

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

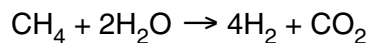
- The quality of written communication is assessed in questions marked with a pencil (.
- The number of marks is given in brackets [] at the end of each question or part question.
- The total number of marks for this paper is **60**.
- The Periodic Table is printed on the back page.
- This document consists 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 ₄	16
H ₂ O	18
H ₂	2
CO ₂	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]

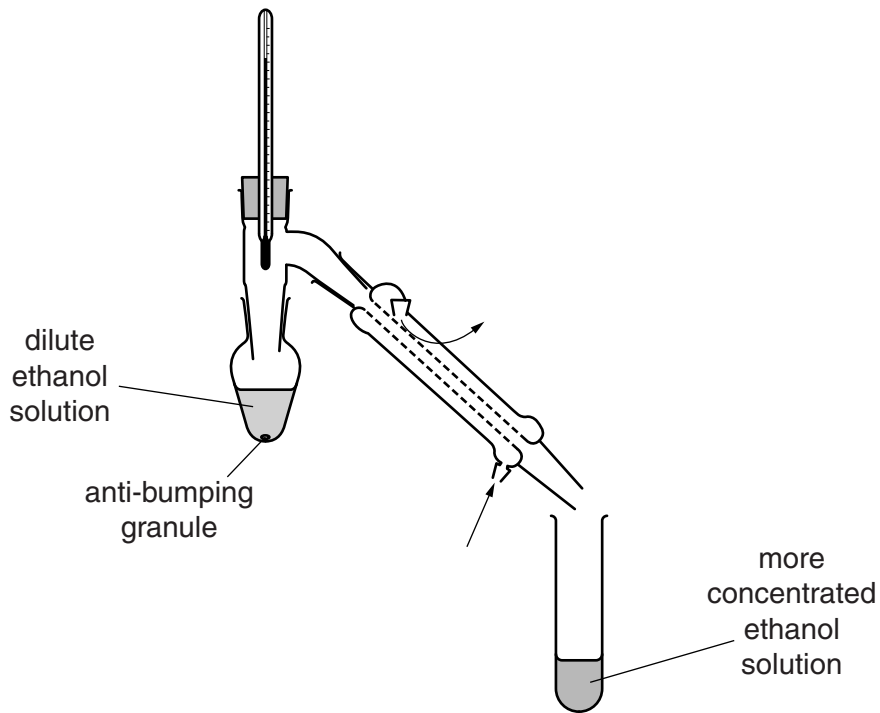
[Total: 6]

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, C₄H₉OH, 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]

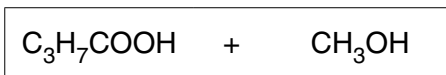
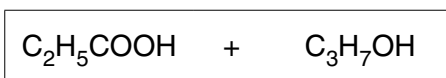
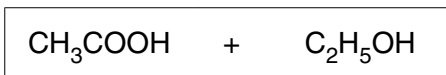
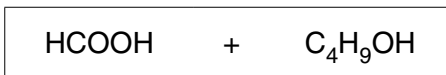
[Total: 15]

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

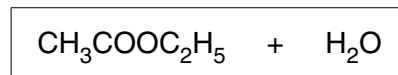
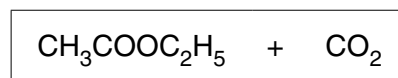
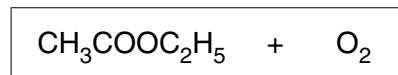
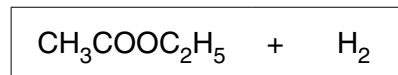
- (a) An acid and an alcohol react to make the ester, $\text{CH}_3\text{COOC}_2\text{H}_5$, plus one other product. What is the equation for this reaction?

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

left hand side



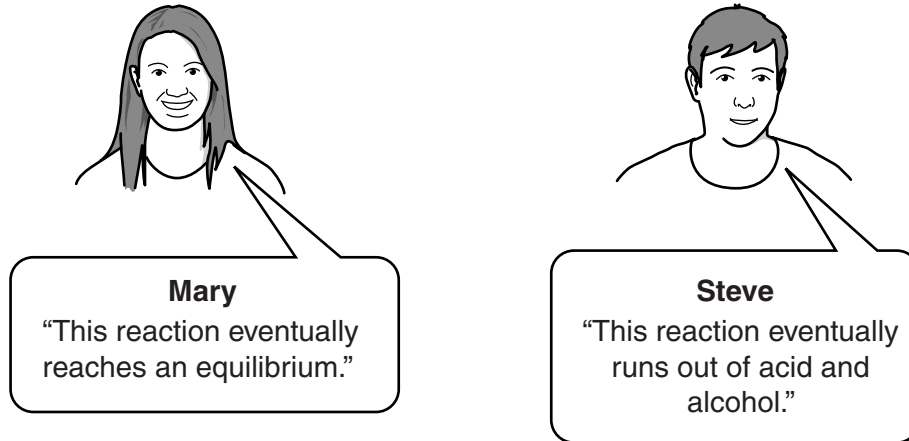
right hand side



[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.

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..... [2]

[Total: 7]

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

answer g [2]

- (c) James gets these results.

