CH 17 Aldehyde and Ketones

Friday, 29 August 2025 2:06 PM

Chemical tests for Aldehyde & Ketones

1. Iodoform
2. Fehling's Solution
   - → +tive for aldehyde
   - → -ive " ketone
3. Tollen's test / Silver Mirror test
   - +tive for aldeh
   - -ive for Ketone
4. 2,4 DNPH
   - Positive for both aldeh and Ketone

(1) Iodoform (O.A)

$CHCl_3$ → chloroform

CHI_3 → Iodoform

* Aldehyde & Ketones which have $CH_3-\overset{O}{\overset{\|}{C}}-$ group will give iodoform

Aldehyde

✓ $CH_3-\overset{O}{\overset{\|}{C}}-H$

✗ $H-\overset{O}{\overset{\|}{C}}-H$

✗ $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-H$

Ketone

✓ $CH_3-\overset{O}{\overset{\|}{C}}-CH_3$

✓ $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_3$

✗ $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-CH_2-CH_3$

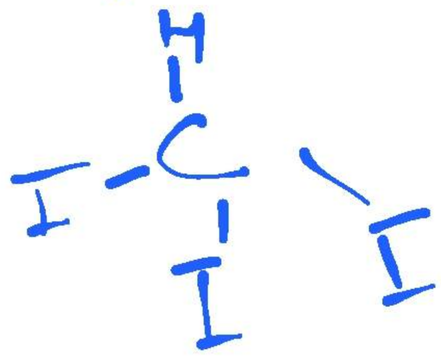
Condition for Iodoform reaction

Reagent I_2 + NaOH (Aqueous alkaline Iodine and heat)

