

Wednesday 17 June 2015 – Morning

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

A173/01 Module C7 (Foundation 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 Large amounts of nitrogen gas in the air are turned into nitrogen compounds every year. This is called 'fixing' the nitrogen. It happens by different routes.

The table shows how much nitrogen is fixed every year by each route.

Route for fixing nitrogen	Amount of nitrogen fixed in million tonnes per year
burning fuels	20
making chemicals in industry	50
lightning in thunderstorms	10
growing crops on farms	90
trees growing	50
plankton in the sea	35

- (a) Which route fixes the most nitrogen in a year?

..... [1]

- (b) One of these routes is the Haber process for making ammonia.

Use the table to suggest how much nitrogen is fixed each year by the Haber process.

..... million tonnes [1]

- (c) In the Haber process, nitrogen and hydrogen react. Ammonia is the only substance made.

Write a word equation for this reaction.

..... [1]

- (d) The hydrogen needed for the Haber process is made in a separate reaction.

Which **two** substances are needed for this reaction?

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

hydrogen and steam

natural gas and steam

nitrogen and steam

water and steam

[1]

- (e) The UK makes 3000 tonnes of ammonia every day.
 For every tonne of ammonia, 1.6 tonnes of carbon dioxide are made.
 Half of this carbon dioxide can be captured.

How much carbon dioxide can be captured each day?

..... tonnes [2]

- (f) Most of the ammonia is used to make fertilisers.
 Fertilisers are very useful, but can cause pollution.

Suggest why fertilisers are useful and how they might cause pollution.

.....

 [2]

- (g) Nitrogen is also fixed by some plants.
 They use bacteria in their roots.
 These bacteria need different conditions from the Haber process.

Finish the sentences about the conditions for bacteria to fix nitrogen in plants.

Put ticks (✓) in the boxes next to the correct terms.

The bacteria work best at	high temperature		and	high pressure.	
	room temperature			room pressure.	
	low temperature			low pressure.	

The bacteria use	acids		as the catalyst.
	alkalis		
	enzymes		
	iron		

[3]

- (h) The table shows some chemicals which are manufactured. Chemicals such as ammonia are made on a large scale. Some other chemicals are made on a small scale.

Put ticks (✓) in the boxes to complete the table.

Chemical	Large scale	Small scale
food additives		
phosphoric acid		
sodium hydroxide		
fragrances for perfumes		

[2]

[Total: 13]

- 2 Some 'green' buses use biodiesel 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.

How do plants use the oils that they make?

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

to give them energy

to make them slippery

to make them taste nasty

to make them float in water

[1]

- (b) Most fats are made by animals.

The esters in animal fats are different from the esters in plant oils.

What is the difference between these esters?

Use words from the list to complete the sentence.

glycerol
saturated
fatty acid
unsaturated

Animal fats have mostly molecules and oils have mostly

..... molecules.

[2]

(c) A catalyst is used to turn the fats and oils into biodiesel.
The usual catalyst is hot concentrated sodium hydroxide.

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

Here is some information about both catalysts.

Features of enzyme	Features of hot concentrated sodium hydroxide
needs gentle heating	needs strong heating
easy to remove from the reaction mixture	dissolves in reaction mixture
speeds up this reaction only	speeds up other reactions which produce waste material
expensive	very cheap

Identify the **advantages** and **disadvantages** of using the enzyme, and explain which catalyst is best.

.....

.....

.....

.....

.....

.....

