

THIS IS A NEW SPECIFICATION

**H**

Thursday 23 May 2013 – Morning

**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	
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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 **24** pages. Any blank pages are indicated.

2

Answer **all** the questions.**SECTION A – Module C1**

1 This question is about the gases in the air.

(a) Clean air is a mixture of gases.

Complete the table to show the percentage of gases in clean air.

Gas	Percentage
.....	78%
.....	21%
carbon dioxide	.....

[2]

(b) (i) Carbon monoxide and oxides of nitrogen are pollutants found in air.

Explain why it is important that atmospheric pollution is controlled.

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

(ii) Catalytic converters are fitted to cars to help reduce air pollution from carbon monoxide, CO, and nitrogen monoxide, NO.

What happens in a catalytic converter?

Include a **balanced symbol** equation in your answer.

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



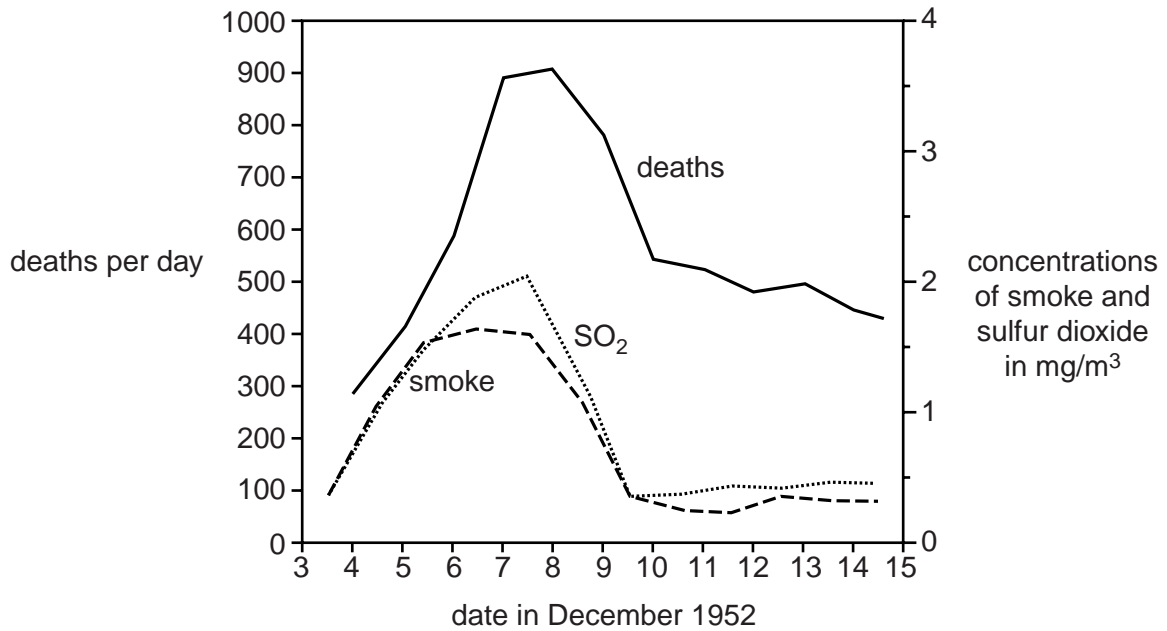
Air quality in the UK has improved over the last 60 years.

In December 1952, air pollution was so bad in London that sometimes people could not see their own feet.

Look at the graph.

It shows the number of deaths each day in London, between 3 December and 15 December 1952.

It also shows the concentrations of smoke and sulfur dioxide.



Describe the relationship between the number of deaths and the concentrations of smoke and sulfur dioxide.

.....

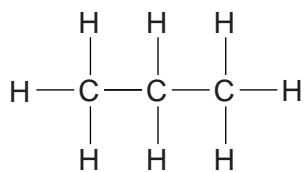
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..... [2]

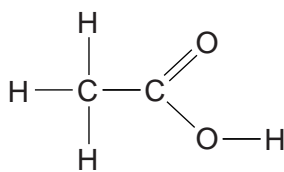
[Total: 9]

## 4

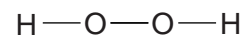
2 Look at the displayed formulas of some compounds.



