Carboxylic acid Derivatives

Part C

B. Pharm. Semester-1

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Learning Outcomes

At the end of this lesson, students will be able to describe Carboxylic acid derivatives

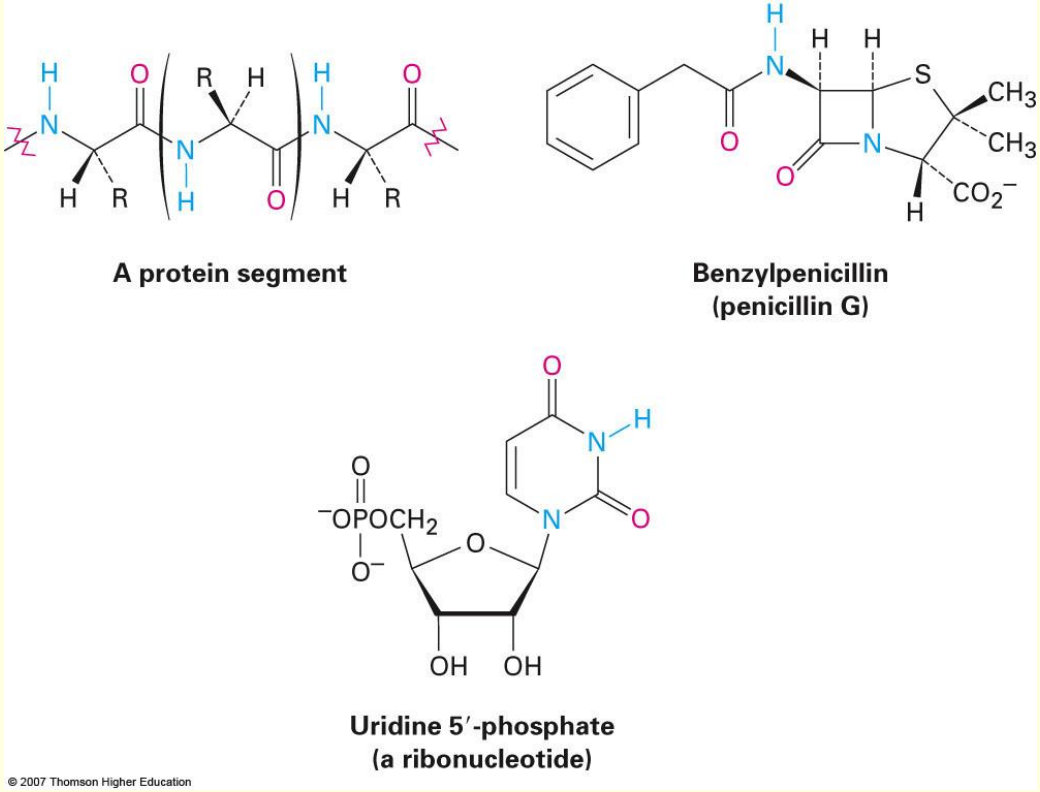
- **Chemistry and Reactions of amides**
- **Chemistry of Thioesters and Acyl Phosphates**
- **Polyamides and Polyamides**
- **Spectroscopy of carboxylic acid derivatives**

Objective

The objective of this course is to give to the students of pharmacy the basic knowledge about the organic chemistry.

