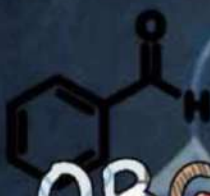
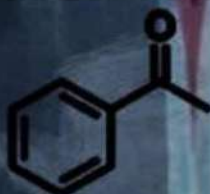




Toluene



Benzaldehyde



Acetophenone



Pyrrro



Piperidine

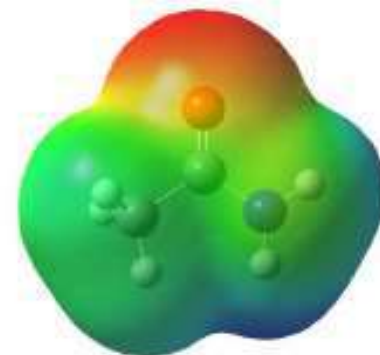


ORGANIC CHEMISTRY HAYAT BATCH

done by :Dana Mohammad

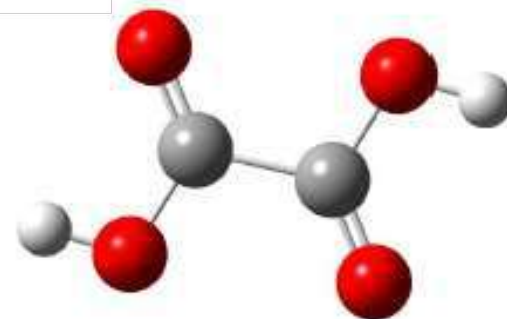
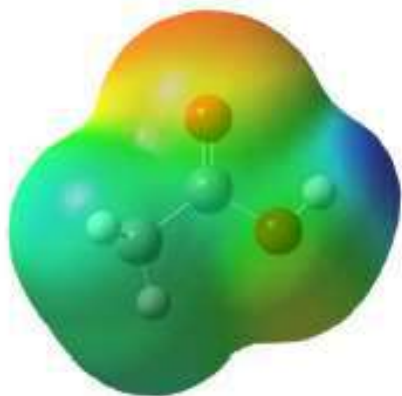
lecture no:Ch 10





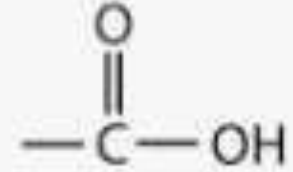
Chapter 10: Carboxylic Acids and Their Derivatives

Done by: Khalid Awadallah



Carboxylic acids

They contain a **carboxyl group** : COOH



The carboxyl group **must be terminal** on the chain

Acid derivatives :

ببندل OH بمجموعات أخرى ↓

1)Amides (NH₂)

2)Esters (OR)

3)Acyl halides (X)

4)Anhydrides (COOR)

بالنسبة للمشتقات من الحموض الكربوكسيلية عندي 4 انواع :

(1)الامينات

(2) الاستر

(3) الاسيل

(4)الانهايدير ايد

كيف بنحصل عليهم ؟ ببندل ال OH بالمجموعات المكتوبة فوق

تلخيص السلايد انو عنا عشان نحكي انو هاد

المركب حمض كربوكسيلي لازم يتوافر

شغلتين :

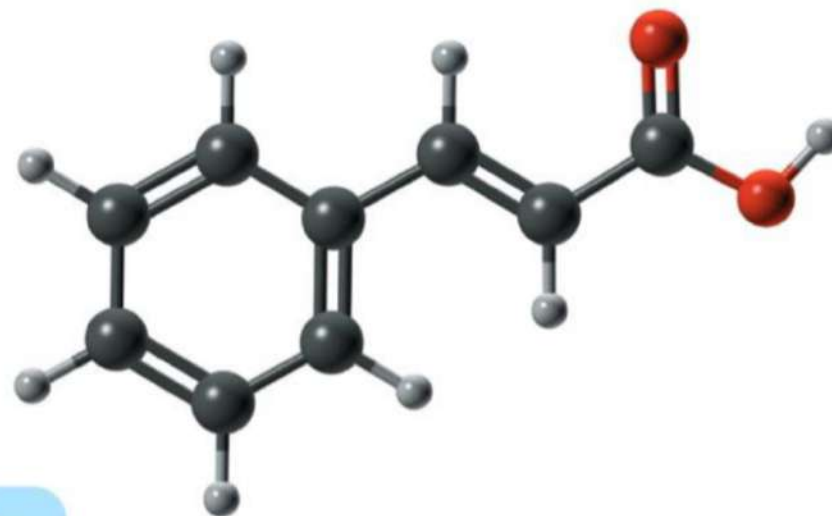
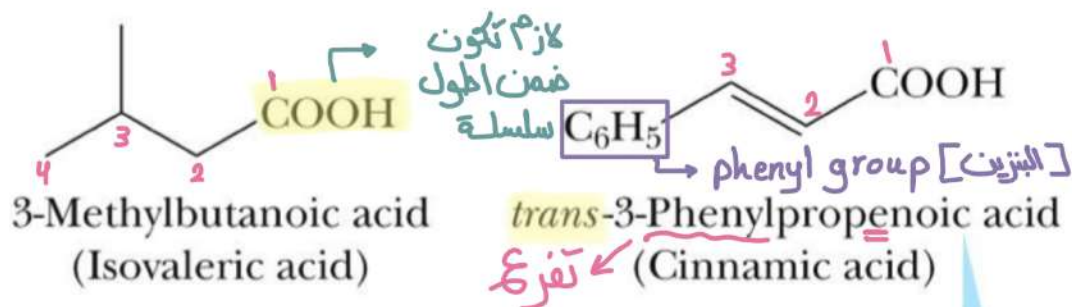
(1)لازم يكون عندي مجموعة كربوكسيل

(2) لازم تكون مجموعة الكربوكسيل طرفية

Nomenclature

هون الفكرة اني بدل ع وجود الكربوكسيل في المركب في التسمية اني بحكي **oic acid** بنهاية الاسم طبعا اذا كان ال **chain** عبارة عن الكين او يحتوي على رابطة ثنائية بين ذرتي كربون بنسبيه الكين بعدين بتطبق قاعدة ال **oic acid**

- IUPAC names: drop the **-e** from the parent alkane and add the suffix **-oic acid** → *Alkanoic acid*
 - If the compound contains a carbon-carbon double bond, change the infix **-an-** to **-en-**.

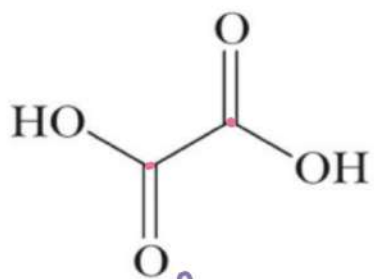


it is not necessary to indicate that the alkene occurs at position 2 because there is no other position where it can occur

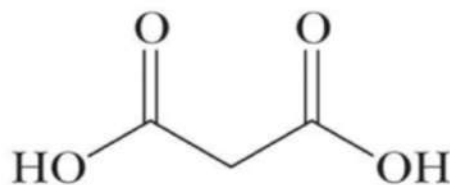
Nomenclature

لما يكون عنا أكثر من
↙ Carboxyl group

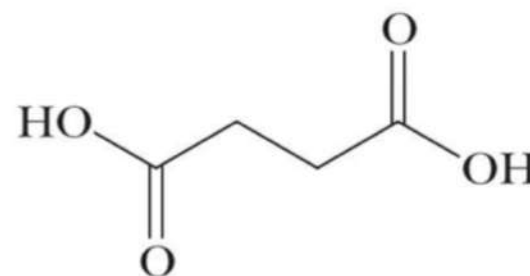
- Dicarboxylic acids: add **-dioic acid** to the name of the parent alkane containing both carboxyl groups.
- There is no need to use numbers to locate the carboxyl groups; they can only be on the ends of the chain.



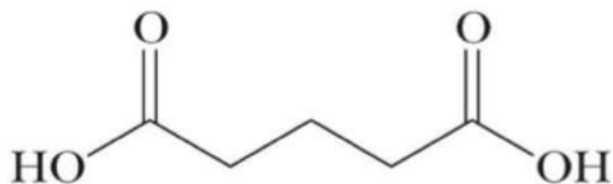
Ethanedioic acid
(~~Oxalic acid~~)



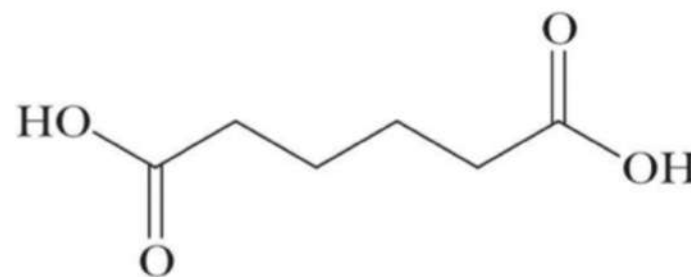
Propanedioic acid
(~~Malonic acid~~)



Butanedioic acid
(~~Succinic acid~~)



Pentanedioic acid
(~~Glutaric acid~~)

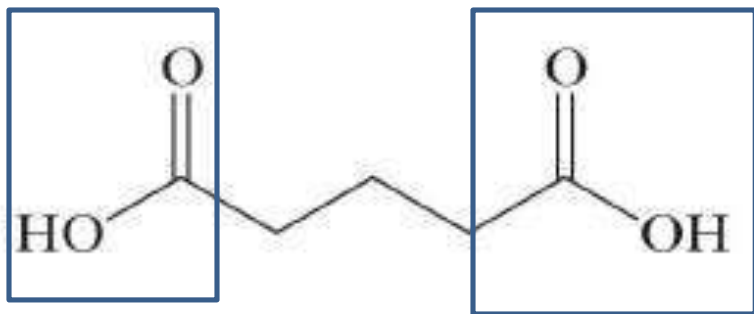


Hexanedioic acid
(~~Adipic acid~~)

Nomenclature

هون بحكيلي كيف بنسمي لما يكون عندي
مجموعة كربوكسيل ع كل طرف
ببساطة بخليها dioic acid وبخلي ال -e
تبعث الالكان

We might have a carboxyl group at each end so
the way to name them is **-dioic acid**



This is a :
Pentanedioic acid

Note that in the **dioic acid** example the **-e** from the alkane nomenclature remained and this only happens in dioic examples

Nomenclature

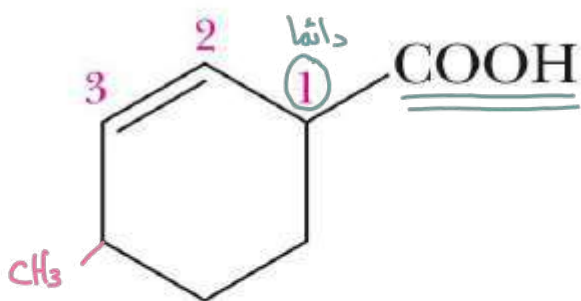
Note that a ring structure is different than an aromatic structure

If the carboxyl group is bonded to a ring, name the ring compound and then add the suffix

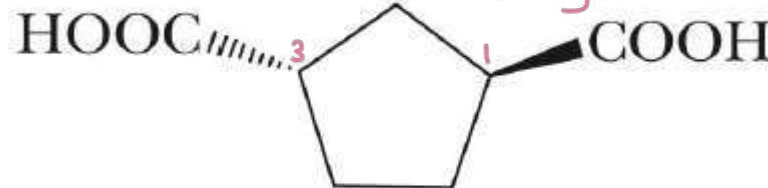
-carboxylic acid

Note that we use # to locate the substituents and the double bond

بنسبة كـ cycloalkane أو cycloalkene وبنهي الاسم
بـ ← carboxylic acid



4-methyl-2-Cyclohexenecarboxylic acid



trans-1,3-Cyclopentane-dicarboxylic acid

لازم ارقم وبتار اقرب مسافة بينهم
Note that u can have more than 2 carboxyl groups in ring structures while u can NOT have more than 2 in chain structures

Note that the first C atom is NOT the one forming the carboxyl group as we treat the carboxyl group as a substituent (only in ring structures)

Nomenclature

عنا هون اول اشى لازم نراعيه بالتسمية هو ال parent وهاد الجدول بوضحلنا مين الي اله الاولوية

TABLE 12.1 Increasing Order of Precedence of Six Functional Groups

Functional Group	Suffix	Prefix	Example of When the Functional Group Has Lower Priority	
① Carboxyl	-oic acid	—		
② Aldehyde	-al	oxo-	3-Oxopropanoic acid	
③ Ketone	-one	oxo-	3-Oxobutanal	
④ Alcohol	-ol	hydroxy-	4-Hydroxy-2-butanone	
⑤ Amino	-amine	amino-	2-Amino-1-propanol	
⑥ Sulfhydryl	-thiol	mercapto-	2-Mercaptoethanol	

Highest priority

Lowest priority

مثلا عندي كربوكسيل و كحول ف بعطي الاولوية للكربوكسيل لانه دائما هو الاعلى من حيث الاولوية ف بصفي ك تسمية في المثال السابق : hydroxy carboxylic acid

الفكرة انو اذا لقيت مركب يحتوي على مجموعتين وظيفيات ف بعطي الاولوية لل parent يكون اللي اعلى في الجدول

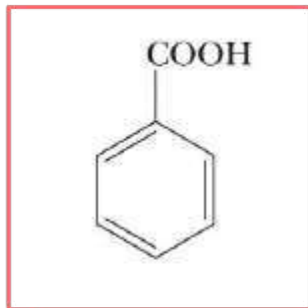
هون معطيك كيف تسمى المركبات الاروماتية الي
بتختلف عن الحلقات زي ما حكينا بالاسلايد القبل
وكيف انو ال benzoic acid هو ابسطها

Nomenclature

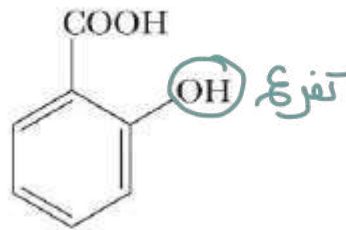
Benzoic acid is the **simplest aromatic carboxylic acid**

We use # to locate the substituents or we may use the **o,m,p** nomenclature → بقدر استخدمهم هون

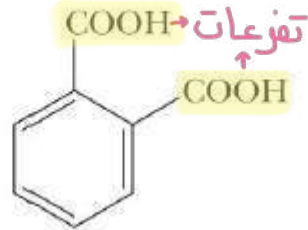
We don't use # only if we have 1 substituent and that's when there is only 1 carboxyl group



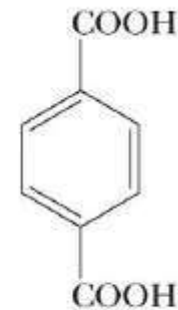
بنظ
Benzoic acid



2-Hydroxybenzoic acid



1,2-Benzenedicarboxylic acid



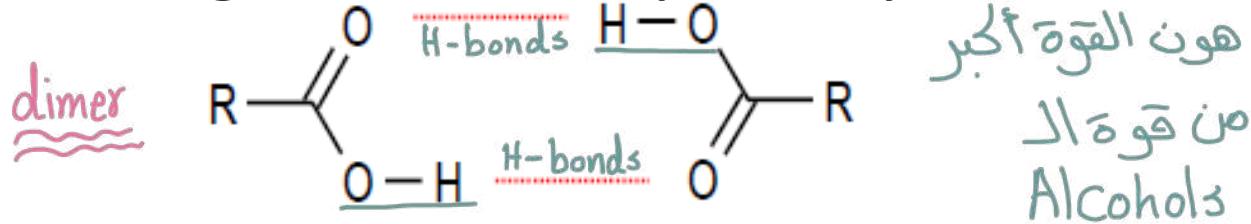
1,4-Benzenedicarboxylic acid

Physical properties of Acids

① They are acidic => $pK_a = 5$

They are **more acidic than alcohols**

② The form strong **H-bonds** especially with each other



They have high BP,MP=> higher than eq. MW alcohols

They are very soluble in polar protic solvents

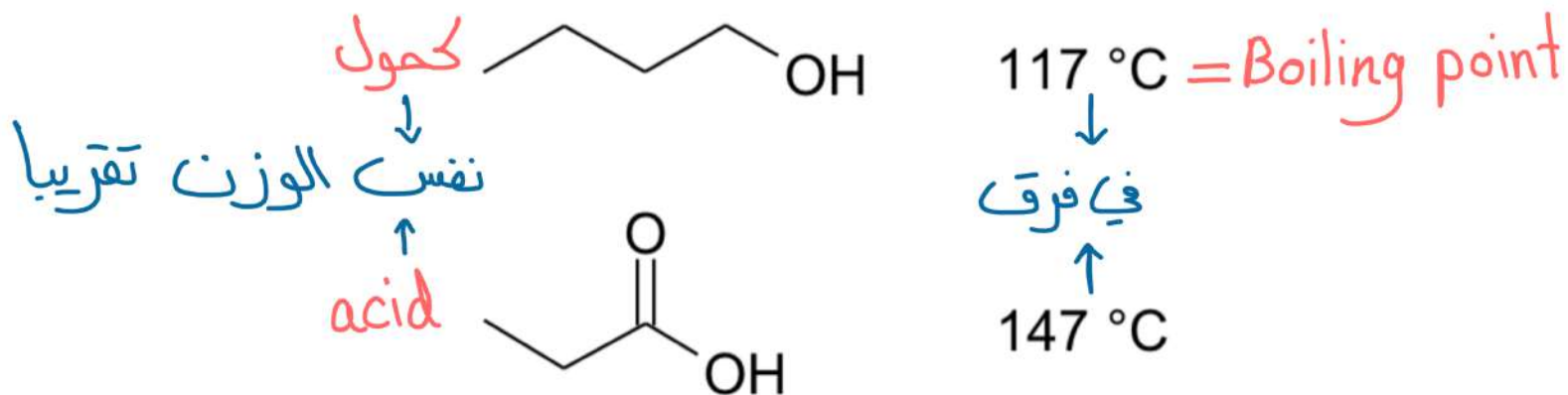
هون الفكرة انو بحكيك عن خصائص الحموض الكربوكسيلية الفزيائية :
انو هي (1) اكثر حمضية لانها اكثر استقرارا (الشرح بالاسلايد الجاي) (2) وبتعمل روابط هيدروجينية تابعة لل
IMF (3) وعندها درجة غليان وانصهار اعلى من الكحول اللي عندها نفس الكتلة الذرية (4) وانها قوية الذوبان في
المحاليل ال polar protic الكحول والماء

