WJEC GCSE CHEMISTRY

CHEMISTRY



EXAM QUESTION PACK

UNIT C1 HIGHER TIER 4462 PAPERS

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4462/02

S16-4462-02

SCIENCE A/CHEMISTRY

CHEMISTRY 1
HIGHER TIER

A.M. FRIDAY, 17 June 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**5**	
3.	**7**	
4.	**6**	
5.	**6**	
6.	**7**	
7.	**5**	
8.	**8**	
9.	**4**	
10.	**6**	
Total	**60**	

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ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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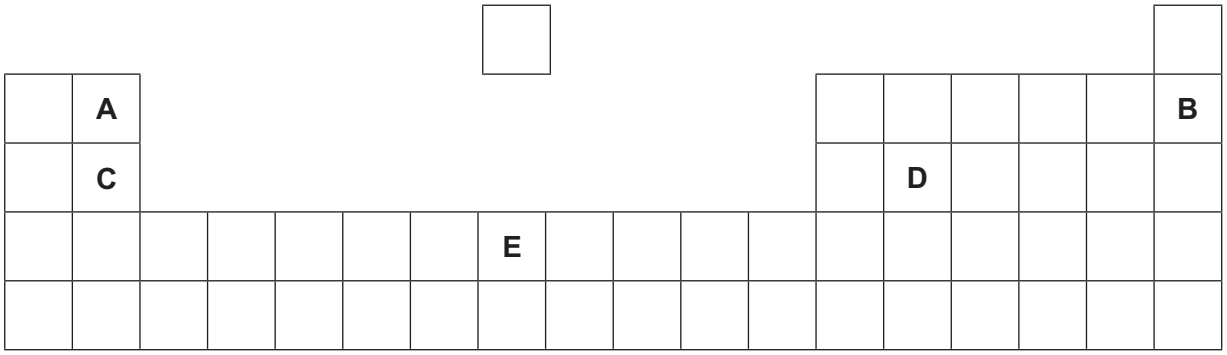
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Answer **all** *questions.*

1. *(a)* The following diagram shows an outline of the Periodic Table.

The letters shown are NOT the chemical symbols of the elements



(i) Give the group and period of the element labelled **C**. [2]

Group ..... Period .....

(ii) Give the **letter** of the element which has **both** metallic and non-metallic properties. Give the reason for your choice. [2]

Letter .....

Reason .....

.....

(b) (i) The chemical formula of aluminium nitrate is $Al(NO_3)_3$. Give the number of nitrogen atoms in the formula $Al(NO_3)_3$. [1]

.....

(ii) Give the chemical formula of lithium carbonate. [1]

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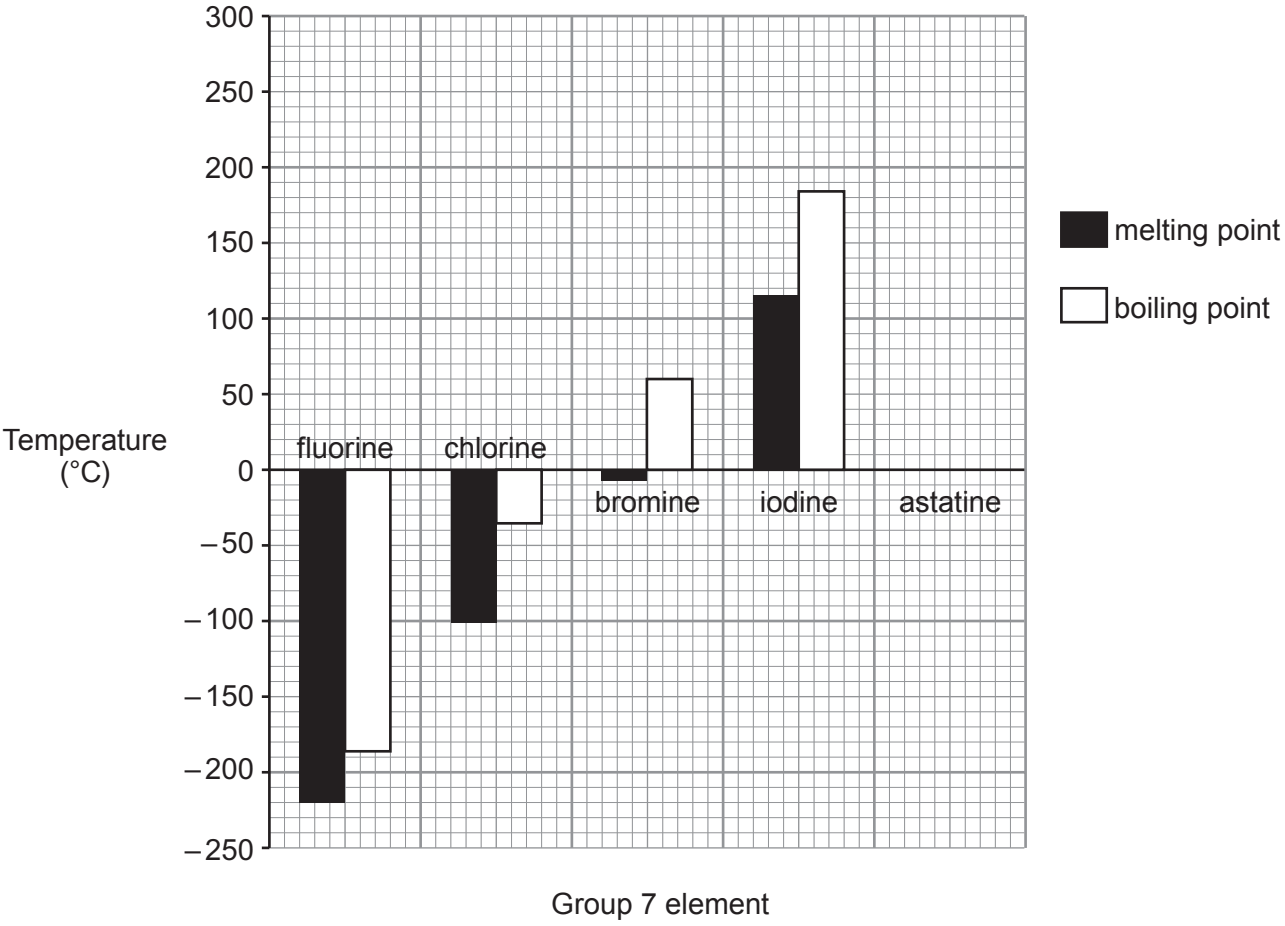
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2. The bar charts below show the melting points and boiling points of Group 7 elements.



Use the information in the bar charts to answer parts *(a)*-*(d)*.

(a) Describe the trend, if any, in the melting point going down the group. [1]

.....

(b) Name the element which has the **lowest** melting point. [1]

.....

(c) Using the same key, draw bars on the grid above to predict the approximate values for the melting point **and** boiling point of astatine. [2]

(d) Give the name of the element which is **liquid** at −70 °C. [1]

.....

