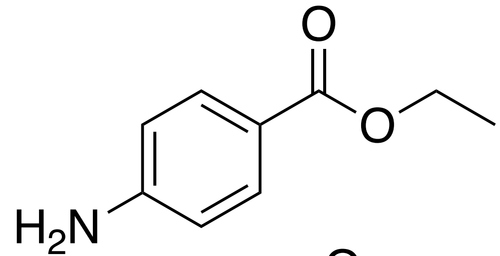
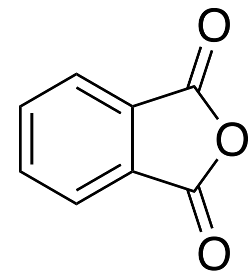
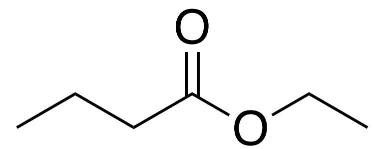
Universidad Nacional Autónoma de México

Química Orgánica IV (1606)
Laboratorio
Semestre 2026 - 2

M. en C. Arturo García Zavala







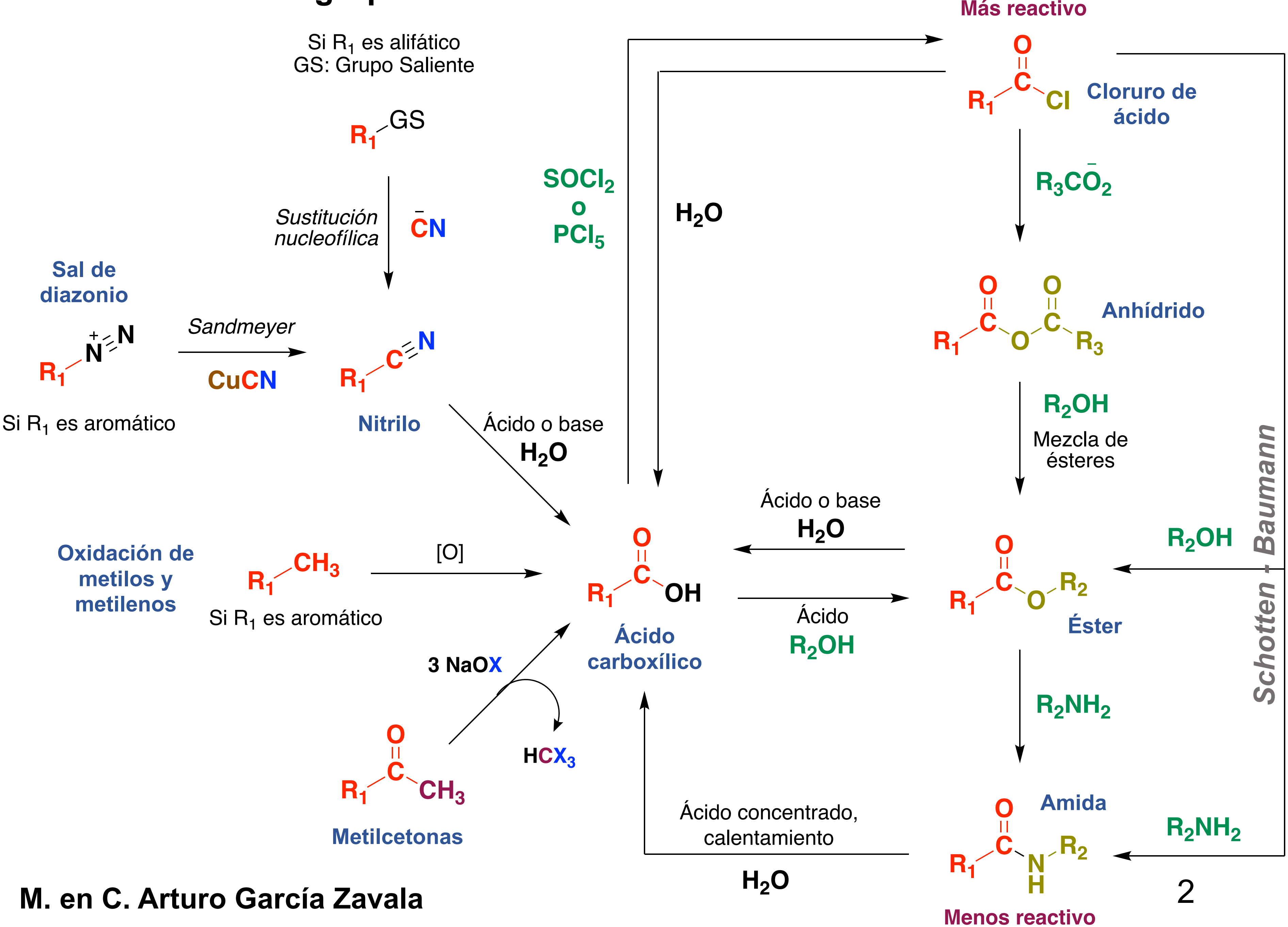
## Práctica 4

# Derivados de ácidos carboxílicos I

## Benzocaína / Butirato de etilo
## Anhídrido ftálico

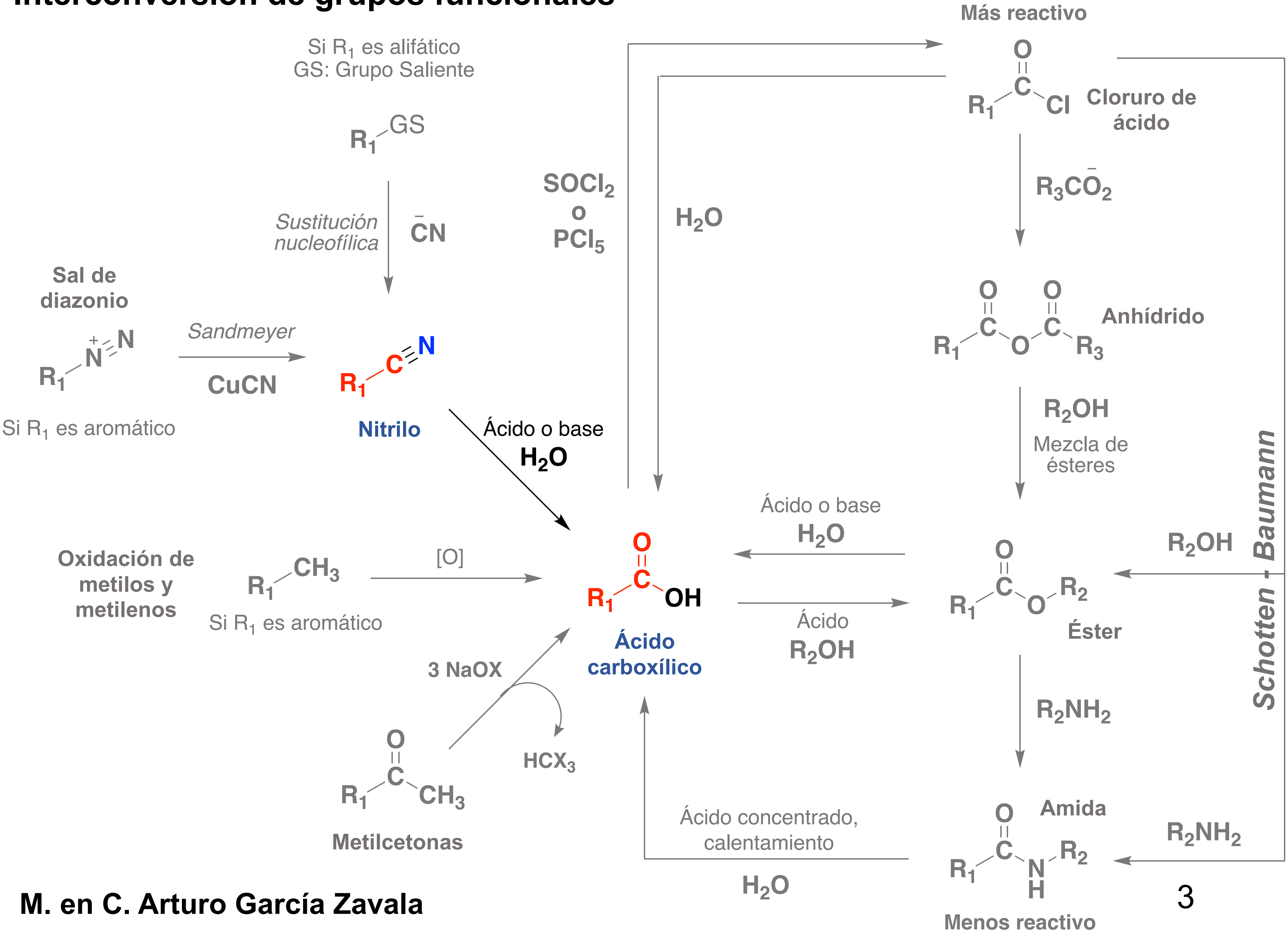
