NR

Chapter ^^10^^

R–C(=O)–OH
carboxylic acid

R–C(=O)–Cl
acid chloride

R–C(=O)–O–C(=O)–R
anhydride

R–C(=O)–O–R′
Ester

R–C(=O)–NHR
Amide

10.1 : naming of carboxylic acid

H–C(=O)–OH
methanoic acid
اسم حمض كربوكسيلي

C–C–C(=O)–OH
propanoic acid

* دائماً في الحمض الكربوكسيلي ⇐ OH بتاخذ رقم ((1)) وما نعطي الرقم قبلها

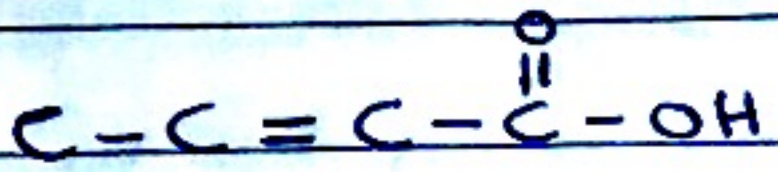
C–C–C–C–C(=O)–OH (Cl on the first C)
5- chloropentanoic acid

* تذكري انه :
–OH لما يكون فرع بيكون اسمها hydroxy
–C(=O)– لما تكون فرع بيكون اسمها oxo ⇐ مثال :

C(=O)–C–C–C(=O)–OH
4-oxobutanoic acid

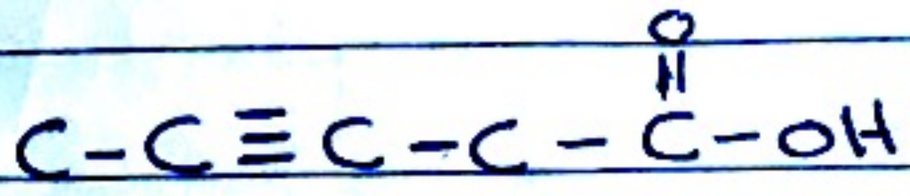
C–C–C–C(=O)–OH (OH on the first C)
4- hydroxy butanoic acid

C–C–C(=O)–C–C(=O)–OH
3- oxo pentanoic acid



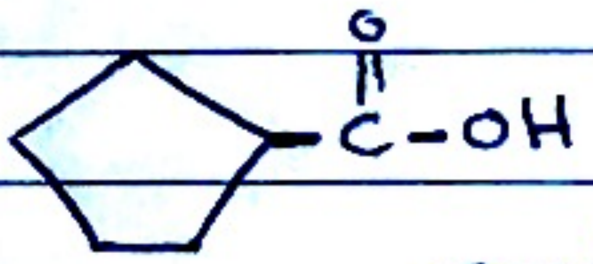
2- butenoic acid

** رابطة ثنائية + $-\overset{O}{\overset{\|}{C}}-OH$ ←



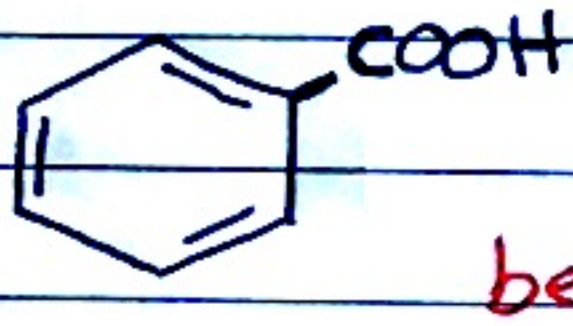
3- pentynoic acid

** رابطة ثلاثية + $-\overset{O}{\overset{\|}{C}}-OH$ ←



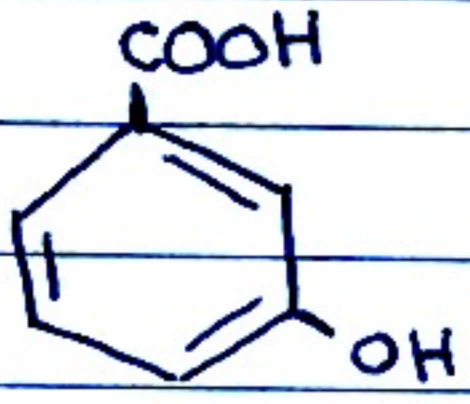
cyclopentane carboxylic acid

** حلقة + $-\overset{O}{\overset{\|}{C}}-OH$ ←

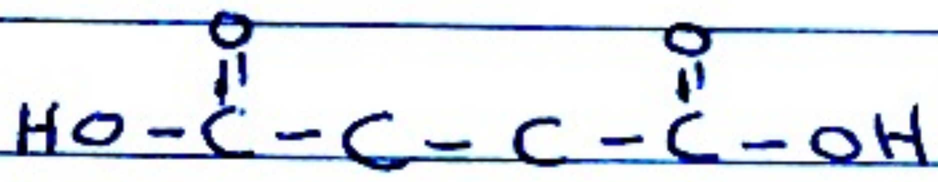


benzoic acid

** حلقة بنزين + $-\overset{O}{\overset{\|}{C}}-OH$ ←

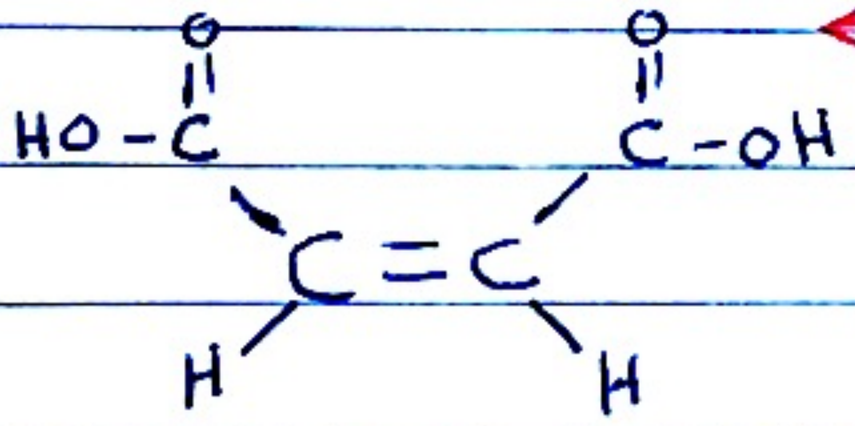


m-hydroxybenzoic acid



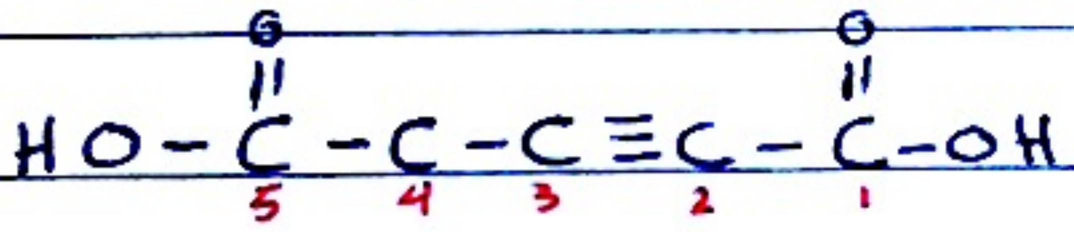
butanedioic acid

** لما تكون الـ $\overset{O}{\overset{\|}{C}}-OH$ على الطرفين ←



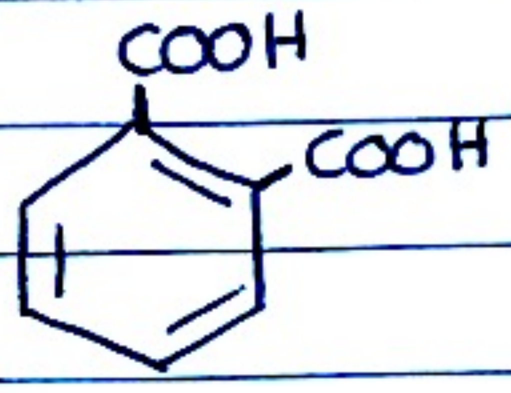
** مجموعتين $-\overset{O}{\overset{\|}{C}}-OH$ + رابطة ثنائية ←

