OXFORD CAMBRIDGE AND RSA EXAMINATIONS

GCSE

TWENTY FIRST CENTURY SCIENCE

A173/02

CHEMISTRY A/FURTHER ADDITIONAL SCIENCE A

Module C7 (Higher Tier)

THURSDAY 19 JUNE 2014: Afternoon

DURATION: 1 hour
plus your additional time allowance

MODIFIED ENLARGED

Candidate forename		Candidate surname	

Centre number						Candidate number				

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

OCR SUPPLIED MATERIALS:

Periodic Table

OTHER MATERIALS REQUIRED:

Pencil
Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

DC (SJF/JG) 4068459815 95398

INSTRUCTIONS TO CANDIDATES

Write your name, centre number and candidate number in the boxes on the first page. 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).

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.

Any blank pages are indicated.

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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.

$$CH_4 + 2H_2O \rightarrow 4H_2 + CO_2$$

Formula	Relative formula mass (RFM)
CH_4	16
H_2O	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?

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____ [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]

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2 Millions of tonnes of ammonia are made every year.

(a) Ammonia is made by reacting nitrogen and hydrogen.
The only product for this reaction is ammonia.

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

If nitrogen and hydrogen are heated together in a flask, the reaction is slow and only a low percentage of the reactants are converted.

Suggest why so little is actually produced and how the Haber process overcomes this problem. **[6]**

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

(b) Ammonia can be used to make many different products.
One product is explosives that can be used to make weapons.
Dave says that we should not make ammonia because it is used to harm people.
Eve does not agree.
Give some arguments Eve could use to support her view.

[3]

[TOTAL: 9]

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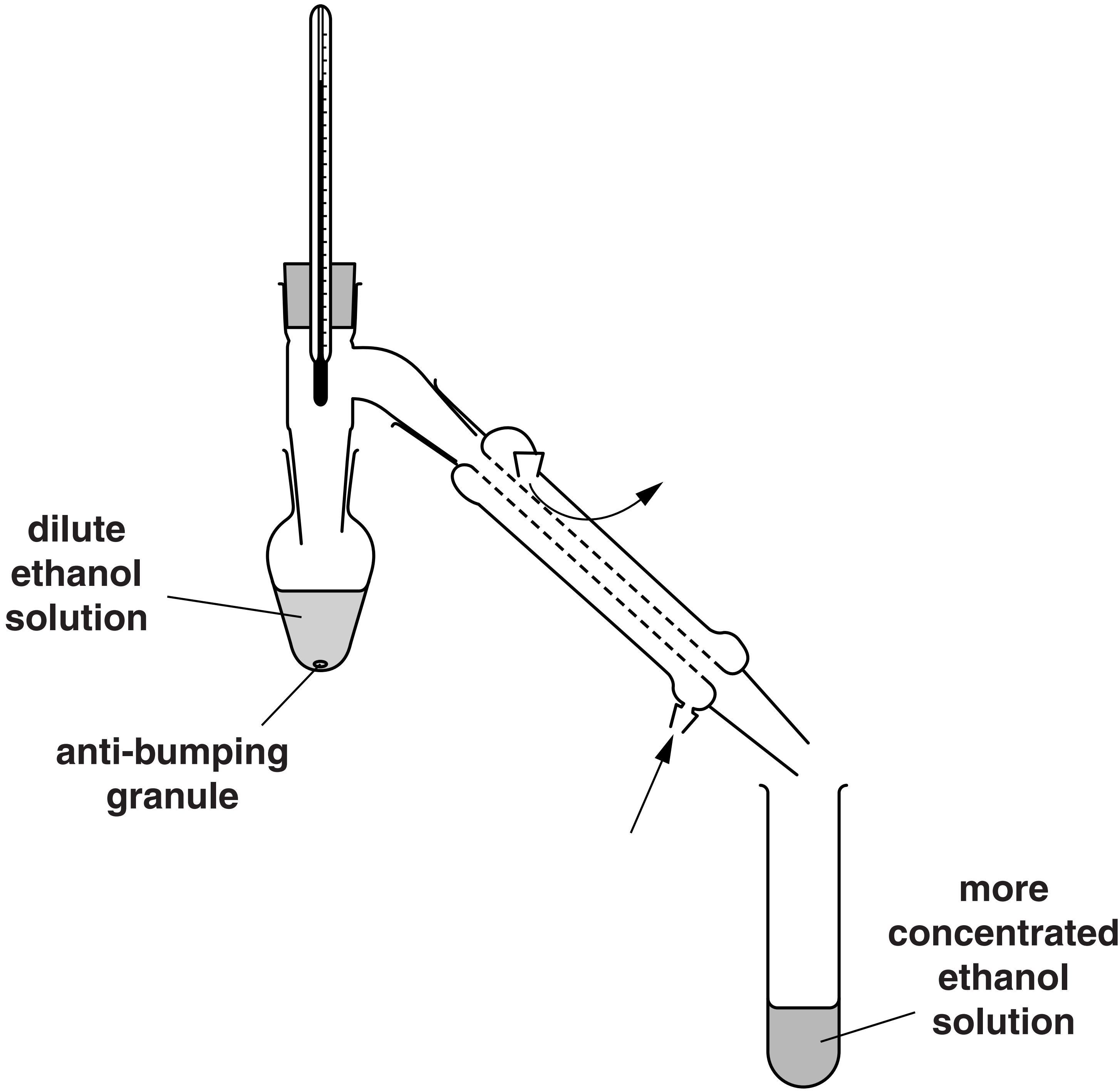
3 **Kate and William decide to make some ethanol. Ethanol is an alcohol. They add yeast to sugar solution and leave it to ferment. This makes a dilute solution of ethanol.**