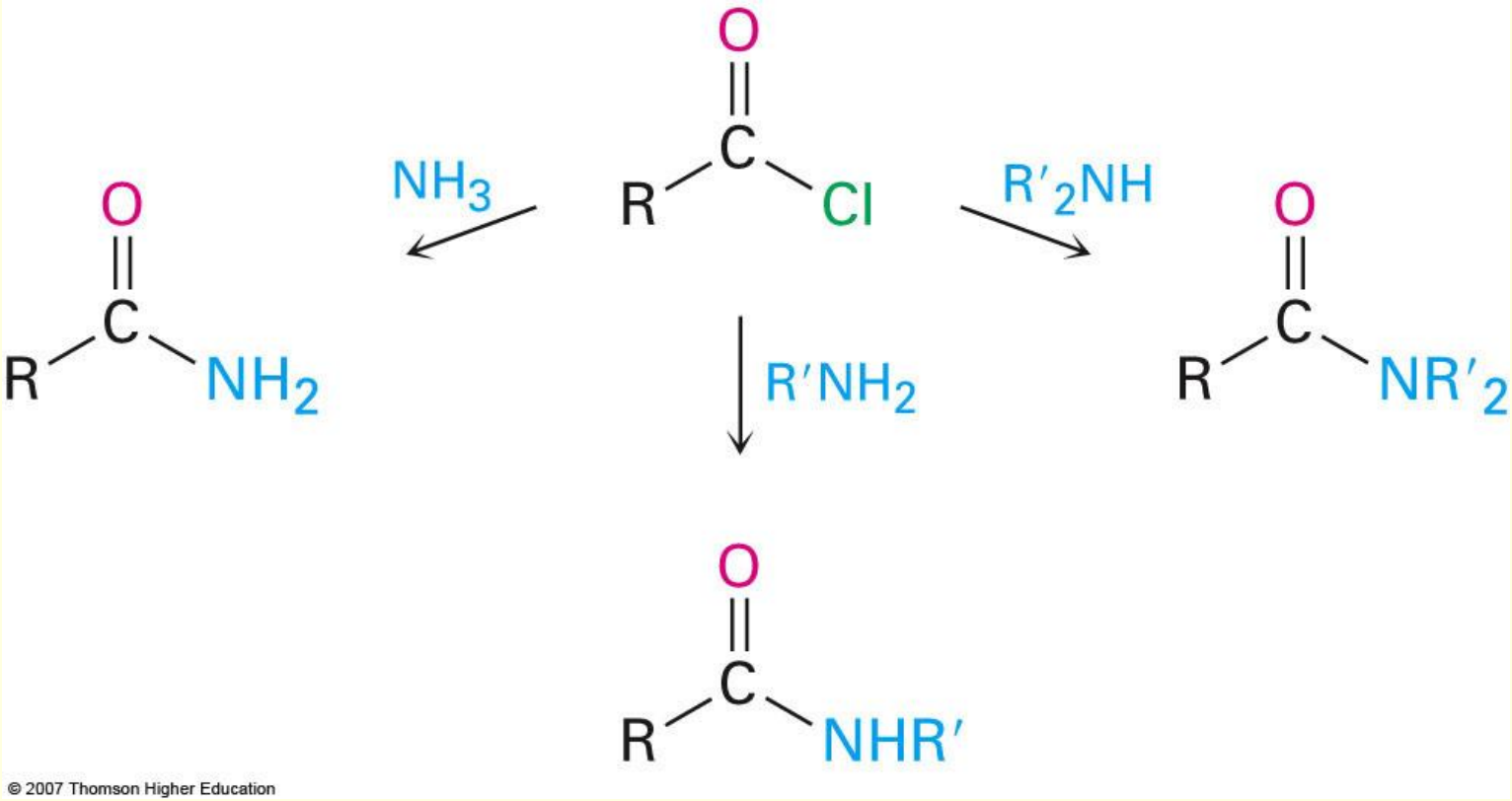
Chemistry of Amides

Amides are abundant in all living organisms…proteins, nucleic acids, and other pharmaceuticals have amid functional groups