5

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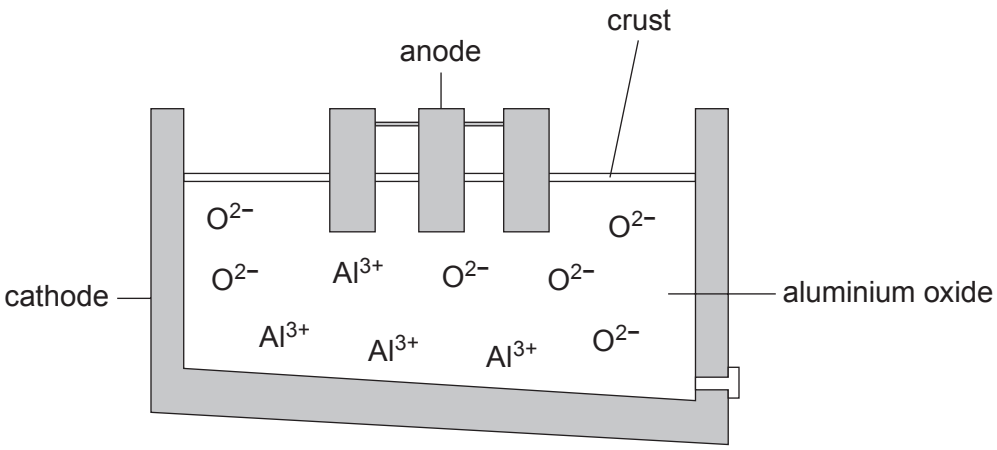
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3. *(a)* The diagram below shows an electrolysis cell used in the extraction of aluminium.



(i) Give the state (solid, liquid or gas) of the aluminium oxide during this process. [1]

.....

(ii) Explain the movement of Al^{3+} and O^{2-} ions during the process. [3]

.....

.....

.....

.....

(b) State **one** property of aluminium that is **unusual** compared to most other metals. Give a use which relies on this property. [1]

Property .....

Use .....

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(c) Scandium is added to aluminium alloys to increase their strength.

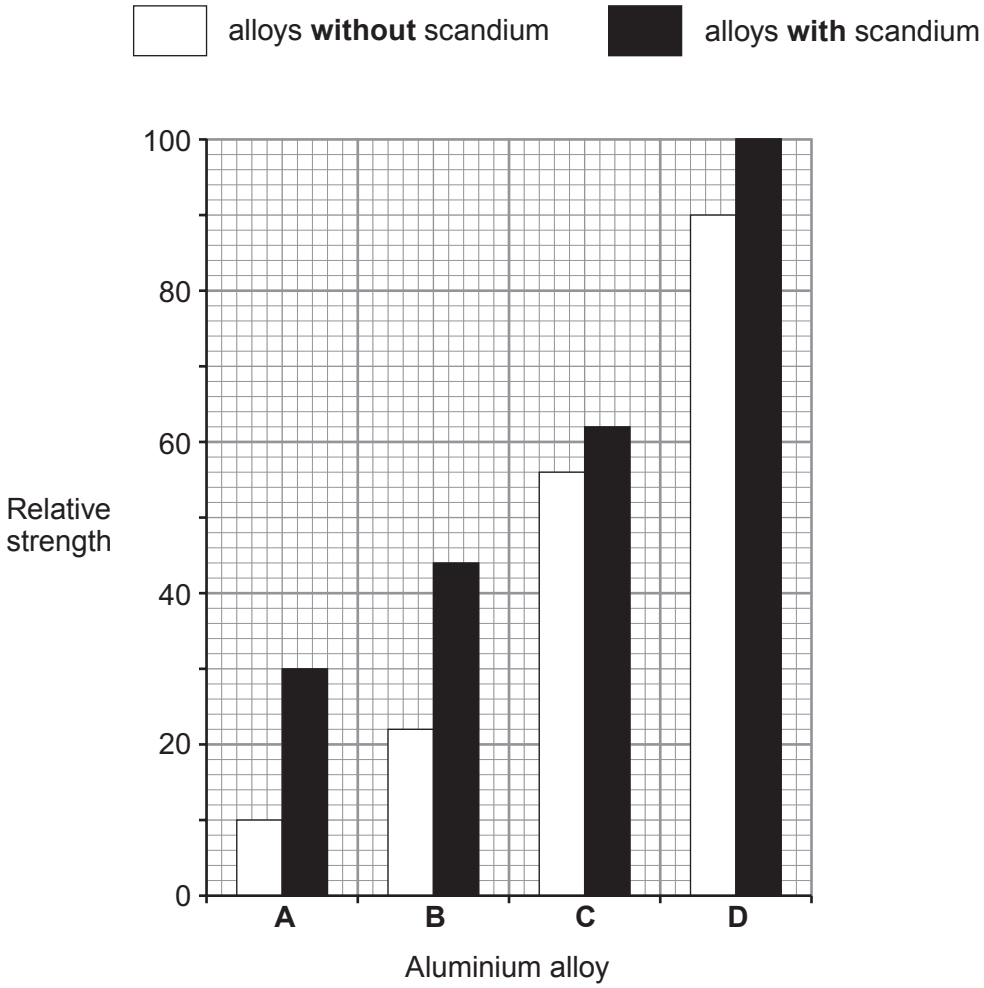
The graph below shows the relative strength of aluminium alloys, **A**-**D**, with and without added scandium.

Give the **letter** of the aluminium alloy where the relative strength is **increased** by 100 % when scandium is added. Use data from the graph to explain your choice. [2]

Letter .....

Reason .....

.....



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4. Describe the benefits and drawbacks associated with the **recycling** of plastic household waste. [6 QWC]