cis-2-butenedioic acid

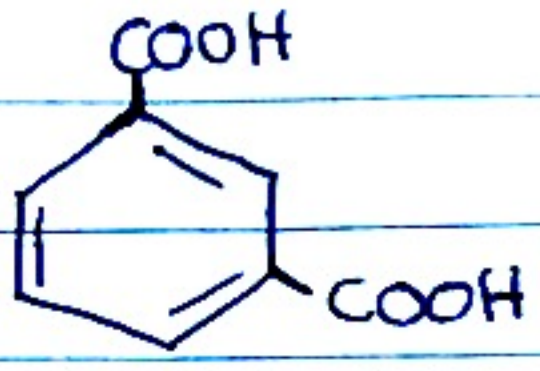


** مجموعتين $-\overset{O}{\overset{\|}{C}}-OH$ + رابطة ثلاثية

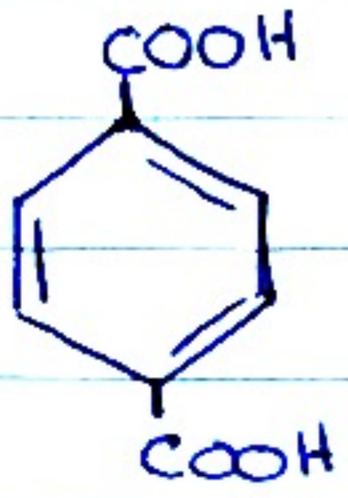
2-pentynedioic acid



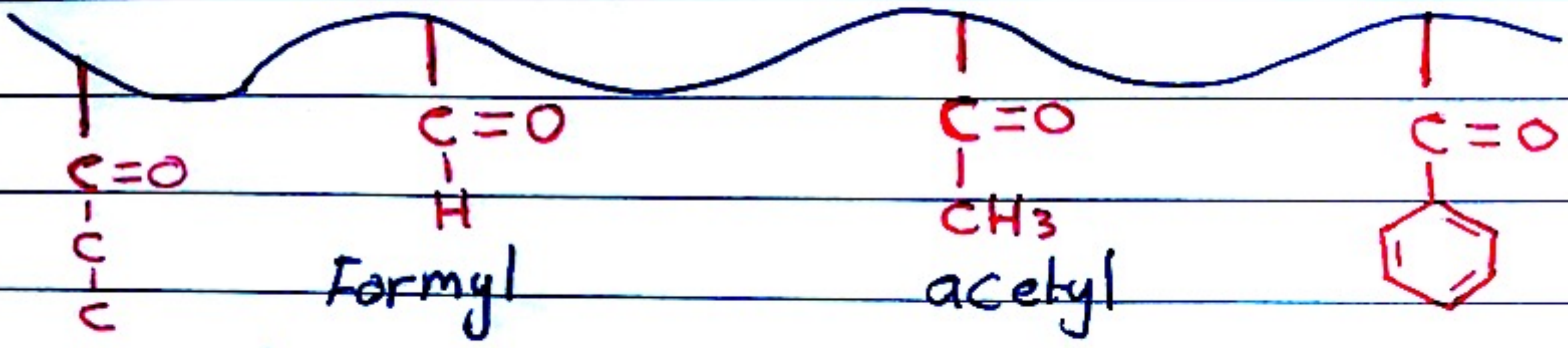
phthalic acid



isophthalic acid



terephthalic acid



propanoyl Formyl acetyl benzoyl

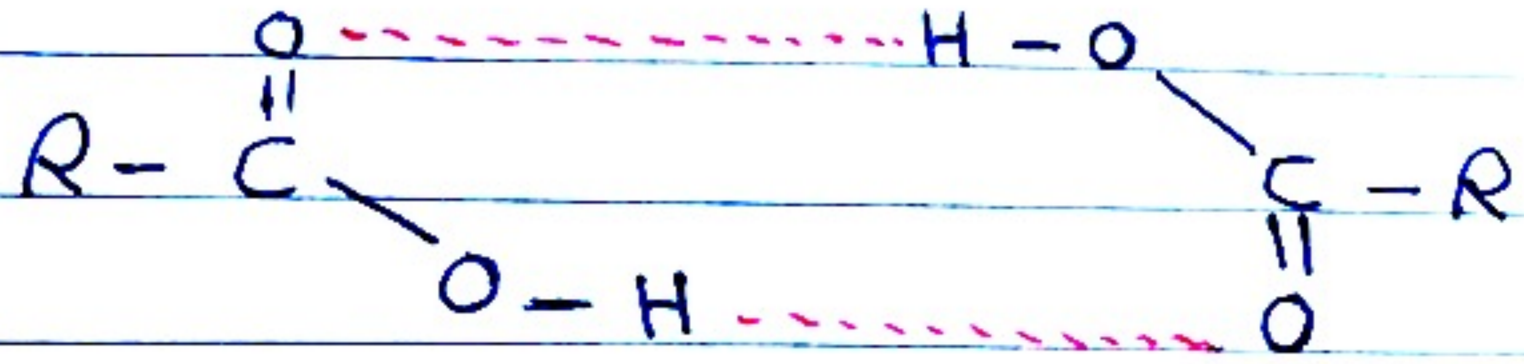
10.2 : physical properties For acid

	b.p
$H-\overset{O}{\overset{\|\|}{C}}-OH$	101
$CH_3-\overset{O}{\overset{\|\|}{C}}-OH$	118
$CH_3-C-\overset{O}{\overset{\|\|}{C}}-OH$	164
$CH_3-C-C-\overset{O}{\overset{\|\|}{C}}-OH$	205

* كلما زادت عدد ذرات الكربون يزداد ال b.p

** if we compare the alcohol with the carboxylic acid :
^^ Methanoic acid have a higher b.p than methanol ^^
why?!

in carboxylic acid : there are two hydrogen bonds between two molecules



10.3 + 10.4 + 10.5 : Acidity of carboxylic acid

$$R-\overset{O}{\overset{\|}{C}}-OH + H_2O \rightleftharpoons R-\overset{O}{\overset{\|}{C}}-O^- + H_3O^+$$

$$ka = \frac{[R-\overset{O}{\overset{\|}{C}}-O^-][H_3O^+]}{[R-\overset{O}{\overset{\|}{C}}-OH]} \quad , \quad pka = -\log ka$$

	pka	
$H-\overset{O}{\overset{\|}{C}}-OH$	3.68	more acidic why ?!
$CH_3-\overset{O}{\overset{\|}{C}}-OH$	4.74	

$$CH_3-\overset{O}{\overset{\|}{C}}-OH + H_2O \rightleftharpoons CH_3-\overset{O}{\overset{\|}{C}}-O^- + H_3O^+$$

CH_3 will increase the intensity of the negative charge on $CH_3-\overset{O}{\overset{\|}{C}}-O^-$

go to the left

** الكربون رح تعطي الالكترونات وبالتالي رح تزيد كثافة الشحنة السالبة وهيك التفاعل رح يروح لليسار لحتى يقلل منها

	pka
$Cl-CH_2-\overset{O}{\overset{\|}{C}}-OH$	2.82
$CH_3-\overset{O}{\overset{\|}{C}}-OH$	4.74

الكلور رح يسحب الالكترونات رح تقلل من كثافة الشحنة السالبة وهيك التفاعل رح يروح لليمين

go to the right

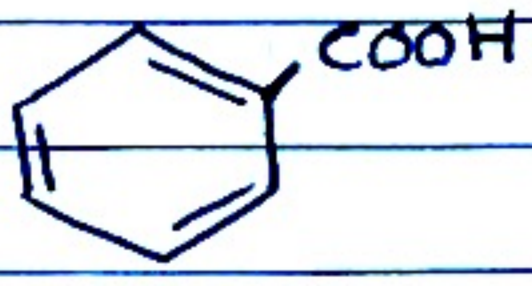
* كلما زاد عدد ذرات الكلور تزيد الحمضية.

	pka
$Cl-\overset{Cl}{\overset{\mid}{\underset{H}{\underset{\mid}{C}}}}-\overset{O}{\overset{\|}{C}}-OH$	1.3
$Cl-\overset{Cl}{\overset{\mid}{\underset{Cl}{\underset{\mid}{C}}}}-\overset{O}{\overset{\|}{C}}-OH$	0.7

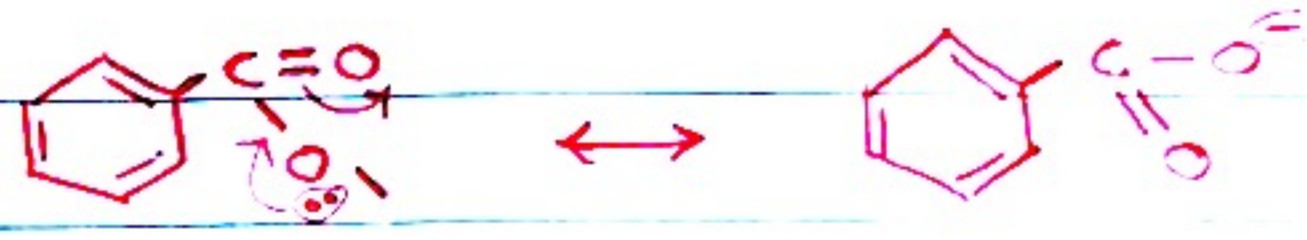
donor group (CH_3) → decreases acidity

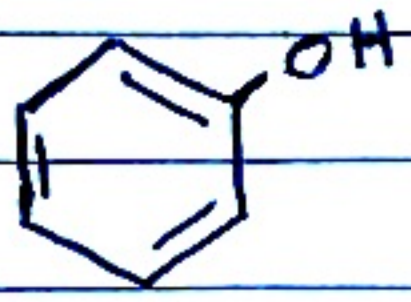
group (Cl) → increases acidity
↓
Earning

C–C–C–C(=O)–OH	4.8	** كل ما كانت ذرة الكلور قريبة من الشحنة السالبة ($-O^-$) رح تقلل من كثافة الشحنة السالبة وتزيد الحمضية
C–C–C(Cl)–C(=O)–OH	2.8	
C–C(Cl)–C–C(=O)–OH	4.05	go to the right

