OCR

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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

* B 7 4 1 0 2 *

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

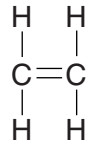
- The quality of written communication is assessed in questions marked with a pencil (✎).
- The Periodic Table can be found on the back page.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **75**.
- This document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

Answer **all** the questions.

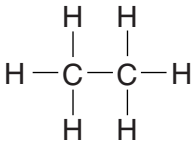
SECTION A – Module C1

1 This question is about compounds containing carbon.

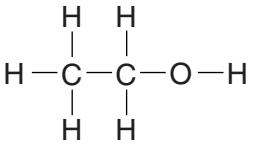
Look at the displayed formulas of some compounds.



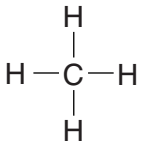
compound **A**



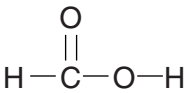
compound **B**



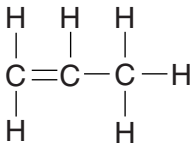
compound **C**



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.

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

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

Which two?

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

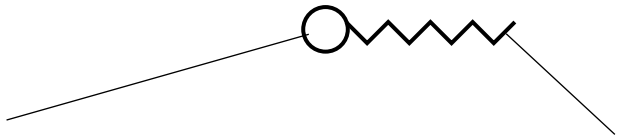
[Total: 5]

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.



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(i) Label the two parts of the emulsifier molecule. **[1]**

(ii) Explain how an emulsifier helps to stop oil and water from separating.

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..... **[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.

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

[Total: 5]

3 A power station burns methane, CH_4.

(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.

	Limestone	**Sea water**
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.

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

[Total: 4]

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Question 4 begins on page 6

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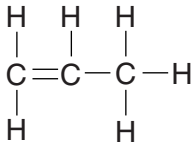
4 Poly(propene) is a polymer made from propene.

Look at the displayed formula for propene.

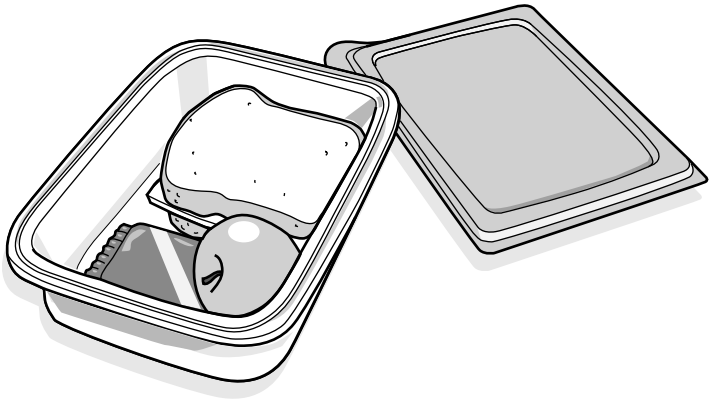


(a) Draw the displayed formula for poly(propene).

[2]

(b) Poly(propene) is used to make sandwich boxes.

Look at Anna's sandwich box. It contains the sandwiches for her lunch.



One of the properties of poly(propene) is that it is flexible.

Explain **why** poly(propene) is flexible and suggest, with reasons, two **other** properties needed by poly(propene) to be suitable for making a sandwich box.

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

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

[Total: 8]

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.

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

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

The solvent evaporates.

What happens to the oil?

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..... **[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^3	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.

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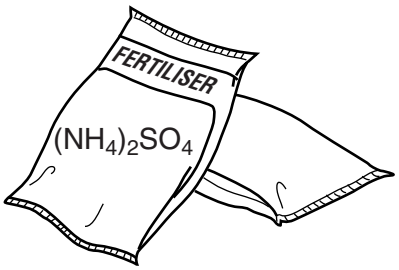
..... **[2]**

[Total: 4]

7 This question is about fertilisers.

(a) Ammonium sulfate, $(NH_4)_2SO_4$, 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]**

(c) Nitric acid is used to manufacture fertilisers.

Ammonia, NH_3, and oxygen, O_2 are used to manufacture nitric acid, HNO_3.

Water is the other product.

The reaction between ammonia and oxygen uses the following conditions:

- a temperature of 900 °C
- atmospheric pressure
- a platinum catalyst.

Construct the **balanced symbol** equation for the manufacture of nitric acid and explain the **advantages** and **disadvantages** of using these conditions.

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

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

[Total: 10]

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.

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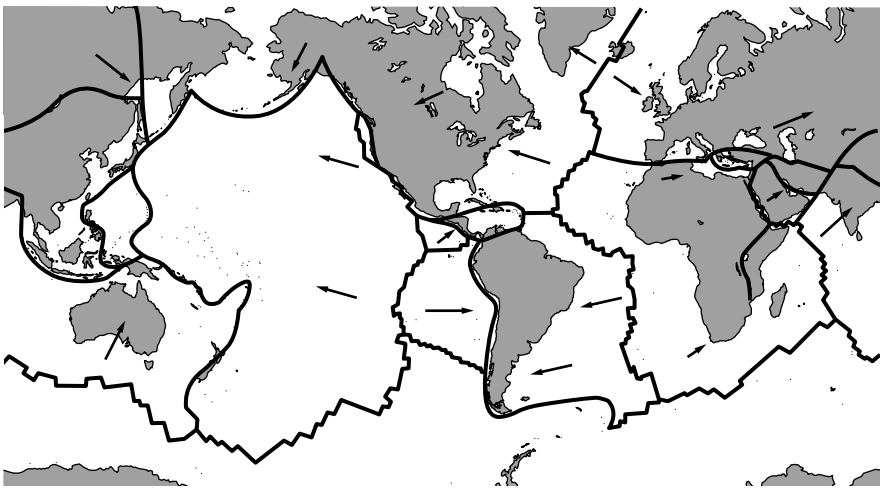
..... **[1]**

(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.

