

**Friday 6 June 2014 – 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	
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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**

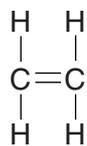
- The quality of written communication is assessed in questions marked with a pencil (.
- The Periodic Table can be found on the back page.
- The number of marks is given in brackets [ ] at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document consists of **24** pages. Any blank pages are indicated.

Answer **all** the questions.

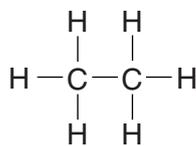
**SECTION A – Module C1**

- 1 This question is about compounds containing carbon.

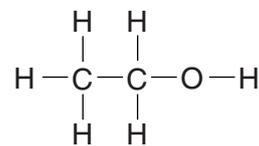
Look at the displayed formulas of some compounds.



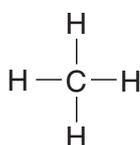
compound **A**



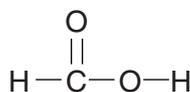
compound **B**



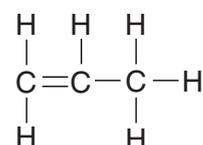
compound **C**



compound **D**



compound **E**



compound **F**

- (a) What is the **molecular formula** for compound **B**?

.....

[1]

- (b) Explain why compound **B** is a hydrocarbon but compound **C** is not a hydrocarbon.

.....  
 .....  
 .....

[3]

- (c) Two compounds are **unsaturated**.

Which two?

..... and .....

[1]

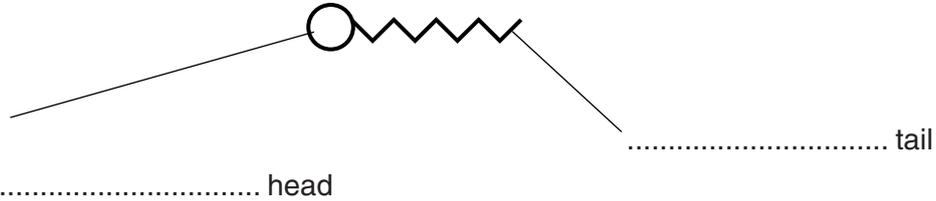
[Total: 5]

2 This question is about emulsifiers and cooking.

(a) Mayonnaise is a mixture of an emulsifier, an oil and water.

The emulsifier helps to stop the oil and water from separating.

Look at the structure of an emulsifier molecule.



- (i) Label the two parts of the emulsifier molecule. [1]
- (ii) Explain how an emulsifier helps to stop oil and water from separating.

.....

.....

.....

.....

.....

.....

..... [2]

(b) Egg yolk is a runny liquid.

The egg yolk becomes a solid when it is cooked.

Explain why.

Use ideas about the type of molecules in egg yolk.

.....

.....

.....

..... [2]

[Total: 5]

3 A power station burns methane, CH<sub>4</sub>.

(a) Construct a **balanced symbol** equation for the complete combustion of methane.

..... [2]

(b) The power station produces nitrogen dioxide gas.

The owners need to stop the nitrogen dioxide going into the atmosphere.

They can choose two methods:

- use limestone
- use sea water.

Look at the table. It shows some information about each method.

	<b>Limestone</b>	<b>Sea water</b>
Percentage of nitrogen dioxide removed	90%	99%
Waste made	carbon dioxide and a solid waste product	none – sea water is pumped back into the sea
Cost	expensive	cheap
Availability	mined from under the ground	must be pumped in from the coast
Mass needed to remove 1 g of nitrogen dioxide	1.2 g	3000 g

The power station is 100 kilometres from the coast.

The power station makes 9000 g of nitrogen dioxide.

Which method would be more suitable for removing nitrogen dioxide from the waste gases?

Explain your answer.

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

[Total: 4]

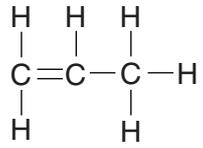
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**Question 4 begins on page 6**

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- 4 Poly(propene) is a polymer made from propene.

Look at the displayed formula for propene.



