

4.5.3 Carboxylic derivatives and condensation links

Name: _____ Class: _____ Date: _____

Total: 19 marks

KEY WORDS condensation

Objective

Predict products while retaining the carbonyl carbon and balancing by-products. Questions and marking guidance are original.

1 Key knowledge and worked examples

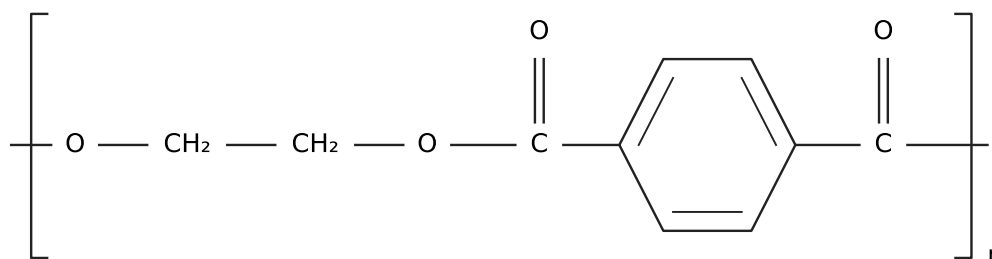
Carboxylic acids react with bases/carbonates to form salts; carbonate releases CO_2 . LiAlH_4 in dry ether reduces RCOOH to RCH_2OH after work-up. PCl_5 gives $\text{RCOCl} + \text{POCl}_3 + \text{HCl}$.

■ Worked reaction choice

$\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{OH} \rightleftharpoons \text{CH}_3\text{COOCH}_2\text{CH}_3 + \text{H}_2\text{O}$ uses heat and an acid catalyst. The ester is ethyl ethanoate. Hot aqueous NaOH hydrolyses it to sodium ethanoate and ethanol; do not write a free acid as the immediate alkaline product.

Acyl chlorides react readily with water, alcohols and amines. $\text{CH}_3\text{COCl} + 2\text{NH}_3 \rightarrow \text{CH}_3\text{CONH}_2 + \text{NH}_4\text{Cl}$: one ammonia makes the amide, another accepts HCl . A diacid/diol condensation makes a polyester with $-\text{CO}-\text{O}-$ links and water. The repeat unit keeps both monomer skeletons and open bonds through brackets.

Terylene: completed repeat unit with para benzene links



From ethane-1,2-diol and benzene-1,4-dicarboxylic acid; ester links form by condensation.

2 Practice

2.1 Write a balanced equation for ethanoic acid with sodium carbonate. [3]

2.2 Name the ester made from propanoic acid and methanol, with reagent conditions.[2]

2.3 Write products of ethanoyl chloride with water and with ethanol. [2]

3 Exam-style questions

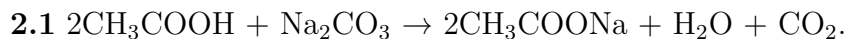
3.1 Write the overall equation for ethanoyl chloride with excess methylamine. Explain why two methylamine molecules appear. [4]

3.2 Compare acid and alkaline hydrolysis of methyl propanoate. Name both organic products in each case and explain why the alkaline process is driven strongly toward products. [4]

3.3 Draw one terylene repeat unit from ethane-1,2-diol and benzene-1,4-dicarboxylic acid. Show brackets and open bonds. [4]

Solutions

Original marking guidance: M1 method, A1 accuracy, B1 explanation.



2.2 Methyl propanoate; heat with an acid catalyst.

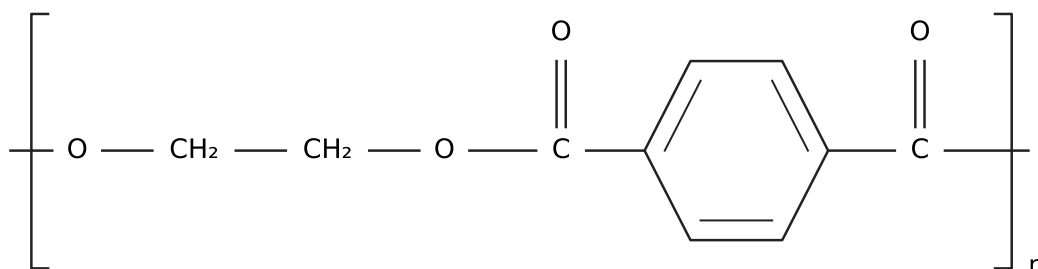


3.1 $\text{CH}_3\text{COCl} + 2\text{CH}_3\text{NH}_2 \rightarrow \text{CH}_3\text{CONHCH}_3 + \text{CH}_3\text{NH}_3\text{Cl}$. One amine forms the amide; the other accepts HCl.

3.2 Acid: propanoic acid and methanol, reversible. Alkali: propanoate salt and methanol; formation of carboxylate removes the free acid from the esterification equilibrium and drives the process.

3.3

Terylene: completed repeat unit with para benzene links



From ethane-1,2-diol and benzene-1,4-dicarboxylic acid; ester links form by condensation.

B1 diol skeleton; B1 para aromatic skeleton; B1 correct ester links/carbonyls; B1 brackets with open bonds and n.