Physical Properties of Acids

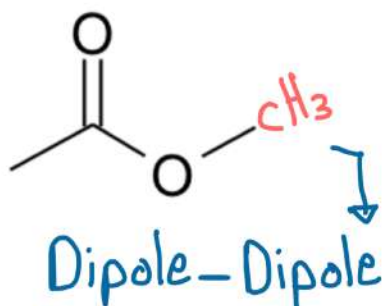
This produces:

1. High BP & MP, higher than equivalent weight alcohols

small ← 2. Very soluble in polar protic solvents like water or alcohols
لحد 5 كربونات



London < Dipole-Dipole < Hydrogen •

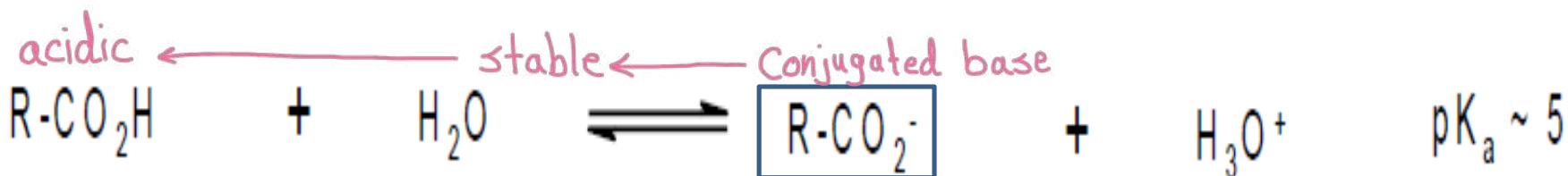
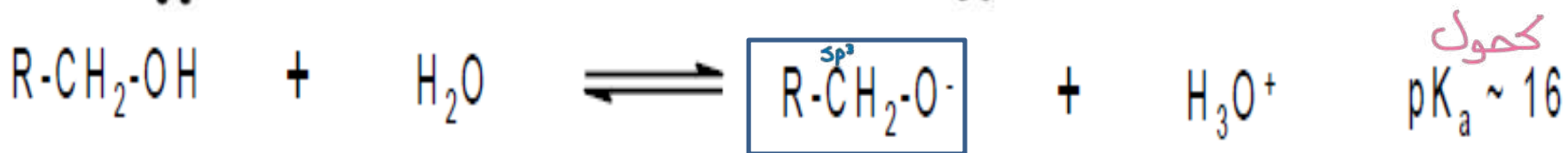
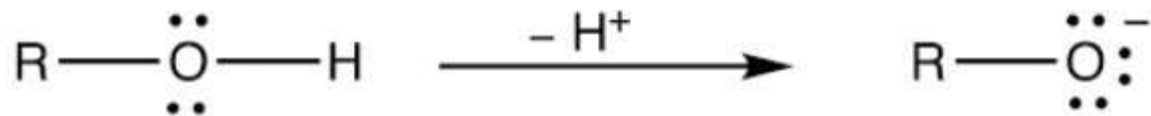


57 °C

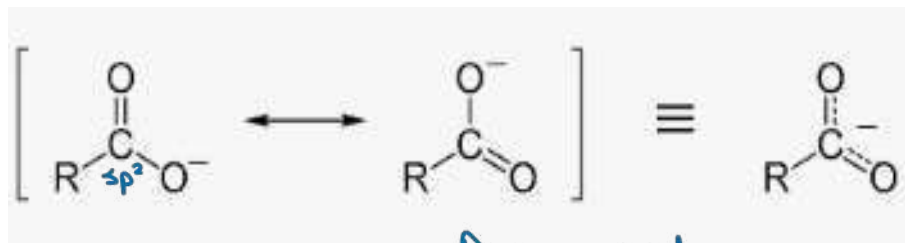
يمكن عجتكم 😊
 الملخص انو لما يكون
 عندي resonance بتزيد
 الحموضة

Physical properties of Acids

هون بغض النظر عن تفاعل تكوين الكوكسايد بس لما نيجي نشوف هون بنلاقي **anofish** عندي resonance حيث انو عندي شحنة مثبتة في مكانها (**localized**) وال resonance مقترنة بال stability برضو ال acidity علاقتها طردية مع ال stability



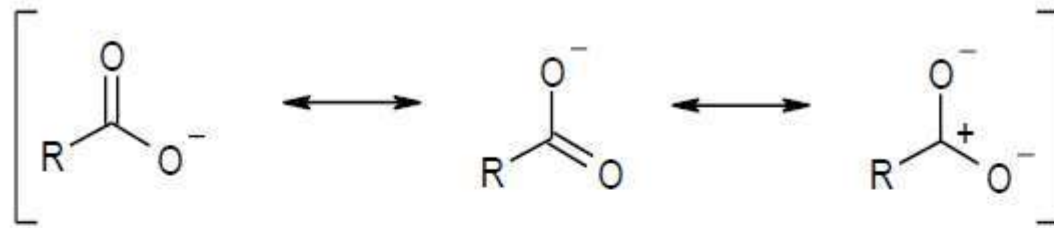
بينما هون **انا عندي resonance** بتشكالي اشلي اسمه ال **carboxylate ion** (رح يتكرر معنا لقدام) وزى ما احنا شايفين فالشحنة بتقدر تتحرك من ذرة لاخرى (**delocalized**) بسبب وجود ال resonance الي بيعني وجود ال stability علاقتة طردية مع ال acidity



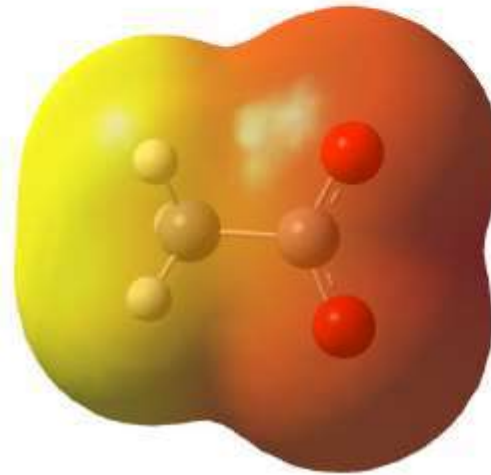
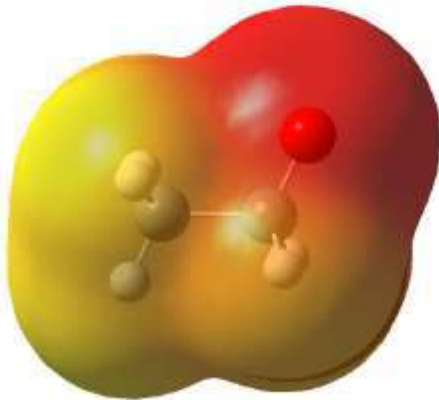
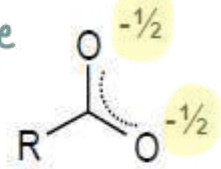
بعل resonance
 ↓↓
 stable

Carboxylate ion

طبعا هي ال resonance مع ال carboxylate ion تتبعته

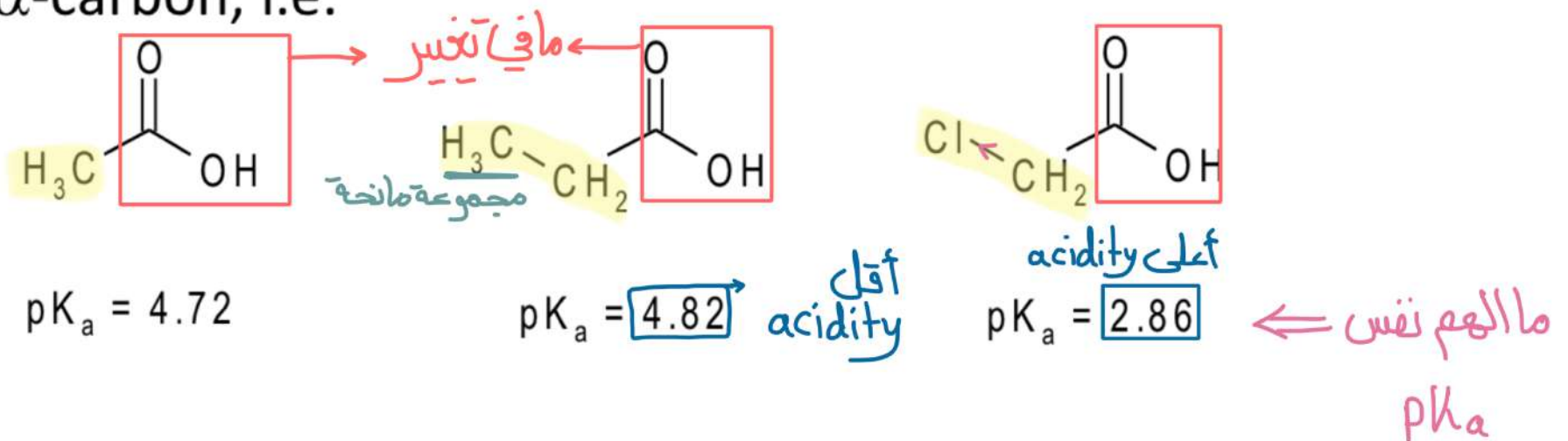


وزعت ← negative charge



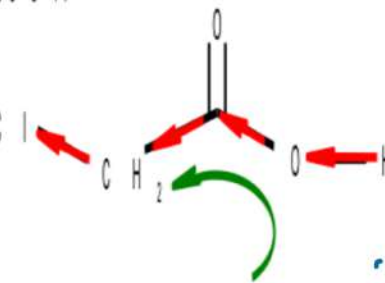
Physical Properties of Acids

The pK_a can also be affected by *inductive processes* from groups on the α -carbon, i.e.



C l atom pulls electron density towards itself

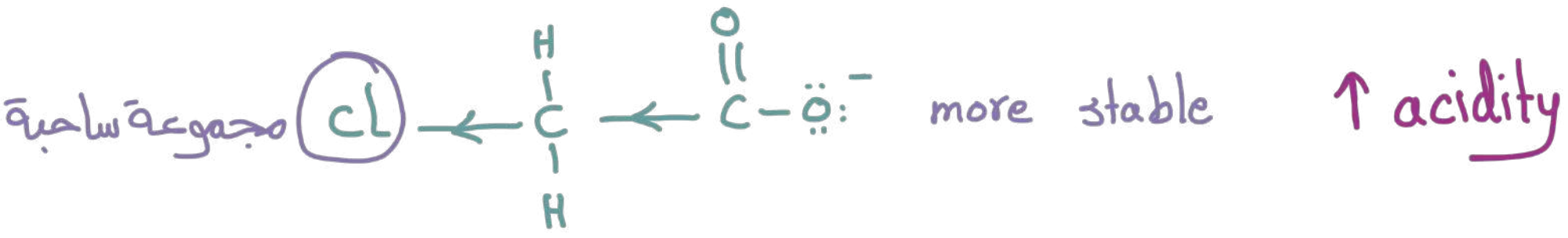
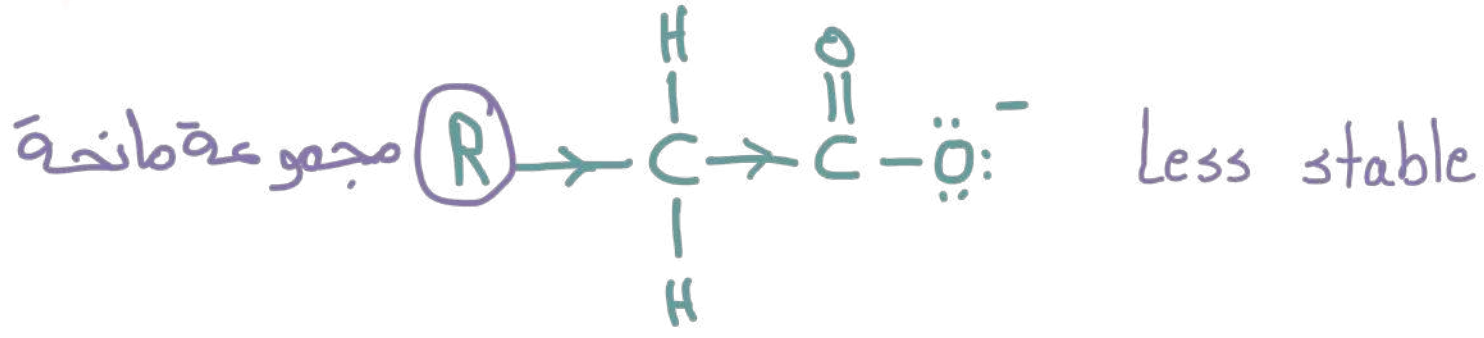
electron density is pulled towards the O atom



electron density is pulled towards the C atom

* العلاقة بين pK_a و acidity

عكسية

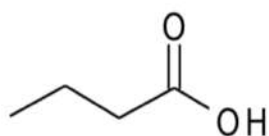


عطية السحب والإعطاء يتكون عن طريق Inductive effect

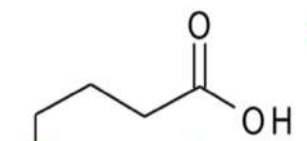
Physical Properties of Acids

This helps stabilize the conjugate base by shifting the charge density away from the O atom, but is distance dependent, i.e.

أقرب للمجموعة ← سحب أكثر

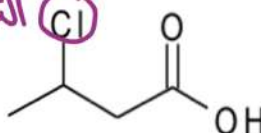


$pK_a = 4.82$



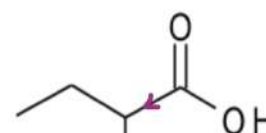
$pK_a = 4.52$

التأثير أقل



$pK_a = 4.05$

قريبة : تأثيرها أعلى ما يمكن

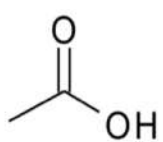


$pK_a = 3.15$

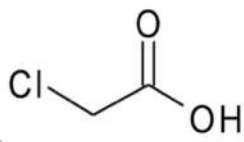
The effect is cumulative so the greater the number of electron withdrawing atoms the greater the effect, i.e.

هون تأثير عدد الذرات التي بتسحب الشحنة بعيدا عن ذرة الاكسجين الي عليها الشحنة عشان تزيد الحموضة والاستقرار

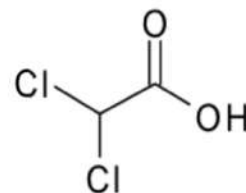
الترتيب حسب ال acidity



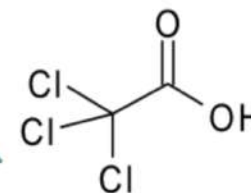
$pK_a = 4.74$



$pK_a = 2.82$



$pK_a = 1.30$



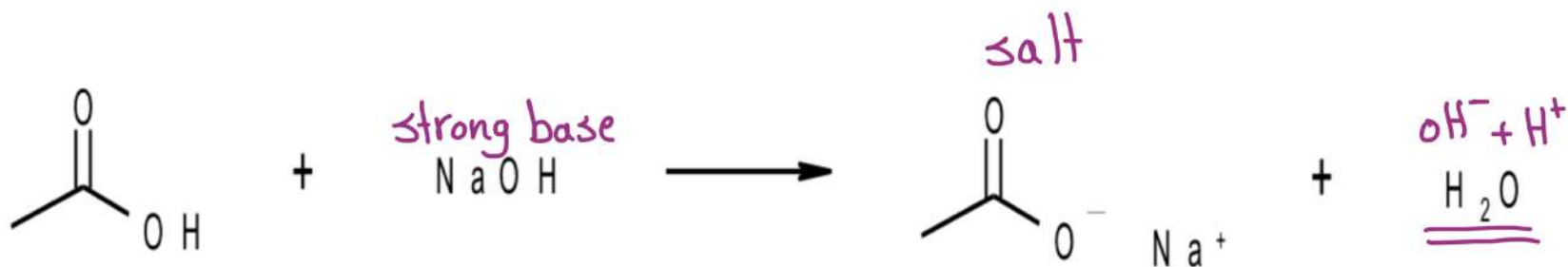
$pK_a = 0.70$

أعلى ما يمكن acidity

Formation of Salts

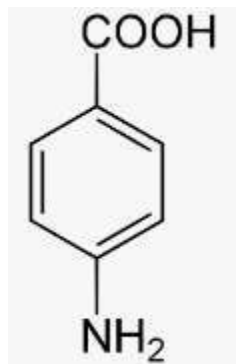
A salt is an ionic compound containing the conjugate base of an acid and a group I or II metal.

They are generated by treating an organic acid with NaOH or KOH, the OH^- combines with the acidic proton in a neutralization reaction to form water. The conjugate base and metal ion form an ionic solid, i.e.