9/03/2026

# Interconversión de grupos funcionales



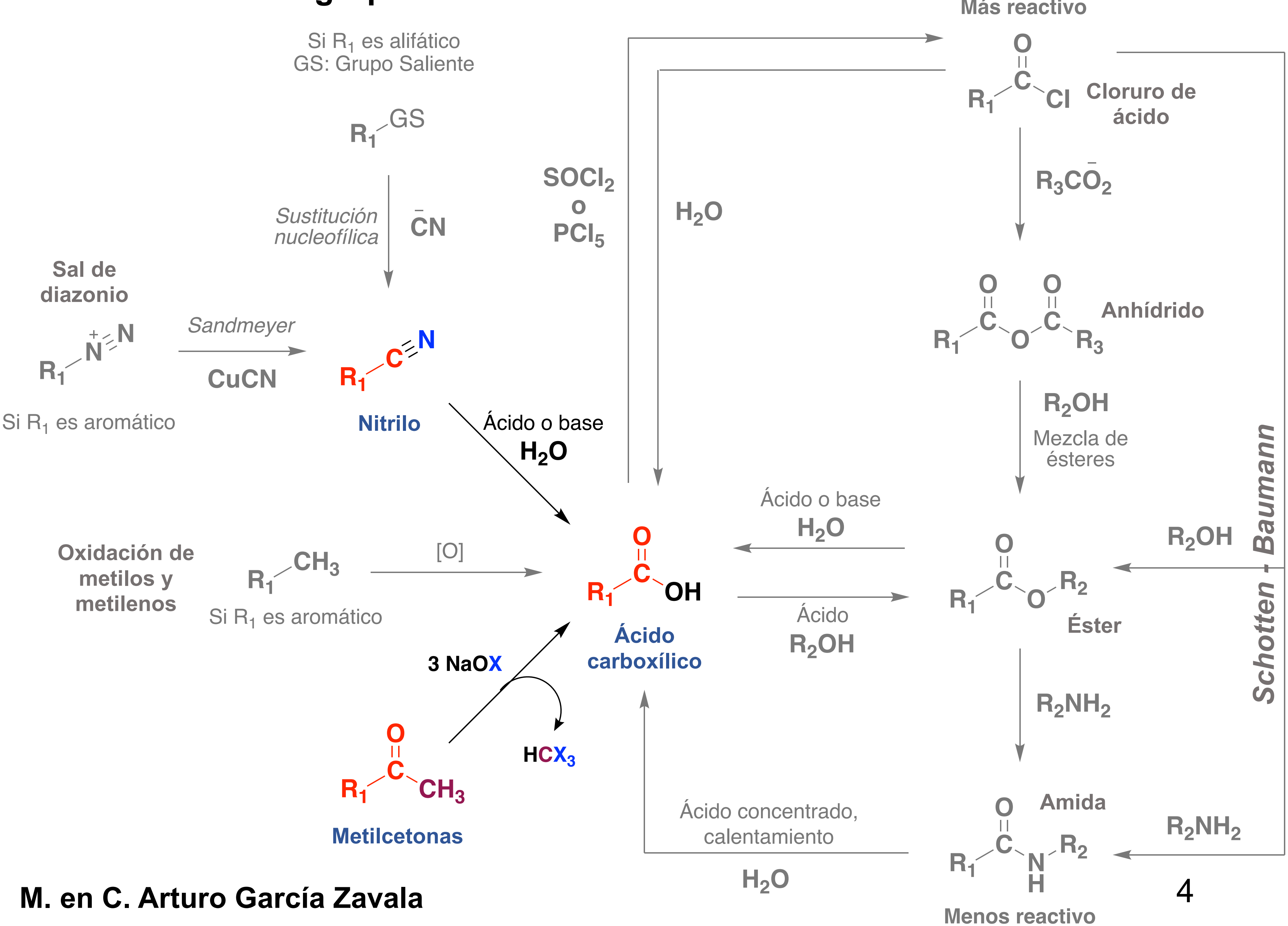

**M. en C. Arturo García Zavala**

# Interconversión de grupos funcionales



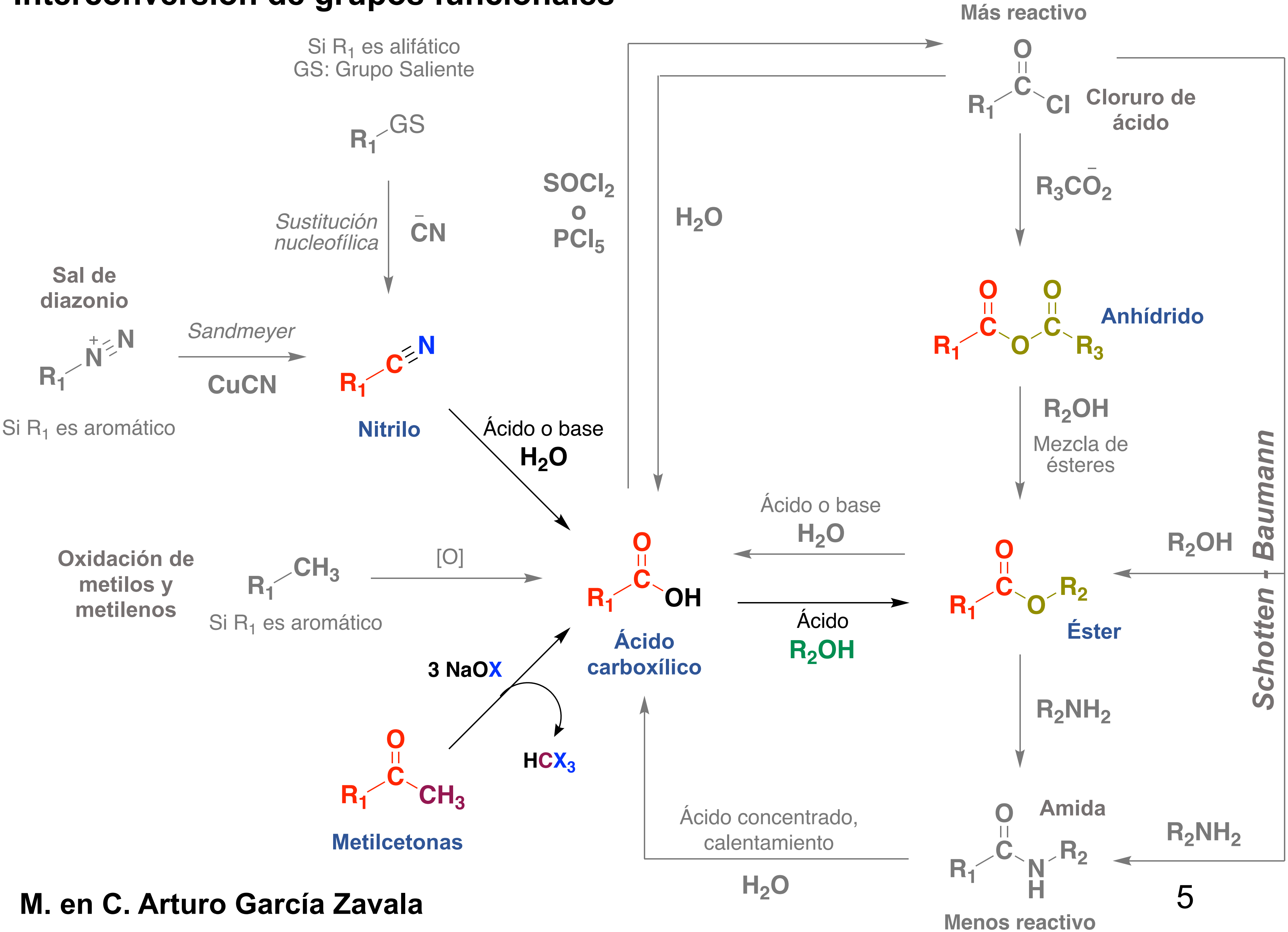

M. en C. Arturo García Zavala

# Interconversión de grupos funcionales




M. en C. Arturo García Zavala

