

# Carbonyl Compounds, Carboxylic Acids, Esters & Polyesters

## AS & A Level

### Question Paper 4

Level	A Level
Subject	Chemistry
Exam Board	OCR
Module	Organic chemistry & Analysis
Topic	Carbonyl Compounds, Carboxylic Acids, Esters & Polyesters
Paper	AS & A Level
Booklet	Question Paper 4

**Time allowed:** 28 minutes

**Score:** /21

**Percentage:** /100

**Grade Boundaries:**

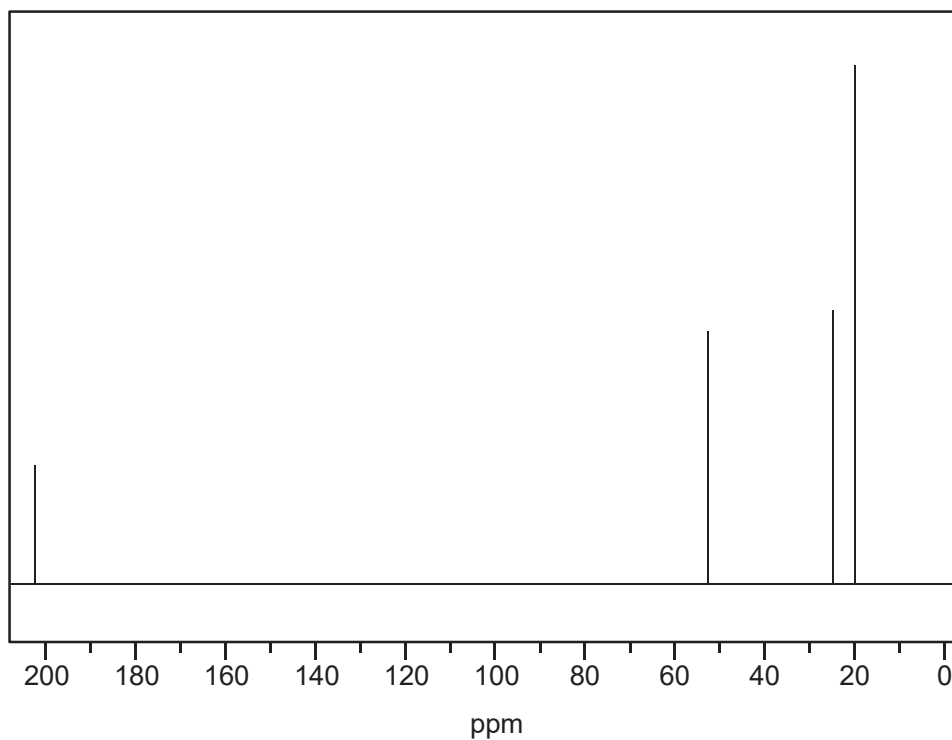
A*	A	B	C	D	E
>85%	73%	60%	47%	34%	21%

## Question 1

Compound **D** and compound **E** are carbonyl compounds with the molecular formula  $C_5H_{10}O$ .

(a) Compound **D** reacts with Tollens' reagent to form a silver mirror.

The  $^{13}C$  NMR spectrum of compound **D** is shown below.



Use this information to deduce the structure of compound **D**.

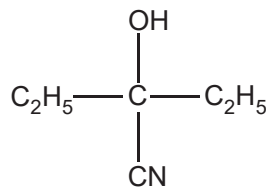
Explain your reasoning.

[3]

(b) Carbonyl compounds react with cyanide ions,  $\text{:CN}^-$ , in the presence of dilute acid.

This is a nucleophilic addition reaction in which  $\text{:CN}^-$ , acts as a nucleophile.

Compound **E** reacts with  $\text{:CN}^-$  and  $\text{H}^+$  to form the organic compound shown below.



Identify compound **E** and suggest the mechanism for this reaction.

Use curly arrows and show relevant dipoles.

[4]

[Total: 7 marks]

## Question 2

Stearic acid, oleic acid and linoleic acid are examples of naturally occurring fatty acids.

Traditional name	Structure	Systematic name
<b>Stearic acid</b>	$C_{17}H_{35}COOH$	Octadecanoic acid
<b>Oleic acid</b>	$C_{17}H_{33}COOH$	Octadec-9-enoic acid
<b>Linoleic acid</b>	$C_{17}H_{31}COOH$	Octadeca-9,12-dienoic acid

- (a) Suggest which fatty acid in the table is most likely to be linked with concerns about heart disease and obesity.

Explain your choice.

[1]

- (b) Sodium stearate is the salt formed when stearic acid reacts with sodium hydroxide solution.

Write an equation for the formation of sodium stearate.

[1]

- (c) A triglyceride formed from stearic acid can be found in some types of food.

Draw the structure of this triglyceride with any functional groups fully displayed.

[2]

(d) Partial hydrogenation of linoleic acid may result in the formation of *trans*-octadec-12-enoic acid.

(i) Draw the **skeletal** formula of *trans*-octadec-12-enoic acid. [2]

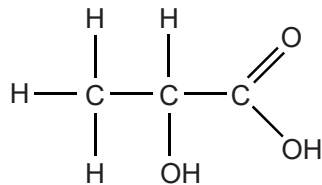
(ii) Some fatty acids show *cis-trans* isomerism because there is restricted rotation about a C=C double bond.

State **one** other feature of these molecules that enables them to show *cis-trans* isomerism. [1]

[Total 7 Marks]

### Question 3

This question is about the preparation, properties and uses of lactic acid.



**lactic acid**

(a) What is the systematic name of lactic acid? [1]

(b) Lactic acid can be produced by chemical synthesis or by the fermentation of sugars using bacteria.

Describe **one** important difference between lactic acid manufactured by chemical synthesis and lactic acid manufactured by the fermentation of sugars. [1]

(c) When heated strongly, lactic acid forms a cyclic 'diester'.  
The diester has the molecular formula,  $\text{C}_6\text{H}_8\text{O}_4$ .

Draw the structure of the cyclic diester. [1]

(d) Poly(lactic acid), PLA, is used to make 'dissolvable' stitches (for holding wounds together). PLA breaks down into smaller molecules after one or two weeks.

(i) Draw the structure of **one** repeat unit in PLA. [1]

(ii) Explain how PLA breaks down and why the stitches 'dissolve'.



*In your answer you should use the appropriate technical terms spelled correctly.* [3]

[Total 7 Marks]