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

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

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

[Total: 4]

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Question 9 begins on page 14

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9 This question is about metals.

(a) Phil wants to buy a new bicycle.

He uses the internet to research which metal is the most suitable for making the bicycle frame.

Look at the table.

It shows the information he finds out.

Metal	Density in g/cm^3	Relative strength (1= low, 10 = high)	Resistance to corrosion	Cost per tonne in £
aluminium	2.7	0.9	very good	2220
copper	8.9	2.1	good	5550
stainless steel	7.8	7.3	very good	900
titanium	4.5	10	very good	17000

Which metal is the most suitable for making Phil's bicycle frame?

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Explain your answer using information from the table.

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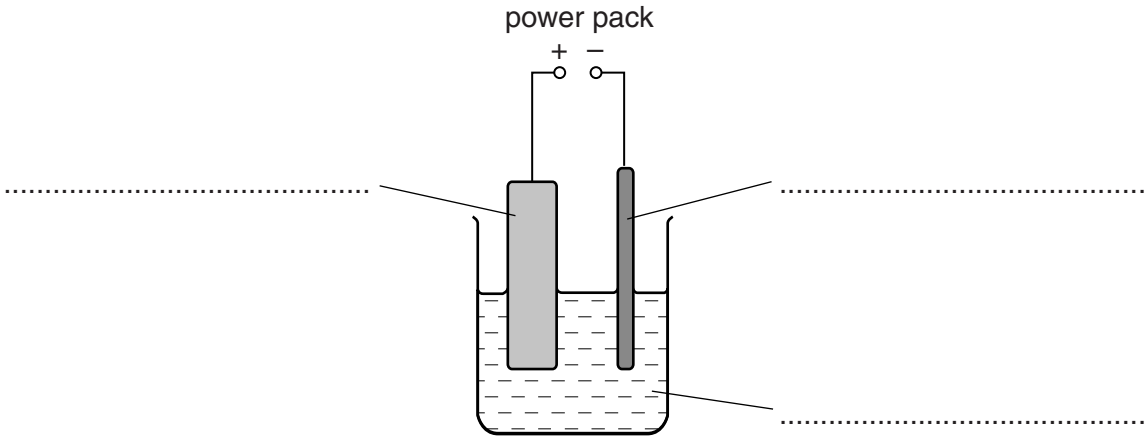
..... **[3]**

(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.

$$\ldots\ldots\ Br^- \ - \ \ldots\ldots e^- \ \rightarrow \ Br_2$$

[1]

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

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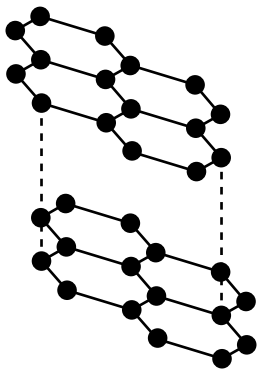
..... **[1]**

[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.

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..... **[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.

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

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

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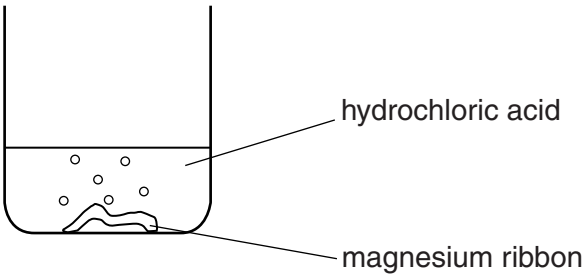
..... **[2]**

[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.

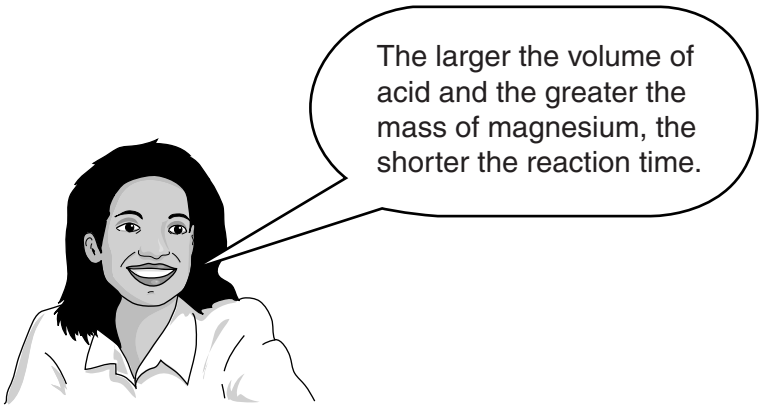


Rachel measures the time it takes for all the magnesium ribbon to react.

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^3	Concentration of acid in mol/dm^3	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

(a) Explain if Rachel's results support her prediction. Use the reacting particle model to explain the difference between the reaction time in experiments **3** and **4**.

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

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

(b) Rachel repeats experiment **1**. This time she uses acid at a **higher** temperature.

Explain, using the reacting particle model, what happens to the rate of reaction.

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

[Total: 8]

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.

$$CH_4O + CO \rightarrow C_2H_4O_2$$

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

Explain how you can tell this from the symbol equation.

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

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

$$2NaC_2H_3O_2 + H_2SO_4 \rightarrow Na_2SO_4 + 2C_2H_4O_2$$

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 8.2 g of sodium ethanoate reacts with excess sulfuric acid.

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

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mass of ethanoic acid = ... g **[2]**

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

Sodium sulfate, Na_2SO_4, is a waste product.

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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.

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

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

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..... **[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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..... **[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
							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.