

**GENERAL CERTIFICATE OF SECONDARY EDUCATION
TWENTY FIRST CENTURY SCIENCE
CHEMISTRY A**

A323/01

Unit 3: Ideas in Context plus C7
(Foundation Tier)

**Thursday 4 June 2009
Morning**

Duration: 60 minutes

Candidates answer on the question paper
A calculator may be used for this paper

OCR Supplied Materials:

- Insert (inserted)

Other Materials Required:

- Pencil
- Ruler (cm/mm)



Candidate Forename		Candidate Surname	
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Centre Number						Candidate Number				
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MODIFIED LANGUAGE

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **55**.
-  Where you see this icon you will be awarded a mark for the quality of written communication in your answer.
- The Periodic Table is printed on the back page.
- This document consists of **16** pages. Any blank pages are indicated.

Answer **all** the questions.

1 This question is based on the article ‘The bioethanol dilemma’.

- (a) (i) The article suggests that most bioethanol produced in the UK would be made from wheat.

Name two **other** fuel crops mentioned in the article that are used to make bioethanol.

1

2 [1]

- (ii) The table in the article shows how bioethanol consumption increased in a number of European countries from 2005 to 2006.

In which country did bioethanol consumption have the biggest increase?

..... [1]

- (b) Describe **two** of the environmental benefits of burning bioethanol, compared to petrol, that are mentioned in the article.

.....

.....

.....

..... [2]

- (c) (i) The European Union expects biofuels to make up 5.75% of transport fuel needs by 2010.

Soon most petrol sold in the UK will contain some bioethanol.

It is not likely that petrol will contain more than 5% bioethanol in the near future.

Suggest why.

.....

..... [1]

- (ii) Cars may be fuelled by 100% bioethanol in the more distant future.

A typical driver in the UK drives 600 000 miles in their lifetime.

How many hectares of wheat would need to be grown to produce bioethanol to fuel a car for the total mileage driven by this typical driver?

.....hectares of wheat [1]

(d) (i) The article suggests that food prices will rise as demand for bioethanol increases.

Suggest why.

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

(ii) The article also suggests that there will be a decline in soil fertility as demand for bioethanol increases.

This will result in farmers using more fertilizers.

Suggest why using more fertilizers might harm the environment.

.....
.....
.....
..... [2]

(e) (i) List **two** factors mentioned in the article that are involved in the Life Cycle Assessment for bioethanol that do not apply to petrol.

1

2

..... [2]

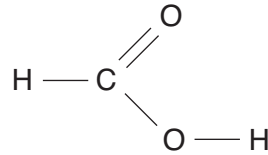
(ii) Explain how bioethanol may be a more sustainable fuel than petrol.

.....
.....
.....
..... [2]

[Total: 13]

2 Methanoic acid is a carboxylic acid that is released in bee stings.

(a) The diagram shows the structural formula of methanoic acid.



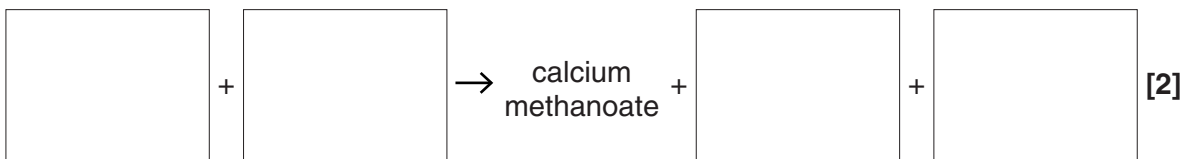
On the diagram, draw a circle around the functional group that is responsible for the characteristic properties of carboxylic acids. [1]

(b) Methanoic acid is used to remove the limescale that can build up in kettles. Limescale is made of calcium carbonate, which is insoluble in water.

Carboxylic acids react with carbonates in a similar way to other acids, such as hydrochloric acid.

calcium carbonate + hydrochloric acid \rightarrow calcium chloride + carbon dioxide + water

(i) Complete this word equation for the reaction between methanoic acid and calcium carbonate.



(ii) Suggest a property of calcium methanoate that explains how this reaction removes limescale.

.....
 [1]

(iii) Some kettles have metal bodies, and all have metal heating elements.

Hydrochloric acid is not used to remove limescale from kettles.

Explain why methanoic acid is used to remove limescale but hydrochloric acid is not.

Use ideas about strong and weak acids in your answer.



One mark is for correct spelling.

.....

 [3+1]

5

(c) Ethanoic acid, CH_3COOH , is another carboxylic acid. It is present in vinegar.

Draw a diagram to show the structural formula for ethanoic acid.

[2]

[Total: 10]

- 3 Vegetable oils are commonly used in cooking. Examples are rape seed oil and sunflower seed oil.



- (a) These oils are found in the seeds produced by plants.

What is the job of the oil in these seeds?

..... [1]

- (b) (i) When an ester is hydrolysed it forms an alcohol and a carboxylic acid. This reaction is the reverse of that used to make the ester.

