Carbonyl Compounds :-

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

- Aldehyde
  - $R-CH=O$
  - $H-\overset{\overset{O}{\|}}{C}-H$
- Ketone
  - Sym. $R-\overset{\overset{O}{\|}}{C}-R$ (2°)
  - Unsym $R-\overset{\overset{O}{\|}}{C}-R'$ (2°)

$>C=O$ (sp^2)

G.M.P. :-

1. From Alkane :-

$R-CH_3 \xrightarrow{MoO_3 \,/\, 300^\circ C} R-CH=O$

2. From Alkene :-

$>C=C< \xrightarrow[\text{② } Zn \,/\, H_2O]{\text{① } O_3 \,/\, N_2} >C=O + O=C<$

Ozonolysis

(3) Alkyne :-

(a) Hydration :-

$HC \equiv CH \xrightarrow[H_2O]{1\%\ HgSO_4 / H_2SO_4,\ M.K.} H_2C=CH(OH) \rightleftharpoons CH_3-CH=O$

$R-C \equiv CH \xrightarrow{"} R-C(OH)=CH_2 \rightleftharpoons R-C(=O)-CH_3$

(b) HBO Reacn :-

$R-C \equiv CH \xrightarrow[② H_2O_2 / OH^{\ominus}]{① B_2H_6 / THF} R-CH_2-CH=O$ AMK

$CH_3-C \equiv C-CH_3 \xrightarrow{"} CH_3-CH_2-C(=O)-CH_3$

(4) From Alkyl Halide :-

$R-CH(Cl)(Cl) \xrightarrow{aq\ KOH} R-CH(OH)(OH) \longrightarrow R-CHO$

$R-C(Cl)(Cl)-R' \xrightarrow{aq.\ KOH} R-C(OH)(OH)-R' \rightarrow R-C(=O)-R'$

$C_4H_8Cl_2\ (A) \xrightarrow{aq\ KOH} (B) \xrightarrow{I_2 / NaOH} (C)$ Yellow ppt

$CH_3-CH_2-C(Cl)(Cl)-CH_3$ $\quad CH_3-CH_2-C(=O)-CH_3$ $\quad CHI_3$

(5) From alcohol

$R-CH_2-OH \xrightarrow{Cu / 300^\circ C} R-CH=O$ (1°)

$R_2CH-OH \xrightarrow{"} R_2C=O$

$CH_3-C(CH_3)_2-OH \xrightarrow{"} CH_3-C(CH_3)=CH_2$

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(6) Oxidation of Alcohol

$R-CH_2-OH \xrightarrow{PCC} R-CH=O$

$\overset{\oplus}{NH}\ Cr O_3 Cl^{\ominus}$

CrO_3 / Acetone / H_2O
Jones Oxidation

$R-CH(R)-OH \xrightarrow[\text{or PCC or Jones Oxidation}]{K_2Cr_2O_7/H^{\oplus}} R-\underset{\underset{O}{\|}}{C}-R$

$[(CH_3)_3C-O]_3Al$
Oppenaur Oxidn

All these oxidising agents does not affect C=C.

$CH_3-CH=CH-CH_2-OH \xrightarrow{PCC} CH_3-CH=CH-CHO$

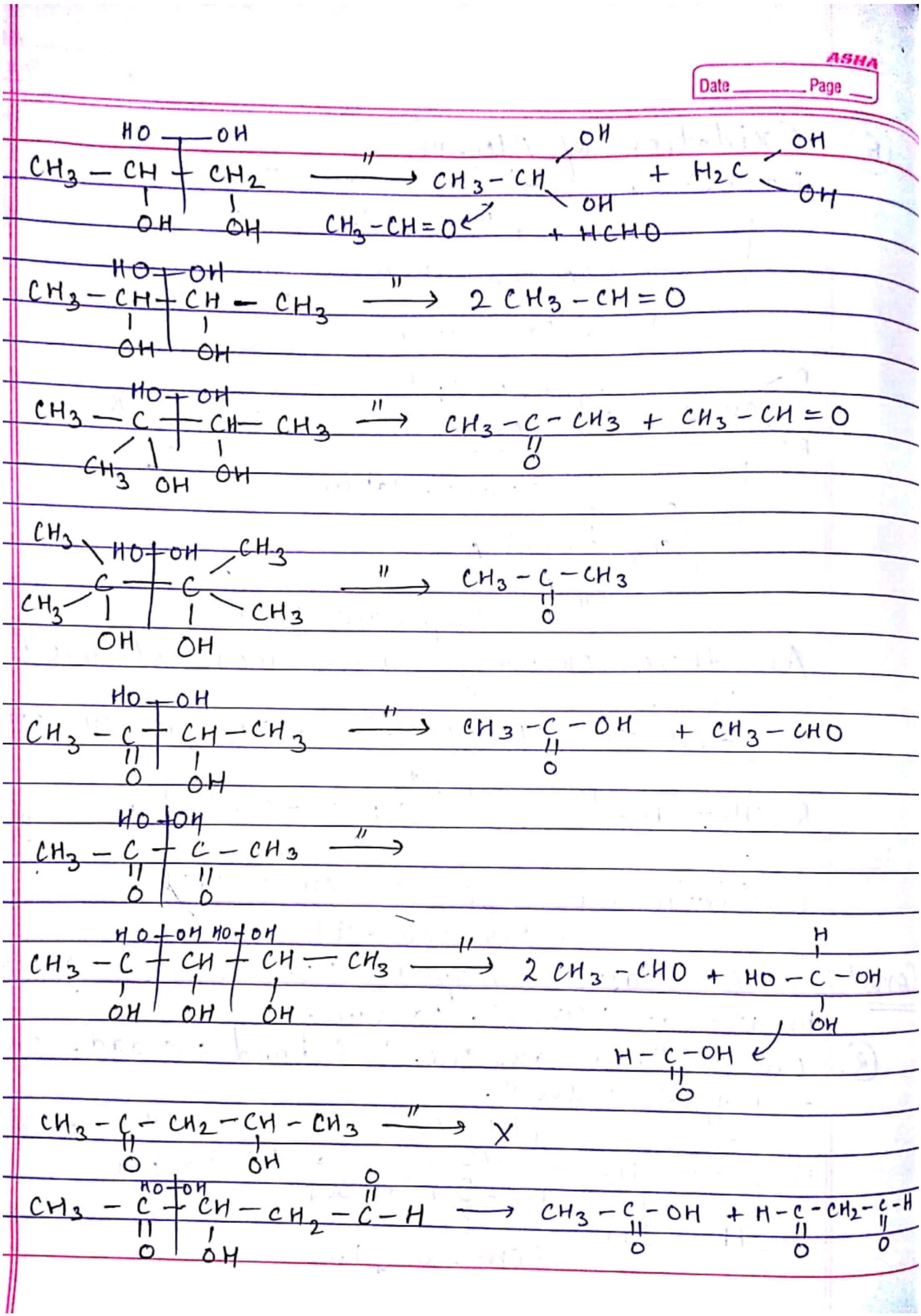
$R-CH_2-OH \xrightarrow{K_2Cr_2O_7/H^{\oplus}} R-CH=O \xrightarrow{[O]} R-\underset{\underset{O}{\|}}{C}-OH$

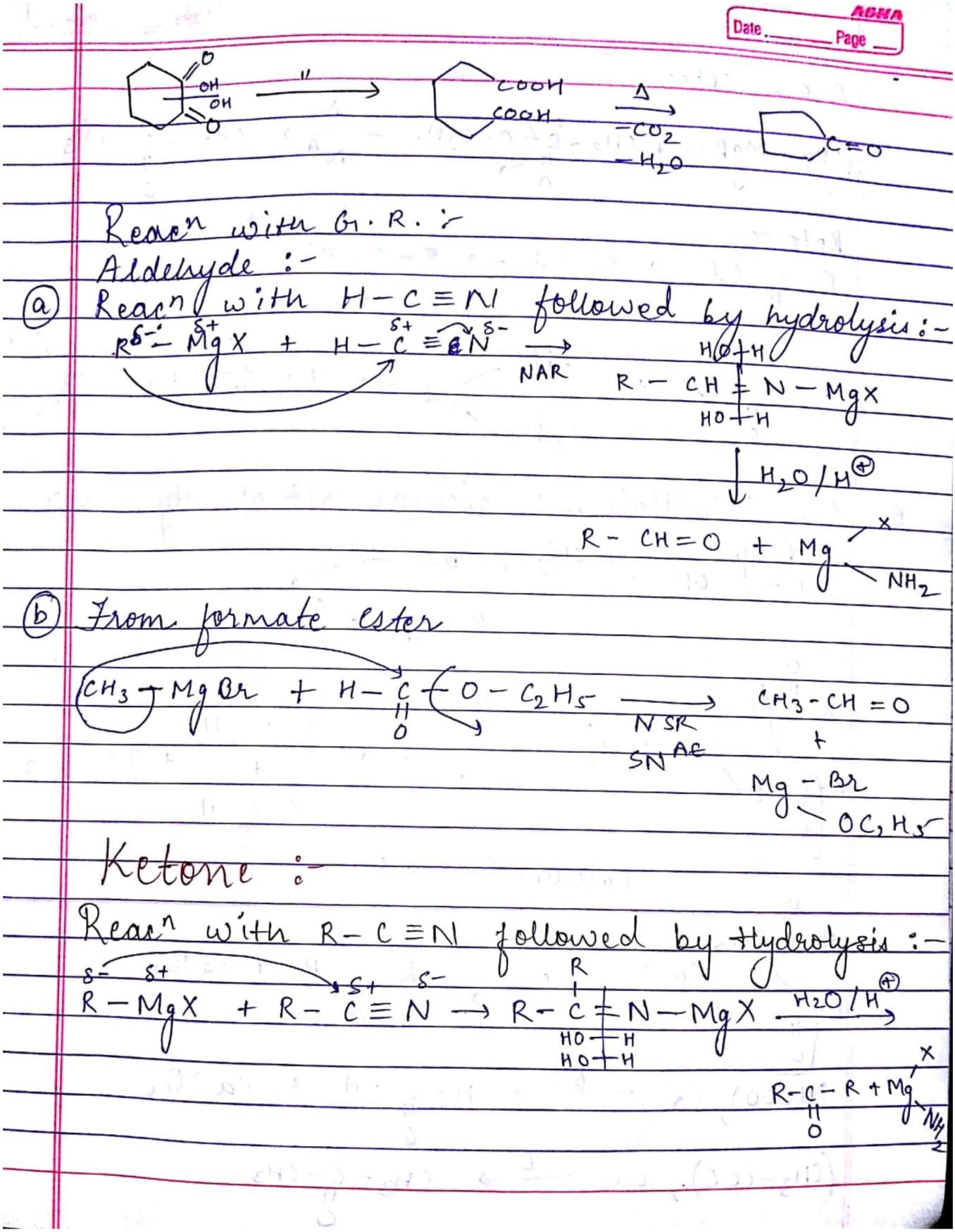
Oxidation by HIO_4 or $(CH_3COO)_4Pb$
Per Iodic Acid

Condn :- ① At least 2-OH gp or 1 OH & $-\underset{\underset{O}{\|}}{C}-$ gp should be ent at Vicinal carbon.

② One HIO_4 breaks one C-C bond and adds one -OH gp to each C.