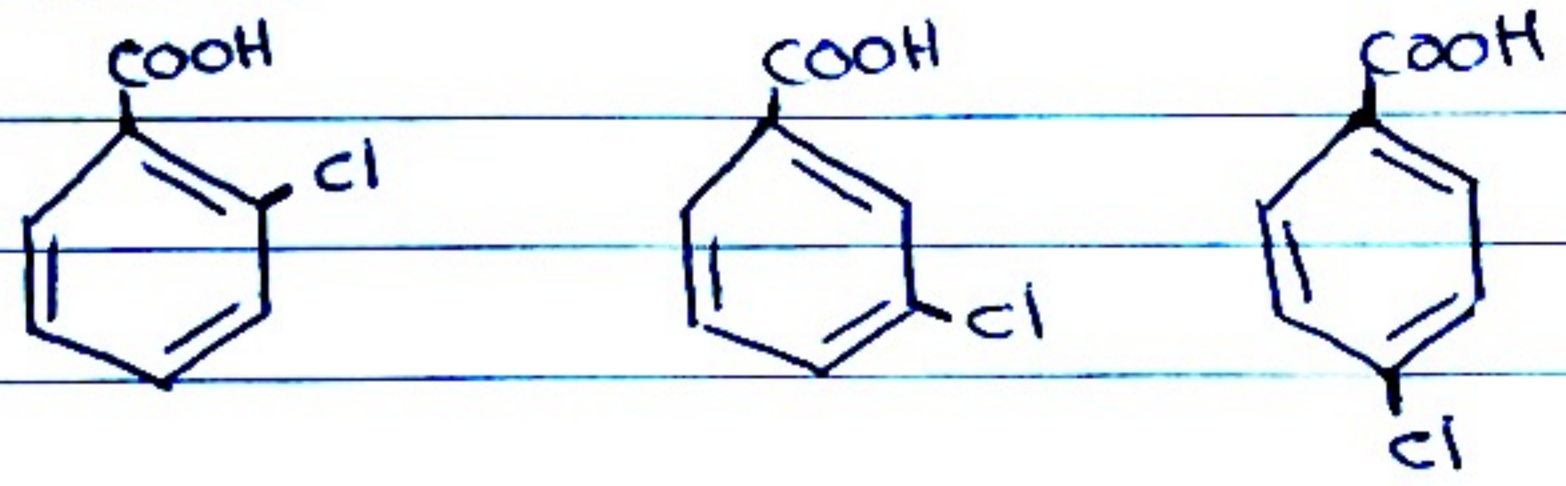


4.18 → more acidic → more resonance





10

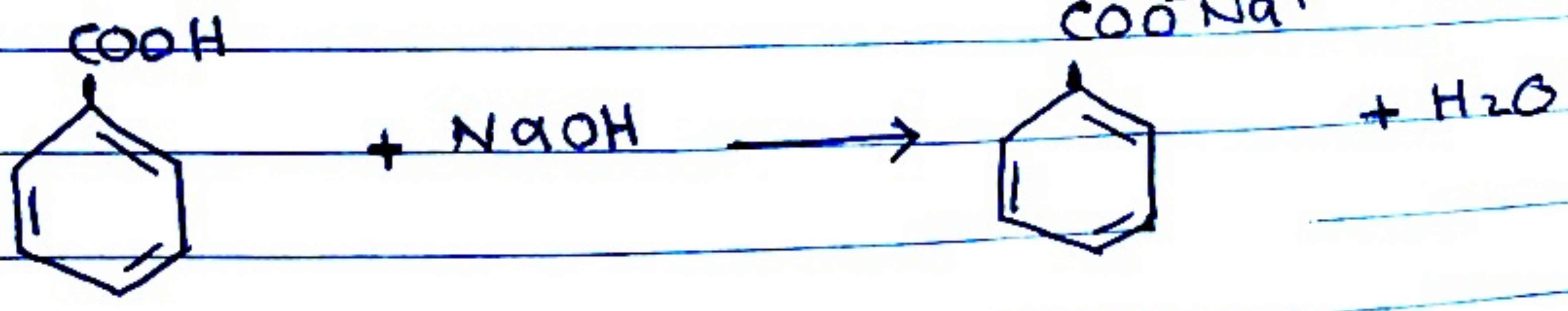


2.9 3.8 4.0

هون الفكرة بقرب ذرة الكلور !! كلما كانت اقرب اكثر حمضية !!

10.6 : Conversion of acid to salt

^^ Carboxylic acid is more acidic than phenol ^^

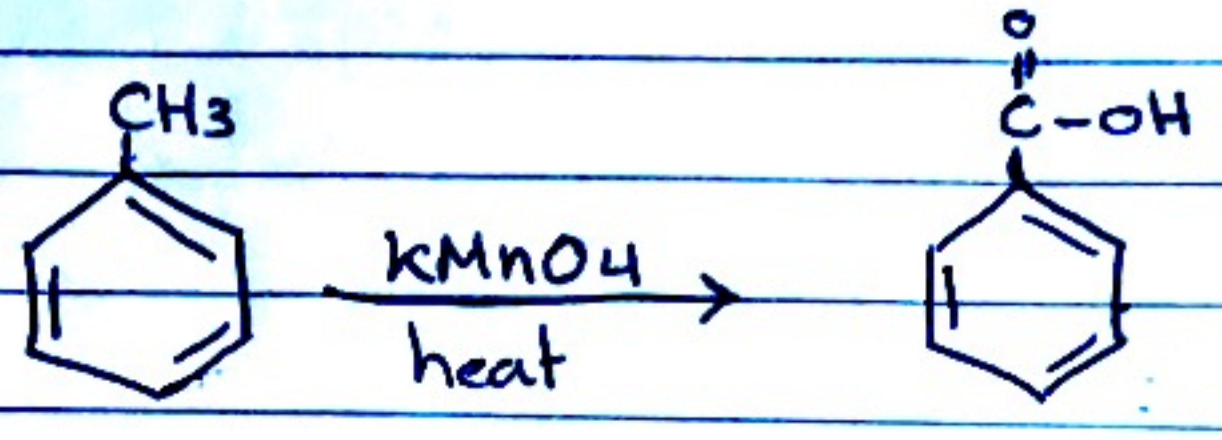


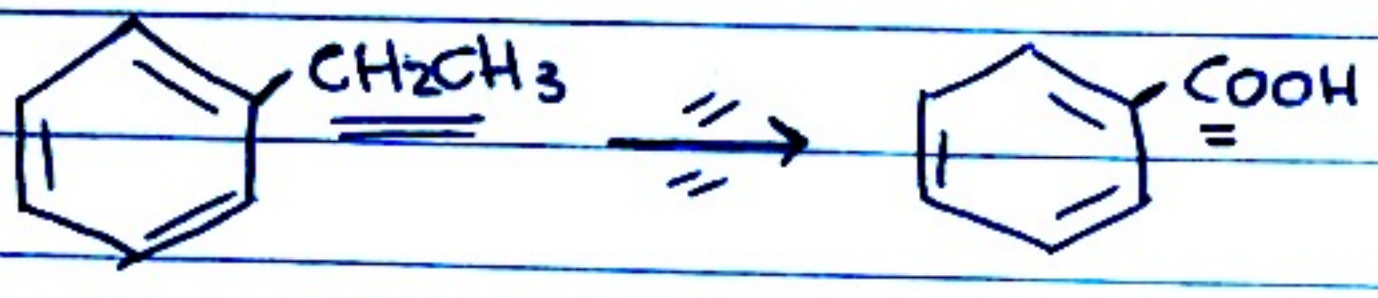
preparation of carboxylic acid :

$R-CH_2-OH \xrightarrow[CrO_3/H^+]{\text{oxidizing agent}} R-\overset{O}{\overset{||}{C}}-OH$ ① oxidation of alcohol