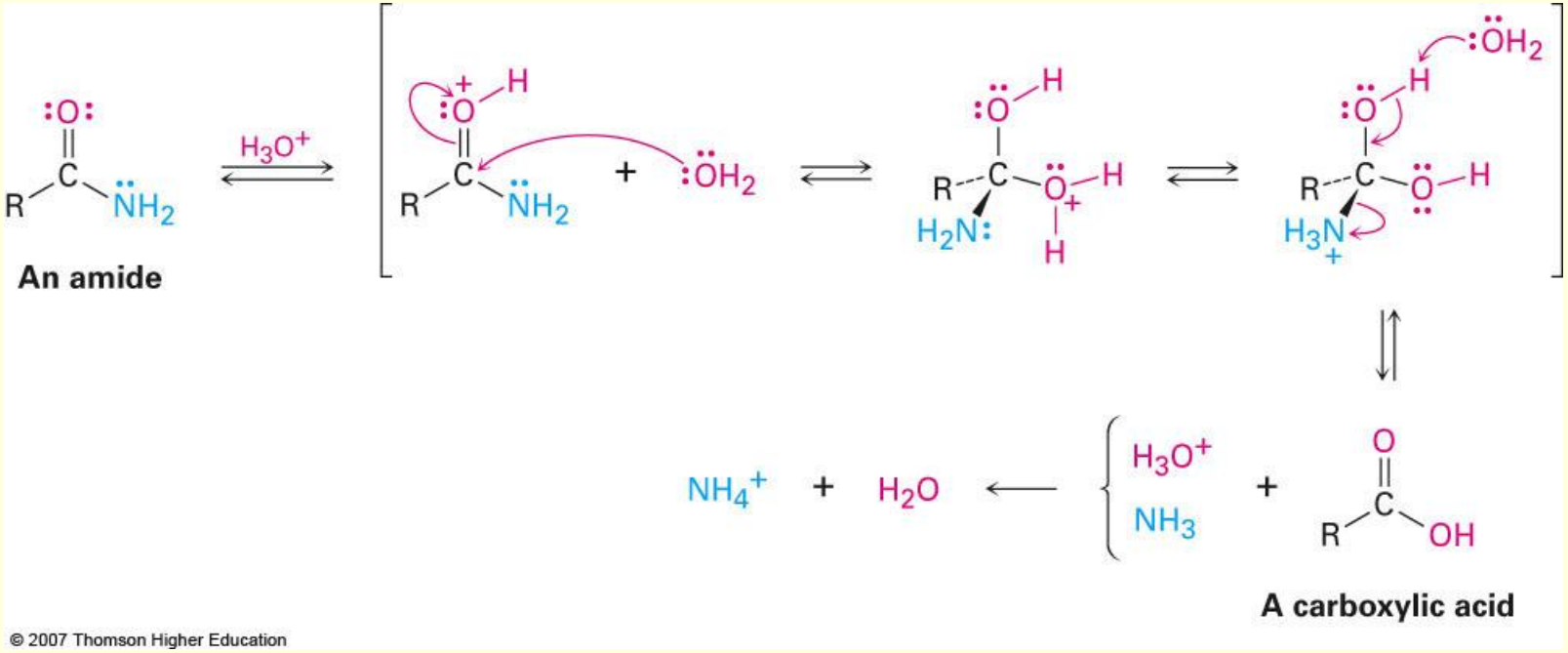
Preparation of Amides

Amides are usually prepared by a reaction of an acid chloride with ammonia, monosubstituted amines, or disubstituted amines.



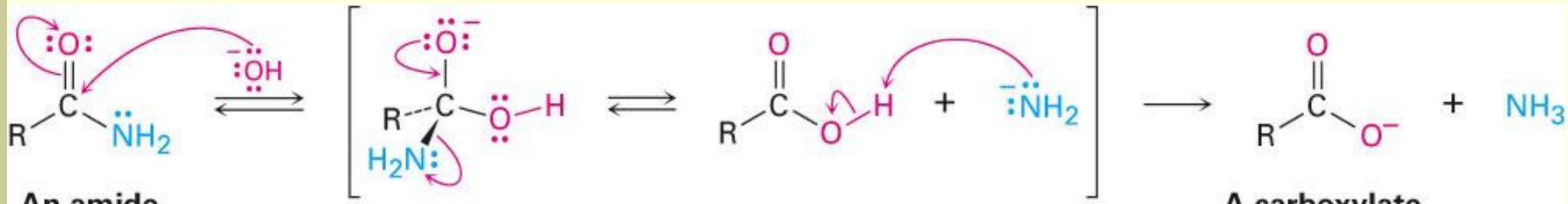
Reactions of Amides

- Heating in either aqueous acid or aqueous base produces a carboxylic acid and amine.
- Acidic hydrolysis by nucleophilic addition of water to the protonated amide, followed by loss of ammonia.



