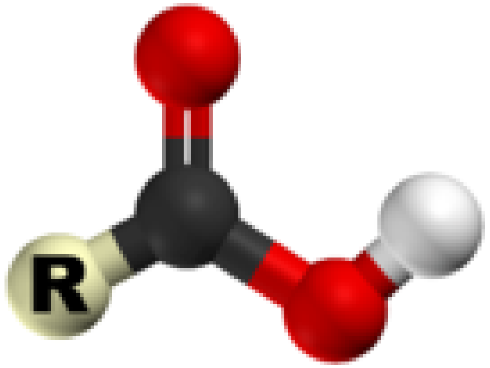
2302106 – Basic Organic Chemistry for ISE – Part II

Lecture 5-3

Carboxylic and Derivatives – Nucleophilic Substitution-1



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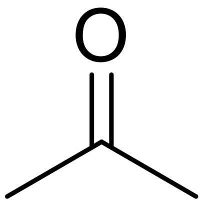
Recommended Textbook:

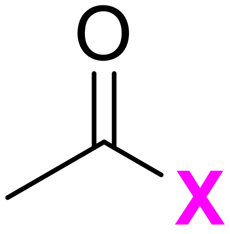
Chapter 20 in *Organic Chemistry*, 8th Edition, L. G. Wade, Jr., **2010**, Prentice Hall (Pearson Education)

Nucleophilic Addition vs. Substitution

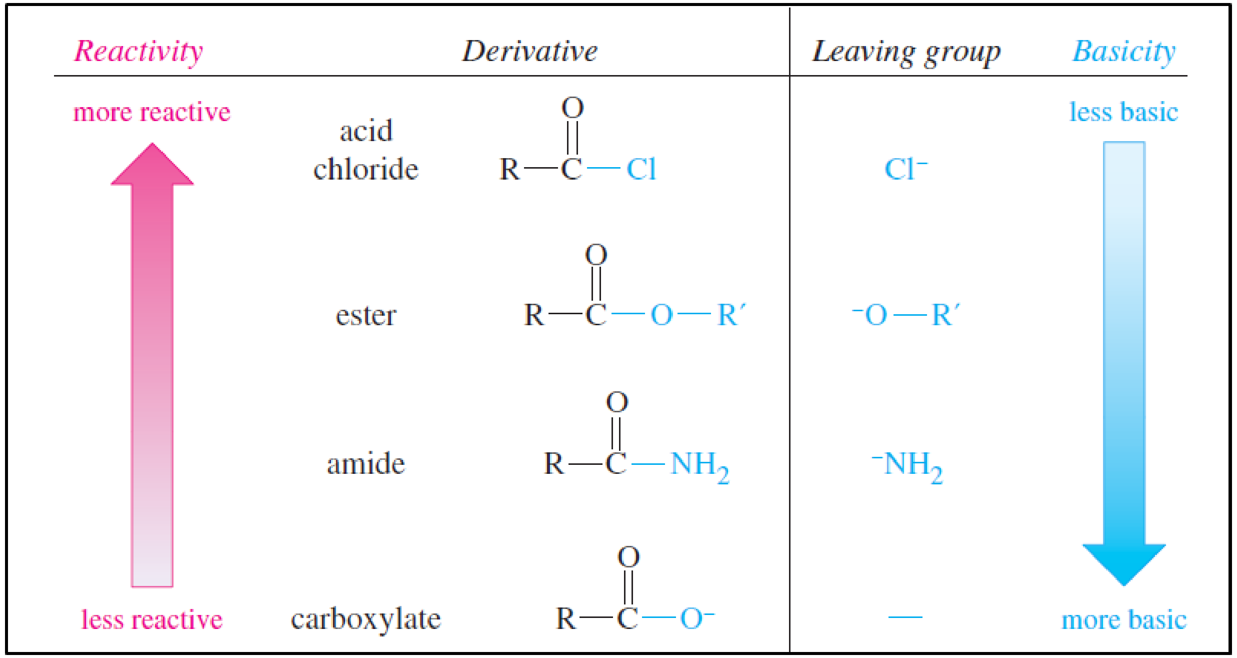
Ketone



Carbox.
Deriv.