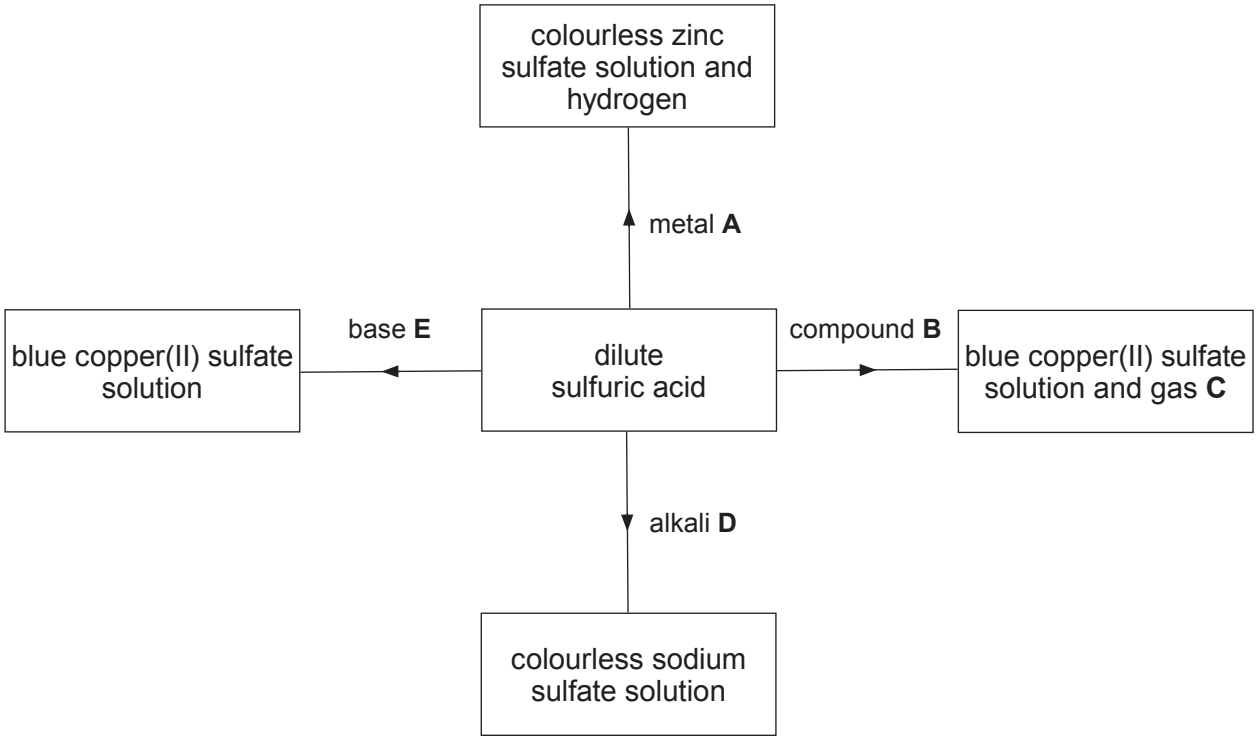
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5. *(a)* The diagram below shows some reactions of dilute sulfuric acid.



Give the names of each of the substances **A** to **E**. [5]

A .....

B .....

C .....

D .....

E .....

(b) Give the chemical formula of ammonium sulfate. [1]

.....

6

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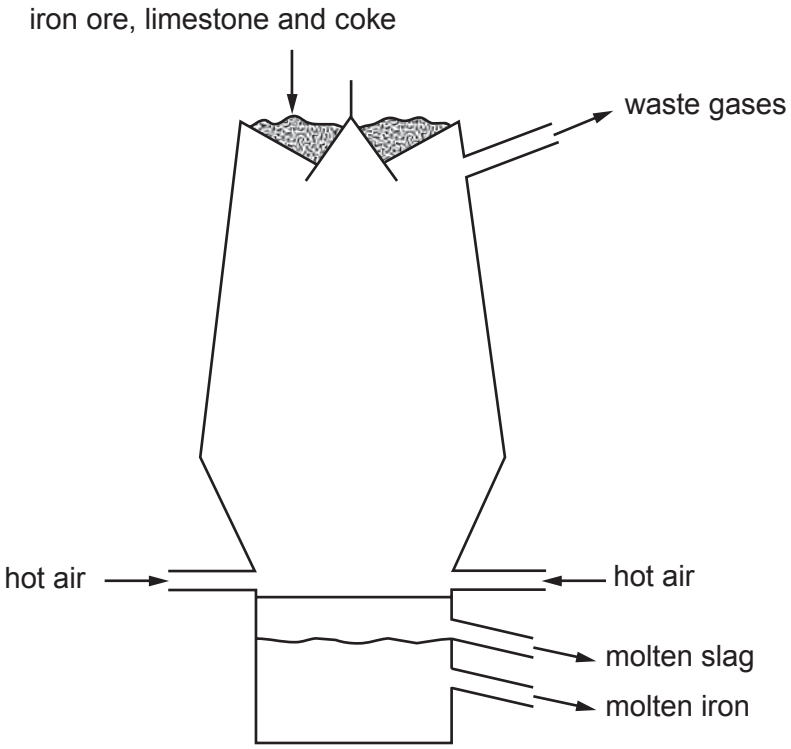
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6. Iron is extracted from its ore in the blast furnace.



(a) Explain the functions of coke in the extraction of iron from iron(III) oxide. [3]

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(b) (i) One of the reactions occurring in the furnace is shown below. Balance this equation. [1]



(ii) The reaction in part (i) shows the processes of oxidation and reduction.

State which of the substances shown in the above equation is reduced and which is oxidised. Explain your answers. [2]

Substance reduced ..... Substance oxidised .....

Explanation .....

.....

(c) Most of the iron produced is converted into an alloy called steel before use. State what is meant by an *alloy*. [1]

.....

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7. *(a)* Silver can be recovered from photographic solutions using iron. This reaction can be demonstrated in the laboratory by adding iron filings to a beaker containing silver nitrate solution. A grey solid forms and the solution turns a pale green colour.

Explain the reaction taking place in the beaker. [3]

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(b) Nano-silver has become widely used in everyday life. Explain **one** disadvantage of using nano-silver in sports clothing. [2]

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8. When magnesium powder is heated with copper(II) oxide a violent reaction occurs. The equation for this reaction is given below:

$$Mg + CuO \longrightarrow MgO + Cu$$

(a) 4.0 g of magnesium oxide is formed when 2.4 g of magnesium reacts with 8.0 g of copper(II) oxide. Assuming both reactants are used up during the reaction and that no product is lost, calculate the mass of copper that forms. Explain your answer in terms of atoms. [2]

Mass of copper = ... g

Explanation .....

.....

(b) The table below shows the mass of copper formed when different masses of magnesium were heated with 8.0 g of copper(II) oxide.

Mass of magnesium used (g)	Mass of copper formed (g)
0.05	0.14
0.10	0.27
0.15	0.40
0.20	0.53
0.25	0.66

(i) Plot the results from the table on the grid opposite and draw a suitable line. [3]

(ii) Describe the relationship between the mass of magnesium used and the mass of copper formed. [2]

.....

.....

