

**Thursday 17 January 2013 – Afternoon**

**GCSE GATEWAY SCIENCE  
CHEMISTRY B**

**B741/01** Chemistry modules C1, C2, C3 (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 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**

- Your 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 **28** pages. Any blank pages are indicated.

Answer **all** the questions.

**SECTION A – Module C1**

- 1 This question is about food additives.

Chloe uses a cake mix to make a cake.

Some of the ingredients in the cake mix are listed below.



**Ingredients**

sugar  
wheat flour  
fat  
baking powder  
emulsifier  
flavour enhancers

Chloe adds oil, eggs and water to the cake mix.

- (a) Emulsifiers and flavour enhancers are food additives.

Draw a straight line from each **food additive** to its **job**.

Food additive	Job
emulsifier	stops food reacting with oxygen
flavour enhancer	improves colour of food
	stops food going off
	helps oil and water to mix and not separate
	improves the taste of food

[1]

(b) The baking powder helps the cake rise.

Baking powder contains sodium hydrogencarbonate,  $\text{NaHCO}_3$ .

(i) Write down the number of different **elements** in sodium hydrogencarbonate.

answer ..... [1]

(ii) Chloe thinks that carbon dioxide is given off when sodium hydrogencarbonate is heated.

Describe how Chloe can show that carbon dioxide gas is given off.

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

[Total: 4]

**Question 2 begins on page 4**

- 2 (a) Crude oil, coal and natural gas are fossil fuels.

These fuels are **non-renewable**.

Explain what is meant by non-renewable.

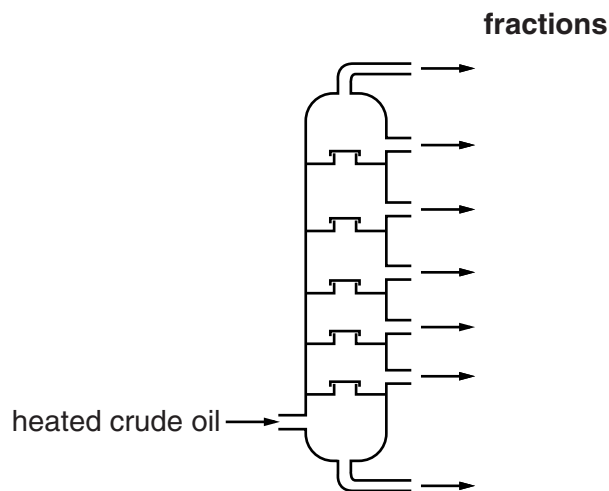
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..... [2]

- (b) Crude oil is separated into many fractions by fractional distillation.

The diagram shows a fractionating column.



Look at the table. It shows the boiling point range for some of the fractions.

Fraction	Boiling point range in °C
bitumen	above 350
heating oil	240 to 350
paraffin	120 to 240
petrol	20 to 70
LPG	-160 to 20

Write down the name of the fraction which 'exits' from the **bottom** of the fractionating column.

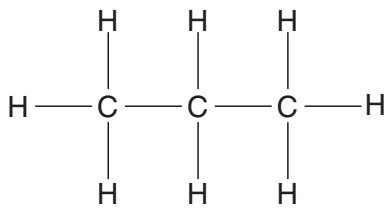
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Explain your answer.

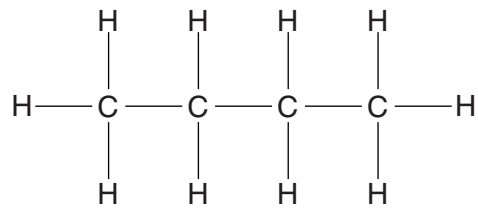
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[2]

(c) LPG contains propane and butane.



**propane**



**butane**

(i) Write down the **number of atoms** in a molecule of **butane**.

answer .....

[1]

(ii) Look at the displayed formulas of propane and butane.

Propane and butane are **hydrocarbons**.

They are also **alkanes**.

Explain why they are both hydrocarbons and alkanes.

.....

.....

.....

