

**Friday 5 June 2015 – Afternoon**

**GCSE GATEWAY SCIENCE  
CHEMISTRY B**

**B741/02** Chemistry modules C1, C2, C3 (Higher Tier)

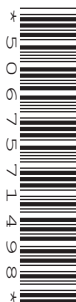
Candidates answer on the Question Paper.  
A calculator may be used for this paper.

**OCR supplied materials:**  
None

**Other materials required:**

- Pencil
- Ruler (cm/mm)

**Duration:** 1 hour 15 minutes



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 Periodic Table can be found on the back page.
- 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 **75**.
- This document consists of **24** pages. Any blank pages are indicated.

Answer **all** the questions.

**SECTION A – Module C1**

- 1** This question is about some of the hydrocarbons found in crude oil.

The table shows some information about four of these hydrocarbons.

Hydrocarbon	Molecular formula	Fraction of crude oil that contains the hydrocarbon	Melting point in °C	Boiling point in °C	Density in g/cm <sup>3</sup>
propane	C <sub>3</sub> H <sub>8</sub>	liquefied petroleum gases	–188	–42	0.002
hexane	C <sub>6</sub> H <sub>14</sub>	petrol	–95	68	0.66
decane	C <sub>10</sub> H <sub>22</sub>	paraffin	–30	174	0.73
hexadecane	C <sub>16</sub> H <sub>34</sub>	diesel	18	287	0.77

- (a)** Propane is a **hydrocarbon**.

What is meant by a hydrocarbon?

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

- (b)** Propane is a saturated compound.

What is meant by a **saturated** compound?

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

- (c)** A mixture of hexane, decane and hexadecane can be separated by fractional distillation.

Explain why. Use ideas about intermolecular forces and information from the table.

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

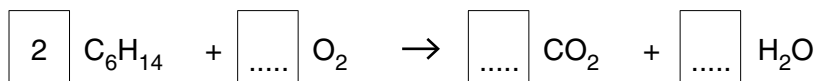
3

- (d) Hexane is one of the hydrocarbons found in petrol.

Hexane completely burns in excess air.

Look at the symbol equation for this reaction.

Balance the equation by putting numbers in the boxes.



[2]

- (e) Hexane burns in a limited supply of oxygen.

Incomplete combustion happens.

Write a **word equation** for the **incomplete** combustion of hexane.

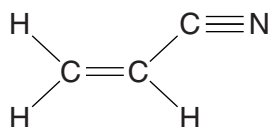
..... [1]

4

2 Stowmarket Synthetics is a chemical company that makes polymers.

They make a polymer from a monomer called propenenitrile.

Look at the displayed formula for the monomer propenenitrile.



(a) How many covalent bonds are shown in the displayed formula of propenenitrile?

Tick (✓) the correct box.

three

☐

four

☐

five

☐

eight

☐

nine

☐

[1]



**3** Some foods contain additives.

An emulsifier stops oil and water in a food from separating.

**(a)** Phil finds some information about four substances.

Look at this information.

Substance	Is it poisonous?	Does it have a smell?	Cost of making 1g of substance in pence	Does it stop oil and water from separating?
<b>A</b>	yes	no	3	yes
<b>B</b>	no	no	6	yes
<b>C</b>	no	no	1	no
<b>D</b>	no	yes	5	yes

Which substance is the most suitable to be used as an emulsifier in food?

Explain your answer.

.....

.....

.....

.....

..... [3]

**(b)** A processed food contains an emulsifier.

**(i)** Draw a diagram of an emulsifier molecule.

Label the **two** important parts of the molecule.

[2]

7

- (ii) The processed food also contains cooked potato.

Potato is easier to digest when it is cooked rather than raw.

Explain why.

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.....

.....

..... [2]

- 4 Cosmetics such as perfumes must be tested to ensure they are safe to use.

Many scientists believe that cosmetics should not be tested on animals.

In the EU the testing of cosmetics on animals has been banned.

Explain why.

.....

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.....

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..... [2]

## SECTION B – Module C2

5 This question is about construction materials.

(a) Cement is used in the construction of buildings.