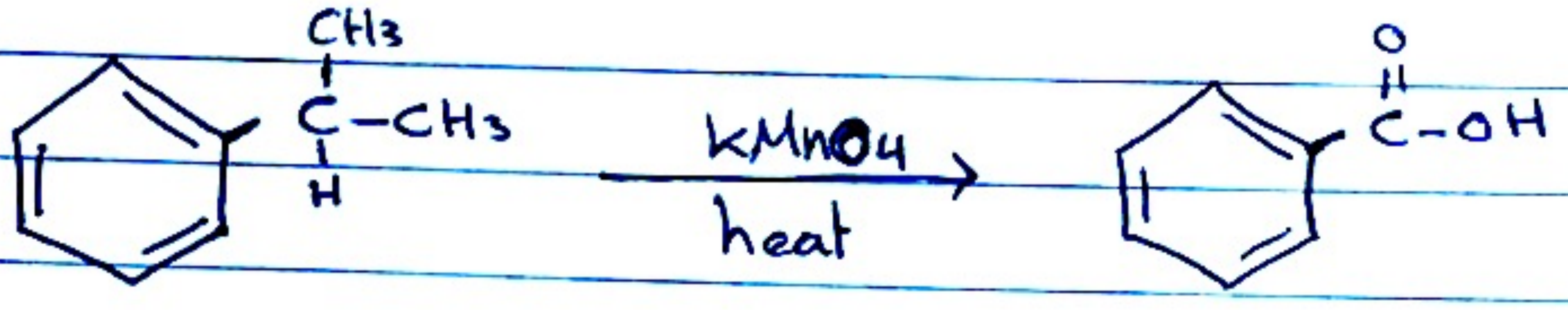
كحول اولي

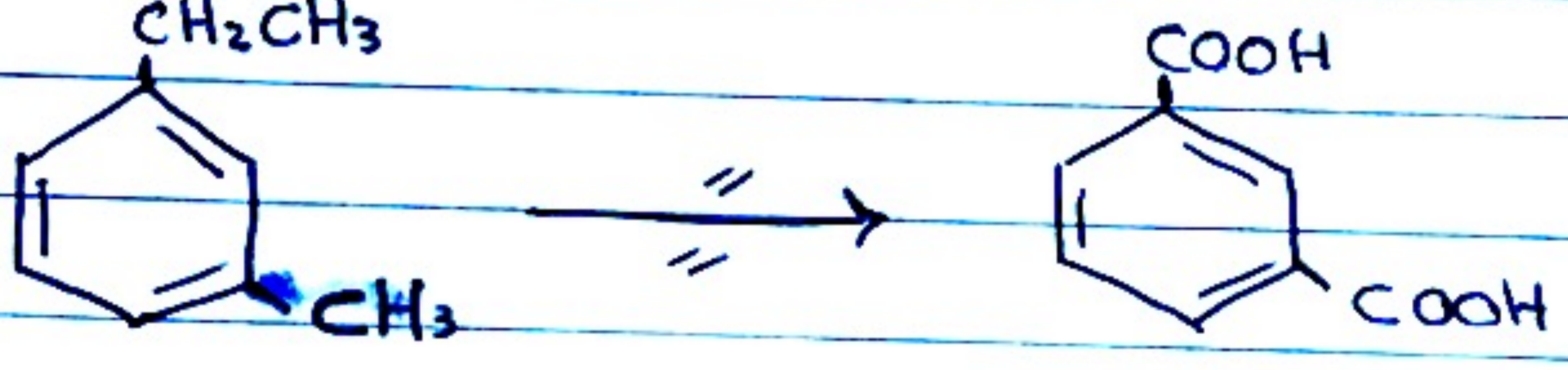
② oxidation of aromatic side chains





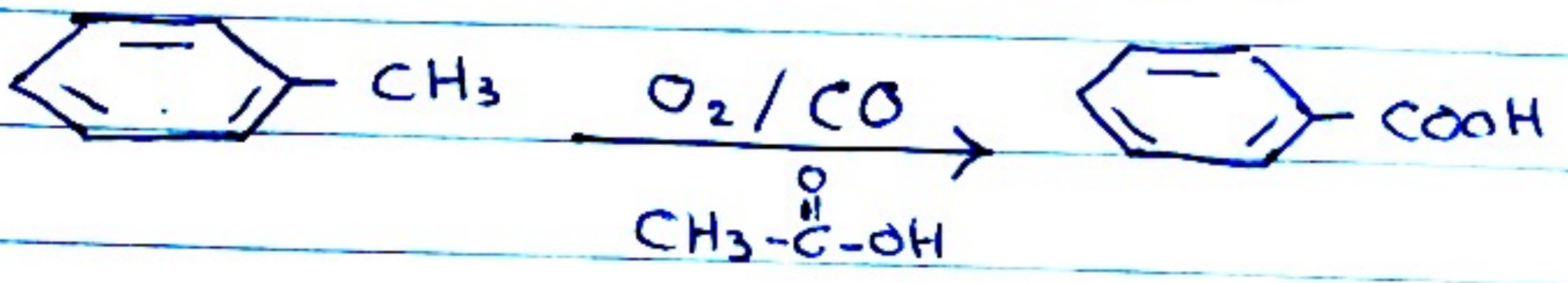
هاي الحالة كل الـ sidechain بيتأكسد
شو ما كان بيطلع هاد -COOH



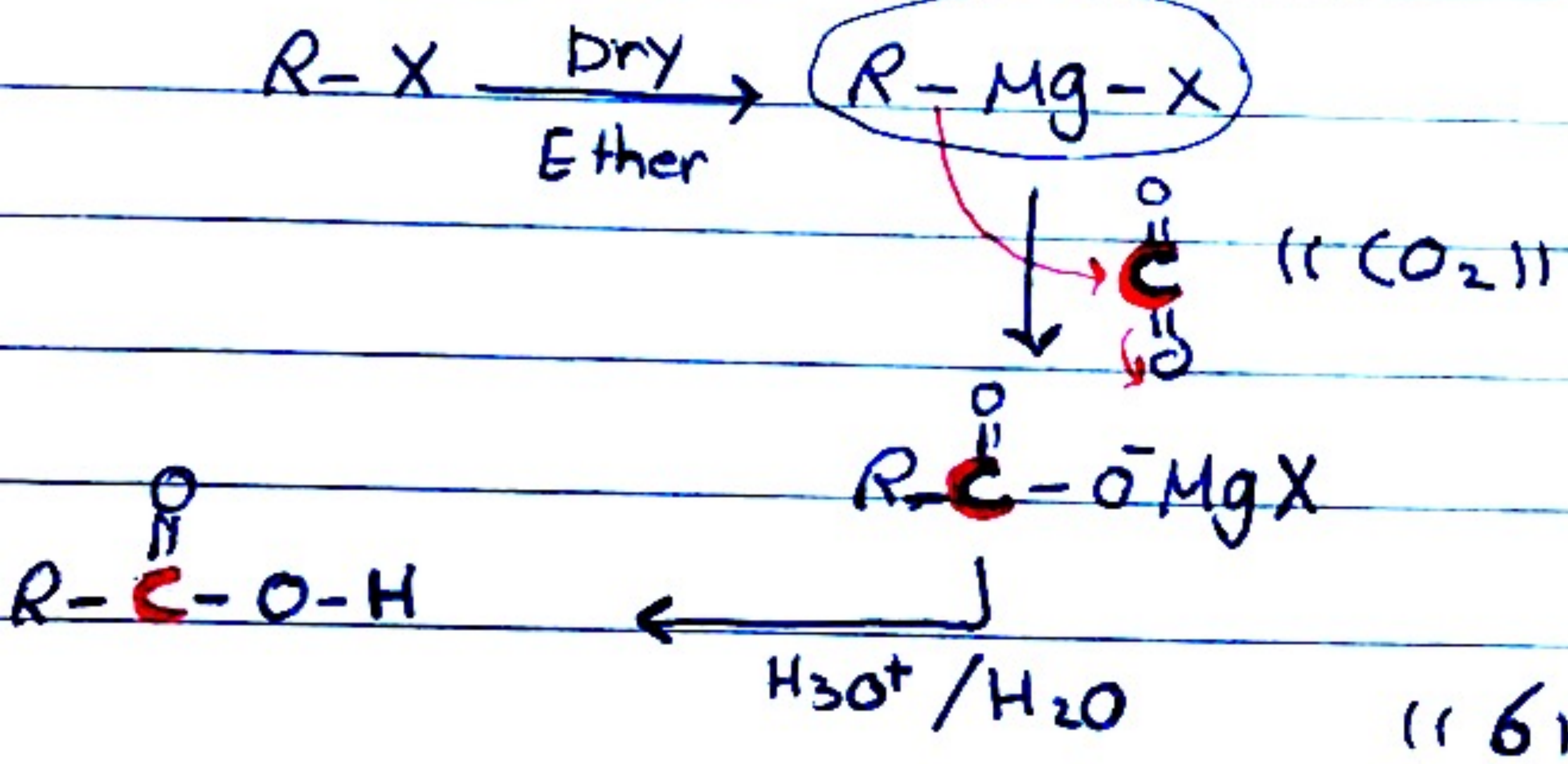


isophthalic

We can use another oxidizing agent such as O_2/CO, $CH_3-\overset{O}{\overset{||}{C}}-OH$



③ rxn of grignard with CO_2



اذا امسك الغرينيارد CO_2
بتحول لـ حمض كربوكسيلي

④ hydrolysis of cyanide

$$R{-}X + :C{\equiv}N^{-} \longrightarrow R{-}C{\equiv}N \quad (S_N2)$$

$$R{-}C{\equiv}N \xrightarrow{OH^-} R{-}\overset{O}{\overset{\|}{C}}{-}O^- + NH_3\uparrow \text{ (gas)} \xrightarrow{H_3O^+} R{-}\overset{O}{\overset{\|}{C}}{-}OH$$

$$R{-}C{\equiv}N \xrightarrow{HCl/H_2O} R{-}\overset{O}{\overset{\|}{C}}{-}OH + NH_4Cl$$

Mechanism :)

$$R{-}C{\equiv}N \xrightarrow[H^+ \text{ or } OH^-]{H_2O} R{-}\underset{OH}{\underset{|}{C}}{=}\underset{H}{\underset{|}{N}} \rightleftharpoons \underset{\text{amide}}{R{-}\underset{O}{\underset{\|}{C}}{-}NH_2} \xrightarrow[H^+/OH^-]{H_2O} R{-}\overset{O}{\overset{\|}{C}}{-}OH$$