Oils and fats are esters. Write the **name** of the alcohol and of the **type** of carboxylic acid to complete this word equation for the hydrolysis of an oil.

oil + water \rightleftharpoons + [2]

- (ii) What **two** things does the \rightleftharpoons sign tell you about this reaction?

.....

 [2]

- (c) A food product may contain other esters in addition to vegetable oil.

Suggest **two** reasons why other esters may be added to food products.

.....
 [2]

[Total: 7]

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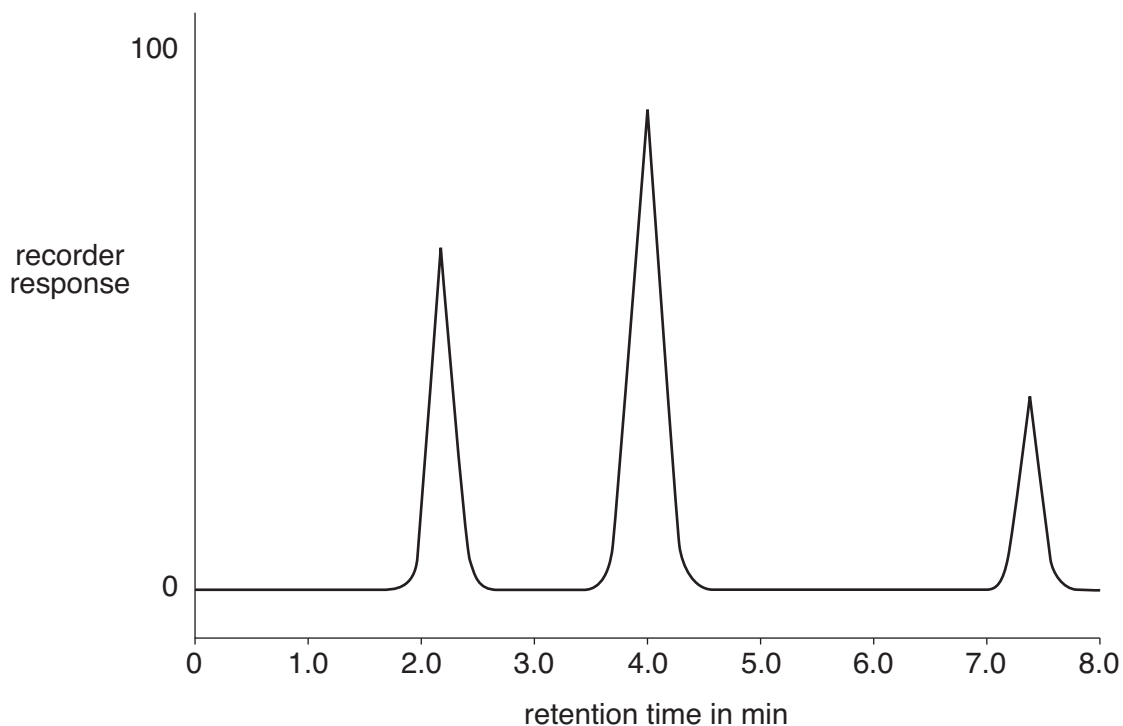
Question 4 starts on page 8.

- 4 A technician uses gas chromatography to analyse a mixture of hydrocarbons.

She first calibrates the equipment using standard hydrocarbons. The retention times for these hydrocarbons are shown in the table.

hydrocarbon	retention time in min
methane	1.7
ethane	2.2
propane	3.5
propene	4.0
butane	7.4

The technician then analyses the mixture of hydrocarbons. The recorder print-out from this analysis is shown below.



- (a) Explain what is meant by the term *retention time*.

.....
..... [2]

(b) (i) Which **three** hydrocarbons are present in the mixture?

1

2

3

[2]

(ii) Name the hydrocarbon that has the highest concentration in the mixture.

..... [1]

(iii) One of the gases in the mixture is not an alkane.

What is the name of this gas?

..... [1]

(c) Two of the hydrocarbons in the mixture are alkanes.

Alkanes burn but they do not react with solutions of other chemicals, for example bromine water.

(i) Explain why alkanes do not react with bromine water.

Use ideas about the bonds in alkanes in your answer.

.....
.....
..... [2]

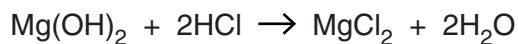
(ii) The burning of alkanes gives out energy.

Use ideas about bond making and breaking to explain why.

.....
.....
..... [2]

[Total: 10]

- 5 Some indigestion tablets contain the active ingredient, magnesium hydroxide. This reacts with excess stomach acid to relieve the symptoms of acid indigestion.



The tablets also contain starch.

A chemist uses quantitative analysis to find the mass of active ingredient in each tablet.

(a) The statements describe the main stages of this analysis, but they are in the wrong order.

- A Crush the tablet and stir it into approximately 25 cm³ distilled water.
- B Use the average titration result to calculate the mass of magnesium hydroxide in each tablet.
- C Titrate the mixture against hydrochloric acid of known concentration.
- D Measure accurately the mass of one indigestion tablet.
- E Estimate the degree of uncertainty in the result.
- F Repeat the procedure using several more tablets.

