THIS IS A LEGACY SPECIFICATION

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RECOGNISING ACHIEVEMENT

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Thursday 24 May 2012 – Morning

GCSE TWENTY FIRST CENTURY SCIENCE CHEMISTRY A

A323/02 Unit 3: Ideas in Context plus C7 (Higher Tier)

Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR supplied materials:
- Insert (supplied)

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: 1 hour

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES
- The Insert will be found in the centre of this document.
- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Write your answer to each question in the space provided. Additional paper may be used if necessary but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

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, 'Do plasticizers make boys more feminine?'

(a) Tests have shown that plasticizers are present in most people.

Explain how plasticizers get into people's bodies.

....

....

.... **[2]**

(b) A recent research study into boys' play activities suggests that phthalates may make boys more feminine.

Some scientists have little confidence in the data from this study.

Suggest why.

....

....

....

.... **[2]**

(c) The two scientists quoted in the article have opposite opinions on the health risks of phthalate plasticizers.

They disagree even though they have both looked at the same data.

Suggest why they have different opinions.

....

....

.... **[2]**

(d) Authorities in the EU and the USA have banned the use of phthalates in toys for babies and young children.

Explain how this is an example of the **precautionary principle**.

....

....

....

.... **[2]**

(e) Plasticizers change the properties of polymers such as PVC.

Use ideas about forces and energy to explain how plasticizers change the properties of a polymer.

....

....

....

....

.... **[3]**

(f) Products made of plasticized PVC deteriorate with time.

Explain why this happens.

....

....

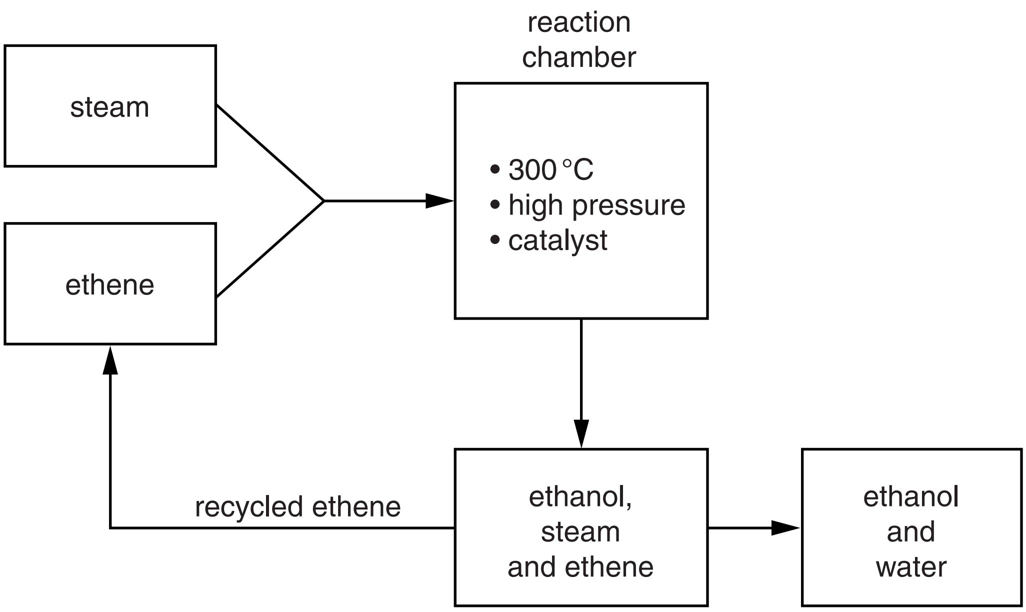
.... **[2]**

[Total: 13]

2 Ethanol is manufactured from ethene and steam.

ethene + steam ⇌ ethanol

The flow diagram shows the process.



(a) The reaction produces a mixture of ethanol, unreacted steam and ethene.

Ethanol and water are separated from the reaction mixture.

(i) Ethene, ethanol and water leave the reaction chamber at 300 °C.

The table shows their boiling points.

	Boiling point in °C
Ethene	–104
Ethanol	78
Water	100

How is ethene separated from ethanol and steam?

Use data from the table to help you.

