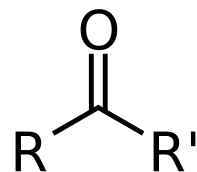
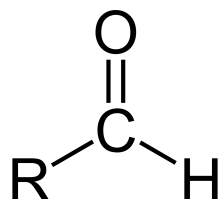


## KETONES AND ALDEHYDES

### 1. Ketone



### 2. Aldehyde



#### Carbonyl Group $\rightarrow \text{C}=\text{O}$

- $\sigma$  bond formed by overlap of two  $\text{sp}^2$  orbitals
- $\pi$  electrons are weakly held and mobile making bond reactive
  - 2 unhybridised p orbitals overlap but poorly
- Oxygen retains two lone pairs
- Bond is polarised towards oxygen atom
  - Carbon carries positive charge – electrophiles
  - It likes to react with negative molecules – nucleophiles

#### Reduction

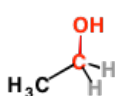
- Decrease oxygen content
- Increase hydrogen content
- Aldehydes reduced to primary alcohols, Ketones **can** be reduced to secondary alcohols

Alcohols: we count the number of carbons directly attached *to the carbon bonded to the OH*



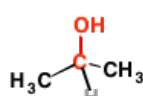
0 carbons

Methyl alcohol



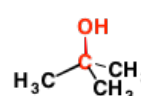
1 carbon directly attached

Primary (1°) alcohol



2 carbons attached

Secondary (2°) alcohol



3 carbons attached

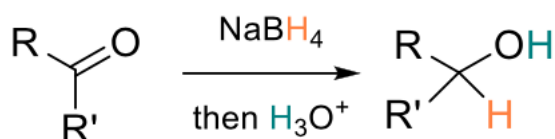
Tertiary (3°) alcohol

- Hydrides often used to reduce



(H with a lone pair)

- $\text{NaBH}_4$  and  $\text{LiAlH}_4$  are common sources of hydride



◦

- Orange  $\text{H}^-$  – reduction of carbonyl group
- Green  $\text{H}^+$  – attach to O due to free  $\text{H}^+$  in aqueous solution
- Aldehydes and ketones are reduced by hydrides in **two-step addition**.

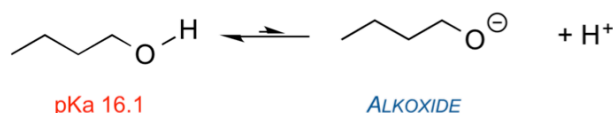
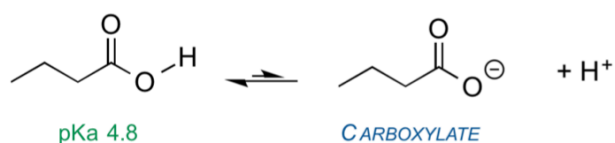
### Properties

- Boiling point
  - Ketones > Aldehydes
  - Complexity and molecular mass of extra  $\text{CH}_3$  groups
- Solubility
  - Aldehydes > Ketones
  - Fewer  $\text{CH}_3$  non-polar group
  - Both form hydrogen bonds with water
- Reactivity
  - Aldehydes > Ketones
  - Due to steric hindrance
    - Number and complexity of side groups  $\text{CH}_3$

## CARBOXYLIC ACID

### Acidity

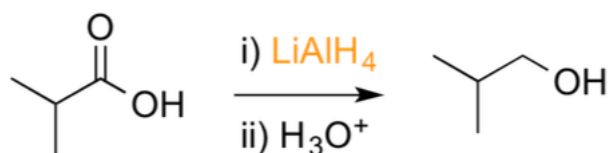
- Participate in acid-base reactions
- More acidic than alcohols



- Differences in acidity due to stability of conjugate base
- Movement of electron along different atoms

### Reduction

- Oxidisation of  $1^\circ$  alcohols and aldehydes  $\rightarrow$  carboxylic acid



- $\text{NaBH}_4$  not reactive enough to reduce carboxylic acids.

### Fatty Acids

- Long Chain carboxylic Acids  $\text{C}_8 - \text{C}_{20}$
- Saturated fatty acids – alkane
- Mono/Polyunsaturated fatty acids – alkenes
  - One double bond vs. multiple double bonds
- Fats (solids) and oils (liquids) are esters of fatty acids and an alcohol