

Candidate Name	Centre Number	Candidate Number
		2



GCE A level

334/01

CHEMISTRY CH4

P.M. THURSDAY, 11 June 2009

1 hour 40 minutes

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 in all written answers.

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

SECTION A

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

1. Propene is a typical alkene. It can be polymerised to form poly(propene) which has a wide range of uses, such as caps for water bottles and bump-resistant toys.

(a) Give the formula of the repeating unit in poly(propene). [1]

- (b) Describe a test which would show that propene contains a C = C double bond by stating the reagent(s) and expected observation(s).

Reagent(s) [1]

Observations(s) [1]

- (c) Propene reacts with hydrogen bromide to give 2-bromopropane as the major product.

- (i) Classify the type of reaction taking place and draw the mechanism for this reaction. [4]

Type of reaction

Mechanism

- (ii) State briefly why 2-bromopropane is the main product of this reaction. [1]

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.....

- (d) 2-Bromopropane can be re-converted to propene.
Give the necessary reagent(s) and condition(s) needed for this re-conversion.

Reagent(s) [1]

Condition(s) [1]

- (e) Propene can also be obtained from propan-1-ol.
Classify the type of reaction taking place and name the reagent(s) needed for this conversion.

Type of reaction [1]

Reagent(s) [1]

Total [12]

2. (a) Both butylamine and phenylamine possess unpleasant odours. However, both are useful since butylamine is used in the manufacture of pesticides and pharmaceuticals while phenylamine is the parent substance for many dyes and drugs.

(i) Draw the graphic (full structural) formula of butylamine. [1]

(ii) Explain why phenylamine is a weaker base than butylamine. [2]

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(iii) Both butylamine and phenylamine react with aqueous nitrous acid (nitric(III) acid), HNO_2 , in the cold (below 10°C) and on warming. Aqueous HNO_2 is made from NaNO_2 and HCl .

Give the formula of the main organic product in these reactions. [3]

I. Butylamine + HNO_2 in the cold.

.....

.....

Butylamine + HNO_2 on warming.

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II. Phenylamine + HNO_2 in the cold.

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Phenylamine + HNO_2 on warming.

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.....

- (iv) Give the formula of the compound formed when an alkaline solution of phenol reacts with the product of (iii)II. under cold conditions. [1]

(b) One method of obtaining bromobenzene in the laboratory is to add bromine to a mixture of benzene and a suitable catalyst. The mixture is warmed until the red vapours of bromine are no longer visible. The product is washed and purified.

- (i) Give the formula of the species attacking the benzene ring. [1]
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- (ii) Name a suitable catalyst. [1]
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- (iii) Apart from speeding up the reaction, explain the part played by the catalyst in this process. [1]
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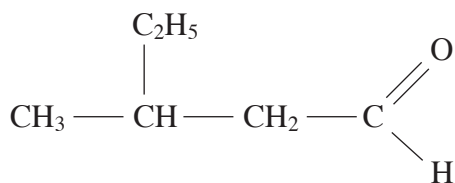
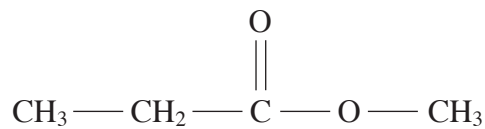
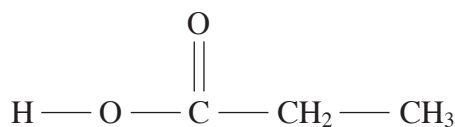
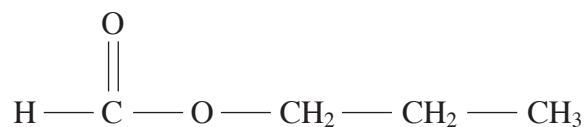
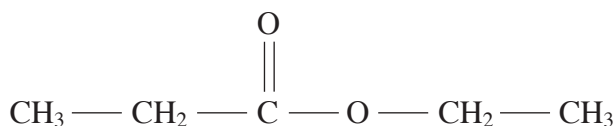
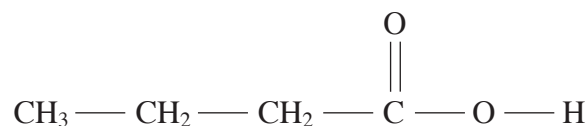
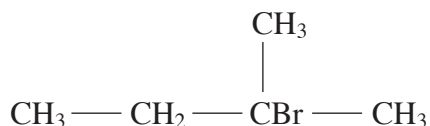
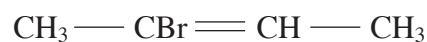
(iv) Bromobenzene is a liquid with a boiling temperature of 159°C and is immiscible with the aqueous mixture obtained during the above reaction.

- I. State how you would separate the bromobenzene from the aqueous mixture. [1]
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- II. State how you would obtain a pure sample of bromobenzene after separation. [1]
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Total [12]

3. (a) Consider the following structures.