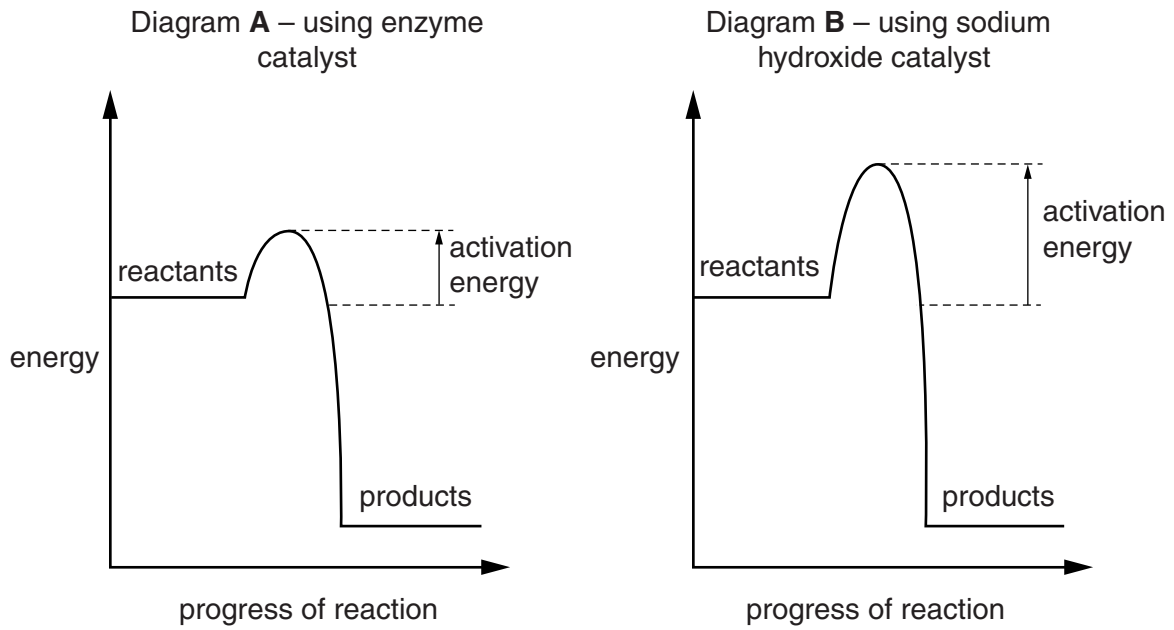
.....

.....

.....

..... [6]

(d) Scientists draw energy level diagrams for the reactions.



Give **one** similarity and **one** difference between the changes shown in these diagrams.

.....

 [2]

(e) The formula of one substance in biodiesel is $C_{19}H_{38}O_2$.

Biodiesel burns completely if there is plenty of air.

Suggest the **two** substances which are produced.

..... and [2]

[Total: 13]

3 Fred investigates ethanoic acid.

(a) The formula of ethanoic acid is CH_3COOH .

(i) How many different elements are there in CH_3COOH ?

..... [1]

(ii) How many atoms of carbon are there in the formula CH_3COOH ?

..... [1]

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

Put a **ring** around the correct answer.

CH₃

CO

OH

COOH

[1]

(iv) This 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]

(v) 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) Fred reacts the acid with ethanol to make an ester.

(i) Which of these is a property of esters?

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

They are all solids.

They give off purple fumes.

They have distinctive smells.

They have a distinctive colour.

[1]

(ii) The equation for the reaction is



What does the symbol \rightleftharpoons tell you?

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

The reaction is fast.

The reaction is reversible.

The reaction is exothermic.

The reaction is hard to control.

[1]

(iii) This type of reaction can reach equilibrium.

What happens when it is at equilibrium?

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

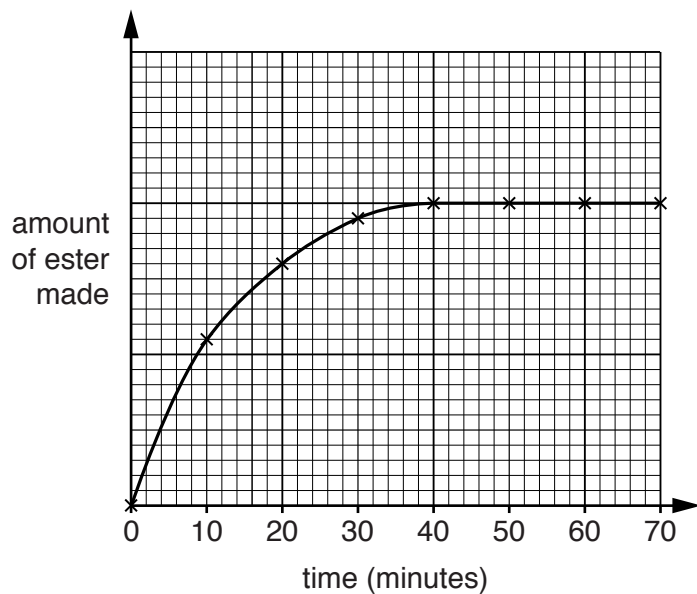
Only reactants are present.

