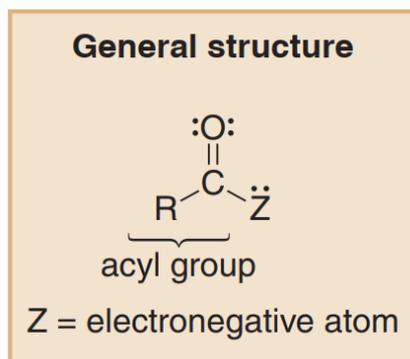


كلية التربية للعلوم الصرفة	الكلية
قسم الكيمياء	القسم
Organic chemistry	المادة باللغة الانجليزية
الكيمياء العضوية	المادة باللغة العربية
المرحلة الثانية	المرحلة الدراسية
د. عمر جمال مهدي العسافي	اسم التدريسي
Acid chloride	عنوان المحاضرة باللغة الانجليزية
كلوريد الحامض	عنوان المحاضرة باللغة العربية
العاشر	رقم المحاضرة
<i>Organic Chemistry</i> 6 <sup>ed</sup> , William H. Brown, Christopher S. Foote, Brent L. Iverson, Eric V. Anslyn, Bruce M. Novak, 2012	المصادر والمراجع
<i>Organic Chemistry</i> 3 <sup>ed</sup> , Janice Gorzynski Smith, 2011	
<i>Organic Chemistry</i> " by Jonathan Clayden, Nick Greeves, and Stuart Warren	



## 1. Introduction

Carbonyl compounds bonded to an electronegative atom called an acyl group. These include carboxylic acids and their derivatives such as acid chlorides.

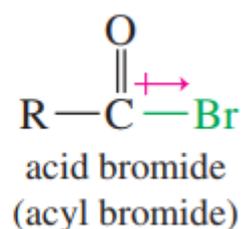
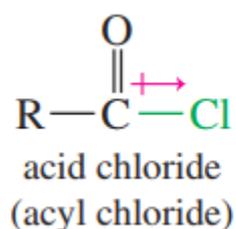
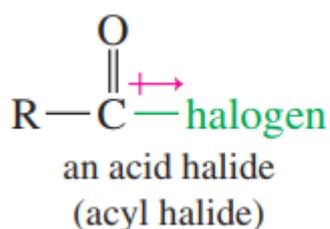


## 2-Nomenclature

The names of carboxylic acid derivatives are formed from the names of the parent carboxylic acids discussed in section previous. Keep in mind that the common names formic acid, acetic acid, and benzoic acid are virtually always used for the parent acid, so these common parent names are used for their derivatives as well.

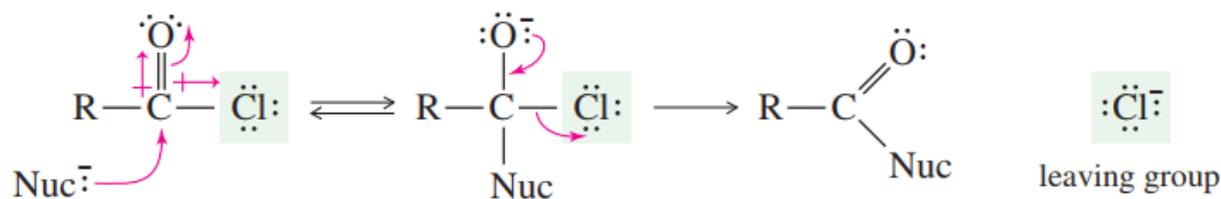
### ➤ Naming an Acid Chloride—RCOCl

The most common acyl halides are the acid chlorides (acyl chlorides), and we will generally use acid chlorides as examples.



The halogen atom of an acyl halide inductively withdraws electron density from the carbonyl carbon, enhancing its electrophilic nature and making acyl

halides particularly reactive toward nucleophilic acyl substitution. The halide ion also serves as a good leaving group.

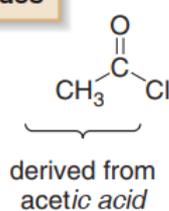


Acid chlorides are named by naming the acyl group and adding the word **chloride**. Two different methods are used.