Nucleophilic Substitution – Reactivity towards Nucleophile

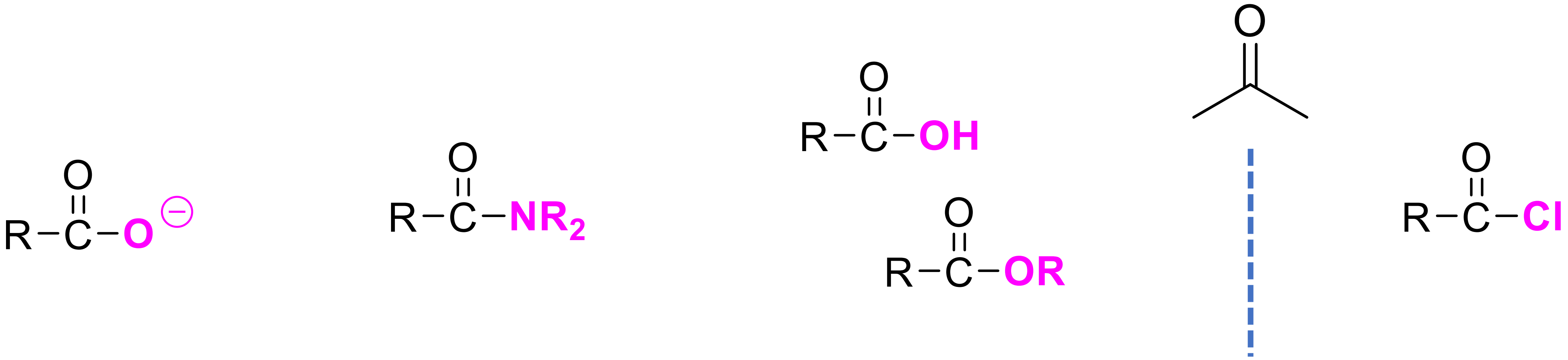


Factor #1 – Leaving group ability

Factor #2 – Resonance stabilization

Nucleophilic Substitution – Reaction with Weak Nucleophiles

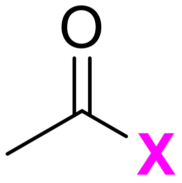
1 – Reaction with water (no catalyst)