هاد التفاعل كتبه الدكتور مشان يذكرنا فيه لانه نفس مبدأ التفاعل السابق

$$R{-}C{\equiv}C{-}H \xrightarrow[H^+/Hg^{+2}]{H_2O} R{-}\underset{OH}{\underset{|}{C}}{=}\underset{H}{\underset{|}{C}}{-}H \rightleftharpoons R{-}\underset{O}{\underset{\|}{C}}{-}CH_3$$

** بأسئلة التحضير اذا زاد عدد ذرات الكربون تكون عن خلال طريقتين :

① اما استخدام Grignard

② أو استخدام Nitrile $R{-}C{\equiv}N$

" مثل " ←

$$CH_3CH_2Cl \longrightarrow \longrightarrow \longrightarrow CH_3CH_2\overset{O}{\overset{\|}{C}}{-}OH$$

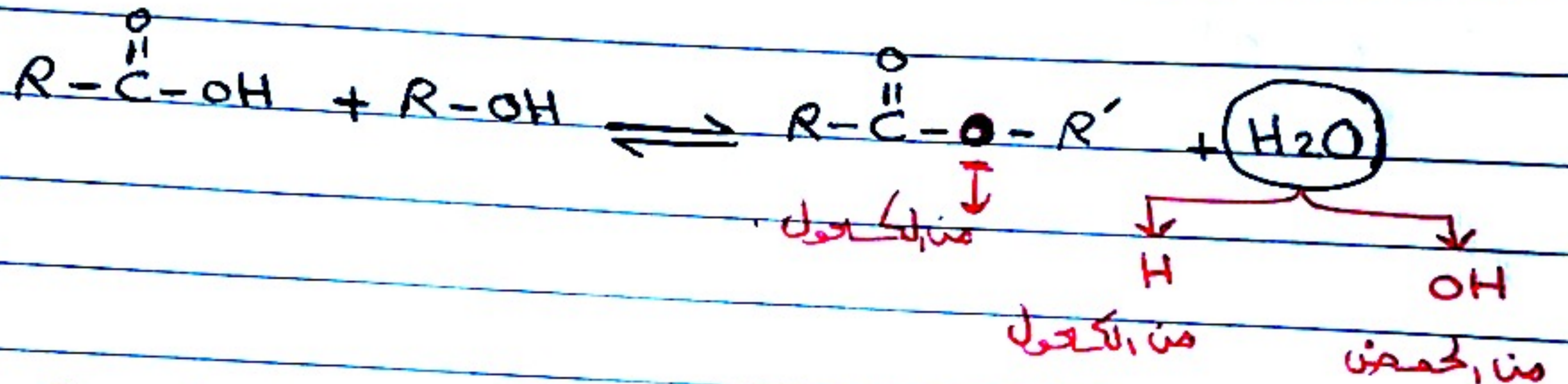
كربونة زيادة

** ملاحظة هامة: اي شي بيتعلق بتسمية غير الـ Carboxylic acid ما بتشلبنا مو داخل يعني مثل تسمية الاستر والـ anhydride

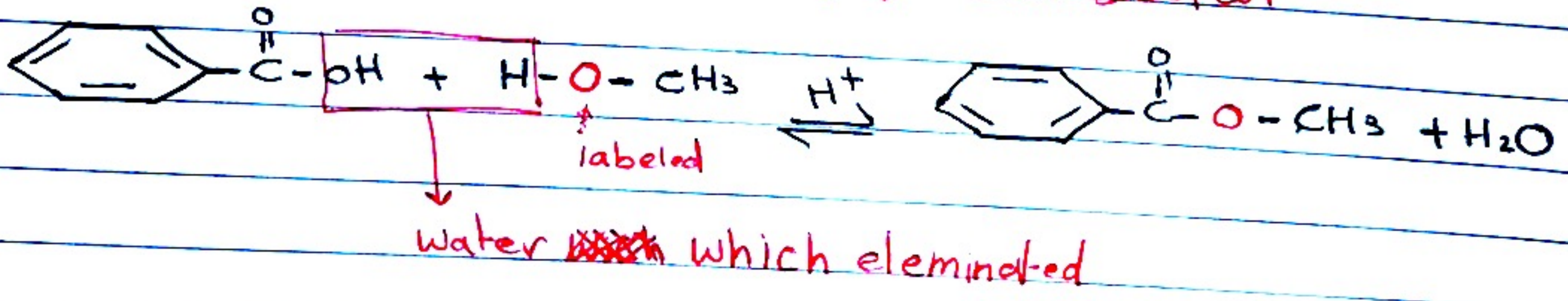
10.9 : Ester $R-\overset{O}{\overset{\|}{C}}-O-R'$

والله الدكتور بس كتب هيك عند هاد الـ Concept انا مالي دخل 😊 ^^)