Hydrolysis of Amides

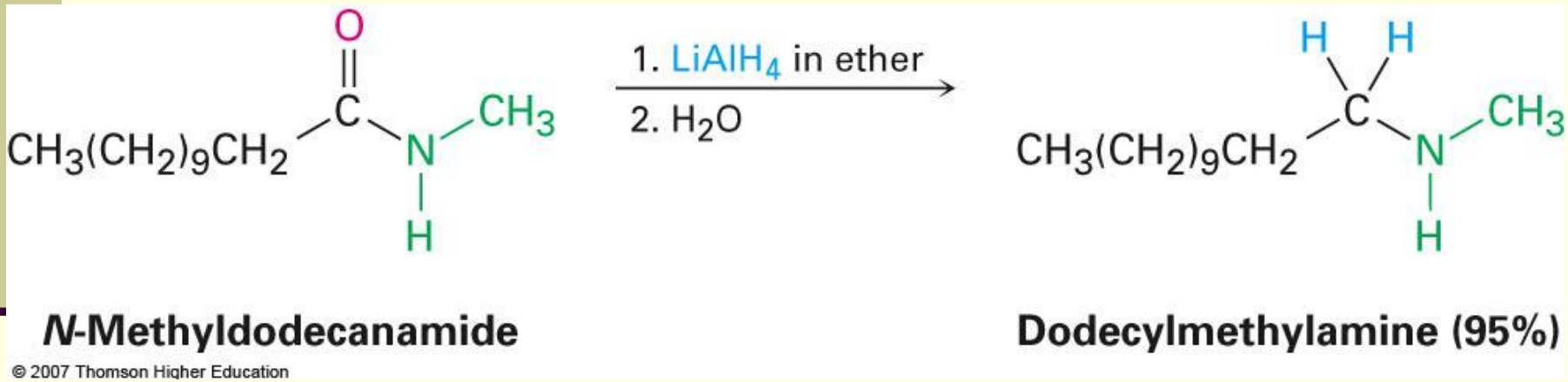
Amide is hydrolyzed by the addition of hydroxide and loss of amide ion.



Reduction: Conversion of Amides into Amines

Reduced by $LiAlH_4$ to an amine rather than an alcohol,

Converts C=O to CH_2

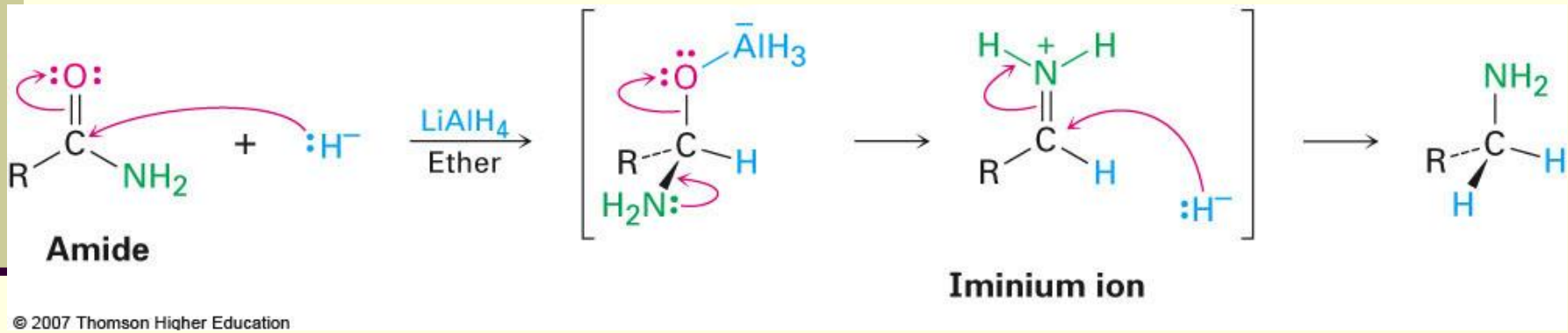


***N*-Methyldodecanamide**

Dodecylmethylamine (95%)

