OCR

SPECIMEN F

GENERAL CERTIFICATE OF SECONDARY EDUCATION

TWENTY FIRST CENTURY SCIENCE **A173/01**

CHEMISTRY A / FURTHER ADDITIONAL SCIENCE A

Unit A173/01: Module C7 (Foundation Tier)

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

OCR Supplied Materials:
None

Other Materials Required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

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.
- Write your answer to each question in the space provided, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

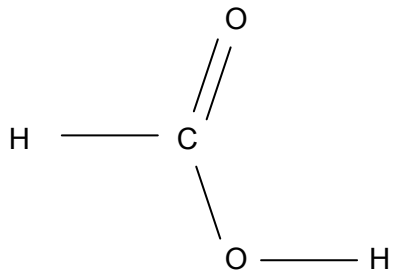
- Your quality of written communication is assessed in questions marked with a pencil (✎).
- The Periodic Table is printed on the back page.
- The number of marks for each question is given in brackets **[ ]** at the end of the question or part question.
- The total number of marks for this paper is **60**.
- This document consists of **20** pages. Any blank pages are indicated.

For Examiner's Use		
	Max	**Mark**
1	**11**	
2	**3**	
3	**11**	
4	**11**	
5	**8**	
6	**9**	
7	**7**	
TOTAL	**60**	

Answer **all** the questions.

1 Methanoic acid is a carboxylic acid.

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



On the diagram, draw a circle around the functional group that gives carboxylic acids their characteristic properties.

[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.

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

	+		→	calcium methanoate	+		+	

[2]

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

Hydrochloric acid is not used for removing limescale from kettles.

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

The quality of written communication will be assessed in your answer.

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..... **[6]**

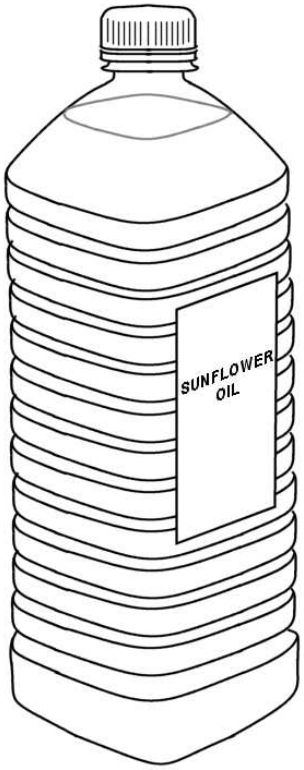
(c) Propanoic acid, CH_3CH_2COOH, is another carboxylic acid. It is found in some foods.

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

[2]

[Total: 11]

2 Sunflower oil is an example of a vegetable oil. The oil comes from the seed of the sunflower plant.



(a) Green plants get energy from sunlight.

Sunflower seeds cannot get energy from sunlight when they are in the soil.

Sunflower seeds contain oil.

Complete the sentence to describe how sunflower seeds use this oil.

Sunflower seeds use oil as a store of ..... . **[1]**

(b) The chemicals in sunflower oil are esters.

When an ester is hydrolysed it forms an alcohol and a carboxylic acid.

This reaction is the reverse of the reaction that makes the ester.

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

oil + water $\rightleftharpoons$ ..... + ... **[1]**

(c) Esters are often added to processed foods.

How does adding esters most commonly improve food?

Put ticks (✓) in the boxes next to the **two** best answers.

It can improve the taste.	☐
It can improve the appearance.	☐
It can stop bacteria growing.	☐
It can prevent reaction with oxygen.	☐
It can improve the smell.	☐
It can make the food last longer.	☐

[1]

[Total: 3]

3 A technician wants to analyse a mixture of hydrocarbons using gas chromatography.

She first calibrates the equipment using standard hydrocarbons.

The retention times of these standard hydrocarbons are shown in the table.

standard hydrocarbon	formula	retention time in minutes
methane	CH_4	1.7
ethane	C_2H_6	2.2
propane	C_3H_8	3.5
butane	C_4H_{10}	4.0
pentane	C_5H_{12}	7.4

(a) (i) Explain what is meant by retention time.

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

(ii) Use data in the table to write a conclusion relating the formula of each standard hydrocarbon to its retention time.

