OCR
Oxford Cambridge and RSA

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Friday 5 June 2015 – 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 *

* 5 0 6 7 5 7 1 4 9 8 *

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 some of the hydrocarbons found in crude oil.

The table shows some information about four of these hydrocarbons.

Hydrocarbon	Molecular formula	Fraction of crude oil that contains the hydrocarbon	Melting point in °C	Boiling point in °C	Density in g/cm^3
propane	C_3H_8	liquefied petroleum gases	–188	–42	0.002
hexane	C_6H_{14}	petrol	–95	68	0.66
decane	$C_{10}H_{22}$	paraffin	–30	174	0.73
hexadecane	$C_{16}H_{34}$	diesel	18	287	0.77

(a) Propane is a **hydrocarbon**.

What is meant by a hydrocarbon?

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

(b) Propane is a saturated compound.

What is meant by a **saturated** compound?

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

(c) A mixture of hexane, decane and hexadecane can be separated by fractional distillation.

Explain why. Use ideas about intermolecular forces and information from the table.

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

(d) Hexane is one of the hydrocarbons found in petrol.

Hexane completely burns in excess air.

Look at the symbol equation for this reaction.

Balance the equation by putting numbers in the boxes.

$$\boxed{2}\ C_6H_{14} + \boxed{\ldots\ldots}\ O_2 \rightarrow \boxed{\ldots\ldots}\ CO_2 + \boxed{\ldots\ldots}\ H_2O$$

[2]

(e) Hexane burns in a limited supply of oxygen.

Incomplete combustion happens.

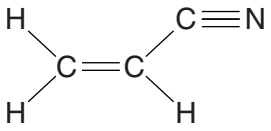
Write a **word equation** for the **incomplete** combustion of hexane.

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

2 Stowmarket Synthetics is a chemical company that makes polymers.

They make a polymer from a monomer called propenenitrile.

Look at the displayed formula for the monomer propenenitrile.



(a) How many covalent bonds are shown in the displayed formula of propenenitrile?

Tick (✓) the correct box.

three	☐
four	☐
five	☐
eight	☐
nine	☐

[1]

(b) Stowmarket Synthetics also make a polymer that is used to make bottles for fizzy drinks.

The polymer they use has a low melting point.

Suggest, with reasons, **two other** properties of the polymer that make it suitable for use as a bottle for fizzy drinks.

Use a simple model of the structure of the polymer to explain why it has a low melting point.

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

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

3 Some foods contain additives.

An emulsifier stops oil and water in a food from separating.

(a) Phil finds some information about four substances.

Look at this information.

Substance	Is it poisonous?	Does it have a smell?	Cost of making 1g of substance in pence	Does it stop oil and water from separating?
A	yes	no	3	yes
B	no	no	6	yes
C	no	no	1	no
D	no	yes	5	yes

Which substance is the most suitable to be used as an emulsifier in food?

Explain your answer.

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

(b) A processed food contains an emulsifier.

(i) Draw a diagram of an emulsifier molecule.

Label the **two** important parts of the molecule.

[2]

(ii) The processed food also contains cooked potato.

Potato is easier to digest when it is cooked rather than raw.

Explain why.

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

4 Cosmetics such as perfumes must be tested to ensure they are safe to use.

Many scientists believe that cosmetics should not be tested on animals.

In the EU the testing of cosmetics on animals has been banned.

Explain why.

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

SECTION B – Module C2

5 This question is about construction materials.

(a) Cement is used in the construction of buildings.

Cement is made when **two** substances are heated together.

Which two?

Put a tick (✓) in the correct box.

sand and water	☐
limestone and sand	☐
limestone and clay	☐
limestone and granite	☐
sand and clay	☐

[1]

(b) Concrete is another construction material.

Concrete is quite strong.

It is reinforced using a mesh of steel rods.

This is called **reinforced concrete**.

(i) Reinforced concrete is a better construction material for making bridges than non-reinforced concrete.

Explain why.

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

(ii) Look at the table.

It gives some information about three types of steel used to reinforce concrete.

Type of steel	Relative strength	Density in g/cm^3	Cost of 1 m × 2 m mesh	Resistance to corrosion	Other properties
A	386	7.85	£26.99	limited	easily shaped
B	414	7.90	£40.35	limited	hard, more difficult to shape
C	515	7.80	£50.52	very good	easily shaped

Which type of steel would be best to reinforce concrete?

Use information from the table to suggest why.

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

6 Martin investigates the corrosion of different metals and alloys.

He places pieces of the metals or alloys in different concentrations of sulfuric acid.