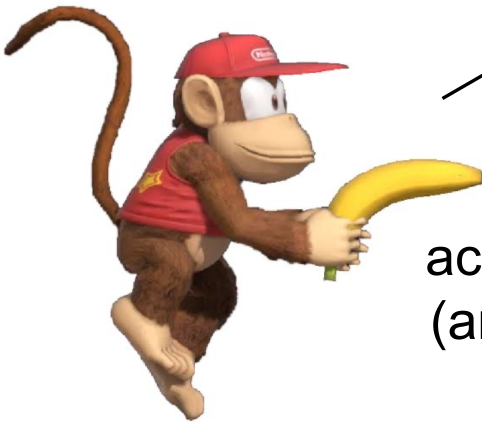
# Interconversión de grupos funcionales

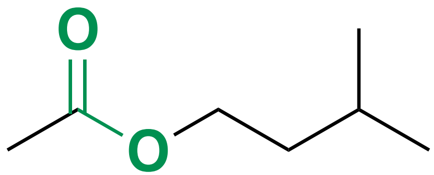



M. en C. Arturo García Zavala

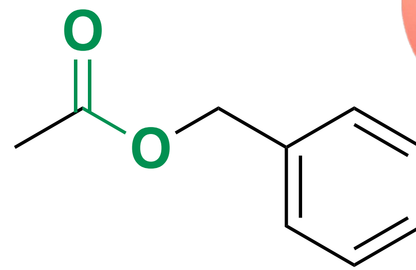
# Ésteres

## Productos naturales

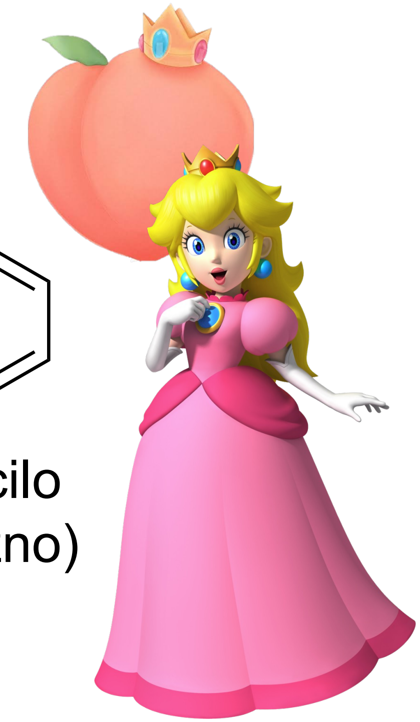


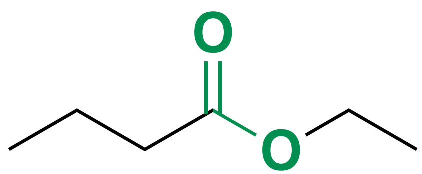



acetato de isoamilo
(aroma de plátano)




acetato de bencilo
(aroma de durazno)