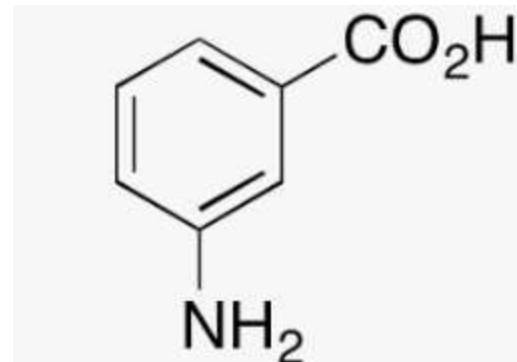


Resonance + inductive effects

(2)



(1)



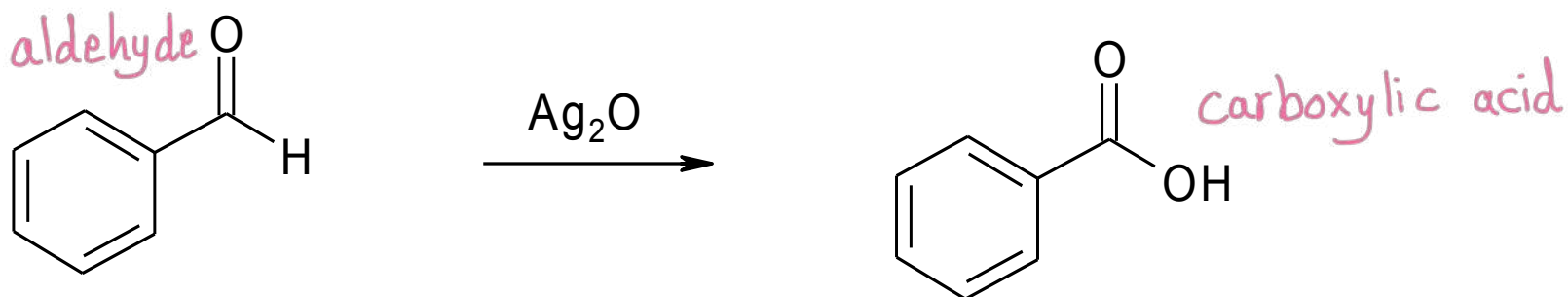
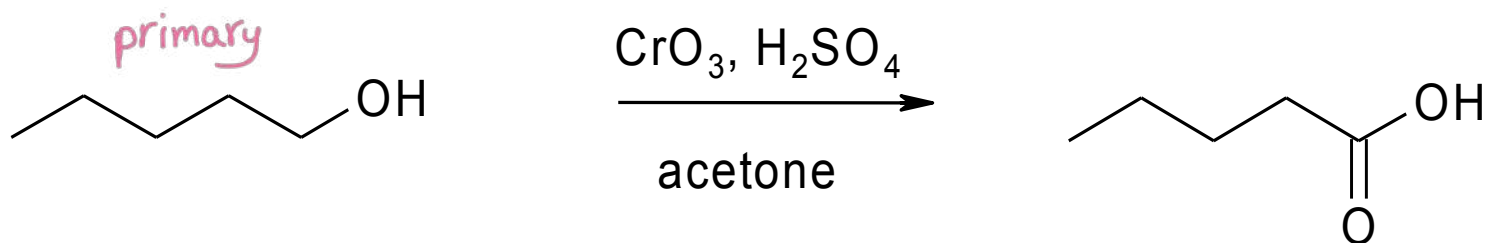
هون عندي اشئ مهم حكى عنه الدكتور اللي هو انو فيهم عنده حموضة اكثر ؟
هسا اول اشئ مجموعة الامين (NH₂) بتعمل توجيه meta والكربوكسيل بتعمل توجيه ortho para
واذا بتتذكروا ب شابتير 4 انو احنا ما بنحط المجموعات ع اساس الاولوية والاولوية هون للكربوكسيل ف
الكربوكسيل زي ما قلنا بوجه ortho para ف الي بصير عندك في (1) انو وانا ما عندي direct
resonance زي ما عندي اياها ب (2)
بصير عندك بالآخر انو <= (1) عندها بس inductive effect
(2) عندها direct para resonance وفوق هيك عندها ال inductive effect
طبعا احنا قلنا كل ما زاد ال resonance وال inductive effect كل ما زادت الحموضة
(2) Is more acidic than (1)

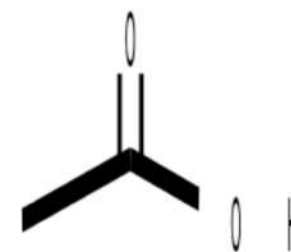
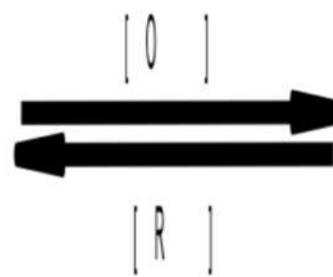
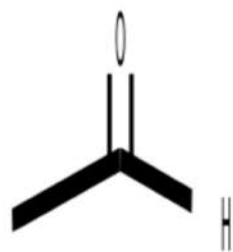
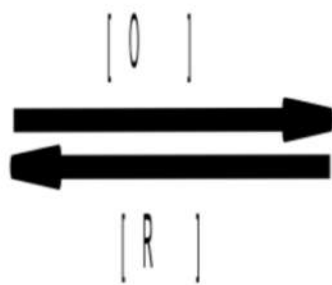
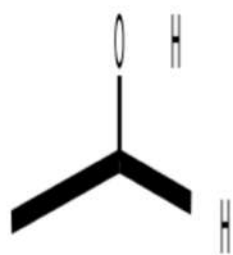
Preparation of Acids

There are a number of ways to create carboxylic acids:

1. Oxidation of 1° alcohols or aldehydes:

Common reagents include; CrO_3 , H_2SO_4 in acetone (Jones' reagent), KMnO_4 , HNO_3 , and for aldehydes Ag_2O , i.e.

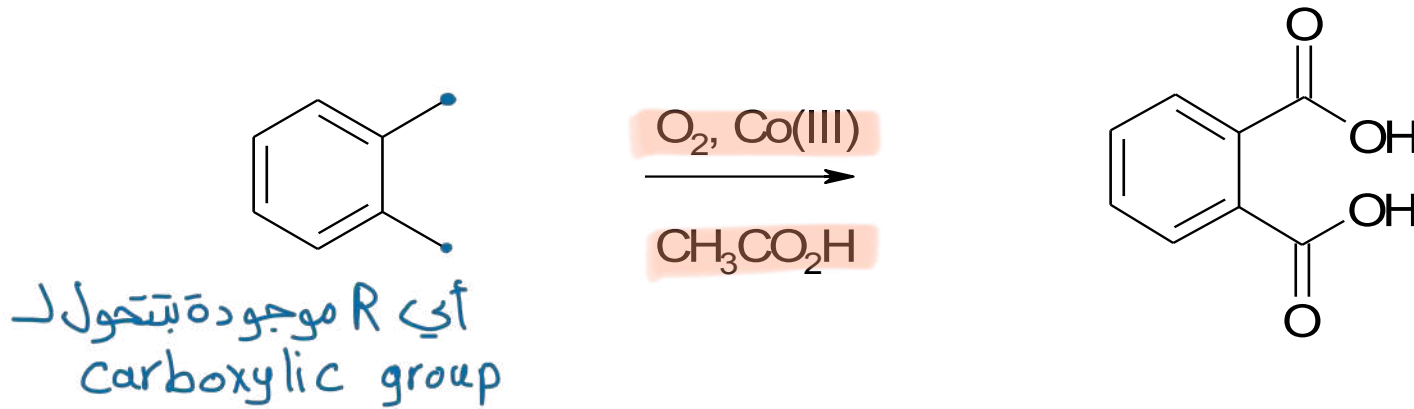
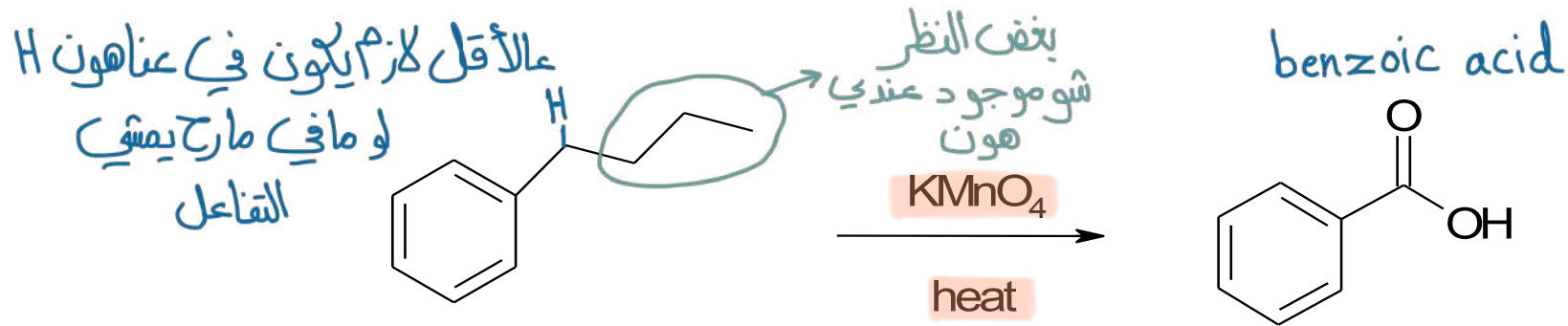




Preparation of Acids

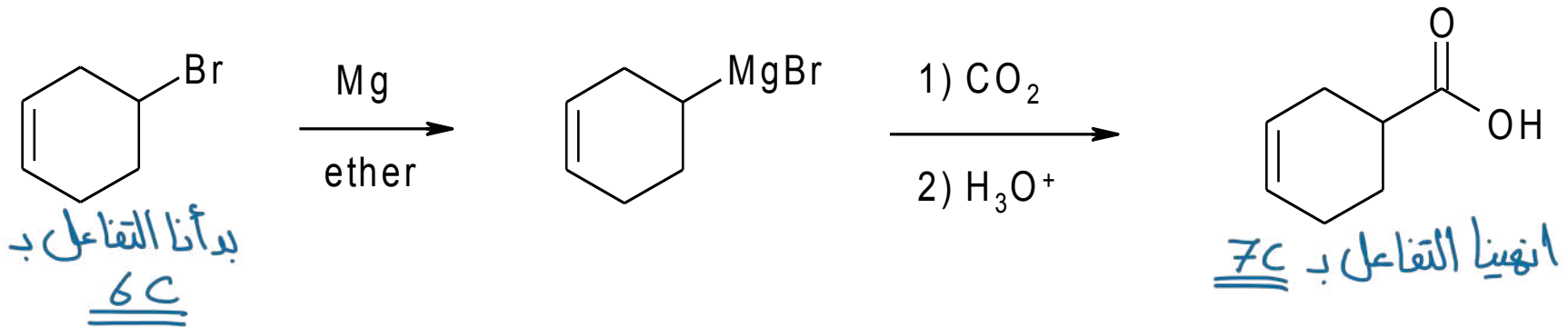
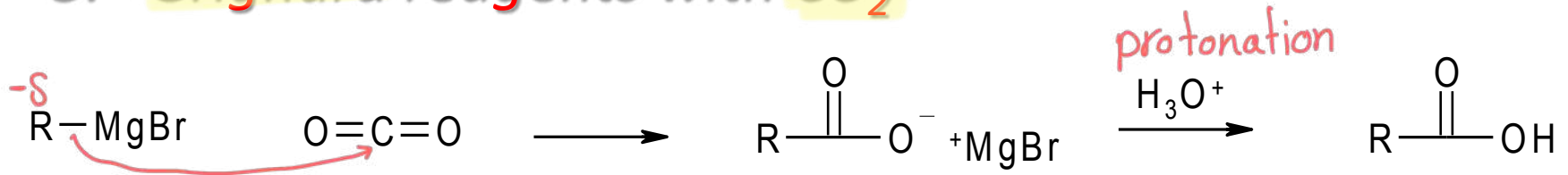
2. Oxidation of aromatic alkyl side chains:

Common reagents include; KMnO_4 , commercially: O_2 , Co(III) in $\text{CH}_3\text{CO}_2\text{H}$, i.e.



Preparation of Acids

3. Grignard reagents with CO_2 :



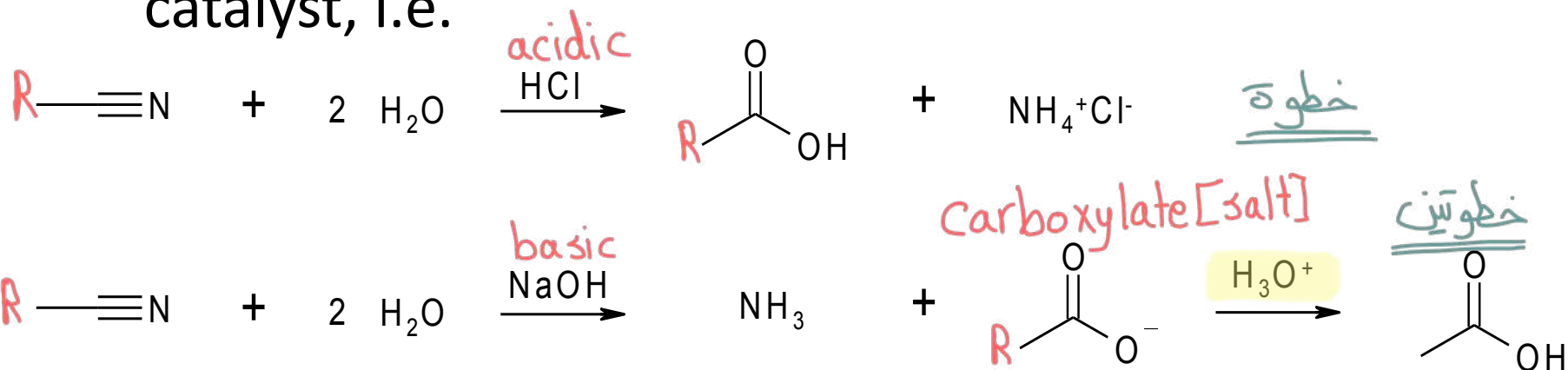
Note: the acid is **one** carbon atom longer than the Grignard reagent.

هاي طريقة جيدة لو بدى ازيد عدد الكربونات لكنها بتكون مو منيحة لو بدى التزم بعدد الكربونات

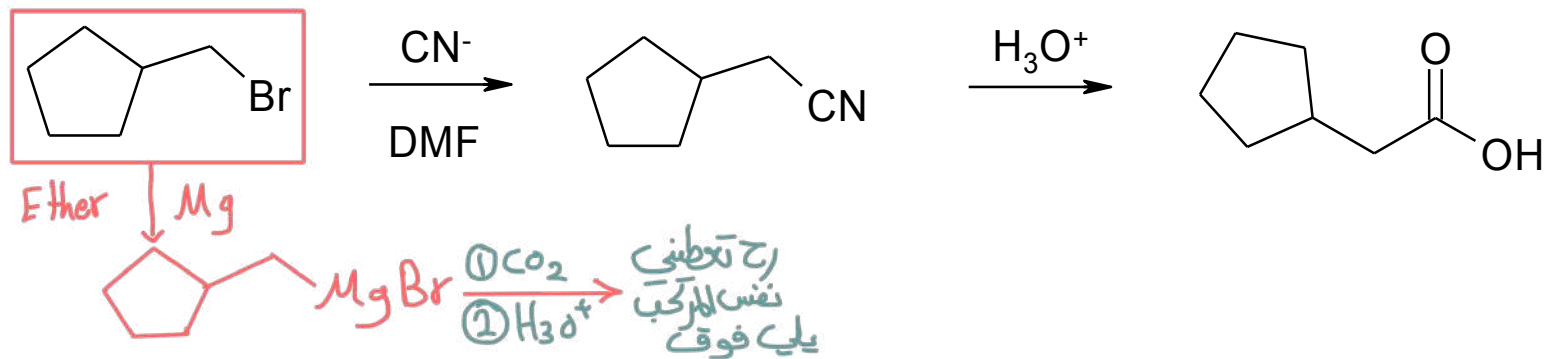
Preparation of Acids



4. **Hydrolysis of nitriles**: need either an acid or base catalyst, i.e.

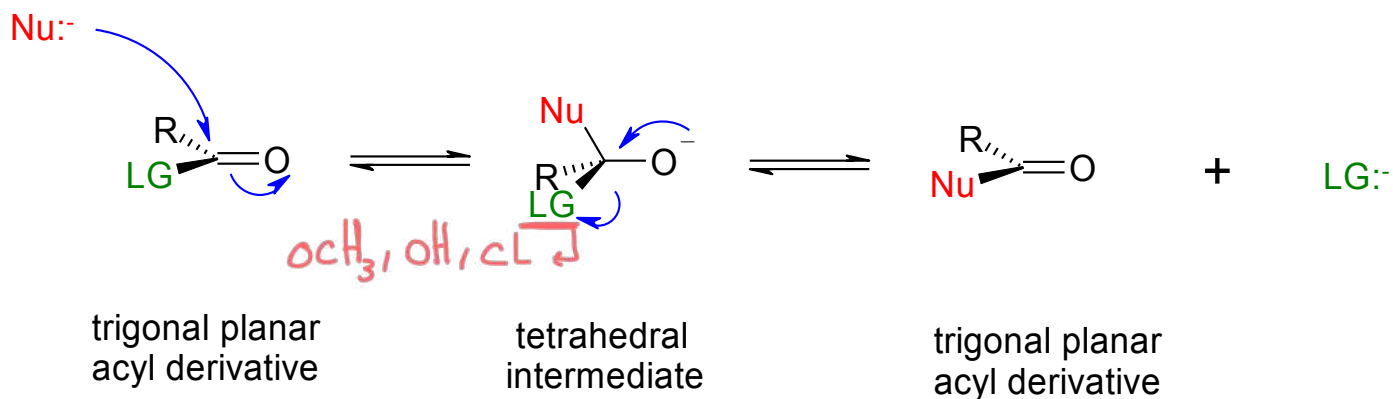
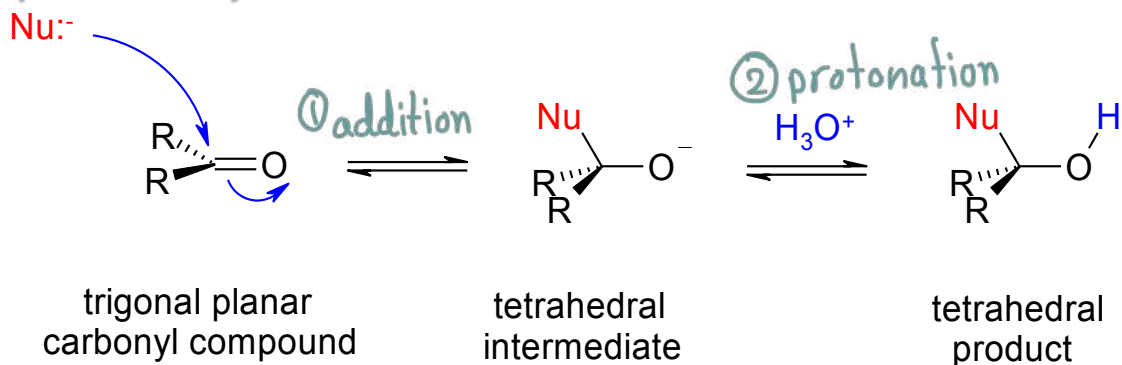


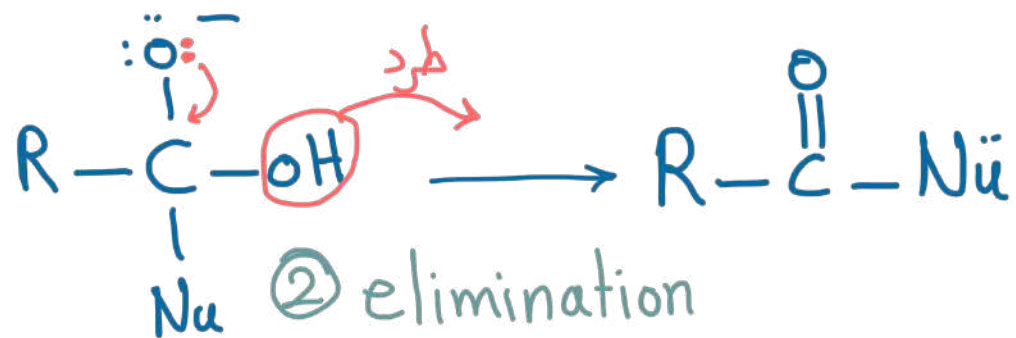
Note: the nitrile can be made from an alkyl halide, i.e.