Mechanism of Reduction

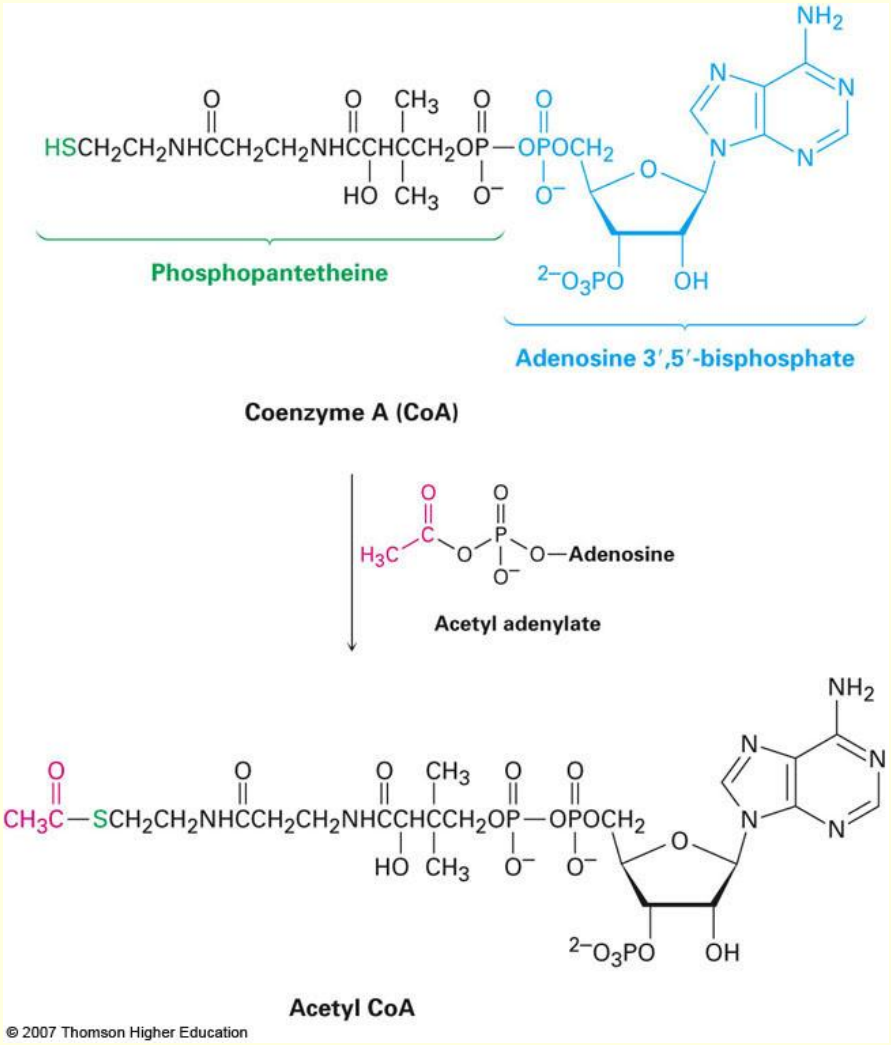
- ✓Addition of hydride to carbonyl group.
- ✓Loss of the oxygen as an aluminate anion to give an iminium ion intermediate which is reduced to amine.



Chemistry of Thioesters and Acyl Phosphates

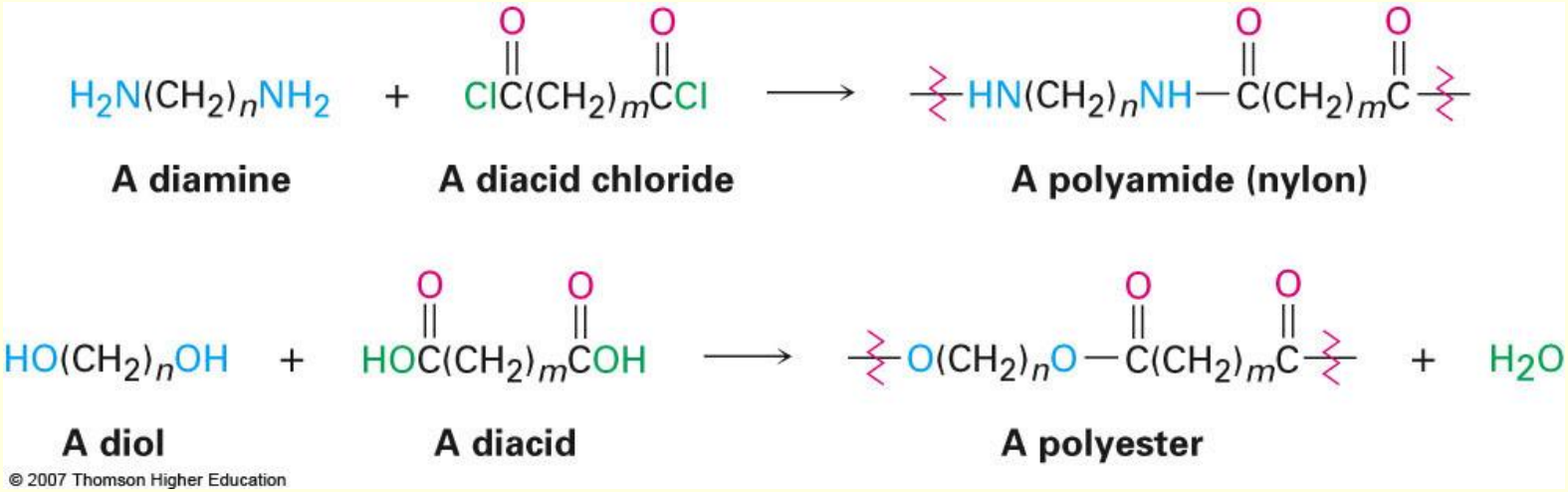
Nucleophilic carboxyl substitution in nature often involves a thioester or acyl phosphate.