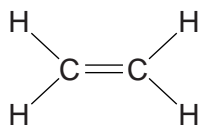
compound **A**



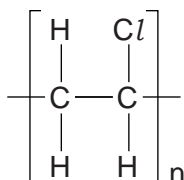
compound **B**



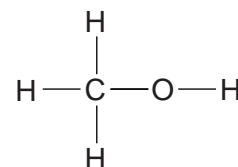
compound **C**



compound **D**



compound **E**



compound **F**

(a) Compound **F** is **not** a hydrocarbon.

Explain how you can tell from the displayed formula.

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

(b) Which compound is an **unsaturated** hydrocarbon?

Choose from **A, B, C, D, E** or **F**.

..... [1]

(c) Which compound is a **polymer**?

Choose from **A, B, C, D, E** or **F**.

..... [1]

(d) Compound **D** makes an addition polymer.

Draw the **displayed formula** of this addition polymer.

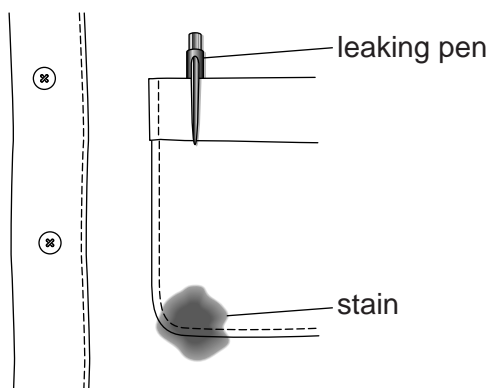
[1]

[Total: 4]

## 5

3 Chemicals called esters can be used as **solvents**.

Sarah investigates how good four different solvents are at removing a stain from cotton.



Look at her results.

Solvent	Percentage of stain removed		Effect on cotton
	At 40°C	At 60°C	
<b>A</b>	0%	35%	colour fades
<b>B</b>	10%	60%	none
<b>C</b>	85%	100%	cotton shrinks
<b>D</b>	75%	95%	none

(a) Which solvent is the most suitable for removing stains from cotton?

.....

Explain your choice.

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

(b) Sarah thinks her results do not provide sufficient evidence to make a firm conclusion.

Explain what further tests would help to make her conclusion more secure.

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

[Total: 4]

## 6

4 Fractional distillation separates crude oil into useful fractions.

The fractions have different boiling temperatures.

Look at the table.

It shows some information about fractions obtained from crude oil.

Fraction	Boiling temperature in °C
bitumen	above 350
LPG	less than 40
fuel oil	300 – 350
heating oil	250 – 300
petrol	40 – 200
paraffin	200 – 250

- (a) Use ideas about intermolecular forces to explain how fractional distillation separates crude oil into fractions and list the fractions in the position, from top to bottom, that they 'exit' the fractionating column.



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

.....

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..... [6]

7

(b) The LPG fraction contains propane gas,  $C_3H_8$ .

Write a **balanced symbol** equation for the **incomplete** combustion of propane in oxygen,  $O_2$ .

Only carbon monoxide, CO, and water are made.

..... [2]

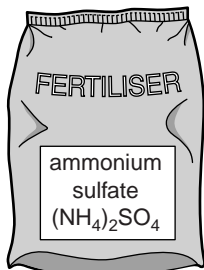
[Total: 8]

Question 5 begins on page 8

## SECTION B – Module C2

5 This question is about fertilisers.

(a) Ammonium sulfate is used as a fertiliser.



The formula for ammonium sulfate is  $(\text{NH}_4)_2\text{SO}_4$ .

(i) Write down the number of **different elements** in ammonium sulfate.

answer ..... [1]

(ii) Write down the number of **atoms** in this formula.

answer ..... [1]

(b) Amy and Chris decide to make some **solid ammonium sulfate** by neutralisation.

They use an acid and an alkali.