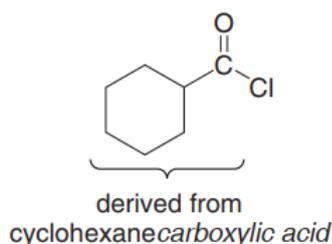
[1] For acyclic acid chlorides: Change the suffix **-ic acid** of the parent carboxylic acid to the suffix **-yl chloride**; or

[2] When the  $\text{-COCl}$  group is bonded to a ring: Change the suffix **-carboxylic acid** to **-carbonyl chloride**.

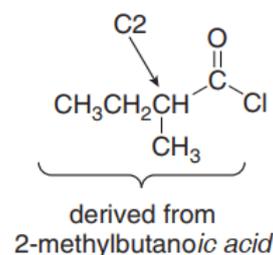
#### Naming acid chlorides



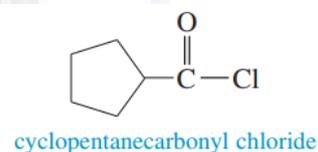
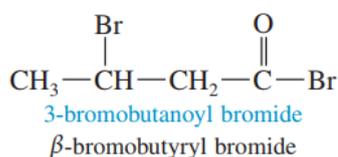
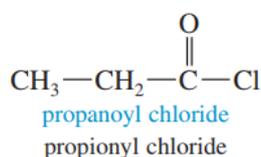
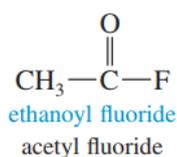
acetyl chloride



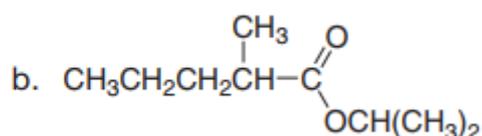
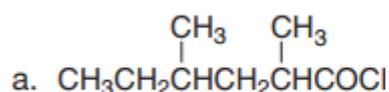
cyclohexanecarbonyl chloride



2-methylbutanoyl chloride



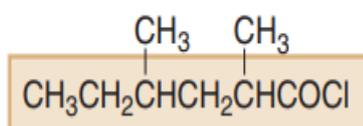
**Problem:** Give the IUPAC name for each compound.



**Solution**

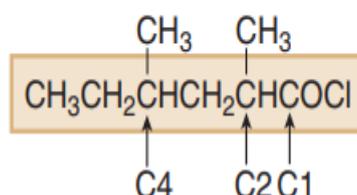
a. The functional group is an acid chloride bonded to a chain of atoms, so the name ends in **-yl chloride**.

[1] Find and name the longest chain containing the COCl:



**hexanoic acid** (6 C's)  $\longrightarrow$  **hexanoyl chloride**

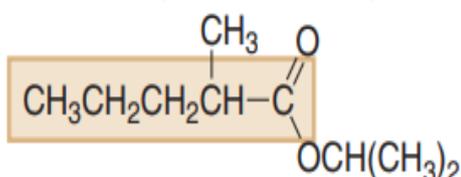
[2] Number and name the substituents:



**Answer:**  
**2,4-dimethylhexanoyl chloride**

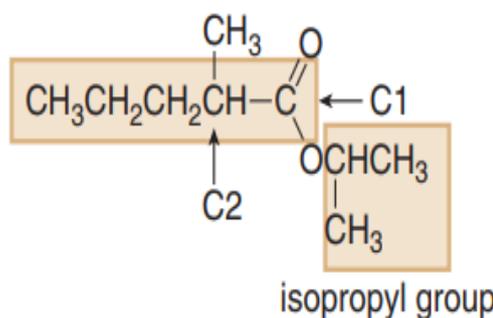
b. The functional group is an ester, so the name ends in **-ate**.