Acetyl CoA's are most common thioesters in nature



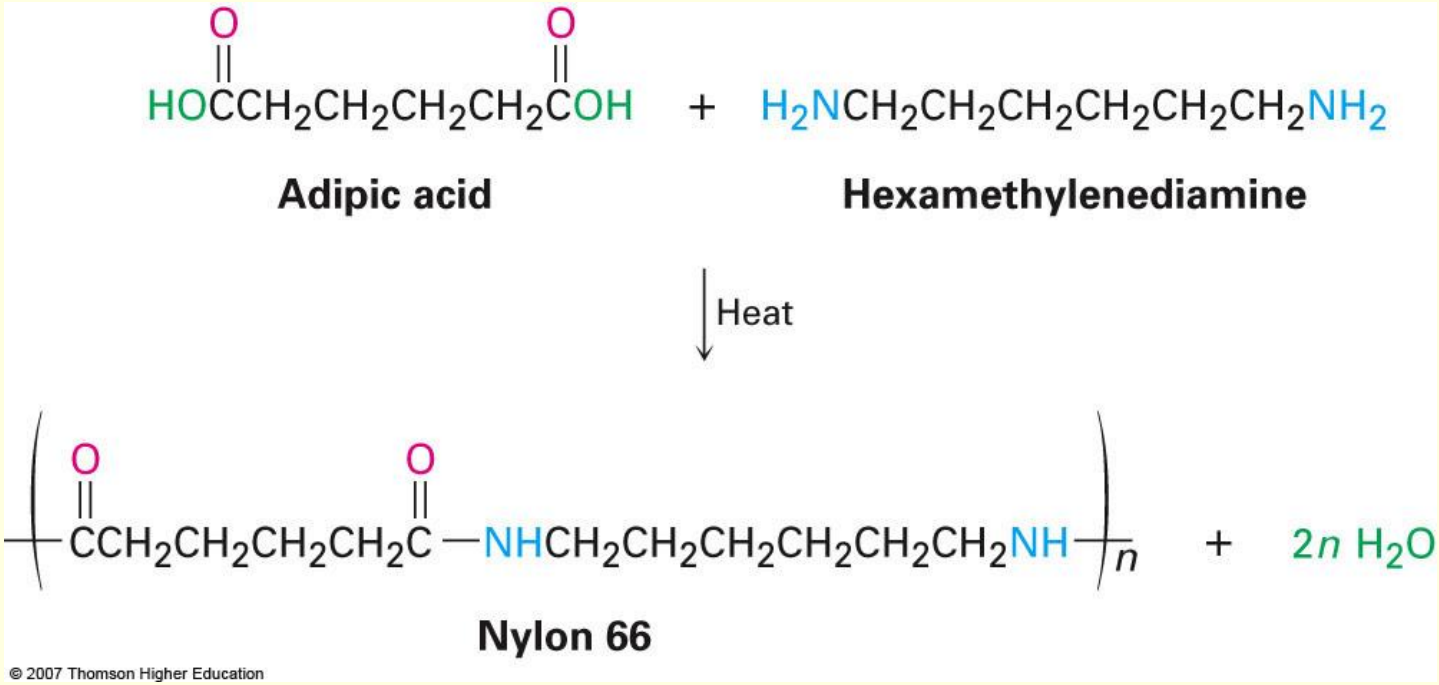
Polyamides and Polyesters: Step-Growth Polymers