Cement is made when **two** substances are heated together.

Which two?

Put a tick (✓) in the correct box.

sand and water

☐

limestone and sand

☐

limestone and clay

☐

limestone and granite

☐

sand and clay

☐

[1]

- (b) Concrete is another construction material.

Concrete is quite strong.

It is reinforced using a mesh of steel rods.

This is called **reinforced concrete**.

- (i) Reinforced concrete is a better construction material for making bridges than non-reinforced concrete.

Explain why.

.....

.....

.....

..... [2]

- (ii) Look at the table.

It gives some information about three types of steel used to reinforce concrete.

Type of steel	Relative strength	Density in g/cm <sup>3</sup>	Cost of 1 m × 2 m mesh	Resistance to corrosion	Other properties
<b>A</b>	386	7.85	£26.99	limited	easily shaped
<b>B</b>	414	7.90	£40.35	limited	hard, more difficult to shape
<b>C</b>	515	7.80	£50.52	very good	easily shaped

Which type of steel would be best to reinforce concrete?

Use information from the table to suggest why.

.....

.....

..... [2]

6 Martin investigates the corrosion of different metals and alloys.

He places pieces of the metals or alloys in different concentrations of sulfuric acid.

He does his experiment at three different temperatures.

Look at his results.

Temperature in °C	Sulfuric acid concentration in %	Resistance to corrosion		
		Niobium	Zirconium	Hastelloy
20	10	excellent	excellent	poor
	40	excellent	excellent	good
	70	excellent	excellent	excellent
	90	good	poor	excellent
40	10	poor	excellent	poor
	40	poor	excellent	poor
	70	poor	excellent	poor
	90	poor	poor	poor
60	10	poor	excellent	poor
	40	poor	excellent	poor
	70	poor	good	poor
	90	poor	poor	poor

(a) Martin concludes that:

- all three metals or alloys are more resistant to corrosion at lower concentrations of sulfuric acid
- all three metals or alloys are more resistant to corrosion at lower temperatures.

Is he correct?

Use information from the table to explain your answer.

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..... [2]

(b) Martin does another experiment.

He investigates how the pH of an acid affects the rate of corrosion of one alloy.

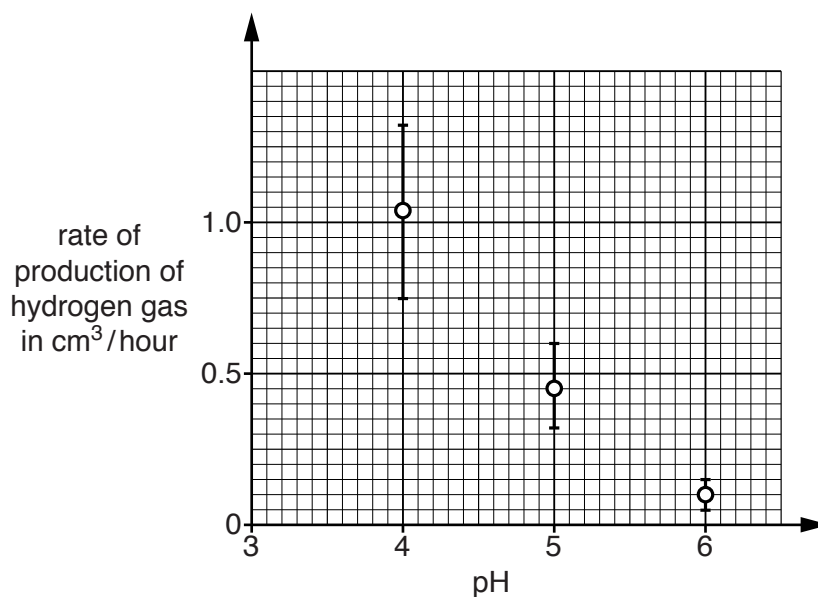
The alloy reacts with the acid to produce hydrogen gas.

Martin measures the rate at which the hydrogen gas is made.

He does this at three different pH values.

He repeats his experiment five times at each pH and then plots a graph of his results.