Nucleophilic Acyl Substitution

In contrast to aldehydes and ketones, which react by *nucleophilic* (acyl) *addition*, carboxylic acids (and derivatives) react by *nucleophilic acyl substitution*, i.e.





ملخص تفاعلات تحضير الحمض

العوامل المساعدة	المتفاعلات	الطريقة
Jones' reagent KMnO4 HNO3	Primary alcohol	Primary alcohol oxidation
Ag2O	Primary aldehyde	Primary aldehyde oxidation
KMnO4 with heat =1eq O2,Co(III) in CH3CO2H= 2eq	Aromatic alkyl side chain	Aromatic alkyl side chain oxidation
H3O+ in step 2 to protonate carboxylate ion	Grignard+CO2	Grignard + CO2
Either acidic or basic catalyst	CN+2H2O	Nitrile hydrolysis

Acid Derivatives

The -OH group of the acid has been replaced by another functional group.

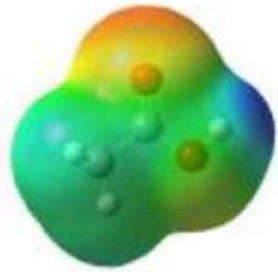
All of the derivatives can be hydrolyzed back to the carboxylic acid.

Types of derivatives:

1. *Esters*: $\text{R-CO}_2\text{-R}'$
2. *Acyl halides*: R-CO-Cl
3. *Anhydrides*: $\text{R-CO}_2\text{CO-R}$
4. *Amides*: R-CO-NH_2

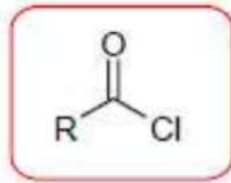
هاد الشكل اذا فهمته ف انتا وضعتك
بالسليم وهو اهم شكل بالشابتر

Acid derivatives

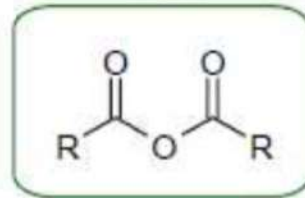


Acyl chloride

Most reactive

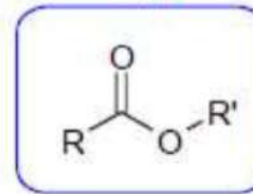


Anhydride

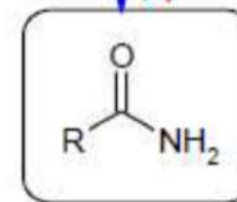


Note : every molecule present in this figure can be hydrolyzed back to acid

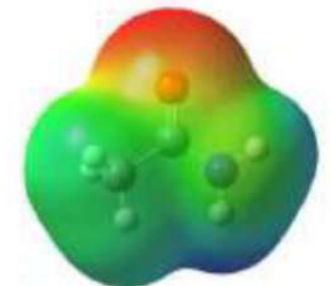
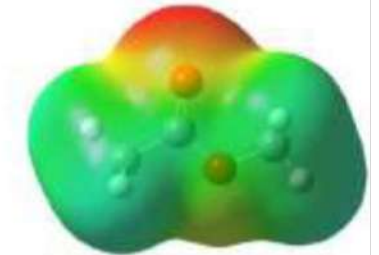
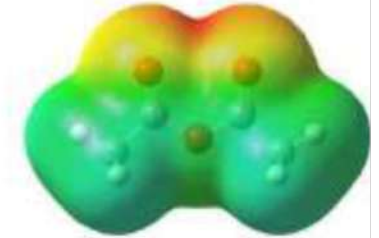
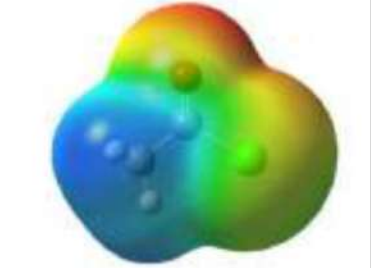
Ester



Most stable



Amide

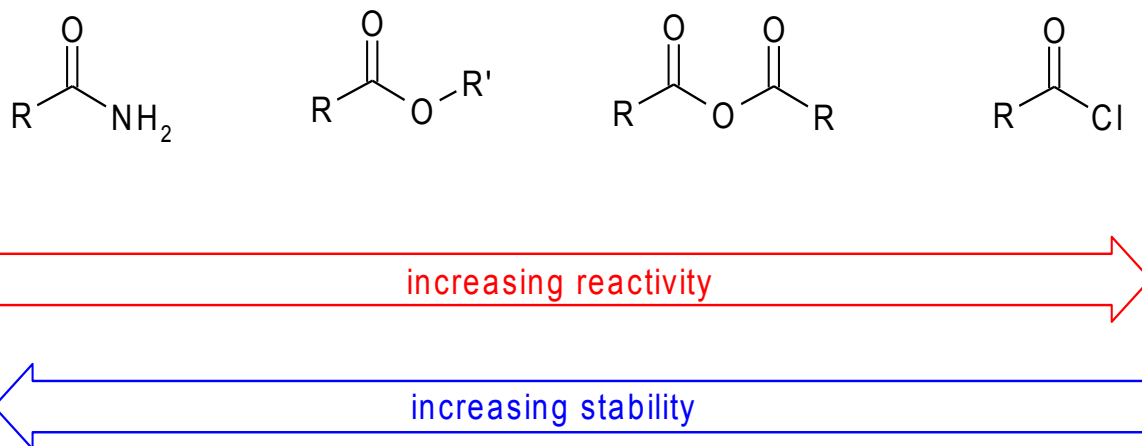


You can convert any functional group higher in the diagram into one lower in the diagram.

هون بقلنا انو المركب بقدر يكون المركب اللي تحته والاسهم بتدل على هاي التفاعلات .. بس العكس لا

Nucleophilic Acyl Substitution

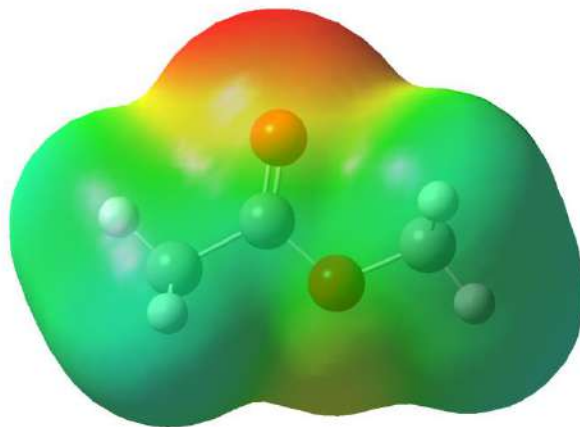
The reaction proceeds by a substitution since the acid / derivative has a leaving group in place of an H atom or alkyl group of the aldehyde or ketone, neither of which is a good leaving group. The relative reactivity of the derivatives depends on the leaving group ability, i.e.



Esters

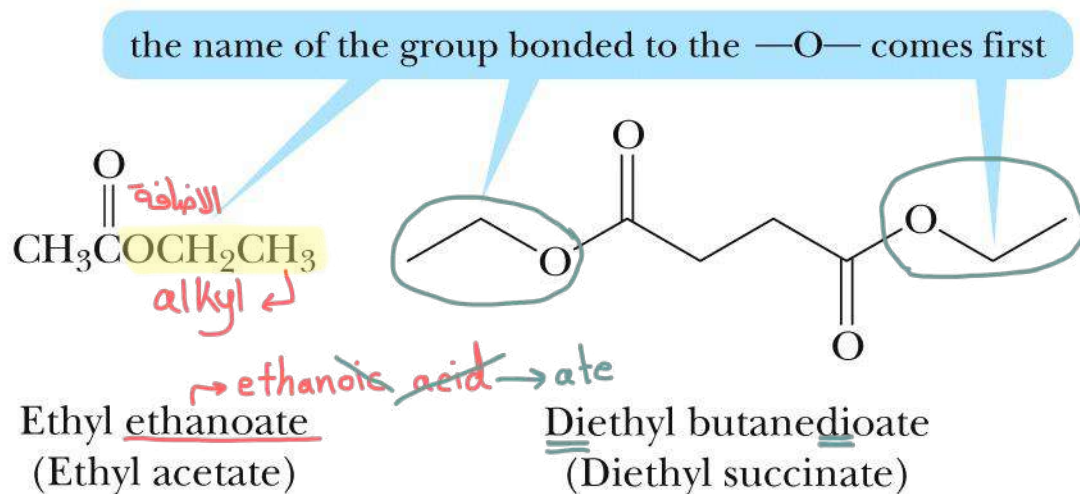
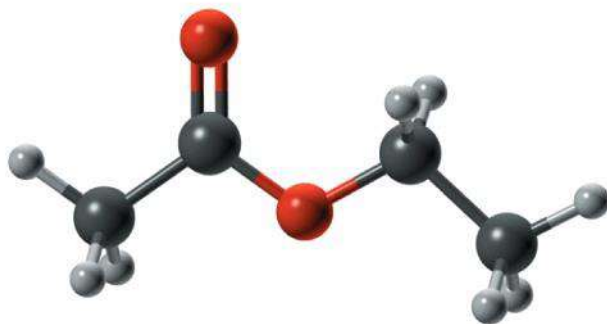
The $-OH$ of an acid has been replaced by a $-OR'$ from an alcohol. $OH \xrightarrow{\text{استبدال}} OR$

Very common compounds in nature and a wide variety are produced commercially.



Esters

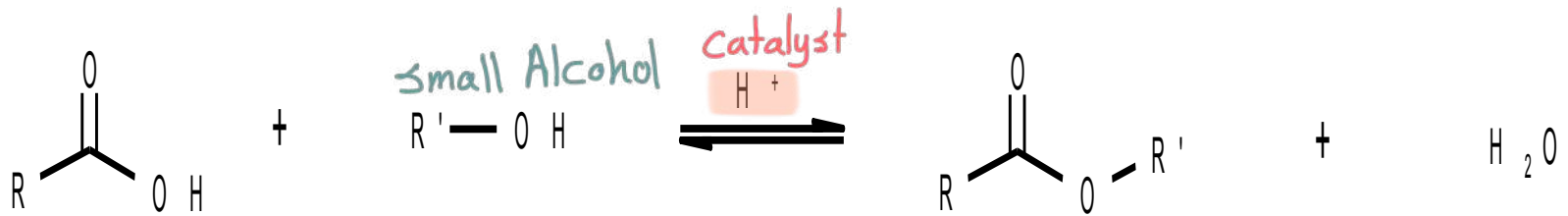
- The functional group of an ester is an acyl group bonded to -OR or -OAr.
 - Name the alkyl or aryl group bonded to oxygen followed by the name of the acid.
 - Change the suffix **-ic acid** to **-ate**.



Preparation of Esters

The most common method is a “*Fisher esterification*”.

The general reaction is:



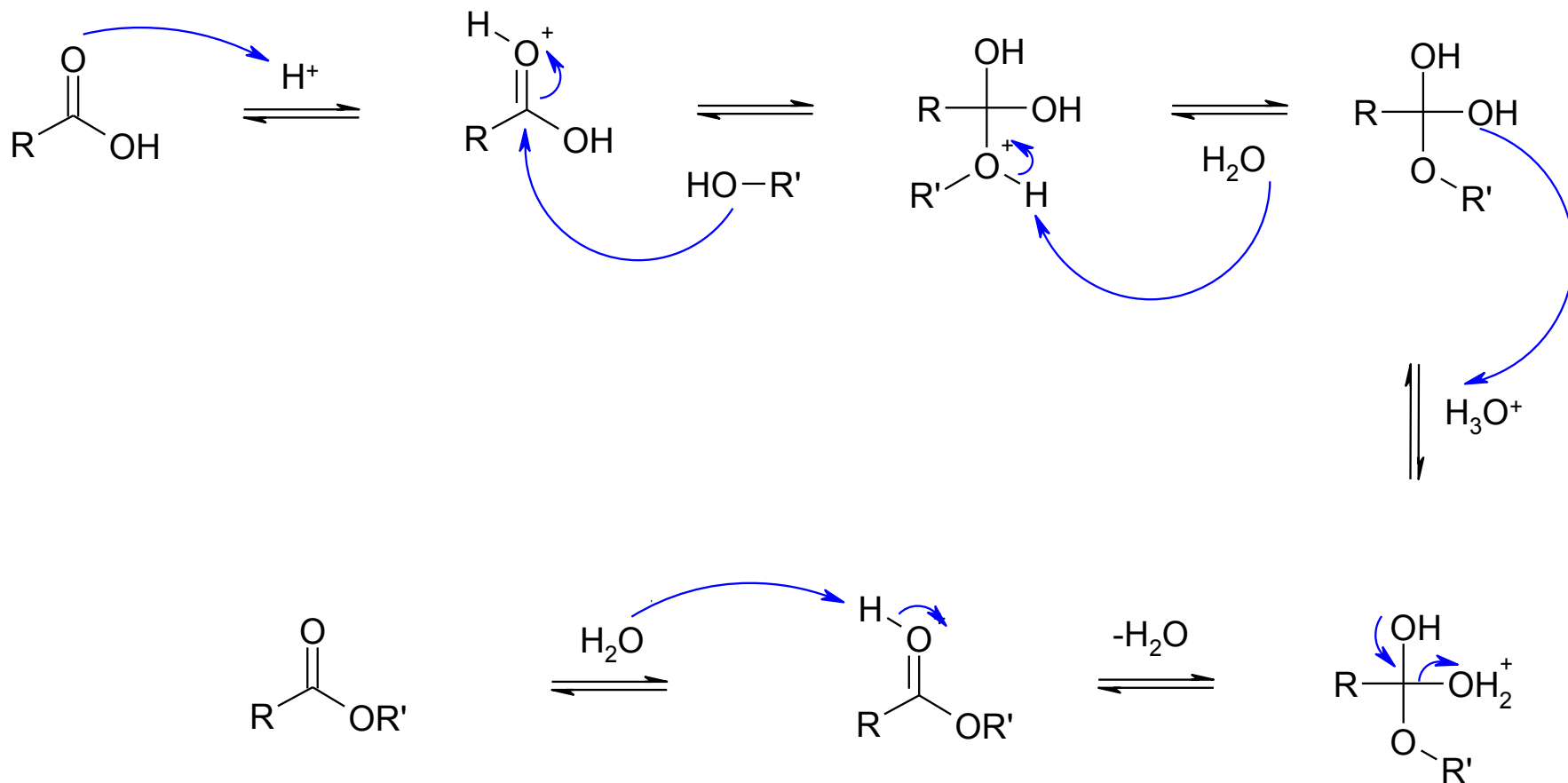
Note: you need an acid catalyst.

it is an equilibrium reaction, to drive it forward use excess alcohol or acid, or distill off the ester or water.

↓
بحاجة انو الملع واحد من products
لحتى يهشي التفاعل باتجاه واحد

Preparation of Esters

The mechanism:



Preparation of Esters

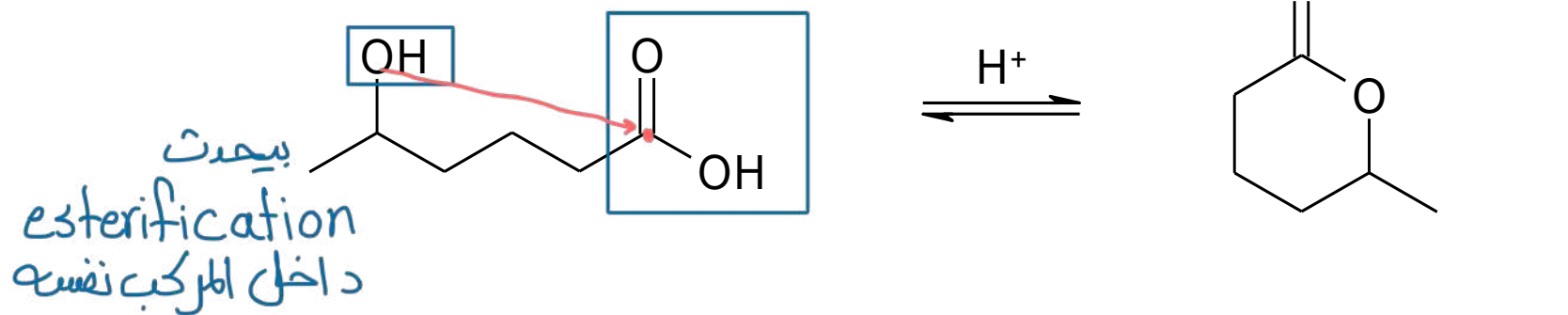
Note:

- i. Every step is reversible so the entire reaction is reversible
- ii. The $-OR'$ comes from the alcohol, i.e. it is a nucleophilic attack by the alcohol O atom on the carboxylate C atom (this is confirmed by radioisotopic labeling).
- iii. Substitution occurs rather than addition as we generate a very good leaving group, a water molecule.

