

Thursday 17 January 2013 – 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

- 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 **20** pages. Any blank pages are indicated.

Answer **all** the questions.

SECTION A – Module C1

1 This question is about fuels.

(a) Crude oil is a fossil fuel.

Crude oil is being used up faster than it is being made.

Write about the problems this will cause in the future.

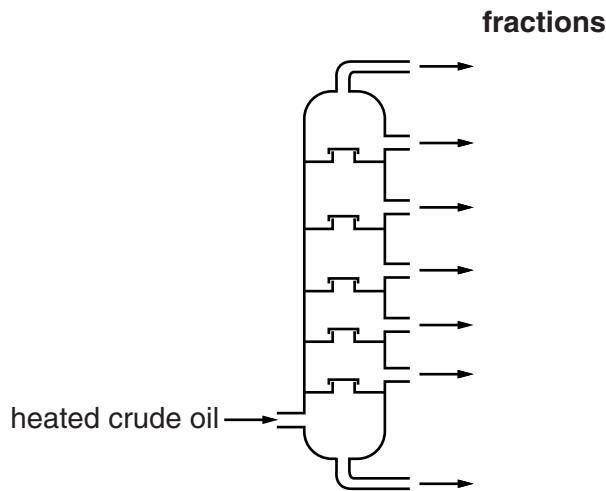
.....

.....

..... [2]

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

The diagram shows a fractionating column.



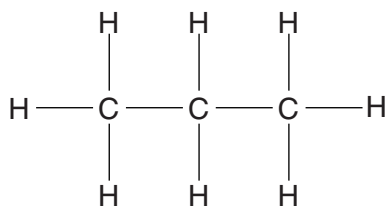
Look at the table. It shows the boiling point range for some of the fractions.

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

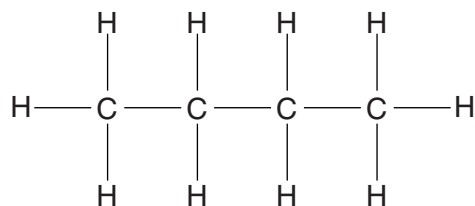
Write down the name of the fraction which 'exits' from the **bottom** of the fractionating column.

..... [1]

(c) LPG contains propane and butane.



propane



butane

(i) Write down the **molecular formula** 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: 7]

2 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?
A	stiff	no	yes
B	flexible	no	yes
C	flexible	yes	yes
D	stiff	yes	yes
E	flexible	yes	no

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

Explain your choice.

.....

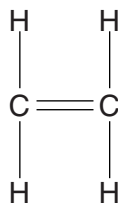
.....

.....

..... [2]

[Total: 2]

3 Look at the displayed formula of ethene.



(a) Why is ethene described as **unsaturated**?

..... [1]

(b) Bromine water is used to test for an alkene.

Ethene decolourises bromine water.

(i) What type of reaction is this?

..... [1]

(ii) What type of compound is formed in this reaction?

..... [1]

(c) Poly(ethene) is used to make plastic bags.

Draw the displayed formula of poly(ethene).

[2]

[Total: 5]

4 Perfumes, flavourings and nail varnish remover all contain an ester.

Esters are flammable.

Describe how to do a simple experiment to make an ester including an explanation of the safety precautions you should take.



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

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [6]

[Total: 6]

5 This question is about foods.

(a) Mayonnaise is made by mixing oil, water and egg yolk.

Egg yolk acts as an emulsifier and stops the oil and water from separating.

Look at the diagram.

It shows a molecule of an emulsifier.



Explain how the emulsifier stops oil and water from separating.

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

(b) When eggs are cooked, a chemical change happens.

Explain why the texture of the egg changes during this chemical change.

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

(c) Baking powder is used to make cakes rise.

Baking powder contains sodium hydrogencarbonate.

Sodium hydrogencarbonate decomposes when it is heated.

Write the **balanced symbol** equation for the decomposition of sodium hydrogencarbonate.

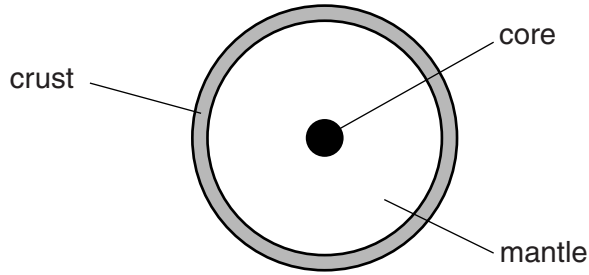
..... [2]

[Total: 5]

PLEASE DO NOT WRITE ON THIS PAGE

SECTION B – Module C2

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



(a) The **lithosphere** is part of the structure of the Earth.

What is the lithosphere?

