

**Thursday 19 June 2014 – Afternoon**

**GCSE TWENTY FIRST CENTURY SCIENCE  
CHEMISTRY A/FURTHER ADDITIONAL SCIENCE A**

**A173/02** Module C7 (Higher 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	
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Centre number							Candidate number				
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**INSTRUCTIONS TO CANDIDATES**

- 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**

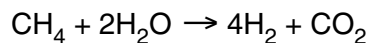
- The quality of written communication is assessed in questions marked with a pencil (.
- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- The Periodic Table is printed on the back page.
- This document consists of **16** pages. Any blank pages are indicated.

Answer **all** the questions.

- 1 Millions of tonnes of hydrogen are made every year.

The hydrogen is usually made from methane.

The process starts with methane and steam, and makes hydrogen and carbon dioxide.



Formula	Relative formula mass (RFM)
CH <sub>4</sub>	16
H <sub>2</sub> O	18
H <sub>2</sub>	2
CO <sub>2</sub>	44

- (a) Scientists calculate the atom economy to help decide how green the process is.
- (i) Use the following formula to calculate the atom economy for the production of hydrogen in this process.

$$\text{atom economy} = \frac{\text{mass of atoms of hydrogen}}{\text{mass of atoms of all reactants}} \times 100\%$$

answer = ..... % [2]

- (ii) Why does this suggest that the process is not very green?

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

- (b) A new process for making hydrogen is by heating wood from trees. Both processes for making hydrogen make carbon dioxide. Suggest why this new process might be greener than the old one.

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

[Total: 6]

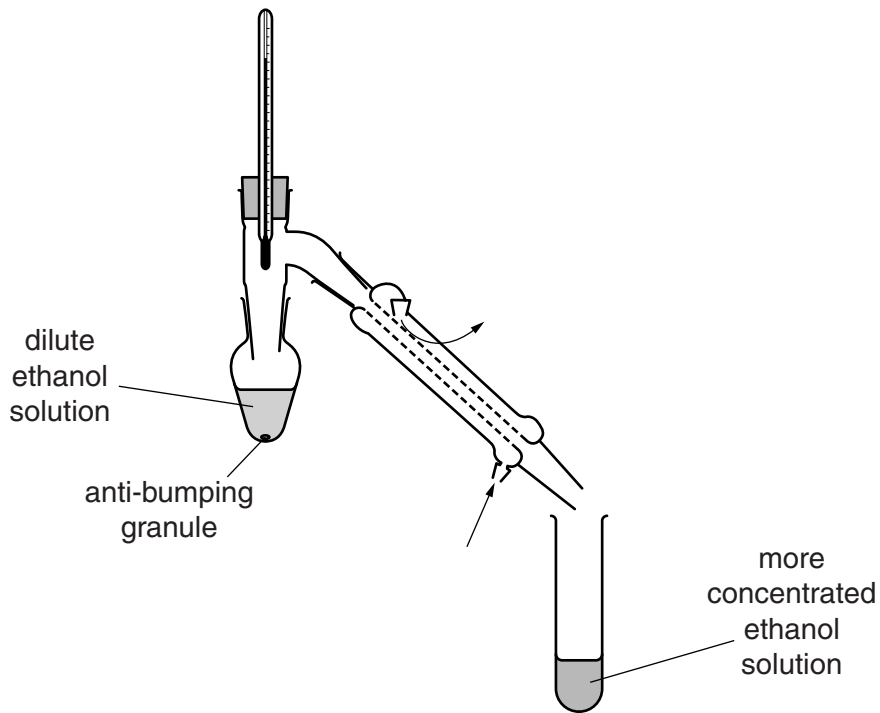


3 Kate and William decide to make some ethanol. Ethanol is an alcohol. They add yeast to sugar solution and leave it to ferment. This makes a dilute solution of ethanol.

(a) Write down the formula of ethanol.

answer ..... [1]

(b) Kate and William decide to make their dilute ethanol solution more concentrated. They use this apparatus.