$H_2C(OH)-CH_2(OH) \xrightarrow[\text{or } NaIO_4/H_2SO_4 \text{ or } (CH_3COO)_4Pb]{HIO_4/\Delta} 2\,CH_2(OH) \rightarrow 2\,CHO$





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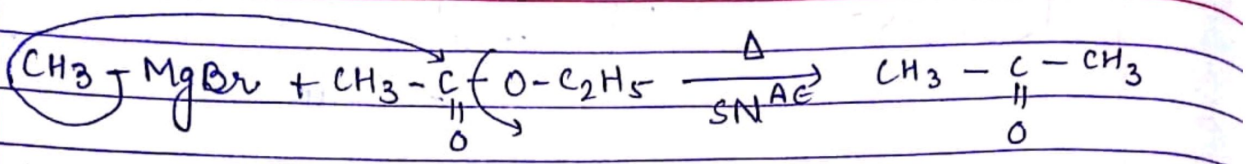
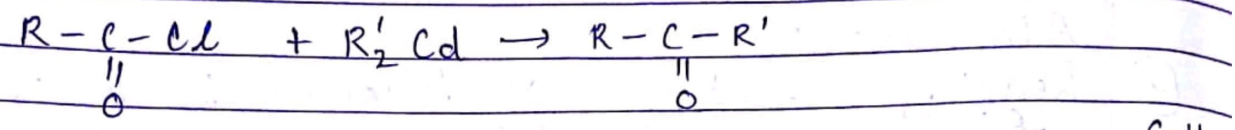
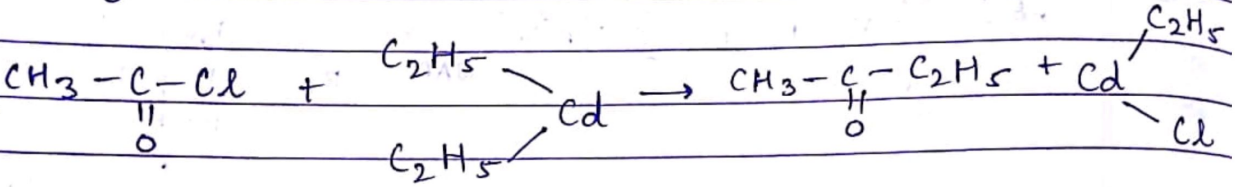
From ester

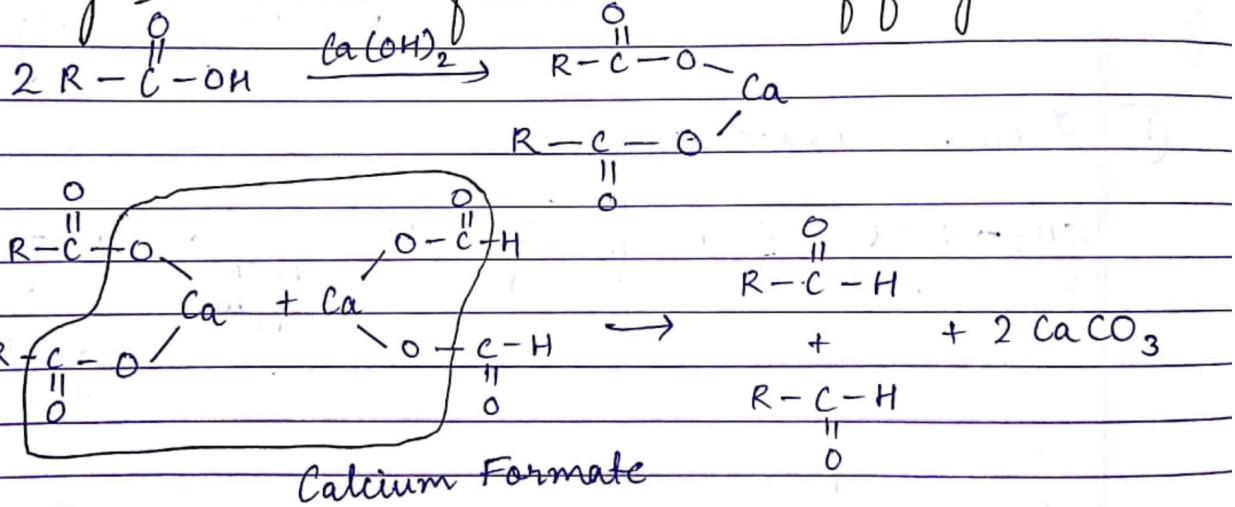


Ketone

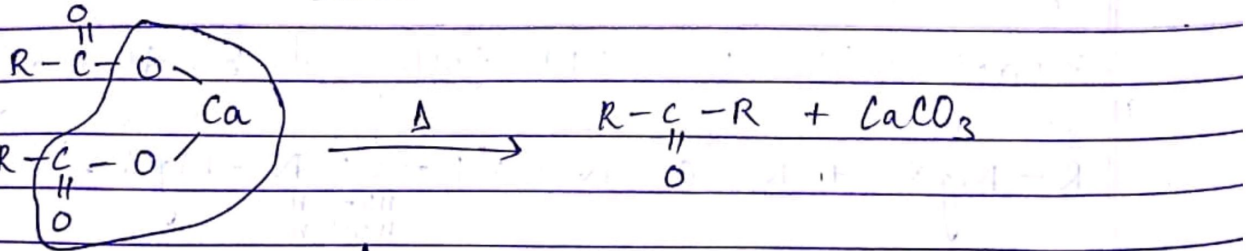


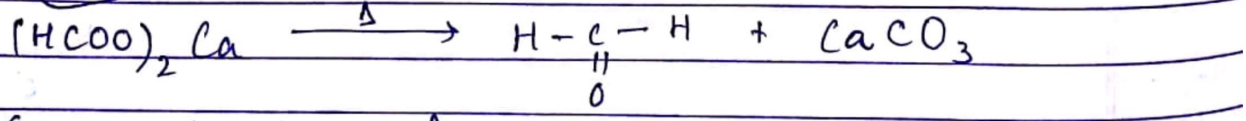


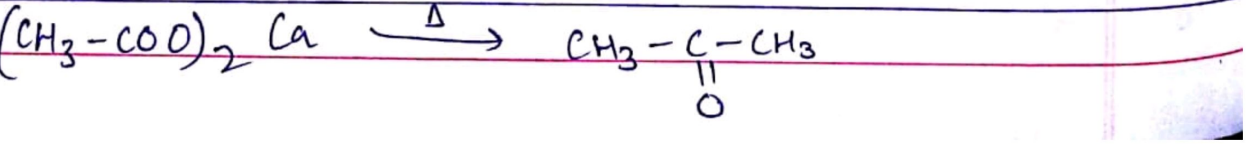
8 Dry Distillation of Calcium salt of fatty acids :-

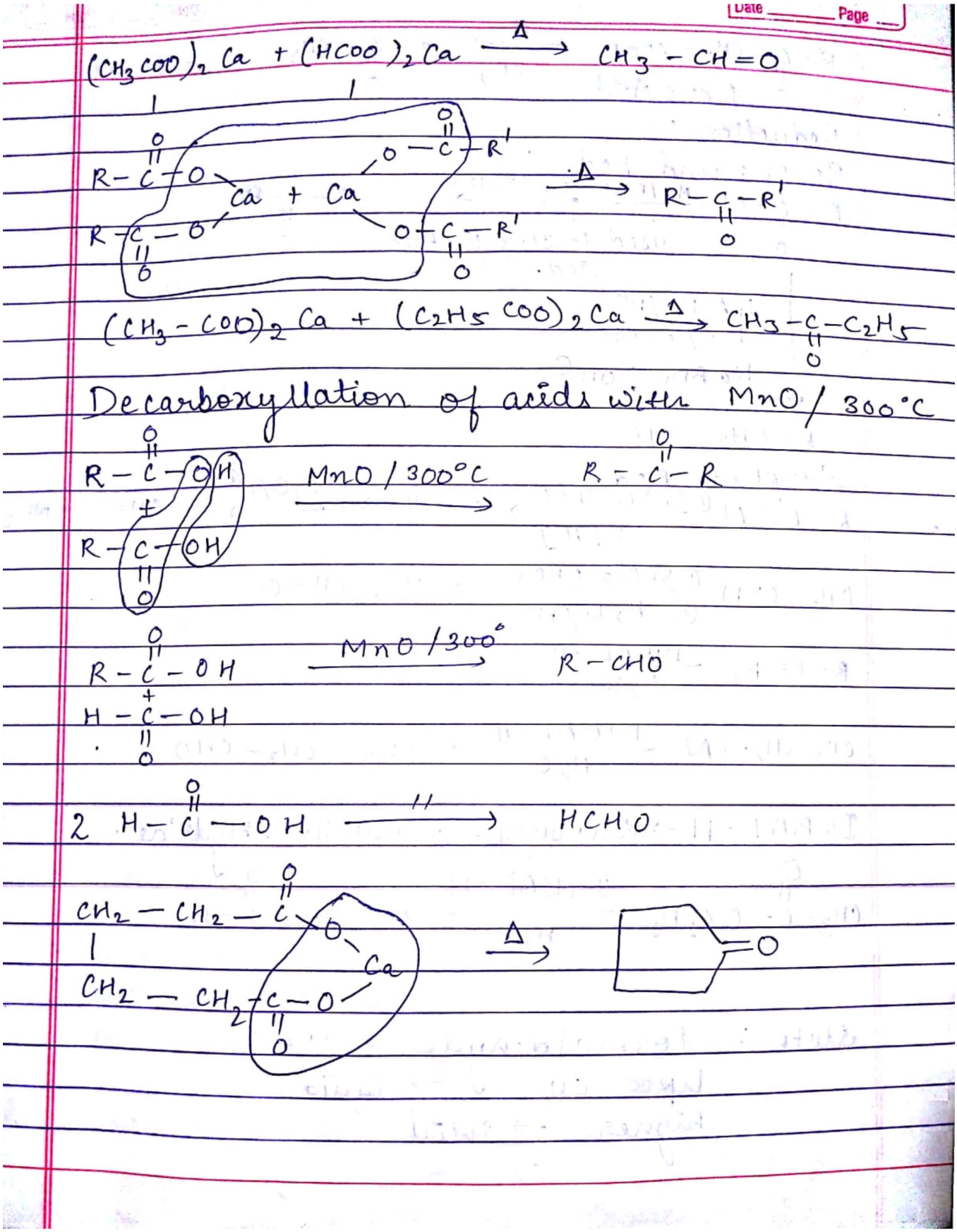


Calcium Formate









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$R-\underset{\underset{O}{\|}}{C}-CH_2-COOH \xrightarrow[-CO_2]{\Delta} R-\underset{\underset{O}{\|}}{C}-CH_3$

β Keto Acid

Reduction :-

Rosenmund Red. :-

$R-\underset{\underset{O}{\|}}{C}-Cl \xrightarrow{H_2/Pd.BaSO_4/Xylene} R-\underset{\underset{O}{\|}}{C}-H$

used to stop further red.

$\downarrow$ $LiAlH_4/H^{\oplus}$, $Na/etOH$, $NaBH_4/OH^{\ominus}$

$R-CH_2-OH$

Stephun Red.

$R-C\equiv N \xrightarrow[2[H]]{①\ SnCl_2/HCl} R-CH=NH \xrightarrow{H_2O/H^{\oplus}} R-CH=O + NH_3$

$CH_3-C\equiv N \xrightarrow[②\ H_2O/H^{\oplus}]{①\ SnCl_2/HCl} CH_3-CH=O$

$R-C\equiv N \xrightarrow[H_2O]{DIBAL-H} R-CHO$

$CH_3-CH_2-CN \xrightarrow[H_2O]{DIBAL-H} CH_3-CH_2-CHO$

DiBAL-H → Diisobutyl Aluminium Hydride.