Only products are present.

Reactants and products are both present.

[1]

- (iv) Fred measures the amount of ester made in the reaction to see how it changes with time.



Use the graph to describe how the amount of ester changes.

.....

.....

..... [3]

- (c) Fred needs to calculate the relative formula mass of ethanol to work out the overall yield of the reaction.

Calculate the relative formula mass of ethanol, C_2H_5OH .

In your answer, use the relative atomic masses from the Periodic Table.

..... [1]

[Total: 12]

- 4 When chemical engineers design an industrial process, they make it as sustainable as possible. One of the things that they consider is the energy changes during the chemical reaction.

(a) During a reaction, chemical bonds are broken and new bonds are made.

Put ticks (✓) in the boxes to complete these sentences.

When chemical bonds are broken, energy is	taken in	<input type="checkbox"/>
	given out	<input type="checkbox"/>
	not needed	<input type="checkbox"/>

When chemical bonds are made, energy is	taken in	<input type="checkbox"/>
	given out	<input type="checkbox"/>
	not needed	<input type="checkbox"/>

If more energy is taken in than is given out the reaction is	endothermic	<input type="checkbox"/>
	exothermic	<input type="checkbox"/>

Some energy is usually needed to start the reaction.

This energy is the	activation energy	<input type="checkbox"/>
	green energy	<input type="checkbox"/>
	geothermal energy	<input type="checkbox"/>
	energy output	<input type="checkbox"/>

[3]

13
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Turn over for the next question

(b) Use this formula to calculate the *Rf* value for **Spot 1**.

$$Rf = \frac{\text{distance travelled by spot}}{\text{distance travelled by solvent}}$$

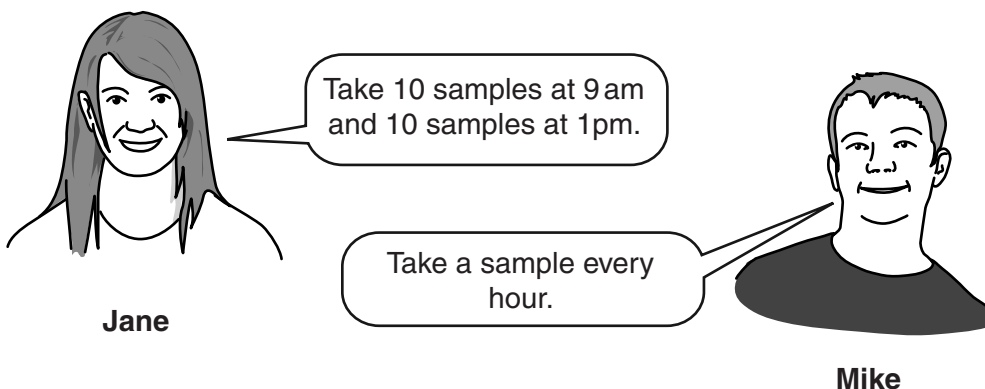
Show your working.

Rf for **Spot 1** = [2]

(c) Sometimes when scientists do chromatography they have to use locating agents. Explain why.

.....
 [2]

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



Explain who has the best approach.

.....

 [3]

[Total: 13]

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 S sulfur 16	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 [98]	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 [209]	85 At astatine [210]	86 Rn radon [222]
	87 Fr francium 87	88 Ra radium 88	89 Ac* actinium 89	104 Rf rutherfordium [261]	105 Db dubnium [262]	106 Sg seaborgium [266]	107 Bh bohrium [264]	108 Hs hassium [277]	109 Mt meitnerium [268]	110 Ds darmstadtium [271]	111 Rg roentgenium [272]	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.