Describe how they use this equipment to make their dilute ethanol solution more concentrated, and why it works.



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

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..... [6]

**Question 3 continues on page 6**

- (c) An alcoholic drink is made by distilling a dilute alcohol solution. The solution contains a mixture of alcohols.

	Boiling point	Amount which will poison a person [in g]
methanol	65 °C	120
ethanol	79 °C	560
propanol	97 °C	400
butanol	117 °C	350
pentanol	138 °C	120

William says that you should only make the drink from alcohol that distils at 79 °C. He says that it isn't safe to drink alcohol that has been distilled at other temperatures.

Is he right? Explain your answer.

.....

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.....

..... [3]

- (d) Butanol,  $C_4H_9OH$ , is another alcohol. Butanol burns in oxygen to make carbon dioxide and water.

Write a balanced chemical equation for this reaction.

..... [3]

- (e) Butanol reacts with sodium. Water also reacts with sodium. In both cases the same gas is made.

(i) Name this gas.

..... [1]

(ii) Give one difference between the reaction of sodium with water and of sodium with butanol.

.....

..... [1]

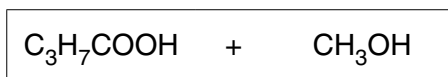
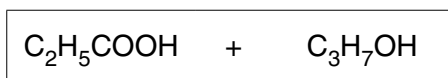
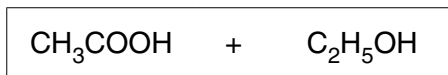
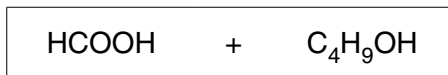
[Total: 15]

4 Mary and Steve make an ester by reacting a carboxylic acid with an alcohol.

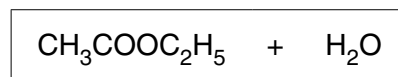
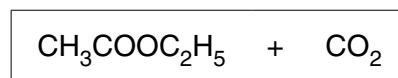
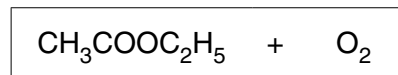
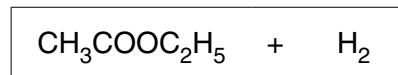
- (a) An acid and an alcohol react to make the ester,  $\text{CH}_3\text{COOC}_2\text{H}_5$ , plus one other product. What is the equation for this reaction?

Draw a straight line to join the correct **left hand side** to the correct **right hand side**.

**left hand side**



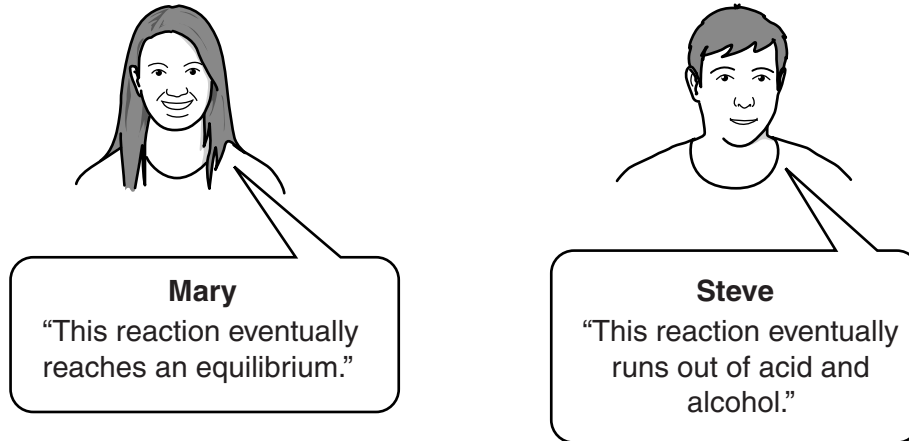
**right hand side**



[2]

- (b) They know that one molecule of acid reacts with one molecule of alcohol to make the ester. They start with equal amounts of acid and alcohol. They measure the amount of the ester which is made. However long they leave the reaction, they never get as much ester as expected.

They try to explain this.