..... [3]

[Total: 8]

3 This question is about car engines.

(a) Car engines make carbon dioxide.

Look at the table.

The table shows the amount of carbon dioxide emitted by 5 cars, **A**, **B**, **C**, **D** and **E**.

Car	Carbon dioxide emissions in g/km
<b>A</b>	109.0
<b>B</b>	147.3
<b>C</b>	98.8
<b>D</b>	170.6
<b>E</b>	91.7

Henry wants to buy a car.

Henry finds out that car tax is not paid on cars with carbon dioxide emissions lower than **100g/km**.

Henry would not have to pay car tax on some of these cars.

Which cars? Choose from **A**, **B**, **C**, **D** and **E**.

.....

[1]

(b) Many car engines burn petrol.

Petrol contains octane.

Octane reacts with oxygen.

Carbon dioxide and water are made.

Write down the **word equation** for this reaction.

..... [1]

- (c) Carbon monoxide and oxides of nitrogen are also made in a car engine.

Write about how carbon monoxide is made in a car engine, and the problems caused by carbon monoxide and oxides of nitrogen.



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

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..... [6]

**[Total: 8]**

**Question 4 begins on page 8**

4 This question is about polymers.

(a) Jill wants to buy a sports jacket that she can wear **in all weathers**.

Look at the information about polymers **A, B, C, D** and **E**.

Polymer	Is it stiff or flexible?	Is it waterproof?	Is it breathable?
<b>A</b>	stiff	no	yes
<b>B</b>	flexible	no	yes
<b>C</b>	flexible	yes	yes
<b>D</b>	stiff	yes	yes
<b>E</b>	flexible	yes	no

Which polymer would be best for making Jill's sports jacket?

Explain your choice.

.....

.....

.....

..... [2]

(b) Ethene is used to make a **polymer**.

Write down the name of this polymer.

..... [1]

[Total: 3]



5 The picture shows two feeding bottles for a baby.



These bottles have been painted with a special paint.

This paint contains a thermochromic pigment.

Explain why this paint has been used.

.....

.....

..... [2]

[Total: 2]

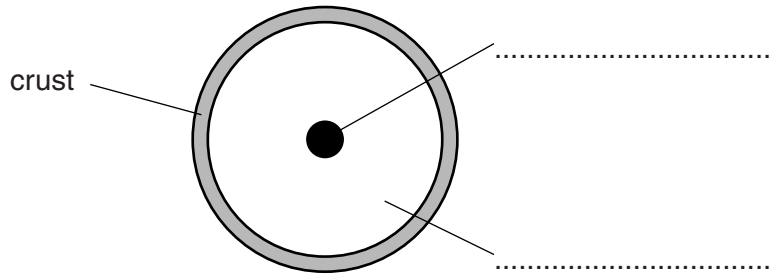
**Question 6 begins on page 11**

**10**  
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SECTION B – Module C2

6 Look at the diagram. It shows the structure of the Earth.



(a) Complete the labels on the diagram. [1]

(b) The surface of the Earth is made up of tectonic plates.

The tectonic plates move very slowly.

Write down what can happen when tectonic plates move.

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

(c) Lava and magma are both molten rock.

What is the difference between lava and magma?

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

[Total: 5]

7 A bottle contains a solution.



The label has fallen off the bottle.

Sophia wants to find out the pH of the solution in the bottle.

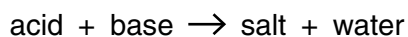
(a) Describe how she can do this.

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..... [2]

(b) An acid reacts with a base to make a salt and water.



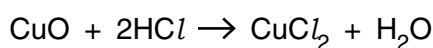
Look at the table. It shows some acids, bases and the salts made from them.

Acid	Base	Salt
sulfuric acid	copper oxide	copper sulfate
nitric acid	sodium carbonate	.....
.....	zinc oxide	zinc chloride
sulfuric acid	.....	magnesium sulfate

Complete the table.

[3]

(c) Look at the equation for a neutralisation reaction.



Write down the **formula** of one **product** of this reaction.

.....

