

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
GCSE
B741/02

GATEWAY SCIENCE
CHEMISTRY B
Chemistry modules C1, C2, C3
(Higher Tier)

THURSDAY 17 JANUARY 2013: Afternoon

DURATION: 1 hour 15 minutes
plus your additional time allowance

MODIFIED ENLARGED 18pt

Candidate forename		Candidate surname	
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Centre number						Candidate number				
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Candidates answer on the Question Paper.
A calculator may be used for this paper.

OCR SUPPLIED MATERIALS:

Periodic Table (inserted)

OTHER MATERIALS REQUIRED:

Pencil


Ruler (cm/mm)

READ INSTRUCTIONS OVERLEAF

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes on the first page. 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).

INFORMATION FOR CANDIDATES

- Your quality of written communication is assessed in questions marked with a pencil ()
- An enlarged copy of the Periodic Table is inserted.
- 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.

Answer ALL the questions.

SECTION A – MODULE C1

1 This question is about fuels.

(a) Crude oil is a fossil fuel.

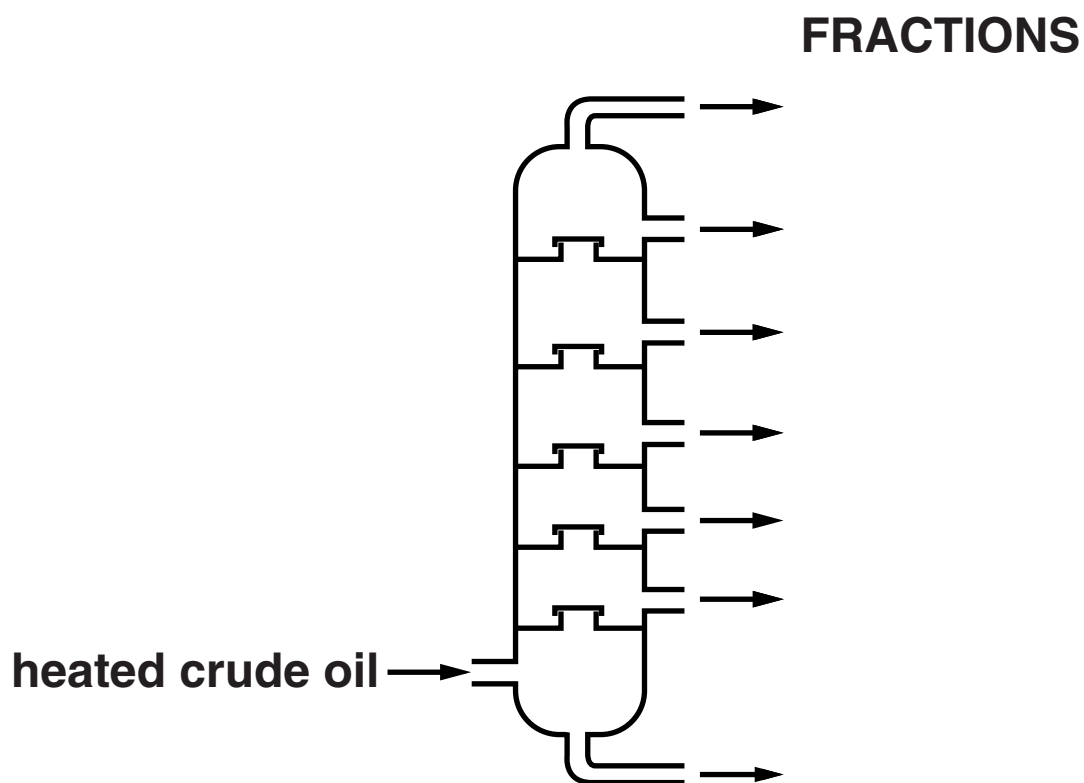
Crude oil is being used up faster than it is being made.

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.



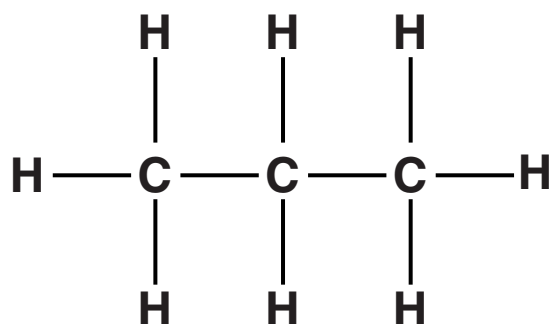
Look at the table. It shows the boiling point range for some of the fractions.