Explain who is right and who is wrong.

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..... [3]

- (c) Mary and Steve add a few drops of concentrated sulfuric acid to their reaction mixture.

Explain why.

.....

..... [2]

[Total: 7]





- (b) The sodium hydroxide solution contains  $40\text{g/dm}^3$  of sodium hydroxide. How much sodium hydroxide is in  $25.0\text{cm}^3$  of the solution?

answer ..... g [2]

- (c) James gets these results.

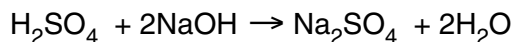
titration number	1	2	3	4
volume of acid in $\text{cm}^3$	26.4	25.2	25.6	25.4

James decides that the best value for the volume of acid is  $25.4\text{cm}^3$ .

Show how he arrived at this value.

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

- (d) The equation for this reaction is



- (i) The relative formula mass of sodium hydroxide is 40.  
 Calculate the relative formula mass of sulfuric acid.  
 Relative atomic masses are given in the Periodic Table on the back page.

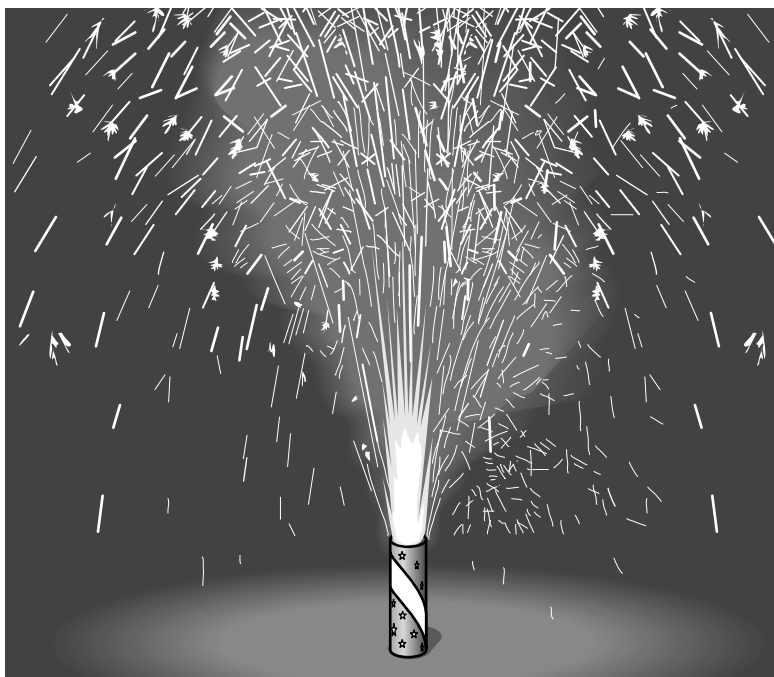
answer ..... [1]

- (ii) What mass of sulfuric acid reacts with 40 g of sodium hydroxide?  
 Show your working.

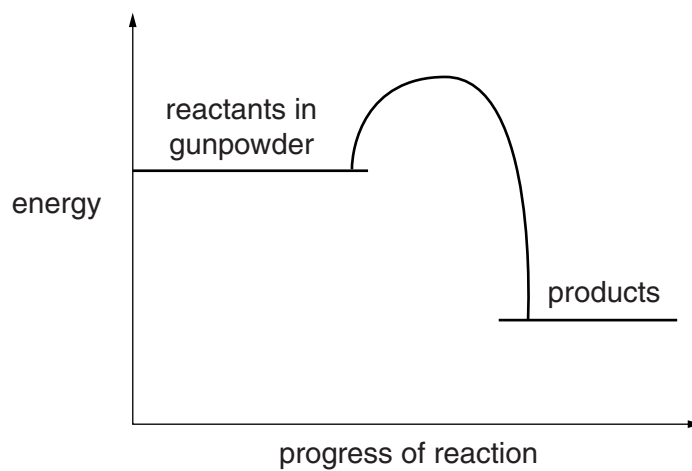
answer ..... g [2]

[Total: 13]

- 6 Fireworks contain gunpowder.  
The gunpowder reacts when the firework is lit.