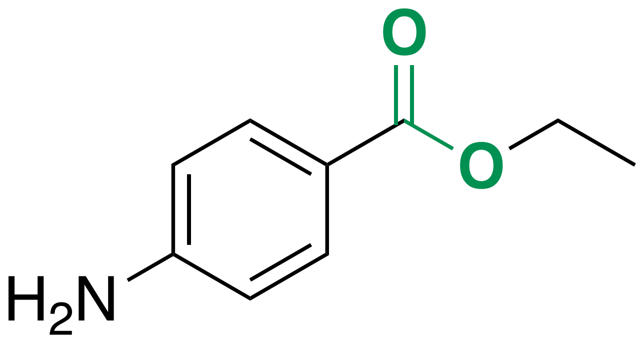




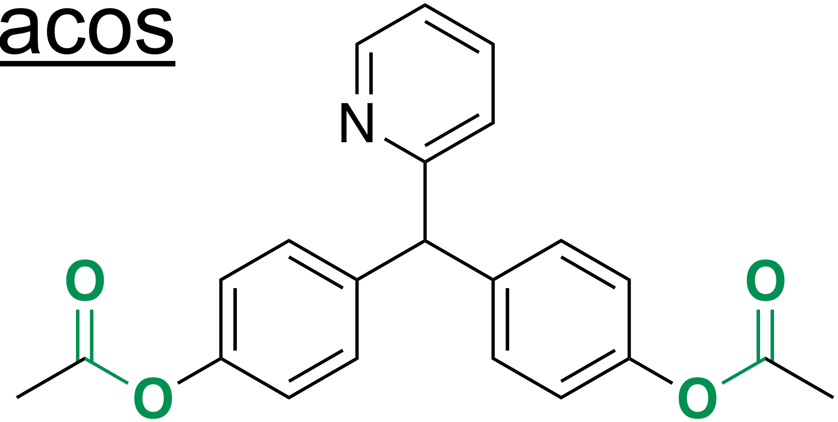

butirato de etilo
(aroma de piña)

# Ésteres

## Fármacos



benzocaína
(analgésico)



bisacodilo
(laxante)

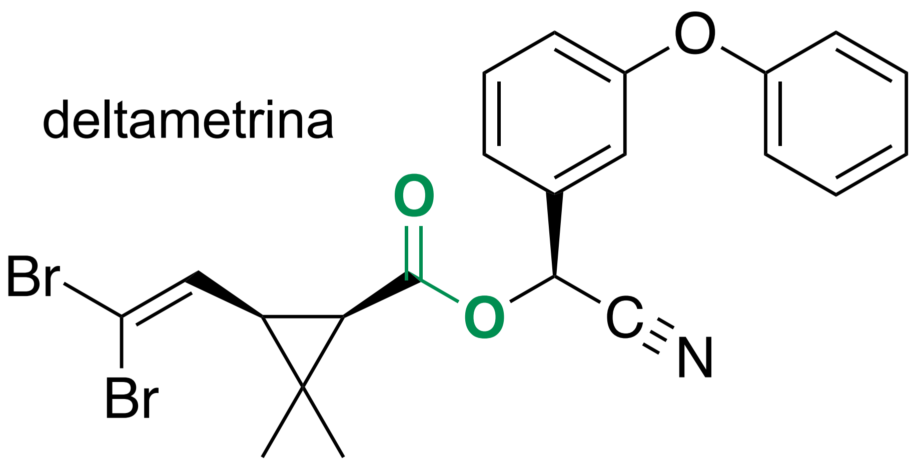


M. en C. Arturo García Zavala

# Ésteres

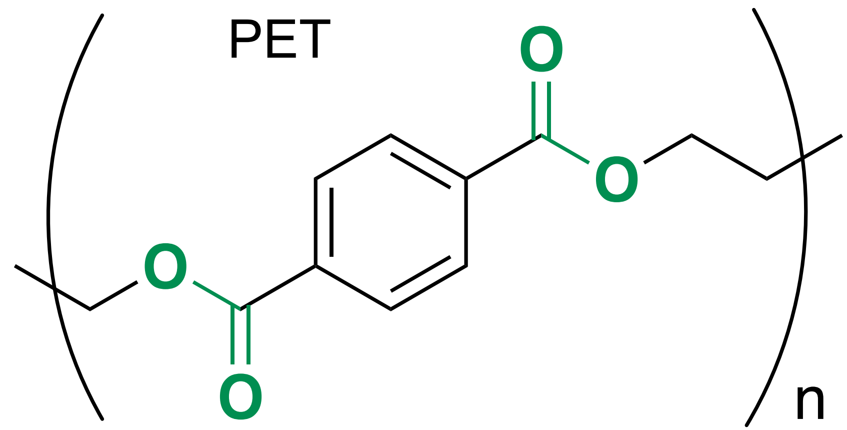
## Insecticidas

deltametrina



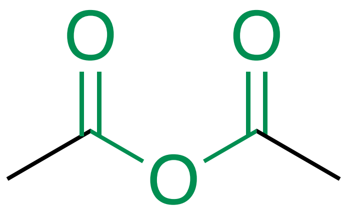
## Plásticos

PET

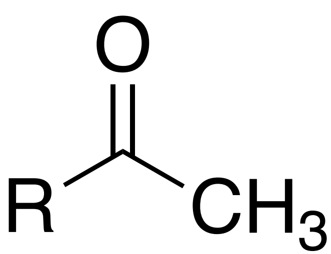


M. en C. Arturo García Zavala

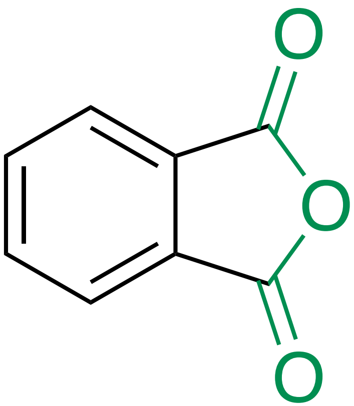
# Anhídridos    Bloques de construcción



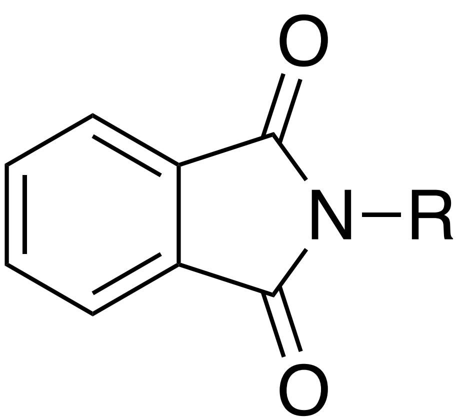

anhídrido acético
(agente acilante)




