

Making and reacting esters and acyl chlorides

Chemistry grades 11-12 (A Level · IB · Class 11-12) · Test answers (mark scheme)

The answers include a mark scheme for each question. Award marks for correct chemistry even if the wording differs, but do not accept a single arrow for esterification or an ester name with the parts reversed.

Level: Chemistry grades 11-12 (A Level · IB · Class 11-12) · **Curriculum:** A Level 3.3.9

Question 1 Naming an ester (2 marks)

- a. **Ethyl propanoate.**
- b. Propanoic acid and ethanol.

Marking: 1 mark each.

Question 2 Esterification (2 marks)

- a. $\text{CH}_3\text{COOH} + \text{CH}_3\text{CH}_2\text{CH}_2\text{OH} \rightleftharpoons \text{CH}_3\text{COOCH}_2\text{CH}_2\text{CH}_3 + \text{H}_2\text{O}$.
- b. Concentrated sulfuric acid.

Marking: 1 mark each.

Question 3 Alkaline hydrolysis (2 marks)

- a. $\text{CH}_3\text{COOCH}_3 + \text{NaOH} \rightarrow \text{CH}_3\text{COONa} + \text{CH}_3\text{OH}$.
- b. The acid is converted into the ethanoate ion, which does not react with methanol, so the reverse reaction cannot occur.

Marking: 1 mark each.

Question 4 Making an acyl chloride (2 marks)

- a. Thionyl chloride, SOCl_2 .
- b. Sulfur dioxide and hydrogen chloride.

Marking: 1 mark each.

Question 5 Addition-elimination (3 marks)

- a. **Nucleophilic addition-elimination.**
- b. A tetrahedral intermediate where the carbonyl carbon carries O^- , Cl , CH_3 and the

- ethanol oxygen.
c. $\text{CH}_3\text{COOC}_2\text{H}_5$ and HCl .

Marking: 1 mark each.

Question 6 Equilibrium amounts (3 marks)

- a. $K_c = / ()$.
b. $x^2 / (0.800 - x)^2 = 4.0$, so $x / (0.800 - x) = 2.0$ and $x = 1.60 - 2x$, giving $x = \mathbf{0.533}$ mol.

Marking: 1 for the expression; 1 for setting up the equation; 1 for the answer.

Question 7 Identify an ester (3 marks)

- a. A is ethanoic acid ($M = 60.0$). B is propan-2-ol: its oxidation product is a ketone (propanone).
b. **Propan-2-yl ethanoate**, $\text{CH}_3\text{COOCH}(\text{CH}_3)_2$.

Marking: 1 for A; 1 for B; 1 for the ester name.

Question 8 Reactivity of acyl chlorides (3 marks)

- a. The carbonyl carbon is more δ^+ because it is bonded to O and Cl, and Cl^- is a good leaving group, so the nucleophile attacks faster.
b. Advantage: irreversible and fast, so a high yield. Disadvantage: corrosive and gives off HCl fumes.

Marking: 1 for the carbon being more positive; 1 for the leaving group; 1 for advantage and disadvantage together.