Lactones = cyclic esters

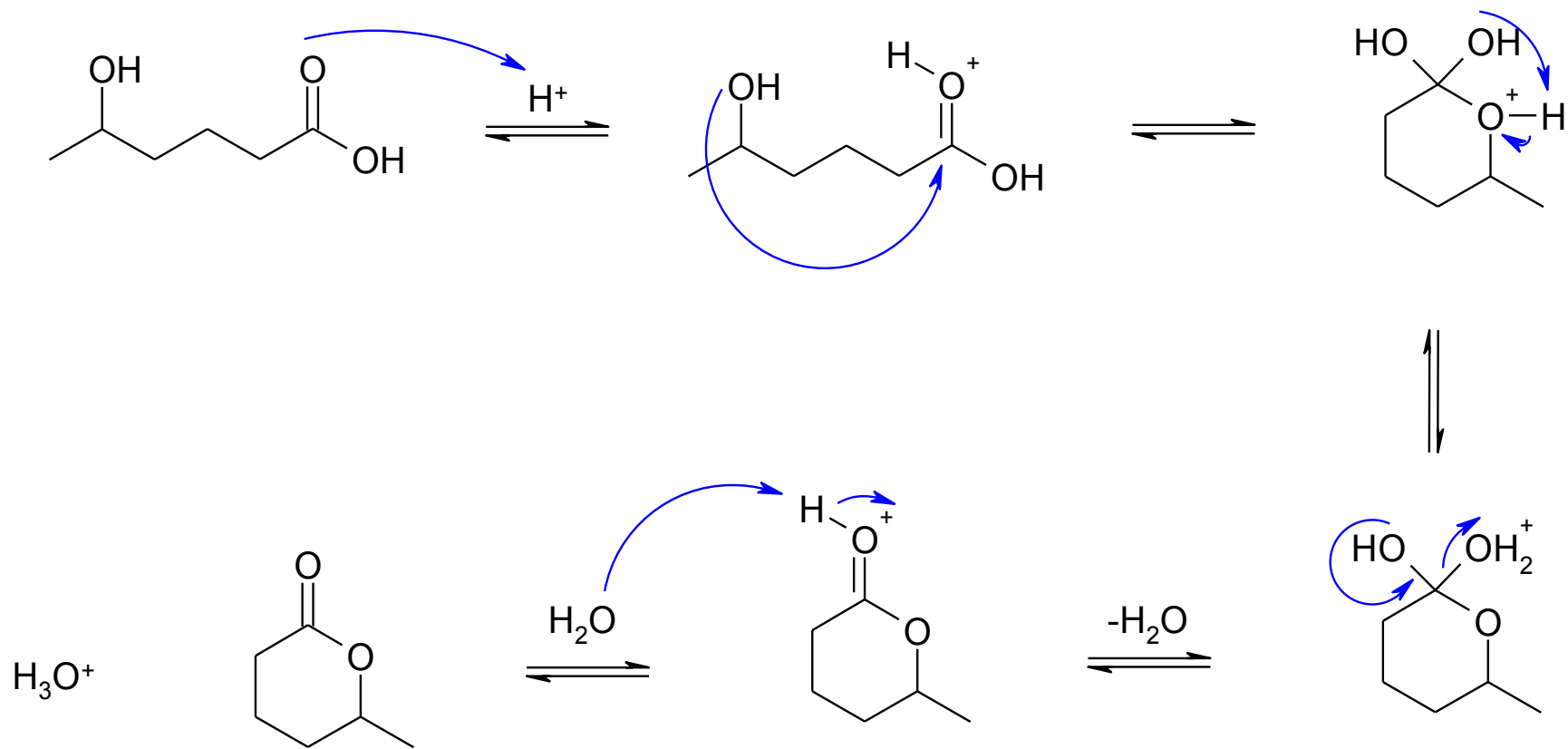
Lactones are cyclic esters made from γ or δ hydroxy acids.

Common reaction produces a **5 or 6** membered ring which are stable, i.e.



Lactones

Mechanism:



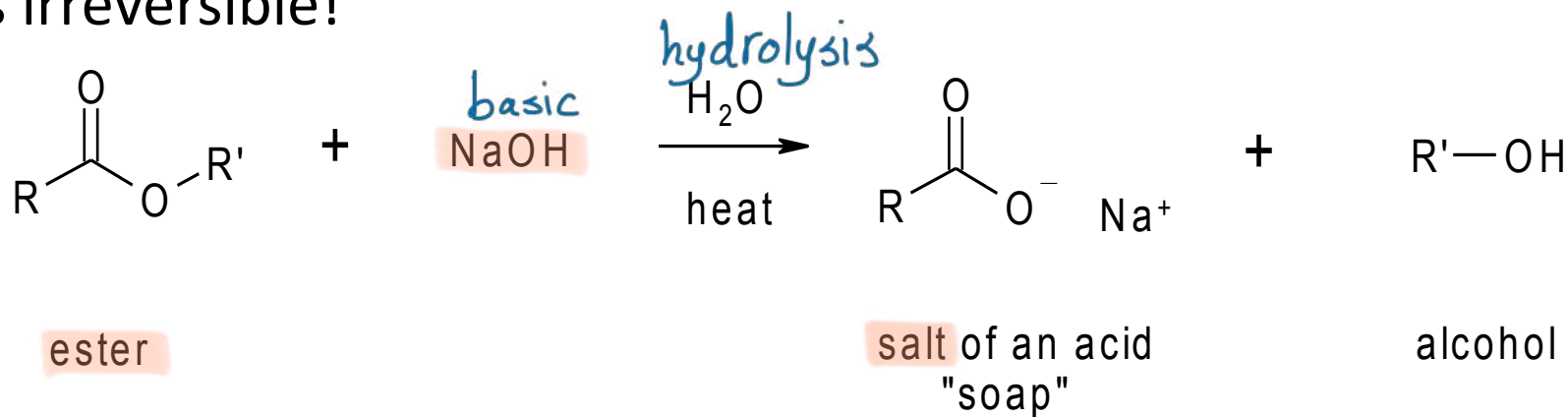
Saponification = base hydrolysis

Generally done on esters but acids work also.

Used to make soap (or in structure determination to remove the alcohol group).

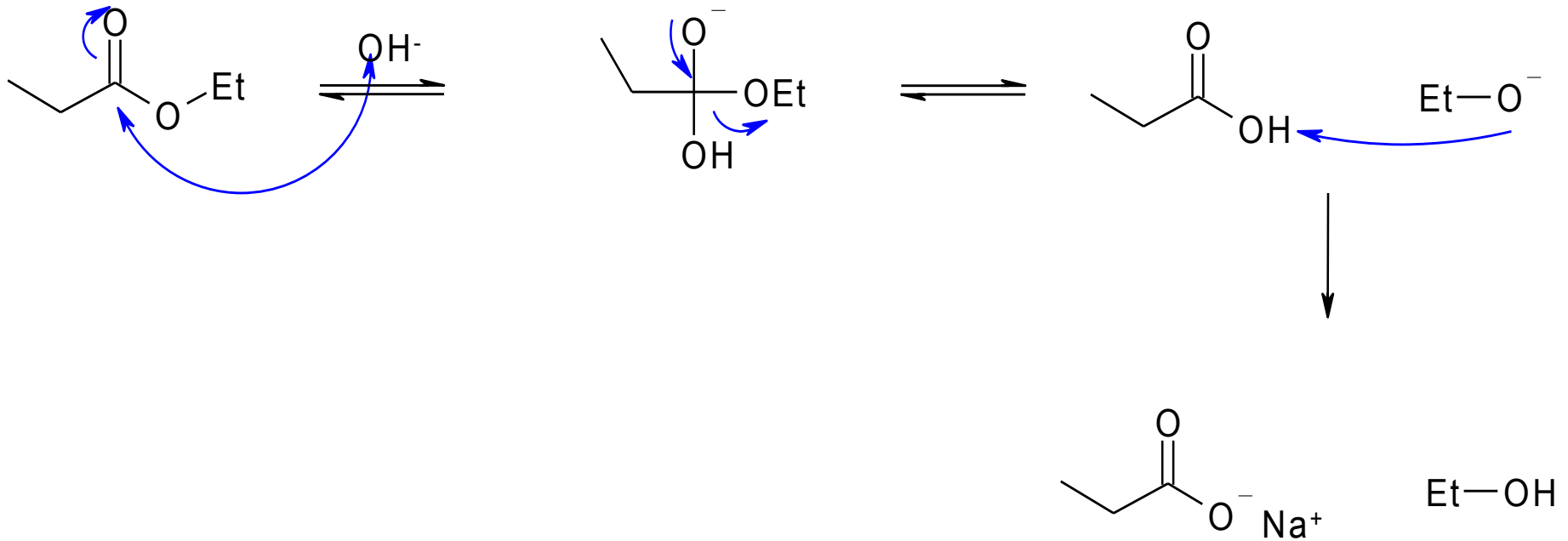
This is a *base hydrolysis* reaction

It is irreversible!



Saponification

Mechanism:



Ammonolysis of Esters

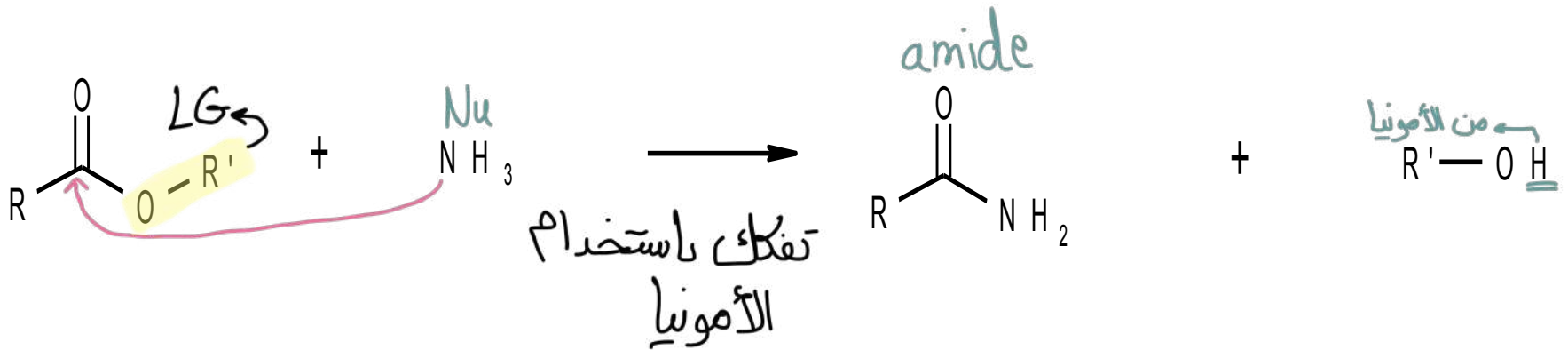
أكثر استقرار من Esters

Used to make amides

Ammonia is the nucleophile, i.e.

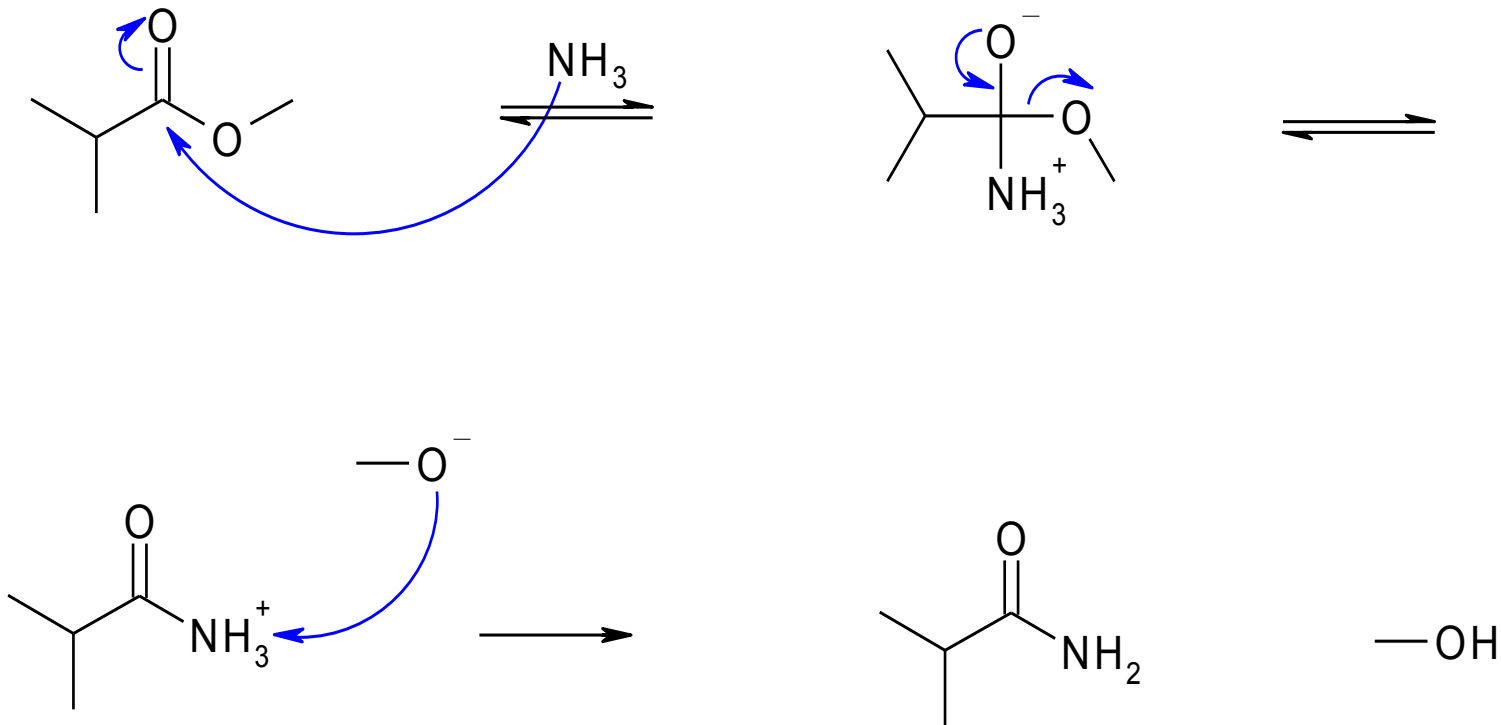
① Addition

② Elimination



Ammonolysis of Esters

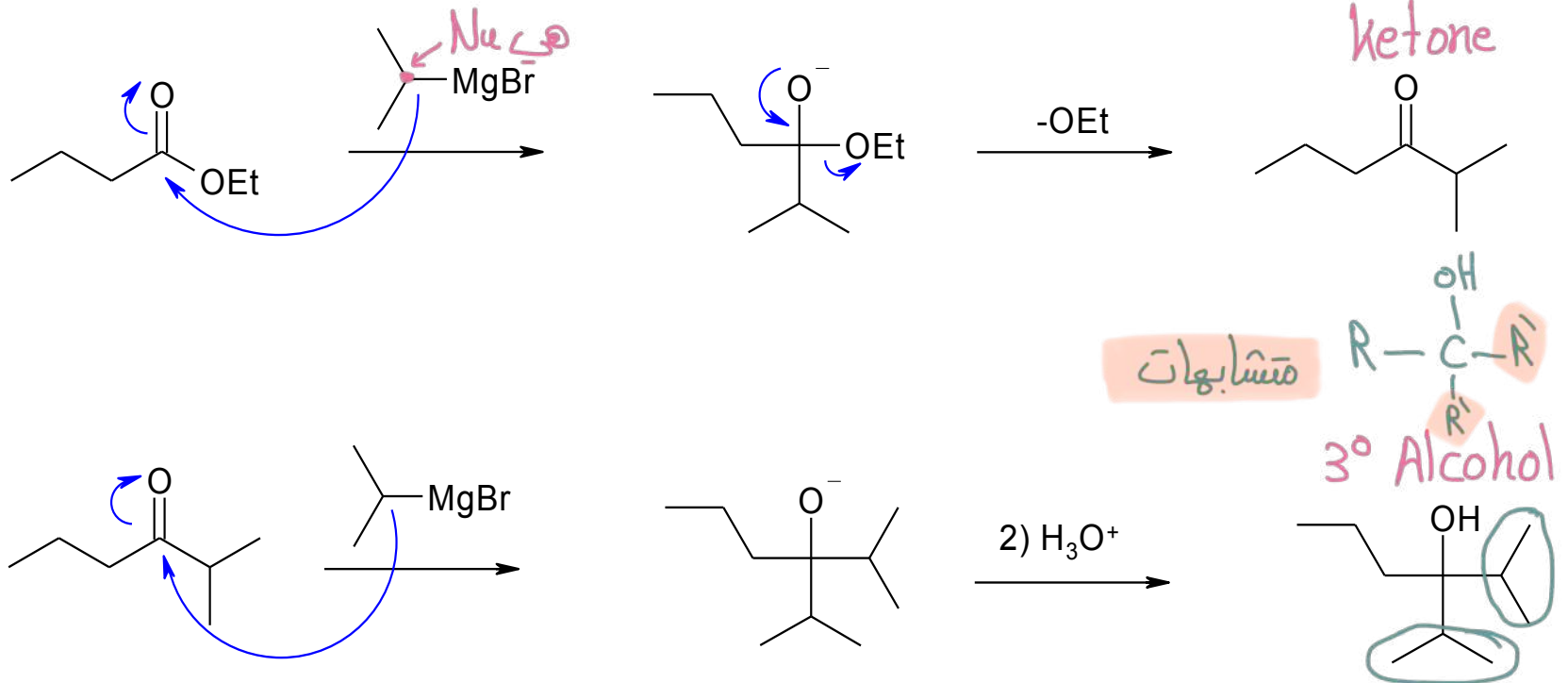
Mechanism: ركزوا على ال general mechanism انو ال Nu بتضيف وبيطلع عندي LG



تفاعل مهم جدًا ..