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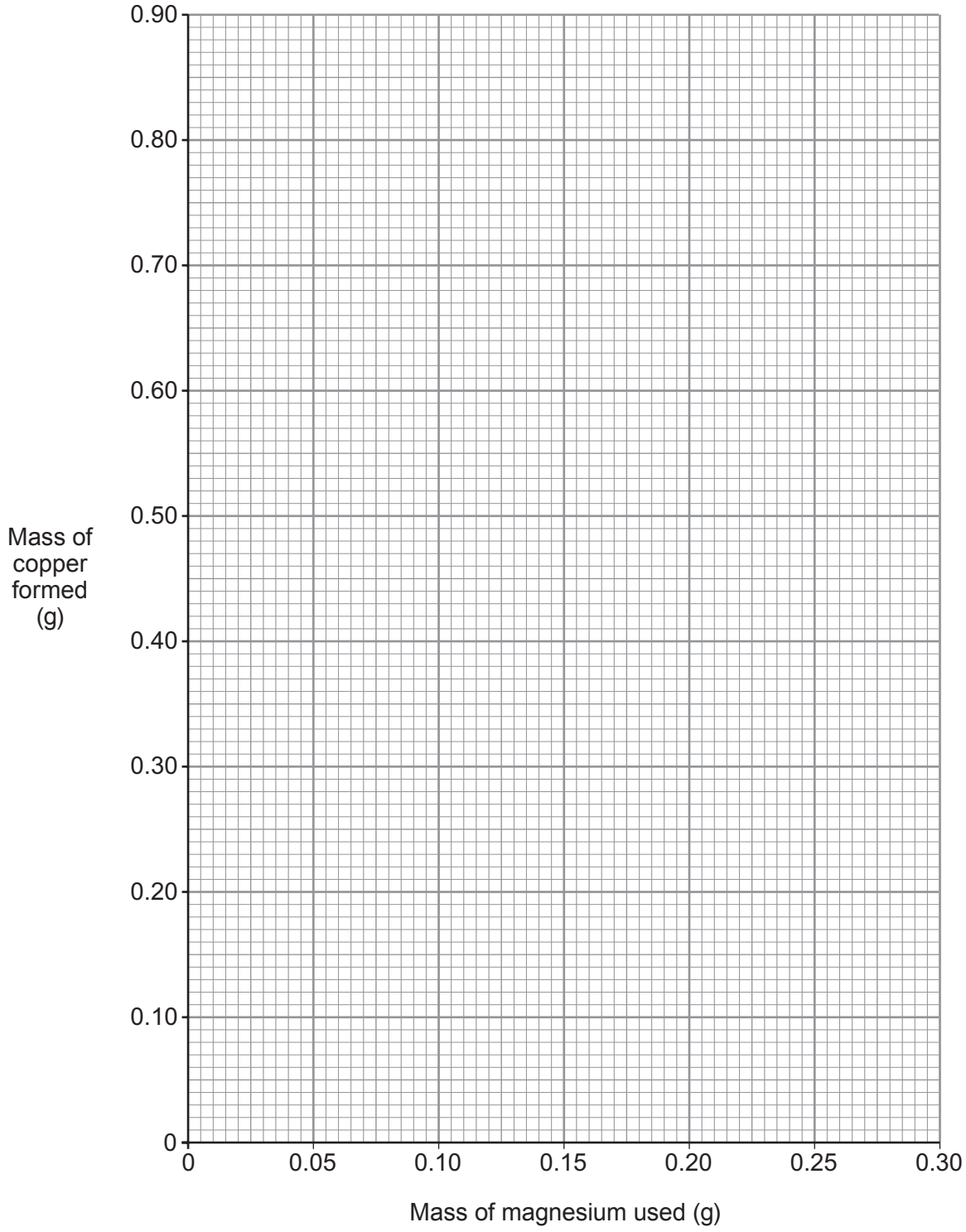
(iii) Use your graph to find the mass of copper formed when 0.30 g of magnesium is used. [1]

Mass of copper = ... g

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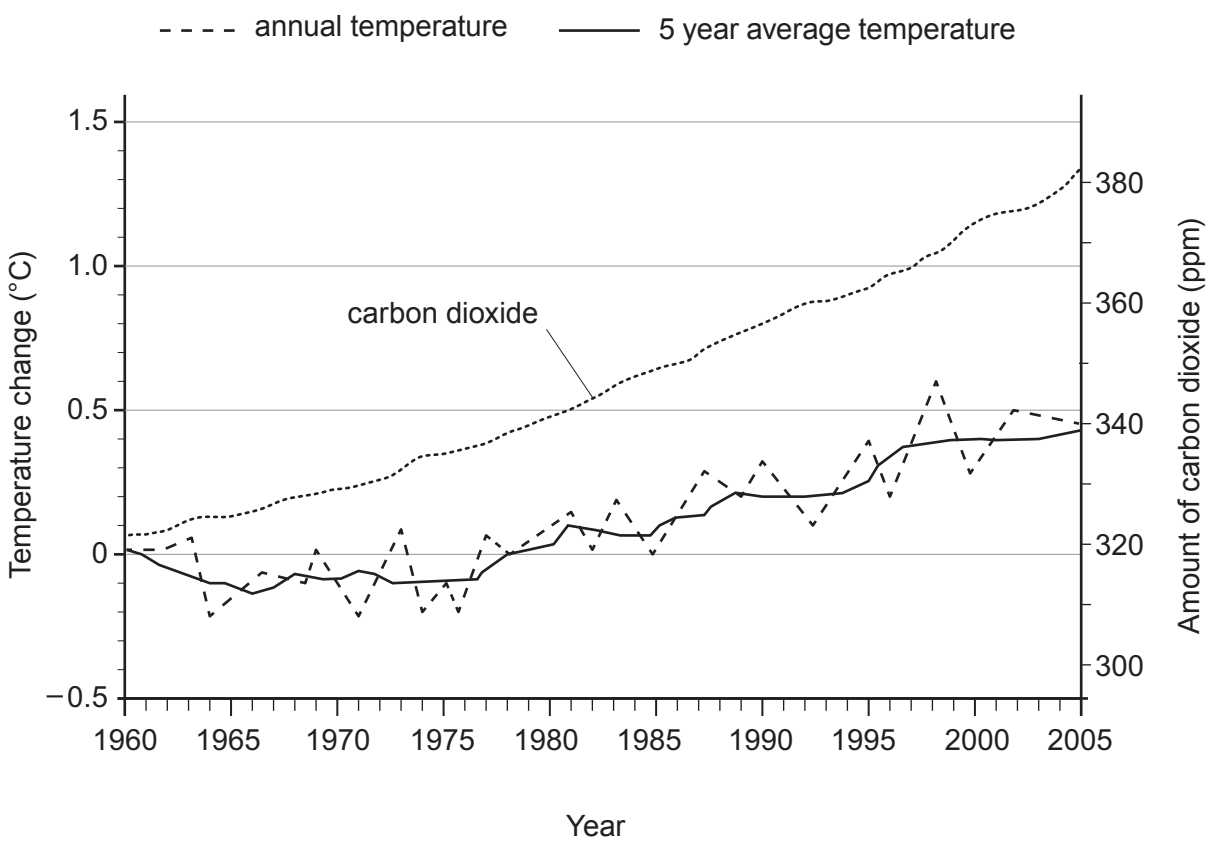
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9. *(a)* The graphs below show the changes in carbon dioxide levels and atmospheric temperature between 1960 and 2005.



Describe how the evidence from the graphs can be used to support and to oppose the statement: [2]

"Global warming is caused by releasing carbon dioxide into the atmosphere."

Support .....

.....

Oppose .....