Nucleophilic Substitution – no catalyst vs. base/acid catalyzed

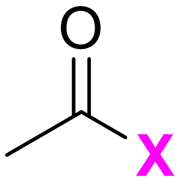
#1 No catalyst

Nu-H



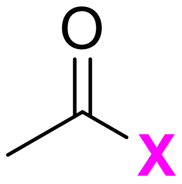
#2 Base catalyzed

Nu-H



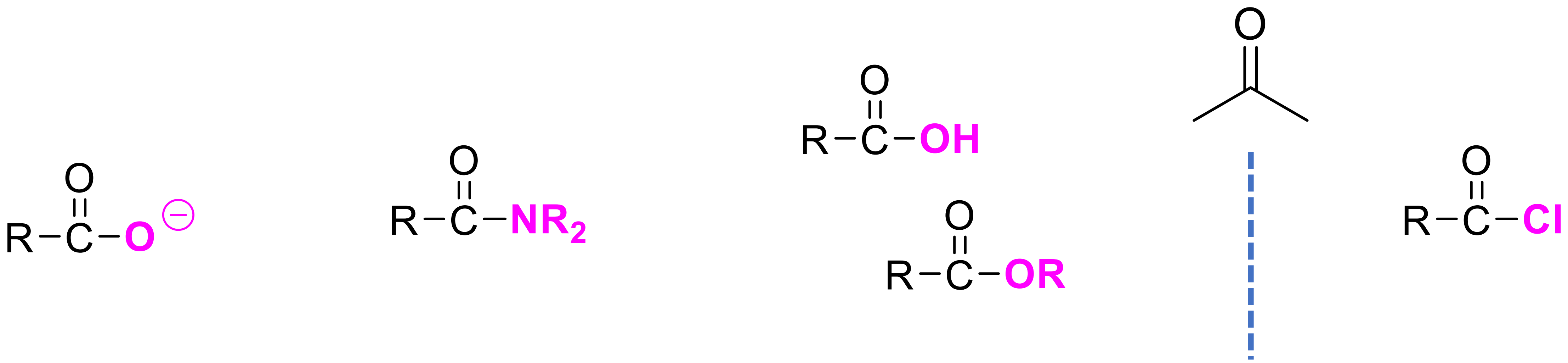
#3 Acid catalyzed

Nu-H



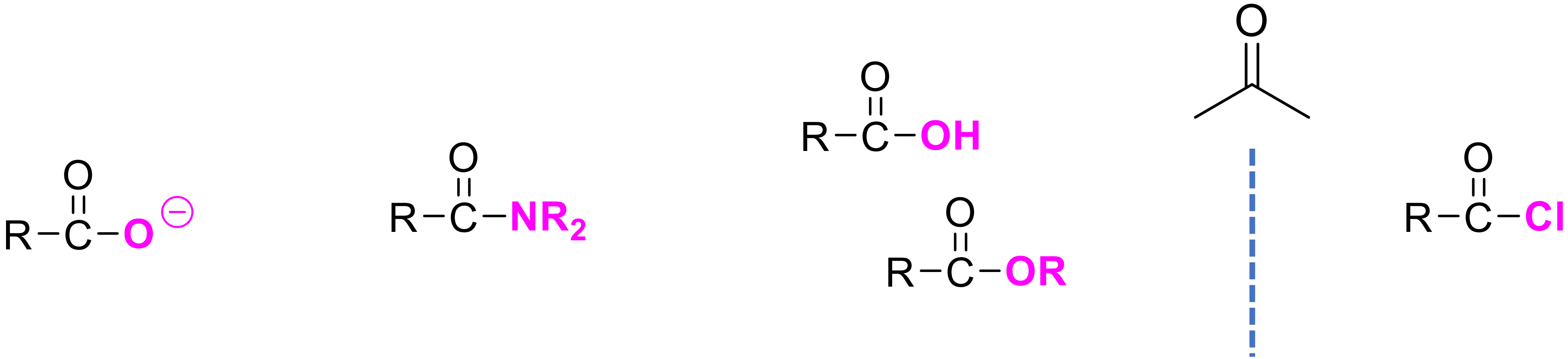
Nucleophilic Substitution

1 – Reaction with water (base catalyzed)



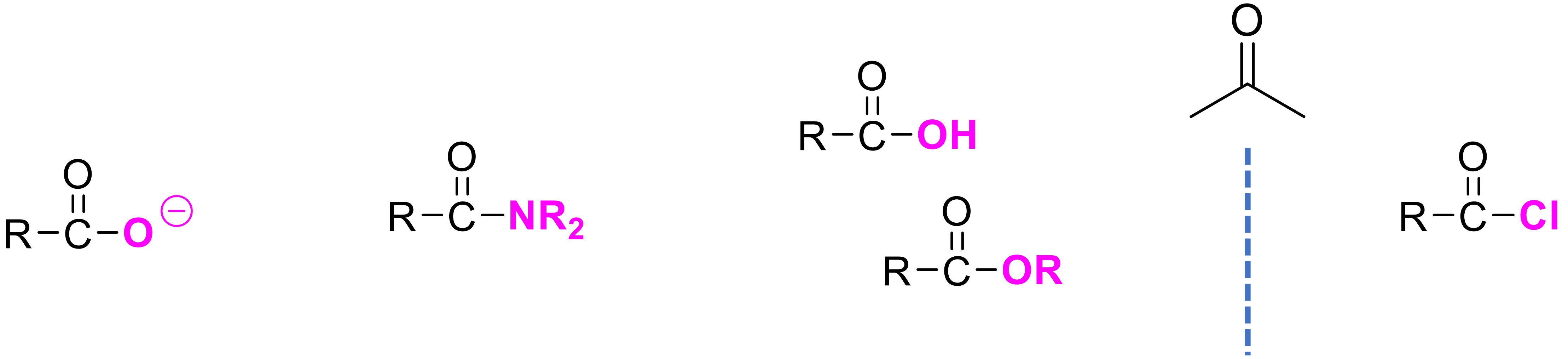
Nucleophilic Substitution

1 – Reaction with water (acid catalyzed)