- ✓Reactions occur in distinct linear steps, not as chain reactions
- ✓Reaction of a diamine and a diacid chloride gives an ongoing cycle that produces a polyamide
- ✓A diol with a diacid leads to a polyester



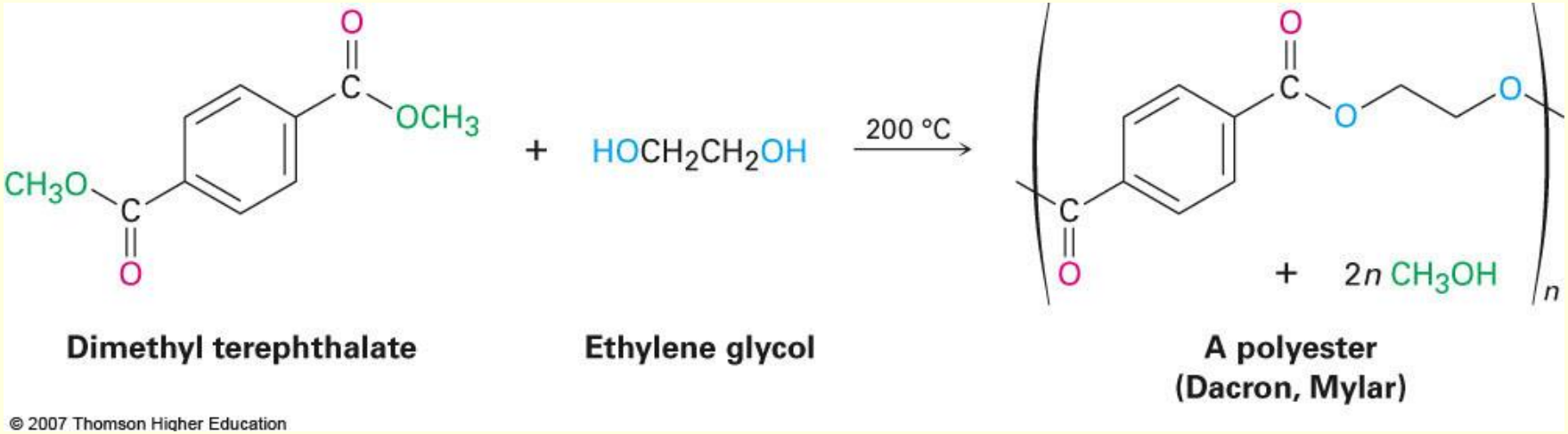
Polyamides: Nylon

- ✓Heating a diamine with a diacid produces a polyamide called Nylon®
- ✓Nylon 66® is from adipic acid and hexamethylene-diamine at 280°C.



Polyesters

The polyester from dimethyl terephthalate and ethylene glycol is called Dacron® and Mylar® to make fibers.



