

Candidate Name	Centre Number	Candidate Number

WELSH JOINT EDUCATION COMMITTEE  
General Certificate of Education  
Advanced



CYD-BWYLLGOR ADDYSG CYMRU  
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Uwch

334/01

**CHEMISTRY CH4**

A.M. MONDAY, 23 January 2006

(1 hour 40 minutes)

FOR EXAMINER'S USE ONLY		
Section	Question	Mark
A	1	
	2	
	3	
B	4	
	5	
TOTAL MARK		

**ADDITIONAL MATERIALS**

In addition to this examination paper, you will need:

- a calculator;
- an 8 page answer book;
- a **Data Sheet** which contains a **Periodic Table** supplied by WJEC. Refer to it for any **relative atomic masses** you require.

**INSTRUCTIONS TO CANDIDATES**

Write your name, centre number and candidate number in the spaces at the top of this page.

**Section A** Answer **all** questions in the spaces provided.

**Section B** Answer **both** questions in **Section B** in a separate answer book, which should then be placed inside this question-and-answer book.

Candidates are advised to allocate their time appropriately, between **Section A (35 marks)** and **Section B (40 marks)**.

**INFORMATION FOR CANDIDATES**

The number of marks is given in brackets at the end of each question or part-question.

The maximum mark for this paper is 75.

Your answers must be relevant and must make full use of the information given to be awarded full marks for a question.

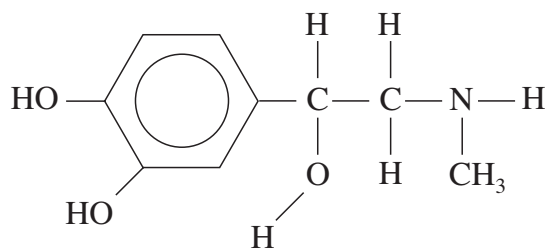
You are reminded that marking will take into account the Quality of Written Communication used in your answers.

No certificate will be awarded to a candidate detected in any unfair practice during the examination.

## SECTION A

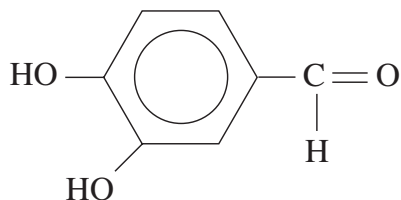
Answer **all** the questions in the spaces provided.

1. (a) Adrenalin, a hormone which acts as a stimulant in the body, has the structure shown below.



- (i) **Name two** functional groups in the molecule. [2]
- I. ....
- II. ....
- (ii) On the diagram, identify a chiral centre in the molecule, using an asterisk, \*. [1]
- (iii) Draw the structure of the product formed when adrenalin is treated with
- I. excess aqueous sodium hydroxide, [1]
- II. aqueous acid,  $\text{H}^+(\text{aq})$ . [1]

- (b) Adrenalin can be synthesised in several stages from a compound called 3,4-dihydroxybenzenecarbaldehyde, the structure of which is given below.



- (i) During the first stage, the compound is reacted with hydrogen cyanide, HCN. Classify this reaction. [1]

.....

- (ii) Theoretically, 1 mole of 3,4-dihydroxybenzenecarbaldehyde can be converted to 1 mole of adrenalin. Calculate the maximum yield of adrenalin, in grams, which can be obtained from 8.42 g of 3,4-dihydroxybenzenecarbaldehyde.

(Give your answer correct to 3 significant figures.) [3]

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Total [9]

2. (a) Functional groups in aliphatic compounds behave differently to functional groups attached to benzene rings.

For **each** of the following pairs of compounds, describe a **chemical** test that can be used to distinguish between them. The reagent(s) and condition(s) used, as well as the observations for **each** compound, are required.