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

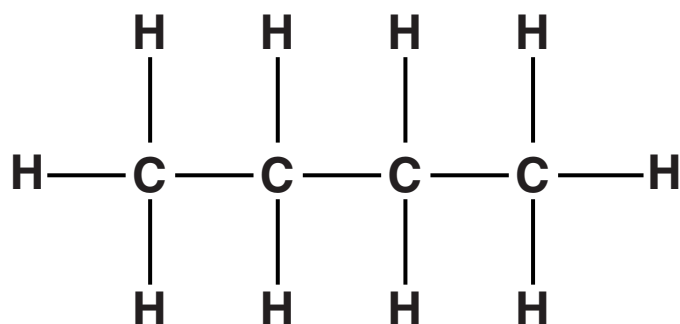
Write down the name of the fraction which ‘exits’ from the BOTTOM of the fractionating column.

_____ [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]

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2 Jill wants to buy a sports jacket that she can wear IN ALL WEATHERS.

Look at the information (opposite) about polymers A, B, C, D and E.

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

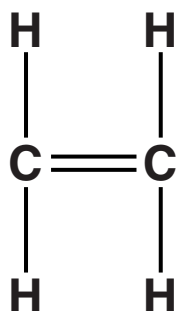
Explain your choice.

[2]

[TOTAL: 2]

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

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.

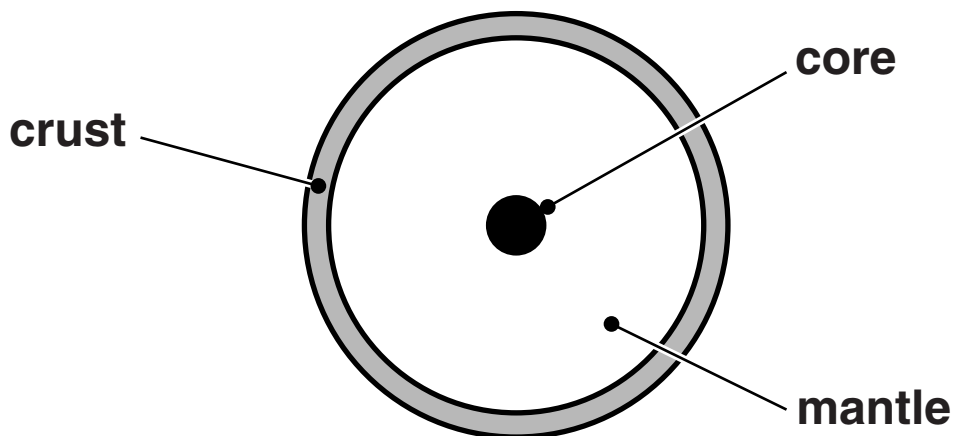
Write the BALANCED SYMBOL equation for the decomposition of sodium hydrogencarbonate.

_____ [2]

[TOTAL: 5]

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]

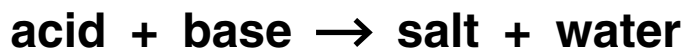
- (b) Scientists study volcanoes.

Explain why.

[2]

[TOTAL: 4]

7 An acid reacts with a base to make a salt and water.



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

(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]

ACID	BASE	SALT
sulfuric acid	copper oxide	copper sulfate
nitric acid	sodium carbonate	_____
_____	zinc oxide	zinc chloride
sulfuric acid	_____	magnesium sulfate

(d) Many fertilisers are made by neutralisation.

Fertilisers can cause EUTROPHICATION.

Explain what happens during eutrophication.