Name the acid and alkali they use and describe the experimental method they use.



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

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..... [6]

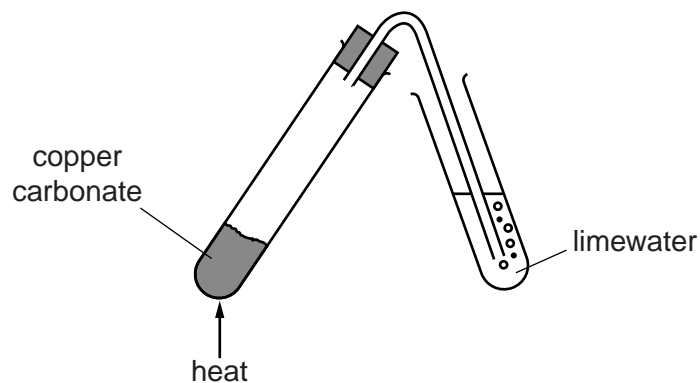
[Total: 8]



9

- 6 (a) (i) Sam investigates the action of heat on copper carbonate.

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



Look at the word equation for the reaction



This is a **thermal decomposition** reaction.

Explain why.

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

- (ii) Sam makes some copper.

Sam heats copper oxide, CuO, with carbon, C.

Copper, Cu, and carbon dioxide, CO<sub>2</sub>, are made.

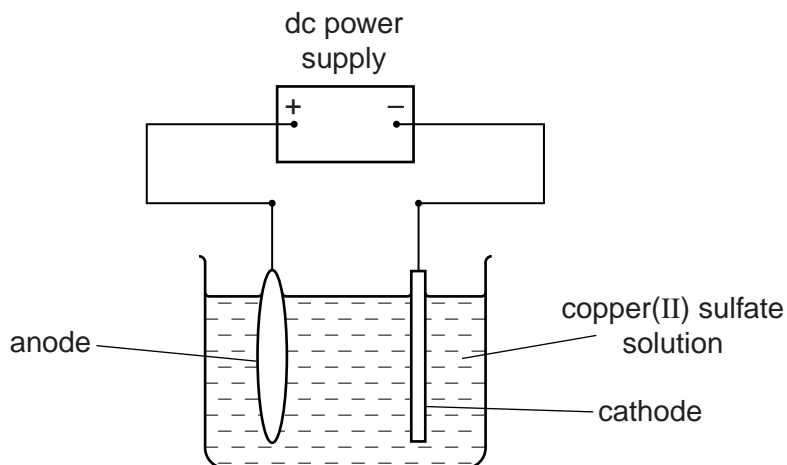
Write a **balanced symbol** equation for this reaction.

..... [2]

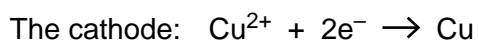
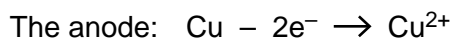
10

(b) The copper Sam makes is impure.

Look at the diagram. It shows the apparatus he uses to purify copper.



Look at the equations below for the electrode reactions.



(i) Which reaction is oxidation and which is reduction?

Explain why.

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

(ii) Use the electrode reactions to explain why the anode **loses** mass and the cathode **gains** mass.

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

(c) Explain one **advantage** and one **problem** of recycling copper.

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

11

(d) Look at the table. It shows some properties of three metals.

	Density in $\text{g/cm}^3$	Relative electrical conductivity (0 = low, 100 = high)	Relative strength (0 = weak, 1000 = very strong)	Corrosion in moist air	Cost per tonne in £
<b>Aluminium</b>	2.7	40	300	does not corrode	770
<b>Copper</b>	8.9	64	400	corrodes slowly	5900
<b>Iron</b>	7.9	11	600	corrodes	200

Look at the picture. It shows overhead power cables used by electric trains.



overhead  
power cables

Which metal would you choose to make the overhead power cables?

.....

Justify your answer.

Use the data in the table.

.....