Look at his graph.



(i) What was the **highest** rate of production of hydrogen gas that Martin measured at pH 5?

answer ..... cm³/hour [1]

(ii) At which pH did Martin get the most **repeatable** results?

..... [1]

(c) Aluminium,  $Al$ , reacts with sulfuric acid,  $H_2SO_4$ .

Aluminium sulfate,  $Al_2(SO_4)_3$ , and hydrogen,  $H_2$ , are made.

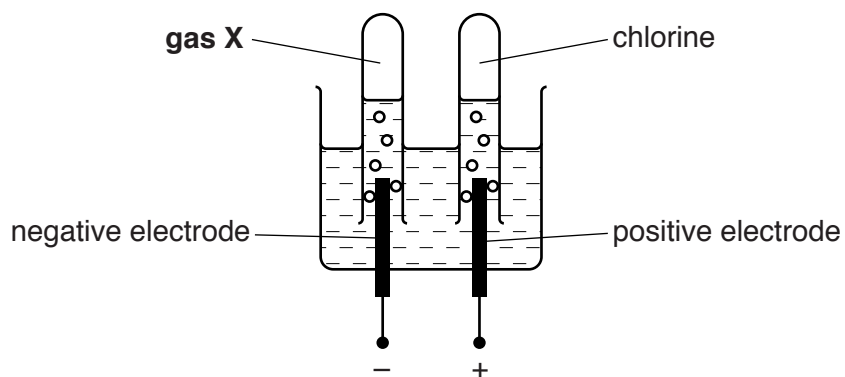
Write a **balanced symbol** equation for this reaction.

..... [2]

12

- 7 Anita investigates the electrolysis of concentrated sodium chloride solution (brine).

Look at the diagram. It shows the apparatus she uses.



- (a) What is the name of gas **X**?

Choose your answer from the list.

carbon dioxide

hydrogen

hydrogen chloride

oxygen

answer ..... [1]

- (b) It is important to use **inert electrodes** in the electrolysis of sodium chloride solution.

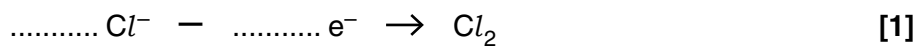
Explain why.

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

13

(c) During the electrolysis of sodium chloride solution, the chloride ions are turned into chlorine molecules.

(i) Complete the equation for this reaction.



(ii) Is this reaction **oxidation** or **reduction**?

Explain how you can tell from the equation.

.....

..... [1]

8 This question is about fertilisers.

(a) Farmers add fertilisers to the soil.

Some people think that farmers should not use fertilisers.



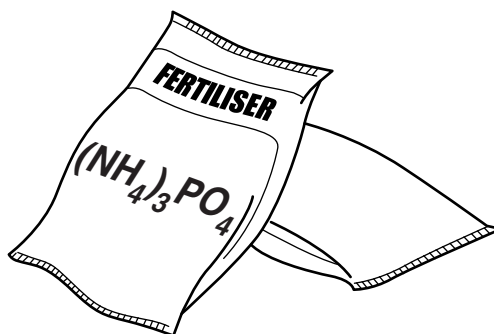
Write down a reason **for** and a reason **against** the use of fertilisers.

.....

.....

..... [2]

(b) Ammonium phosphate,  $(\text{NH}_4)_3\text{PO}_4$ , is a fertiliser.



(i) Complete the table to show the number of each **type of atom** in the formula  $(\text{NH}_4)_3\text{PO}_4$ .

Atom	Number
N	.....
H	.....
P	.....
O	.....

[2]

15

- (ii) Ammonium phosphate solution is made by reacting an acid with an alkali in a **neutralisation** reaction.

Describe how pure, dry crystals of ammonium phosphate can be made, including the names of the **acid** and **alkali** needed.



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

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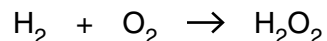
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..... [6]

## SECTION C – Module C3

9 Hydrogen peroxide,  $\text{H}_2\text{O}_2$ , is used in some spacecraft to provide oxygen.

(a) Hydrogen peroxide can be made from hydrogen and oxygen.