grupo acilo/acetilo

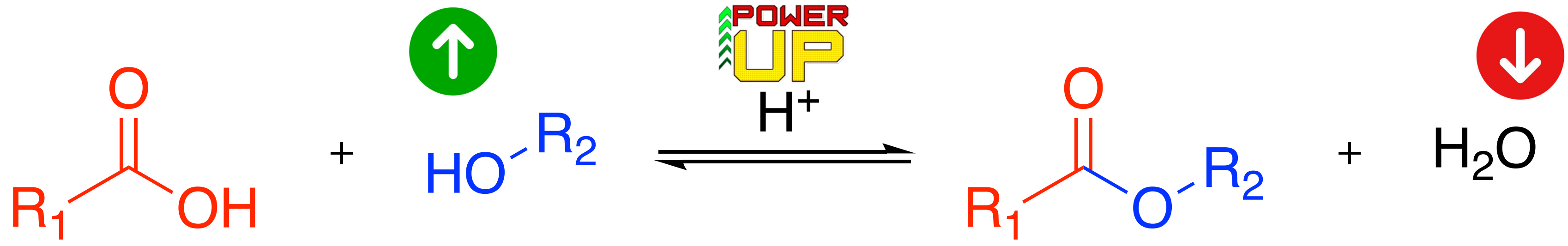



anhídrido ftálico
(precursor de ftalimidas)




ftalimida
(síntesis de Gabriel)

# Esterificación de Fischer-Speier




Ácido carboxílico

Alcohol

Éster

¿Cómo favorezco la formación de productos?

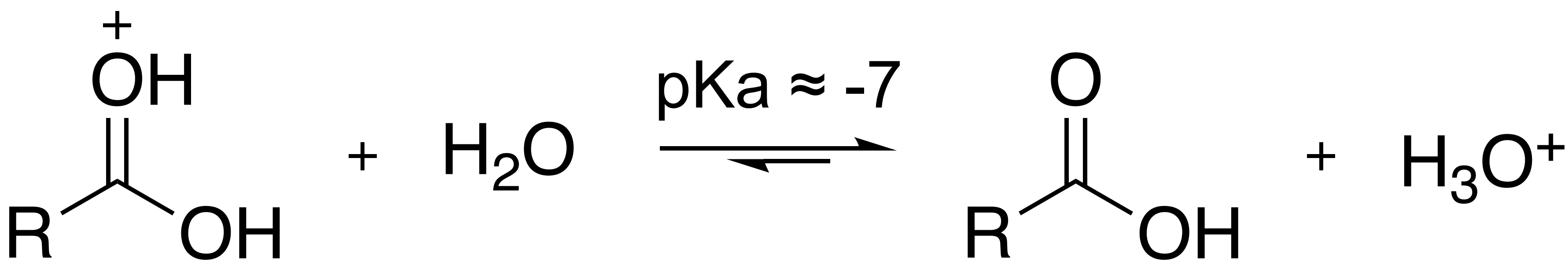
Retirar el agua generada (químicamente y/o físicamente)

Usar un exceso de alcohol

Aumentar el carácter electrofílico del ácido carboxílico (catálisis ácida)

