

4.2 Alcohols acids and esters

Name: _____ Class: _____ Date: _____

Total: 25 marks

Objective

Cover (C) alcohols, carboxylic acids and esters (4.29C–4.43C): structures and naming, ethanol manufacture and oxidation, acid reactions, esterification with ethyl ethanoate. Original IGCSE Chemistry-only practice.

1 Key knowledge and worked examples

alkanes C_nH_{2n+2} C-C single bonds only	alkenes C_nH_{2n} one C=C double bond	alcohols (C) $C_nH_{2n+1}OH$ -OH group
carboxylic acids (C) $C_nH_{2n+1}COOH$ -COOH group	esters (C) $RCOOR'$ -COO- link	

■ Ethanol: made two ways

Ethene + steam (phosphoric acid catalyst, $\approx 300^\circ\text{C}$, 60–70 atm) – fast, pure, from crude oil. **Fermentation** of glucose (yeast enzymes, **no air**, $\approx 30^\circ\text{C}$ – the enzymes' optimum; without oxygen the yeast makes ethanol, not water).

■ Oxidation of ethanol

Complete combustion $\rightarrow \text{CO}_2 + \text{H}_2\text{O}$; **microbial oxidation** in air $\rightarrow$ ethanoic acid (wine to vinegar); warming with **potassium dichromate(VI)** in **dilute sulfuric acid** $\rightarrow$ ethanoic acid (orange $\rightarrow$ green).

■ Acids behave like acids

Carboxylic acid + metal $\rightarrow$ salt + hydrogen; + carbonate $\rightarrow$ salt + water + CO_2 . Vinegar is dilute ethanoic acid.

■ Esters

Ethanol + ethanoic acid $\rightleftharpoons$ ethyl ethanoate + water (acid catalyst, warmed). Join the acid's $-\text{COOH}$ to the alcohol's $-\text{O}-$; esters are volatile, sweet-smelling – flavourings, perfumes.

2 Practice

2.1 Name the functional groups of alcohols, carboxylic acids and esters. [3]

2.2 Name the four alcohols required, and the first four carboxylic acids. [4]

2.3 State the optimum temperature for fermentation and why air is excluded. [2]

2.4 Give two conditions for the oxidation of ethanol to ethanoic acid with potassium dichromate(VI). [2]

2.5 Write the word equation for making ethyl ethanoate, naming the catalyst. [3]

3 Exam-style questions

3.1 Compare the two industrial routes to ethanol, giving one advantage and one disadvantage of each. [4]

3.2 Describe what is seen when dilute ethanoic acid is added to sodium carbonate, and write the equation type with the gas identified. [3]

3.3 Draw or describe the displayed formula of ethyl ethanoate, marking which part came from the acid and which from the alcohol. [4]