He does his experiment at three different temperatures.

Look at his results.

Temperature in °C	Sulfuric acid concentration in %	Resistance to corrosion		
		Niobium	Zirconium	Hastelloy
20	10	excellent	excellent	poor
	40	excellent	excellent	good
	70	excellent	excellent	excellent
	90	good	poor	excellent
40	10	poor	excellent	poor
	40	poor	excellent	poor
	70	poor	excellent	poor
	90	poor	poor	poor
60	10	poor	excellent	poor
	40	poor	excellent	poor
	70	poor	good	poor
	90	poor	poor	poor

(a) Martin concludes that:

- all three metals or alloys are more resistant to corrosion at lower concentrations of sulfuric acid
- all three metals or alloys are more resistant to corrosion at lower temperatures.

Is he correct?

Use information from the table to explain your answer.

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

(b) Martin does another experiment.

He investigates how the pH of an acid affects the rate of corrosion of one alloy.

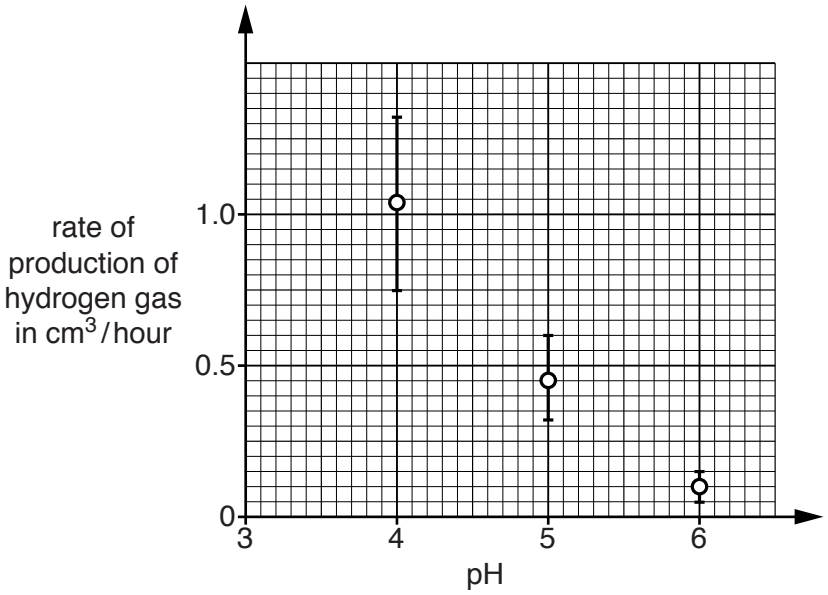
The alloy reacts with the acid to produce hydrogen gas.

Martin measures the rate at which the hydrogen gas is made.

He does this at three different pH values.

He repeats his experiment five times at each pH and then plots a graph of his results.

Look at his graph.



(i) What was the **highest** rate of production of hydrogen gas that Martin measured at pH 5?

answer ..... cm^3/hour **[1]**

(ii) At which pH did Martin get the most **repeatable** results?

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

(c) Aluminium, A*l*, reacts with sulfuric acid, H_2SO_4.

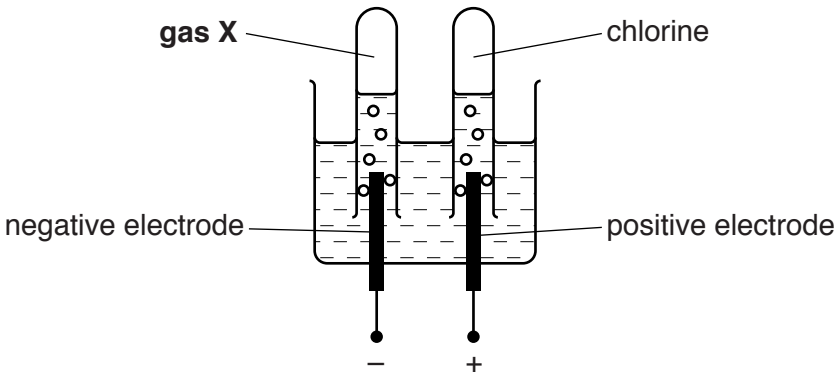
Aluminium sulfate, $Al_2(SO_4)_3$, and hydrogen, H_2, are made.

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

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

7 Anita investigates the electrolysis of concentrated sodium chloride solution (brine).

Look at the diagram. It shows the apparatus she uses.