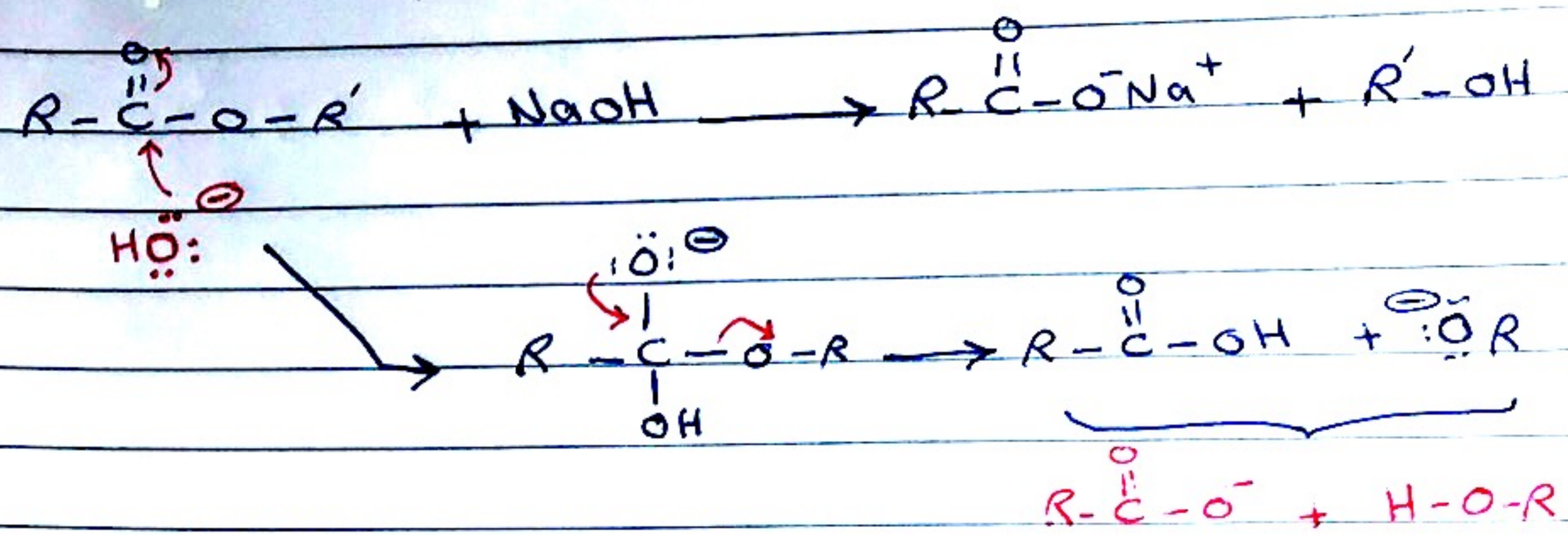
10.10 : Fischer esterification



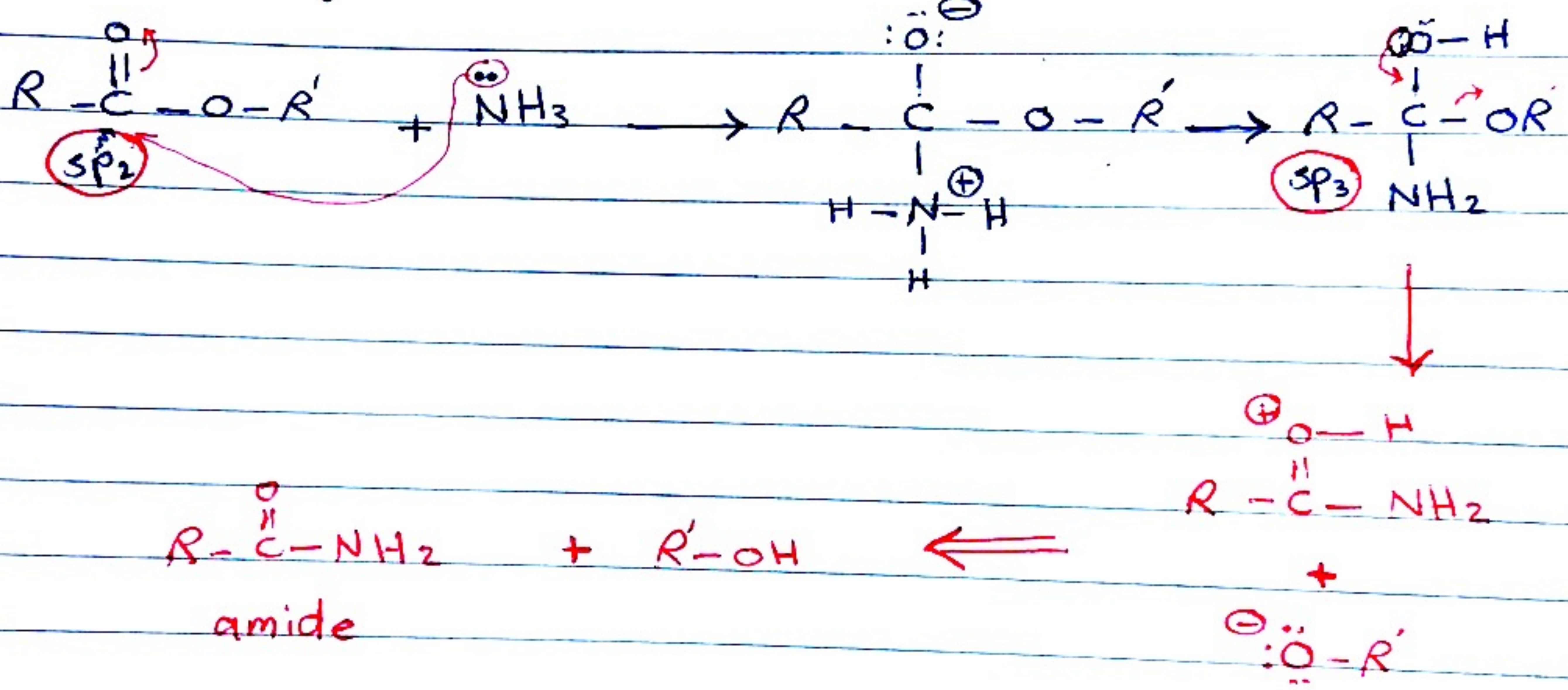
هاي مشان نتذكر فقط : لانه الحمض عنده اوكسجينين بناخد منه وحدة اما الكحول لانه مسكين وما عنده غير وحدة بنخليها اله 😁



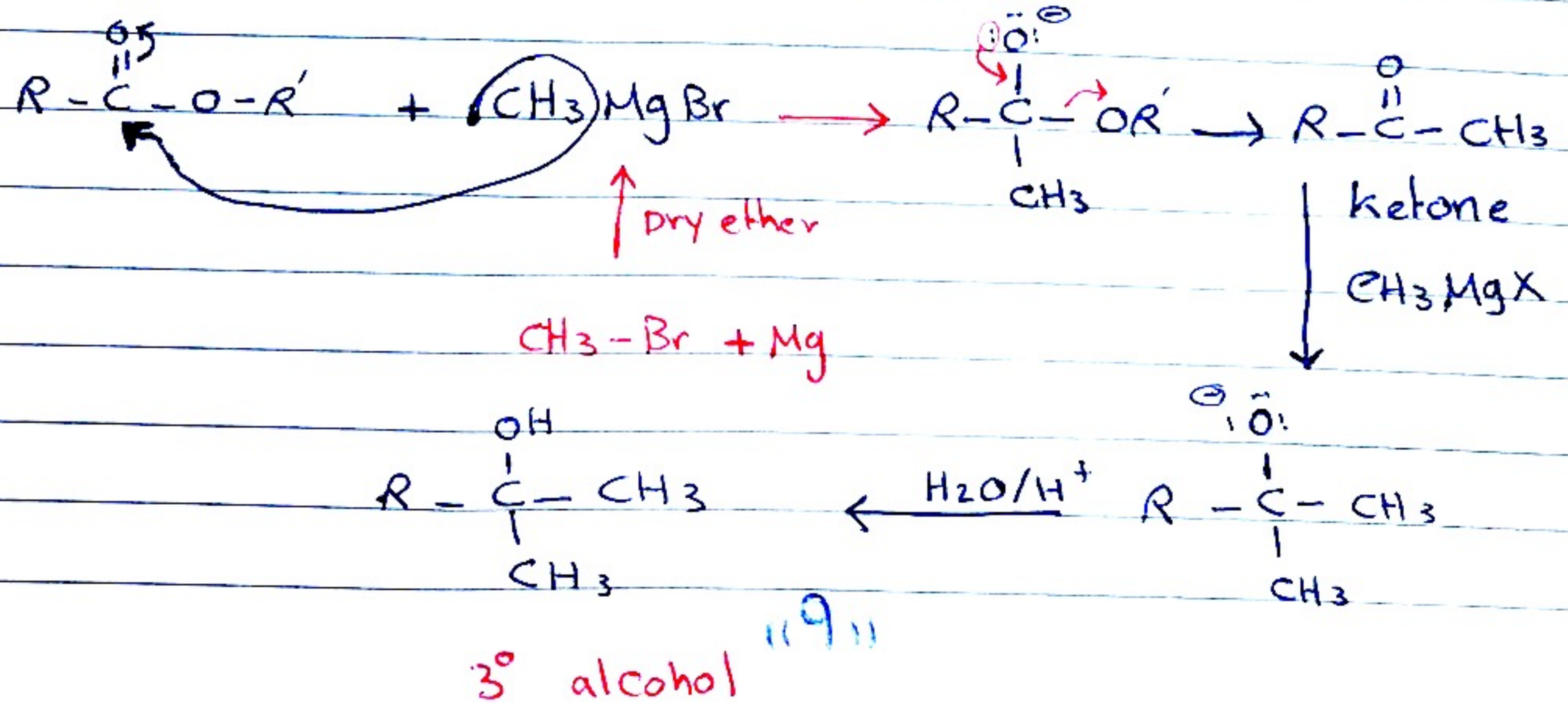
10.13 : saponification of esters:



10.14 : Ammonlysis of ester

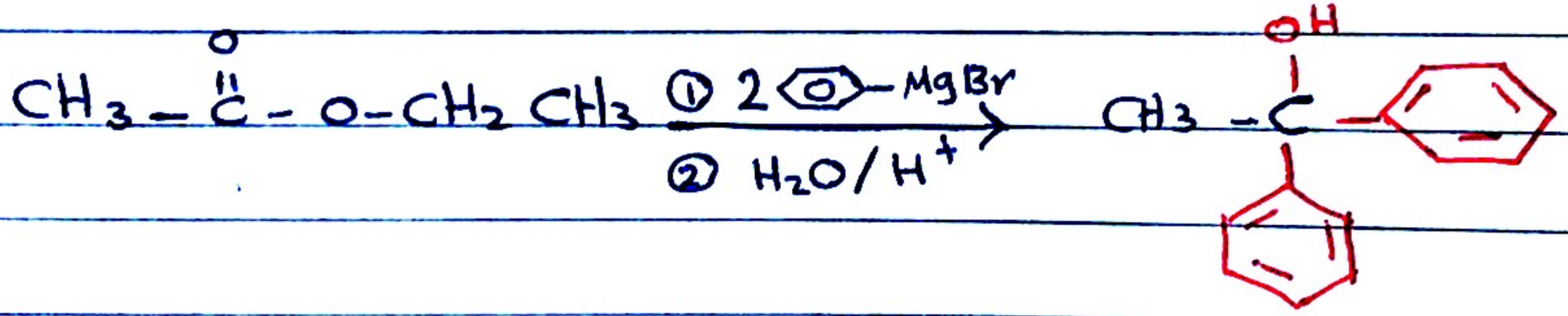


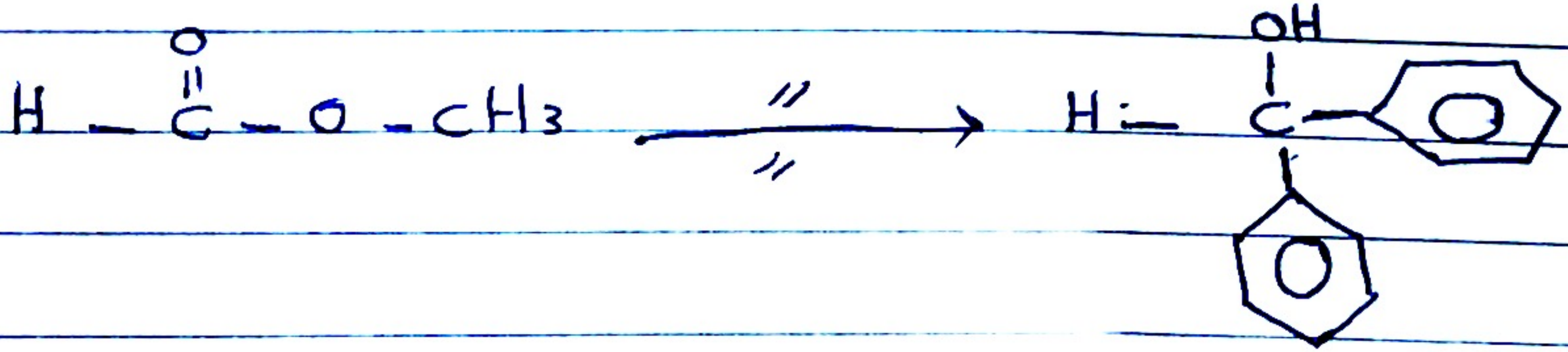
10.15 : Reaction of esters with grignard