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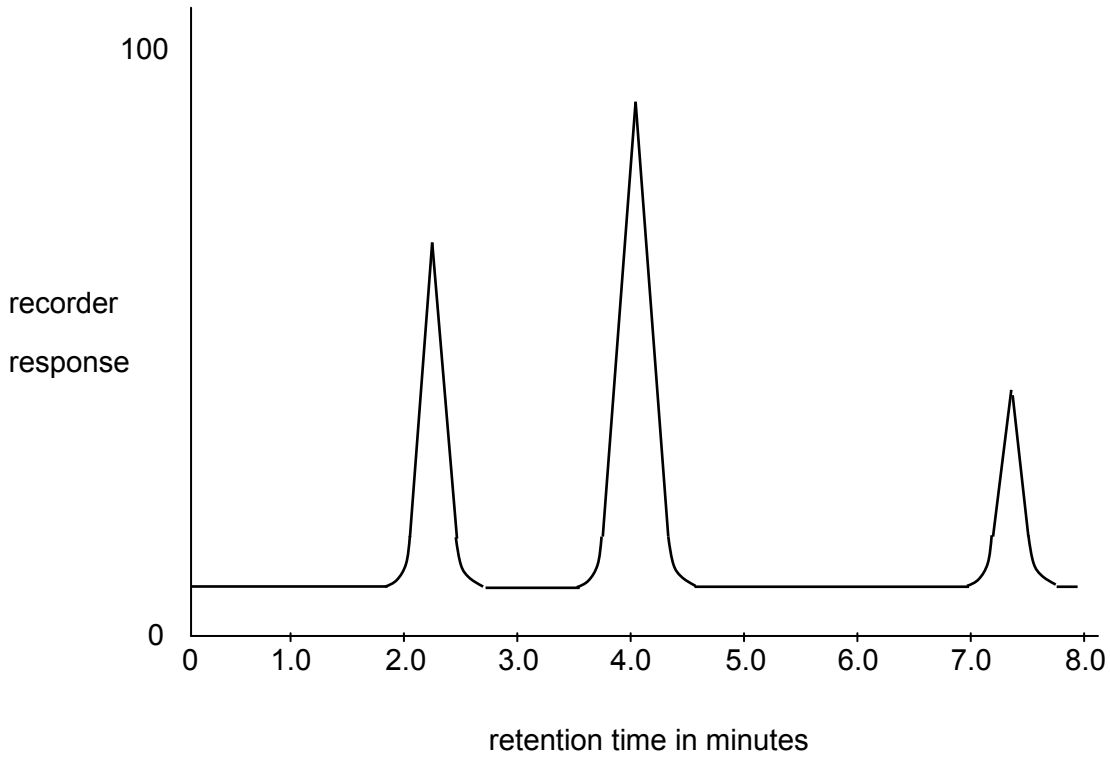
..... **[1]**

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



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

1 .....

2 .....

3 ..... **[1]**

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

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

(c) Natural gas is used as a fuel. It contains the hydrocarbon methane.

Methane burns in air according to this equation.

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$

Energy changes are involved in the breaking and making of bonds when methane burns.

Use ideas about the energy involved to explain why the reaction of methane with oxygen is exothermic.

The quality of written communication will be assessed in your answer.

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..... **[6]**

[Total: 11]

4 A company makes indigestion tablets that contain the active ingredient magnesium hydroxide.

This reacts with excess stomach acid to relieve the symptoms of acid indigestion.

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

The tablets also contain starch.

A chemist analyses samples from each batch of indigestion tablets that the company makes.

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

(a) The statements describe the main stages of this analysis. 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 concentration 40 g/dm^3.

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 the letters in the boxes to show the correct order of the stages. The first one has been done for you.

D					

[3]

(b) What piece of apparatus should the chemist use to measure the volume of hydrochloric acid used in each titration?

Explain why he should use this.

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

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

The formula shown below can be used to work out the mass of magnesium hydroxide in each indigestion tablet.

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

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

Relative atomic masses are given in the Periodic Table on the back page.

relative formula mass (RFM) = ... **[1]**

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

Give your answer to 2 decimal places.

mass = ... g **[2]**

(d) The company makes batches of 100 000 tablets. The chemist samples and tests some tablets from each batch to obtain data about the mass of magnesium hydroxide in the tablets.

Look at his results.

	batch 1	**batch 2**	**batch 3**
number of tablets sampled	2	8	6
average mass of magnesium hydroxide in one tablet in grams	0.64	0.77	0.72

(i) Should the company be concerned about these results?

Explain your answer.

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

(ii) Suggest what changes the chemist should make to the testing procedure.

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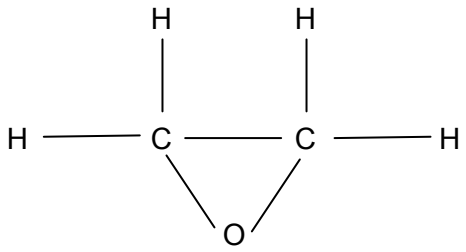
..... **[2]**

[Total: 11]

5 Epoxyethane is an intermediate in the production of car anti-freeze.



epoxyethane

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.

What is a bulk chemical?

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

(ii) It may not be sustainable to make epoxyethane from ethene.

Which statements suggest why not?

Put ticks (✓) in the boxes next to the **two** statements, when taken together, that give the correct answer.

