

# OCR

Oxford Cambridge and RSA

## Tuesday 13 June 2017 – Afternoon

### A2 GCE CHEMISTRY A

#### F324/01 Rings, Polymers and Analysis

Candidates answer on the Question Paper.

**OCR supplied materials:**

- *Data Sheet for Chemistry A* (inserted)

**Other materials required:**

- Scientific calculator

**Duration:** 1 hour 15 minutes




Candidate forename		Candidate surname	
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Centre number						Candidate number				
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### INSTRUCTIONS TO CANDIDATES

- The Insert will be found inside this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. If additional space is required, you should use the lined page(s) at the end of this booklet. The question number(s) must be clearly shown.
- Do **not** write in the barcodes.

### INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [ ] at the end of each question or part question.
-  Where you see this icon you will be awarded marks for the quality of written communication in your answer.  
This means, for example, you should:
  - ensure that text is legible and that spelling, punctuation and grammar are accurate so that meaning is clear;
  - organise information clearly and coherently, using specialist vocabulary when appropriate.
- You may use a scientific calculator.
- A copy of the *Data Sheet for Chemistry A* is provided as an Insert with this Question Paper.
- You are advised to show all the steps in any calculations.
- The total number of marks for this paper is **60**.
- This document consists of **16** pages. Any blank pages are indicated.



- (i) Predict the number of peaks in the carbon-13 NMR spectrum of compound **A**.

..... [1]

- (ii) Compound **A** is formed in **reaction 1** by reacting ethylbenzene with chlorine in the presence of an  $AlCl_3$  catalyst.

Explain, with the aid of curly arrows, the mechanism for the formation of compound **A** in **reaction 1**.

Your answer should show how  $AlCl_3$  behaves as a catalyst.

[5]

- (iii) State the reagents and conditions required for the preparation of compound **B** from ethylbenzene in **reaction 2**.

..... [1]

- (iv) 2.65 g of ethylbenzene is converted into compound **B** in **reaction 2**.

2.31 g of compound **B** is formed.

Calculate the percentage yield of compound **B**.

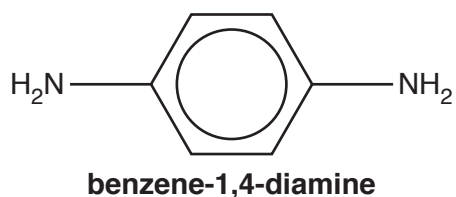
Give your answer to **three** significant figures.

percentage yield of compound **B** = ..... % [3]

[Total: 15]

Turn over

2 Diamines such as benzene-1,4-diamine can be used to make polyamides.



(a) Benzene-1,4-diamine reacts with acids to form salts.

Explain how benzene-1,4-diamine is able to react with acids.

.....  
.....  
..... [1]

(b) Benzene-1,4-diamine can be prepared by the reduction of 1,4-dinitrobenzene.

(i) State the reagents and conditions used for this reduction.

.....  
..... [1]

(ii) Write an equation for the formation of benzene-1,4-diamine from 1,4-dinitrobenzene.

Use **[H]** to represent the reducing agent.

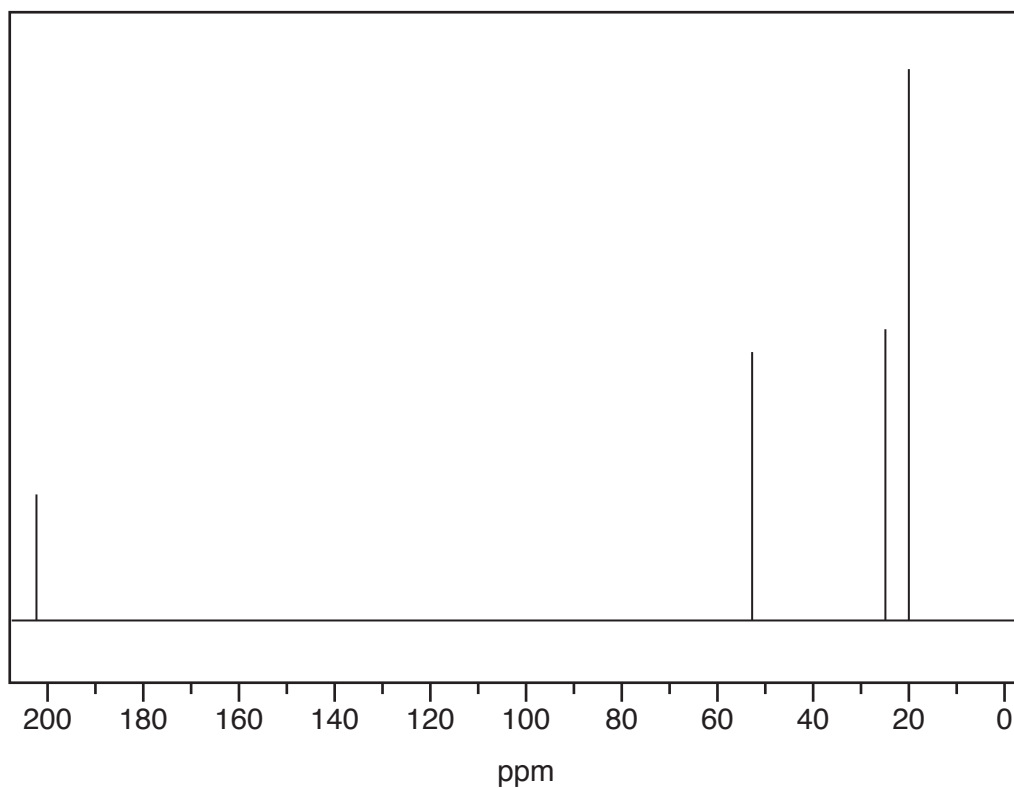
[1]



