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| [O] - **acidified** Cr2O72-  [H] - LiAlH4 | | | Reagent [Condition] -> Product {Type}  R = CnH2n+1 | | E\*: Electrophilic  N\*: Nucleophilic  A: Addition  S: Substitution  E: Elimination  O: Oxidation  R: Reduction  H: Hydrolysis  N: Neutralization |
| Alkane  Cycloalkane  Alkene  Halogenoalkane  Alcohol  Aldehydes  Carboxylic acid  Ketone  Esters  Nitriles  Amines  Amides | | CnH2n+2  CnH2n  CnH2n  R-X  R-OH  R-CHO  R-COOH  R-CO-R’  R-COO-R’  R-C≡N  R-NH2  R-ONH-R’ | | -ol  -al  -oic acid  -one  R’-yl R-oate  -nitrile  -amine  N-R’-yl R-amide |
| Alkanes | **X2 [UV] → Haloalkanes + HX {S}** | | | | |
| Alkenes | **H2 [Pt cat.] → Alkanes {A}**  **X2 → Haloalkanes {EA}**  **H2O(g) [H2SO4 cat.] → Alcohols {A, H}**  C2H4 + H2O → [H2SO4] → C2H5OH  **[O] → Diols {O}** | | | | |
| Haloalkanes  **R-X** | Compound degree proportional to reaction speed  **NaOH [Reflux, aq. sol] → Alcohols NaX {NS}**  RX + OH- → ROH + X-  Hydrolysis: RX + H2O → ROH + HX (heat + catalyst)  **KOH [Reflux, ethanolic sol] → Alkene H2O KX {E}**  **KCN [Reflex, ethanolic sol] → Nitriles KX {NS}**  RX + CN- → RCN + X-  **2Conc. NH3 [Heat in sealed tube] → Amines NH4X {NS}**  RX + 2NH3 → RNH2 + NH4X *(Sealed tube to prevent escape of NH3)* | | | | |
| Alcohols  **R-OH** | **[Conc. H2SO4 cat. Reflux] → Alkenes H2O {E}**  **1°: [O] [Distil] → Aldehydes H2O, [O] [Reflux] → Carboxylic acids {O}**  Aldehydes - [1°ROH] + [O] → RCHO + H2O - Distil product as it’s formed  Carboxylic acids - RCHO + [O] → RCOOH - Heat under reflux  At the same time - ROH + 2[O] → RCOOH + H2O  **2°: [O] [Reflux] → Ketones H2O {O}**  **Na → Sodium alkoxide**  ROH + Na → RONa(s) + 1/2 H2(g) | | | | |
| Aldehydes  **R-CHO** | **[O] [Reflux] → Carboxylic acids {O}**  **2[H] [Ether] → Alcohols {R}**  **HCN [KCN Alkaline aq. sol] → Nitriles {NA}**  RCHO + HCN → R(OH)CN  *Naming R+1:*  *Propanal → 2-hydroxybutanenitrile (OH- prefixed)* | | | | |
| Ketones  **RCOOR’** | **2[H] [Dry ether] → Alcohols {R}**  **HCN [KCN Alkaline aq. sol] → Nitriles {NA}**  RCOOR’ + HCN → RCN(OH)R’  *R (additional C added as methyl group): propanone → 2-hydroxy-2-methylpropanenitrile* | | | | |

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| Carboxylic acids  **R-COOH** | *All reactions except PCl5 produces* ***H2O***  **4[H] [Ether] → Alcohols {R}**  **NaOH → ROONa Sodium alkenoate {N}**  **PCl5 → Acyl chlorides POCl3 HCl {A}**  **R’OH → Esters H2O {NS Esterification}**  ROOH + R’OH ⇌ ROOR’ + H2O  Ester naming: R’ from OH before R from acid: R’-yl R-oate |
| Acyl chlorides  **R-COCl** | *All reactions produce* ***HCl****. NH3+ HCl → NH4Cl*  **Cold H2O → Carboxylic acids**  **R’OH → Esters**  **NH3 → RONH2 Amides**  **R’NH2 → RONHR’ Amides** |
| Esters  **ROOR’** | **H2O [Sulfuric acid sol] → Acids Alcohols {H}**  ROOR’ + H2O ⇌ ROOH + R’OH  **NaOH [Alkaline sol] → ROO- Na+ R’OH {H}**  ROOR’ + NaOH → ROO- + Na+ + R’OH  ROO- + H+ → ROOH  *Advantage to produce acids with this method: no equilibrium* |