....

....

.... **[2]**

(ii) The atom economy of the reaction between ethene and steam is 100%.

Explain what this means.

....

.... **[1]**

(iii) Although the atom economy of the reaction is 100%, the overall yield of the process is only 95%.

Suggest a reason for this difference.

....

.... **[1]**

(b) If ethene and steam are mixed and left for a long time, a dynamic equilibrium is formed.

What is meant by the term dynamic equilibrium?

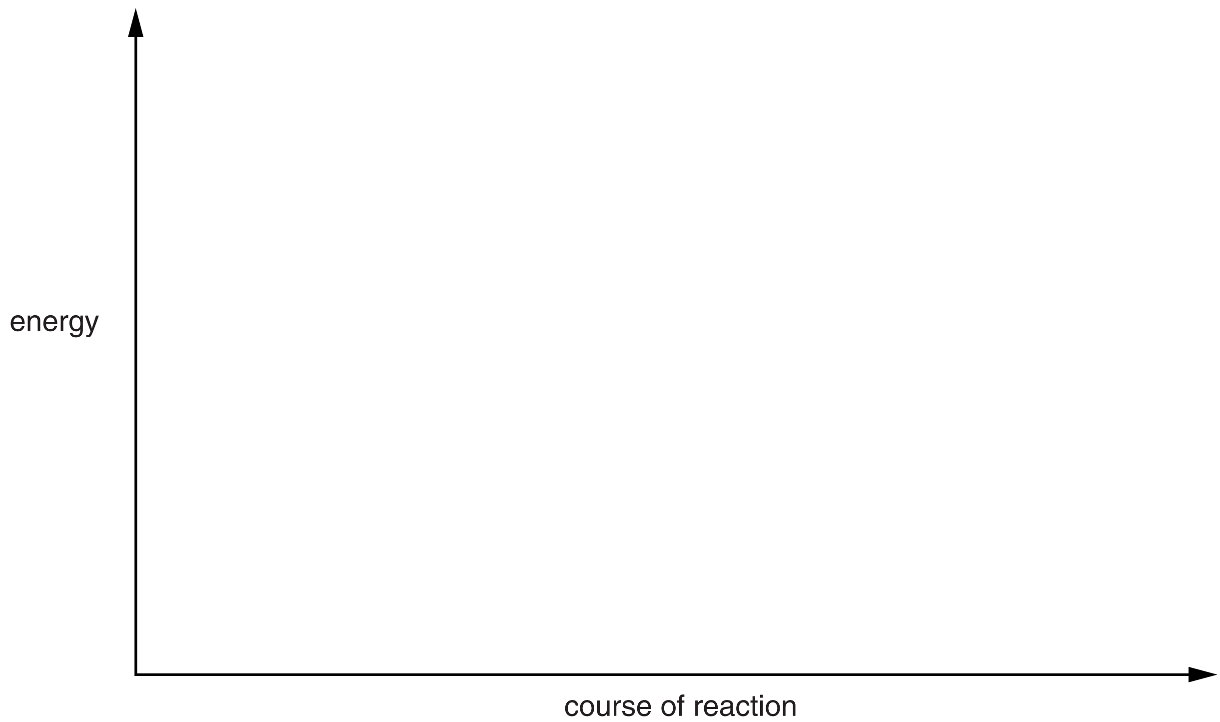
....

....

.... **[2]**

(c) The reaction between ethene and steam is exothermic.

Use the axes below to draw and label an energy level diagram for this reaction.



[3]

(d) Ethene does not react with water at room temperature.

Ethene does react with steam at a high temperature.

Use ideas about activation energy to explain this difference.

....

....

....

.... **[2]**

(e) A catalyst is used to speed up the reaction between ethene and steam.

Explain how a catalyst speeds up a reaction.

....

....

.... **[2]**

[Total: 13]

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Question 3 begins on page 8

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3 Vegetable oils can be changed into bio-diesel for use in diesel engines.

Bio-diesel contains methyl esters.

Gas chromatography is used to identify the methyl esters in a sample of bio-diesel.

The gas chromatography apparatus is first calibrated using a standard mixture of methyl esters.