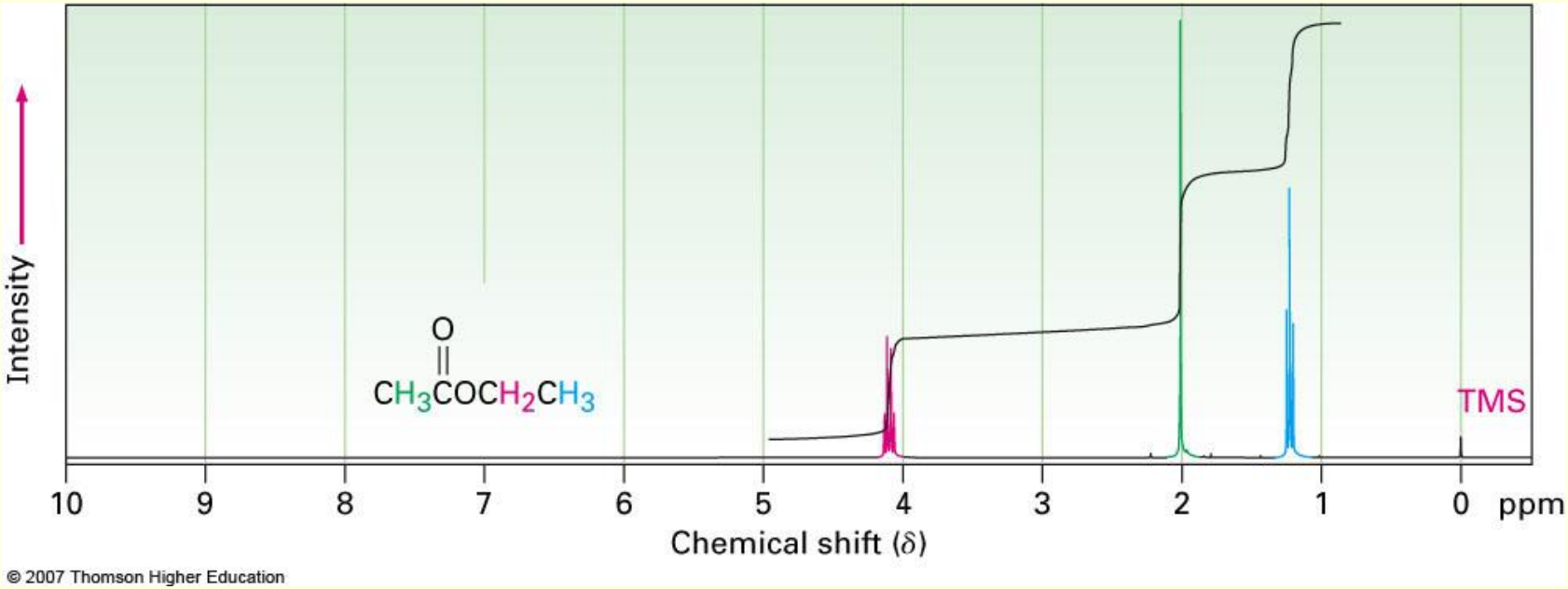
Spectroscopy of Carboxylic acid derivatives

IR Spectroscopy

- Acid chlorides absorb near 1800 cm^{-1}
- Acid anhydrides absorb at 1820 cm^{-1} and also at 1760 cm^{-1}
- Esters absorb at 1735 cm^{-1}, higher than aldehydes or ketones
- Amides absorb near the low end of the carbonyl region.

^{1}H-NMR Spectroscopy

- Hydrogens on the carbon next to a C=O are near δ 2 ppm in the ^{1}H NMR spectrum.
- All acid derivatives absorb in the same range, so NMR does not distinguish them from each other.



^{13}C-NMR Spectroscopy

- It is useful for determining the presence or absence of a carbonyl group in a molecule of unknown structure
- Carbonyl carbon atoms of the various acid derivatives absorb from δ 160 to δ 180 ppm.

Table 21.4 | **^{13}C NMR Absorptions in Some Carbonyl Compounds**

Compound	Absorption (δ)	Compound	Absorption (δ)
Acetic acid	177.3	Acetic anhydride	166.9
Ethyl acetate	170.7	Acetone	205.6
Acetyl chloride	170.3	Acetaldehyde	201.0
Acetamide	172.6		

REFERENCES

Textbooks:

1. **Organic Chemistry, 9th Edition, 2015, Author: John E. McMurry, Publisher: Cengage Learning, ISBN: 978-1305080485.**
2. **Organic Chemistry, 7th Edition, 2010, Authors: Saibal Kanti Bhattacharjee, Robert Thornton Morrison, Robert Neilson Boyd, Publisher: Pearson India, ISBN: 978-0199270293.**
3. **Textbook of Organic Chemistry, 22nd Edition, 2022, Authors: Arun Bahl & B S Bahl, Publisher: S Chand, ISBN: 978-9352531967.**

Supplementary book:

Organic Chemistry, 11th Edition, 2015, Authors: Francis Carey Robert Giuliano Neil Allison Susan Bane, Publisher: McGraw Hill, ISBN: 978-1260148923.