$CH_3-\underset{\underset{O}{\|}}{C}-OC_2H_5 \xrightarrow[H_2O]{DiBAL-H} CH_3-\underset{\underset{O}{\|}}{C}-H$

State : Formaldehyde → gas
upto C_{11} → liquid
higher → solid

Solubility: Formaldehyde, acetaldehyde, acetone } soluble in water due to H-bond

Solubility $\propto \frac{1}{Mw}$

B.P. $B.P. \propto Mw$

$HCHO < CH_3-CHO < CH_3-CH_2-CH=O < CH_3-\overset{\overset{O}{\|}}{C}-CH_3$

(Mw) (Sym)

B.P. Order: alcohols > Carbonyl Comp^d > ethers > alkanes

↑ H-Bonding; ↓ due to polarity of $-\overset{\overset{O}{\|}}{C}-$ bond; ↓ less Polar; ↓ non Polar

$CH_3-CH_2-CH_2-CH_2-OH > CH_3-CH_2-CH_2-CHO > CH_3-CH_2-O-CH_2CH_3 > CH_3-CH_2-CH_2-CH_2CH_3$

$CH_3-CH_2-OH > CH_3-CHO > CH_3-O-CH_3 > CH_3-CH_2-CH_3$

Chemical Properties :-

1. NAR
2. Other Reac^{n}s
3. Reac^n for aldehyde only
4. Reac^n of ketone only

2. Other Reac^{n}s

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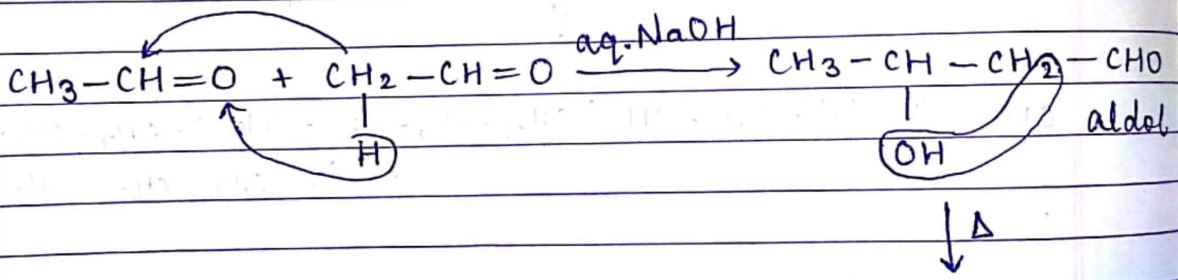
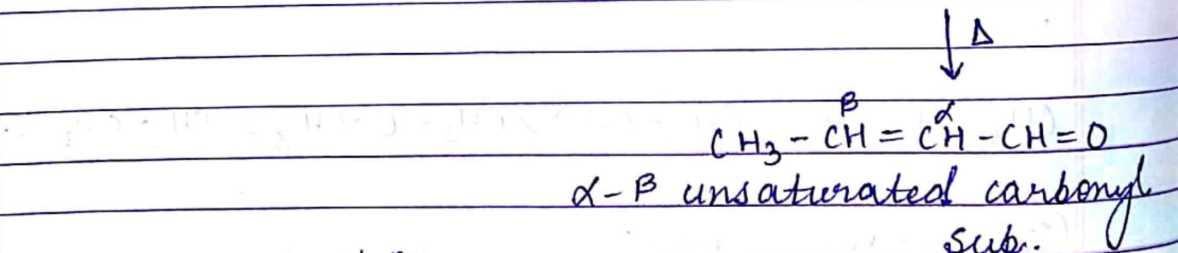
Aldol Condensation :- When α-H containing carbonyl substance is treated with dil. alkali like aq NaOH then condensation takes place and aldol pdts is formed. When this aldol pdt is heated with alkaline medium it gets converted into α-β unsaturated carbonyl compds k/n Aldol condensation.

Qm Which of the following give aldol condensation in the of aq. KOH ?

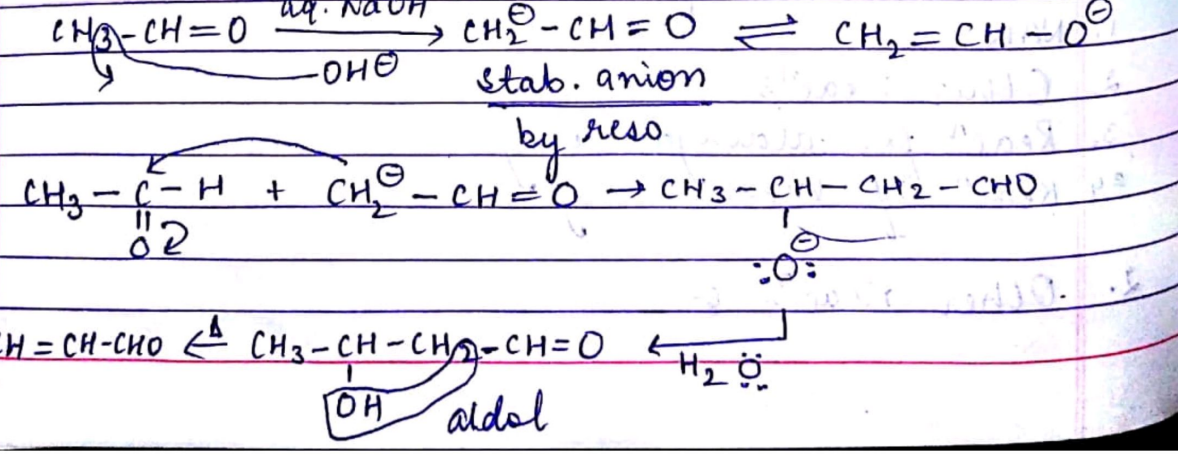
① Formaldehyde ② Benzaldehyde ③ acetaldehyde ④ all

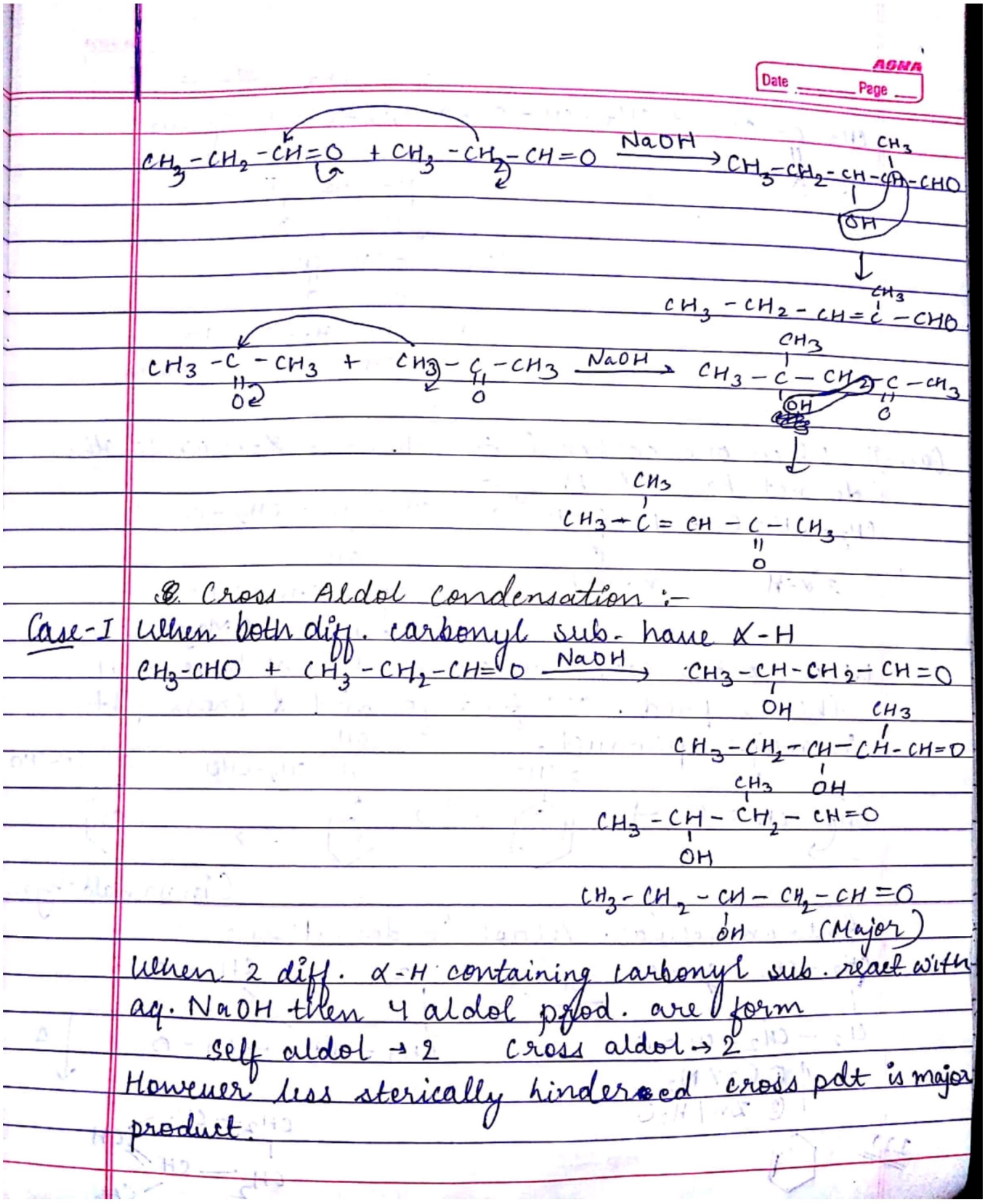




α-β unsaturated carbonyl sub.

Mech:





Cross Aldol condensation :-

Case-I When both diff. carbonyl sub. have α-H

$CH_3-CHO + CH_3-CH_2-CH=O \xrightarrow{NaOH}$

$CH_3-CH(OH)-CH_2-CH=O$

$CH_3-CH_2-CH(OH)-CH(CH_3)-CH=O$

$CH_3-CH(OH)-CH_2-CH=O$

$CH_3-CH_2-CH(OH)-CH_2-CH=O$ (Major)

When 2 diff. α-H containing carbonyl sub. react with aq. NaOH then 4 aldol pdt. are form

self aldol → 2 cross aldol → 2

However less sterically hindered cross pdt is major product.

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$CH_3-\underset{\underset{O}{\|}}{C}-CH_3 + CH_3-CH=O \rightarrow CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-\underset{\underset{O}{\|}}{C}-CH_3$

$CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-\underset{\underset{O}{\|}}{CH}$

$CH_3-\underset{\underset{OH}{|}}{\overset{\overset{CH_3}{|}}{C}}-CH_2-\underset{\underset{O}{\|}}{CH}$

$CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-\underset{\underset{O}{\|}}{C}-CH_3$ Major

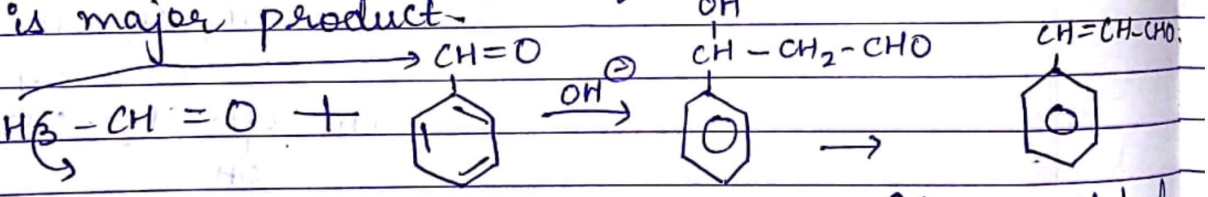
Case-II When one carbonyl ~~co~~ sub. have α-H while other do not have α-H.

$CH_3-CH=O + H-\underset{\underset{O}{\|}}{C}-H \xrightarrow{OH^\ominus} CH_3-\underset{\underset{OH}{|}}{CH}-CH_2-CH=O$

3 α-H no α-H

$CH_2-CH_2-CH=O$ (Major)
$\underset{OH}{|}$

When out 2 carbonyl sub. only one have α-H then 2 prod. are ~~fold~~ formed & cross pdt is major product.