[1] Find and name the longest chain containing the carbonyl group:



**pentanoic acid** (5 C's)  $\longrightarrow$  **pentanoate**

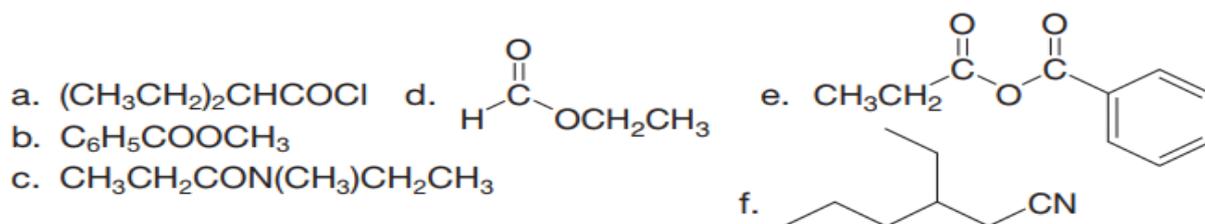
[2] Number and name the substituents:



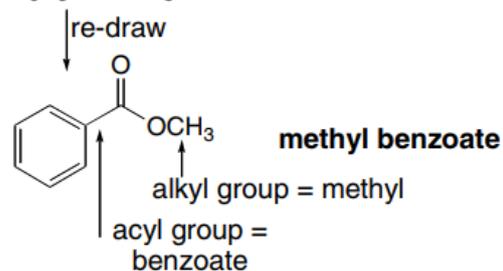
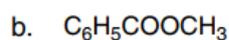
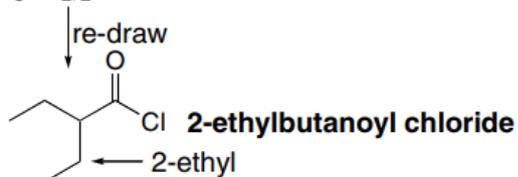
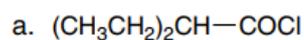
**Answer: isopropyl 2-methylpentanoate**

The name of the alkyl group on the O atom goes **first** in the name.

**Problem:** Give an IUPAC or common name for each compound



**Solution**

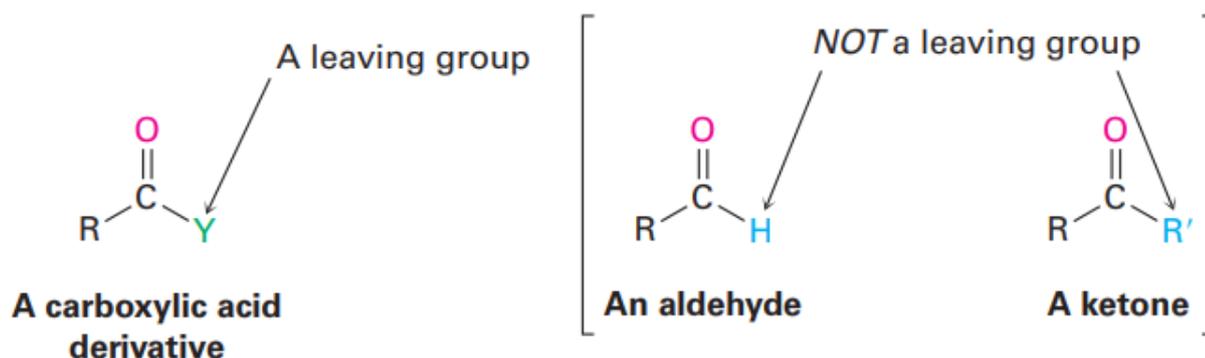


**Problem:** Draw the structure corresponding to each name.

- a. 5-methylheptanoyl chloride    e. 3-methylpentanenitrile  
b. isopropyl propanoate    f. o-cyanobenzoic acid  
c. acetic formic anhydride    g. sec-butyl 2-methylhexanoate  
d. N-isobutyl-N-methylbutanamide    h. N-ethylhexanamide