or

+ heat

Observation: Yellow Precipitate due to CHI_3 formation



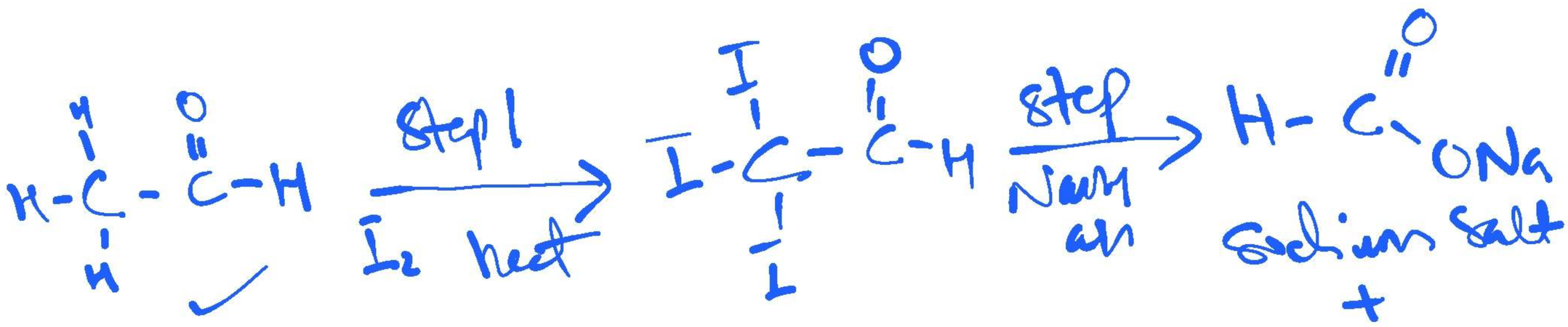
Reaction have 2 steps

① Halogenation

3H atoms in $-CH_3$ group are replaced with 3I atom forming $-CI_3$ group

② Hydrolysis

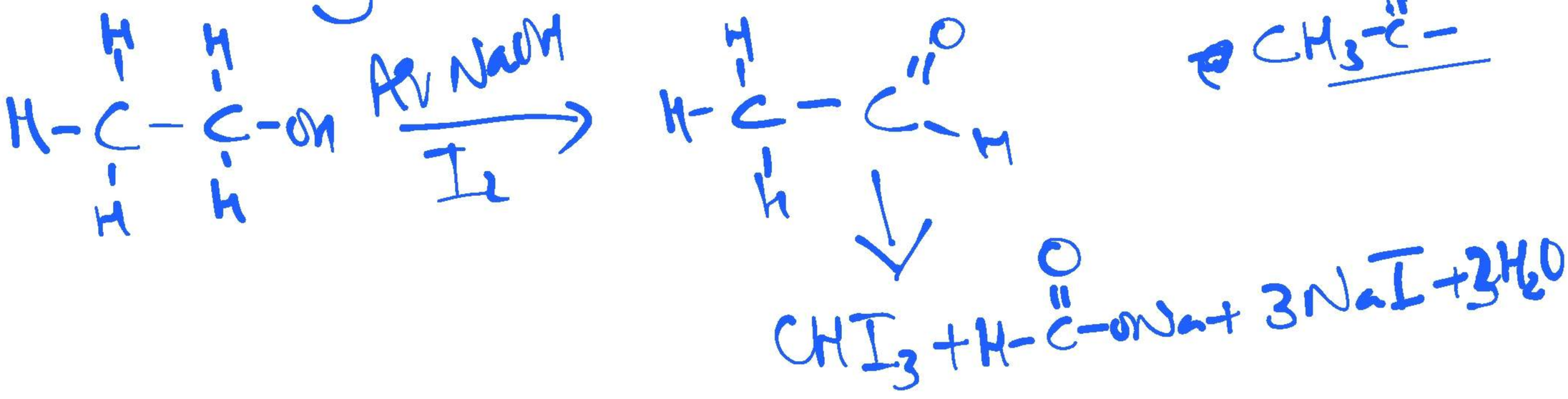
The Intermediate compound will be hydrolysed by alkaline solution to form salt RCOONa and Yellow ppt of CHI_3.



