Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GENERAL CERTIFICATE OF SECONDARY EDUCATION

A323/01

TWENTY FIRST CENTURY SCIENCE

CHEMISTRY A

Unit 3 Ideas in Context plus C7
(Foundation Tier)

THURSDAY 4 JUNE 2009: Morning

DURATION: 60 minutes

SUITABLE FOR VISUALLY IMPAIRED CANDIDATES

Candidates answer on the question paper

OCR SUPPLIED MATERIALS:

Insert (inserted)

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (LEO/SW) OV90738 10921

INSTRUCTIONS TO CANDIDATES

- **Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes on the first page.**
- **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.**
- **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.**

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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 meet 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) In the more distant future, cars may be fuelled by 100% bioethanol.

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 as demand for bioethanol increases, food prices will rise.**

Suggest why.

_____

_____

_____ **[1]**

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

This will result in farmers using more fertilizers.

Suggest why using more fertilizers might harm the environment.

_____

_____

_____

_____ **[2]**

(e) (i) List <u>TWO</u> 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.

_____

_____

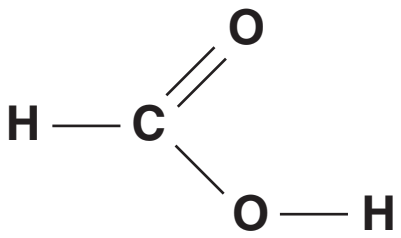
_____

_____ **[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 → calcium chloride + carbon dioxide + water

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

☐ + ☐ → calcium methanoate + ☐ + ☐

[2]

(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]**

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

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

[2]

[Total: 10]

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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) In addition to vegetable oil, a food product may contain other esters.

Suggest <u>TWO</u> reasons why other esters may be added to food products.

_____

_____ **[2]**

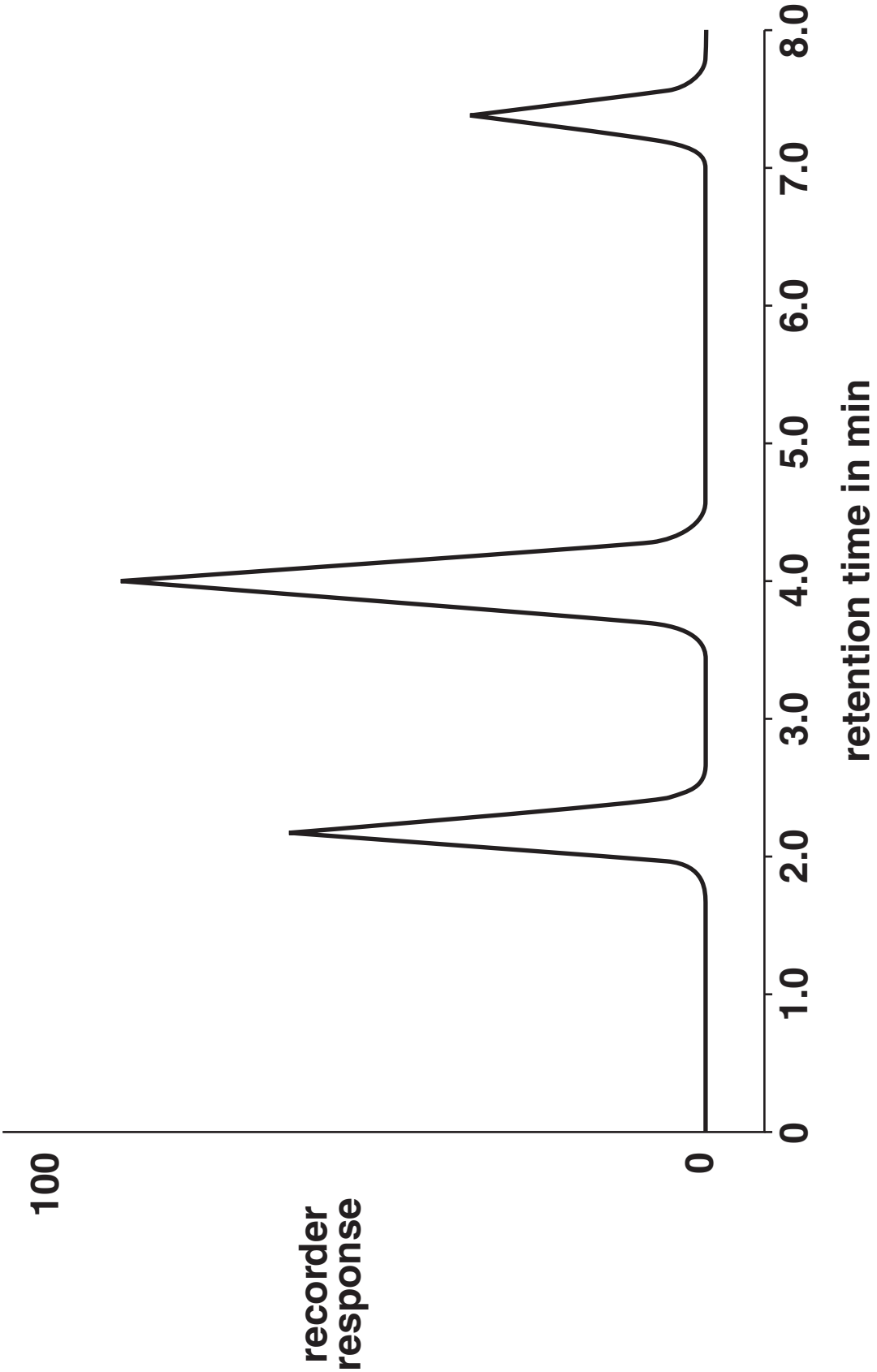
[Total: 7]