Trabajar en un medio no acuoso

# Baja basicidad del átomo de oxígeno (en agua)

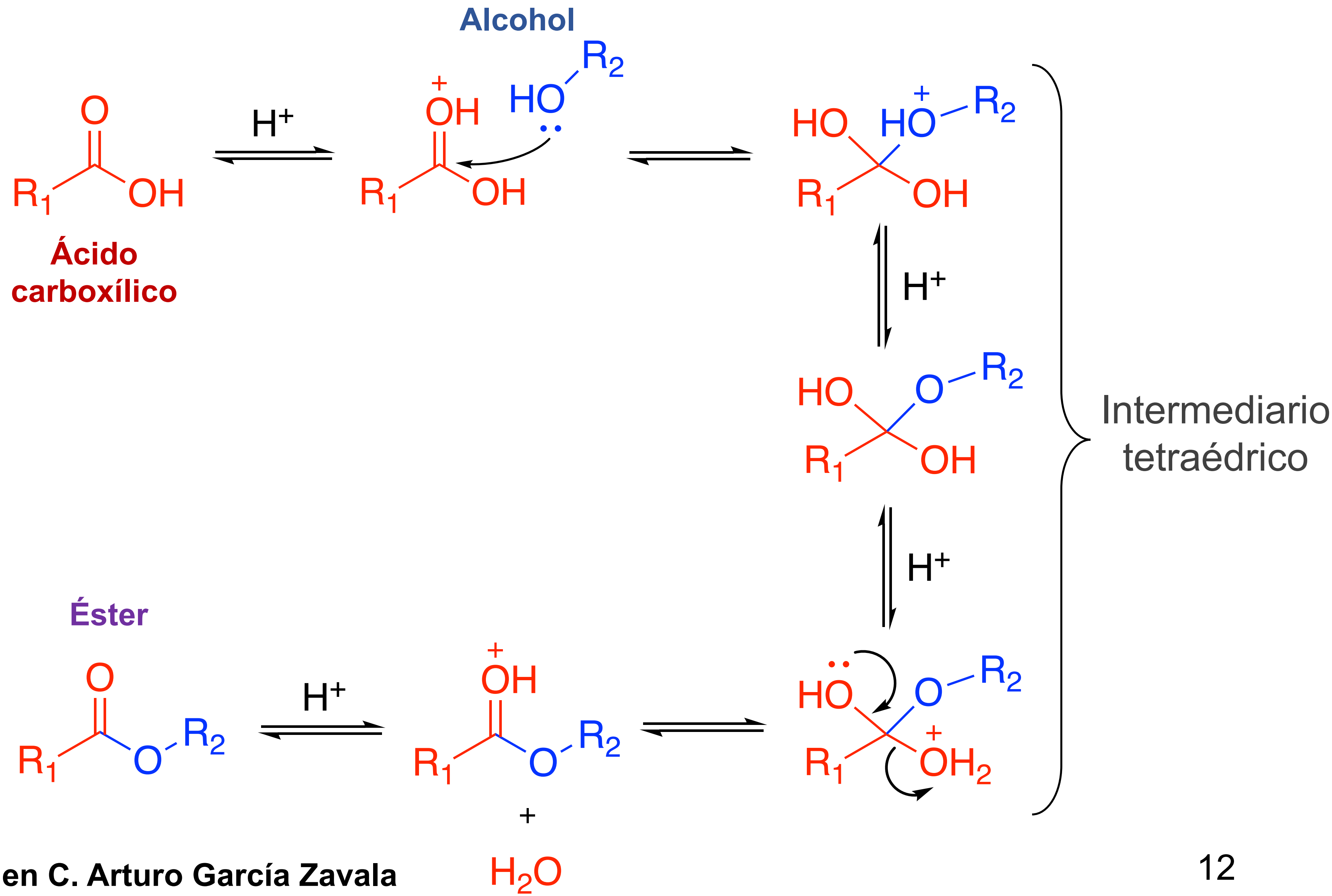



En un medio acuoso es imposible protonar el oxígeno de carbonilo.

Necesario un disolvente protogénico: $H_2SO_4$

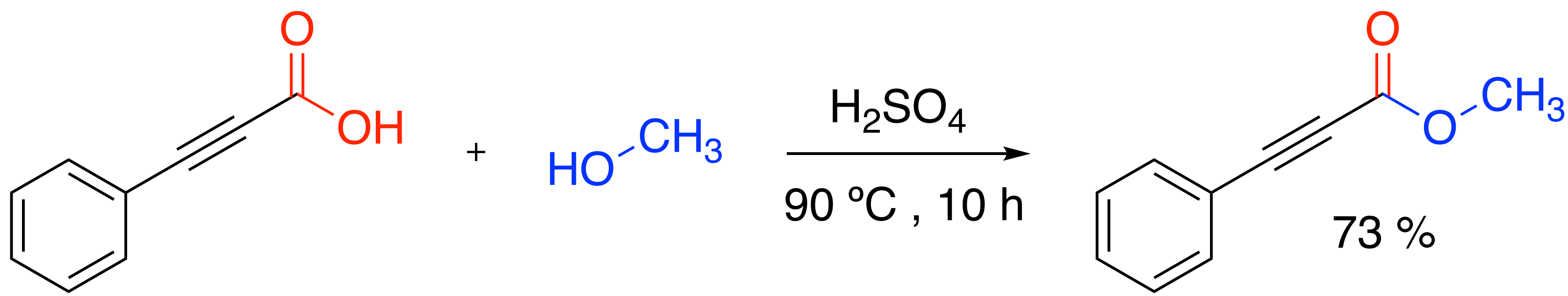
Clayden, J.; Greeves, N.; Warren, S. *Organic chemistry*; Oxford University Press, 2012.

# Mecanismo: Esterificación de Fischer-Speier



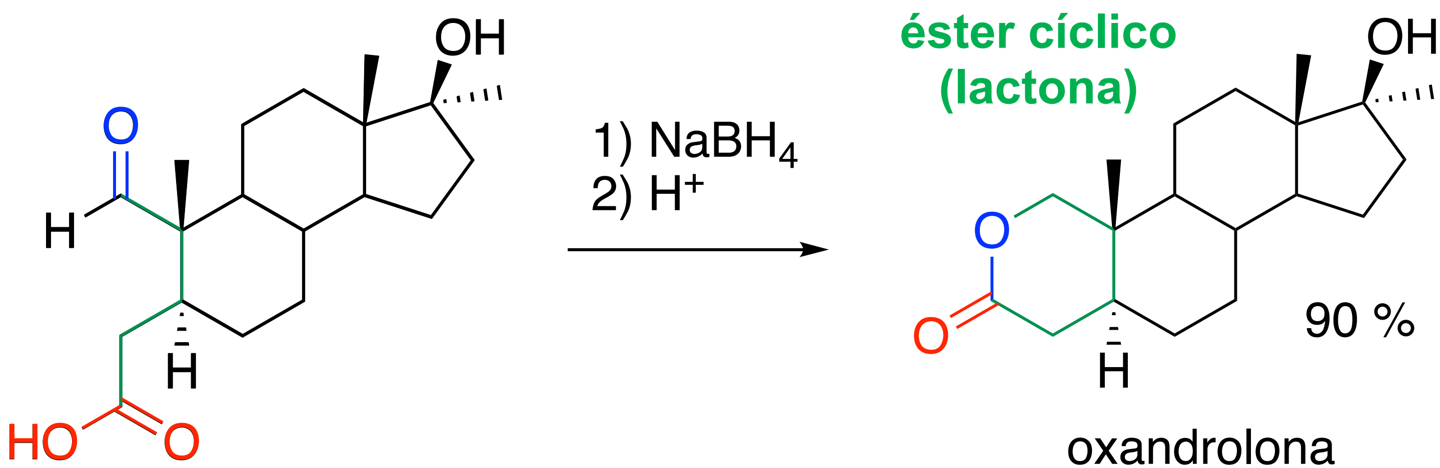

**M. en C. Arturo García Zavala**

# Ejemplos de esterificaciones




*Chem. – A Eur. J.* **2008**, *14* (11), 3371–3379.

---




*Chem. Rev.* **2006**, *106* (7), 2990–3001.

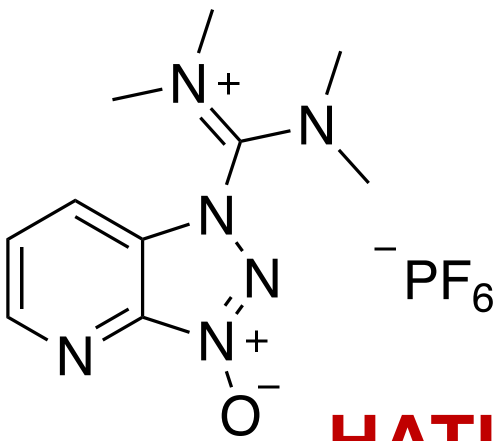
# ¿Siempre que quiera obtener un éster tengo que usar ácido?