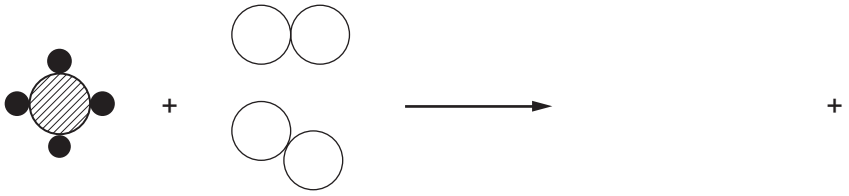
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(b) Natural gas is mainly methane, CH_4. Complete the equation for its combustion in air by drawing diagrams to represent **all** the molecules formed. [2]



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10. Use the information from the table below to evaluate the potential of hydrogen as a replacement for petrol and diesel to fuel cars.

Your answer should include **both** advantages and disadvantages. [6 QWC]

	Hydrogen	Petrol and diesel
Raw material	water	crude oil
Production method	electrolysis	fractional distillation
Combustion product(s)	water	carbon dioxide and water
State at room temperature and atmospheric pressure	gas	liquid
Storage	thick steel containers	petrol tanks

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END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

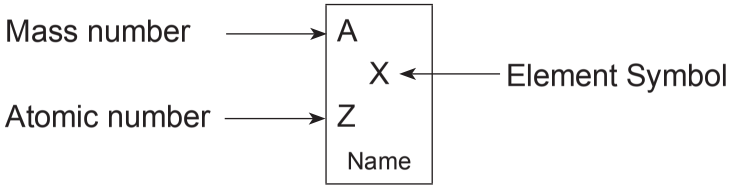
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PERIODIC TABLE OF ELEMENTS

Group 1	Group 2	Group 3	Group 4	Group 5	Group 6	Group 7	Group 0
							$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium						$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium						$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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GCSE MARKING SCHEME

SUMMER 2016

SCIENCE - CHEMISTRY C1
4462/01/02

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INTRODUCTION

This marking scheme was used by WJEC for the 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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GCSE Science - Chemistry 1

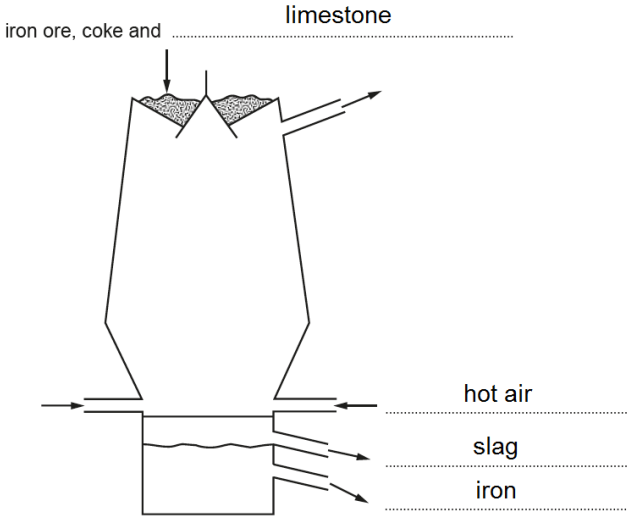
Summer 2016

Mark Scheme

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
1		*(a)*			3	**Stage 1** beaker (containing sulfuric acid and copper(II) carbonate) (1) **Stage 2** filter funnel & paper (containing unreacted copper(II) carbonate) (1) **Stage 3** evaporating basin (containing solution and tripod, gauze and Bunsen burner) (1)	 beaker	ignore stirring rod, heating apparatus ignore collecting vessel	funnel evaporating basin heating apparatus funnel
		(b)			1	filtration / filtering	filter		
		(c)			1	copper(II) sulfate + water + carbon dioxide all **three** needed - any order	correct formulae	incorrect balancing if correct formulae given	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		*(a)*			4	 award (1) for each correct label			
		(b)	(i)		1	coke …… (hot) air both needed	carbon	oxygen	
			(ii)		1	limestone ……. slag both needed			
		(c)			1	3			
		(d)			2	55 (2) if answer incorrect award (1) for 1100/2000			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
3		*(a)*			1	**C** **D** **A** **B** must be in correct order			
		(b)			2	any 2 of following for (1) each • jig-saw fit of coastlines / continents (e.g. South America and Africa) close fit of coastlines / continents (e.g. South America and Africa) • <u>similar</u> fossils / fossil types / fossilised plants / fossilised animals • <u>similar</u> rock types / common mountain ranges	same / matching fossils same / matching	reference to 'countries' 'similar shape of coastlines' 'fit like puzzle' reference to 'animals' and/or 'plants'	
		(c)			1	earthquake			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		*(a)*	(i)		1	15			
			(ii)		1	petrol	40 to 100	4-12	
			(iii)		1	refinery gases	-160 to 40	1-4	
			(iv)		1	hydrogen /H		H_2	
		(b)			3	any 3 of following for (1) each • doesn't corrode/rust/rot • flexible/not brittle • can be coloured • easier installation/easer to replace • less dense /lighter		strong/won't break water proof poor conductor	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		*(a)*			2	any 2 of following for (1) each • contains (the elements) hydrogen and oxygen / it is a compound / formula is H_2O • ratio of elements is 2:1 credit points 1 and 2 for ratio of hydrogen to oxygen is 2:1 / twice as much hydrogen as oxygen • (water) conducts electricity / is broken down by an electric current / is an electrolyte	contains H and O	contains H_2 and O_2 can be electrolysed	
		(b)			1	**B**			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
6		*(a)*	(i)		3	all four points plotted correctly (2) any three correct (1) tolerance ± ½ square straight line of best fit through origin (using ruler) (1)	judgement by eye		
			(ii)		1	1.8-1.9 ecf possible from incorrect line - tolerance ± 1 square			
			(iii)		1	**dry** it / remove water/evaporate <u>water</u>		heat / put in an oven / evaporate it	
			(iv)		1	$MgSO_4$ + Cu both needed – either order		ignore incorrect balancing if formulae are correct	
		(b)			2	correct order Mg Cu Ag (1) any of following for (1) • metals high in the reactivity series displace metals lower (from solution) • Mg displaces Cu , and Cu displaces Ag (therefore Mg most reactive and Ag least reactive)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	*(a)*	(i)		2	Group **2** (1) Period **3** (1)			
			(ii)		2	**D** (1) on the boundary / divide <u>between</u> metals and non-metals (1)		in the middle of the Periodic Table because it is silicon / in Group 4 / a semi-metal / a metalloid	
		(b)	(i)		1	3			
			(ii)		1	Li_2CO_3	$Li^+_2CO_3^{2-}$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	*(a)*			1	increases			
		(b)			1	fluorine	F / F_2		
		(c)			2	melting point any value above iodine's i.e. higher than 115°C (1) boiling point any value above iodine's i.e. higher than 185°C **and** higher than given melting point (1)			
		(d)			1	chlorine	Cl/ Cl_2		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	*(a)*	(i)		1	liquid	molten		
			(ii)		3	aluminium ions go to cathode **and** oxide ions go to anode (1) cathode is negative **and** anode is positive (1) movements is due to attraction / because opposite charges attract (1)		oxygen ions	
		(b)			1	any correct property **and** relevant use for (1) e.g. low density **and** aircraft / window frames / ladders / overhead power lines / gutters / cars / bike frames corrosion resistance **and** aircraft / window frames / ladders / gutters / cars / saucepans	light forms an oxide layer/ forms a protective layer	foil / cans doesn't rust	
		(c)			2	**B** (1) increased from 22 to 44 (1)			