**A****B****C****D****E****F****G****H****I****J**

(i) Give the systematic name of compound **A**. [1]

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(ii) Give the letters of the compounds that will exhibit geometric or optical isomerism. [4]

Geometric isomerism

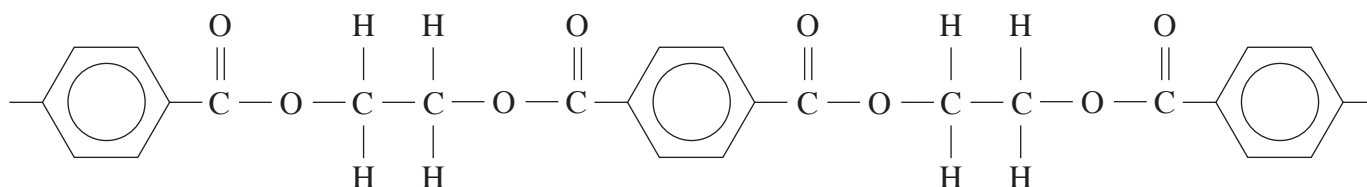
Optical isomerism

(iii) Give the letters of the compounds that are isomers of ethyl ethanoate. [2]

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- (iv) Give the structure of a compound, not in the list opposite, that is also an isomer of ethyl ethanoate. [1]

- (b) Polyesters are made by condensation polymerisation.
PET is the most widely used polyester. For example, it is used to make plastic containers for fizzy drinks, sails on sailboards and clothing. A section of the PET chain is shown below.



- (i) Draw the structures of the two molecules which react to form PET. [2]

- (ii) State a difference between addition and condensation polymerisation. [1]

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Total [11]

Section A Total [35]

SECTION B

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

4. (a) The information given below relates to a corrosive white solid, **X**.

Quantitative analysis shows that its percentage composition by mass is C 33.2%, Cl 32.7%, H 4.6% and the remainder is oxygen.

Gentle heating of the solid with ethanol and a few drops of concentrated sulphuric acid produces a sweet-smelling reaction mixture.

On addition to an aqueous solution of sodium carbonate, effervescence is seen.

The infrared spectrum shows a broad intense peak at 3000 cm^{-1} and a sharper peak at 1715 cm^{-1} .

The mass spectrum shows two molecular ion signals at m/e 108 and m/e 110 in the ratio of 3:1.

The NMR spectrum shows three peaks, a doublet centred around 1.7δ , peak area 3, a quartet centred around 4.3δ , peak area 1 and a singlet centred around 11.0δ , peak area 1.

Compound **X** shows optical isomerism.

- (i) Use **all** the information above to give the structural formula for compound **X**. [9]
- (ii) Give one chemical test which could be used to confirm that compound **X** contained a chlorine atom. Your answer should include all reagents, conditions and expected observations. [2]
- (iii) Explain why compound **X** shows optical isomerism and state how the optical isomers could be distinguished from each other. [2]
- (b) (i) Explain why ethanoic acid is very soluble in water but hexanoic acid is only slightly soluble. [2]
- (ii) Ethanoic acid can be converted into a number of compounds and be formed from a number of compounds.

Write an equation to show

- I. the conversion of ethanoic acid to ethanoyl chloride, [1]
- II. the formation of ethanoic acid from ethyl ethanoate. [1]
- (iii) When 5.80 g of hexanoic acid was converted into hexanoyl chloride, 5.38 g was obtained. Calculate the percentage yield for the reaction. [3]

Total [20]

5. (a) Ethanol, usually referred to as ‘alcohol’, is the legal drug most commonly used by adults. However, it is a depressant and addiction to ethanol is the greatest medical problem resulting from the use of drugs.

It consists of a hydroxyl group, $-\text{OH}$, attached to an alkyl group.

- (i) State a large scale use of ethanol other than in beers, wines and spirits. [1]
- (ii) Phenol also contains a hydroxyl group but it is attached to a benzene ring.
State how and explain why the hydroxyl group in phenol behaves differently from that in ethanol. [2]
- (iii) Give a chemical test to distinguish between ethanol and phenol, stating reagent(s) and observation(s). [2]
- (b) Describe how you could prepare ethanal from ethanol. Your answer should include any reagents and essential experimental conditions. [3]
- (c) (i) State what you would expect to observe when **each** of ethanal and propanone are added separately to the following: [4]
- I. Tollens’ reagent;
 - II. iodine in the presence of aqueous sodium hydroxide;
 - III. 2,4-dinitrophenylhydrazine.
- (ii) Explain how the product of the reaction in (c)(i)III may be used to identify ethanal or propanone.
- (d) When methane and chlorine are combined in sunlight, a reaction occurs with chloromethane as the main organic product. Write the mechanism for this reaction. [4]
- (e) Starting with bromoethane, outline how you could prepare a sample of propylamine. Your answer should include any reagents and conditions needed for this conversion. [4]

Total [20]

Section B Total [40]