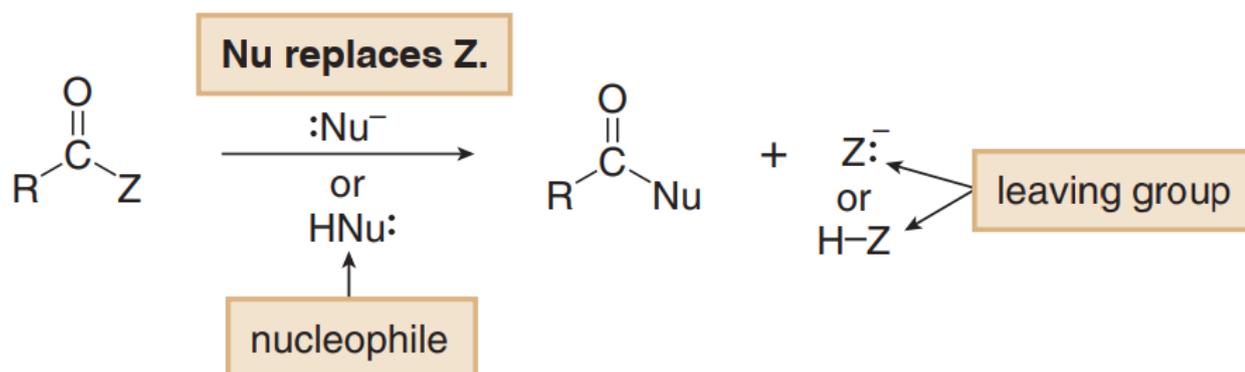
### 3. Introduction to Nucleophilic Acyl Substitution

The different behavior toward nucleophiles of aldehydes/ketones and carboxylic acid derivatives is a consequence of structure. Carboxylic acid derivatives have an acyl carbon bonded to a group-Y that can leave as a stable anion. As soon as addition of