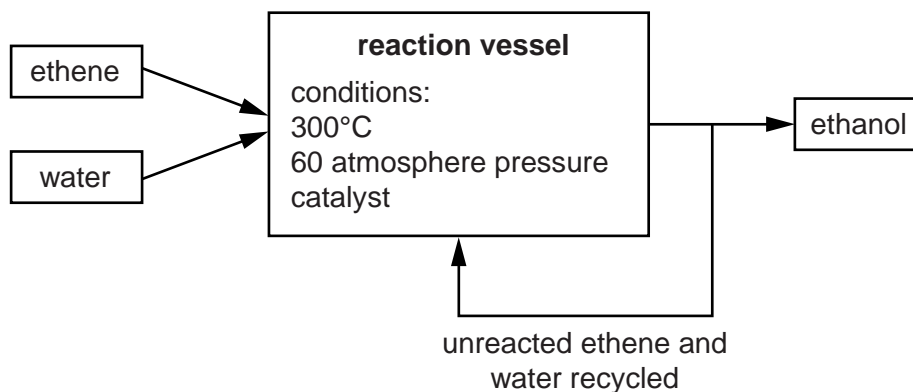
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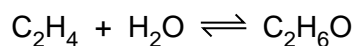
[Total: 11]

7 Ethanol can be made from ethene and water.

The flowchart shows this process.



The symbol equation for the reaction is:



The percentage of ethanol changes as the temperature and pressure change.

Look at the table.

It shows the percentage of ethanol at different temperatures and pressures.

Pressure in atmospheres	Percentage of ethanol (%)			
	At 100°C	At 200°C	At 300°C	At 400°C
20	15	10	5	2
40	20	15	10	5
60	40	30	20	10
80	60	50	40	20

(a) Which of the following conditions gives the **highest** percentage of ethanol?

- A high pressure with high temperature
- B high pressure with low temperature
- C low pressure with high temperature
- D low pressure with low temperature

Choose from **A**, **B**, **C** or **D**.

answer .....

[1]

13

(b) The conditions used for making **ethanol** are:

- 300°C
- 60 atmospheres pressure.

Suggest why these conditions are used even though the percentage of ethanol is only 20%.

.....

.....

..... [2]

[Total: 3]

**Question 8 begins on page 14**

8 This question is about the structure of the Earth.

(a) Look at the table of densities.

Layer of Earth	Density in $\text{g/cm}^3$
crust	2.2 – 3.9
outer mantle	3.4 – 4.4
inner mantle	4.4 – 5.6
outer core	9.9 – 12.2
inner core	12.8 – 13.1

The lithosphere includes the crust and outer part of the mantle.

The lithosphere is made of tectonic plates.

Some scientists claim that these tectonic plates 'float' on the inner mantle.

How does the data in the table help to support this claim?

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

(b) In 1914, Wegener proposed a theory to explain the structure of the Earth.

This was not accepted by many scientists at the time.

His original theory has now been developed into the theory of plate tectonics.

This developed theory is more widely accepted.

Explain why developed theories are often more widely accepted.

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

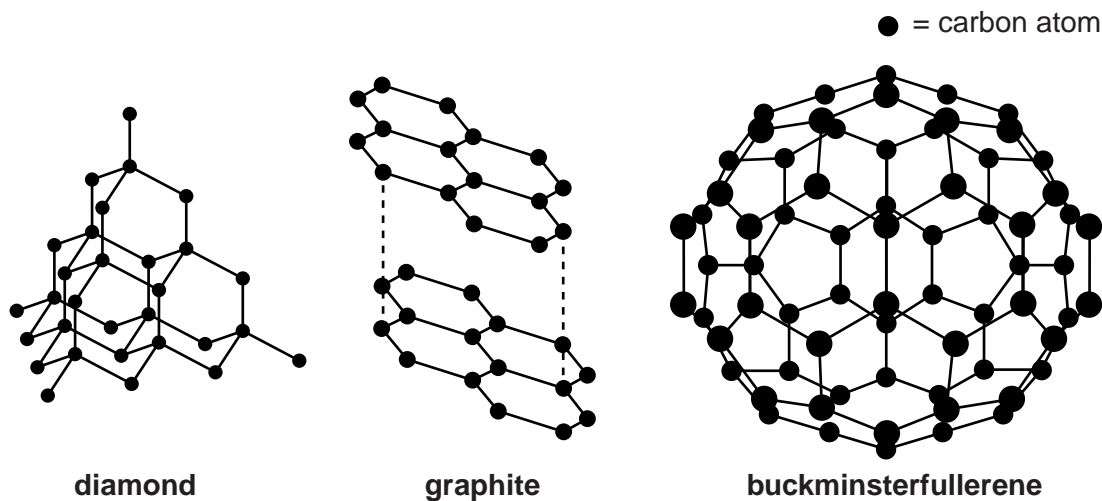
[Total: 3]