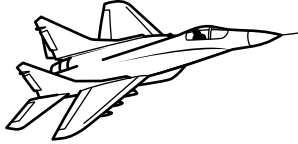
[3]

[TOTAL: 9]

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- 8 Look at the table (opposite). It gives information about the properties of some metals.**

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]

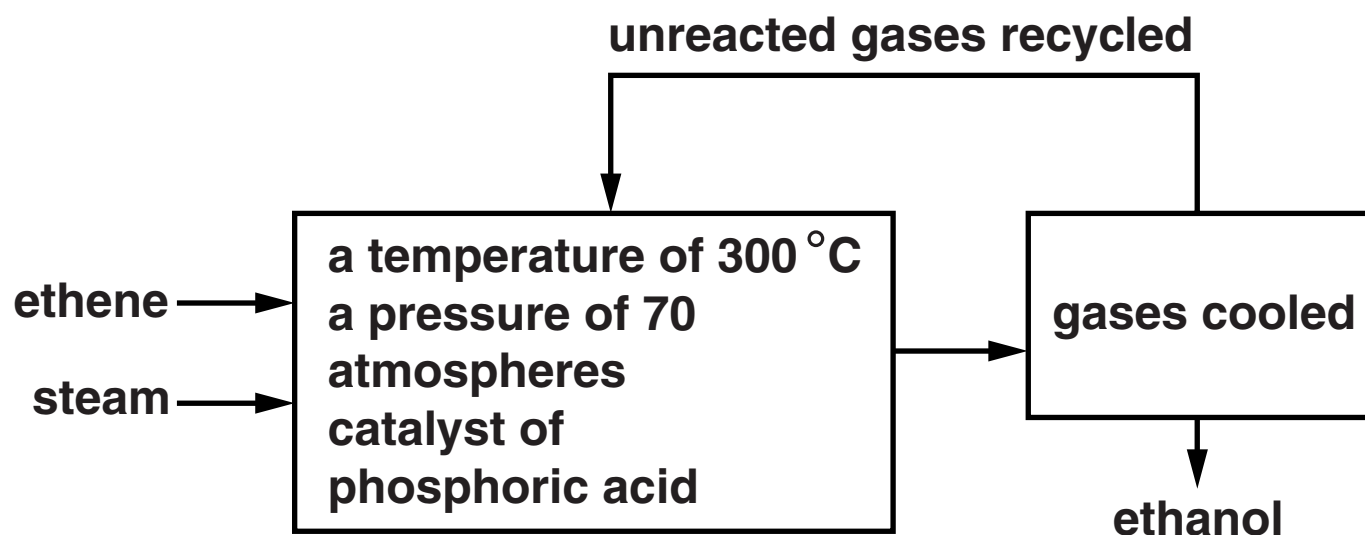
[TOTAL: 6]

METAL	MELTING POINT IN °C	DENSITY IN g/cm³	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

- 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.

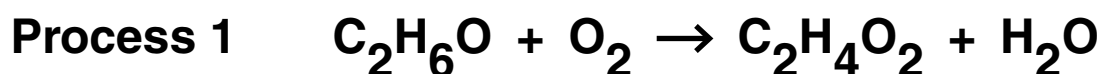
[1]

[TOTAL: 6]

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SECTION C – MODULE C3

10 Stowmarket Synthetics manufacture ethanoic acid, $\text{C}_2\text{H}_4\text{O}_2$, by two different processes.



Look at the table of relative formula masses.

COMPOUND	FORMULA	RELATIVE FORMULA MASS, M_r
ethanol	$\text{C}_2\text{H}_6\text{O}$	46
oxygen	O_2	32
ethanoic acid	$\text{C}_2\text{H}_4\text{O}_2$	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 320 g 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]**

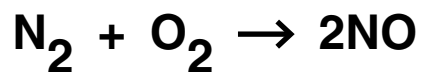
(ii) Explain one advantage, other than cost, of a very high percentage yield.

_____ **[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]

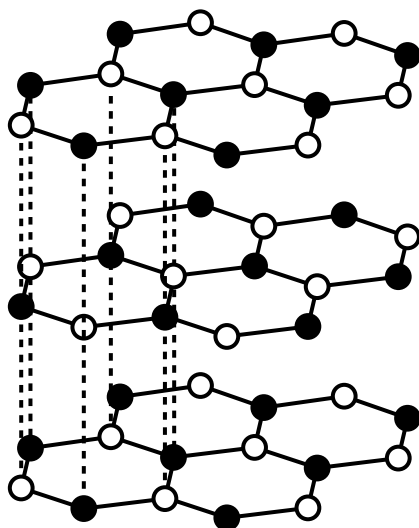
12 Boron nitride, BN, exists in two physical forms.