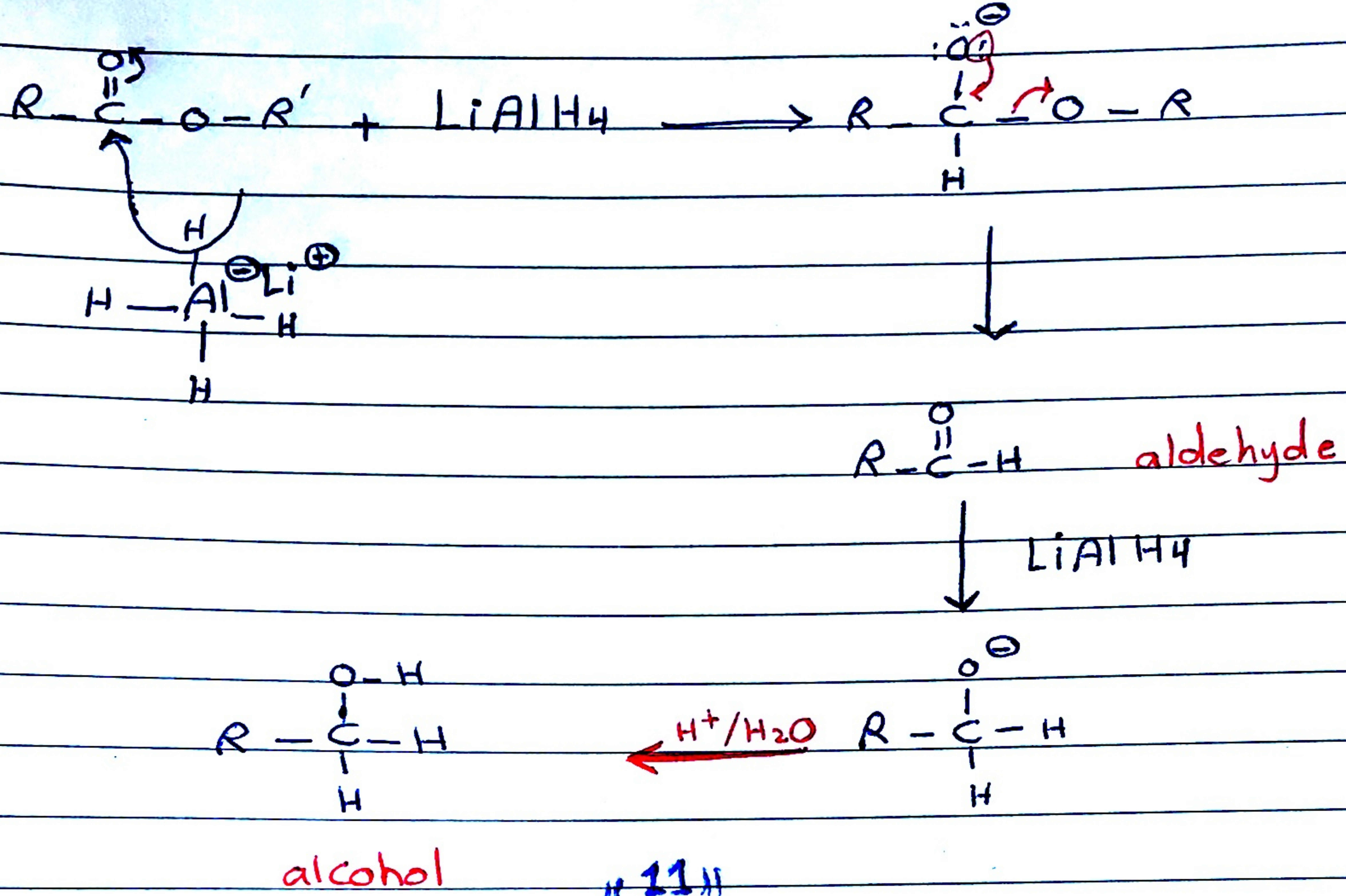
10.15

تابع

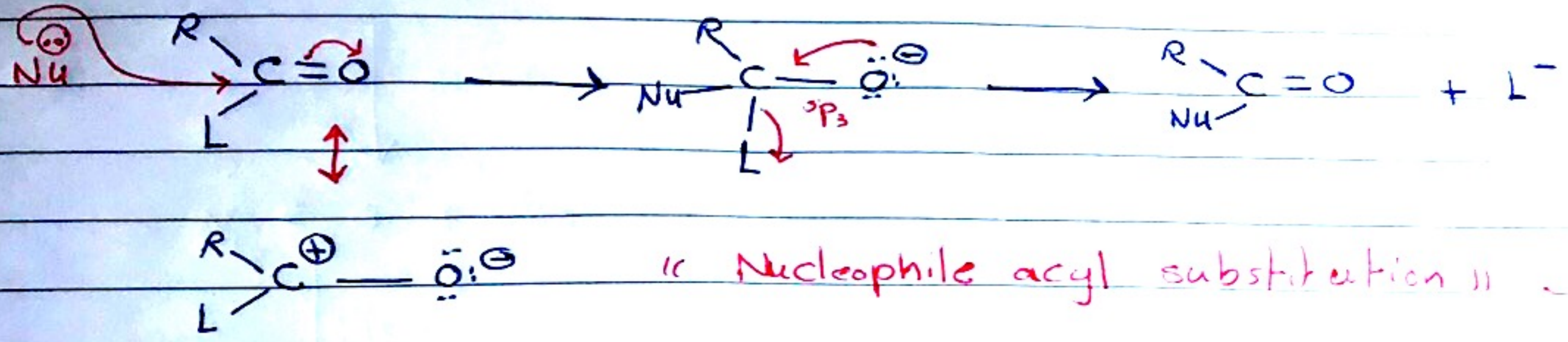




10.16 : reduction of esters

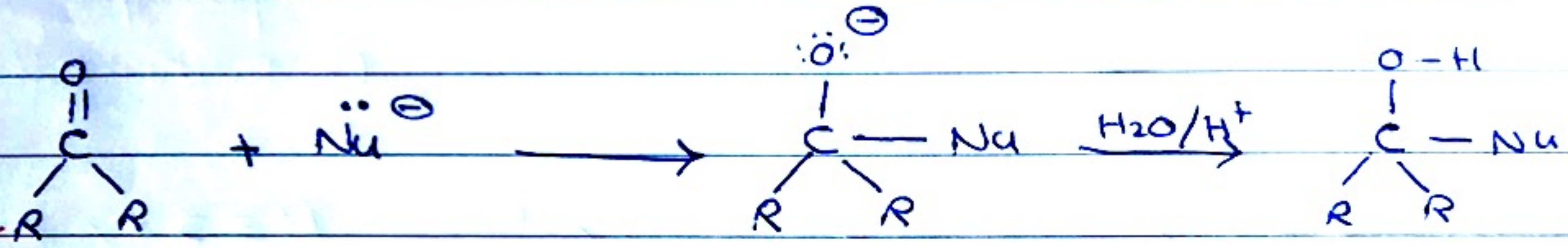


10:17 : The needed for activated acyl compounds.



" Nucleophile acyl substitution ".

* the leaving group must be more electronegative in this reaction



NO leaving group

→ not good leaving group

" Nucleophilic addition "

نوعين من التفاعل

10·18 : acyl halides

هاد التفاعل من نوع

→ Nucleophile acyl substitution

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

$R-\overset{O}{\overset{\|}{C}}-OH + SOCl_2 \longrightarrow R-\overset{O}{\overset{\|}{C}}-Cl$

$R-\overset{O}{\overset{\|}{C}}-OH + PCl_5 \longrightarrow R-\overset{O}{\overset{\|}{C}}-Cl$

} طريقة تكوينه

→ rxn of acyl halide :

$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{R-\overset{O}{\overset{\|}{C}}-\ddot{O}:^{\ominus}} R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R$ anhydride

$\xrightarrow{R'-OH} R-\overset{O}{\overset{\|}{C}}-O-R'$ ester

يتبع

تكملة التفاعلات

$R-\overset{O}{\overset{\|}{C}}-Cl \xrightarrow{NH_3} R-\overset{O}{\overset{\|}{C}}-NH_2$ amide

$\xrightarrow{R-NH_2} R-\overset{O}{\overset{\|}{C}}-\underset{H}{\underset{|}{N}}-R$

موجودة كلها نفس ال mechanism 1

$\xrightarrow{NHR_2} R-\overset{O}{\overset{\|}{C}}-\underset{R}{\underset{|}{N}}-R$

$\xrightarrow{H_2O} R-\overset{O}{\overset{\|}{C}}-OH$ carboxylic acid

10.19 : acid anhydride : $R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R$ symmetric $\quad R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R'$ unsymmetric

For symmetric :

$CH_3-\overset{O}{\overset{\|}{C}}-OH + HO-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow[heat]{H^+} CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_3 + H_2O$