Write letters in the boxes to show the correct order of the stages. The correct letter has already been written in the first box.

D					
---	--	--	--	--	--

[3]

(b) What apparatus should the chemist use to measure each of the following?

- (i) The 25 cm³ distilled water.

..... [1]

- (ii) The volume of hydrochloric acid used in each titration.

..... [1]

(c) The chemist finds that 23.5 cm^3 is the average volume of hydrochloric acid used to react with the magnesium chloride in a tablet.

(i) The relative formula mass of hydrochloric acid is 36.5.

Work out the relative formula mass (RFM) of magnesium hydroxide, $\text{Mg}(\text{OH})_2$.

You should show your working.

(relative atomic masses: $\text{H} = 1$, $\text{Mg} = 24$, $\text{O} = 16$)

relative formula mass (RFM) of magnesium hydroxide = [2]

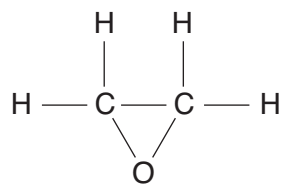
(ii) Use this formula to work out the mass of magnesium hydroxide in each indigestion tablet.

$$\text{mass of magnesium hydroxide} = \frac{\text{volume HCl} \times 40 \times \text{RFM Mg}(\text{OH})_2}{2000 \times 36.5}$$

mass of magnesium hydroxide in each tablet = g [1]

[Total: 8]

- 6 Epoxyethane, $(\text{CH}_2)_2\text{O}$, is an intermediate in the production of car anti-freeze, and is used to sterilize medical supplies.



epoxyethane

Epoxyethane is poisonous, carcinogenic and highly flammable.

Ethene is the raw material used to make epoxyethane. Ethene is obtained by the cracking of hydrocarbons from petroleum.

- (a) (i) Epoxyethane is a bulk chemical.

Explain what is meant by the term 'bulk'.

.....
 [1]

- (ii) The manufacture of epoxyethane may not be sustainable to the end of this century.

Use information about the raw material used in its manufacture to suggest why.

.....

 [2]

- (b) Two methods have been used to make epoxyethane.

- original method – from ethene, chlorine and calcium hydroxide
- modern method – ethene and oxygen are passed over a silver catalyst at $250\text{-}350^\circ\text{C}$

- (i) The original method produces solid calcium chloride as a by-product, but the modern method does not.

There is little use for this calcium chloride.

Explain why this makes the original method less sustainable than the modern method.

.....
 [1]

(ii) The catalyst in the modern method consists of very fine particles.

Explain why.

.....
.....
..... [2]

(c) The government has strict regulations that control the way that epoxyethane is made, stored and transported.

What is the purpose of these regulations?

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

[Total: 7]

END OF QUESTION PAPER

14
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The Periodic Table of the Elements

	1	2	3	4	5	6	7	0	
	7 Li lithium 3	9 Be beryllium 4		11 B boron 5	12 C carbon 6	14 N nitrogen 7	16 O oxygen 8	19 F fluorine 9	20 Ne neon 10
	23 Na sodium 11	24 Mg magnesium 12		27 Al aluminium 13	28 Si silicon 14	31 P phosphorus 15	32 S sulfur 16	35.5 Cl chlorine 17	40 Ar argon 18
	39 K potassium 19	40 Ca calcium 20		70 Ga gallium 31	73 Ge germanium 32	75 As arsenic 33	79 Se selenium 34	80 Br bromine 35	84 Kr krypton 36
	85 Rb rubidium 37	88 Sr strontium 38		115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
	133 Cs caesium 55	137 Ba barium 56		204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
	[223] Fr francium 87	[226] Ra radium 88		201 Hg mercury 80	197 Au gold 79	195 Pt platinum 78	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				65 Zn zinc 30	63.5 Cu copper 29	59 Ni nickel 28	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				56 Fe iron 26	59 Co cobalt 27	59 Ni nickel 28	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				55 Mn manganese 25	59 Co cobalt 27	59 Ni nickel 28	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				48 Ti titanium 22	51 V vanadium 23	59 Ni nickel 28	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				45 Sc scandium 21	51 V vanadium 23	59 Ni nickel 28	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				48 Ti titanium 22	51 V vanadium 23	59 Ni nickel 28	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				91 Zr zirconium 40	93 Nb niobium 41	106 Pd palladium 46	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				91 Zr zirconium 40	93 Nb niobium 41	106 Pd palladium 46	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				178 Hf hafnium 72	181 Ta tantalum 73	195 Pt platinum 78	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				178 Hf hafnium 72	181 Ta tantalum 73	195 Pt platinum 78	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				139 La* lanthanum 57	186 Re rhenium 75	195 Pt platinum 78	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
				139 La* lanthanum 57	186 Re rhenium 75	195 Pt platinum 78	[209] Po polonium 84	[210] At astatine 85	[222] Rn radon 86
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