[1]

(d) Many fertilisers are made by neutralisation.

Write about one **benefit** and one **problem** caused by using fertilisers.

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..... [2]

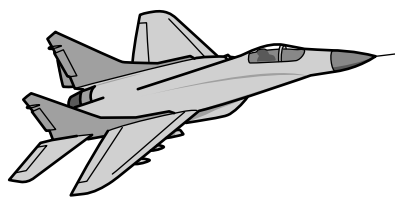
[Total: 8]

**Question 8 begins on page 14**

8 Look at the table. It gives information about the properties of some metals.

Metal	Melting point in °C	Density in g/cm <sup>3</sup>	Relative strength (1 = weak, 10 = strong)	Relative heat conductivity (1 = low, 10 = high)
<b>A</b>	1083	8.9	4.8	9.5
<b>B</b>	1660	4.5	6.4	8.6
<b>C</b>	420	7.1	4.3	9.0
<b>D</b>	1535	7.9	8.2	7.3

Look at the picture of an aircraft.



What properties of a metal would make it suitable for making the **body** and **wings** of this aircraft?

Which metal, **A**, **B**, **C** or **D**, would you choose and why?



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

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[Total: 6]

**15**  
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**Question 9 begins on page 16**  
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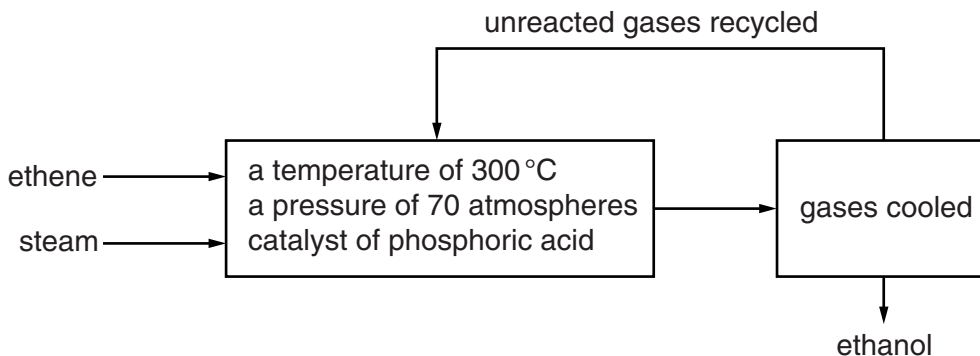
9 Ethanol (alcohol) is made by reacting ethene with steam.



(a) What is meant by the symbol  $\rightleftharpoons$  in the equation?

..... [1]

(b) Look at the flowchart.



Look at the table.

It gives some information about the percentage yield of ethanol at different temperatures and pressures.

Pressure in atmospheres	Percentage yield		
	200 °C	300 °C	400 °C
40	16	12	6
80	30	22	12
120	42	30	17
160	50	36	21

(i) What conditions give the **highest** percentage yield?

pressure ..... atmospheres

temperature ..... °C [1]

(ii) Suggest why a pressure of 70 atmospheres is used rather than the pressure you answered in part (i).

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



- (c) One cost in making ethanol is the cost of heating the equipment to 300°C and generating a pressure of 70 atmospheres.

Write about the **other** costs involved.

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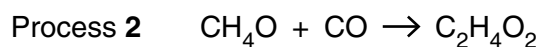
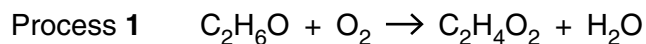
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[Total: 6]

**Question 10 begins on page 18**

## SECTION C – Module C3

10 Stowmarket Synthetics manufacture ethanoic acid,  $C_2H_4O_2$ , by two different processes.



Look at the table of relative formula masses.

Compound	Formula	Relative formula mass, $M_r$
ethanol	$C_2H_6O$	
oxygen	$O_2$	32
ethanoic acid	$C_2H_4O_2$	60
water	$H_2O$	18
methanol	$CH_4O$	32
carbon monoxide	$CO$	28

The relative atomic mass of H = 1, of C = 12, and of O = 16.

