

Exercise walk-through

4.2

Alcohols acids and esters

Pearson Edexcel · International GCSE · Chemistry

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The method

Method — Ethanol: made two ways

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

Method — 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).

Exercises 2.1·2.3

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]

Exercises 2.1·2.3

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2.1 $-\text{OH}$; $-\text{COOH}$; $-\text{COO}-$.

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

2.2 Methanol, ethanol, propan-1-ol, butan-1-ol; methanoic, ethanoic, propanoic, butanoic acid.

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

2.3 $\approx 30^\circ\text{C}$ – the optimum for yeast enzymes; no air so the yeast ferments the sugar to ethanol (with oxygen it respires to water and CO_2).

Exercises 2.4·3.1

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]

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

Exercises 2.4·3.1

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

2.4 Warm/heat; with dilute sulfuric acid (acidified).

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

2.5 Ethanol + ethanoic acid $\rightleftharpoons$ ethyl ethanoate + water; concentrated sulfuric acid catalyst.

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

3.1 Ethene + steam: advantage – continuous, fast, pure ethanol; disadvantage – uses a non-renewable crude-oil product (and needs high pressure). Fermentation: advantage – renewable sugar source, low temperature; disadvantage – slow, impure (needs distilling) and low concentration.

Exercises 3.2-3.3

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]

Exercises 3.2·3.3

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]

3.2 Effervescence/fizzing; acid + carbonate $\rightarrow$ salt + water + carbon dioxide; the gas is CO_2 – turns limewater milky.

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

3.3 $\text{CH}_3\text{--COO--C}_2\text{H}_5$: the $\text{CH}_3\text{--CO--}$ part came from ethanoic acid (its --COOH loses OH); the $\text{--O--C}_2\text{H}_5$ part came from ethanol (its --OH loses H). Displayed formula shows every bond with the ester link --COO-- central.