3 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.

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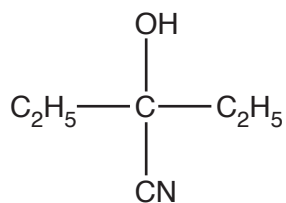
[3]

7

(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]

4 The general formula of an  $\alpha$ -amino acid is  $\text{RCH}(\text{NH}_2)\text{COOH}$ .

(a) Draw 3-D diagrams for the two optical isomers of the  $\alpha$ -amino acid serine, where R is  $\text{CH}_2\text{OH}$ .

[2]

(b) Compound **F**,  $\text{C}_4\text{H}_7\text{O}_2\text{Br}$ , is one of two optical isomers.

Compound **F** reacts with excess ethanolic ammonia to form the  $\alpha$ -amino acid **G**.

Compound **H** has *E/Z* isomers and can be converted into compound **F** by addition of  $\text{HBr}$ .

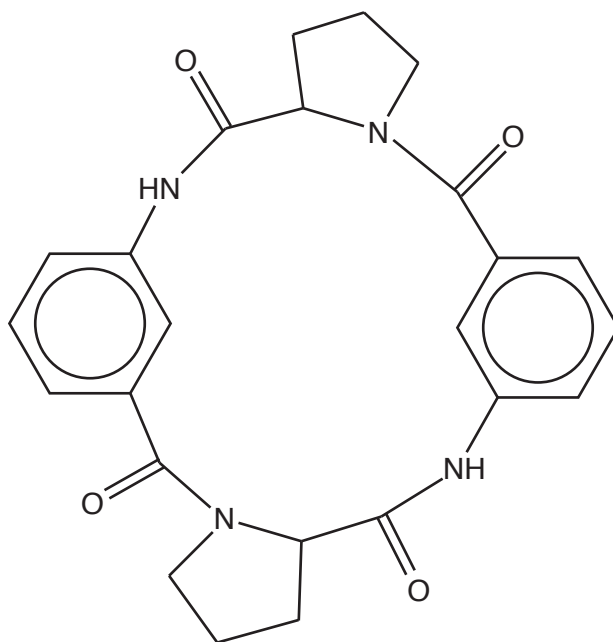
Compound **H** forms polymer **I**, which has the empirical formula  $\text{C}_2\text{H}_3\text{O}$ .

- Suggest structures for compound **F**, compound **G** and compound **H**.
- Draw a repeat unit of polymer **I**.
- State the type of reaction for the formation of **F** and for the formation of **G**.

[6]



(c) A cyclic tetrapeptide has been synthesised from 3-aminobenzoic acid and an amino acid.



**cyclic tetrapeptide**

The cyclic tetrapeptide is hydrolysed by heating under reflux with aqueous sodium hydroxide.

Draw the structures of **two** organic products formed by the complete alkaline hydrolysis of the cyclic tetrapeptide.

[3]

[Total: 11]



(b) A mixture of esters is separated and identified using gas chromatography, GC.

Explain the possible limitations of GC in both the separation and the identification of esters.