4 A technician carries out an analysis of a mixture of hydrocarbons using gas chromatography.

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 opposite.



(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.

$$Mg(OH)_2 + 2HCl \longrightarrow MgCl_2 + 2H_2O$$

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 cm^3 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 cm^3 distilled water.

_____ [1]

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

_____ [1]

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

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

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

You should show your working.

(relative atomic masses: H = 1, Mg = 24, 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.

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

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

[Total: 8]

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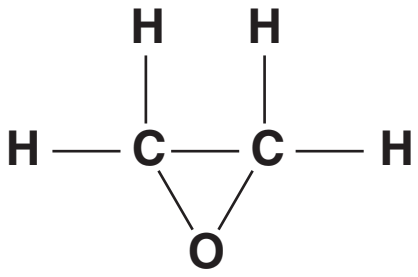
6 Epoxyethane, $(CH_2)_2O$, is an intermediate in the production of car anti-freeze, and is used to sterilize medical supplies.



epoxyethane

Epoxyethane is poisonous, carcinogenic and highly flammable.

The raw material used to make epoxyethane is ethene. This 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 250-350 °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

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The Periodic Table of the Elements

1	2											3	4	5	6	7	0
							1 **H** hydrogen 1										4 **He** helium 2
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	45 **Sc** scandium 21	48 **Ti** titanium 22	51 **V** vanadium 23	52 **Cr** chromium 24	55 **Mn** manganese 25	56 **Fe** iron 26	59 **Co** cobalt 27	59 **Ni** nickel 28	63.5 **Cu** copper 29	65 **Zn** zinc 30	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	89 **Y** yttrium 39	91 **Zr** zirconium 40	93 **Nb** niobium 41	96 **Mo** molybdenum 42	[98] **Tc** technetium 43	101 **Ru** ruthenium 44	103 **Rh** rhodium 45	106 **Pd** palladium 46	108 **Ag** silver 47	112 **Cd** cadmium 48	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	139 **La*** lanthanum 57	178 **Hf** hafnium 72	181 **Ta** tantalum 73	184 **W** tungsten 74	186 **Re** rhenium 75	190 **Os** osmium 76	192 **Ir** iridium 77	195 **Pt** platinum 78	197 **Au** gold 79	201 **Hg** mercury 80	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	[227] **Ac*** actinium 89	[261] **Rf** rutherfordium 104	[262] **Db** dubnium 105	[266] **Sg** seaborgium 106	[264] **Bh** bohrium 107	[277] **Hs** hassium 108	[268] **Mt** meitnerium 109	[271] **Ds** darmstadtium 110	[272] **Rg** roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

Key

relative atomic mass
atomic symbol
name
atomic (proton) number

**** The lanthanoids (atomic numbers 58-71) and the actinoids (atomic numbers 90-103) have been omitted.***

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.