The table shows the retention times for five methyl esters.

Methyl ester	Number of carbon atoms	Retention time in min
Lauric	12	1.6
Myristic	14	2.2
Palmitic	16	3.1
Heptadecanoic	17	3.5
Stearic	18	3.9

(a) (i) Why is it important to find the retention times for a standard mixture of the methyl esters?

....

.... **[1]**

(ii) The data in the table show a correlation.

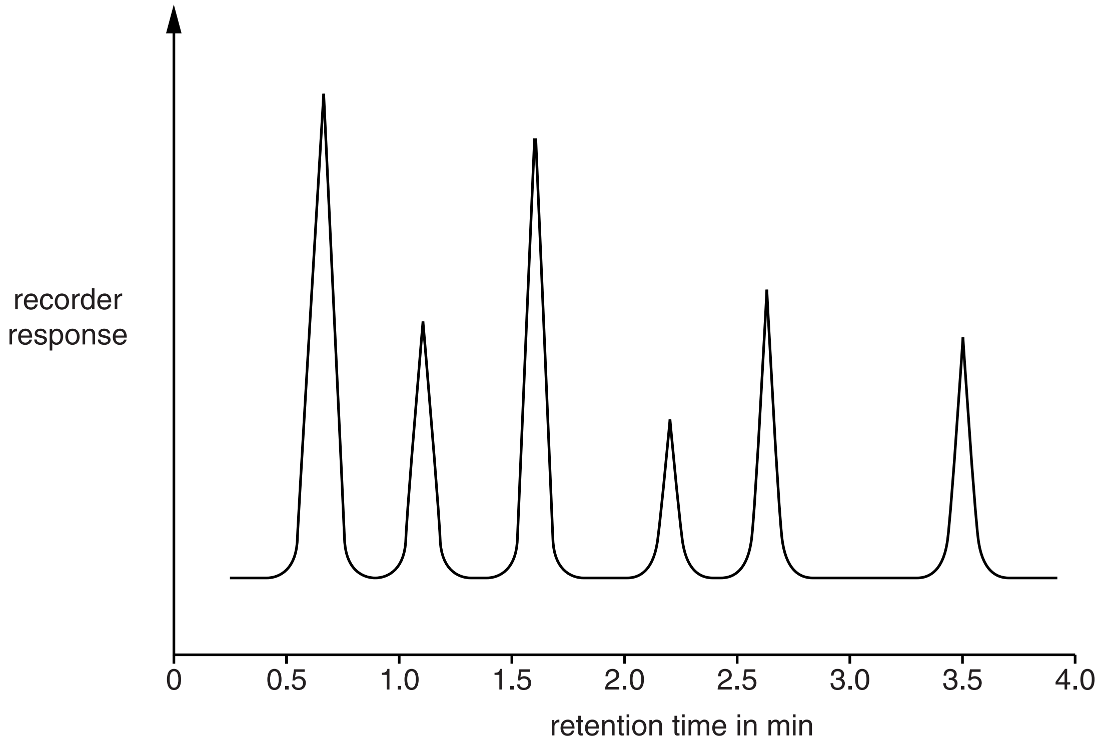
Describe this correlation.

....

.... **[1]**

(b) The gas chromatography trace from one sample of bio-diesel is shown below.

The sample contains methyl esters and impurities.



(i) Which three methyl esters are present in the sample of bio-diesel?

1 ....

2 ....

3 .... **[2]**

(ii) There are only three methyl esters in this sample of bio-diesel.

Explain why there are more than three peaks on the gas chromatography trace.

....

.... **[1]**

(iii) Which methyl ester was present in the **lowest** concentration?

.... **[1]**

(c) During the gas chromatography each methyl ester forms an equilibrium between the mobile phase and stationary phase.

Use this information to help you explain how the methyl esters in the sample of bio-diesel are separated.

One mark is for the correct use of scientific terms.

[3+1]

[Total: 10]

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Question 4 begins on page 12

PLEASE DO NOT WRITE ON THIS PAGE

4 Amy works in the quality control department of a company that makes aspirin tablets.

The tablets are made in batches. Each batch contains millions of tablets.