- (a) Look at the energy level diagram for this reaction.



What does the diagram tell you about the energy changes during the reaction?

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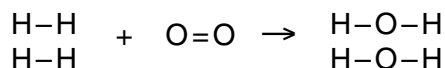
.....

[3]

- (b) Gunpowder doesn't react until it is lit.  
Use ideas about bonds to explain why.

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

- (c) Some space rockets use the reaction between hydrogen and oxygen.



- (i) In this reaction, bonds in the hydrogen and oxygen are broken.

Fill in the blank spaces in the table.

Type of bond	Energy needed to break each bond in kJ	Number of bonds	Energy needed in kJ
H-H	436		
O=O	498	1	498
Total energy needed			1370

[2]

- (ii) New bonds are made when water is made.

The total amount of energy given out when the bonds form = 1856 kJ.

Calculate the total energy change for the whole reaction.

..... kJ [1]

- (d) Not all rockets use the reaction between hydrogen and oxygen.  
Some rockets use the reaction between hydrocarbons and oxygen.  
Give one similarity and one difference between the products of these two reactions.

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

[Total: 10]

END OF QUESTION PAPER

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**14**  
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# The Periodic Table of the Elements

1	2	3	4	5	6	7	0										
7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>Mg</b> magnesium 12	13 <b>Al</b> aluminium 13	14 <b>Si</b> silicon 14	15 <b>P</b> phosphorus 15	16 <b>S</b> sulfur 16	17 <b>Cl</b> chlorine 17	18 <b>Ar</b> argon 18								
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	21 <b>Sc</b> scandium 21	22 <b>Ti</b> titanium 22	23 <b>V</b> vanadium 23	24 <b>Cr</b> chromium 24	25 <b>Mn</b> manganese 25	26 <b>Fe</b> iron 26	27 <b>Co</b> cobalt 27	28 <b>Ni</b> nickel 28	29 <b>Cu</b> copper 29	30 <b>Zn</b> zinc 30	31 <b>Ga</b> gallium 31	32 <b>Ge</b> germanium 32	33 <b>As</b> arsenic 33	34 <b>Se</b> selenium 34	35 <b>Br</b> bromine 35	36 <b>Kr</b> krypton 36
37 <b>Rb</b> rubidium 37	38 <b>Sr</b> strontium 38	39 <b>Y</b> yttrium 39	40 <b>Zr</b> zirconium 40	41 <b>Nb</b> niobium 41	42 <b>Mo</b> molybdenum 42	[98] <b>Tc</b> technetium 43	44 <b>Ru</b> ruthenium 44	45 <b>Rh</b> rhodium 45	46 <b>Pd</b> palladium 46	47 <b>Ag</b> silver 47	48 <b>Cd</b> cadmium 48	49 <b>In</b> indium 49	50 <b>Sn</b> tin 50	51 <b>Sb</b> antimony 51	52 <b>Te</b> tellurium 52	53 <b>I</b> iodine 53	54 <b>Xe</b> xenon 54
55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	72 <b>Hf</b> hafnium 72	73 <b>Ta</b> tantalum 73	74 <b>W</b> tungsten 74	75 <b>Re</b> rhenium 75	76 <b>Os</b> osmium 76	77 <b>Ir</b> iridium 77	78 <b>Pt</b> platinum 78	79 <b>Au</b> gold 79	80 <b>Hg</b> mercury 80	81 <b>Tl</b> thallium 81	82 <b>Pb</b> lead 82	83 <b>Bi</b> bismuth 83	84 <b>Po</b> polonium 84	85 <b>At</b> astatine 85	86 <b>Rn</b> radon 86
[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[264] <b>Bh</b> bohrium 107	[277] <b>Hs</b> hassium 108	[268] <b>Mt</b> meitnerium 109	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated						

1 <b>H</b> hydrogen 1
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relative atomic mass atomic symbol name atomic (proton) number
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\* 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.