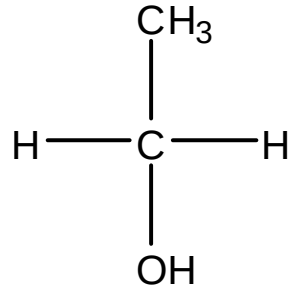
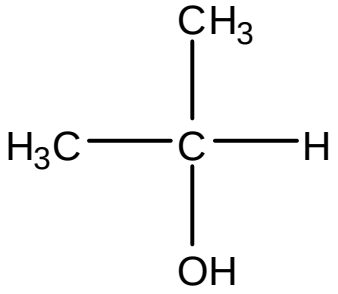
# Chemistry 3.5
# Advanced Organic Chemistry

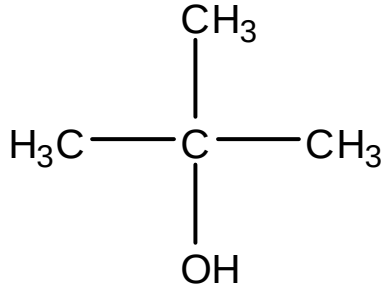
Alcohol Chemistry

# Alcohols

- Three types of alcohols
  - Primary
    - The –OH group bonded to a carbon that is bonded to zero or one other carbon atom
  - Secondary
    - The –OH group bonded to a carbon that is bonded to two other carbon atoms
  - Tertiary
    - The –OH group bonded to a carbon that is bonded to three other carbon atoms



# Lucas test

- Lucas reagent – HCl / $ZnCl_2$
- Lucas test can be used to distinguish between water soluble alcohols
- This is a substitution reaction where the –OH is replaced by –Cl

$$R\text{–}OH + HCl \rightarrow R\text{–}Cl + H_2O$$

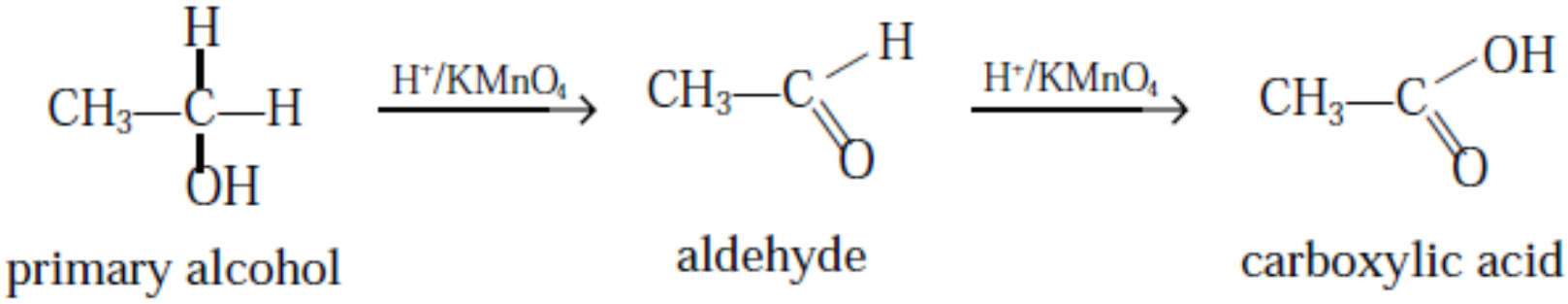
- $ZnCl_2$ is used as catalysis

# Observation for Lucas test

- If reaction occurs, the mixture will turn cloudy due to the formation of the immiscible (insoluble) chloroalkane
- Rate of reactions
  - $3^{o}$ Alcohols very fast (immediately turn cloudy)
  - $2^{o}$ Alcohol go cloudy after few minutes heated
  - $1^{o}$ Alcohol VERY slow (no observation after 10 minutes of heating)

# Oxidation of 1° Alcohol

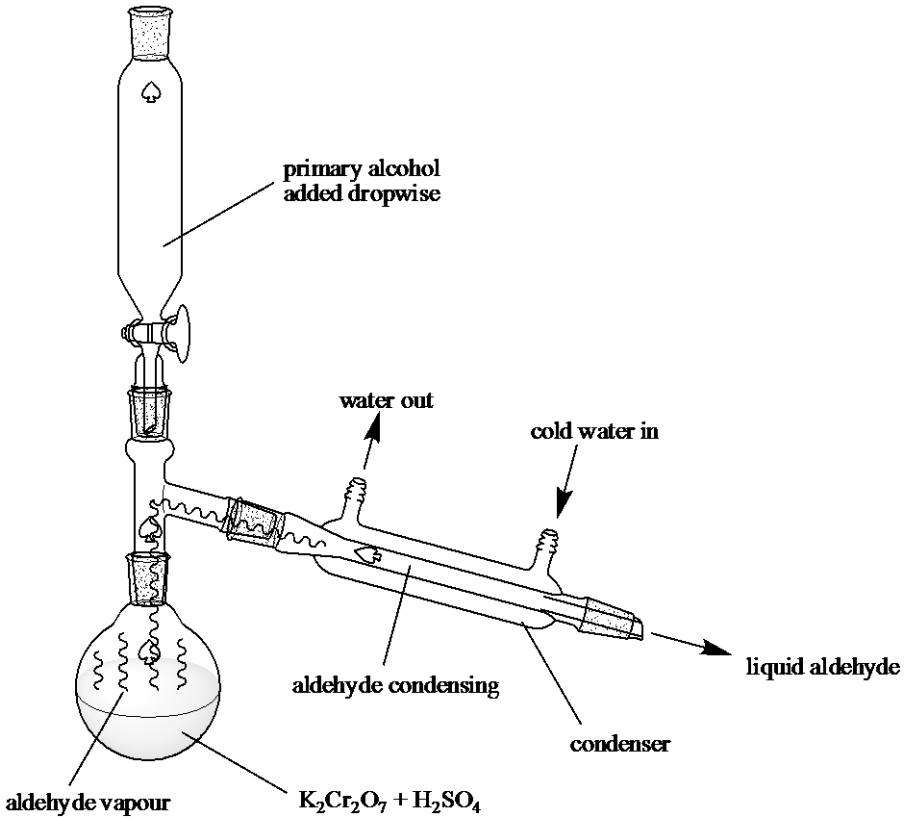
- The reactions of alcohols with an **oxidant** such as **$K_2Cr_2O_7$** or **$KMnO_4$** under **acidic conditions**
- **Primary alcohols** are oxidised **first** to an **aldehyde**
- **Then** further oxidised to a **carboxylic acid**