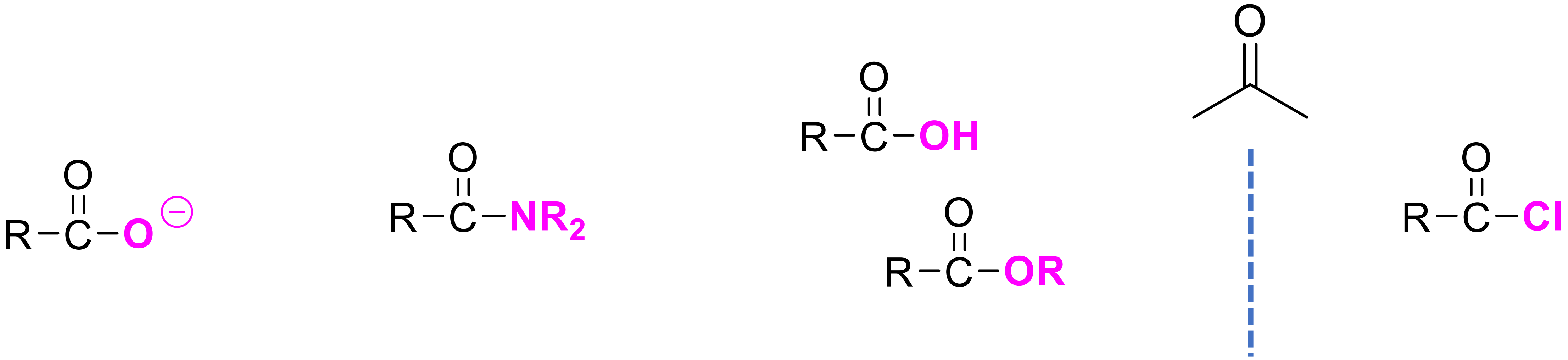
Nucleophilic Substitution

2 – Reaction with alcohol (no catalyst)



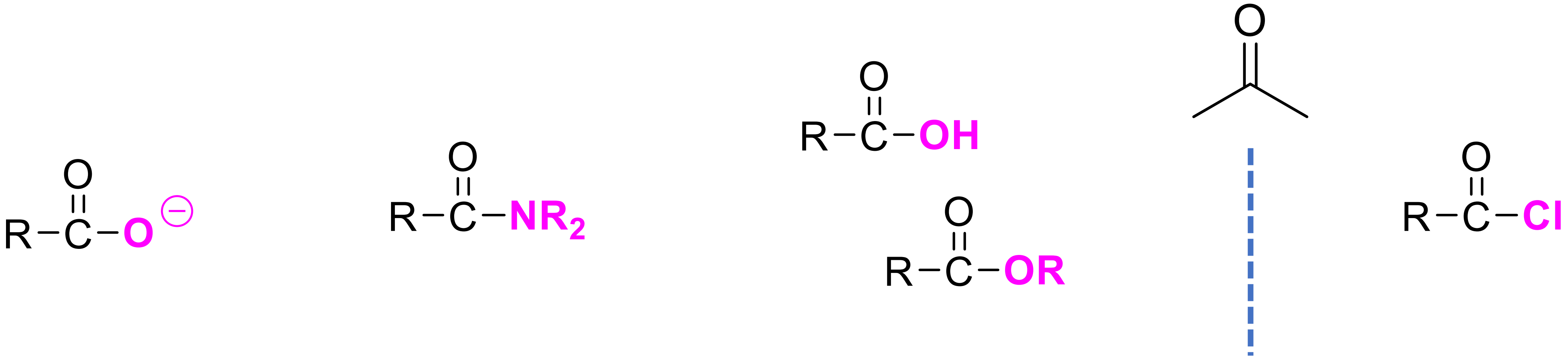
Nucleophilic Substitution

2 – Reaction with alcohol (base catalyzed)