- (i) 1-Chlorobutane and chlorobenzene. [2]

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- (ii) Ethanol and phenol. [2]

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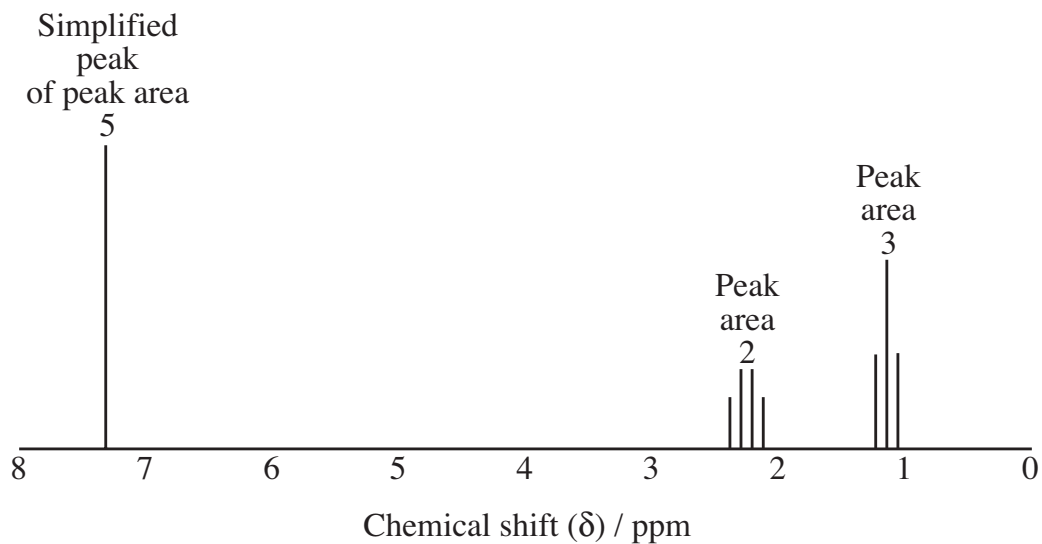
- (iii) Ethylamine and phenylamine. [2]

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(b) A hydrocarbon of molecular formula  $C_8H_{10}$  has the NMR spectrum shown below.



(i) Deduce the structure of the compound, giving your reasoning. [4]

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(ii) Draw the structure of **one** isomer of the hydrocarbon,  $C_8H_{10}$ . [1]

Total [11]

3. (a) Alkanes, alkenes and benzene can be halogenated, but by different mechanisms.

- (i) When propene reacts with hydrogen bromide, there are two possible products, although one is dominant. Name **or** give the structure of both possible products in the spaces below. [1]

..... and .....

- (ii) Draw the mechanism for the reaction between propene and hydrogen bromide, which leads to the formation of the dominant product. [3]

- (iii) Explain why one of the possible products is dominant. [1]

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- (iv) Explain why benzene does not readily undergo addition reactions. [2]

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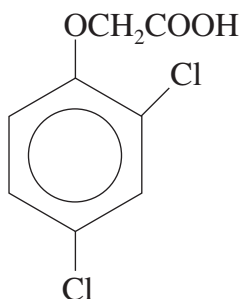
- (v) Name the type of mechanism that occurs when methane reacts directly with chlorine. [1]

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- (vi) Explain why ethane can also form during the direct chlorination of methane. [2]

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.....

- (b) Many organohalogenes are used as herbicides. One of the first herbicides to be developed, 2,4-dichlorophenoxyethanoic acid, was used to defoliate forests in the Vietnam War. Its structure is shown below.



- (i) State the reagent(s) and condition(s) needed to substitute a chlorine atom into a benzene ring. [2]
- .....
- .....
- (ii) Give a chemical test (apart from the use of indicators) to show that the herbicide above contains a carboxylic acid group. [2]
- Reagent(s) .....
- Observation(s) .....
- .....
- (c) Give another large-scale use of a named organohalogen compound of your choice. [1]
- .....
- .....

