OCR
Oxford Cambridge and RSA

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Wednesday 17 June 2015 – Morning

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

A173/02

4824549874

Candidate forename		Candidate surname	

Centre number						Candidate number				

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.

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

Answer **all** the questions.

1 Some 'green' buses use biodiesel fuel which is a fuel that has been made from waste fats and cooking oil.
The fats and oils are esters.

(a) Most oils are made by plants. Most fats are made by animals.

(i) What do plants use the oils for?

Put a (ring) around the best answer.

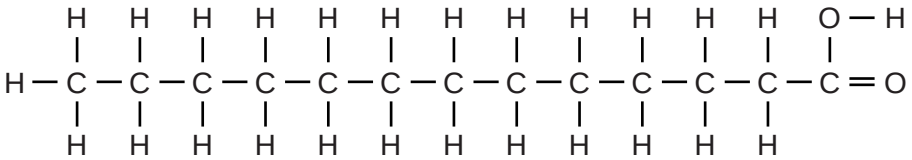
for energy **to fight disease** **for growth** **for repair**

[1]

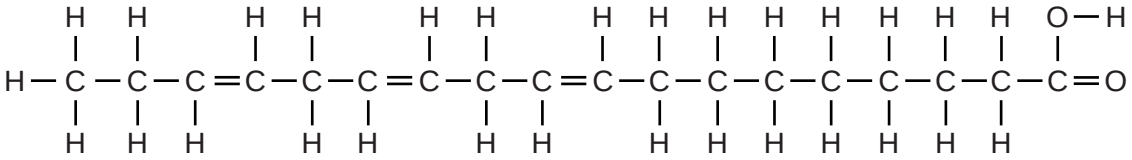
(ii) Animal fats are saturated.

Which of the molecules below is saturated?

Give a reason for your choice.



molecule A



molecule B

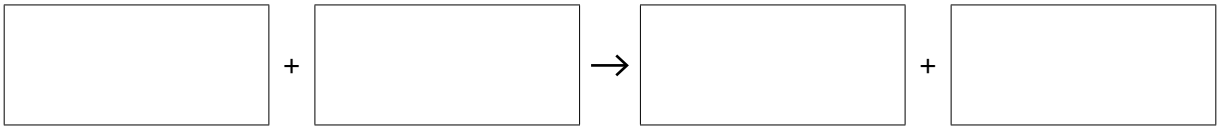
answer .....

reason .....

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

(b) The process for making biodiesel requires heating. Heat can be provided by burning propane, C_3H_8.
When propane burns it reacts with the oxygen, O_2, in the air to make carbon dioxide and water.

Fill in the boxes to complete the **balanced symbol equation** for burning propane.



[2]

(c) The conversion of fats and oils into biodiesel needs a catalyst.
The usual catalyst is hot concentrated sodium hydroxide.

Scientists are investigating a new catalyst. The new catalyst is an enzyme.

Here is some information about both catalysts.

Feature of enzyme	**Feature of hot concentrated sodium hydroxide**
speeds up reaction a lot	speeds up reaction
easily damaged	not easily damaged
needs warm conditions	needs hot conditions
can be coated onto a solid surface	mixed in with the products at the end
speeds up this reaction only	speeds up other reactions of the esters as well as this reaction
expensive	very cheap

Evaluate both catalysts. Suggest which catalyst would be best and explain why.

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

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

[Total: 11]

2 Fred investigates the acid CH_3COOH.

(a) (i) Which part of the formula shows you that CH_3COOH is a carboxylic acid?

Put a ring around the correct answer.

CH_3 **CO** **OH** **COOH**

[1]

(ii) The acid is a weak acid. What does this mean?

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

Its formula contains carbon, hydrogen and oxygen. ☐

It is more dilute than acids such as hydrochloric acid. ☐

It is less reactive than acids such as hydrochloric acid. ☐

It is more runny than acids such as hydrochloric acid. ☐

[1]

(iii) Fred compares solutions of this weak acid with a strong acid of the same concentration.

How do the pH values of the two solutions compare?