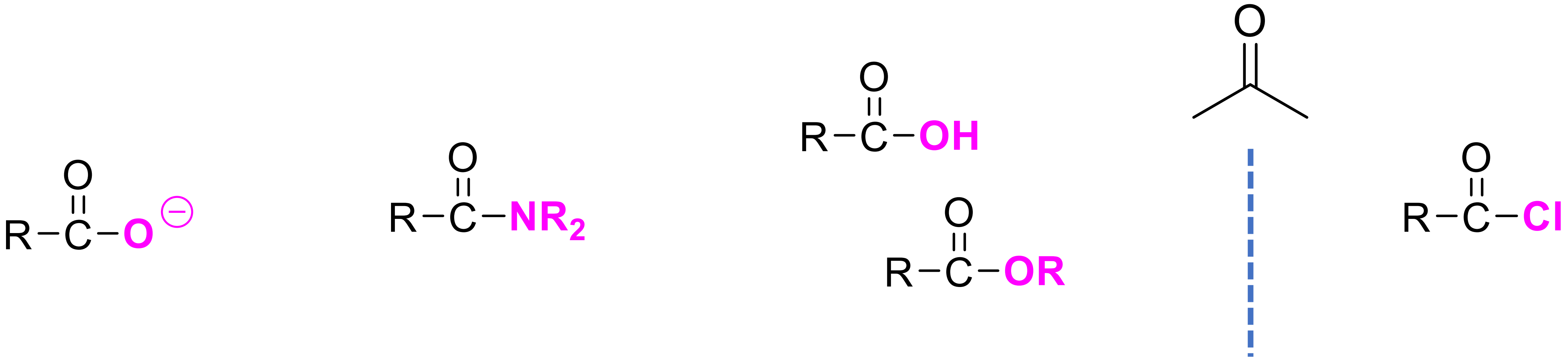
Nucleophilic Substitution

2 – Reaction with alcohol (acid catalyzed)



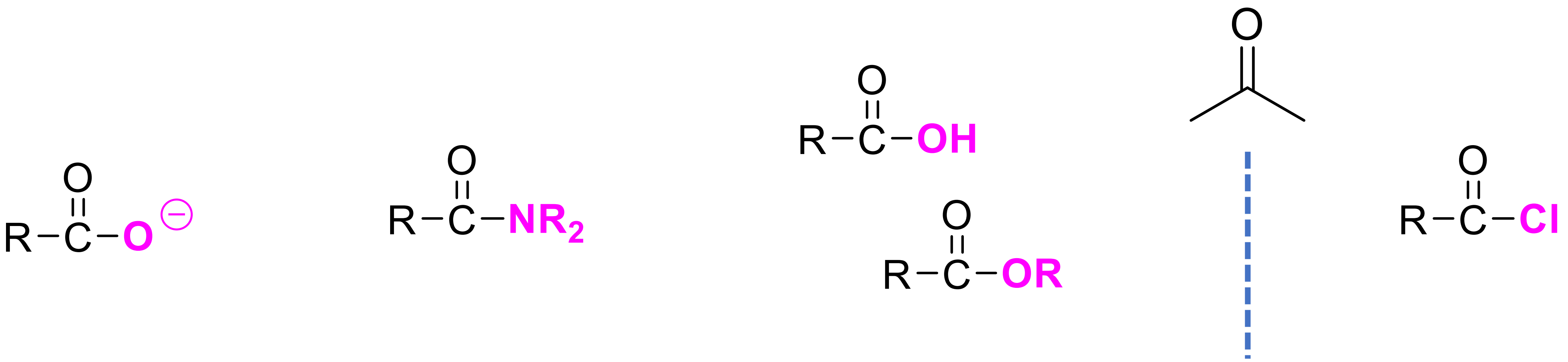
Nucleophilic Substitution

3 – Reaction with amine (no catalyst)