15  
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Question 9 begins on page 16  
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SECTION C – Module C3

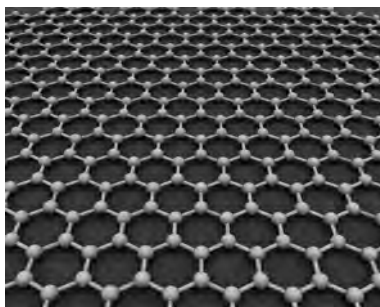
9 Carbon can exist in different solid forms.



(a) What is the name given to these three forms?

..... [1]

(b) Look at the diagram.



It shows the structure of a new solid form of carbon called graphene.

Graphene contains **one layer** of carbon atoms.

Graphene is made from graphite.

Graphene is harder than graphite.

Explain, using ideas about structure and bonding, why **graphene** is **hard** and **graphite** is **slippery**.

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

[2]



(c) Diamond and graphite have different properties and different uses.

Look at the table.

It shows some information about the properties of diamond and graphite.

Property	Diamond	Graphite
State at room temperature	solid	solid
Appearance at room temperature	transparent	black
Melting point	very high	very high
Hardness	very hard	soft
Electrical conductivity	does not conduct	good conductor

Diamond is used to make cutting tools.



The picture shows a drill bit with diamonds on its end.

This drill is used to cut through rock.

Explain why diamond is used to make cutting tools.

Use the table to help you.

.....

.....

.....

..... [2]

[Total: 5]

10 Hilary investigates the reaction between magnesium, Mg, and hydrochloric acid, HCl.

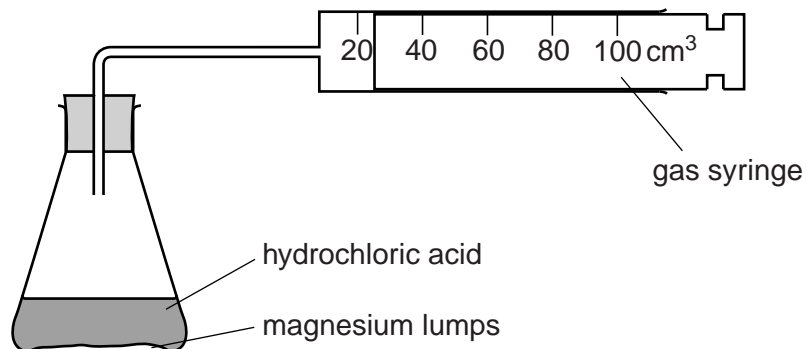
Magnesium chloride,  $MgCl_2$ , and hydrogen,  $H_2$ , are made.

(a) Construct the **balanced symbol** equation for this reaction.

..... [2]

(b) Look at the diagram.

It shows the apparatus she uses.



Hilary measures the total volume of gas in the syringe every 10 seconds.

Look at the graph opposite. It shows her results.

(i) How long does it take for the reaction to stop?

answer ..... seconds [1]

(ii) Calculate the **rate of reaction** during the first **10 seconds** of this experiment.

.....  
 .....

answer .....  $cm^3/s$  [1]

(iii) Hilary repeats the experiment.