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Question Number			
FT	HT	Mark	Answer
10	4	6	**Indicative content** **Benefits** • saves raw materials / crude oil / energy • reduces litter • reduces need for landfill sites • cheaper to make new objects • avoids air pollution caused by burning waste plastic - toxic fumes / carbon dioxide **Drawbacks** • collection costs • dependent on public support • households need to store bins • not all plastics can be recycled • separation cost **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	*(a)*			5	**A** zinc / Zn (1) **B** copper(II) carbonate / $CuCO_3$ (1) **C** carbon dioxide / CO_2 (1) **D** sodium hydroxide / NaOH (1) **E** copper(II) oxide / CuO copper(II) hydroxide / $Cu(OH)_2$ (1)		sodium oxide /Na_2O	
		(b)			1	$(NH_4)_2SO_4$	$(NH_4^+)_2\,SO_4^{2-}$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	*(a)*			3	• **burns** (forming heat) / acts as a fuel (1) • **carbon dioxide** reacts (with carbon / coke) to form **carbon monoxide** (1) • carbon monoxide / coke is a **reducing agent** (1)	appropriate equations for all marking points		
		(b)	(i)		1	$2Fe_2O_3 + 3C \rightarrow 4Fe + 3CO_2$			
			(ii)		2	substance reduced: Fe_2O_3 / iron(III) oxide substance oxidised: C / carbon **both** needed for (1) Fe_2O_3 / iron(III) oxide loses oxygen C / carbon gains oxygen **both** needed for (1)	award (1) for carbon oxidised because it gains oxygen	iron ore coke	loses oxide
		(c)			1	mixture of a metals / mixture of a metal and a non-metal			compound of two metals

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	*(a)*			3	• **displacement identified** e.g. displacement reaction / iron removes silver from solution (1) • **products identified** e.g. silver **and** iron nitrate formed / word equation / symbol equation (1) • **explanation in terms of reactivity** e.g. iron is more reactive than silver / iron is above silver in reactivity series (1)			
		(b)			2	either of following for (1) • pollutes / gets into **water supplies** on **washing** • absorbed into the body / through the skin / inhaled **could be** harmful in the long term / **don't know** long term effects – uncertainty must be implied (1)	lakes / rivers / streams blood	'gets into body'	

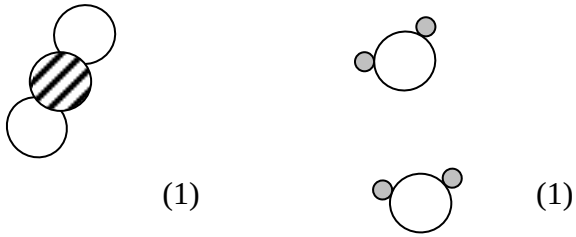
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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	8	*(a)*			2	6.4 (1) atoms cannot be created or destroyed / atoms are re-arranged (in a chemical reaction) (1)		explanation using masses	
		(b)	(i)		3	all five points plotted correctly (2) any four correct (1) tolerance ± ½ square straight line of best fit (using ruler) (1)	judgement by eye		
			(ii)		2	as the mass of magnesium used increases, the mass of copper formed increases / positive correlation between magnesium and copper masses (1) linear / proportional (1) **OR** award (2) for mass of magnesium used and mass of copper formed are directly proportional / doubling mass of magnesium used, doubles mass of copper formed			
			(iii)		1	0.79 if not 0.79 refer to graph – award (1) for correct reading from graph			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	9	*(a)*			2	**Support** as carbon dioxide level increases, (5 year) average temperature increases / is on an upward trend (1) **Oppose** at certain points (e.g. from 1960-65) the carbon dioxide level increases but the temperature decreases / temperature fluctuates (1)			
		(b)			2	 (1) (1) must show two water molecules			

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Question Number			
FT	HT	Mark	Answer
	10	6	**Indicative content** **Advantages** • raw material (water) is readily available / renewable / sustainable • reduced dependency on crude oil • only water formed on combustion / no CO_2 which causes global warming **Disadvantages** • expensive extraction method/ electrolysis is expensive • electricity generation (for production) might cause environmental issues (unless 'green' method of production e.g. solar, wind, etc.) • transport of liquefied gas (no infrastructure) • storage of liquefied gas in thick steel containers **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4462/02

W16-4462-02

SCIENCE A/CHEMISTRY

CHEMISTRY 1
HIGHER TIER

P.M. TUESDAY, 12 January 2016

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**11**	
3.	**6**	
4.	**6**	
5.	**7**	
6.	**5**	
7.	**12**	
8.	**6**	
Total	**60**	

4462
020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answers to questions **3** and **8**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

JAN1644620201

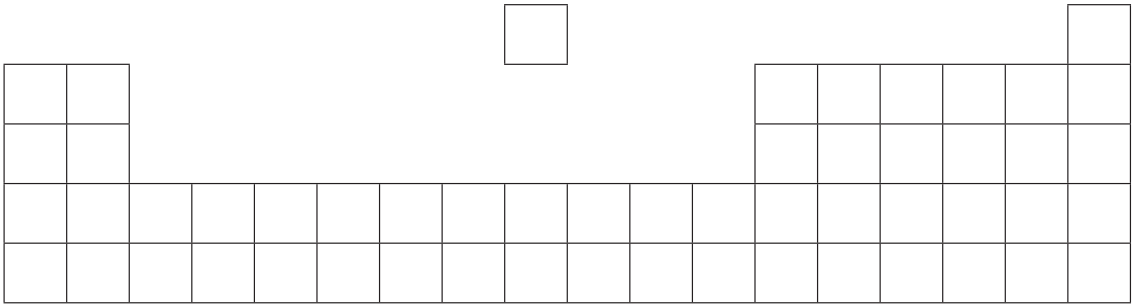
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Answer **all** *questions*.

1. *(a)* The following diagram shows an outline of part of the Periodic Table of Elements shown on the back page of this paper.



Place letters **X**, **Y**, and **Z** in the correct spaces on the diagram to show the following.