a nucleophile occurs, the group leaves and a new carbonyl compound forms. Aldehydes and ketones have no such leaving group, however, and therefore don't undergo substitution.



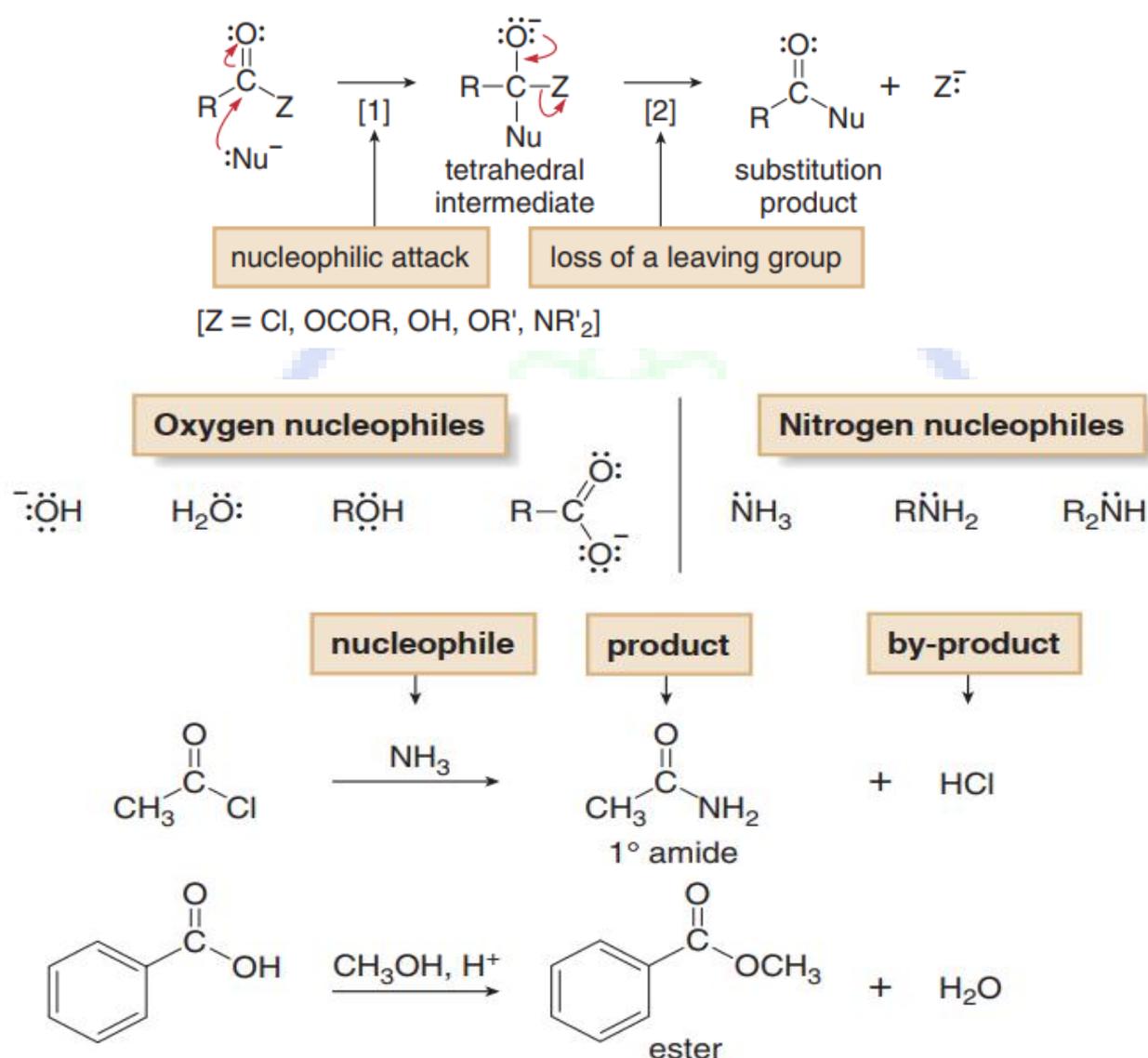
This is a general reaction that occurs with both negatively charged nucleophiles ( $Nu^-$ ) and neutral nucleophiles ( $HNu:$ ).