Ester Reactions with Grignard Reagents

Esters will react with **2 equivalents** of a Grignard reagent to produce a 3° alcohol, i.e.



Ester Reactions with Grignard Reagents

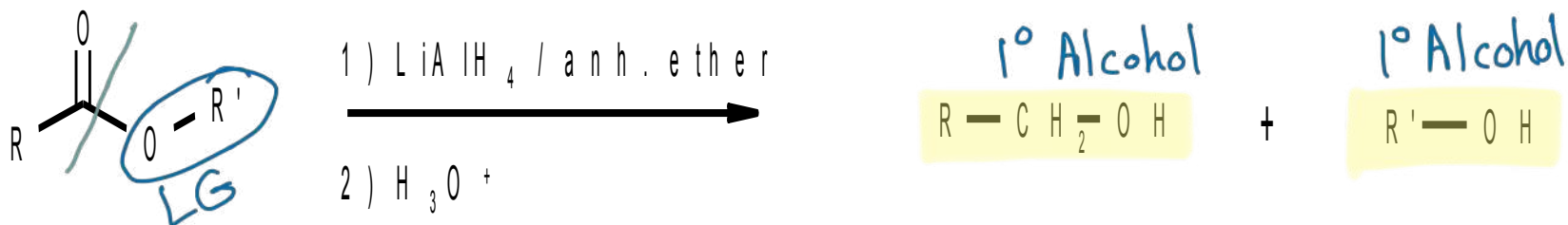
The second addition occurs since the ketone is still reactive to the Grignard reagent.

This is a good method to make 3° alcohol where two of the alkyl groups are the same.

Reduction of Esters

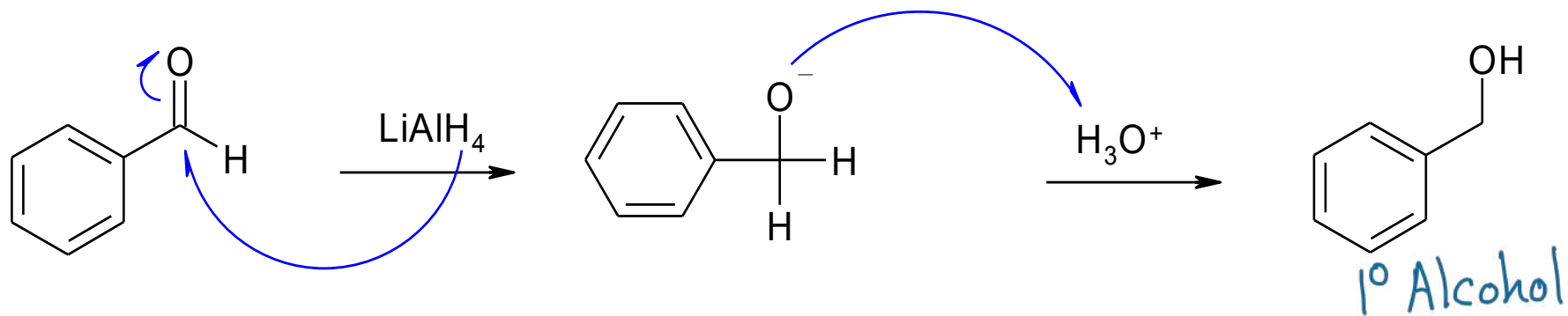
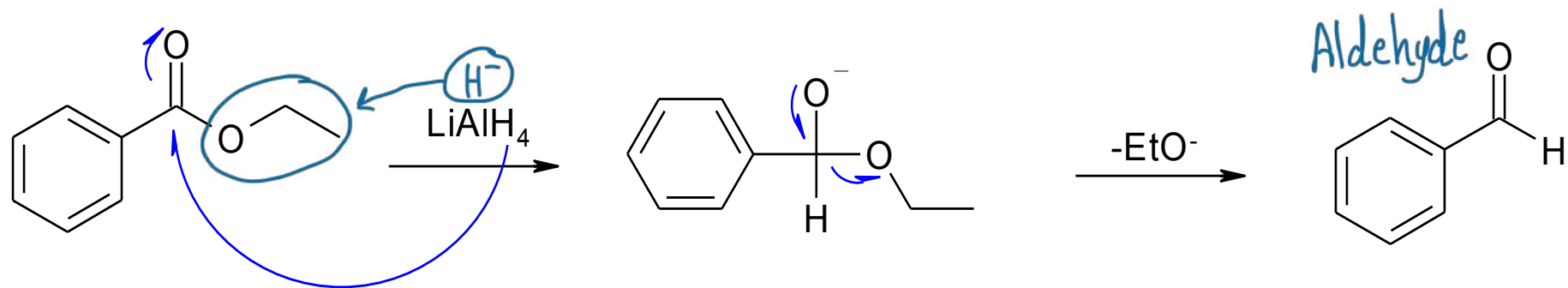
Product is a 1° alcohol.

Reagent: LiAlH_4 in anhydrous ether



Reduction of Esters

Mechanism:



Reduction of Esters

Note:

1. You can not isolate the aldehyde as it is still reactive to the LiAlH_4

ما يأتز عليها

2. LiAlH_4 does not reduce $\text{C}=\text{C}$ so you can selectively reduce an acyl group without reducing a $\text{C}=\text{C}$ π bond.

ما يستخدموا

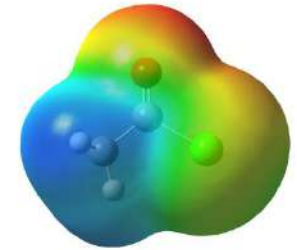
3. NaBH_4 is not strong enough to reduce acids or acid derivatives, this allows for the selective reduction of aldehyde or ketone groups.

ملخص تفاعلات الاستر وتحضيره

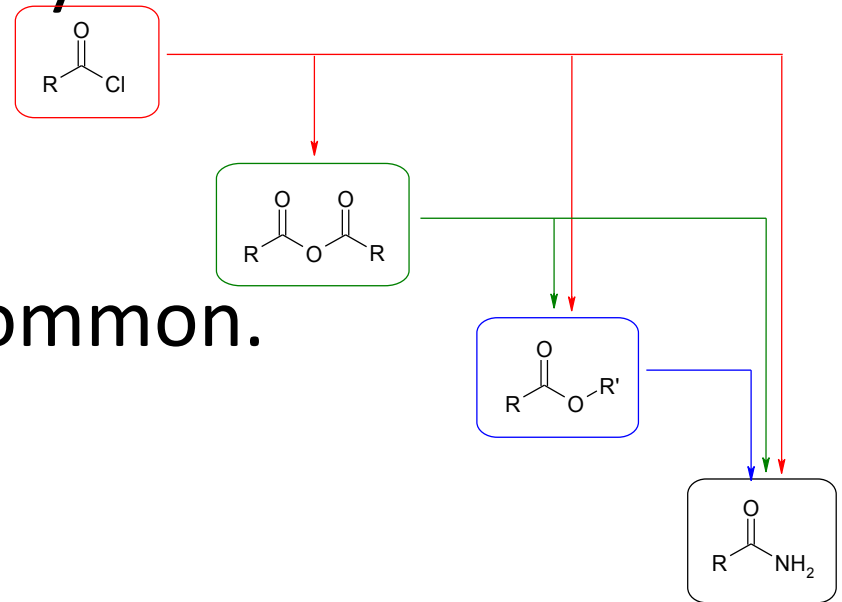
النواتج	العوامل المساعدة	المتفاعلات	الطريقة
Ester + H ₂ O	Acidic catalyst	Carboxylic + alcohol	Ester prep. Fisher esterification
Cyclic ester	Acidic catalyst	Hydroxy carboxylic acid	Lactones prep.
Soap (salt) + Alcohol	Water + heat	Ester + NaOH	Saponification
Amide + Alcohol	x	Ester + NH ₃	Ammonolysis
Tertiary Alcohol	H ₃ O ⁺ To protonate 2 nd eq of Grignard	Ester + R-Mg-X	Ester + Grignard
2eq of 2 different primary alcohol	LiAlH ₄ in anh.ether	Ester	Ester Reduction

Acyl Halides

More reactive than acids or esters.



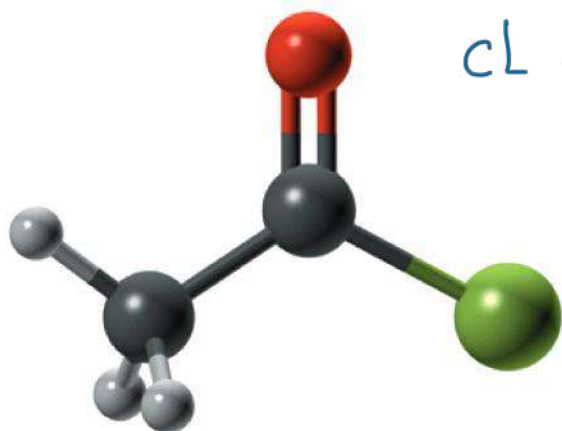
Man made compounds, they do not exist in nature.



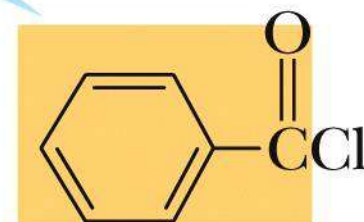
The chloride is the most common.

Acid Chlorides

- The functional group of an acid halide is an acyl group bonded to a halogen.
 - The most widely used are the acid chlorides.
 - To name, change the suffix **-ic acid** to **-yl chloride**.



Ethanoyl chloride
(Acetyl chloride)

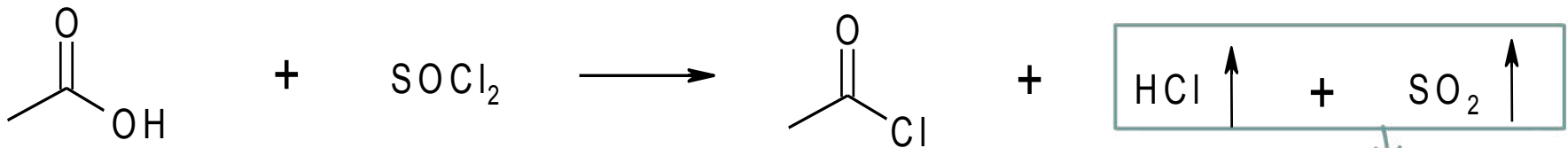


Benzoyl chloride
↪ Benzoic acid $\text{C}_6\text{H}_5\text{COOH}$

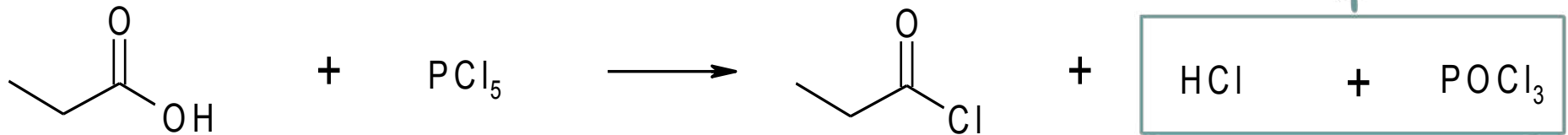
Acyl Halides: Preparation

تحفيس هم صعب
لانهم اقل استقرار

Prepared from acids using ^{SOCl₂} thionyl chloride or ^{PCl₅} phosphorus pentachloride, i.e.

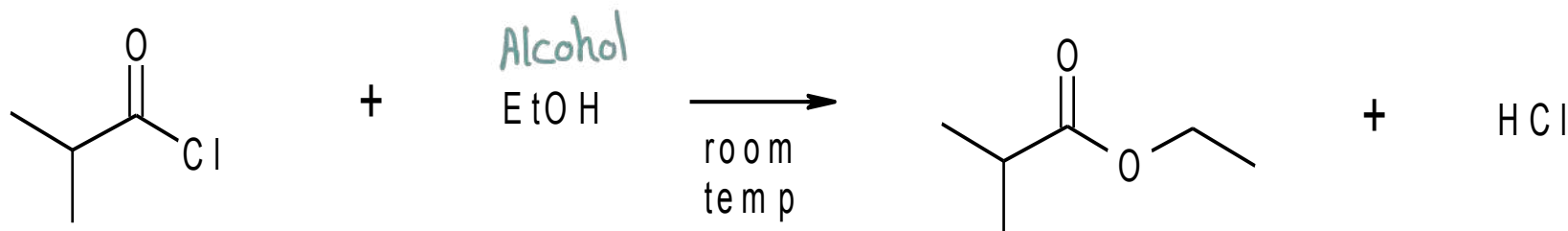


موكتير بهونا



Acyl Halides \longrightarrow Ester

Acyl halides are much more reactive than acids or esters, therefore reactions occur in milder conditions, don't normally need to heat or use acid catalysts.



→ one way
→ سریع
→ مایه و تسخین

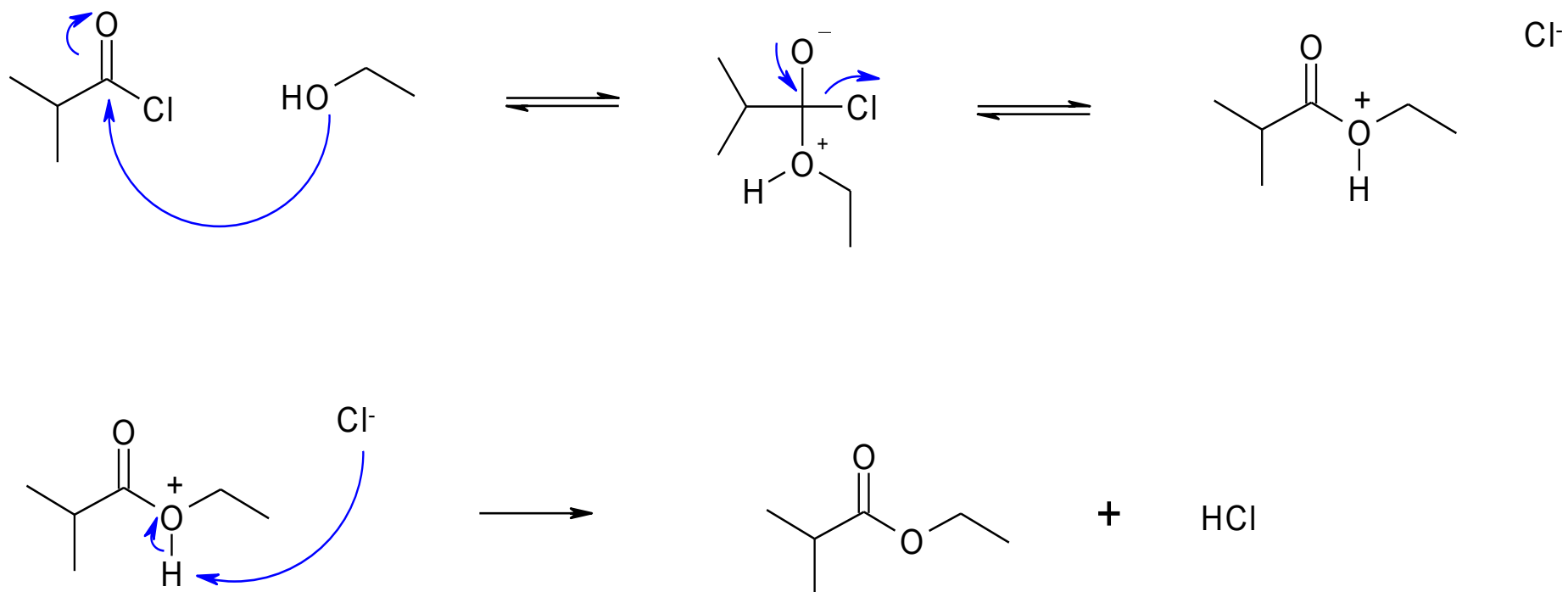
Better way to make esters, no catalyst needed, and a Fisher is an equilibrium.

carboxylic acid

Note: the HCl normally fumes and is an irritant.