(a) What is the name of gas **X**?

Choose your answer from the list.

carbon dioxide

hydrogen

hydrogen chloride

oxygen

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

(b) It is important to use **inert electrodes** in the electrolysis of sodium chloride solution.

Explain why.

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

(c) During the electrolysis of sodium chloride solution, the chloride ions are turned into chlorine molecules.

(i) Complete the equation for this reaction.

..... Cl^- — ..... e^- $\rightarrow$ Cl_2 **[1]**

(ii) Is this reaction **oxidation** or **reduction**?

Explain how you can tell from the equation.

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

8 This question is about fertilisers.

(a) Farmers add fertilisers to the soil.

Some people think that farmers should not use fertilisers.

Write down a reason **for** and a reason **against** the use of fertilisers.

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

(b) Ammonium phosphate, $(NH_4)_3PO_4$, is a fertiliser.

(i) Complete the table to show the number of each **type of atom** in the formula $(NH_4)_3PO_4$.

Atom	Number
N	.....
H	.....
P	.....
O	.....

[2]

(ii) Ammonium phosphate solution is made by reacting an acid with an alkali in a **neutralisation** reaction.

Describe how pure, dry crystals of ammonium phosphate can be made, including the names of the **acid** and **alkali** needed.

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

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

SECTION C – Module C3

9 Hydrogen peroxide, H_2O_2, is used in some spacecraft to provide oxygen.

(a) Hydrogen peroxide can be made from hydrogen and oxygen.

$$H_2 + O_2 \rightarrow H_2O_2$$

(i) This reaction has a 100% atom economy.

Explain how you can tell from the equation.

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

(ii) Industrial chemical processes should have as high an atom economy as possible.

Explain **two** reasons why.

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

(b) Oskar uses 100 g of hydrogen.

(i) Show that the predicted yield of hydrogen peroxide is 1700 g.

$$H_2 + O_2 \rightarrow H_2O_2$$

The relative formula mass, M_r, of H_2 = 2, of O_2 = 32 and of H_2O_2 = 34.

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

(ii) Oskar's actual yield of hydrogen peroxide is 1530 g.

He predicts he should make 1700 g of hydrogen peroxide.

Calculate Oskar's percentage yield of hydrogen peroxide.

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

(c) Hydrogen peroxide can also be made from barium peroxide.

barium peroxide + sulfuric acid → hydrogen peroxide + barium sulfate

BaO_2 + H_2SO_4 → H_2O_2 + $BaSO_4$

The table shows the relative formula masses, M_r, of the substances in the symbol equation.

Substance	Relative formula mass, M_r
BaO_2	169
H_2SO_4	98
H_2O_2	34
$BaSO_4$	233

Barium sulfate is a waste product in this reaction.

Calculate the atom economy for this reaction.

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

10 Fatimah investigates the reaction between sodium hydrogencarbonate and dilute hydrochloric acid.

She always adds 0.5 g of sodium hydrogencarbonate to 20 cm^3 of dilute hydrochloric acid.

She measures the time it takes for the reaction mixture to stop bubbling.