# Preparation of an aldehyde

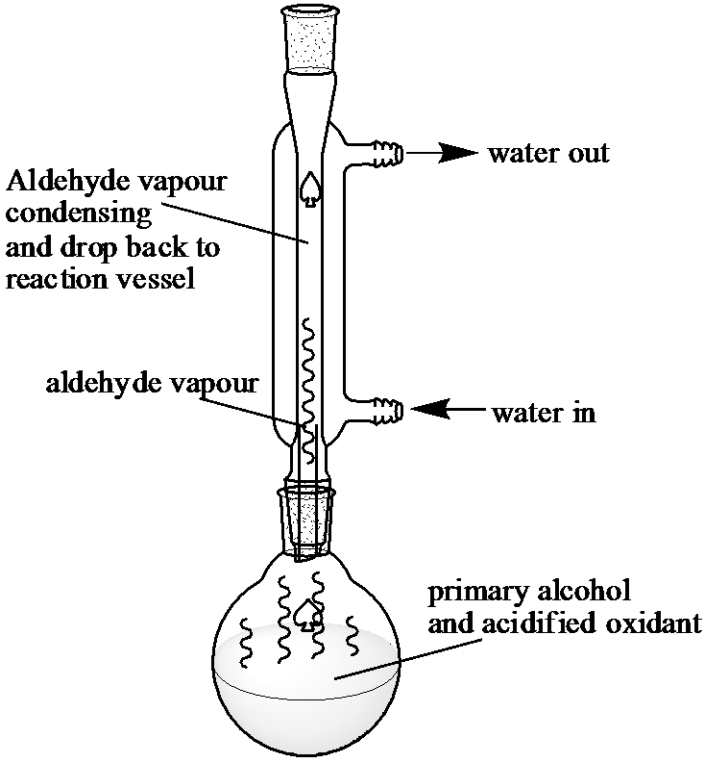
**Distillation (for aldehyde)**

- To separate liquid by their difference in boiling point
- Aldehydes have a lower boiling point compared to alcohols (reactant) and carboxylic acids (by product)
- Therefore aldehyde will turned to gas and separated off from the rest of the mixture



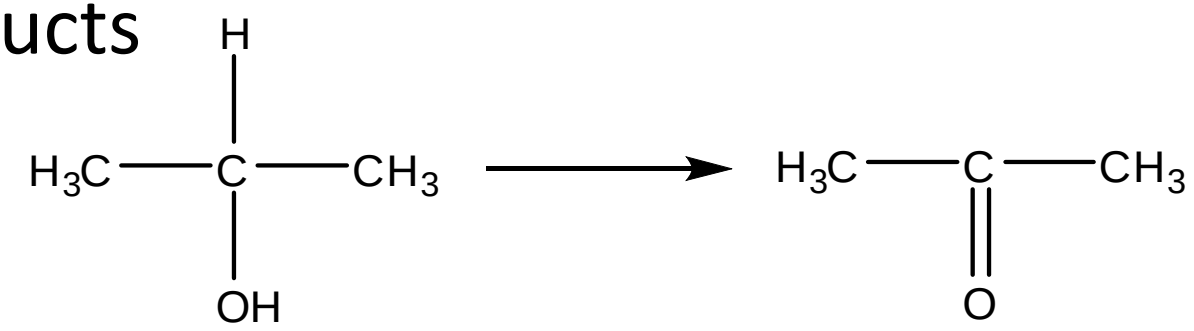
# Preparation of a carboxylic acid

- Reflux (for carboxylic acid)
- To  provide heat to speed up reactions
- Organic chemicals (such as aldehydes) usually have low boiling point
- To keep the reactant in the reaction vessel the condenser is placed above the reaction vessel
- Any chemical that is vaporised will turn back to liquid and return to the reaction vessel



# Oxidation of 2$^{o}$ Alcohol

- Secondary alcohol will oxidize to form a **ketone**
- Reflux is still used to retain the reactants and products




- Tertiary alcohol **cannot** be oxidized

# Other alcohol reactions

- Substitution reactions with $PCl_5$ or $SOCl_2$

  Eg. $CH_3CH_2OH \rightarrow CH_3CH_2Cl$

- Elimination reaction with $H_2SO_{4\ (conc)}$

  Eg. $CH_3CH_2OH \rightarrow CH_2CH_2$