#### Nucleophilic substitution



- Carboxylic acid derivatives ( $RCOZ$ ) react with nucleophiles because they contain an electrophilic, unhindered carbonyl carbon.
- Substitution occurs, not addition, because carboxylic acid derivatives ( $RCOZ$ ) have a leaving group  $Z$  on the carbonyl carbon.

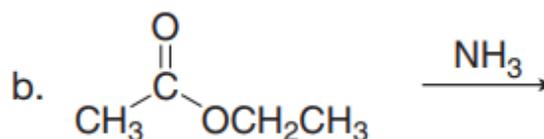
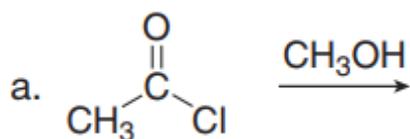
## Mechanism General Mechanism—Nucleophilic Acyl Substitution



Each reaction results in the replacement of the leaving group by the nucleophile, regardless of the identity of or charge on the nucleophile. To draw any nucleophilic acyl substitution product:

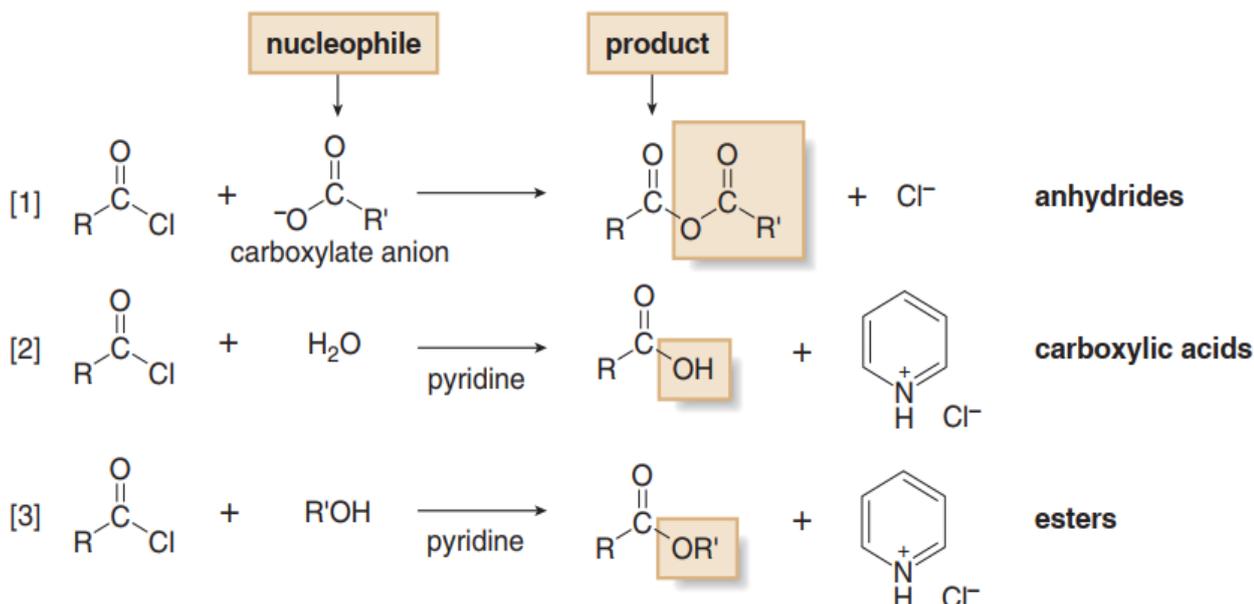
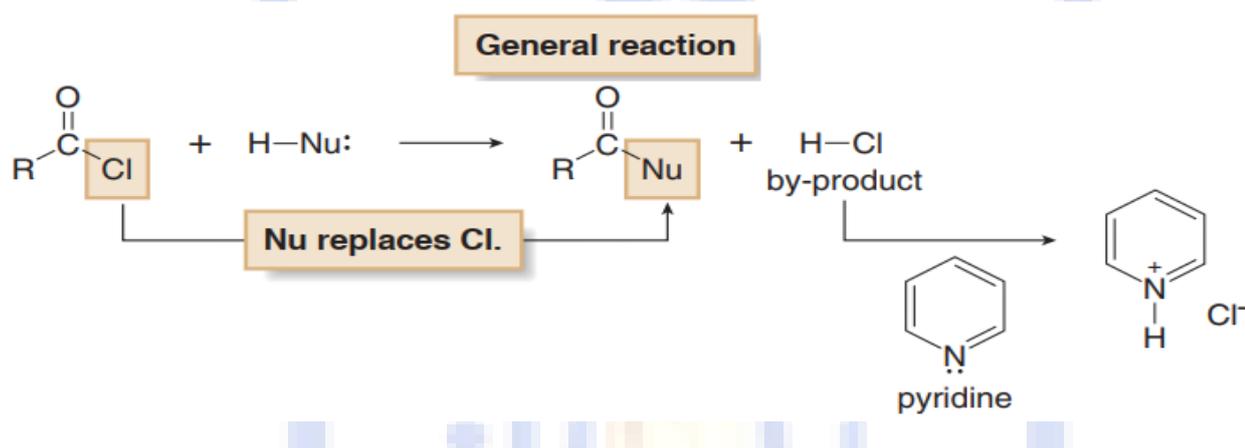
- Find the  $\text{sp}^2$  hybridized carbon with the leaving group.
- Identify the nucleophile.
- Substitute the nucleophile for the leaving group. With a neutral nucleophile a proton must be lost to obtain a neutral substitution product.