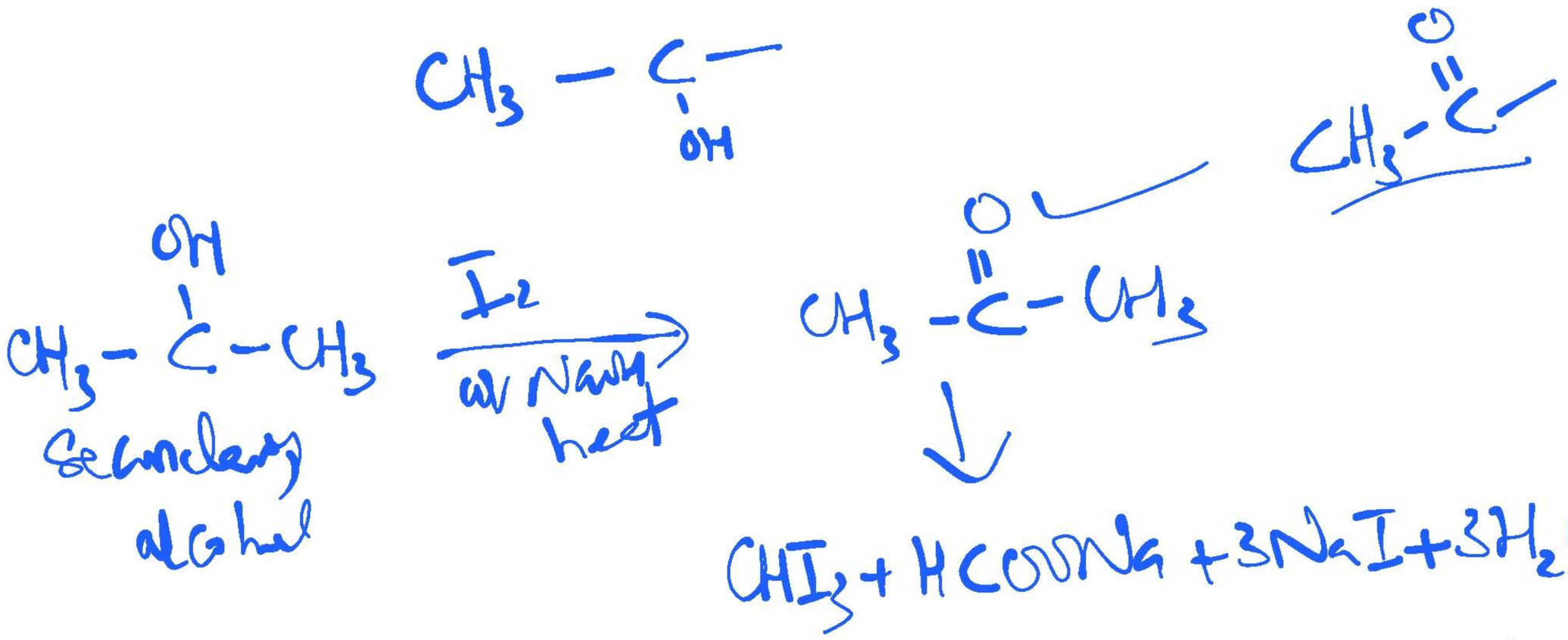
Overall

$$CH_3-\overset{O}{\overset{\|}{C}}-H + 3I_2 + 4NaOH \xrightarrow{heat} CHI_3 + H-\overset{O}{\overset{\|}{C}}-ONa + 3NaI + 3H_2O$$

In Primary alcohol only **ethanol** give Iodoform



Those secondary alcohols which has OH group at second carbon can give yellow iodoform



(2) Fehling's Solution (O.A)

$Cu^{+1}_2O^{-2}$ Cu_2O

Aldehyde oxidised to Carboxylic acid

$R-CHO + [O] \longrightarrow RCOOH$

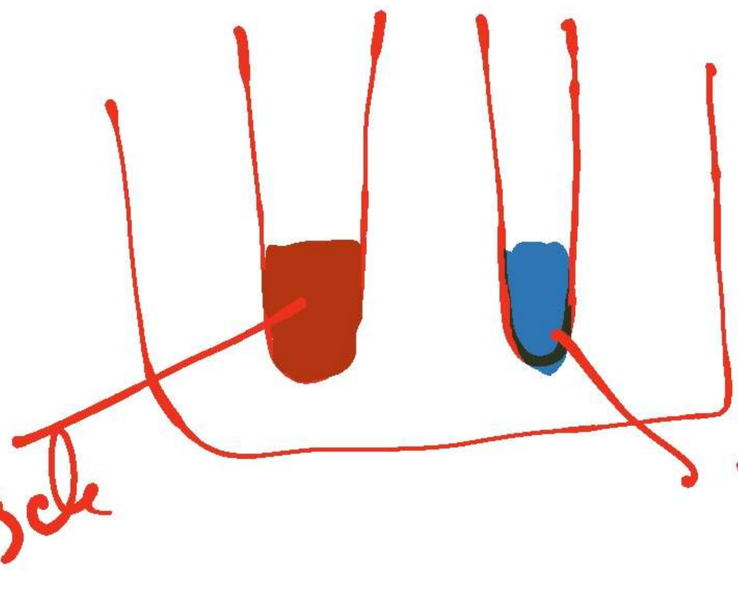
(O.A) $Cu^{+2} + \bar{e} \longrightarrow \underset{\text{Red}}{Cu^{+1}}$ (Cu_2O)

