

Exercise walk-through

17.1

Aldehydes and ketones

A-Level Chemistry

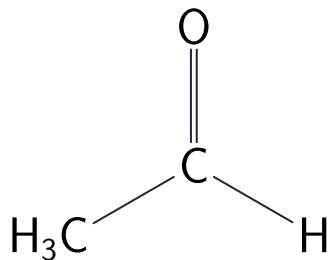
Aldehydes vs ketones

Both have the **carbonyl** ($\text{C}=\text{O}$) group:

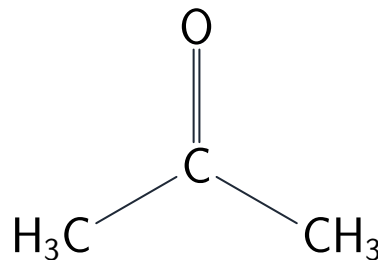
- an **aldehyde** ($-\text{CHO}$) – $\text{C}=\text{O}$ on the end
- a **ketone** – $\text{C}=\text{O}$ in the middle

Both are made by the **oxidation** of an alcohol with acidified $\text{K}_2\text{Cr}_2\text{O}_7$: a **primary** alcohol with **distillation** gives the aldehyde, a **secondary** alcohol gives the ketone.

aldehyde



ketone



$\text{C}=\text{O}$ carbon on the end $\text{C}=\text{O}$ carbon in the middle,

Reactions

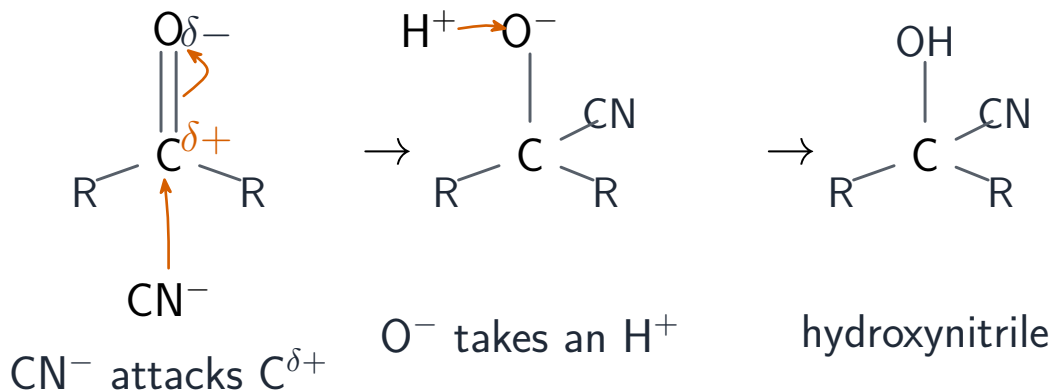
- **reduction** with NaBH_4 or LiAlH_4 turns a carbonyl compound back into an alcohol (an aldehyde gives a primary alcohol; a ketone gives a secondary alcohol).
- reaction with **hydrogen cyanide** (HCN), with KCN as catalyst and heat, adds H and CN across the $\text{C}=\text{O}$ to make a **hydroxynitrile** .

Nucleophilic addition

HCN adds across the $\text{C}=\text{O}$ by **nucleophilic addition** :

- CN^- attacks the δ^+ carbon
- $\text{C}=\text{O}$ breaks to O^-
- O^- takes an H^+ $\rightarrow$ a **hydroxynitrile**

Reduction (NaBH_4) gives back an alcohol.



Exercises 2.1·2.2

2.1 State the difference in structure between an aldehyde and a ketone. [2]

2.2 Name the reagent used to detect the presence of any carbonyl compound. [1]

Exercises 2.1·2.2

2.1 State the difference in structure between an aldehyde and a ketone. [2]

2.1

- in an aldehyde the $\text{C}=\text{O}$ is on the end of the chain (carries an H, $-\text{CHO}$); in a ketone the $\text{C}=\text{O}$ is in the middle, between two carbons
-

2.2 Name the reagent used to detect the presence of any carbonyl compound. [1]

2.2

- 2,4-dinitrophenylhydrazine (2,4-DNPH)

Exercises 3.1-3.2

3.1 Which reagent gives a silver mirror with an aldehyde but no change with a ketone?[1]

☐

A 2,4-DNPH

B Tollens' reagent

C bromine water

D NaBH_4

3.2 The reaction of HCN with a ketone is classified as:

[1]

☐

A electrophilic addition

B nucleophilic addition

C free-radical substitution

D elimination

Exercises 3.1-3.2

3.1 Which reagent gives a silver mirror with an aldehyde but no change with a ketone?[1]

☐

- A 2,4-DNPH
- B Tollens' reagent
- C bromine water
- D NaBH_4

3.1 B

- Tollens' reagent gives a silver mirror with an aldehyde only

3.2 The reaction of HCN with a ketone is classified as:

[1]

☐

- A electrophilic addition
- B nucleophilic addition
- C free-radical substitution
- D elimination

3.2 B

- Addition of HCN to a carbonyl is nucleophilic addition

Exercise 3.3

3.3 (a) Describe the mechanism of the nucleophilic addition of HCN to ethanal. [3]

(b) State the reagent and condition to reduce propanone to an alcohol, and name the alcohol formed. [2]

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3.3

(a)

- the CN^- nucleophile attacks the $\delta+$ carbonyl carbon (curly arrow from the lone pair); the $\text{C}=\text{O}$ π bond breaks, the electrons going to the oxygen to give O^- ; the O^- takes an H^+ (from HCN) to form the hydroxynitrile

(b)

- NaBH_4 (or LiAlH_4); propan-2-ol (a secondary alcohol)

Exercise 3.4

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3.4

- add Tollens' reagent (or Fehling's) and warm; propanal (aldehyde) gives a silver mirror (or brick-red precipitate); propanone (ketone) gives no change