- (a) Draw the displayed formula for poly(propene).

[2]



5 An oil paint contains oil, a solvent, a binder and a phosphorescent pigment.

(a) A phosphorescent pigment will glow in the dark.

Explain why.

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

(b) A layer of oil paint is left to dry and harden.

The solvent evaporates.

What happens to the oil?

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

[Total: 3]

## SECTION B – Module C2

6 Many different materials are needed to build a car.



(a) (i) Suggest a property of glass that makes it useful for making a car windscreen.

..... [1]

(ii) Some car bodies are now built from aluminium instead of steel.

One advantage of using aluminium is that it is less dense than steel.

Write down **one other advantage** of building car bodies from aluminium instead of steel.

..... [1]

(b) Look at the table.

It shows information about some of the materials used to build a car.

Material	Density in g/cm <sup>3</sup>	Electrical conductivity	Flexibility
aluminium	2.7	very high	low
glass	2.5	very low	low
PVC	1.4	very low	high
steel	7.8	high	low

Explain why PVC is used for covering the electrical wires in a car.

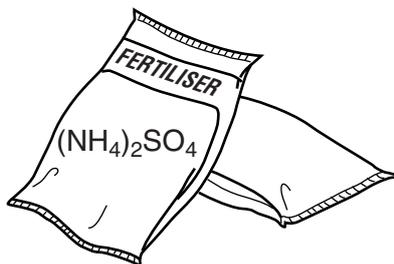
Use the information from the table.

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

[Total: 4]

7 This question is about fertilisers.

(a) Ammonium sulfate,  $(\text{NH}_4)_2\text{SO}_4$ , is used as a fertiliser.



Complete the table to show the number of **atoms of each element** in the formula for ammonium sulfate.

Element	Number of atoms
nitrogen	.....
hydrogen	.....
sulfur	.....
oxygen	.....

[1]

(b) Ammonium sulfate is made by reacting an acid with an alkali.

Name the acid and alkali needed.

Describe how the acid and alkali are used to make a sample of ammonium sulfate.

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.....

[3]



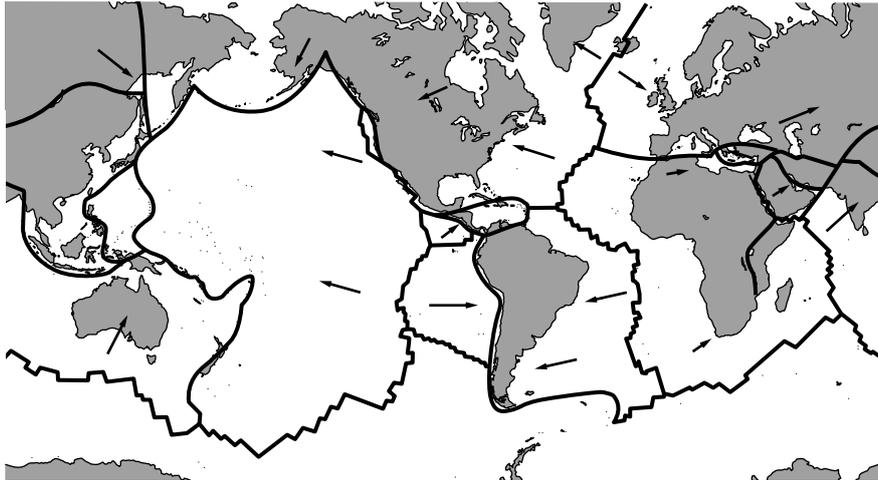
8 This question is about the structure of the Earth.

(a) It is difficult for scientists to study the structure of the Earth.

Explain why.

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

(b) The Earth's crust is made up of tectonic plates that move slowly.



The **theory of plate tectonics** developed over many years.

(i) Write about **two** stages in the **development** of the theory of plate tectonics.

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

(ii) Why do most scientists now accept this developed theory?