The structures of these forms are shown below.

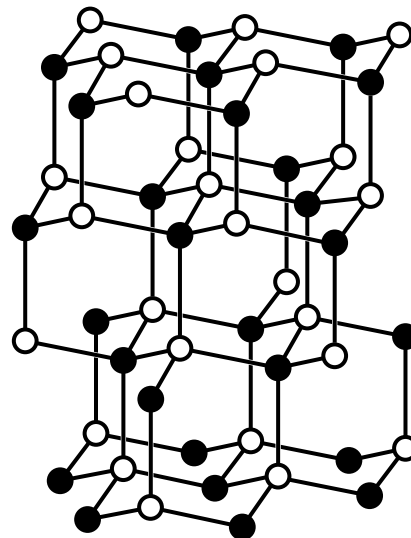
KEY

● 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.

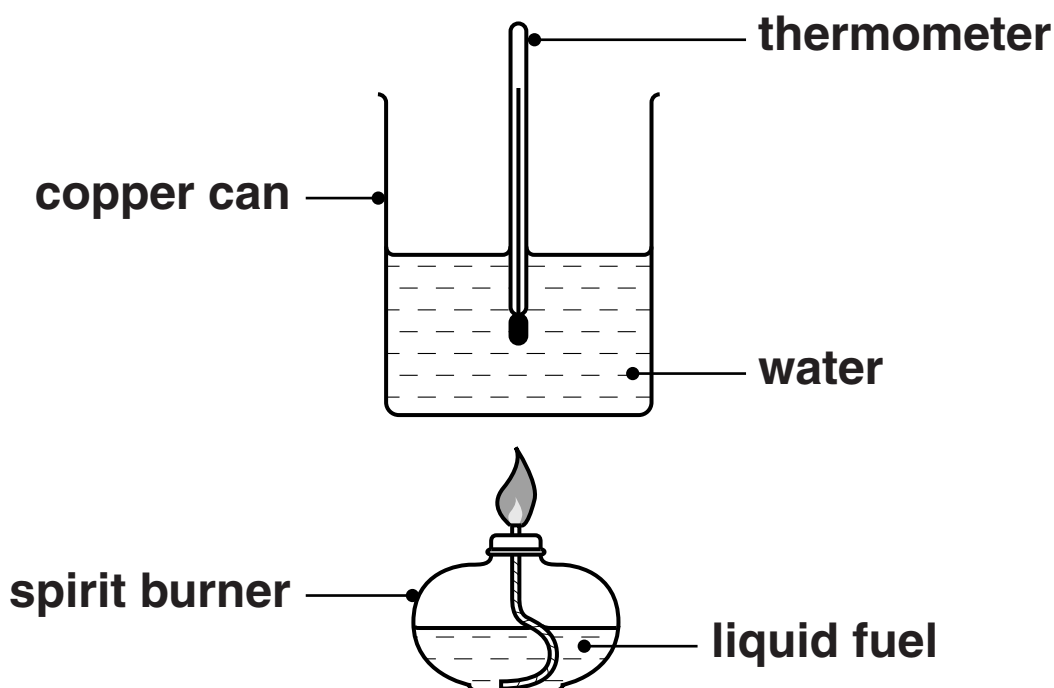
Explain why, in terms of structure and bonding.

[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 cm^3 of water.

Eva uses five liquid fuels.

Each time she burns 1.0 g of liquid fuel.

She makes a prediction.

The more atoms in the molecule of the fuel the greater the energy released.

Look at Eva's results (opposite).

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	CH₄O	6	20	29	9
ethanol	C₂H₆O	9	18	30	12
propanol	C₃H₈O	12	18	32	14
butanol	C₄H₁₀O	15	18	34	16
pentanol	C₅H₁₂O	18	20	35	15

The energy released is given by the equation

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

where specific heat capacity of water = $4.2 \text{ J/g } ^\circ\text{C}$.

(a) Calculate the energy released by methanol.

energy released = _____ J [2]

(b) Do Eva's results (page 35) support her prediction?

Explain your answer.

[TOTAL: 4]

END OF QUESTION PAPER

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