Intramolecular Aldol Condensation :-

$CH_2-CH_2-CH=O$
$|$
$CH_2-CH_2-CH=O$

$\xrightarrow{OH^\ominus/\Delta}$

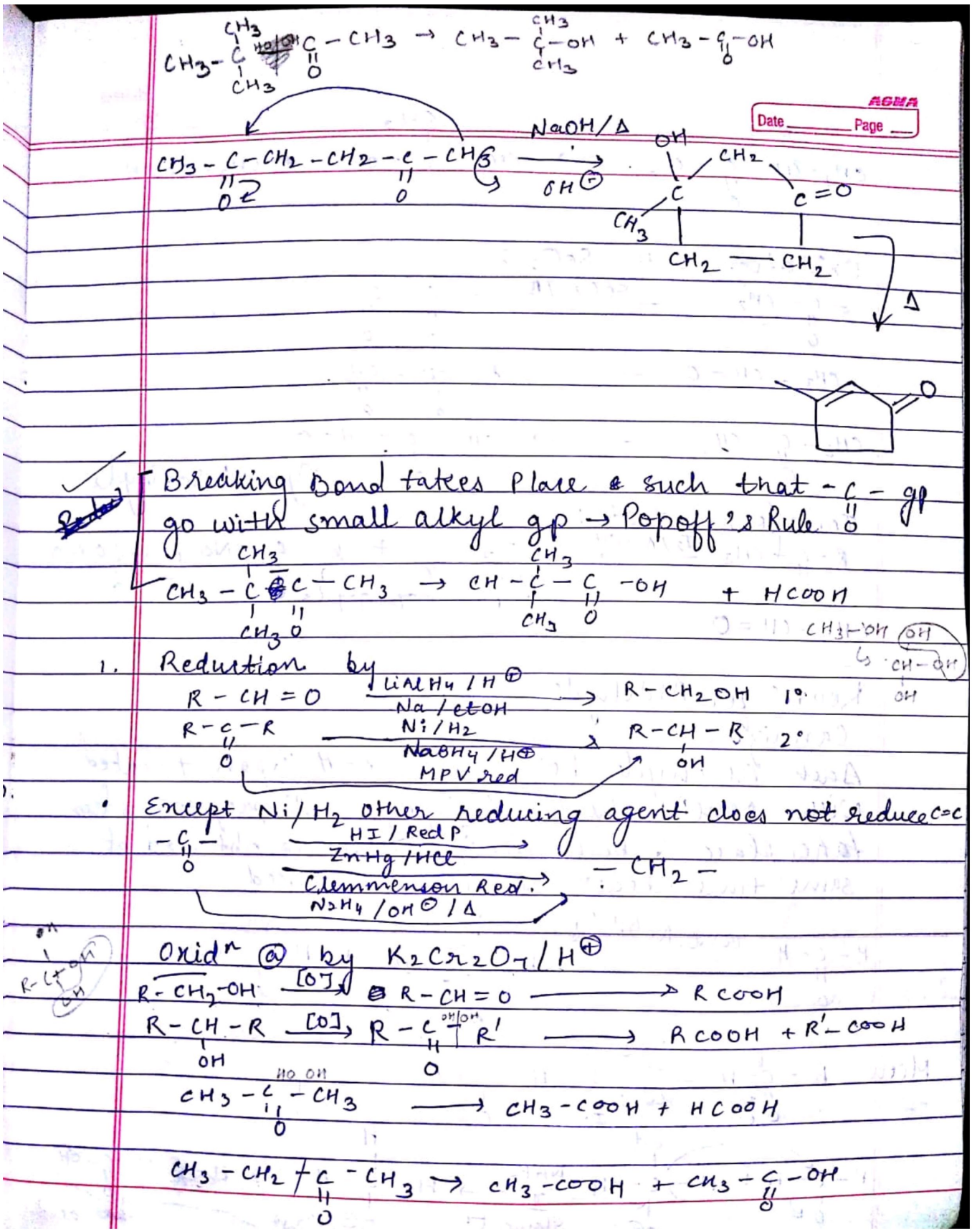
$CH_2-CH_2-CH-OH$
$|$
$CH_2-CH_2-CH=O$

$\xrightarrow{\Delta}$

CH_2-CH_2
$|$
$CH_2-CH=CH-CHO$

$\uparrow$ ① O_3/N_2
② Zn/H_2O

IIT



Breaking Bond takes Place such that $-\overset{\overset{O}{\|}}{C}-$ gp go with small alkyl gp → Popoff's Rule

$$CH_3-\overset{CH_3}{\underset{CH_3}{C}}-C-CH_3 \rightarrow CH-\overset{CH_3}{\underset{CH_3}{C}}-\overset{\overset{O}{\|}}{C}-OH + HCOOH$$

1. Reduction by

$$R-CH=O \xrightarrow[Na/etOH]{LiAlH_4/H^{\oplus}} R-CH_2OH \quad 1^{\circ}$$

$$R-\overset{\overset{O}{\|}}{C}-R \xrightarrow[NaBH_4/H^{\oplus}\ MPV\ red]{Ni/H_2} R-\underset{OH}{CH}-R \quad 2^{\circ}$$

- Except Ni/H_2 other reducing agent does not reduce C=C

$$-\overset{\overset{O}{\|}}{C}- \xrightarrow[Zn\text{-}Hg/HCl\ (Clemmenson\ Red.)]{HI/Red\ P} -CH_2-$$
$$\xrightarrow{N_2H_4/OH^{\ominus}/\Delta}$$

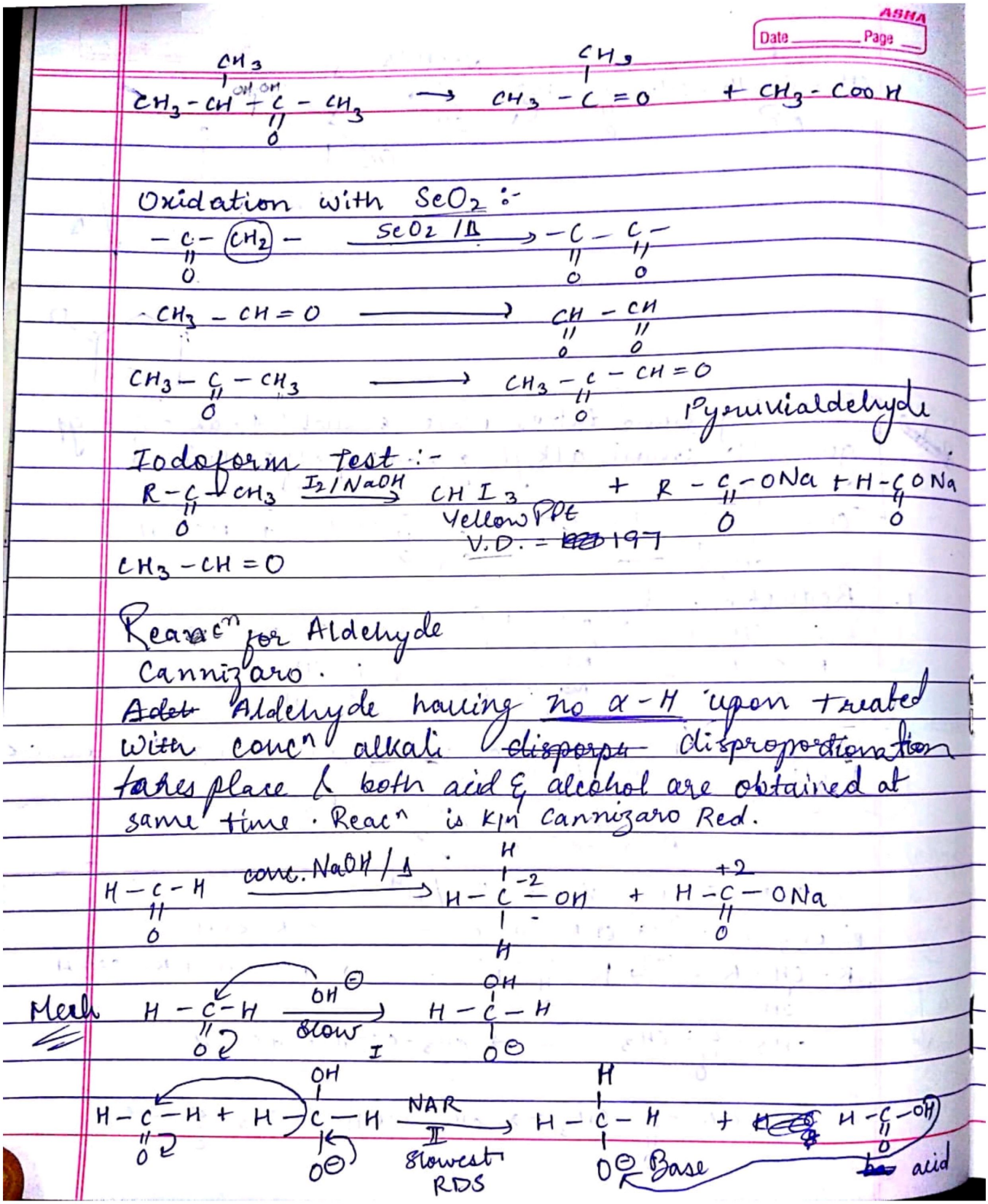
Oxidn @ by $K_2Cr_2O_7/H^{\oplus}$

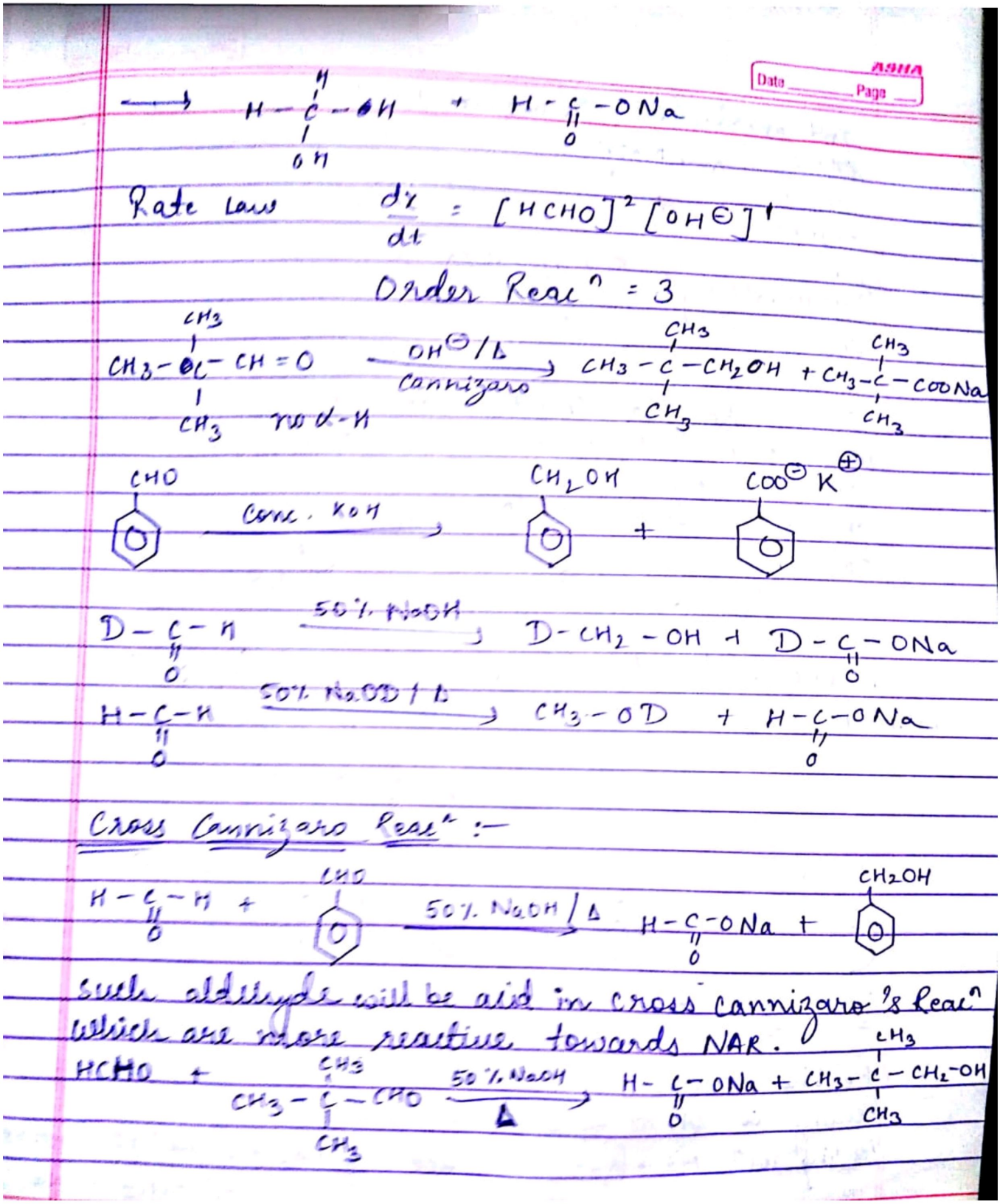
$$R-CH_2-OH \xrightarrow{[O]} R-CH=O \longrightarrow R\,COOH$$

$$R-\underset{OH}{CH}-R \xrightarrow{[O]} R-\underset{H}{\overset{OH/OH}{C}}-R' \longrightarrow R\,COOH + R'-COOH$$

$$CH_3-\overset{\overset{O}{\|}}{C}-CH_3 \longrightarrow CH_3-COOH + HCOOH$$

$$CH_3-CH_2-\overset{\overset{O}{\|}}{C}-CH_3 \rightarrow CH_3-COOH + CH_3-\overset{\overset{O}{\|}}{C}-OH$$