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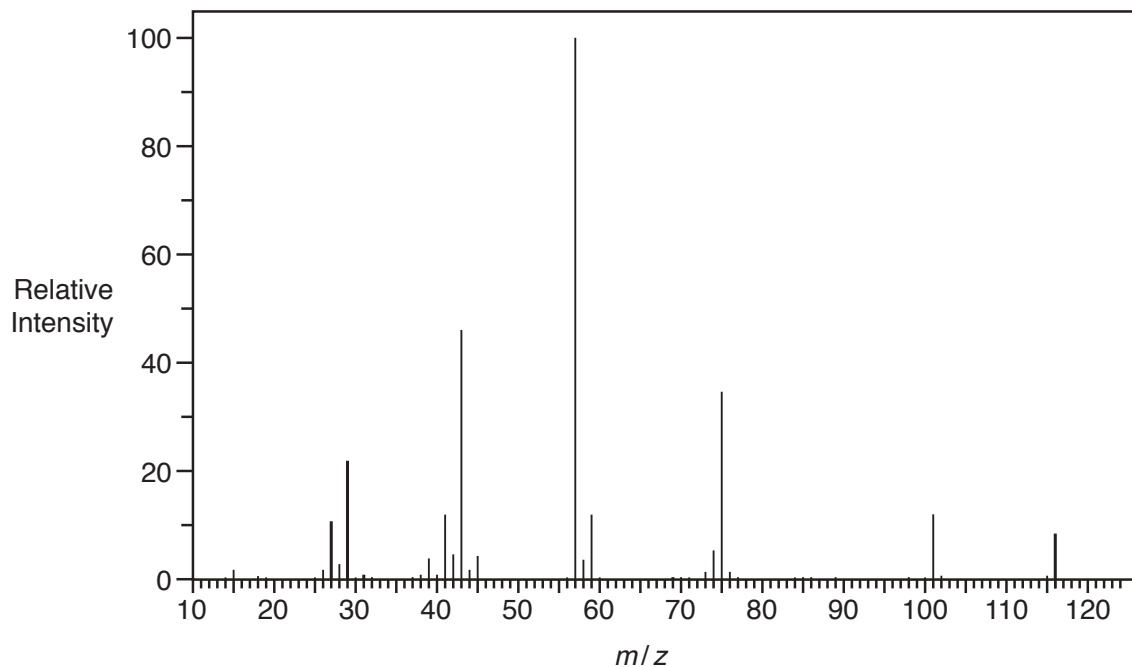
..... [2]

(c) The results of the analysis of an ester are shown below.

### Elemental analysis by mass

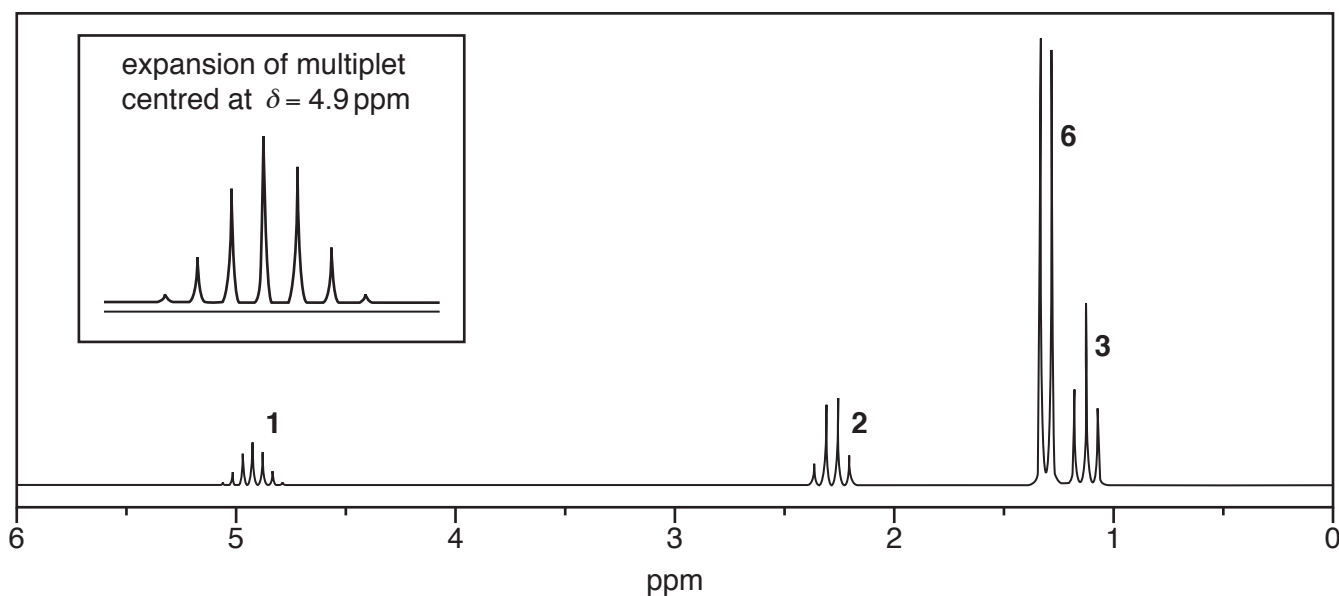
C, 62.07%; H, 10.34%; O, 27.59%

### Mass spectrum



### Proton NMR spectrum

The numbers by each peak are the relative peak areas.



The peak centred at  $\delta = 4.9$  ppm would normally be expected at a chemical shift value about 1 ppm to the right, i.e. 3.9 ppm.



**ADDITIONAL ANSWER SPACE**

If additional space is required, you should use the following lined page(s). The question number(s) must be clearly shown in the margin(s).

A large area of lined paper for writing, consisting of 25 horizontal dotted lines. A solid vertical line runs down the left side of the page, creating a margin. The rest of the page is open for writing.



A large area of the page is reserved for writing, featuring a vertical solid line on the left side and horizontal dotted lines extending across the page.



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