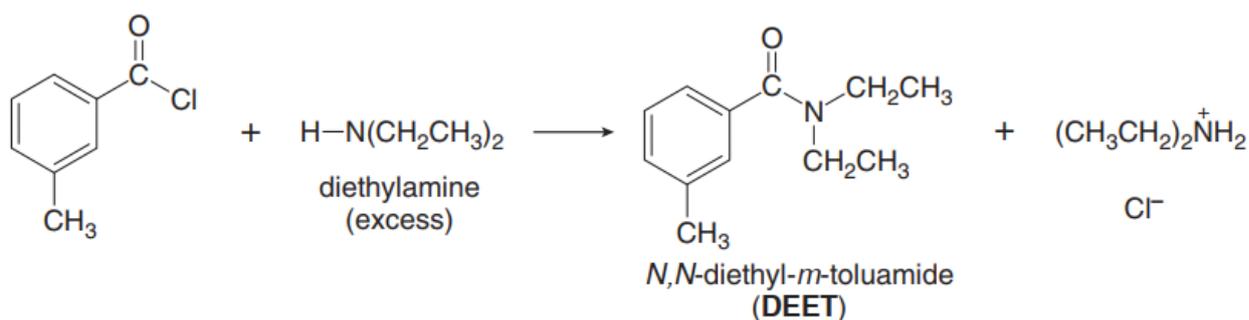
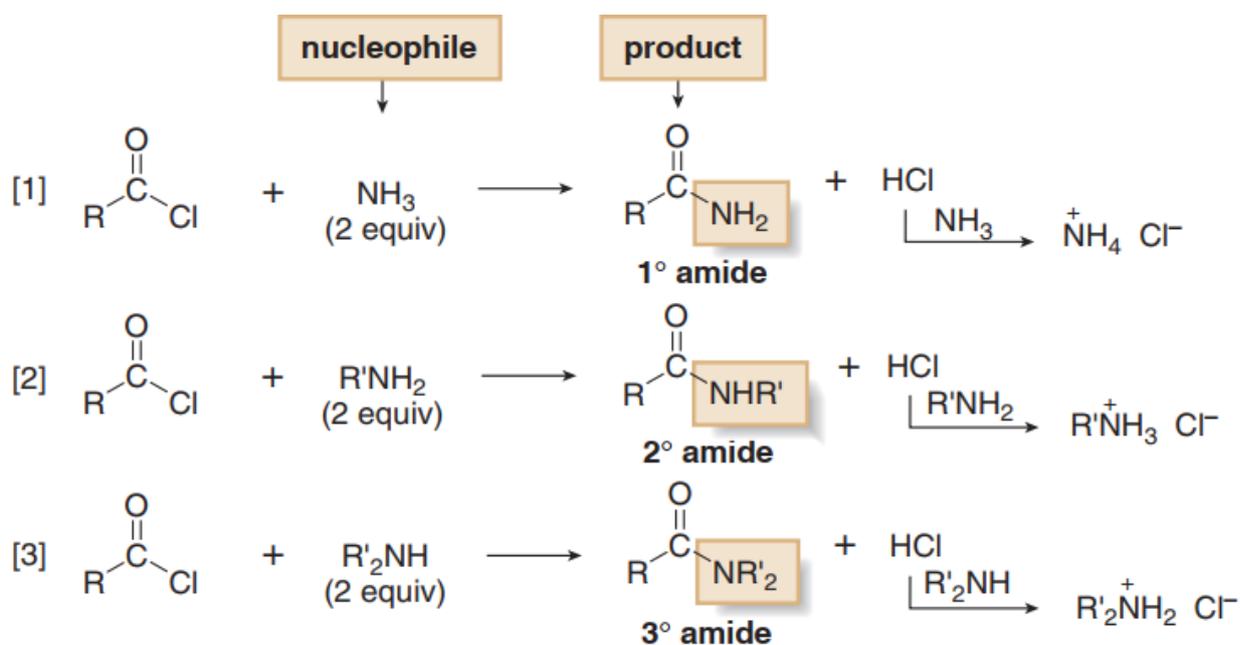
**Problem:** Draw the products of each reaction.



### ➤ Reactions of Acid Chlorides

Acid chlorides readily react with nucleophiles to form nucleophilic substitution products, with HCl usually formed as a reaction by-product. A weak base like pyridine is added to the reaction mixture to remove this strong acid, forming an ammonium salt.





**Problem :** Draw the products formed when benzoyl chloride ( $\text{C}_6\text{H}_5\text{COCl}$ ) is treated with each nucleophile:

- (a)  $\text{H}_2\text{O}$ , pyridine; (b)  $\text{CH}_3\text{COO}^-$ ; (c)  $\text{NH}_3$  (excess); (d)  $(\text{CH}_3)_2\text{NH}$  (excess).

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