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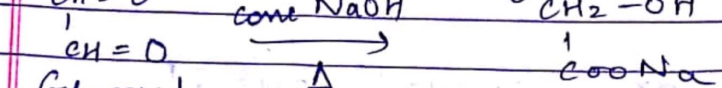
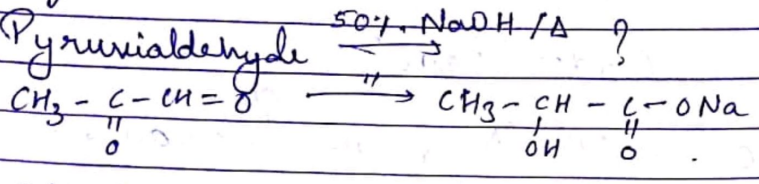
Intramolecular Cannizaro Reaction

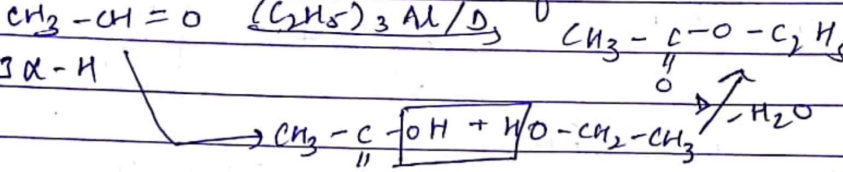


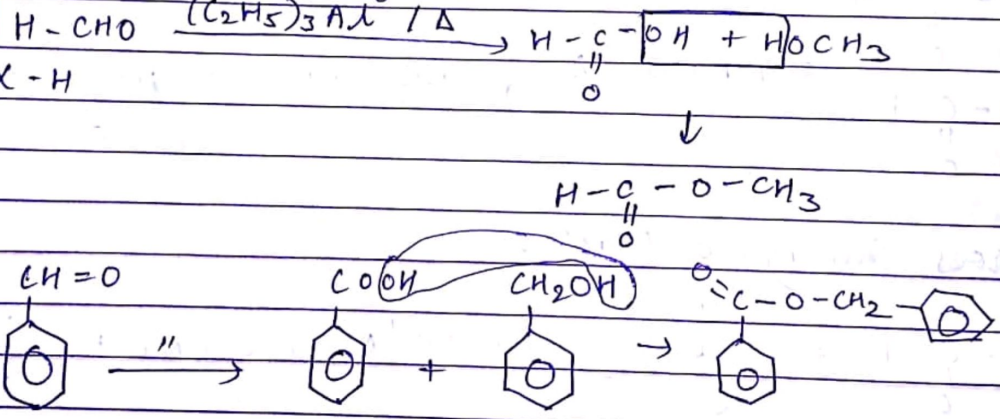
Glyoxal



Tischenko Reaction (Modified form Cannizaro Reaction)

When any aldehyde react with Aluminium ethoxide then it will form ester.



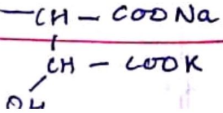


Test for Aldehyde :-

① Fehling sol^n :-

Fehling sol^n (A) → aq. sol^n of $CuSO_4$

Fehling sol^n (B) + Rochelle salt [aq NaOH + Sod. Pot. tartarate]



→ F.S. & B.S. used to distinguish b/w Aldehyde & ketone.
→ F.S. & B.S. is used to test sugar in urine.

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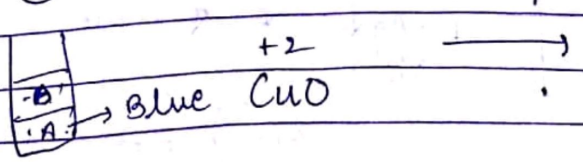
(A) + (B) → F.S. CuO (Blue Color)



Aldehyde except Benzaldehyde give +ve F.S. test while ketone give -ve test becoz Ketone & benzaldehyde cannot be oxidised by F.S.

Benedict Soln :-

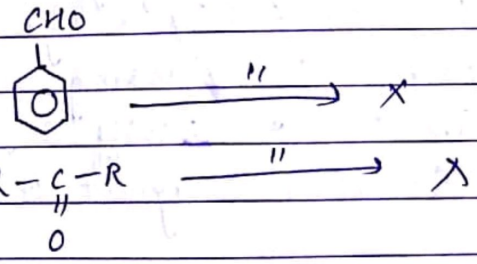
aq $CuSO_4$ soln + Sod. citrate + aq. Na_2CO_3

CuO

$R-CHO + CuO \longrightarrow Cu_2O + R-\underset{\underset{O}{\|}}{C}-OH$

Blue — Red ppt

$Cu^{2+} \longrightarrow Cu^{+1}$



All aldehyde except benzaldehyde give +ve Benedict test while ketone give -ve test.

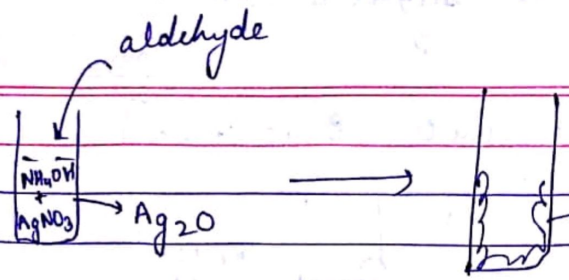
Tollen's Reagent Test :-

T.R. = Ammoniacal Silver Nitrate

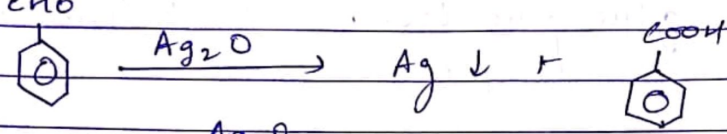
$NH_4OH + AgNO_3$

$[Ag(NH_3)_2]^+ OH^-$

↳ colourless complex Ag_2O



$R-CHO \xrightarrow{Ag_2O} Ag\downarrow + R-COOH$



$R-\underset{\underset{O}{\|}}{C}-R \xrightarrow{Ag_2O} X$

All aldehyde including Benzaldehyde give +ve test with T.R. while ketone give -ve test.

Schiff Reagent (Pink) : Dil. soln of Para-Rosanaline Hydrochloride or magneta dye is a pink coloured dye & K/n as schiff's Dye. Its pink colour is discharged by passing SO_2 gas & the colourless soln is called Schiff's Reagent Aldehyde reacts with this reagent to store the pink color.

Ques CH_3-CHO & $C_6H_5CH_2-CHO$ can be distinguished by
(1) Benedict Test (2) Idoform Test (3) Tollen's Reagent
(4) Fehling soln Test.

Ques CH_3-CHO & $CH_3-\underset{\underset{O}{\|}}{C}-CH_3$ can not be distinguished by-
(1) Fehling Soln (2) Grignard Reagent
(3) Schiff's Reagent (4) Tollen's Reagent

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Qus Aldehyde & ketone are distinguished by
① Fehling sol^ ② H_2SO_4 ③ NH_3 ④ $NaHSO_3$

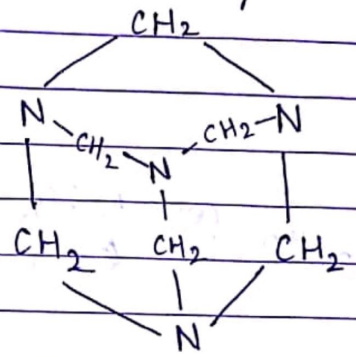
* Reac^ with Ammonia :-

Formaldehyde :-

It will give

$6HCHO + 4NH_3 \longrightarrow (CH_2)_6N_4$

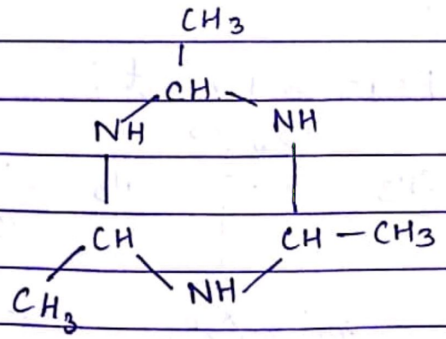
~~Hem.~~ Hexamethylene tetramine
or
Urotropine



Other Aldehyde :-

$CH_3-CH=O + NH_2-H \xrightarrow{NHR_2} CH_3-CH(OH)-NH_2$

$CH_3-CH(OH)-NH_2 \xrightarrow[\Delta]{conc.\ H_2SO_4,\ -H_2O} CH_3-CH=NH$



Polymerisation :-

Formaldehyde $\underset{\Delta}{\overset{\text{Evaporation}}{\rightleftharpoons}}$ $(CH_2O)_n.H_2O$

HCHO

Formalin (40% of HCHO)

Paraformaldehyde (linear polymer)

$n \rightarrow 6-50$

Hydrated white crystal

It shows Reducing character with T.R.

Not imp

$n\,HCHO \xrightleftharpoons[\Delta]{conc.\ H_2SO_4} (CH_2O)_n\ H_2O$

Polyoxymethylene

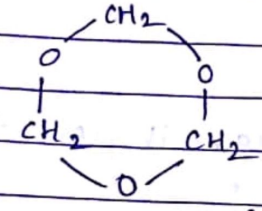
$n > 100$

$3HCHO \xrightarrow{room\ Temp.} (CH_2O)_3$

Metaformaldehyde (Trioxane)

cyclic Polymer (Trioxy methylene)

It doesn't show reducing ch^r with T.R.

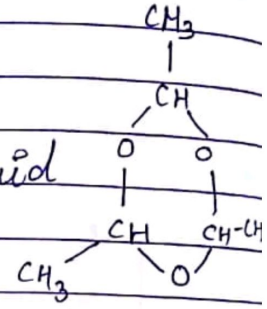


$3\,CH_3CHO \xrightarrow[room\ T.]{conc.\ H_2SO_4} (CH_3CHO)_3$

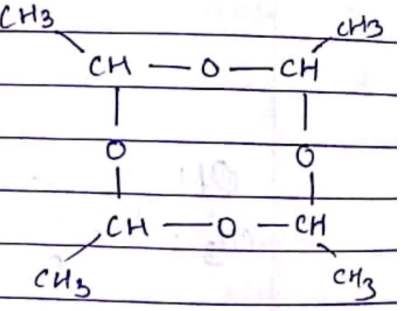
Para acetaldehyde

Pleasant smelling liquid

Hypnotic comp.