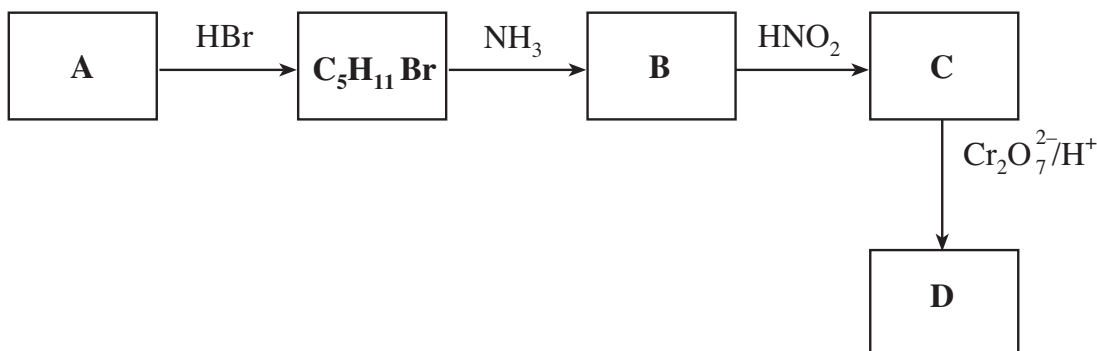
Total [15]

**Total Section A [35]**

## SECTION B

Answer **both** questions in the separate answer book provided.

4. (a) Study the reaction scheme shown below.



- (i) All the compounds are straight chained isomers.

Compound **A** shows geometric isomerism.

Compounds **B** and **C** each contain a **chiral centre**.

Compound **D** gives an orange-yellow solid with 2,4-dinitrophenylhydrazine but does **not** give a silver precipitate with Tollens' reagent.

Use **all** the information to give the structures of compounds **A-D**, showing your reasoning in **each** case.

[8]

- (ii) State the reagent(s) and condition(s) needed for the conversion of **D** → **C**.

[1]

- (b) A compound **E** contains carbon, hydrogen and oxygen only. It has a molar mass of  $90.06 \text{ g mol}^{-1}$ . Quantitative analysis of compound **E** shows that it contains 39.97% carbon and 6.73% hydrogen by mass.

Calculate both the empirical and molecular formulae of compound **E**.

[3]



(c) Carboxylic acids may be converted into several important derivatives.

Give the reagent(s) and necessary condition(s) for the conversion of

- (i) propanoic acid to propanamide, [2]
- (ii) propanoic acid to ethyl propanoate. [2]
- (d) State how the infrared spectrum of propanoic acid would differ from that of ethyl propanoate, by using the characteristic infrared absorption frequencies given in the Data Sheet. [1]
- (e) Explain, in detail, why propanoic acid is more acidic than propan-1-ol. [3]

Total [20]

**Turn over for Question 5**

5. (a) Give **one** example of **each** of the following processes, giving necessary reactants, reaction conditions and balanced chemical equations:
- (i) elimination; [3]
  - (ii) electrophilic substitution; [3]
  - (iii) nucleophilic substitution. [3]
- (b)  $\alpha$ -Amino acids are very important in biochemistry since they are the monomers that make up the natural polymers called proteins.
- (i) Write down the graphic (full structural) formula of aminoethanoic acid. [1]
  - (ii) Write down the structural formula of the peptide link that forms when two aminoethanoic acid molecules react. [1]
  - (iii) Aminoethanoic acid, methyl ethanoate and propanoic acid have similar relative molecular masses. State and explain the trend in the melting temperatures of these compounds. [4]
- (c) Poly(phenylethene), commonly known as polystyrene, and nylon are both important synthetic polymers, but are different types of polymer.
- (i) Draw the structure of the monomer used in the production of poly(phenylethene) and name this type of polymerisation. [2]
  - (ii) Draw the structure of a monomer used in the production of nylon 6,6. [1]
  - (iii) Give **two** differences between these two types of polymerisation. [2]
- Total [20]
- Section B Total [40]**