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

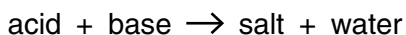
(b) Scientists study volcanoes.

Explain why.

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

[Total: 4]

7 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

(a) Complete the table. [3]

(b) Hydrochloric acid, HCl , reacts with calcium carbonate, CaCO_3 .

Calcium chloride, CaCl_2 , carbon dioxide and water are made.

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

..... [2]

(c) Acids contain hydrogen ions, H^+ . Alkalis contain hydroxide ions, OH^- .

Write the **ionic** equation for neutralisation.

..... [1]

(d) Many fertilisers are made by neutralisation.

Fertilisers can cause **eutrophication**.

Explain what happens during eutrophication.

.....

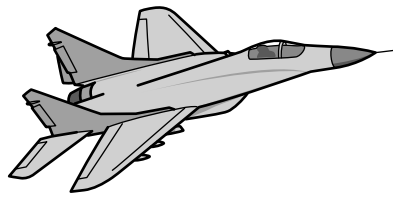
 [3]

[Total: 9]

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

Metal	Melting point in °C	Density in g/cm ³	Relative strength (1 = weak, 10 = strong)	Relative heat conductivity (1 = low, 10 = high)	Cost per tonne in £
A	1660	4.5	6.4	8.6	5000
B	420	7.1	4.3	9.0	870
C	1535	7.9	8.2	7.3	400

Look at the picture of a military aircraft. Only small numbers of these aircraft are made.



Evaluate the advantages and disadvantages of each metal for making the **body** and **wings** of this military aircraft. Which metal, **A**, **B** or **C**, would you choose and why?



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

.....

.....

.....

.....

.....

.....

.....

.....

.....

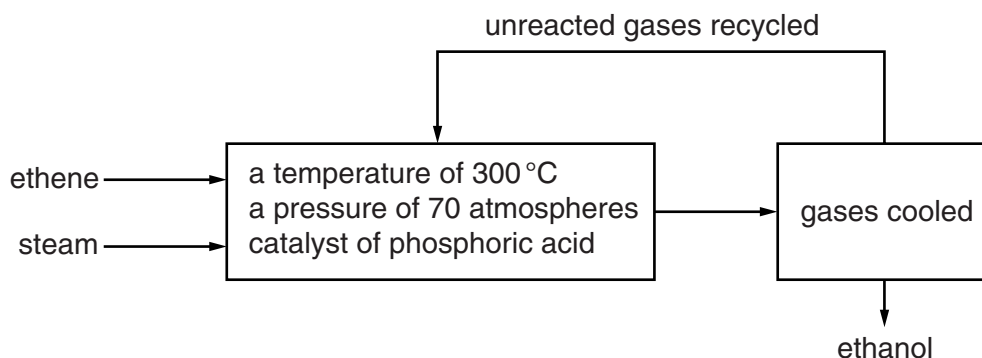
..... [6]

[Total: 6]

- 9 Ethanol (alcohol) is made by reacting ethene with steam.



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

- (a) (i) What happens to the percentage yield as the **pressure** increases?

..... [1]

- (ii) What happens to the percentage yield as the **temperature** increases?

..... [1]

(b) The highest percentage yield is achieved with a temperature of 200°C and 160 atmospheres.

The actual conditions used to make ethanol are:

- catalyst of phosphoric(V) acid
- a pressure of 70 atmospheres
- a temperature of 300°C.

Use ideas about percentage yield and rate of reaction to suggest why each condition is used.

.....

.....

.....

.....

.....

.....

.....

..... [3]

(c) This process is automated.

Explain why automation is used.

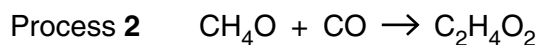
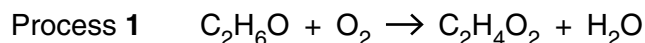
.....

..... [1]

[Total: 6]

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	46
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) In process 2, Stowmarket Synthetics use 320g of methanol.

Calculate the maximum mass of ethanoic acid that can be made.

.....

.....

.....

..... [2]

(b) 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]

- (c) 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]

- (d) 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** has a higher atom economy and a higher percentage yield.

- (i) Explain one advantage, other than cost, of a very high atom economy.

.....

..... [1]

- (ii) Explain one advantage, other than cost, of a very high percentage yield.

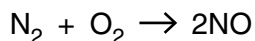
.....

..... [1]

[Total: 8]

- 11 Nitrogen molecules react with oxygen molecules.

Nitrogen monoxide molecules are made.



The reaction is endothermic.

- (a) Explain, in terms of bond breaking and bond making, why this reaction is endothermic.

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

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

The reaction between nitrogen and oxygen becomes faster as both the temperature and the pressure increase.

Explain why, using the reacting particle model.