X – an element in Group 3

Y – the element with the smallest atomic number

Z – the element in Period 2 and Group 1 [3]

(b) Mendeleev published the first accepted 'periodic table' in 1869. Give **one** similarity and **one** difference between his table and the Periodic Table we use today. [2]

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(c) Give the formulae of the following compounds.

calcium oxide .....

magnesium hydroxide ..... [2]

7

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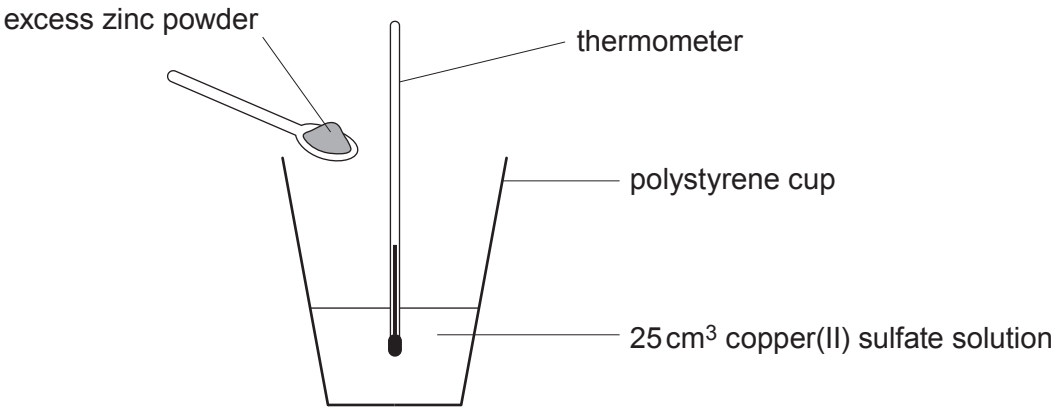
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2. A group of students used the following apparatus to carry out a displacement reaction between zinc powder and copper(II) sulfate solution.



Excess zinc was added to 25 cm^3 of the copper(II) sulfate solution at room temperature. The temperature was recorded every 20 s. The results are shown in the table below.

Time after adding the zinc powder to the copper(II) sulfate solution (s)	Temperature of the reaction mixture (°C)		
	Result 1	Result 2	Mean
0	22.0	22.0	22.0
20	22.8	23.0	22.9
40	24.8	25.2	25.0
60	27.3		27.1
80	26.6	26.6	26.6
100	25.7	25.9	25.8
120	24.8	24.4	24.6

(a) From the data in the table, calculate the missing result for 60 s that must have been used in working out the mean value. [1]

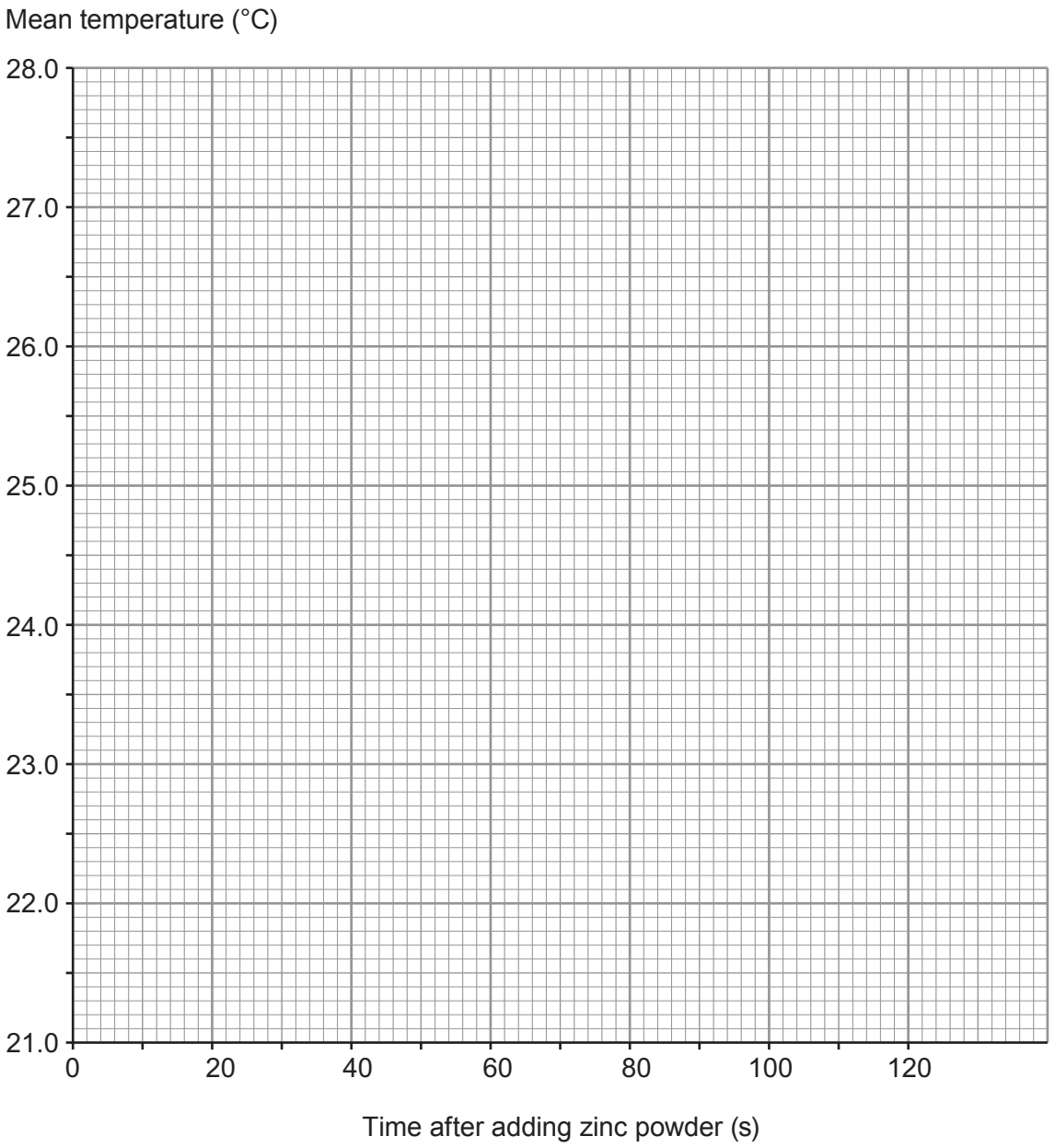
Temperature = ... °C

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(b) On the grid below plot the time after adding the zinc powder against the **mean** temperature of the reaction mixture and draw a suitable line. [3]



(c) One of the students checked the thermometer reading 15 minutes later. State what the temperature would be at this point. Give a reason for your answer. [2]

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(d) Explain why the results recorded in the table can be described as *repeatable*. [2]

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(e) The maximum temperature recorded is not as high as expected. Give the main reason for this and suggest **one** way that this effect could be reduced. [2]

.....

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(f) Balance the following symbol equation that represents the displacement reaction that takes place between zinc and silver nitrate solution. [1]

$$Zn + \square\, AgNO_3 \longrightarrow Zn(NO_3)_2 + \square\, Ag$$

11

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3. Briefly outline the theory of plate tectonics and use this to describe what happens at **one** type of plate boundary. [6 QWC]

6

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4. The table below shows some properties of eight elements.