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

The weak acid has a higher pH. ☐

The weak acid has the same pH. ☐

The weak acid has a lower pH. ☐

The weak acid has a much lower pH. ☐

[1]

(b) (i) Fred reacts the acid with ethanol.

$$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$$

What type of substance is made?

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

alcohol ☐

alkane ☐

ester ☐

fatty acid ☐

[1]

(ii) Fred calculates the theoretical yield for the reaction when he uses 6.0 g of the acid. The table shows some of his working.

Complete his calculation.
[Relative atomic mass of H = 1, C = 12, O = 16]

	Relative formula mass	
CH_3COOH	60	Mass used = 6.0 g
$CH_3COOC_2H_5$		Theoretical yield = ... g

[2]

(c) (i) The reaction between acid and alcohol needs a catalyst.

What catalyst is used?

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

(ii) Use ideas about energy to explain why a catalyst speeds up a reaction.

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

[Total: 10]

3 In the Haber Process, nitrogen and hydrogen react to make ammonia, NH_3.

(a) Write a balanced symbol equation for this reaction.

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

(b) State and explain the main use of ammonia.

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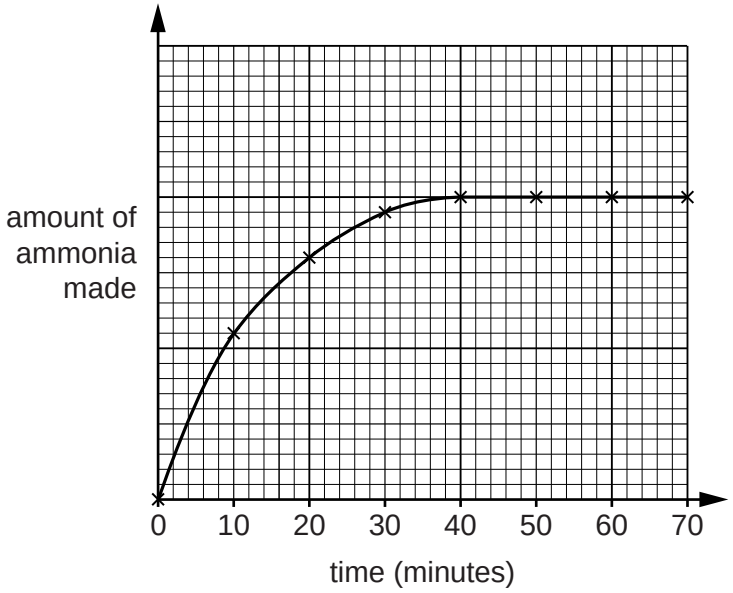
..... **[2]**

(c) The reaction between nitrogen and hydrogen is reversible and can reach an equilibrium.
Ann heats some nitrogen and hydrogen with a catalyst in a closed container.
She plots a graph to show how the amount of ammonia made changes with time.



(i) At what time does the amount made stop increasing?

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

(ii) The amount made stops increasing when the reaction reaches equilibrium.
At this time the reaction to make ammonia is still taking place.

Explain why the reaction to make ammonia is still taking place but the amount made is not increasing.

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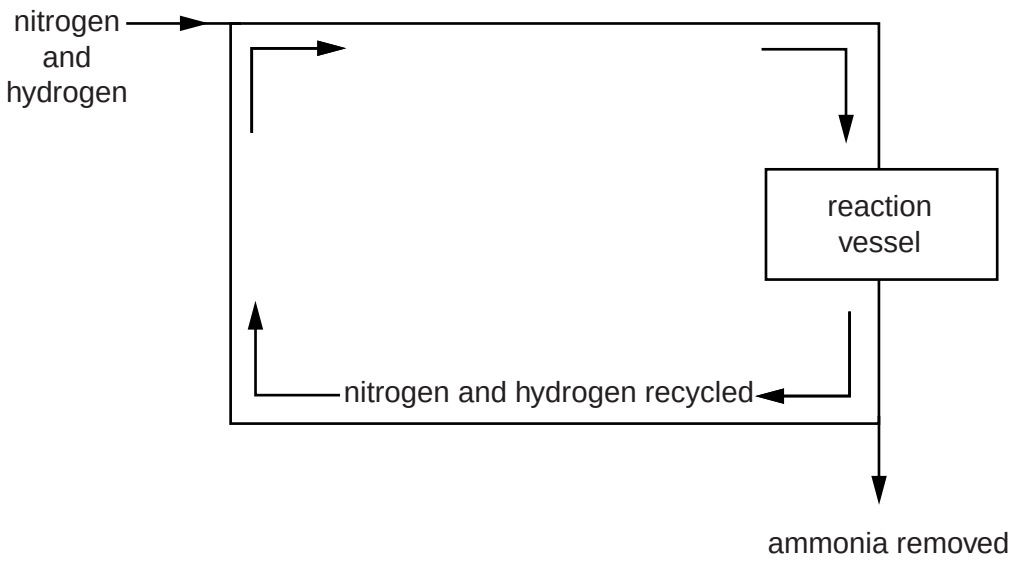
..... **[3]**