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

[Total: 4]

**13**  
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**Question 9 begins on page 14**

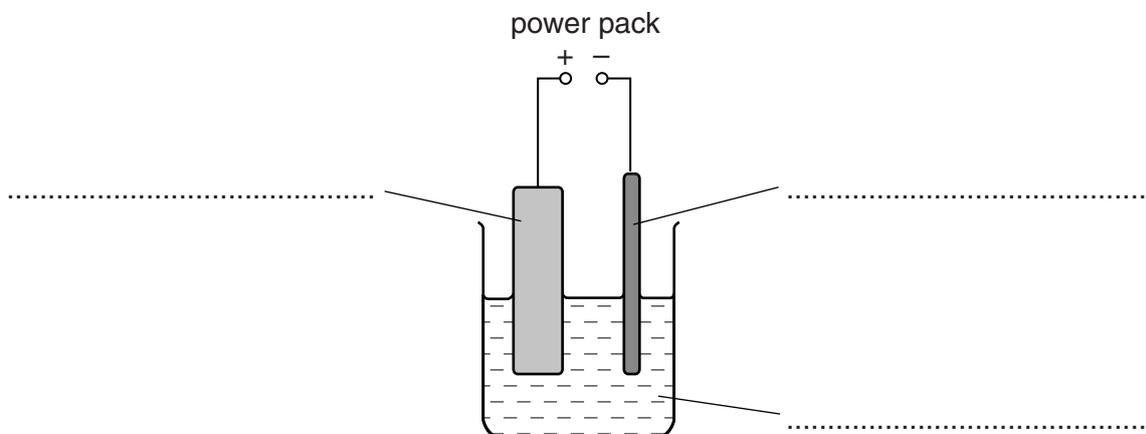
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(b) Pure copper is used for electrical wiring.

The copper is purified by **electrolysis**.

The diagram shows the apparatus used to purify copper.



Complete the labels on the diagram.

Choose your answers from the list.

**copper sulfate solution**

**dilute sulfuric acid**

**impure copper anode**

**impure copper cathode**

**pure copper anode**

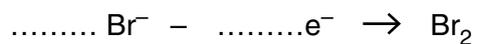
**pure copper cathode**

[2]

[Total: 5]

10 During the electrolysis of sodium bromide solution, bromide ions make bromine molecules.

(a) Complete the equation for this reaction.



[1]

(b) Explain why this reaction is an example of **oxidation**.

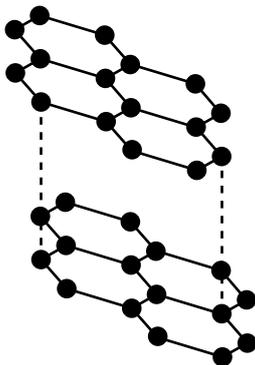
.....

..... [1]

[Total: 2]

## SECTION C – Module C3

11 Graphite is one of the allotropes of carbon.



(a) Graphite is used to make pencil leads.

Explain why the properties of graphite make it suitable for pencil leads.

.....

.....

.....

..... [2]

(b) Graphite is used as an electrode in electrolysis.

This is because it conducts electricity and has a high melting point.

(i) Explain why graphite can conduct electricity. Use the diagram to help you.

.....

..... [1]

(ii) Explain why graphite has a high melting point. Use the diagram to help you.

.....

.....

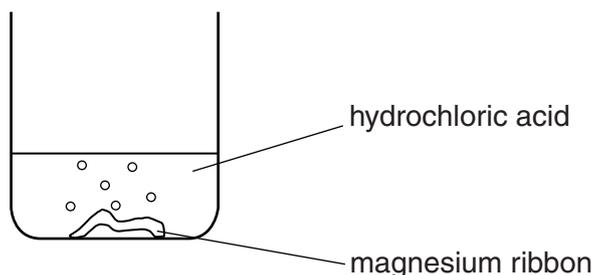
.....

..... [2]

[Total: 5]

12 Rachel investigates the reaction between magnesium and hydrochloric acid.

She adds a piece of magnesium ribbon to hydrochloric acid in a beaker.