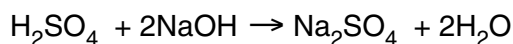
titration number	1	2	3	4
volume of acid in cm^3	26.4	25.2	25.6	25.4

James decides that the best value for the volume of acid is 25.4cm^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.

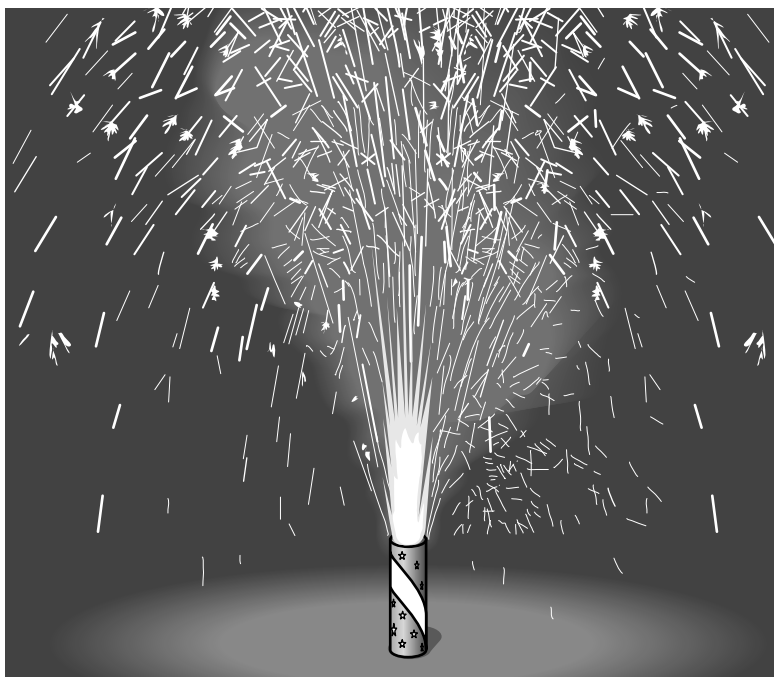
answer [1]

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

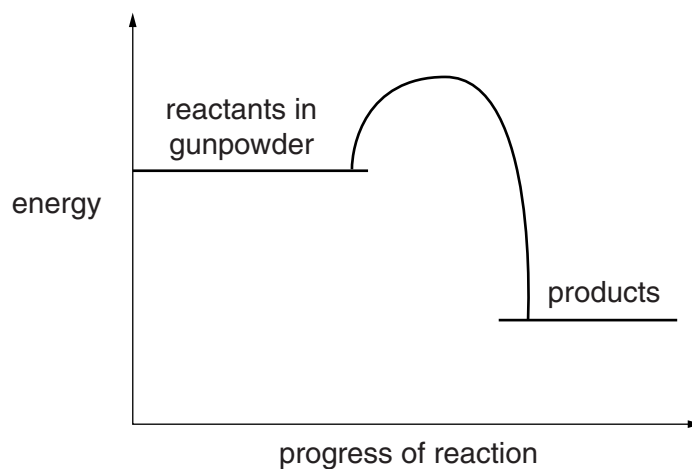
answer g [2]

[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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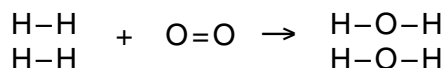
[3]

- (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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The Periodic Table of the Elements

	1	2	3	4	5	6	7	0										
	7 Li lithium 3	9 Be beryllium 4	11 Na sodium 11	12 Mg magnesium 12	13 Al aluminium 13	14 N nitrogen 7	15 P phosphorus 15	16 O oxygen 8	17 Cl chlorine 17	18 Ar argon 18								
	19 K potassium 19	20 Ca calcium 20	21 Sc scandium 21	22 Ti titanium 22	23 V vanadium 23	24 Cr chromium 24	25 Mn manganese 25	26 Fe iron 26	27 Co cobalt 27	28 Ni nickel 28	29 Cu copper 29	30 Zn zinc 30	31 Ga gallium 31	32 Ge germanium 32	33 As arsenic 33	34 Se selenium 34	35 Br bromine 35	36 Kr krypton 36
	37 Rb rubidium 37	38 Sr strontium 38	39 Y yttrium 39	40 Zr zirconium 40	41 Nb niobium 41	42 Mo molybdenum 42	43 Tc technetium 43	44 Ru ruthenium 44	45 Rh rhodium 45	46 Pd palladium 46	47 Ag silver 47	48 Cd cadmium 48	49 In indium 49	50 Sn tin 50	51 Sb antimony 51	52 Te tellurium 52	53 I iodine 53	54 Xe xenon 54
	55 Cs caesium 55	56 Ba barium 56	57 La* lanthanum 57	72 Hf hafnium 72	73 Ta tantalum 73	74 W tungsten 74	75 Re rhenium 75	76 Os osmium 76	77 Ir iridium 77	78 Pt platinum 78	79 Au gold 79	80 Hg mercury 80	81 Tl thallium 81	82 Pb lead 82	83 Bi bismuth 83	84 Po polonium 84	85 At astatine 85	86 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						

1 H hydrogen 1

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.