(i) This reaction has a 100% atom economy.

Explain how you can tell from the equation.

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

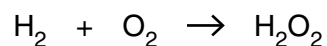
(ii) Industrial chemical processes should have as high an atom economy as possible.

Explain **two** reasons why.

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

(b) Oskar uses 100 g of hydrogen.

(i) Show that the predicted yield of hydrogen peroxide is 1700 g.



The relative formula mass,  $M_r$ , of  $\text{H}_2 = 2$ , of  $\text{O}_2 = 32$  and of  $\text{H}_2\text{O}_2 = 34$ .

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

17

(ii) Oskar's actual yield of hydrogen peroxide is 1530 g.

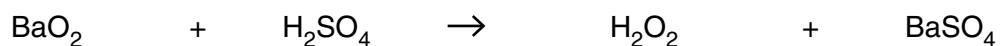
He predicts he should make 1700 g of hydrogen peroxide.

Calculate Oskar's percentage yield of hydrogen peroxide.

percentage yield = .....% [2]

(c) Hydrogen peroxide can also be made from barium peroxide.

barium peroxide + sulfuric acid  $\rightarrow$  hydrogen peroxide + barium sulfate



The table shows the relative formula masses,  $M_r$ , of the substances in the symbol equation.

Substance	Relative formula mass, $M_r$
$\text{BaO}_2$	169
$\text{H}_2\text{SO}_4$	98
$\text{H}_2\text{O}_2$	34
$\text{BaSO}_4$	233

Barium sulfate is a waste product in this reaction.

Calculate the atom economy for this reaction.

atom economy = .....% [2]

- 10 Fatimah investigates the reaction between sodium hydrogencarbonate and dilute hydrochloric acid.

She always adds 0.5 g of sodium hydrogencarbonate to 20 cm<sup>3</sup> of dilute hydrochloric acid.

She measures the time it takes for the reaction mixture to stop bubbling.

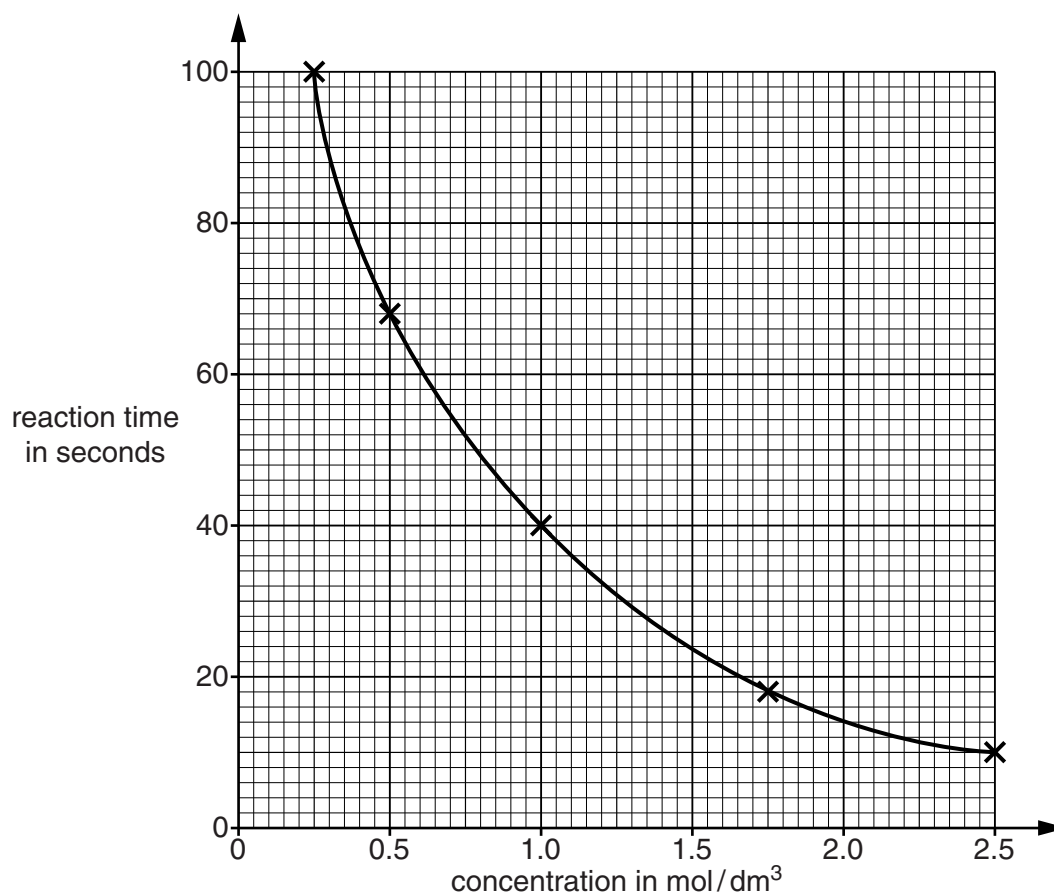
This is called the **reaction time**.