## No

# Tenemos agentes acoplantes

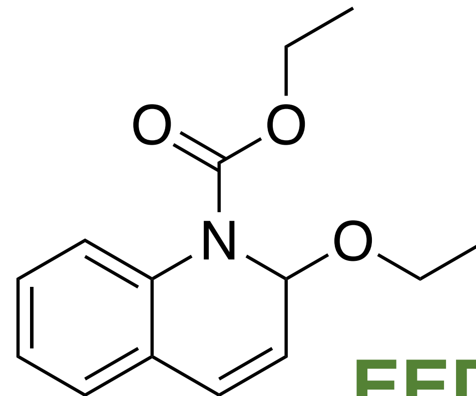
Generan intermediarios más electrofílicos (activación del COOH)

## Sales de aminio



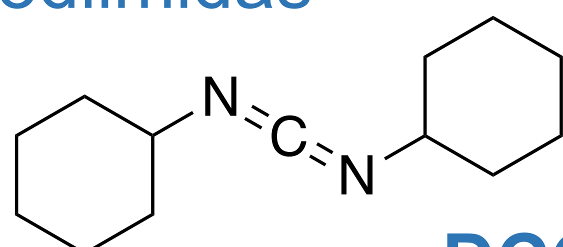
**HATU**

## Carbamatos



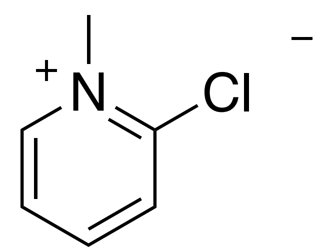
**EEDQ**

## Carbodiimidas



**DCC**

## Sales de piridinas



**Reactivo de Mukaiyama**

# Nuevas estrategias sintéticas

## Research highlights

Synthetic methodology https://doi.org/10.1038/s44160-023-00381-9

## Electrochemical esterification

JACS
JOURNAL OF THE AMERICAN CHEMICAL SOCIETY
pubs.acs.org/JACS

Communication

### An Electrochemical Design for Catalytic Dehydration: Direct, Room-Temperature Esterification without Acid or Base Additives

Jian Han, Christopher A. Haines, Jacob J. Piane, Leila L. Filien, and Eric D. Nacsa*

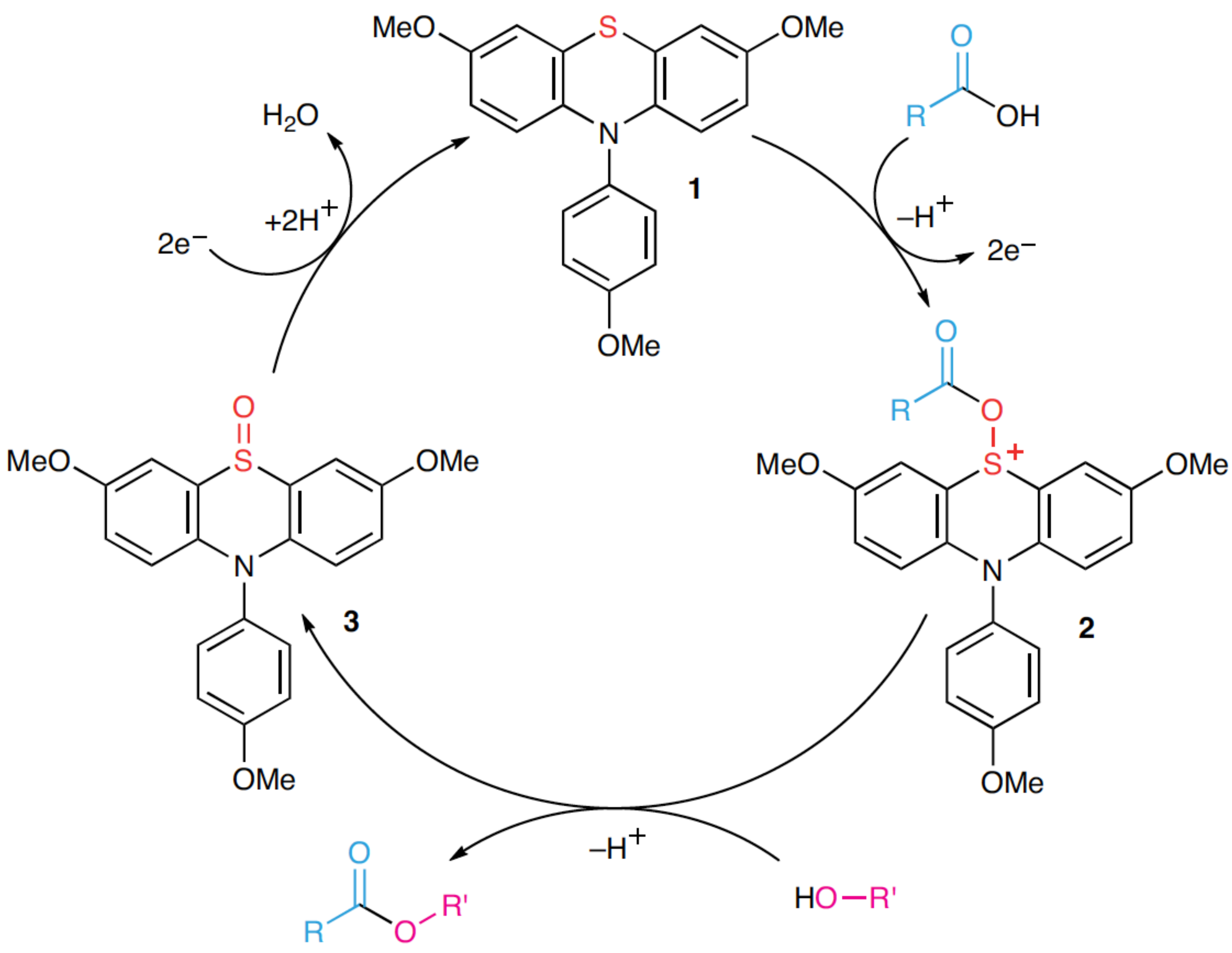
Cite This: *J. Am. Chem. Soc.* 2023, 145, 15680−15687

Read Online

ACCESS | Metrics & More | Article Recommendations | Supporting Information

**ABSTRACT:** An electrochemical approach has been leveraged to underpin a new conceptual platform for dehydration reactions, which has been demonstrated in the context of esterification. Esters were prepared from the corresponding acid and alcohol partners at room temperature without acid or base additives and without consuming stoichiometric reagents. This methodology therefore addresses key complications that plague esterification and dehydration reactions more broadly and that represent a leading challenge in synthetic chemistry.