(a) Calculate the relative formula mass of ethanol,  $C_2H_6O$ .

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

relative formula mass = ..... [1]

(b) In process 2 Stowmarket Synthetics use 320 g of methanol.

They make 600 g of ethanoic acid.

What mass of carbon monoxide do they need?

.....  
 .....

mass of carbon monoxide = ..... g [1]

- (c) Stowmarket Synthetics know that the **atom economy** of a process is important.

Water is a waste product in process 1.

Show that the atom economy for making ethanoic acid by process 1 is 77%.

.....

.....

..... [2]

- (d) Stowmarket Synthetics also know that the **percentage yield** of a process is important.

The factory uses 5.2 tonnes of methanol in process 2.

A scientist predicts they should make 9.8 tonnes of ethanoic acid.

They actually make 9.5 tonnes of ethanoic acid.

Show that the percentage yield of ethanoic acid is 97%.

.....

.....

.....

..... [2]

- (e) Look at the table.

It gives information about the atom economy and percentage yield for making ethanoic acid.

Process	Atom economy (%)	Percentage yield (%)
1	77	85
2	100	97

Process 2 is a 'greener' process than process 1.

Explain why.

.....

..... [1]

[Total: 7]

11 Nitrogen molecules react with oxygen molecules.

Nitrogen monoxide molecules are made.

(a) Write down the **word** equation for the reaction between nitrogen and oxygen.

..... [1]

(b) The reaction is endothermic.

What is meant by the words **endothermic reaction**?

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

(c) Nitrogen molecules and oxygen molecules react extremely slowly, even at 200°C.

Write about the **different ways** in which the reaction between nitrogen and oxygen can be made faster and explain, using the reacting particle model, how one of these ways works.

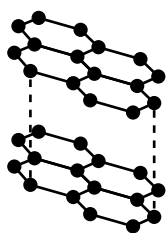


*The quality of written communication will be assessed in your answer to this question.*

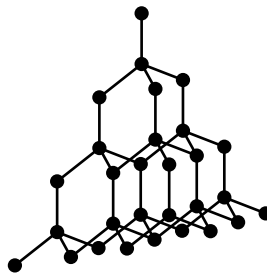
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.....  
..... [6]

[Total: 8]

12 Diamond and graphite are two forms of carbon.



graphite



diamond

(a) One of the physical properties of diamond is that it is colourless.

Describe some of the **other** physical properties of diamond.

.....

.....

..... [2]

(b) Graphite is used to make the electrodes for electrolysis.

Explain why.

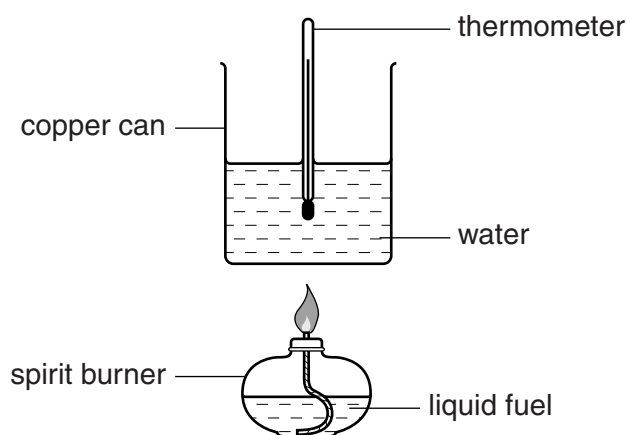
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..... [1]

[Total: 3]

- 13 Eva is investigating liquid fuels. She wants to find out which liquid fuel gives out the most energy per gram.

Look at the apparatus she uses.

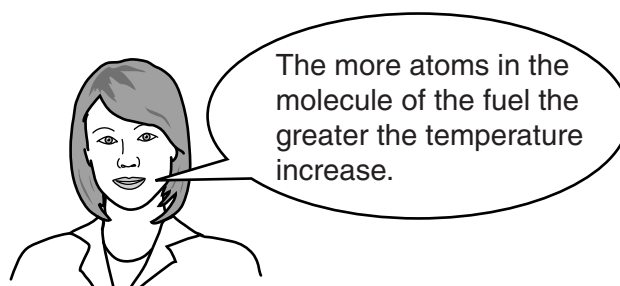


She heats 100 cm<sup>3</sup> of water.