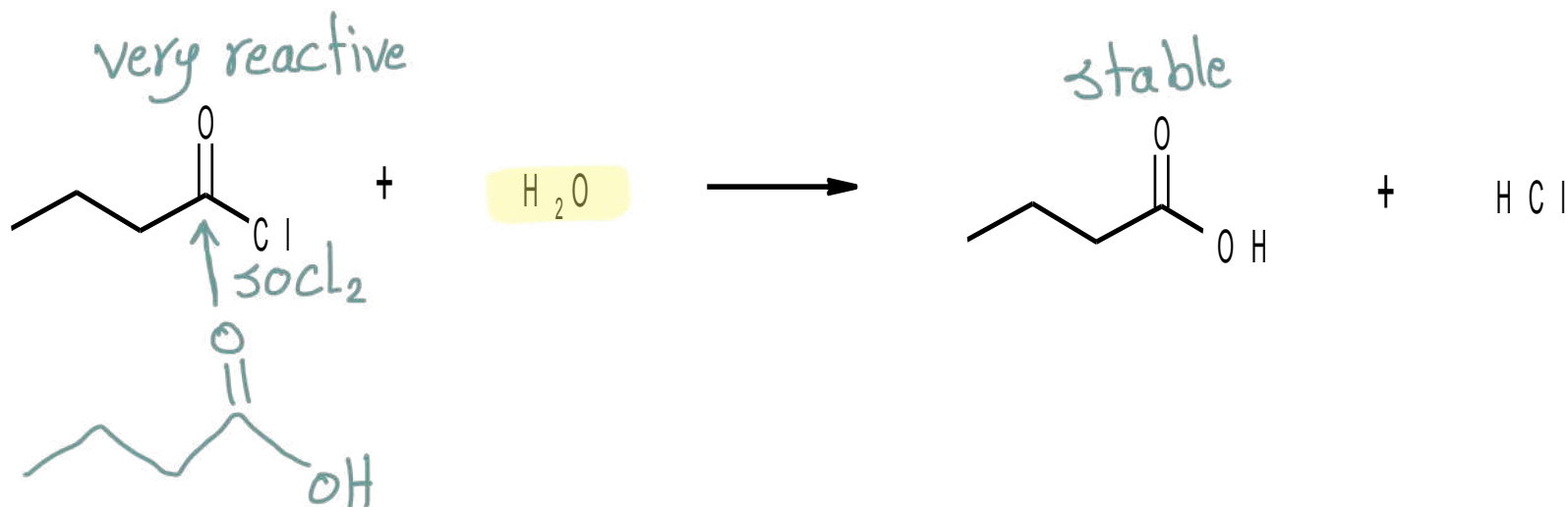
Acyl Halides

Mechanism:



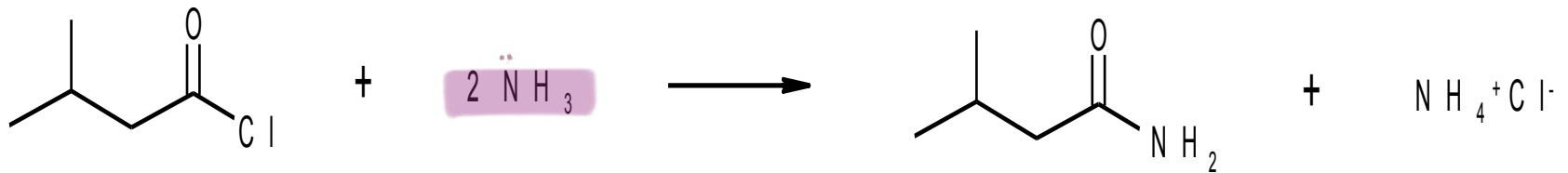
Acyl Halides

Hydrolysis will produce the acid, i.e.

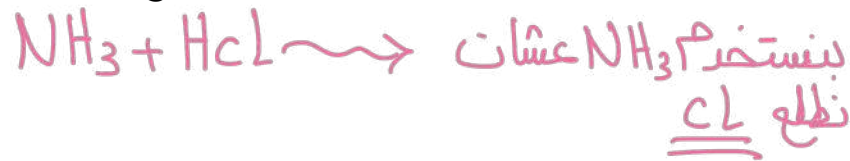


Acyl Halides

Ammonolysis will produce the amide, i.e.



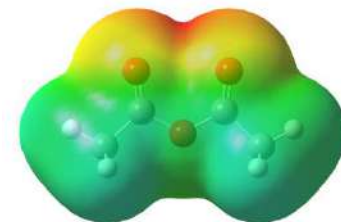
Need 2 equivalents of NH_3 , 1 makes the amide, the other neutralizes the HCl .



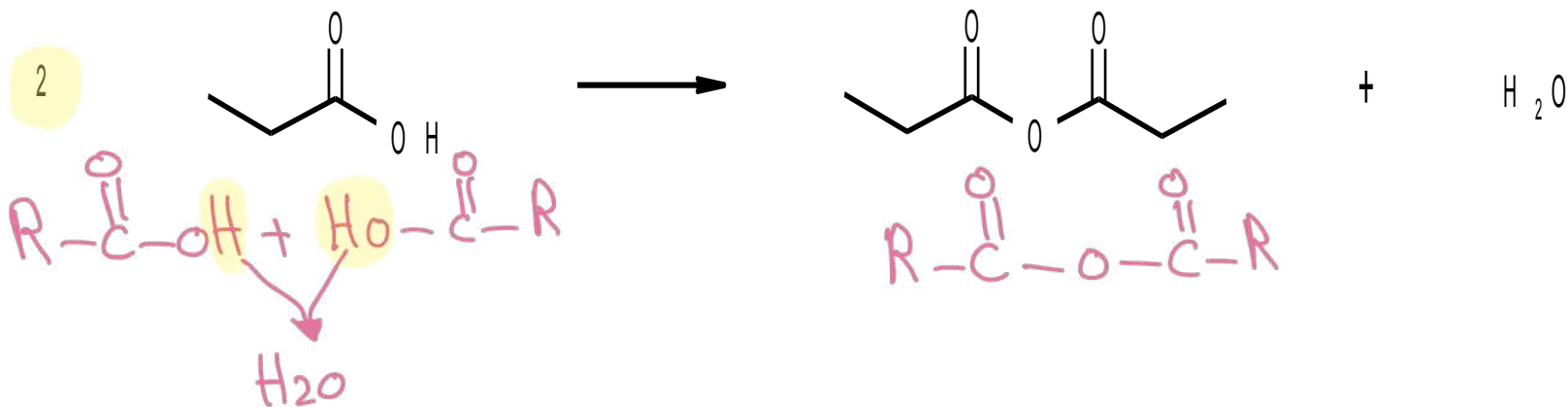
Acyl halides are also used in Friedel-Crafts acylation reactions.

Acid Anhydrides

Another more reactive form is the *anhydride*.

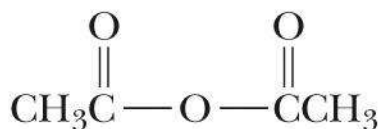


Made by reacting two acid molecules together with the loss of a water molecule, i.e.

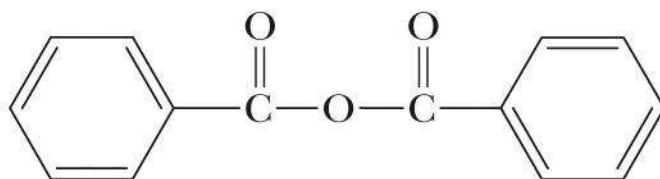


Acid Anhydrides

- The functional group of an acid anhydride is two acyl groups bonded to an oxygen atom.
 - Anhydrides may be symmetrical (two identical acyl groups) or mixed (two different acyl groups).
 - To name, **replace acid** of the parent acid by **anhydride**.

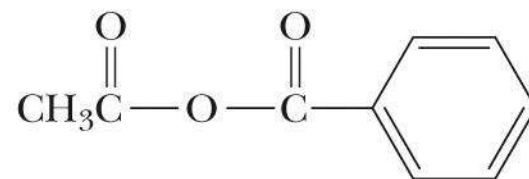


Acetic anhydride



Benzoic anhydride
Benzoic acid *ابو*

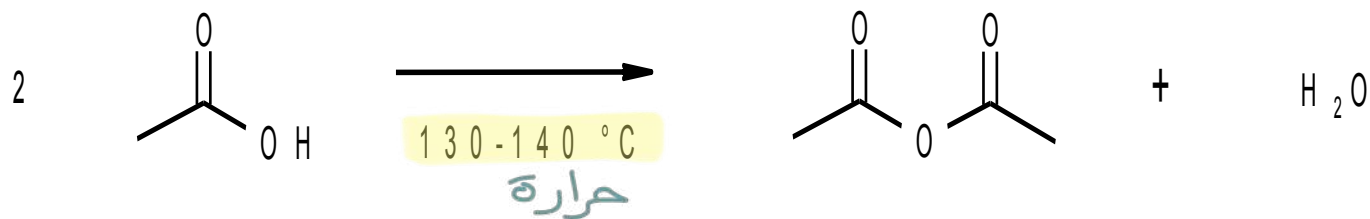
جای 2 acid مختلفات



Acetic benzoic anhydride
(a mixed anhydride)

Acid Anhydrides: Preparation

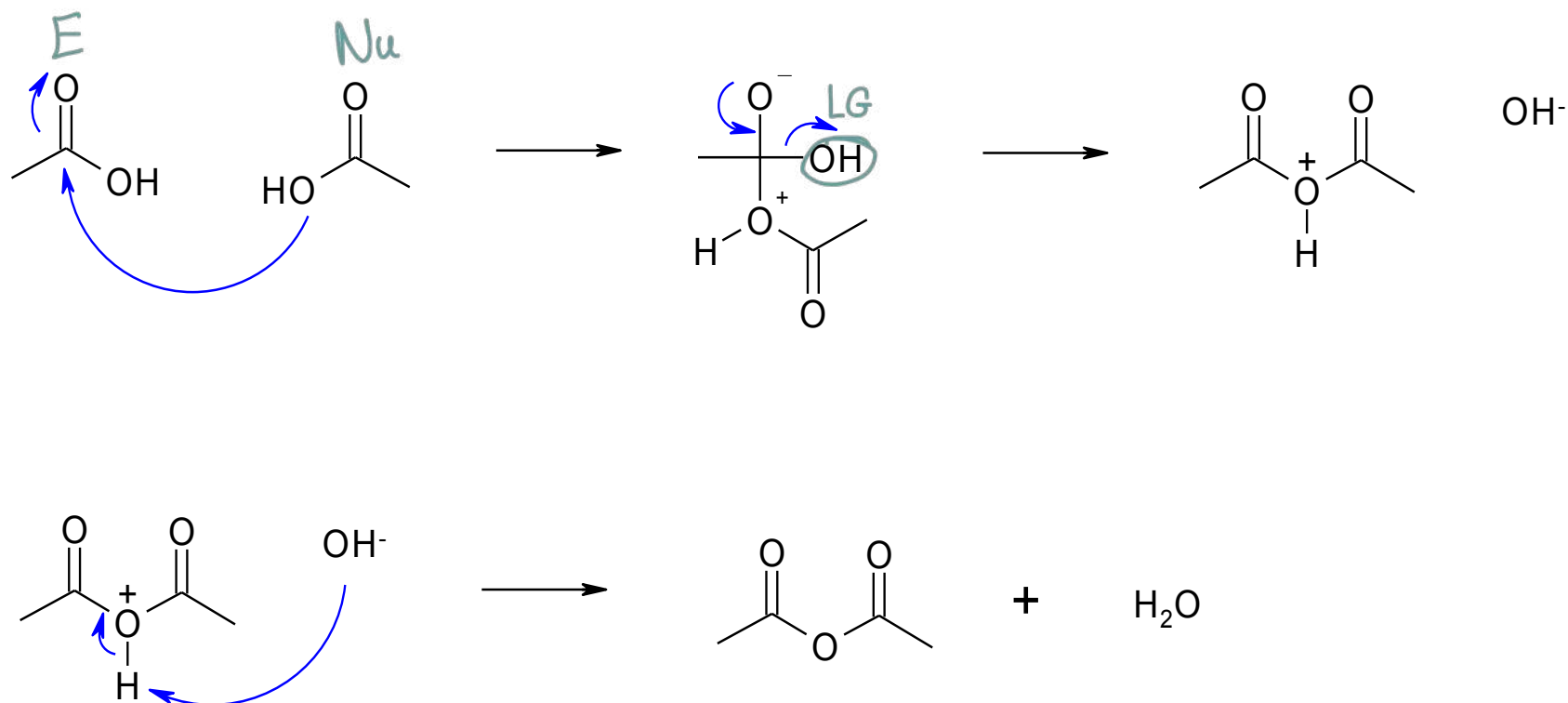
Anhydrides can be made by heating an acid, i.e.



The high temperature drives off the water and drives the reaction forward.

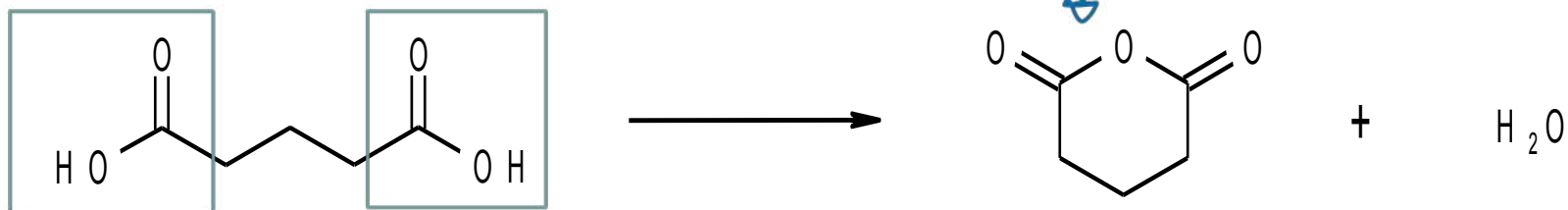
Acid Anhydrides: Preparation

Mechanism:



Acid Anhydrides: Preparation

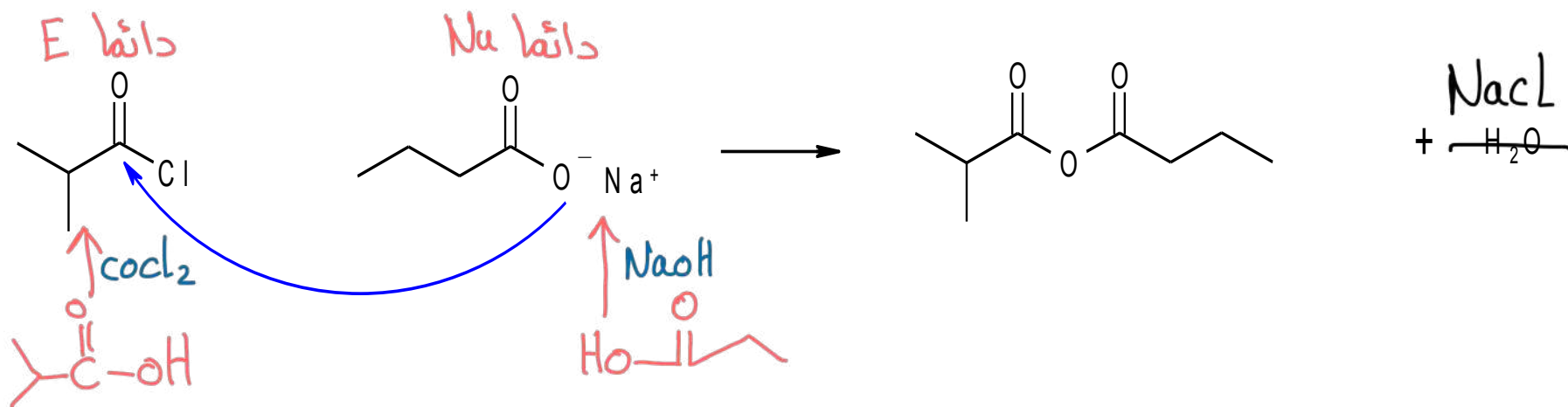
Diacids form **cyclic anhydrides**, i.e.



وحدة راجت تستعمل ك Ne
والثانية ك E

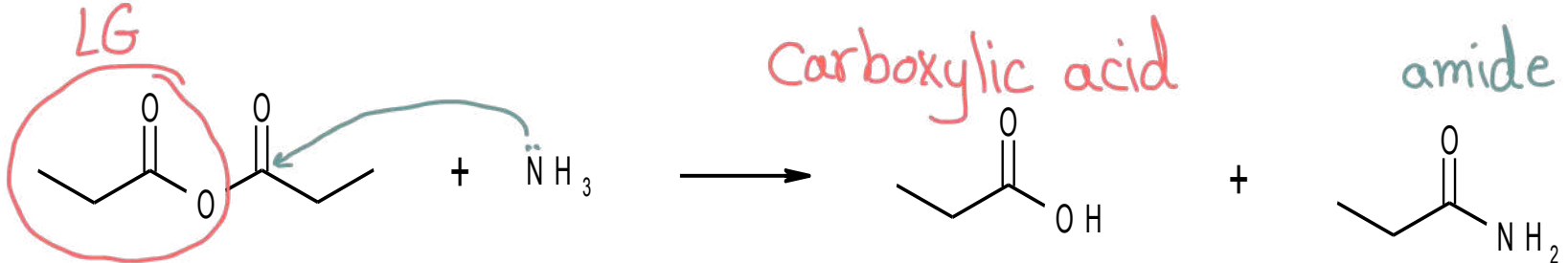
Acid Anhydrides: Preparation

Mixed anhydrides can be made, but you need to use an acyl halide and an acid (or salt) otherwise you get a mixture of products, this way only the acid (or salt) can act as the nucleophile, i.e.



Acid Anhydrides

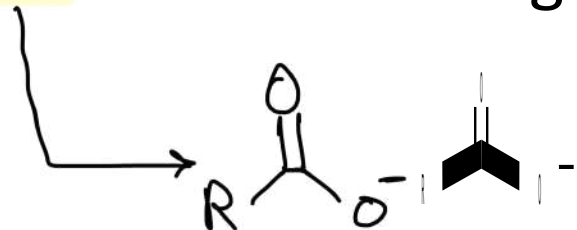
Anhydrides undergo nucleophilic acyl substitution and are more reactive than acids or esters, but not acyl halides, i.e.



Alcohol and water react the same way as ammonia.