(iii) Put a tick (✓) in the box next to the name of this type of equilibrium.

active equilibrium	☐
dynamic equilibrium	☐
fixed equilibrium	☐
static equilibrium	☐

[1]

(d) In the Haber Process, most of the nitrogen and hydrogen has to be recycled to make the process run efficiently.



Explain how and why this recycling affects the total yield of the reaction, and why so much has to be recycled.

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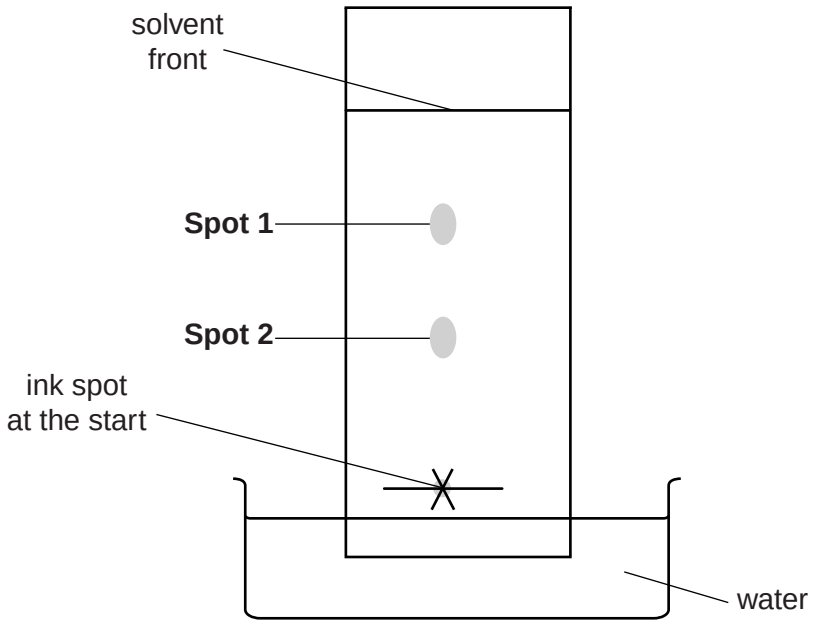
..... **[3]**

[Total: 12]

4 Ben uses paper chromatography to analyse the ink from his pen.
He puts the bottom of the paper in water and leaves it for a few hours.
The diagram shows his result.



(a) Calculate the *Rf* value for **Spot 1**.
Show your working.

Rf for **Spot 1** = ... **[3]**

(b) Ben knows that chromatography depends on the attractions between the ink, the solvent and the paper.

Explain why **Spot 1** and **Spot 2** end up in different places.

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

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

(c) Thin-layer chromatography can be used instead of paper chromatography.

Give **one** similarity and **one** difference between the two methods.