نفس الشي — symmetric

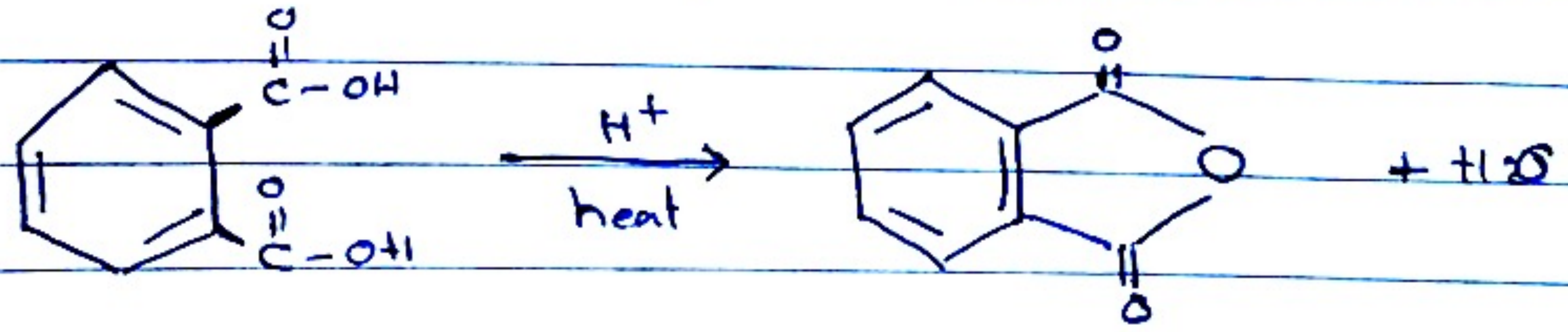
اذا ما كانوا نفس الشي سيكون

عنا mix من ثلاث مركبات

For unsymmetric :

$CH_3-\overset{O}{\overset{\|}{C}}-Cl + CH_3CH_2-\overset{O}{\overset{\|}{C}}-O^- \longrightarrow CH_3-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-CH_2CH_3$

($CH_3CH_2-\overset{O}{\overset{\|}{C}}-O^-$ from $CH_3-CH_2-\overset{O}{\overset{\|}{C}}-OH$ + NaOH)



* تفاعلات ال anhydride

$$R-C(=O)-O-C(=O)-R \xrightarrow{R'-OH} R-C(=O)-O-R' + R-C(=O)-OH$$

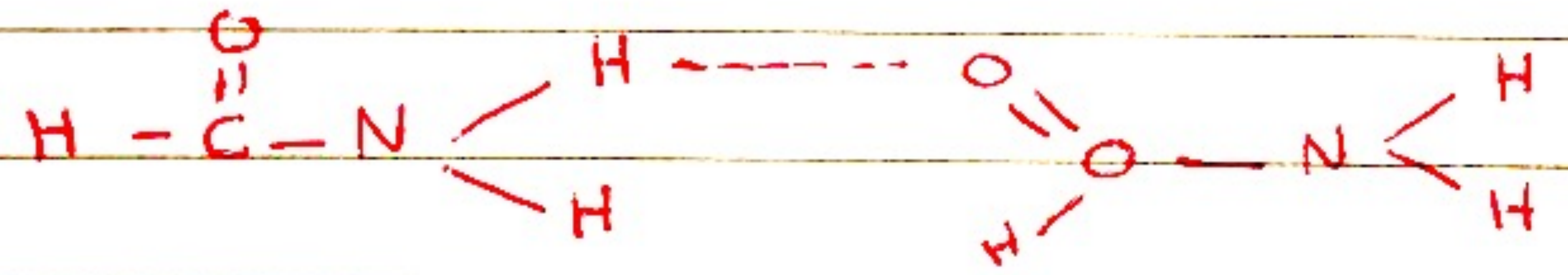
$$\xrightarrow{NH_3} R-C(=O)-NH_2$$

$$\xrightarrow{H_2O} R-C(=O)-OH$$

10:20 : amide

$R-C(=O)-NH_2$	$R-C(=O)-NHR$	$R-C(=O)-NR_2$
1° amide	2° amide	3° amide

$H-C(=O)-NH_2$	$H-C(=O)-N(CH_3)_2$
hydrogen bonding	No hydrogen bonding
b.p = 210	b.p = 153



preparation of amide :

$$R-C(=O)-Cl \xrightarrow{NH_3} R-C(=O)-NH_2$$

$$\xrightarrow{RNH_2} R-C(=O)-NHR$$

$$\xrightarrow{R_2NH} R-C(=O)-NR_2$$

* تكملة لتحضير ال amide

$$R-\overset{O}{\overset{\|}{C}}-O-\overset{O}{\overset{\|}{C}}-R \xrightarrow{NH_3} R-\overset{O}{\overset{\|}{C}}-NH_2$$

$$R-\overset{O}{\overset{\|}{C}}-O-R \xrightarrow{NH_3} R-\overset{O}{\overset{\|}{C}}-NH_2$$

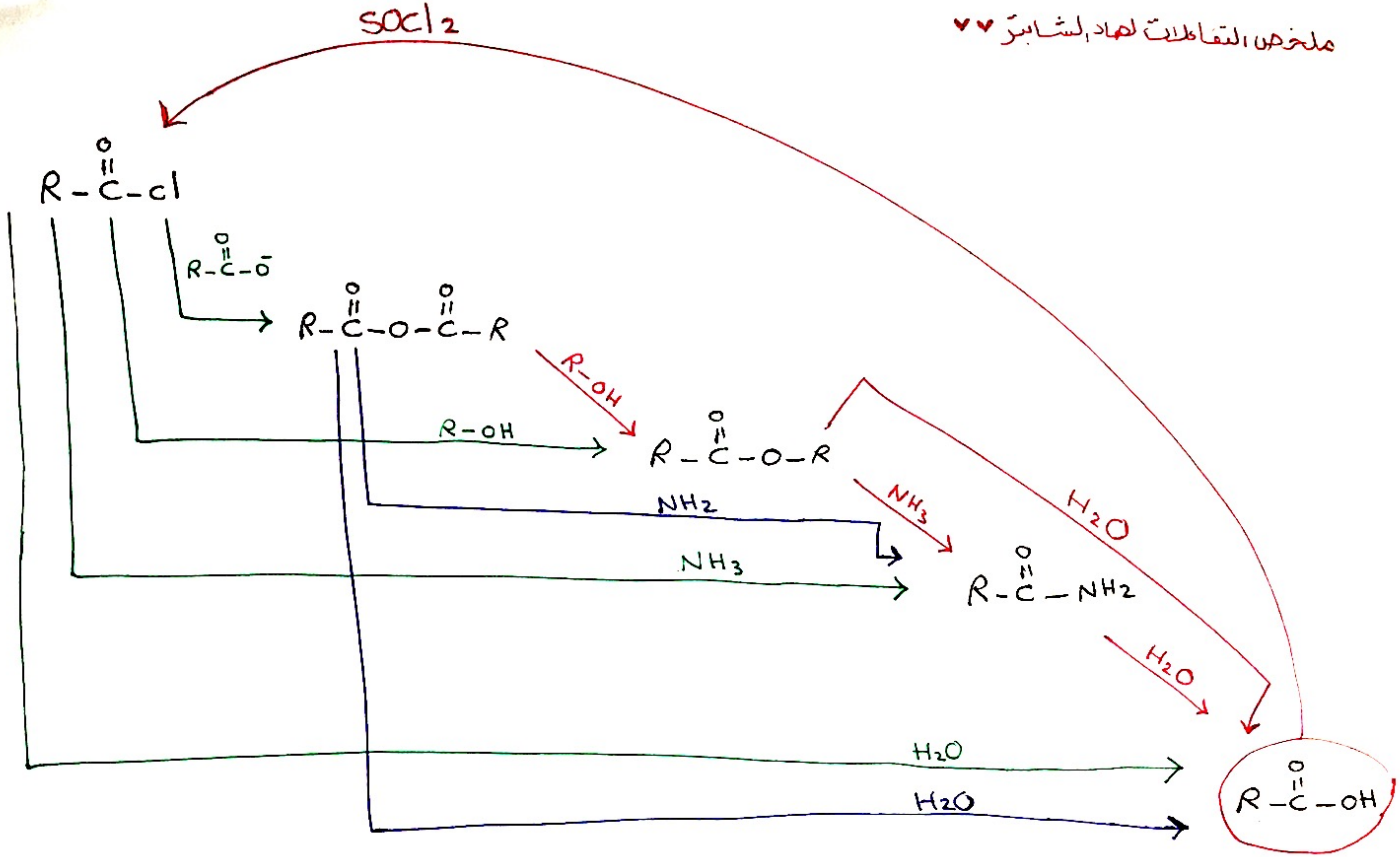
rxn of amide :

$$R-\overset{O}{\overset{\|}{C}}-NH_2 + H^+/H_2O \longrightarrow R-\overset{O}{\overset{\|}{C}}-OH$$

↑ H^+/H_2O (from $R-C\equiv N$)

$$R-Cl + CN^- \longrightarrow R-C\equiv N$$

ملخص التفاعلات لهاد الشابتر ♥♥



$$R-\overset{O}{\overset{\|}{C}}-Cl + CH_3MgBr \longrightarrow R-\overset{O}{\overset{\|}{C}}-CH_3 \xrightarrow{CH_3MgBr} R-\underset{CH_3}{\underset{|}{\overset{OH}{\overset{|}{C}}}}-CH_3$$

good luck ♥♥ 3

نادين الفالوجي