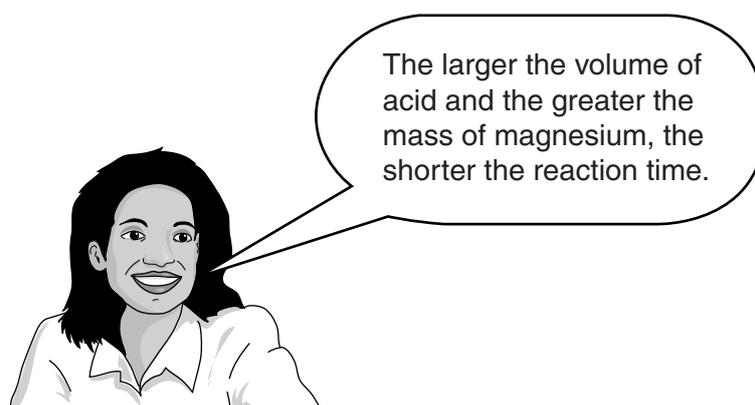


Rachel measures the time it takes for all the magnesium ribbon to react.

This is the reaction time.

She does five different experiments.

Look at Rachel's prediction.



Look at Rachel's results.

Experiment number	Mass of magnesium used in g	Volume of acid used in cm <sup>3</sup>	Concentration of acid in mol/dm <sup>3</sup>	Reaction time in seconds
1	0.05	25	1.0	30
2	0.10	25	1.0	30
3	0.05	50	1.0	30
4	0.05	50	2.0	15
5	0.10	50	2.0	15



13 Ethanoic acid,  $C_2H_4O_2$ , can be made by several different processes.

Three of these are process **R**, process **S** and process **T**.

(a) In process **R**, methanol reacts with carbon monoxide.



Process **R** has 100% atom economy.

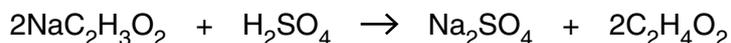
Explain how you can tell this from the symbol equation.

.....

.....

..... [1]

(b) In process **S**, sodium ethanoate,  $NaC_2H_3O_2$ , reacts with sulfuric acid.



Look at the table of relative formula masses,  $M_r$ .

Substance	Relative formula masses, $M_r$
$NaC_2H_3O_2$	82
$H_2SO_4$	98
$Na_2SO_4$	142
$C_2H_4O_2$	60

(i) A mass of 8.2g of sodium ethanoate reacts with excess sulfuric acid.

What mass of ethanoic acid,  $C_2H_4O_2$ , can be made?

.....

.....

.....

.....

.....

mass of ethanoic acid = ..... g

[2]

(ii) Calculate the **atom economy** for process **S**.

Sodium sulfate,  $\text{Na}_2\text{SO}_4$ , is a waste product.

.....  
.....  
.....

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

(c) In process **T**, hydrocarbons are oxidised to make ethanoic acid.

Mike predicts that 5.2 tonnes of ethanoic acid should be made.

The factory actually makes 2.4 tonnes of ethanoic acid.

(i) Calculate the percentage yield of ethanoic acid.

Write your answer to **two** significant figures.

.....  
.....  
.....

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

(ii) Describe one disadvantage of having a percentage yield of this value.

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

[Total: 8]

14 Paraffin is a liquid fuel.

Paraffin releases heat energy when it burns in air.

Jenna wants to find out how much energy is released when she burns 1 g of paraffin.

She decides to use the paraffin to heat some water.

Write about how she does the experiment. You may wish to include a labelled diagram.

.....

.....

.....

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.....