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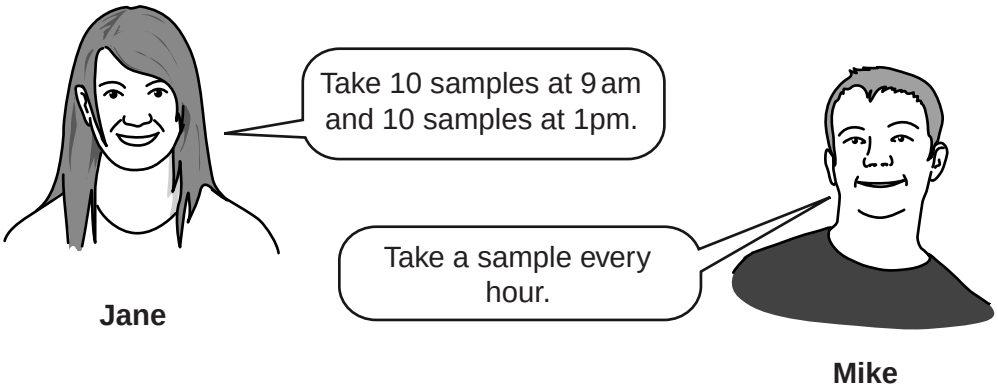
..... **[2]**

(d) A factory makes ink. The ink is made continuously throughout the day. Chromatography is used to test samples of the ink.

Jane and Mike discuss how to take the samples.



Explain who has the best approach.

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

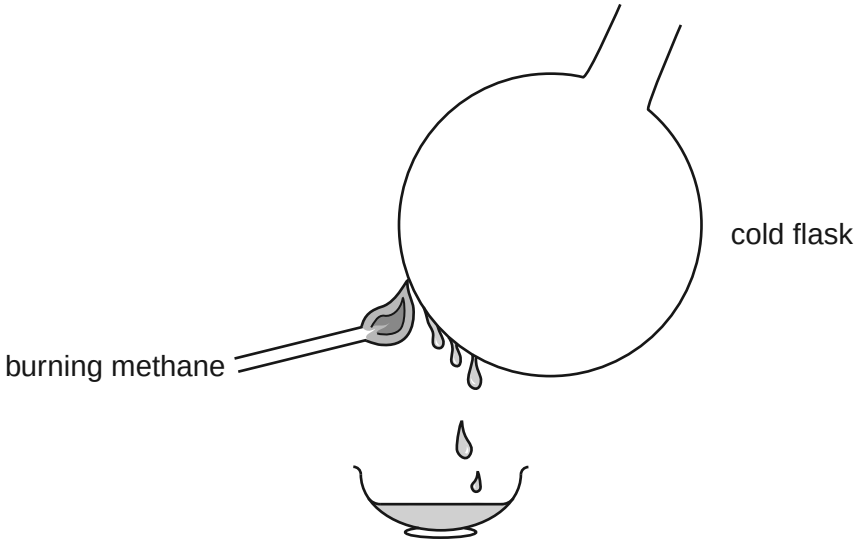
[Total: 14]

5 Mary investigates burning methane.

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

She directs the flame onto the surface of a cold flask.

(a) Where the flame touches the outside of the flask, droplets of liquid appear.



What is the liquid and where does it come from?

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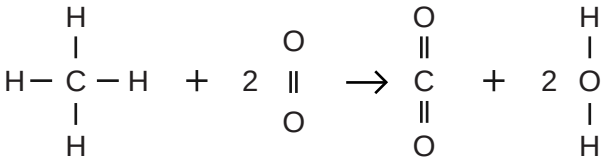
..... **[2]**

(b) Mary wants to know the energy change when methane burns.

She writes out the equation to show all the chemical bonds.



(i) Complete the table to show how many of each type of bond are broken and how many are made when methane reacts with the oxygen in the air.

Bonds broken			**Bonds made**	
Type of bond	**Number of bonds**		**Type of bond**	**Number of bonds**
C–H				
O=O	2			

[2]

(ii) Use the table of bond energies to calculate the overall energy change when methane burns.

Bond	**Energy to break the bond for a formula mass (kJ)**
C–H	435
C=O	805
H–H	436
H–O	464
O=O	498

You must show your working.

..... kJ **[3]**

[Total: 7]

6 When chemical engineers design an industrial process, they make it as sustainable as possible.

To make a process more sustainable, chemical engineers use:

- **renewable** feedstock
- reactions with high **atom economy**.

Explain what the terms **renewable** and **atom economy** mean, and how each can make a process more sustainable.

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

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

[Total: 6]

END OF QUESTION PAPER

The Periodic Table of the Elements

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.*

The relative atomic masses of copper and chlorine have not been rounded to the nearest whole number.