4.2 Alcohols acids and esters

Name: _____ Class: _____ Date: _____ **Total: 22 marks**

Objective

Build the skills to answer exam questions on **alcohols, carboxylic acids and esters** 、 : making ethanol by fermentation and by hydration of ethene, oxidation of ethanol, reactions of carboxylic acids, and making esters.

You must be able to:

- name alcohols, carboxylic acids and esters
- compare fermentation and the hydration of ethene
- write equations for the reactions of ethanoic acid
- calculate reacting masses in organic reactions

1 Key knowledge and worked examples

■ Ethanol and its products

idea	rule
functional groups	alcohols −OH; carboxylic acids −COOH; esters −COO−
fermentation	glucose → ethanol + carbon dioxide, using yeast
hydration of ethene	ethene + steam → ethanol (300 °C, 60 atm, catalyst)
oxidation	ethanol → ethanoic acid (bacteria in air, or potassium dichromate)
esters	alcohol + acid ⇌ ester + water; ethanol + ethanoic acid gives ethyl ethanoate

Worked example 1: naming an ester. Name the ester made from methanol and propanoic acid.

1. Known: alcohol methanol; acid propanoic acid.
2. Rule: alcohol part (-yl) then acid part (-oate).
3. Numbers: methyl + propanoate.
4. Result: **methyl propanoate**.

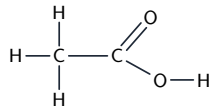
Worked example 2: reacting mass. Find the mass of carbon dioxide made when 90 g of glucose ferments (M_r: glucose 180, CO_2 44).

1. Known: $90 \div 180 = 0.50$ mol glucose; ratio 1 : 2.
2. Rule: mass = moles $\times M_r$.
3. Numbers: 1.0 mol $\times 44$.
4. Result: 44 **g**.

Answer shapes: when comparing two methods, compare the same points for both: raw material, rate, purity, energy.

2 Practice

2.1 Name the homologous series of the compound shown, and give the functional group of an alcohol. [2]



2.2 Give **two** conditions needed for fermentation, other than yeast. [2]



2.3 Name the **three** products when ethanoic acid reacts with sodium carbonate. [2]



3 Exam-style questions

3.1 Write the equation for ethanol reacting with ethanoic acid to make ethyl ethanoate, and name the catalyst. [3]



3.2 A country can make ethanol by fermentation or by the hydration of ethene. The table compares the two methods. (M_r: glucose 180, ethanol 46)

(a) Calculate the maximum mass of ethanol that can be made from 180 g of glucose. [3]

	fermentation	hydration of ethene
raw material	sugar (crops)	ethene (crude oil)
conditions	35 °C, 1 atm	300 °C, 60 atm
rate	slow, batch	fast, continuous
product	about 15% ethanol	pure ethanol

(b) Explain why fermentation is done at about 35 °C and not at 80 °C, and describe how ethanol is separated from the fermentation mixture. [4]

(c) The country grows a lot of sugar cane but has no crude oil. Evaluate which method it should use. [6]