Amy uses titration to get a best estimate of the mass of aspirin per tablet in each batch.

This is what she does.

A She measures out the correct volume of a stock solution containing 40 g/dm^3 of sodium hydroxide. She mixes this with water to make 1 dm^3 of a standard solution containing 4.0 g/dm^3 sodium hydroxide.

B She crushes an aspirin tablet and mixes it with 25 cm^3 of water in a conical flask.

C She titrates the aspirin mixture with the 4.0 g/dm^3 sodium hydroxide solution using an indicator.

D She repeats the titration several times using more aspirin tablets from the same batch.

E She works out the mean of her results and uses this to calculate a best estimate for the mass of aspirin in each tablet.

(a) **(i)** In step **A**, what volumes of stock solution and water should Amy use?

....

....

.... **[2]**

(ii) Describe what the indicator does and explain why it is used in step **C**.

....

....

.... **[2]**

(b) Amy works out the mass of aspirin in each tablet.

(i) Aspirin has a relative formula mass of 180.

Show that the relative formula mass of sodium hydroxide, NaOH, is 40.

Use the Periodic Table to help you.

[2]

(ii) In the equation for the reaction, one molecule of aspirin reacts with one molecule of sodium hydroxide.

The average of Amy's titration results for one batch of aspirin tablets is $27.4\,cm^3$ of $4.0\,g/dm^3$ sodium hydroxide solution.

Work out the mass of aspirin in each tablet.

Show your working.

mass of aspirin in each tablet = ... g **[3]**

(iii) Amy assesses the **degree of uncertainty** in the value she works out for the mass of aspirin in each tablet.

Describe how she can use her titration results to do this.

....

....

.... **[2]**

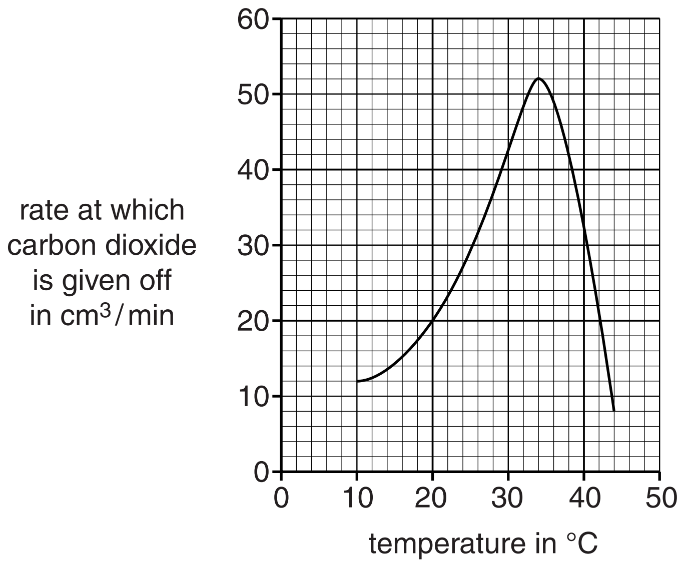
[Total: 11]

5 Ethanol can be made by fermentation using yeast.

Joe carries out fermentation reactions at each of several different temperatures. He keeps all other conditions the same each time.

He measures the rate at which carbon dioxide is given off at each temperature.

His results are shown in the graph.



(a) Use the graph to suggest an optimum temperature for the fermentation of glucose by yeast.

optimum temperature = ...°C **[1]**

(b) In the reaction glucose, $C_6H_{12}O_6$, is converted to ethanol and carbon dioxide.

Write a balanced equation for this reaction.

.... **[2]**

(c) A solution containing 60 g glucose is fermented by yeast.

(i) Show that if all of this glucose is fermented the mass of ethanol formed is 30.7 g.

Show your working.

(Relative atomic masses: H, 1; C, 12: O, 16.)

[3]

(ii) The actual mass of ethanol formed by fermentation of this solution is less than 30.7 g.

Explain why.

....

....

.... **[2]**

[Total: 8]

END OF QUESTION PAPER

The Periodic Table of the Elements

Key

relative atomic mass **atomic symbol** name atomic (proton) number

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						

***** *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.