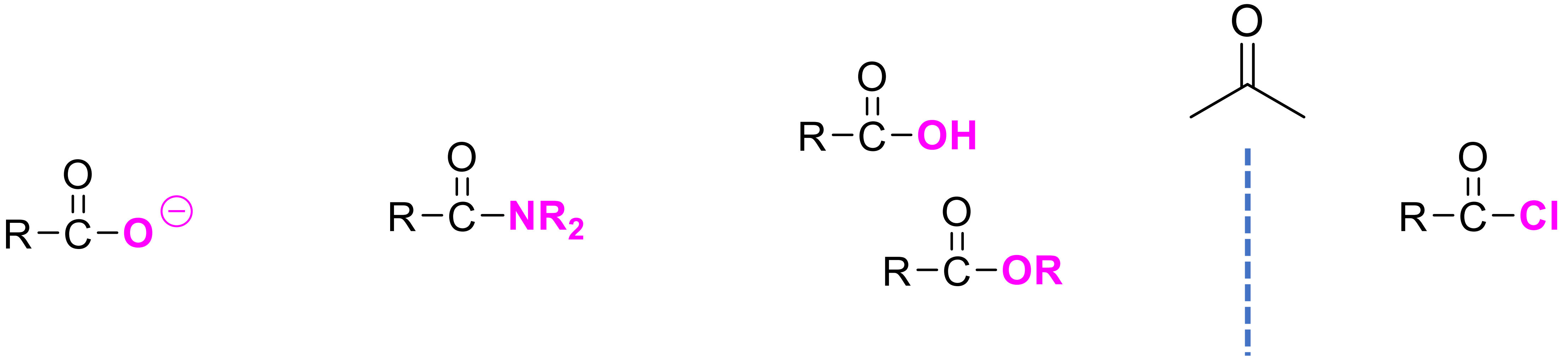
Nucleophilic Substitution

3 – Reaction with amine (base catalyst)



Nucleophilic Substitution

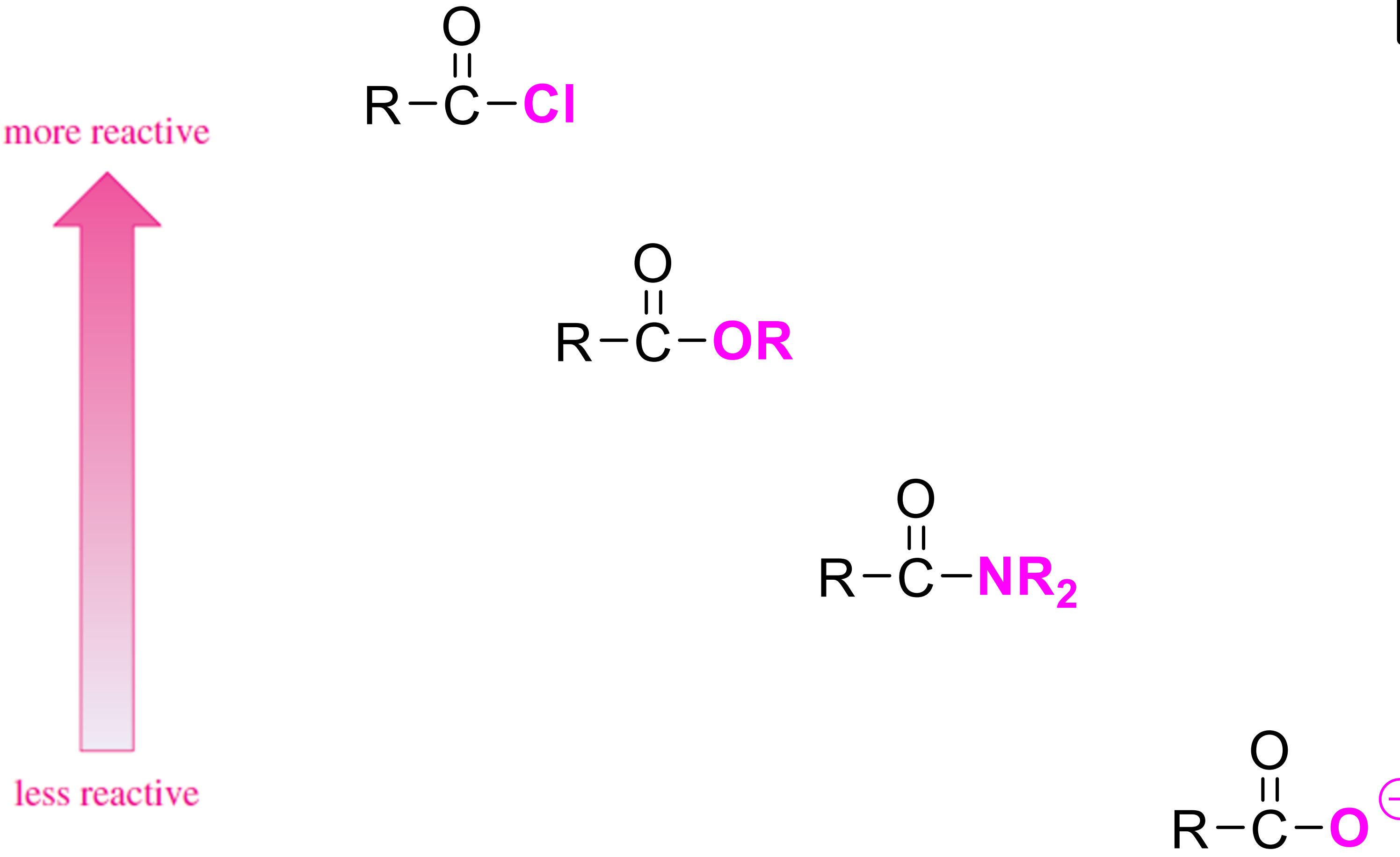
3 – Reaction with amine (acid catalyst)