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..... [4]

[Total: 4]

**END OF QUESTION PAPER**

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# The Periodic Table of the Elements

	1	2	3	4	5	6	7	0																																																																																																																																																																																																																																																									
	7 <b>Li</b> lithium 3	9 <b>Be</b> beryllium 4	11 <b>Na</b> sodium 11	12 <b>Mg</b> magnesium 12	13 <b>Al</b> aluminium 13	14 <b>Si</b> silicon 14	15 <b>P</b> phosphorus 15	16 <b>S</b> sulfur 16	17 <b>Cl</b> chlorine 17	18 <b>Ar</b> argon 18																																																																																																																																																																																																																																																							
	19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	23 <b>Sc</b> scandium 21	24 <b>Y</b> yttrium 39	25 <b>Zr</b> zirconium 40	26 <b>Nb</b> niobium 41	27 <b>Hf</b> hafnium 72	28 <b>Ta</b> tantalum 73	29 <b>W</b> tungsten 74	30 <b>Rh</b> rhodium 45	31 <b>Pd</b> palladium 46	32 <b>Cd</b> cadmium 48	33 <b>Ag</b> silver 47	34 <b>Cu</b> copper 29	35 <b>Zn</b> zinc 30	36 <b>Ga</b> gallium 31	37 <b>Ge</b> germanium 32	38 <b>As</b> arsenic 33	39 <b>Se</b> selenium 34	40 <b>Br</b> bromine 35	41 <b>Kr</b> krypton 36																																																																																																																																																																																																																																												
	39 <b>Rb</b> rubidium 37	40 <b>Sr</b> strontium 38	45 <b>Sc</b> scandium 21	46 <b>Y</b> yttrium 39	47 <b>Zr</b> zirconium 40	48 <b>Nb</b> niobium 41	49 <b>Hf</b> hafnium 72	50 <b>Ta</b> tantalum 73	51 <b>W</b> tungsten 74	52 <b>Rh</b> rhodium 45	53 <b>Pd</b> palladium 46	54 <b>Cd</b> cadmium 48	55 <b>Ag</b> silver 47	56 <b>Cu</b> copper 29	57 <b>Zn</b> zinc 30	58 <b>Ga</b> gallium 31	59 <b>Ge</b> germanium 32	60 <b>As</b> arsenic 33	61 <b>Se</b> selenium 34	62 <b>Br</b> bromine 35	63 <b>Kr</b> krypton 36																																																																																																																																																																																																																																												
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	209 <b>Bi</b> bismuth 83	210 <b>Po</b> polonium 84	211 <b>At</b> astatine 85	212 <b>Rn</b> radon 86	213 <b>Fr</b> francium 87	214 <b>Ra</b> radium 88	215 <b>Ac*</b> actinium 89	216 <b>Th</b> thorium 90	217 <b>Pa</b> protactinium 91	218 <b>U</b> uranium 92	219 <b>Np</b> neptunium 93	220 <b>Pu</b> plutonium 94	221 <b>Am</b> americium 95	222 <b>Cm</b> curium 96	223 <b>Bk</b> berkelium 97	224 <b>Cf</b> californium 98	225 <b>Es</b> einsteinium 99	226 <b>Fm</b> fermium 100	227 <b>Mn</b> manganese 25	228 <b>Fe</b> iron 26	229 <b>Co</b> cobalt 27	230 <b>Ni</b> nickel 28	231 <b>Cu</b> copper 29	232 <b>Zn</b> zinc 30	233 <b>Ga</b> gallium 31	234 <b>Ge</b> germanium 32	235 <b>As</b> arsenic 33	236 <b>Se</b> selenium 34	237 <b>Br</b> bromine 35	238 <b>Kr</b> krypton 36	239 <b>Rb</b> rubidium 37	240 <b>Sr</b> strontium 38	241 <b>Y</b> yttrium 39	242 <b>Zr</b> zirconium 40	243 <b>Nb</b> niobium 41	244 <b>Hf</b> hafnium 72	245 <b>Ta</b> tantalum 73	246 <b>W</b> tungsten 74	247 <b>Rh</b> rhodium 45	248 <b>Pd</b> palladium 46	249 <b>Cd</b> cadmium 48	250 <b>Ag</b> silver 47	251 <b>Cu</b> copper 29	252 <b>Zn</b> zinc 30	253 <b>Ga</b> gallium 31	254 <b>Ge</b> germanium 32	255 <b>As</b> arsenic 33	256 <b>Se</b> selenium 34	257 <b>Br</b> bromine 35	258 <b>Kr</b> krypton 36																																																																																																																																																																																																															
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