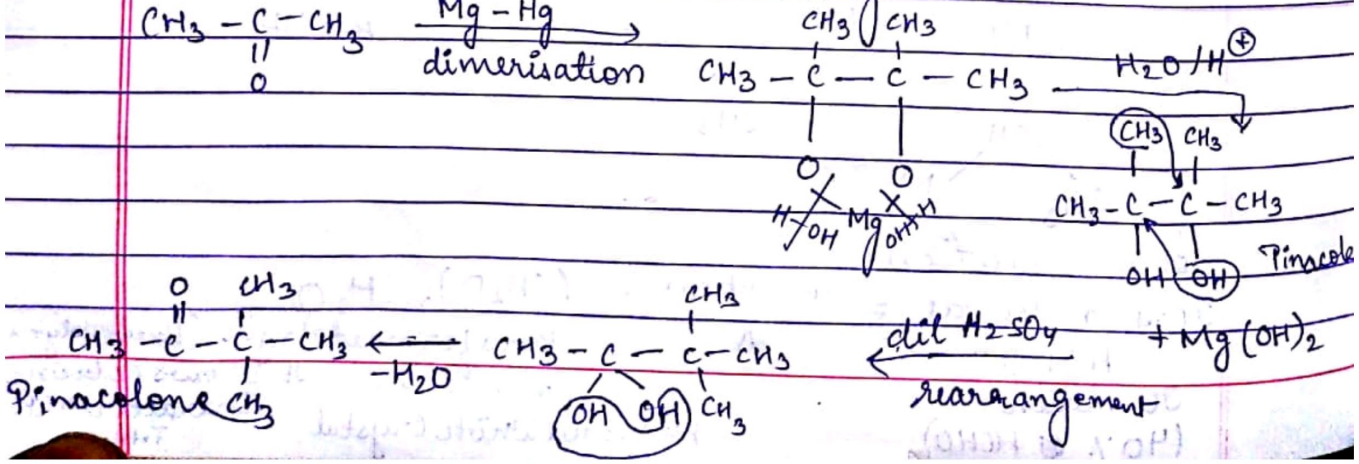


$4\,CH_3CHO \xrightarrow[0°C]{conc\ H_2SO_4} (CH_3CHO)_4$



Reac^n only for ketone :-

Pincole - Pinacolone Rearrangement :-



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Bayer's Villager Oxidation :-

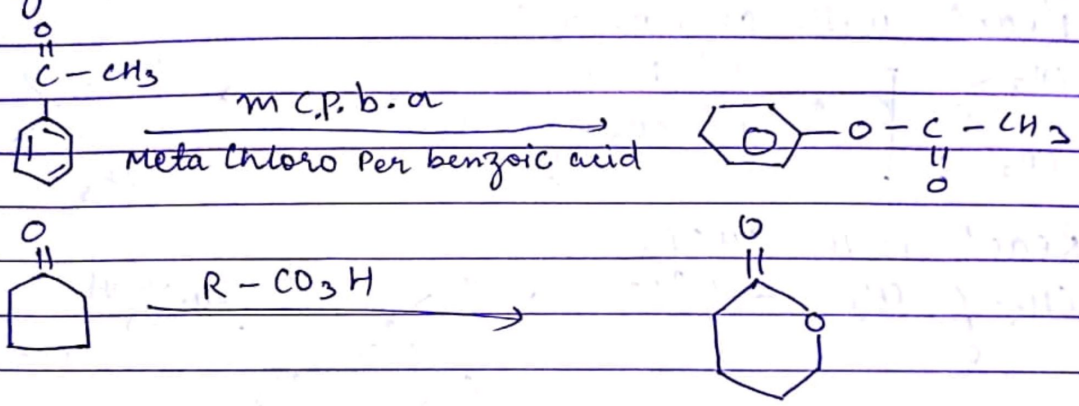
Ketone $\xrightarrow{\text{Per acid}}$ ester