(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 the equipment shown opposite 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]**

(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.

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____ [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, $CH_3COOC_2H_5$, 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
$HCOOH + C_4H_9OH$	$CH_3COOC_2H_5 + H_2$
$CH_3COOH + C_2H_5OH$	$CH_3COOC_2H_5 + O_2$
$C_2H_5COOH + C_3H_7OH$	$CH_3COOC_2H_5 + CO_2$
$C_3H_7COOH + CH_3OH$	$CH_3COOC_2H_5 + H_2O$

[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.

Mary says "This reaction eventually reaches an equilibrium."

Steve says "This reaction eventually runs out of acid and alcohol."

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]

5 **James does a titration with an acid and an alkali.**

He uses dilute sulfuric acid, sodium hydroxide solution and an indicator solution.

(a) **Describe and explain how James would carry out a set of titrations to get an accurate value for how much acid reacts with 25.0 cm^3 of the sodium hydroxide.**

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

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____ **[6]**

(b) **The sodium hydroxide solution contains 40 g/dm^3 of sodium hydroxide. How much sodium hydroxide is in 25.0 cm^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 25.4 cm^3.

Show how he arrived at this value.

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____ **[2]**

(d) The equation for this reaction is

$$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$$

(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.

answer ________________ [1]

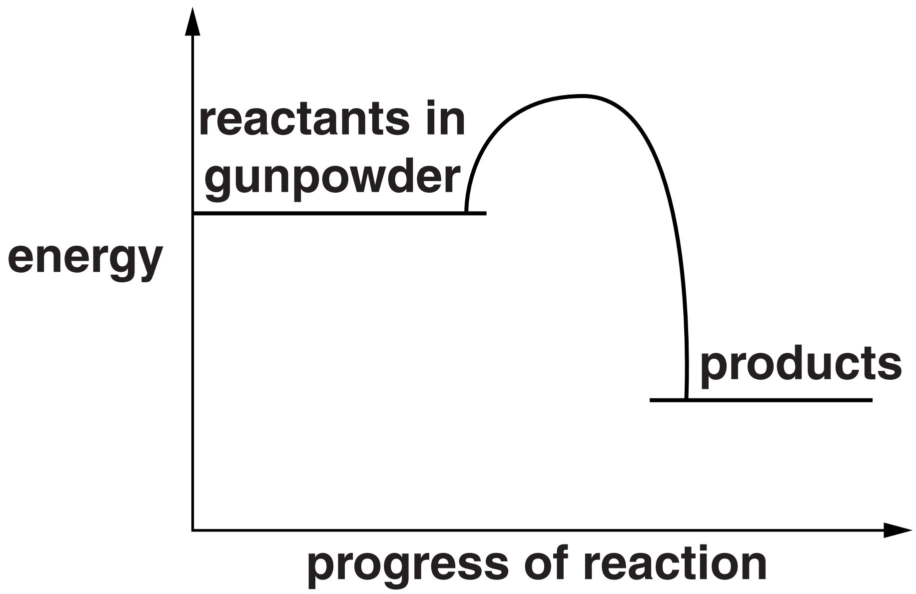
(ii) What mass of sulfuric acid reacts with 40 g of sodium hydroxide?
Show your working.

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.

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____ [2]

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

$$\begin{matrix} H-H \\ H-H \end{matrix} \quad + \quad O=O \quad \rightarrow \quad \begin{matrix} H-O-H \\ H-O-H \end{matrix}$$

(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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