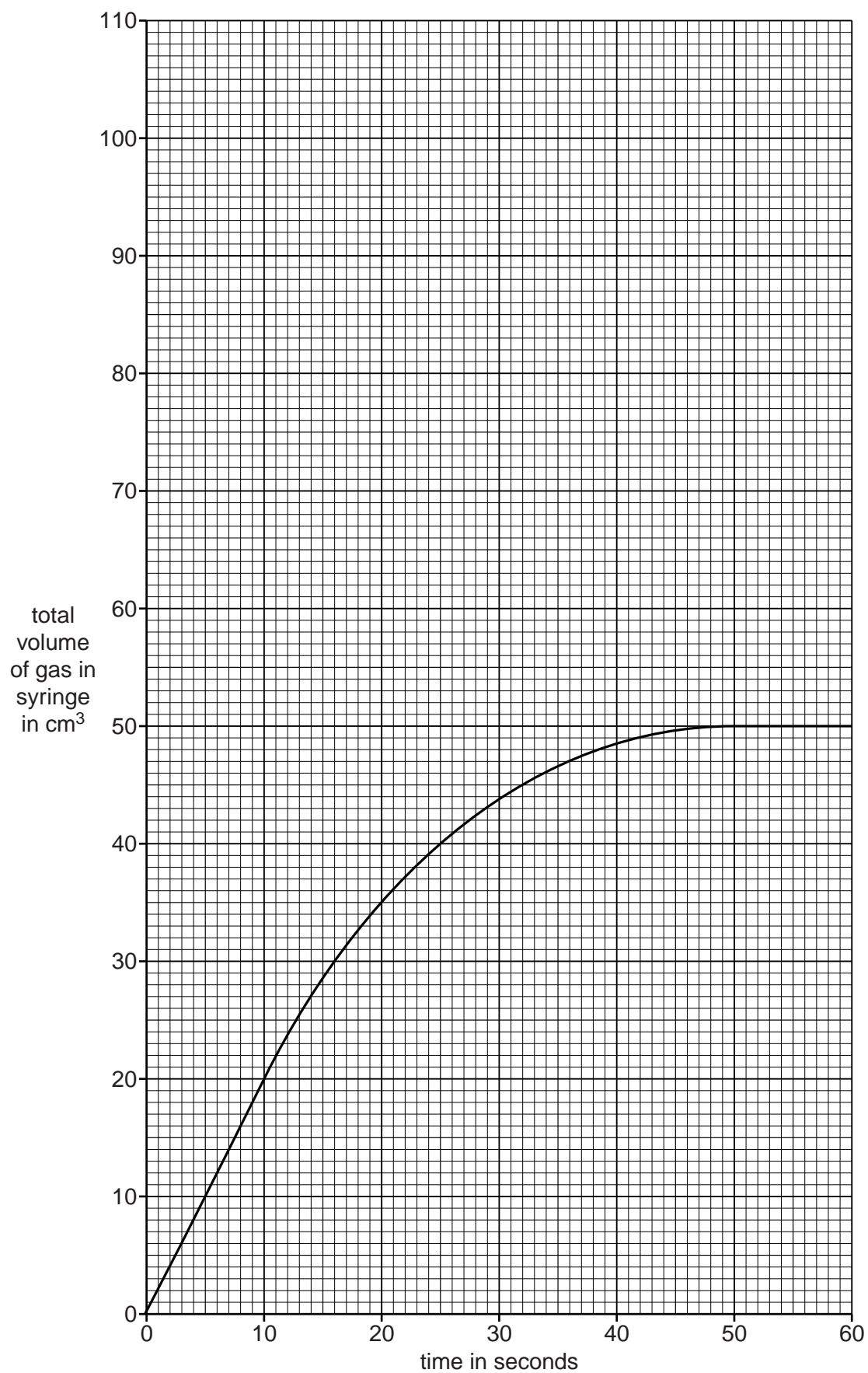
She uses the same mass of magnesium and the same volume and concentration of acid.

This time she uses magnesium **powder**.