$CH_3-C(=O)-CH_3 \xrightarrow{R-C(=O)-O-O-H} CH_3-C(=O)-O-CH_3$

$CH_3-C(=O)-CH_2-CH_3 \xrightarrow{H_2O_2}$ $CH_3-O-C(=O)-CH_2-CH_3$ Minor

$CH_3-C(=O)-O-CH_2-CH_3$ Major

Migration $H > 3^\circ > Ph > 2^\circ > 1^\circ > CH_3$

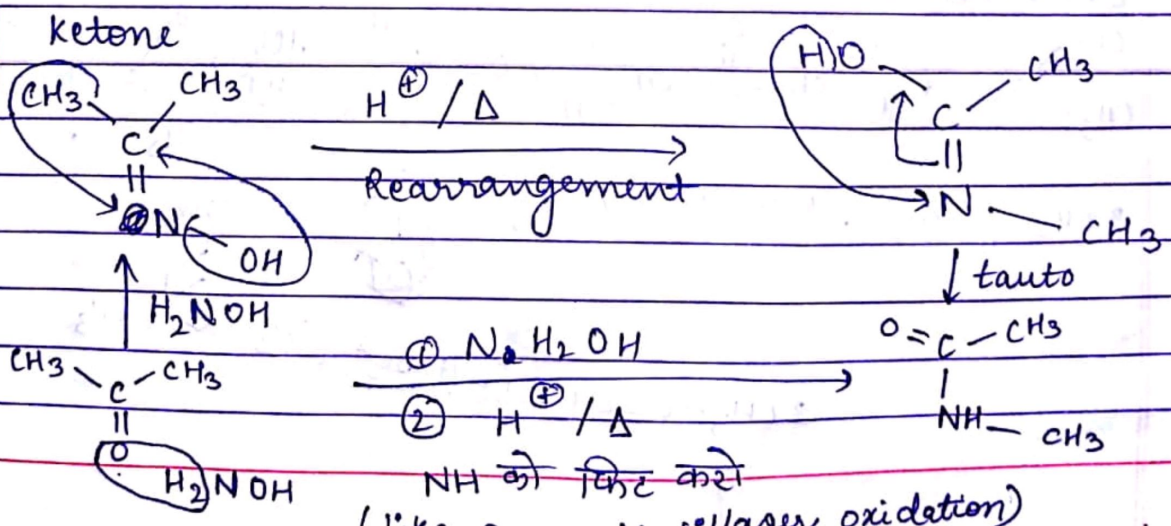


Beakmann Rearrangement :-

Oxime of Ketone $\xrightarrow{H^\oplus/\Delta}$ N-alkyl amide

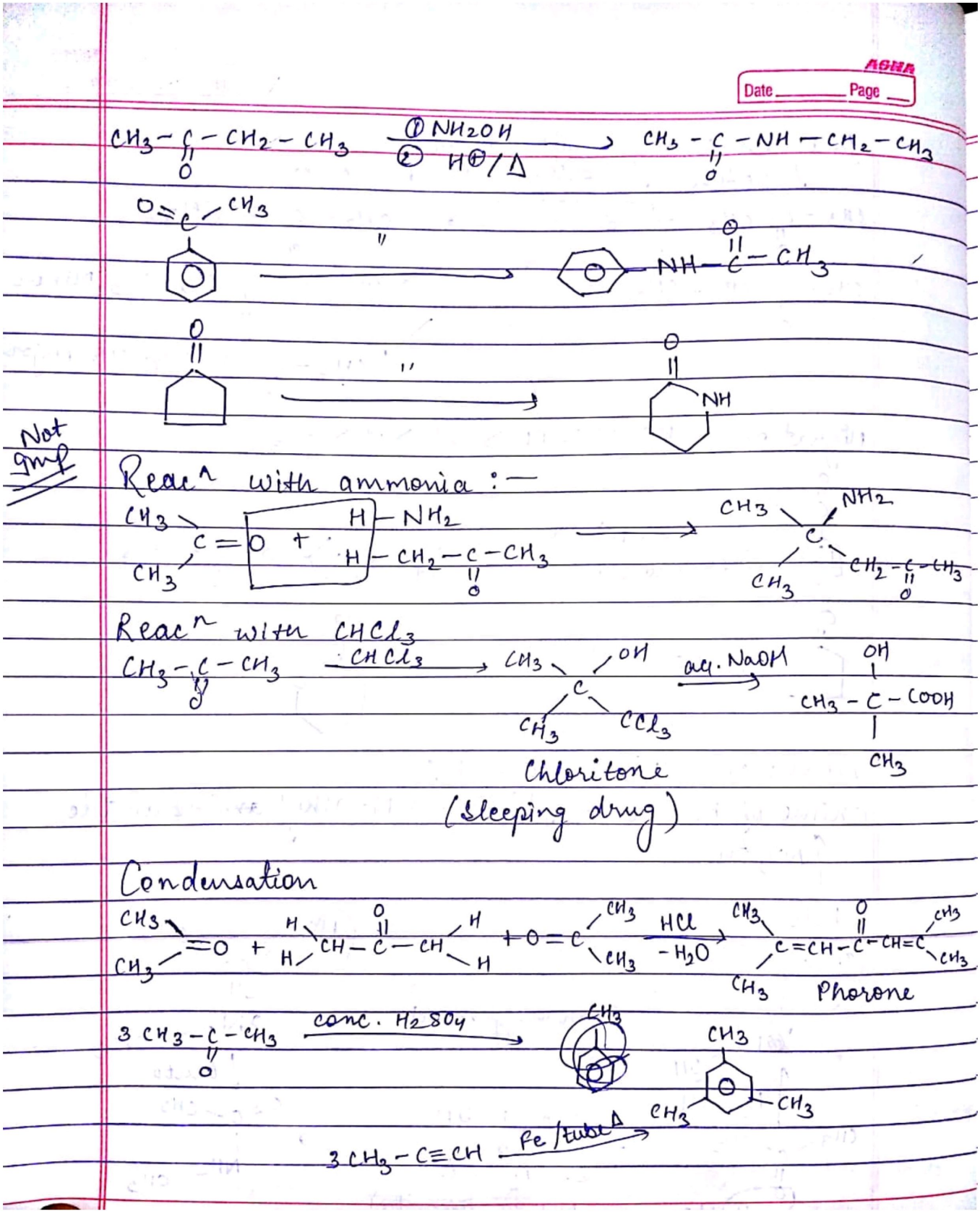
$\uparrow NH_2OH$

Ketone

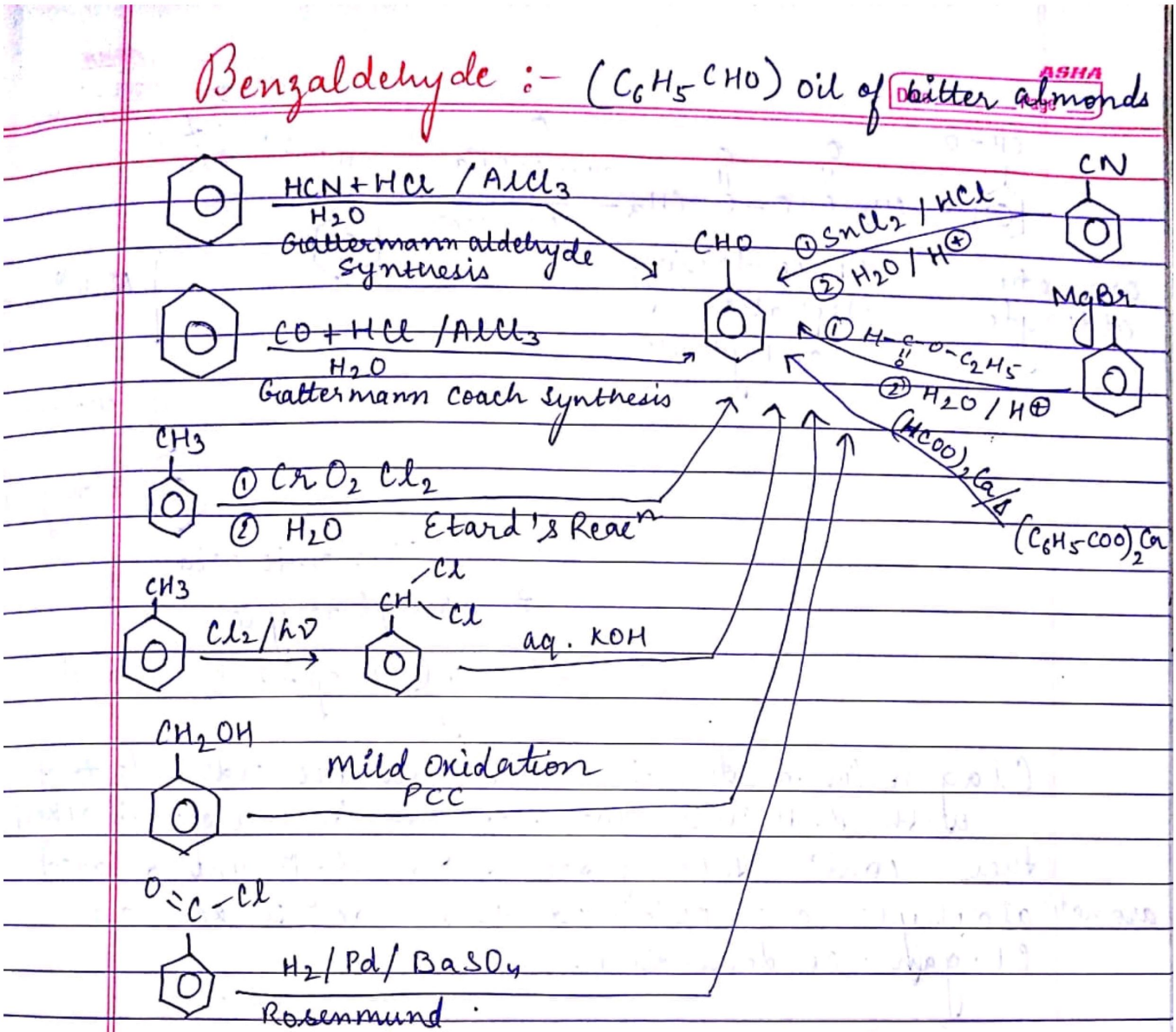


NH को फिर से करो

(like Bayer's villager oxidation)

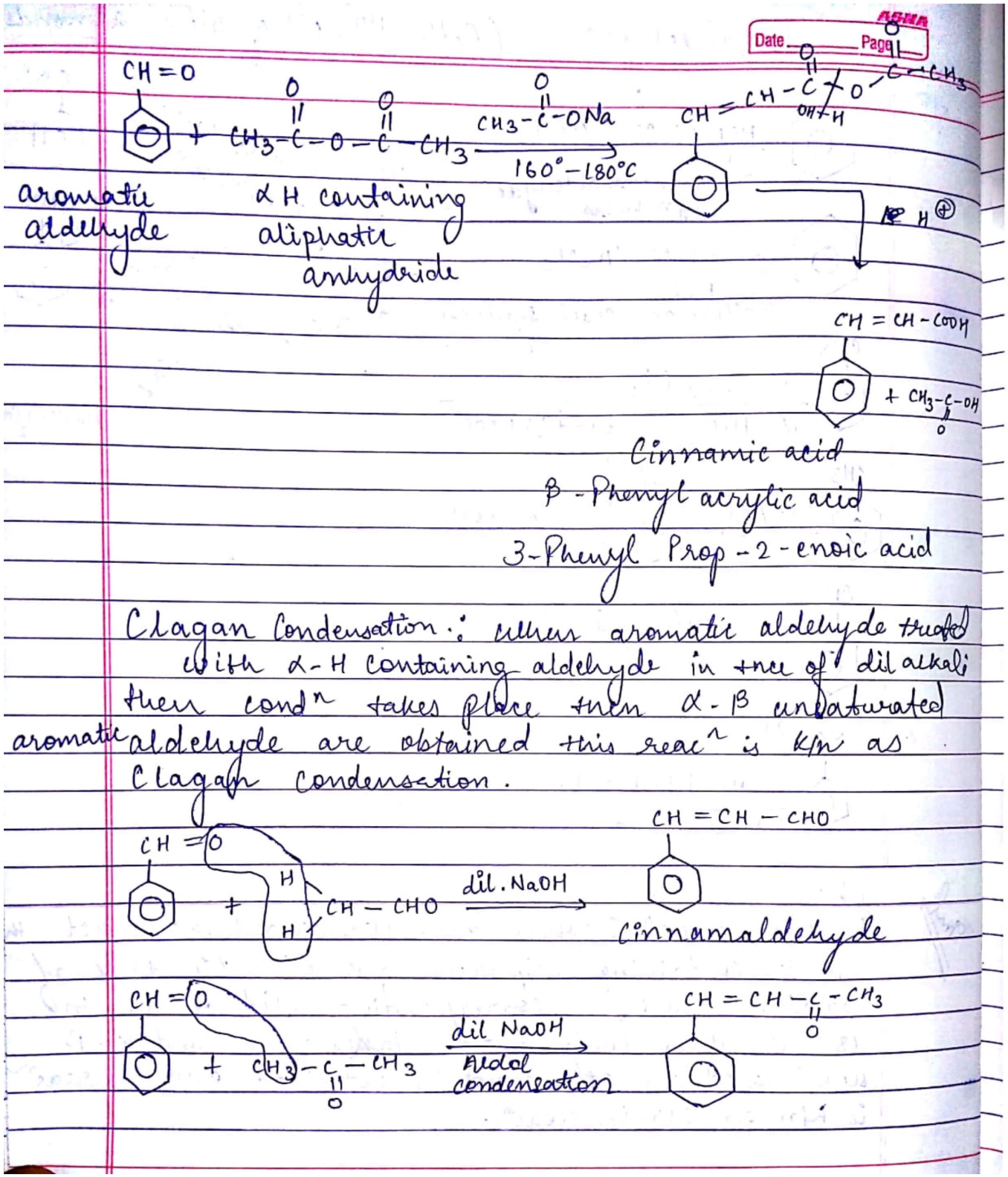


Benzaldehyde :- (C_6H_5CHO) oil of bitter almonds

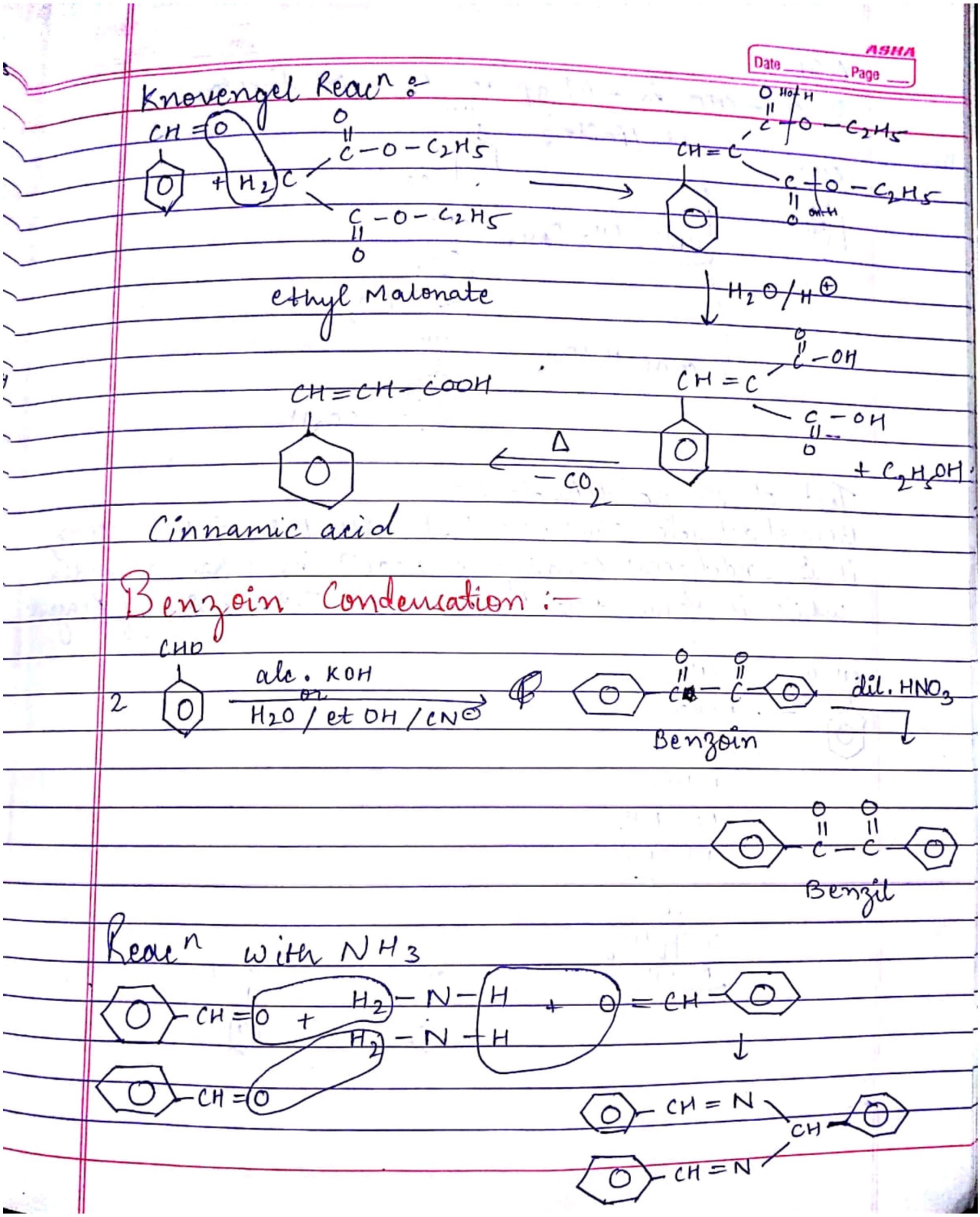


Chemical Properties :-

Perkin Reacn : When aromatic aldehyde react with α-H containing aliphatic anhydride in ⁺nce of sodium salt of corresponding acid at 160 to 180°C then condensation takes place and α-β unsaturated aromatic acid is obtained and the reacn is k/n as Perkin Reacn.

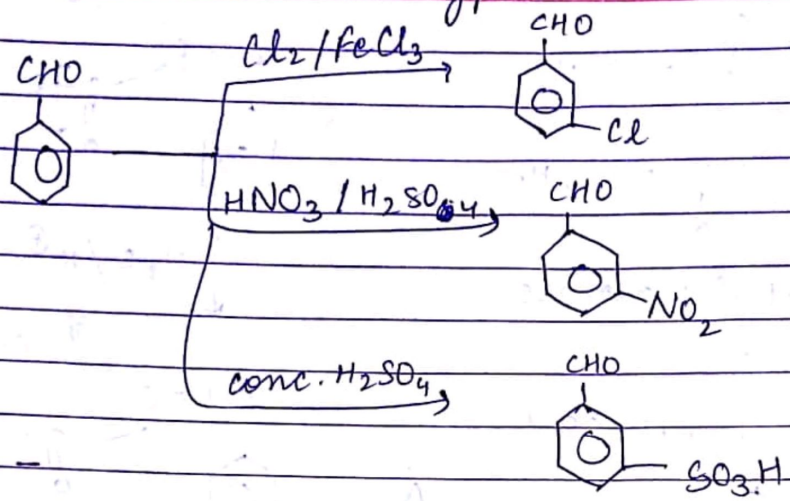


Claagan Condensation: When aromatic aldehyde treated with α-H containing aldehyde in the of dil alkali then cond^n takes place then α-β unsaturated aromatic aldehyde are obtained this reac^n is k/n as Claagh condensation.



