic amines form diazonium salts.

- Example for aliphatic amines:
  $RNH_2 + HNO_2 \rightarrow ROH + N_2 + H_2O$
- Example for aromatic amines:
  $C_6H_5NH_2 + HNO_2 \rightarrow C_6H_5N_2^+Cl^- + H_2O$

10. **Hinsberg Test**:
    - Differentiates between primary, secondary, and tertiary amines using benzenesulfonyl chloride ($C_6H_5SO_2Cl$).
    - Example:
      $RNH_2 + C_6H_5SO_2Cl \rightarrow R–SO_2–C_6H_5$ Primary amines form soluble sulfonamides, secondary amines form insoluble sulfonamides, and tertiary amines do not react.
11. **Diazotization Reaction**:
    - Primary aromatic amines react with nitrous acid to form diazonium salts, which are used in various substitution and coupling reactions.
    - Example:
      $C_6H_5NH_2 + NaNO_2 + HCl \xrightarrow{273-278K} C_6H_5N_2^+Cl^- + 2H_2O$
12. **Sandmeyer Reaction**:
    - Diazonium salts react with copper(I) salts (CuCl, CuBr, CuCN) to form aryl halides or nitriles.
    - Example:
      $C_6H_5N_2^+Cl^- \xrightarrow{CuCl/HCl} C_6H_5Cl + N_2$
13. **Gattermann Reaction**:
    - Diazonium salts react with halogen acids in the presence of copper powder to form aryl halides.
    - Example:
      $C_6H_5N_2^+Cl^- + HCl + Cu \rightarrow C_6H_5Cl + N_2$
14. **Coupling Reaction**:
    - Diazonium salts couple with phenols or aromatic amines to form azo compounds.
    - Example:
      $C_6H_5N_2^+Cl^- + C_6H_5OH \rightarrow C_6H_5–N=N–C_6H_4OH$
15. **Electrophilic Substitution in Aromatic Amines**:
    - Aromatic amines undergo electrophilic substitution reactions, such as bromination, nitration, and sulfonation.
    - Example for bromination:
      $C_6H_5NH_2 + Br_2 \rightarrow C_6H_2Br_3NH_2(2,4,6-tribromoaniline)$

These reactions cover key transformations involving amines and are important for understanding their behavior in organic chemistry.