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

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

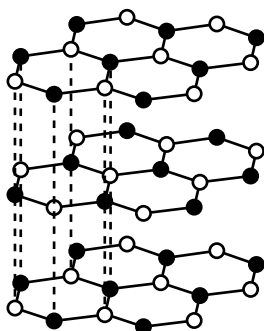
[Total: 9]

12 Boron nitride, BN, exists in two physical forms.

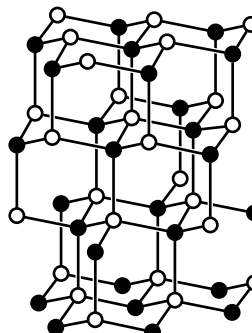
The structures of these forms are shown below.

Key

- boron
- nitrogen



structure A



structure B

These two forms of boron nitride resemble graphite and diamond, the two allotropes of carbon.

(a) Boron nitride, with structure A, is slippery.

Explain why, in terms of structure and bonding.

.....

.....

..... [2]

(b) Boron nitride, with structure B, has a very high melting point.

Explain why, in terms of structure and bonding.

.....

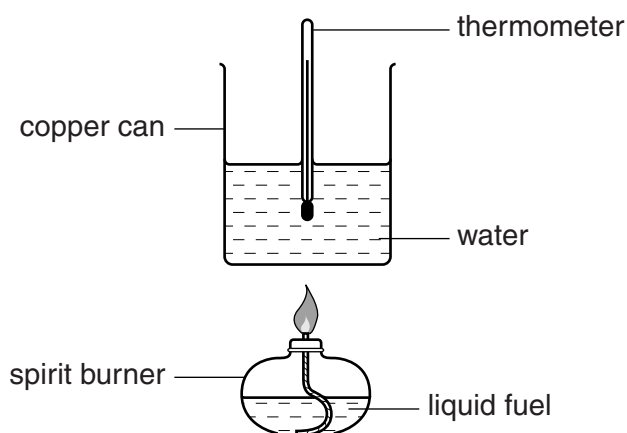
.....

..... [2]

[Total: 4]

- 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.

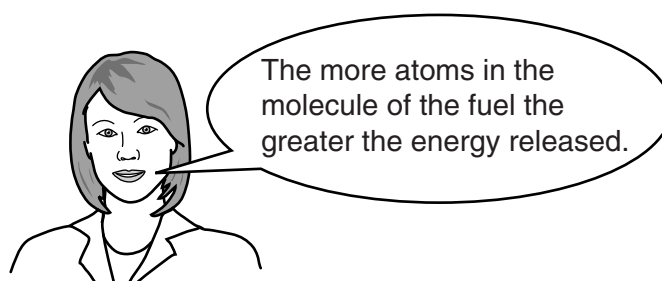


She heats 100 cm³ of water.

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 ₄ O	6	20	29	9
ethanol	C ₂ H ₆ O	9	18	30	12
propanol	C ₃ H ₈ O	12	18	32	14
butanol	C ₄ H ₁₀ O	15	18	34	16
pentanol	C ₅ H ₁₂ O	18	20	35	15

The energy released is given by the equation

$$\text{energy} = \text{mass} \times \text{specific heat capacity} \times \text{temperature change}$$

where specific heat capacity of water = 4.2 J/g °C.

(a) Calculate the energy released by methanol.

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

energy released = J [2]

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

Explain your answer.

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

[Total: 4]

END OF QUESTION PAPER



Copyright Information

OCR is committed to seeking permission to reproduce all third-party content that it uses in its assessment materials. OCR has attempted to identify and contact all copyright holders whose work is used in this paper. To avoid the issue of disclosure of answer-related information to candidates, all copyright acknowledgements are reproduced in the OCR Copyright Acknowledgements Booklet. This is produced for each series of examinations and is freely available to download from our public website (www.ocr.org.uk) after the live examination series.

If OCR has unwittingly failed to correctly acknowledge or clear any third-party content in this assessment material, OCR will be happy to correct its mistake at the earliest possible opportunity.

For queries or further information please contact the Copyright Team, First Floor, 9 Hills Road, Cambridge CB2 1GE.

OCR is part of the Cambridge Assessment Group; Cambridge Assessment is the brand name of University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.

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 Si silicon 14	15 P phosphorus 15	16 S sulfur 16	17 Cl chlorine 17	18 Ar argon 18								
	19 K potassium 19	20 Ca calcium 20	23 Sc scandium 21	24 Ti titanium 22	25 V vanadium 23	26 Cr chromium 24	27 Mn manganese 25	28 Fe iron 26	29 Co cobalt 27	30 Ni nickel 28	31 Cu copper 29	32 Zn zinc 30	33 Ga gallium 31	34 Ge germanium 32	35 As arsenic 33	36 Se selenium 34	37 Br bromine 35	38 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.