Hi dear students I am Padmini Chandan Raiker
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I am going to discuss about the interconversions of acid derivatives.
This is the outline of this module which consists of structures of carboxylic Acids and its derivatives, reactivity order of carboxylic acids and its derivatives, how carboxylic acids and its derivatives react, reactions involving interconversion of carboxylic acid derivatives and then the references.
At the end of this module students will be able to identify the different derivatives of carboxylic acids, compare the reactivities of carboxylic acids and its derivatives, predict the products of the reactions involved with the interconversions of carboxylic acids and its derivatives.
Carboxylic acids are organic compounds which contain a carbon chain which is further attached to a carbonyl carbon and then the carbonyl carbon is further attached to a hydroxyl group.
Now when this hydroxyl group is replaced by some other groups we get the derivatives of carboxylic Acids. When it is replaced by Cl we get acid chlorides, when it is replaced by OCOR we get anhydrides, when it is replaced by alkoxy group we get esters and when it is replaced by NH_2 group we get amides.
When it comes to the reactivity order of carboxylic acids and its derivatives, acid chlorides are the most reactive followed by acid anhydrides, esters and carboxylic acids both have similar reactivity and amides are the least reactive.
Now acid chloride being the most reactive reacts the fastest, it has the best leaving group and is the least stable.
Now amide being the least reactive reacts the slowest has a bad leaving group and is the most stable.
Now how do they react?
We all know that oxygen is more electronegative than carbon.
So the carbonyl group becomes polar wherein the carbon carries a partial positive charge and oxygen carries a partial negative charge.
so the carbon becomes electrophilic in nature and the nucleophile can easily add to it and

when it does so it forms a tetrahedral intermediate
and in the tetrahedral intermediate the carbonyl carbon becomes
sp3 hybridized and it carries an electronegative oxygen and electronegative Y
and electronegative Z. So it becomes highly unstable.

This is the reason the π bond reforms and a group is eliminated.
Now which group is eliminated depends on the basicity of the groups.
The less basic group is eliminated and the product is formed.
Now let us see the interconversions. So first we will have a look at the conversion of
acid chlorides into acids and its derivatives.
Now acid chloride when reacted with water the Cl group gets replaced by
OH group and we get carboxylic acid and the process is called as hydrolysis.
When acid chloride is reacted with ammonia
the Cl group gets replaced by NH2 group
and we get amide and ammonium chloride and this process is called as ammonolysis.
When acid chloride is reacted with alcohol the Cl group gets replaced by
alkoxy group and we get esters and this process is called as alcoholysis. We can also get anhydrides from acid chloride wherein
acid chloride is reacted with carboxylate anion and the anhydrides are formed. Now let us have a look at some of the reactions
related to the previous slide. We have benzoyl chloride and when it is subjected to hydrolysis we get benzoic acid.
When benzoyl chloride is subjected to ammonolysis by reacting it with ammonia we get benzamide, when benzoyl chloride is reacted with ethanol
the Cl group is replaced by ethoxy group and we get
ethyl benzoate and when acetyl chloride is reacted with sodium acetate we get acetic anhydride.
Next we can see the conversion of acid anhydrides into acids and its derivatives.
Acid anhydrides when are hydrolyzed we get two molecules of carboxylic acid.
Now acid anhydride when reacted with ammonia
the OCOR group of acid
anhydride is replaced by NH2 group

and the leaving group forms the ammonium
salt via the process of ammonolysis. When acid
anhydride is reacted with
an alcohol the OCOR group
of the anhydride is replaced by the
alkoxy group and we get
an ester and the leaving group
forms the carboxylic acid via the
process of alcoholysis.
So these are the reactions pertaining to
the previous slide wherein we have
Acetic ahydride which has been subjected
to hydrolysis and two molecules of
acetic acid have been obtained.
Then acetic anhydride when reacted with
Ammonia we are getting acetamide plus ammonium
acetate
and then acidic anhydride is subjected
to alcoholysis
by reacting it with methanol, methyl
acetate and acetic acid have been
formed. Next is the conversion of esters
into acids.
Now esters can be converted into acids
either by acid hydrolysis or by base
hydrolysis. So when ester is reacted with
water in presence of
an acid, carboxylic acid and a molecule
of alcohol is given out.
And when it is reacted with water in
presence of base
carboxylate anion and a molecule of
alcohol is given out.
Here we have to remember a
point that
esters and carboxylic acids both have
similar reactivity and because of this
we have to ensure
that the reaction proceeds in the
forward direction.
So to ensure that, we have to use excess
Of water. Next is the conversion of esters
into derivatives. So when ester is reacted with
ammonia the alkoxy group
is replaced by NH2 group and we get
amide
and the leaving alkoxy group forms the
alcohol via the process of ammonolysis.
When esters are reacted with alcohol the
alkoxy
group of the ester is replaced by the
alkoxy group from the alcohol and we get
a new ester
and because of this, this process is
called as transesterification because
from a starting ester we are getting a
new ester,
and the leaving group forms the alcohol.
these are the reactions pertaining to the
previous two slides wherein
ethyl benzoate when reacted with water
in presence of acid we are getting

benzoic acid and a molecule of ethanol
and when ethyl benzoate is reacted with
water in presence of
base we are getting sodium benzoate and
a molecule of
Ethanol. Here we have ethyl acetate
which when reacted with ammonia the
ethoxy group has been replaced by
NH2 group and a molecule of ethanol is
given out.
Next we can see an example of transesterification reaction wherein
ethyl isobutyrate is the ester which
when reacted with methanol
the ethoxy group of ethyl isobutyrate
has been replaced by methoxy group from
methanol
and we are getting methyl isobutyrate, a
new ester and a molecule of ethanol is given
out here.
Next is the conversion of amides into
acids.
Here amides can be hydrolyzed either by
acid hydrolysis or they can be
hydrolyzed by base hydrolysis. So amides
when reacted with water
in presence of acid catalyst carboxylic
acid is obtained and an ammonium salt is
formed.
Amide when reacted with water in
presence of base
carboxylate anion is obtained and a
molecule of ammonia is given out.
One more thing we have to remember here
is that amides are the least reactive
so they are mostly converted to acids
first and from
acid they are further converted to the
other derivatives if required.
These are the reactions of amides
wherein we have benzamide
which is which is when
reacted with water in presence of
sulfuric acid it is giving us benzoic
acid and an ammonium salt is given out and we
have another amide
that is butanamide which when reacted
with water
in presence of base that is sodium
hydroxide sodium butanoate
is obtained and a molecule of ammonia is
given out.
These are the references. With this i
finish my module in which
we have studied the different
derivatives of carboxylic acids,
their structures, the reactivity order
of carboxylic acids and its derivatives,
how they react and then we also had a
brief overview of the interconversion of acid
derivatives.
Thank you.