On the **grid** sketch the curve she gets. [2]

[Total: 6]

19



## 20

11 Magnesium sulfate and magnesium nitrate are both used as fertilisers.

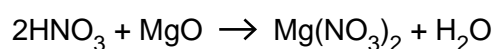
(a) Magnesium sulfate can be made in industry by a **continuous** process.

Explain why batch processes are used to make some pharmaceutical drugs but continuous processes are used to make fertilisers.

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

(b) Magnesium nitrate is made by a neutralisation reaction.

Look at the equation for the reaction.



Water is a waste product.

Show that the atom economy for the reaction is 89% and explain why it is important that the atom economy for a reaction is as high as possible.

The relative atomic masses ( $A_r$ ) for H = 1, N = 14, O = 16 and Mg = 24.



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

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

[Total: 8]

21

12 This question is about energy changes during chemical reactions.

(a) Cold packs are used to treat sports injuries.

The cold pack **reduces** the temperature of the injured part of the body.



An endothermic reaction happens when the chemicals in the cold pack react.

Energy is absorbed when bonds break.

Explain, in terms of bonds between atoms, why this reaction is **endothermic**.

.....

.....

.....

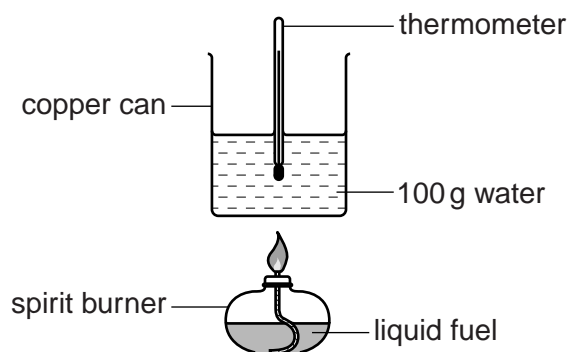
..... [2]

22

(b) Aimee and Luke investigate four liquid fuels.

They burn an amount of each liquid fuel.

Look at the diagram. It shows the apparatus they use.



Look at the table. It shows their results.

Liquid fuel	Mass of fuel burnt in g	Temperature at start in °C	Temperature at end in °C
ethanol	2.2	20	40
methylated spirits	2.4	21	39
paraffin	1.9	22	45
propanol	2.1	22	44

(i) Calculate the energy transferred by **ethanol**.

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

The specific heat capacity of water is 4.2 J/g°C.

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

answer ..... J [2]

(ii) Aimee thinks **paraffin** gives out the **most** energy per gram.

Use the results to show that she is correct.

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

[Total: 6]

END OF QUESTION PAPER

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# The Periodic Table of the Elements

		Key															
		relative atomic mass atomic symbol name atomic (proton) number															
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>Mg</b> magnesium 12	13 <b>Al</b> aluminium 13	14 <b>Si</b> silicon 14	15 <b>P</b> phosphorus 15	16 <b>S</b> sulfur 16	17 <b>Cl</b> chlorine 17	18 <b>Ar</b> argon 18								
19 <b>K</b> potassium 19	20 <b>Ca</b> calcium 20	21 <b>Sc</b> scandium 21	22 <b>Ti</b> titanium 22	23 <b>V</b> vanadium 23	24 <b>Cr</b> chromium 24	25 <b>Mn</b> manganese 25	26 <b>Fe</b> iron 26	27 <b>Co</b> cobalt 27	28 <b>Ni</b> nickel 28	29 <b>Cu</b> copper 29	30 <b>Zn</b> zinc 30	31 <b>Ga</b> gallium 31	32 <b>Ge</b> germanium 32	33 <b>As</b> arsenic 33	34 <b>Se</b> selenium 34	35 <b>Br</b> bromine 35	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 43	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	49 <b>In</b> indium 49	50 <b>Sn</b> tin 50	51 <b>Sb</b> antimony 51	52 <b>Te</b> tellurium 52	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	81 <b>Tl</b> thallium 81	82 <b>Pb</b> lead 82	83 <b>Bi</b> bismuth 83	84 <b>Po</b> polonium 84	85 <b>At</b> astatine 85	86 <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						

\* 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.