Making epoxyethane uses oxygen from the air.	☐
This will reduce the oxygen supply to people.	☐
Chlorine is used to make epoxyethane.	☐
Chlorine is a poisonous gas.	☐
Ethene is obtained from crude oil.	☐
One day we will run out of crude oil.	☐

[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.

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

There is not much use for this calcium chloride and the company cannot sell it.

Why may this mean that the original method is less sustainable than the modern method?

Put a tick (✓) in the box next to the correct answer.

The company has to dispose of the calcium chloride.	☐
Chlorine is used in the original process.	☐
Corrosive hydrochloric acid is produced.	☐
Epoxyethane is poisonous.	☐

[1]

(ii) The modern method uses a catalyst.

Complete the sentence to explain what the catalyst does in this reaction.

Use words from this list.

activation energy	**boiling point**	**feedstock**	**melting point**
product	**rate of reaction**	**reactant**	**route**

The silver catalyst lowers the ..... by allowing

the reaction to take place using an alternative ..... . **[2]**

(c) Epoxyethane is poisonous, carcinogenic and highly flammable.

The Government has strict regulations that control the way that epoxyethane is transported.

Explain the purpose of these regulations.

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

[Total: 8]

6 Bio-ethanol can be used as a fuel for cars. It is made by the fermentation of wheat or beet sugar.

(a) Fermentation of carbohydrates by yeast produces a solution. This solution is distilled to produce bio-ethanol.

Why is the solution distilled?

Put a tick (✓) in the box next to the best answer.

To remove the yeast.	☐
To turn the ethanol into ethanoic acid.	☐
To increase the concentration of ethanol.	☐
To mix ethanol with petrol.	☐

[1]

(b) Ethanol can also be made from ethane. Ethane is obtained from natural gas.

(i) Outline the industrial method used to make ethanol from ethane.

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

(ii) Compare the sustainability of making ethanol by fermentation and making ethanol from ethane.

Explain your comparison.

The quality of written communication will be assessed in your answer.

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..... **[6]**

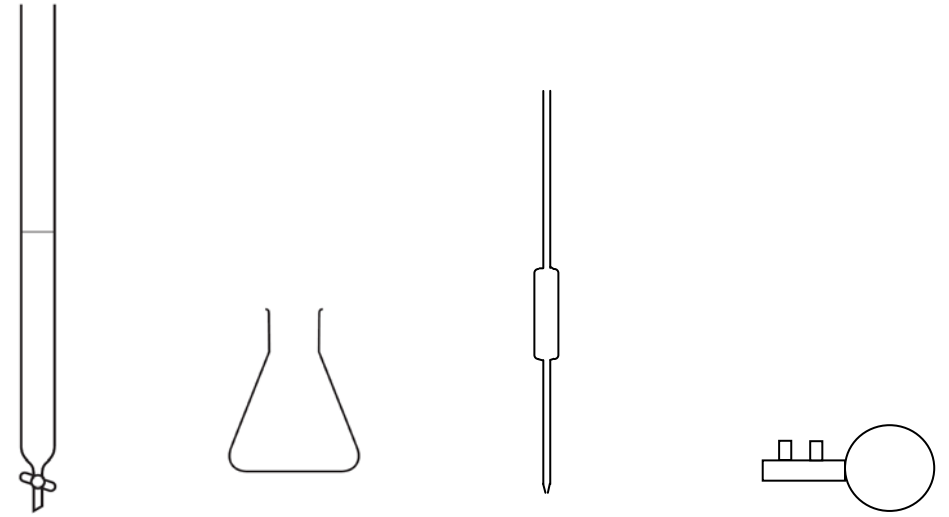
[Total: 9]

7 Gemma works for a company making vinegar.

She measures the amount of ethanoic acid in 25.0 cm^3 samples of the vinegar made each day.

She carries out a titration using a standard solution of sodium hydroxide and an indicator.

(a) Gemma uses this apparatus.



burette conical flask pipette safety pipette filler

(i) What does Gemma measure out using the pipette?

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

(ii) Gemma uses a few drops of an indicator.

Where does she add these drops of indicator?

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

(b) Gemma does two sets of six titrations.

All of the samples she tests are from the same vinegar.

Here are her results.

	volume of sodium hydroxide solution in cm^3					
set 1	12.9	12.2	12.5	12.8	12.9	12.1
set 2	12.4	12.6	12.5	12.5	12.4	12.6

(i) What are the ranges of the two sets of results?

range of **set 1** = ... to ..... cm^3

range of **set 2** = ... to ..... cm^3 **[1]**

(ii) Work out the mean for **set 2**.

Show your working.

mean = ... cm^3 **[2]**

(iii) Gemma uses **set 2** to get a best estimate for the concentration of ethanoic acid in the vinegar.

Explain why she uses **set 2**.

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

[Total: 7]

END OF QUESTION PAPER

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Periodic Table

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.***