The "leaving group" is a carboxylate ion which will get protonated to form the acid.

weak base
good LG

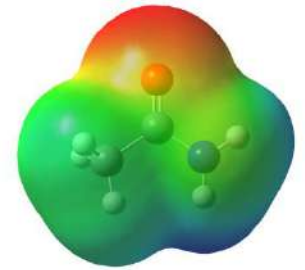
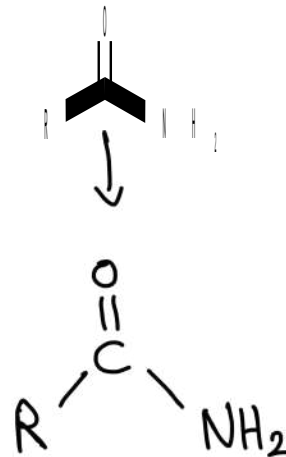


Amides



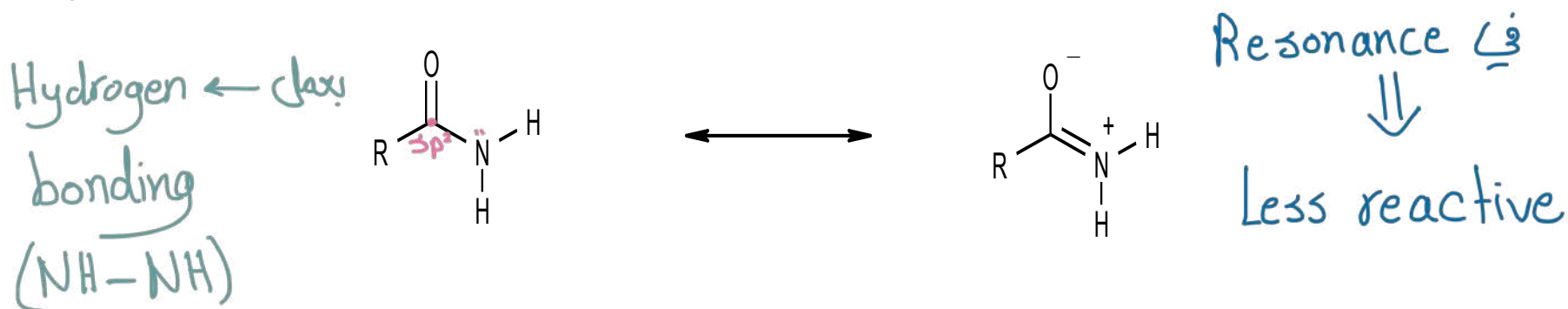
Amides are the least reactive of the acid derivatives.

1° amides: $\text{RCONH}_2 =$
↓
R-C(=O)-



Amides

The N atom in an amide is sp^2 hybridized (and planar). This allows the lone pair electrons on the amide N to interact with the carbonyl π system, i.e.



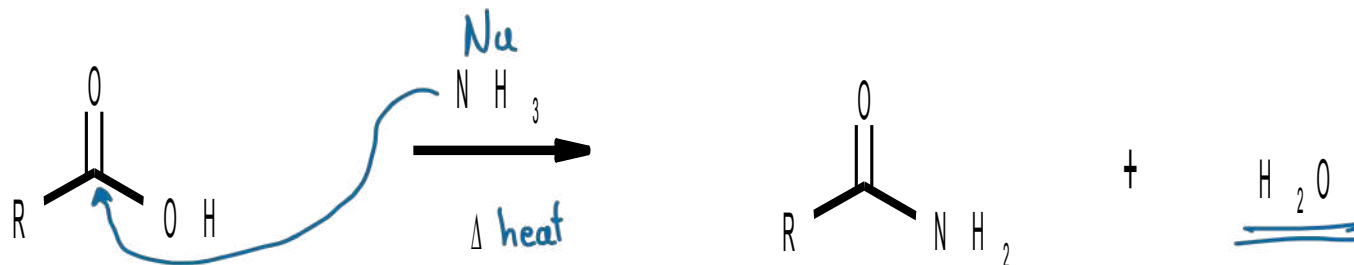
This means the amide bond is rigid to rotation the same as a $C=C$ π bond.

Amides

The amide group possess both a hydrogen bond donor and acceptors so form strongly H-bonded complexes similar to alcohols and acids. This means they are soluble in water and have high MP & BP for their size.

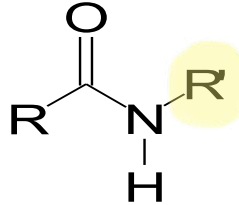
Amides: Preparation

1° amides can be prepared by: reacting NH_3 with esters, acyl halides or anhydrides. They can also be prepared from acids but require heating, i.e.

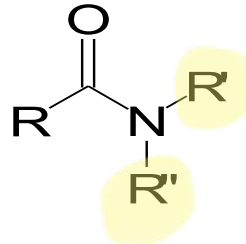


Amides:

2° amides have one H atom replaced by an alkyl group



3° amides have both H atom replaced by alkyl groups



Note: no longer has a H-bond donor →

لانو ما في H

Lactam

**

- **Lactam**: a cyclic amide.

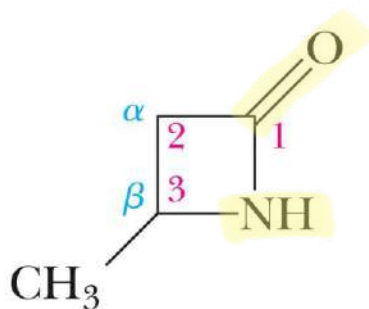
- Name the parent carboxylic acid, drop the suffix -ic acid and add **-lactam**.
- The location of the nitrogen atom in the ring is commonly indicated by a Greek letter, α , β , etc.

اعرفوا انو هذول

Lactam

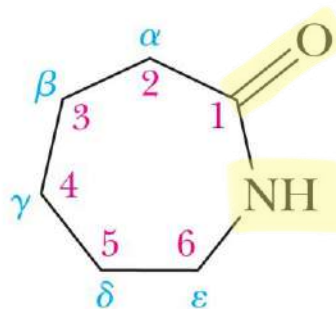


cyclic amide



3-Butanolactam
(A β -lactam)

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6-Hexanolactam
(An ϵ -lactam)

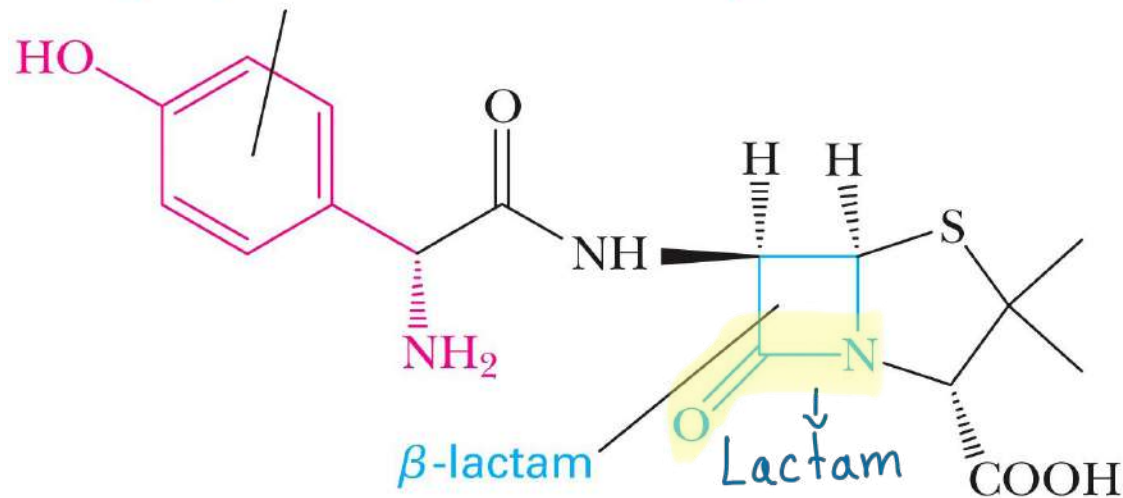
ما بدنا التسمية
ولا α , β

The Penicillins

- The penicillins are a family of β -lactam antibiotics.
 - The structural feature common to all penicillins is a β -lactam ring fused to a five-membered ring containing one S atom and one N atom.

structural
bio-go

The penicillins differ in the group bonded to the carbonyl carbon



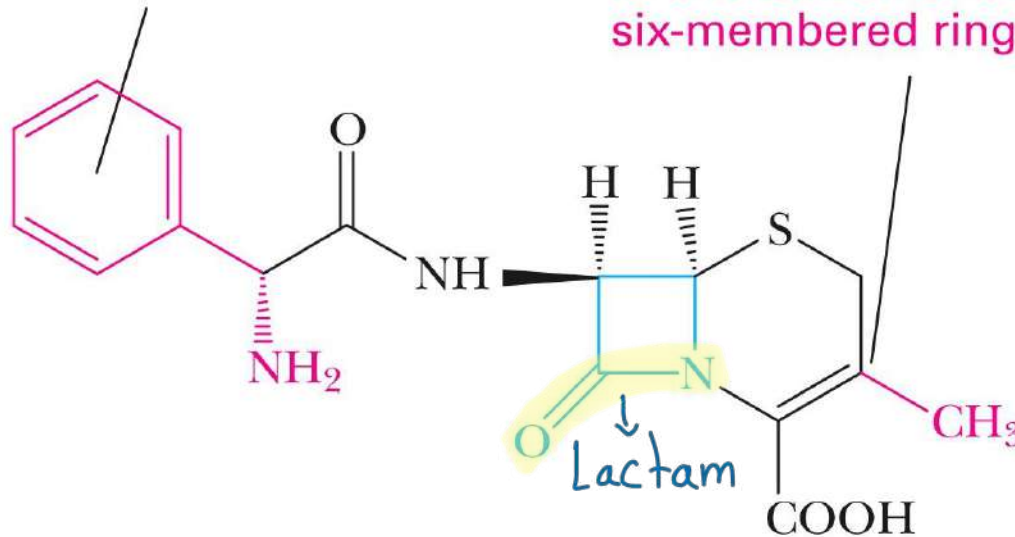
Amoxicillin
(a β -lactam antibiotic)

Cephalosporins

- The cephalosporins are also β -lactam antibiotics.

The cephalosporins differ in the group bonded to the carbonyl carbon...

...and the group bonded to this carbon of the six-membered ring

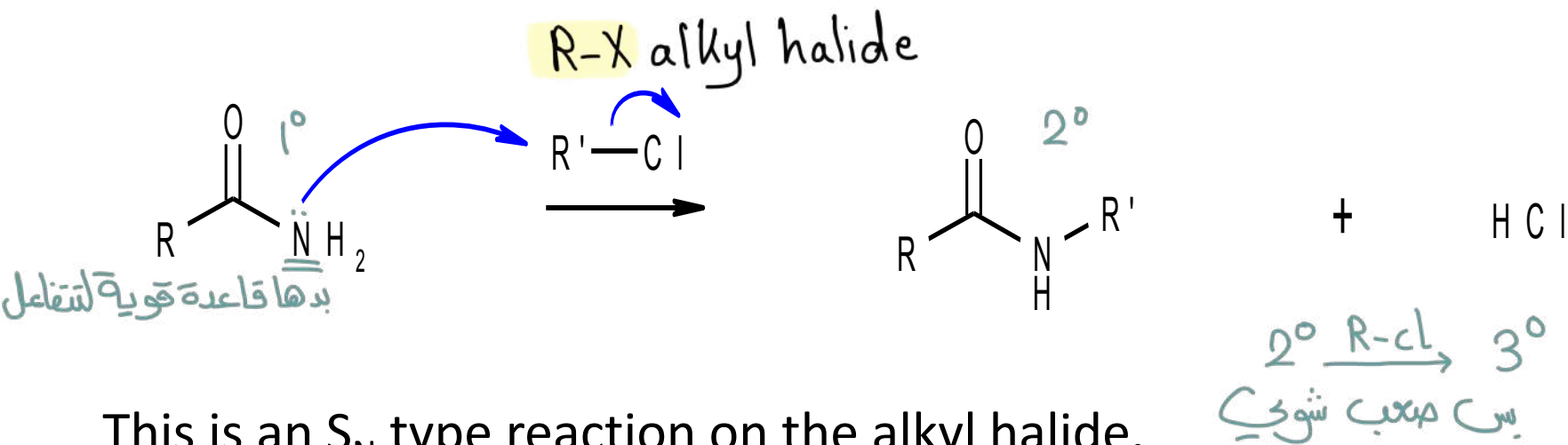


Keflex
(a β -lactam antibiotic)

الأضلة موحدة

Amides: Preparation

The N atom is weakly nucleophilic due to the lone pair electrons, but less than expected as they are conjugated to the carbonyl group. 2° amides can be prepared by reacting a 1° amide with an alkyl halide, i.e.

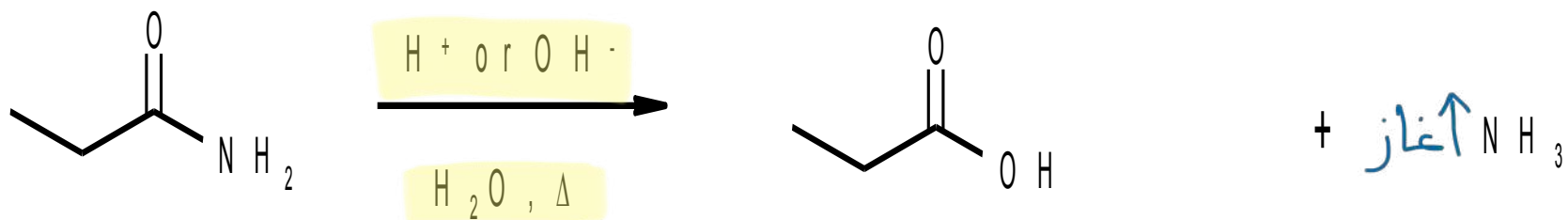


This is an S_{N} type reaction on the alkyl halide.

The initial product can react again to produce a 3° amide.

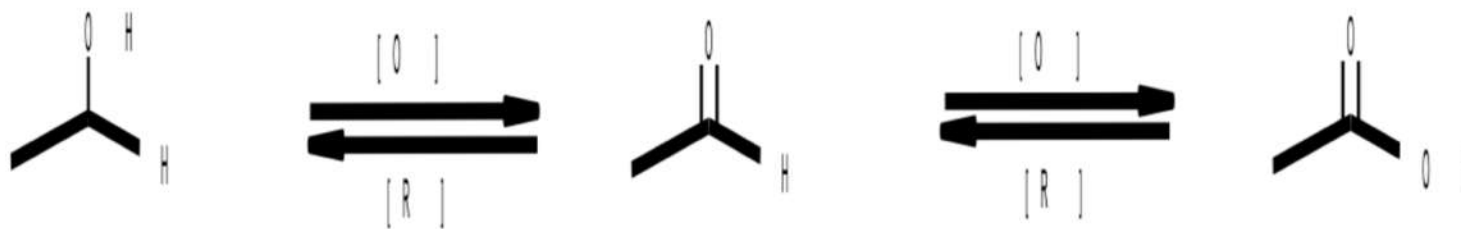
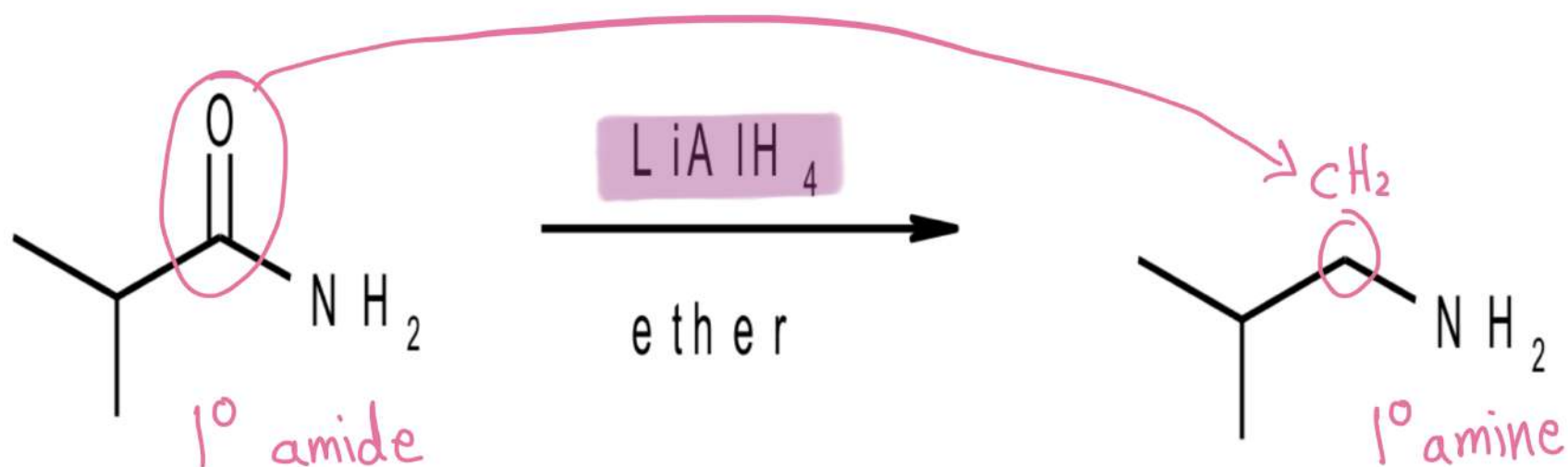
Amides: Hydrolysis

Hydrolysis of an amide leads back to a carboxylic acid.
Requires the use of an **acid or base** catalyst, i.e.



Amides: Reduction

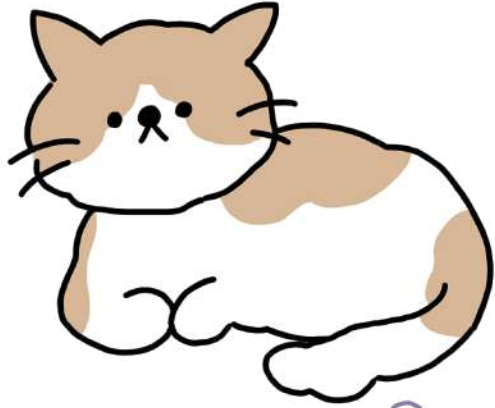
Reduction of an amide leads to 1° amines, i.e.



تلخيص تفاعلات الامين والتحضير

النواتج	العوامل المساعدة	المتفاعلات	الطريقة
Primary amide	1) X 2) heat	1) Derivatives 2) carboxylic acid	Primary amide prep. Ammonolysis
Secondary / Tertiary amide	X	Primary amide	Secondary/ Tertiary amide prep.
Carboxylic acid + NH ₃	Acid or base catalyst in H ₂ O with Heat	Amide	Hydrolysis
Primary amine	LiAlH ₄	Amide	Amide reduction

♡♡ chapter 10 وبهيك بكون انتهى تفريغ



Dana..

#النادي-الطبي
♡#معكم-خطوة-بخطوة

♡موفقين 🖋️