# Nuevas estrategias sintéticas




Seavill, P. W. Electrochemical Esterification. *Nat. Synth.* **2023**, *2* (8), 695. https://doi.org/10.1038/s44160-023-00381-9.

# Nuevas estrategias sintéticas

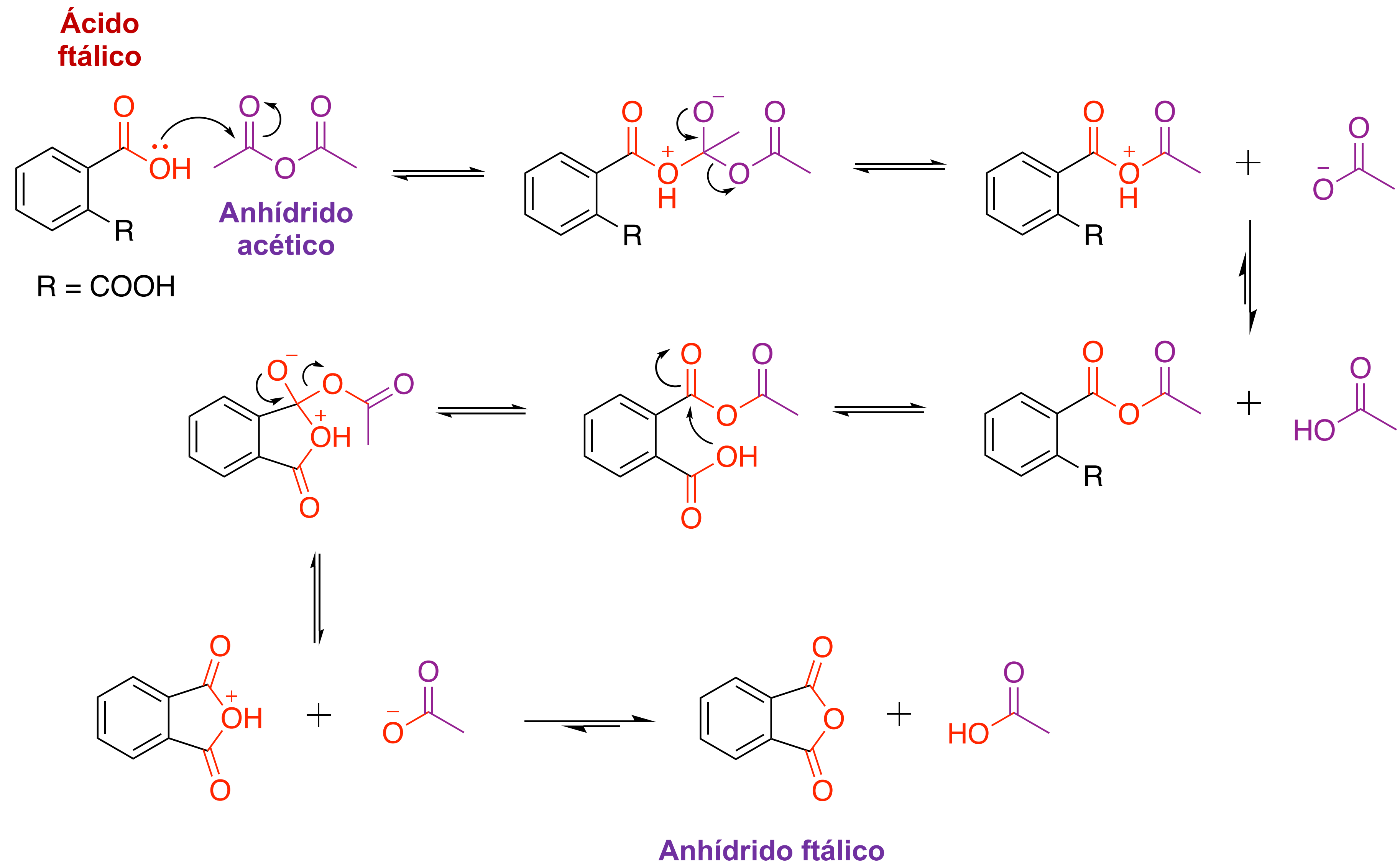
**27 mg, 82% yield**
*9 hours at 10 mA*


**120 mg, 73% yield**
*8 hours at 4.2 V*

**1.42 g, 72% yield**
*11 hours at 4.2 V*

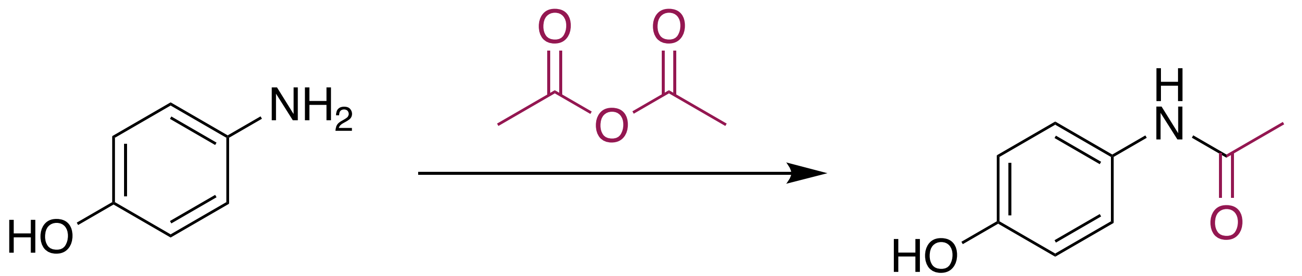
Han, J.; Haines, C. A.; Piane, J. J.; Filien, L. L.; Nacsa, E. D. An Electrochemical Design for Catalytic Dehydration: Direct, Room-Temperature Esterification without Acid or Base Additives. *J. Am. Chem. Soc.* **2023**, *145* (29), 15680–15687. https://doi.org/10.1021/jacs.3c04732.

# Mecanismo: Anhídrido ftálico



# Ejemplos de usos de anhídridos

Síntesis de paracetamol




Síntesis de fluoresceína

2