Eva uses five liquid fuels.

Each time she burns 1.0 g of liquid fuel.

She makes a prediction.



Look at Eva's results.

Fuel	Molecular formula	Number of atoms in a molecule	Temperature of water before heating in °C	Temperature of water after heating in °C	Temperature increase in °C
methanol	CH <sub>4</sub> O	.....	20	29	9
ethanol	C <sub>2</sub> H <sub>6</sub> O	9	18	30	.....
propanol	C <sub>3</sub> H <sub>8</sub> O	12	18	32	.....
butanol	C <sub>4</sub> H <sub>10</sub> O	.....	18	34	16
pentanol	C <sub>5</sub> H <sub>12</sub> O	18	20	35	15

(a) Complete the table by putting in the missing values for:

- number of atoms in a molecule
- temperature increase.

[2]

(b) Do Eva's results support her prediction?

Explain your answer.

.....

.....

.....

..... [2]

[Total: 4]

**Question 14 begins on page 24**

14 Pharmaceutical drugs or medicines are often made in a **batch process**.

(a) What is the difference between a batch process and a continuous process?

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

(b) Pharmaceutical drugs are tested thoroughly before they can be licensed and sold.

Explain why.

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

[Total: 3]

**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>C</b> carbon 6	13 <b>Al</b> aluminium 13	14 <b>N</b> nitrogen 7	15 <b>O</b> oxygen 8	16 <b>F</b> fluorine 9	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>Ti</b> titanium 22	25 <b>V</b> vanadium 23	26 <b>Cr</b> chromium 24	27 <b>Mn</b> manganese 25	28 <b>Fe</b> iron 26	29 <b>Co</b> cobalt 27	30 <b>Ni</b> nickel 28	31 <b>Cu</b> copper 29	32 <b>Zn</b> zinc 30	35.5 <b>Cl</b> chlorine 17	36 <b>Kr</b> krypton 36
	37 <b>Rb</b> rubidium 37	38 <b>Sr</b> strontium 38	39 <b>Y</b> yttrium 39	40 <b>Zr</b> zirconium 40	41 <b>Nb</b> niobium 41	42 <b>Mo</b> molybdenum 42	43 <b>Tc</b> technetium [98]	44 <b>Ru</b> ruthenium 44	45 <b>Rh</b> rhodium 45	46 <b>Pd</b> palladium 46	47 <b>Ag</b> silver 47	48 <b>Cd</b> cadmium 48	53 <b>I</b> iodine 53	54 <b>Xe</b> xenon 54
	55 <b>Cs</b> caesium 55	56 <b>Ba</b> barium 56	57 <b>La*</b> lanthanum 57	72 <b>Hf</b> hafnium 72	73 <b>Ta</b> tantalum 73	74 <b>W</b> tungsten 74	75 <b>Re</b> rhenium 75	76 <b>Os</b> osmium 76	77 <b>Ir</b> iridium 77	78 <b>Pt</b> platinum 78	79 <b>Au</b> gold 79	80 <b>Hg</b> mercury 80	85 <b>At</b> astatine 85	[222] <b>Rn</b> radon 86
	[223] <b>Fr</b> francium 87	[226] <b>Ra</b> radium 88	[227] <b>Ac*</b> actinium 89	[261] <b>Rf</b> rutherfordium 104	[262] <b>Db</b> dubnium 105	[266] <b>Sg</b> seaborgium 106	[264] <b>Bh</b> bohrium 107	[277] <b>Hs</b> hassium 108	[268] <b>Mt</b> meitnerium 109	[271] <b>Ds</b> darmstadtium 110	[272] <b>Rg</b> roentgenium 111	Elements with atomic numbers 112-116 have been reported but not fully authenticated		

1	<b>H</b> 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.