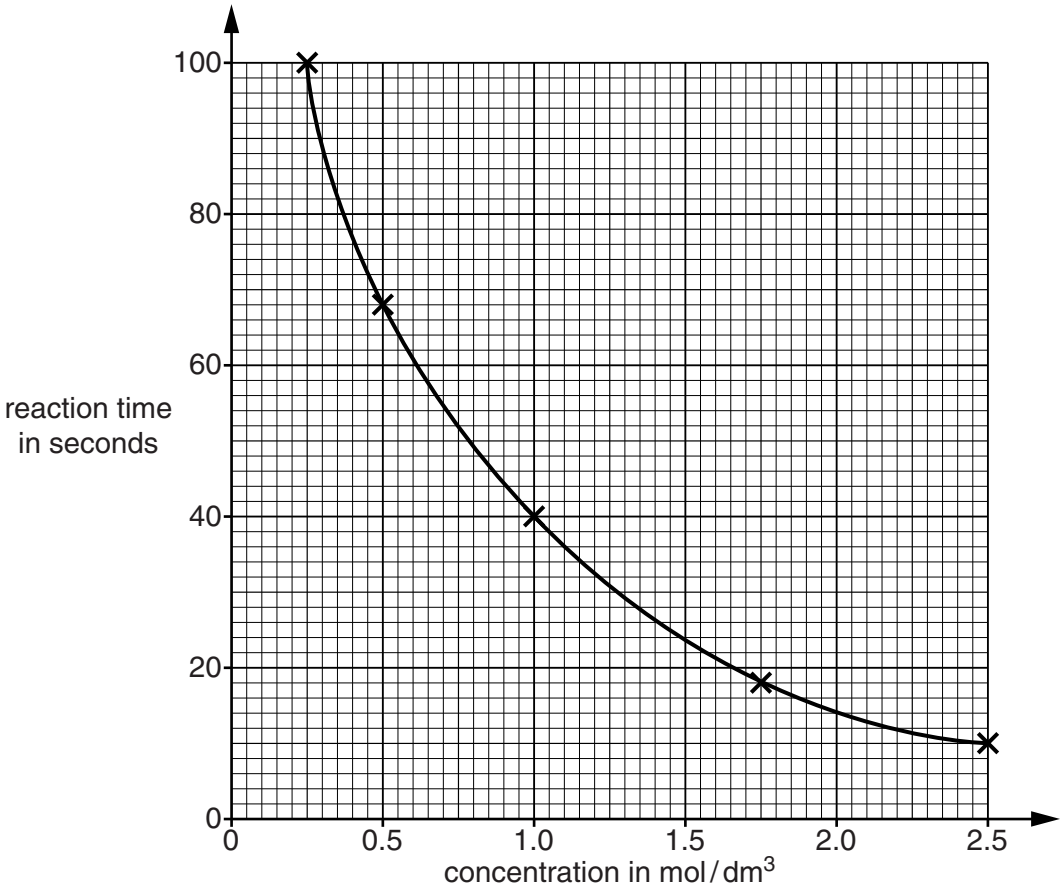
This is called the **reaction time**.

She does five different experiments.

She keeps the temperature the same.

Each experiment uses a **different concentration** of acid.

Look at a graph of her results.



Fatimah concludes that as the concentration of acid increases, the rate of reaction increases.

Explain, with a reason, whether the results support Fatimah's conclusion.

Use the reacting particle model to explain Fatimah's results.

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

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11 A pharmaceutical drug is made by a batch process.

(a) Write about **one** reason why pharmaceutical drugs are often made by a batch process.

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

(b) It is expensive to develop and manufacture a new pharmaceutical drug.

Explain why.

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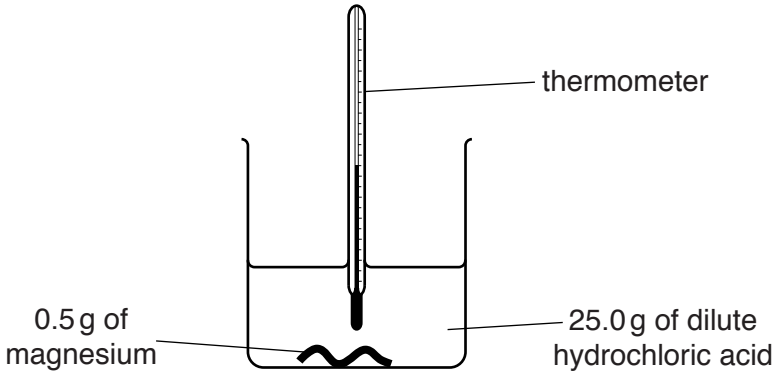
..... **[2]**

12 Sue investigates the reaction between magnesium ribbon and dilute hydrochloric acid.

Look at the apparatus she uses.



The temperature of the acid before the magnesium is added is 22.0 °C.

The energy released by the reaction can be calculated using the equation

energy released = mass of acid heated × specific heat capacity × temperature change

The specific heat capacity of the acid = 4.2 J / g °C

The energy released in Sue's experiment was 1600 J.

(a) Calculate the **final** temperature of the acid.

Quote your answer to **one** decimal place.

Final temperature of the acid is ..... °C **[3]**

(b) Energy is released in this reaction.

Explain why. Use ideas about bond breaking and bond making.

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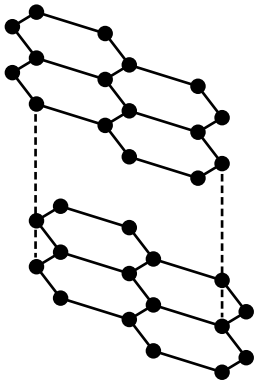
..... **[2]**

13 Graphite is a form of carbon.



(a) Graphite is used as a lubricant.

Write down **one** property of graphite that explains why it is used as a lubricant.

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

(b) Graphite conducts electricity.

Explain how. Use ideas about structure and bonding.

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

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE

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.