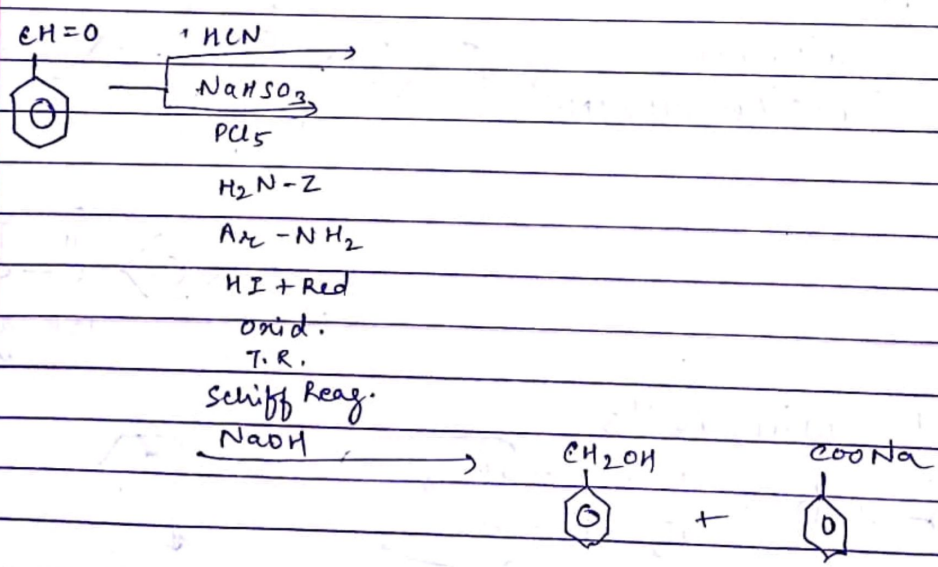
ESR :-

Since -CHO is -M gp so it is M director



Test of Benzaldehyde :-

Benzaldehyde give -ve test with F.S. & B.S. becoz it is undergoes cannizaro reac^n in alkaline media while it give +ve test with T.R. & Schiff Reagent



Carboxylic Acid (-COOH)

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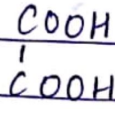
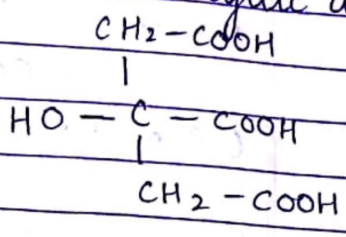
G.F. → $C_nH_{2n}O_2$

Monocarboxylic
CH_3-COOH

Dicarboxylic


Tricarboxyllic acid


G.M.P. :-

1. **By Oxidation :-**

$R-CH_3$
$R-CH=CH_2$
$R-C\equiv CH$
$R-CH_2-Cl$
$R-CH(Cl)-Cl$
$R-CH_2-OH$
$R-CH=O$
$R-\underset{\underset{O}{\|}}{C}-R$

$\xrightarrow{KMnO_4 / H^{\oplus}}$ $R-COOH$

Hydrolysis of ester

$R-\underset{\underset{O}{\|}}{C}-O-R' \xrightarrow{H_2O / H^{\oplus}} R-\underset{\underset{O}{\|}}{C}-OH + R'-OH$

Acidic Hydrolysis of cyanide

$R-C\equiv N \xrightarrow{H_2O / H^{\oplus}} R-COOH + NH_3$

Alkaline hydrolysis of geminal trihalide :-

$R-CX_3 \xrightarrow{aq.\ KOH} R-C(OH)_2-OH \longrightarrow R-\underset{\underset{O}{\|}}{C}-OH$

Heating of geminal dioic acid

$$R-CH(COOH)_2 \xrightarrow{\Delta} R-CH_2-COOH + CO_2$$

OC or IC

not gmf

Gurbet Reac^n :-

$$R-OH \xrightarrow{CO + BF_3} R-\underset{\underset{O}{\|}}{C}-OH$$

By HIO_4 (Per Iodic Acid)

$$-\underset{\underset{O}{\|}}{C}-\underset{\underset{O}{\|}}{C}- \xrightarrow{HIO_4/\Delta} -\underset{\underset{O}{\|}}{C}-OH + \underset{\underset{O}{\|}}{C}-OH$$

Iodoform Test :-

$$R-\underset{\underset{O}{\|}}{C}-CH_3 \xrightarrow{I_2/NaOH} R-\underset{\underset{O}{\|}}{C}-ONa + CHI_3$$

$$R-\underset{\underset{O}{\|}}{C}-ONa \xrightarrow{H^{\oplus}} R-\underset{\underset{O}{\|}}{C}-OH$$

With G.R.

$$R-\overset{\delta+}{Mg}X + \underset{\underset{O}{\|}}{C}=O \xrightarrow{H^{\oplus}} R-\underset{\underset{O}{\|}}{C}-OH$$

$$CH_3-CH_2-MgX \xrightarrow{CO_2/H^{\oplus}} CH_3-CH_2-COOH$$

Carboxylation of Alkene :-

$$R-CH=CH_2 \xrightarrow[Ni-Catalyst]{CO+H_2O} R-CH_2-CH_2-COOH$$

Physical Properties :-

state

$C_1-C_3 \rightarrow$ Pungent smelling liq.

$C_4-C_{11} \rightarrow$ Oily butter smelling liq.

higher → waxy solid

B.P. → B.P. $\propto$ Mw. $\propto$ $\frac{1}{\text{Branching}}$

B.P. acid > ester

$CH_3-CH_2-C(=O)-OH$ > $CH_3-C(=O)-O-CH_3$

due to H-bonding

B.P. acid > alcohol

$CH_3-C(=O)-OH$ > $CH_3-CH_2-CH_2-OH$

↳ dimer form due to H-Bonding

Chemical Properties :-

(A) Reac^n due to acidic H :

A.S. $\propto \frac{-M/-I}{+M/+I}$ Revise of G.O.C. I

pKa: $HCOOH$ (3.76) > C_6H_5COOH (4.42) > CH_3COOH (4.7)

$R-C(=O)-OH$ + Na → $R-C(=O)-ONa + H_2\uparrow$

+ NaH → $R-C(=O)-ONa + H_2\uparrow$

+ NaOH → $R-C(=O)-ONa + H_2O$ (neutralisation)

+ $NaHCO_3$ → $R-C(=O)-ONa + H_2CO_3$ ↓ $CO_2 + H_2O$

$R-C(=O)-OH$ + CH_2N_2/Δ → $R-C(=O)-O-CH_3$

+ ① NaOH, ② $Cl-C(=O)-CH_3$ → $R-C(=O)-O-C(=O)-CH_3$

+ ① Ag_2O, ② $R'-Cl$ → $R-C(=O)-O-R'$

+ $R'-MgX$ → $R'-H$

ASHA
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Reac^ ~~with~~ due to -OH gp :-

$R-\underset{\underset{O}{\|}}{C}-OH$ →
- HX/Δ → $R-\underset{\underset{O}{\|}}{C}-X$
- PCl_5 → $R-\underset{\underset{O}{\|}}{C}-Cl$
- $SOCl_2/Py$ → $R-\underset{\underset{O}{\|}}{C}-Cl$
- NH_3/Δ → $R-\underset{\underset{O}{\|}}{C}-NH_2$
- $R'-OH$ → $R-\underset{\underset{O}{\|}}{C}-OR'$
- P_4O_{10}/Δ or Conc. H_2SO_4 → $R-\underset{\underset{O}{\|}}{C}-O-\underset{\underset{O}{\|}}{C}-R$

B Reac^ due to $-\underset{\underset{O}{\|}}{C}-$ gp

only reduction Reac^

$R-\underset{\underset{O}{\|}}{C}-OH \xrightarrow{LiAlH_4/H^{\oplus}} R-CH_2-OH$

D Reac^ due to $-COOH$ gp

1. Decarboxylation
2. Kolbe Electrolysis
3. HI / Red P
4. Huns Dicker Reac^ (Alkyl halide)

$CH_3COOAg \xrightarrow{Br_2/CCl_4} CH_3-Br + AgBr + CO_2$

E V.V.Imp

Reac^n due to alkyl gp

Hell Volhard Zeilinsky Reac^n (HVZ Reac^n)

$R-CH_2-COOH \xrightarrow{X_2/Red\ P} R-\underset{X}{CH}-COOH$

α-H containing acid

$X_2 = Cl_2, Br_2$ mainly

$CH_3-COOH \xrightarrow{Cl_2/Red\ P} Cl-CH_2-COOH$

aq. KOH → $HO-CH_2-COOH$ Glycolic acid

$Cl_2/Red\ P$ → $CHCl_2-COOH$

$Cl_2/Red\ P$ → CCl_3-COOH

NH_3/Δ → NH_2-CH_2-COOH Glycine, α-amino acid

$CH_3-CH_2-COOH \xrightarrow{Br_2/Red\ P} CH_3-\underset{Br}{CH}-COOH$

aq. KOH → $CH_3-\overset{*}{C}H(OH)-COOH$ Lactic acid

$Br_2/Red\ P$ → $CH_3-C(Br_2)-COOH$ AIPMT-09

NH_3 → $CH_3-CH(NH_2)-COOH$

~~Rea~~ Oxidation :- Oxid^n of carbonylic acid is not possible except Formic acid.

$H-\underset{\underset{O}{\|}}{C}-OH \xrightarrow[\text{or } K_2Cr_2O_7/H^\oplus]{KMnO_4/H^\oplus} HO-\underset{\underset{O}{\|}}{C}-OH \downarrow CO_2 + H_2O$

aldehyde gp

carboxyllic acid

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Note: Only formic give +ve T.R. test & F.S. test becoz -CHO gp is ~~not~~ in it.

Alkyl gp Oxidation

CH_3-CH_2-COOH

- $KMnO_4/H^{\oplus}$ (α-H) → $CH_3-\underset{OH}{\underset{|}{CH}}-COOH$
- $3\%\ H_2O_2$ (β-H) → $CH_2(OH)-CH_2-COOH$
- SeO_2/Δ α(-CH_2-)gp → $CH_3-\underset{O}{\underset{||}{C}}-COOH$

Benzoic Acid (C_6H_5COOH)

G1 = α-H containing gp
$-CH_3$, $-CH_2-CH_3$, $-CH=CH_2$, $-CH_2Cl$, $-CH\langle^{Cl}_{Cl}$, $-CHO$, $-CH_2-OH$

- G1 → $K_2Cr_2O_7/H^{\oplus}$ or $KMnO_4/H^{\oplus}$ → COOH
- CCl_3 → aq. KOH → COOH
- $MgBr$ → $CO_2/H^{\oplus}$ → COOH
- CN → $H_2O/H^{\oplus}$ → COOH
- $\overset{O}{\overset{||}{C}}-Cl$ → H_2O → $\overset{O}{\overset{||}{C}}-OH$
- ① $Cl-\overset{O}{\overset{||}{C}}-Cl/AlCl_3$ ② H_2O → COOH
- $H_3O^{\oplus}$ heat → COOH, COOH(OH), COOH(OH)

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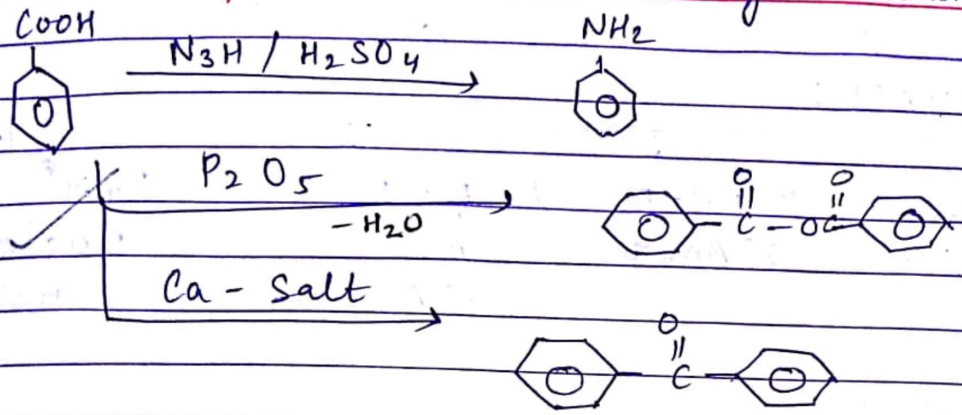
Chemical Properties :- same as carboxylic acid



Acid - derivatives → Revise from G.O.C - II