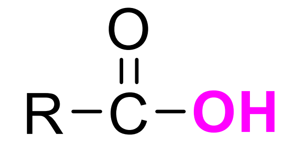


Favourable Interconversion of Acid Derivatives

- Acid chlorides are the **most reactive** acid derivatives

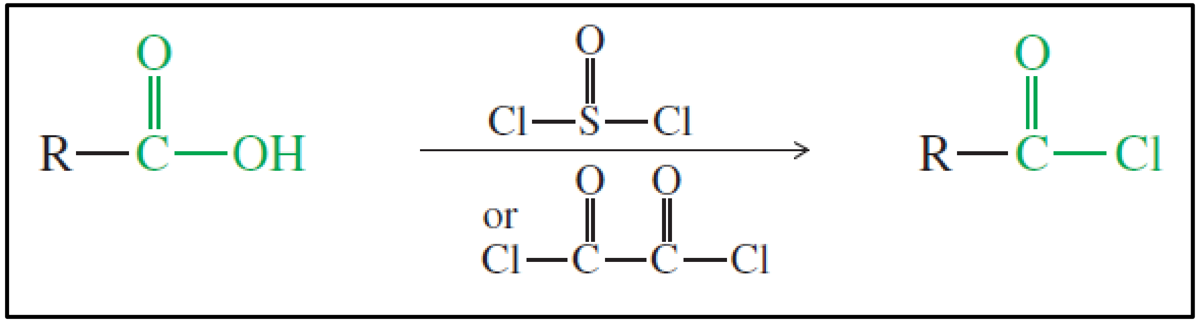
The most frequent strategy is to convert carboxylic acids into acid chlorides using **thionyl chloride ($SOCl_2$)**; then convert the acid chlorides into other acid derivatives





Synthesis of Acid Chlorides

The best reagents for converting carboxylic acids to acid chlorides are **thionyl chloride ($SOCl_2$)** and **oxalyl chloride [$(COCl)_2$]** because they form **gaseous by-products** that do not contaminate the product.



Mechanism:

Nucleophilic Substitution - Example

Fill the gap in the following scheme