Blue

Brick red ppt

Add Fehling solution

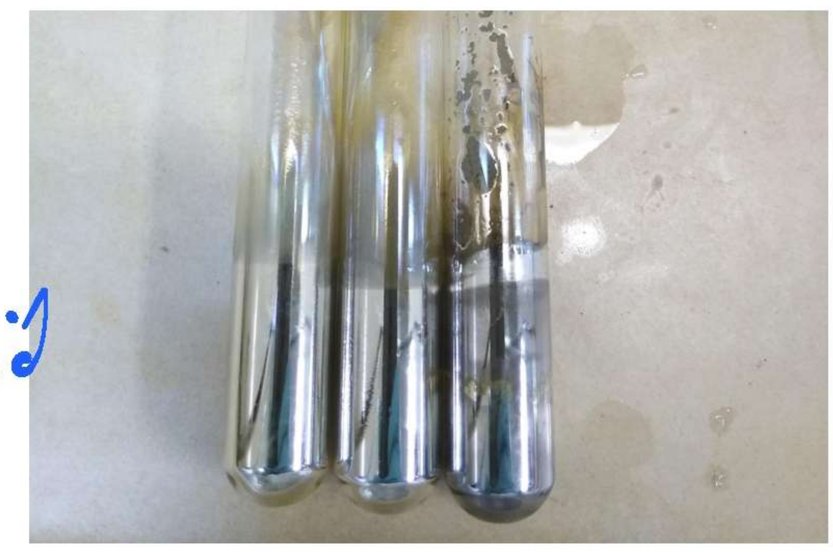
Heat in water bath



(3) Tollen's Reagent / Silver Mirror test /

(O·A) Ammonical silver nitrate solution

→ an aqueous alkaline solution of silver nitrate in excess of Ammonia solution.

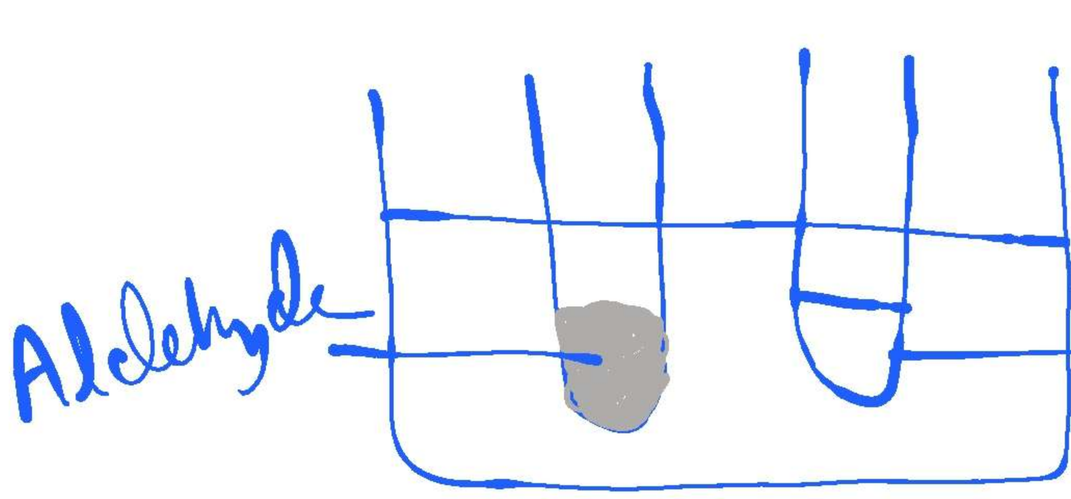


$$R\text{-}CHO + [O] \longrightarrow RCOOH$$

Aldehyde — Carboxylic acid

$$Ag(NH_3)_2^+{}_{(aq)} + \bar{e} \longrightarrow \boxed{Ag_{(s)}} + 2NH_{3(aq)}$$

Silver Mirror → Add Tollens reagent



→ Heat in water bath

(4) 2,4 DNPH (2,4 Dinitrophenyl hydrazine)

to detect Carbonyl group in aldehyde and ketone only.