She does five different experiments.

She keeps the temperature the same.

Each experiment uses a **different concentration** of acid.

Look at a graph of her results.





11 A pharmaceutical drug is made by a batch process.

(a) Write about **one** reason why pharmaceutical drugs are often made by a batch process.

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..... [1]

(b) It is expensive to develop and manufacture a new pharmaceutical drug.

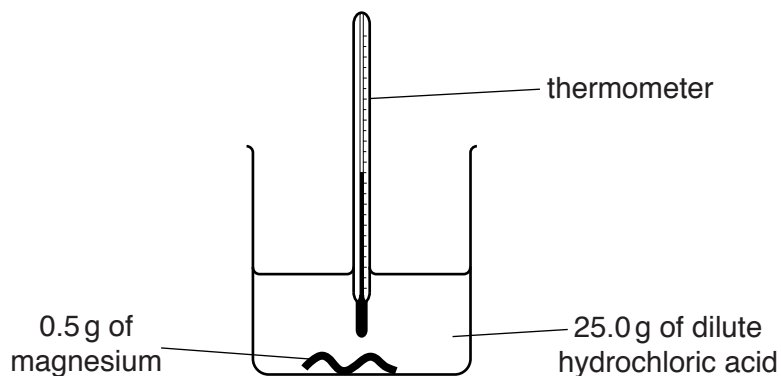
Explain why.

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

21

- 12 Sue investigates the reaction between magnesium ribbon and dilute hydrochloric acid.

Look at the apparatus she uses.



The temperature of the acid before the magnesium is added is  $22.0^{\circ}\text{C}$ .

The energy released by the reaction can be calculated using the equation

$$\text{energy released} = \text{mass of acid heated} \times \text{specific heat capacity} \times \text{temperature change}$$

The specific heat capacity of the acid =  $4.2\text{ J/g}^{\circ}\text{C}$

The energy released in Sue's experiment was  $1600\text{ J}$ .

- (a) Calculate the **final** temperature of the acid.

Quote your answer to **one** decimal place.

Final temperature of the acid is .....  $^{\circ}\text{C}$

[3]

- (b) Energy is released in this reaction.

Explain why. Use ideas about bond breaking and bond making.

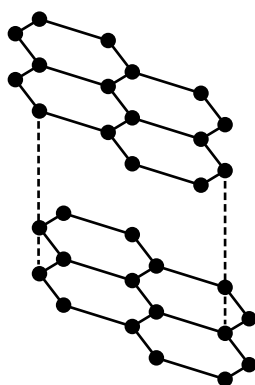
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..... [2]

- 13 Graphite is a form of carbon.



- (a) Graphite is used as a lubricant.

Write down **one** property of graphite that explains why it is used as a lubricant.

..... [1]

- (b) Graphite conducts electricity.

Explain how. Use ideas about structure and bonding.

.....

.....

..... [1]

END OF QUESTION PAPER

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# The Periodic Table of the Elements

1	2	Key										3	4	5	6	7	0
		relative atomic mass atomic symbol name atomic (proton) number															
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						

\* 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.