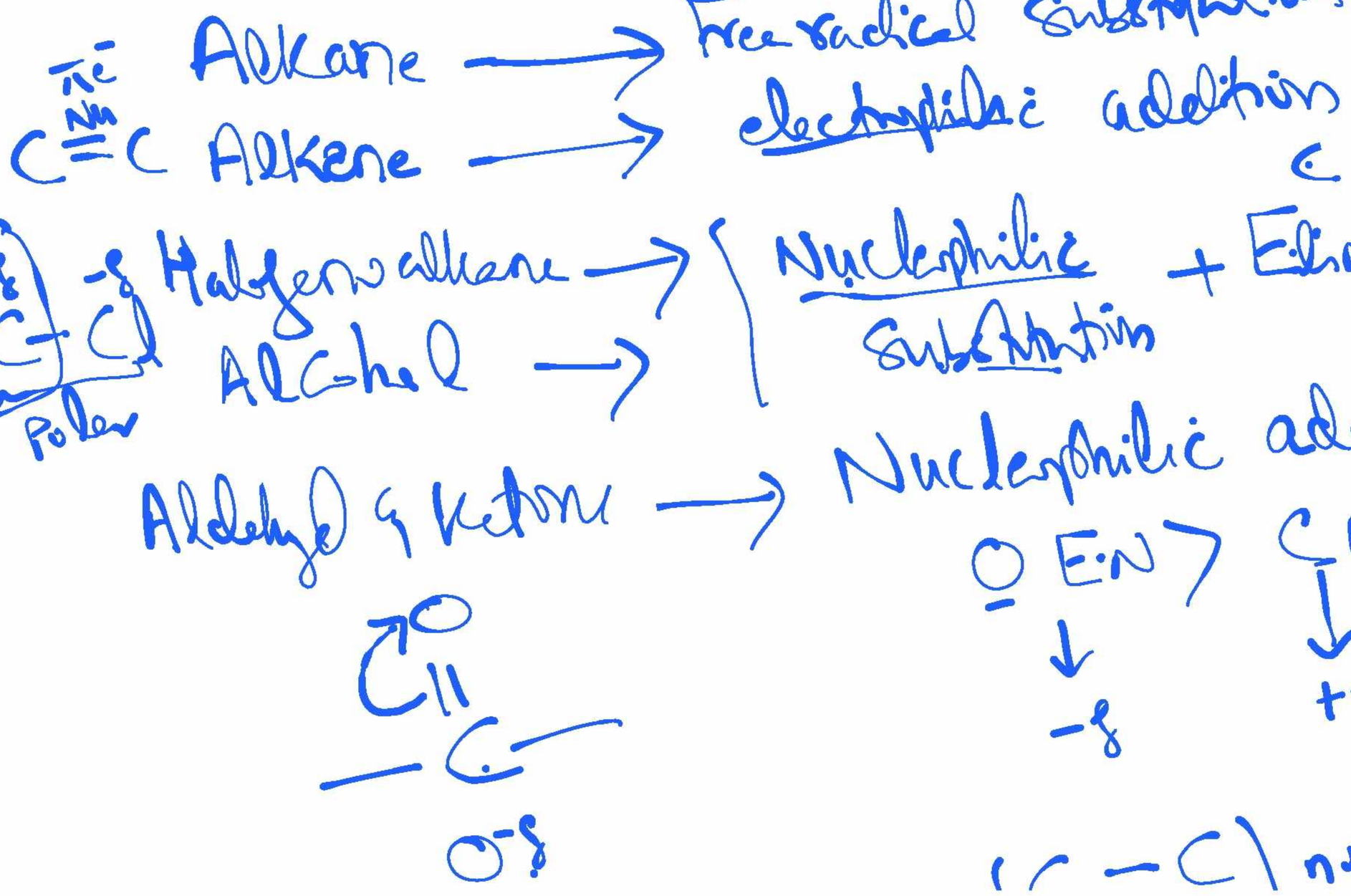
Observation Given Deep orange ppt

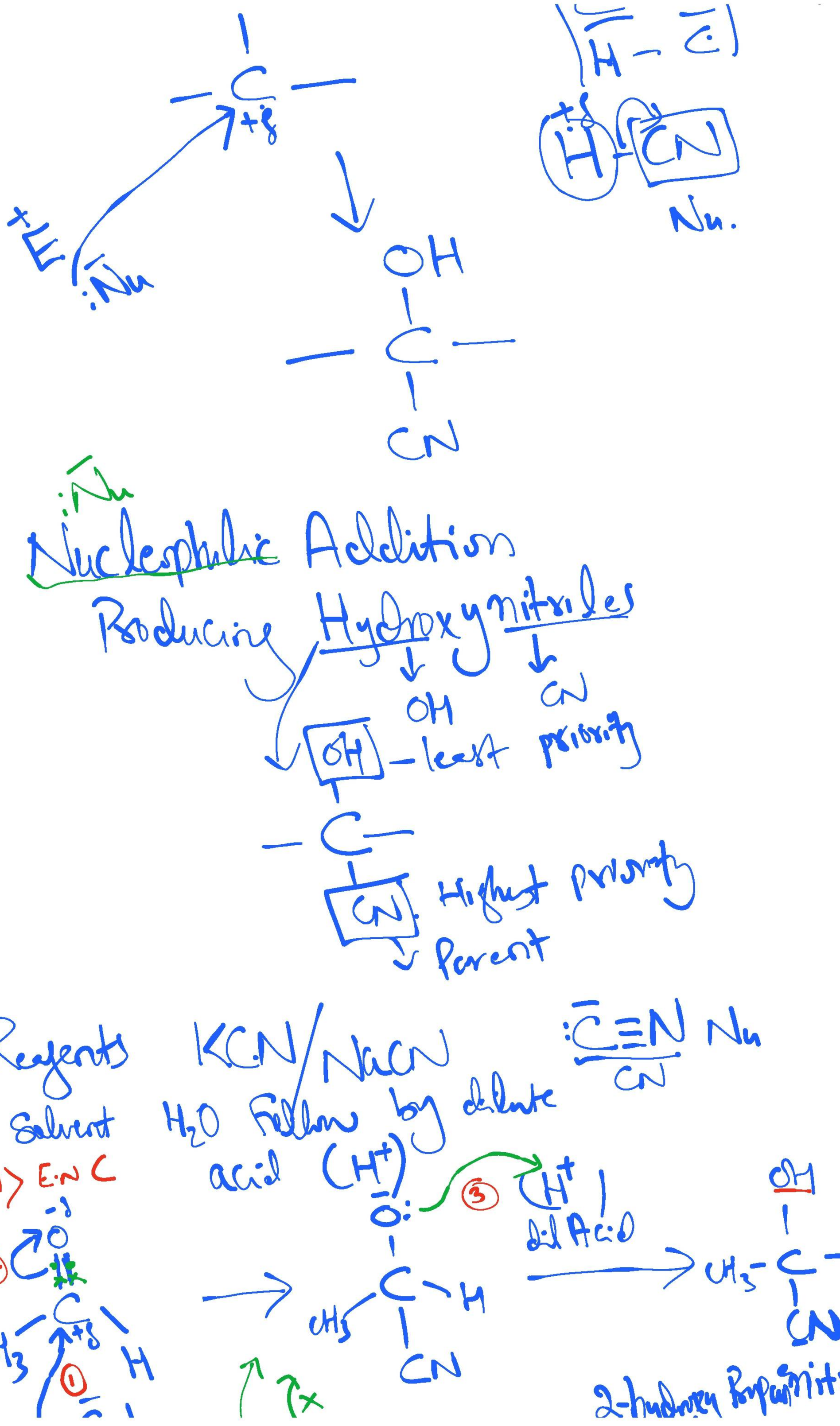
→ Positive only for aldehyde & ketone

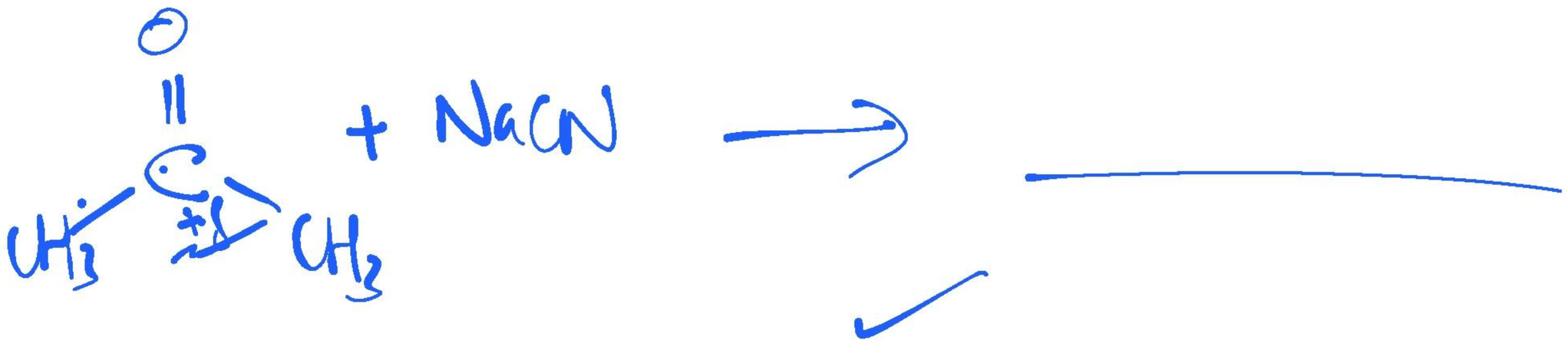
→ -ive for carboxylic acid and esters

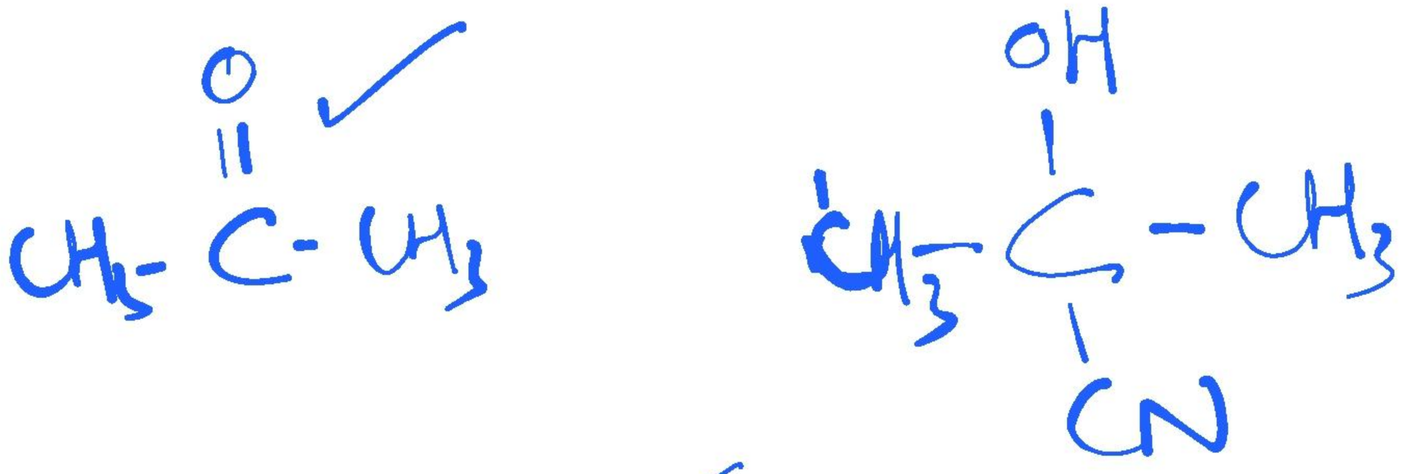
→ Aldehyde and Ketone undergo Condensation reaction with 2,4 DNPH

Reactions of Aldehyde and Ketone



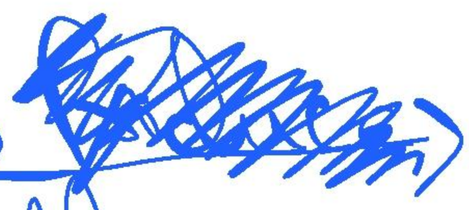

Nucleophilic Addition
Producing Hydroxynitriles
OH
CN
least priority
Highest priority
Parent
Nu.
Reagents KCN/NaCN
Solvent H2O Follow by dilute acid
OEN > ENC
dil Acid
2-hydroxy Propanenitril





highly toxic → store carefully

in fume cupboard



HCN
weak acid

highly toxic gas

→ no need to add acid

→ Harder to store & handle.

ionic
KCN / NaCN are preferred over HCN.

$KCN \rightarrow K^+ + CN^-$

spectator ion.