Element	Metal/ non-metal	Melting point (°C)	Boiling point (°C)	Malleable	Ductile	Appearance at room temperature (20 °C)
bromine	non-metal	−7	59	no	no	brown liquid
carbon	non-metal	3500	4800	no	no	black solid
iodine	non-metal	114	184	no	no	shiny grey solid
chromium	metal	1907	2671	yes	yes	shiny grey solid
lead	metal	327	1740	yes	yes	shiny grey solid
lithium	metal	180	1340	yes	yes	shiny grey solid
potassium	metal	63	760	yes	yes	shiny grey solid
oxygen	non-metal	−218	−183	no	no	colourless gas

Use **only** the information in the table to answer the following questions.

(a) Explain which element is a liquid at 100 °C. [2]

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(b) Carbon and iodine are non-metals but each shows some properties associated with metals.

Give **one** property of each element that is unusual for a non-metal. [2]

Carbon .....

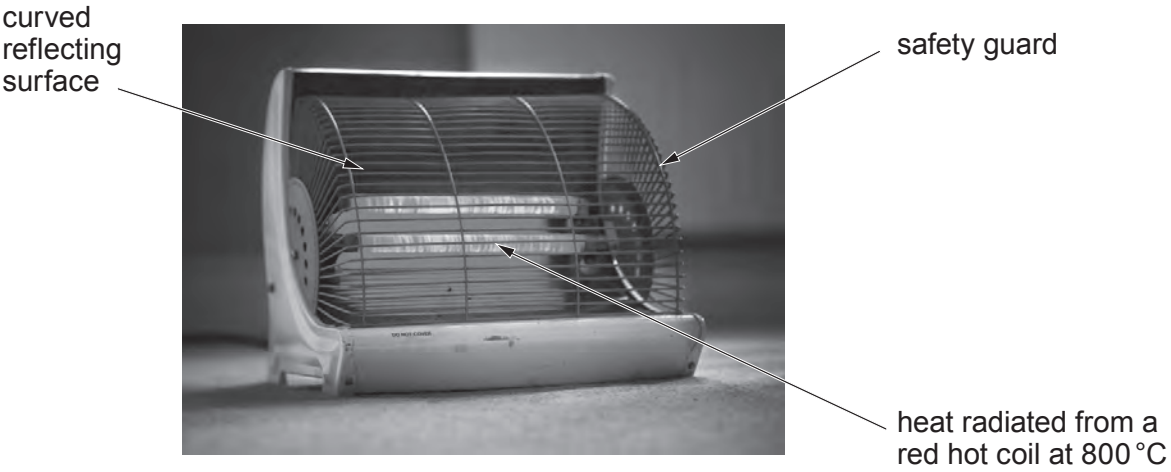
Iodine .....

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(c) An electric fire, such as the one shown in the photograph below, has a curved reflecting surface to increase the heating effect.



Name the element from the table that would be most suitable for making the curved reflecting surface. Explain your choice. [2]

Element .....

Explanation .....

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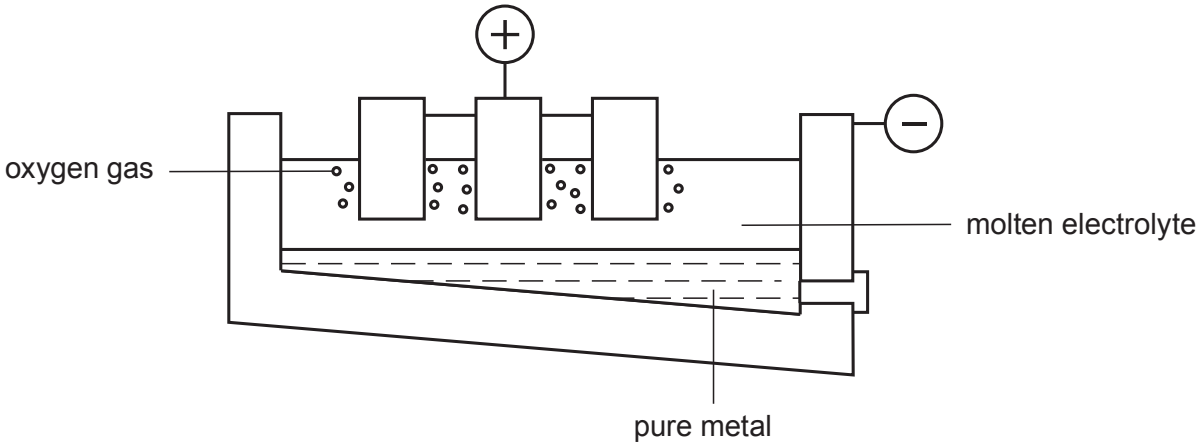
6

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5. *(a)* The process of electrolysis can be used to extract aluminium from aluminium oxide.



(i) State what is meant by the term *electrolysis*. [1]

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(ii) The process is expensive because of the cost of the large amounts of heat and electricity used. Explain why the aluminium oxide is dissolved in cryolite. [2]

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(iii) Balance the symbol equation that represents the reaction taking place. [1]

$$\square\ Al_2O_3 \longrightarrow \square\ Al + \square\ O_2$$

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(b) Iron is extracted from its ore inside the blast furnace.

The table below lists the raw materials needed for the extraction of one tonne of iron. The cost of one tonne of each raw material is also shown.

Raw material needed to extract iron from its ore	Number of tonnes needed to produce one tonne of iron	Cost per tonne of the raw material (£)
iron ore	2	40
coke	1	152
limestone	0.5	90
hot air	4	2

The cost of recycling one tonne of iron is only 10 % of the cost of extracting one tonne of the metal from its ore.

Use the information in the table to calculate how much money would be saved per tonne of recycled iron. [3]

Saving = £ ..... per tonne

7

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6. The table below shows the results of research into the effect of water fluoridation on the teeth of children aged 12 years from different countries.

DMFT – decayed, missing and filled teeth

Country	Average number of DMFT in sample tested	Percentage of sample with fluoridated water (%)
Denmark	0.7	0
England	0.7	11
Australia	1.0	80
United States	1.2	64
Spain	1.3	11
New Zealand	1.4	61
Norway	1.7	0
Japan	1.7	0

(a) Explain whether or not this information supports the argument that fluoridation of water supplies reduces the average number of DMFT in children. [3]

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(b) Without referring to the table above, give **two** reasons why some people oppose the addition of fluoride to water supplies. [2]

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7. Some scientists believe that carbon dioxide and water vapour were the two main gases present in the original atmosphere formed by volcanic outgassing.

(a) State and explain how the levels of these two gases have changed over geological time. [4]

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(b) Explain how the processes of respiration and photosynthesis affect the atmosphere. [3]

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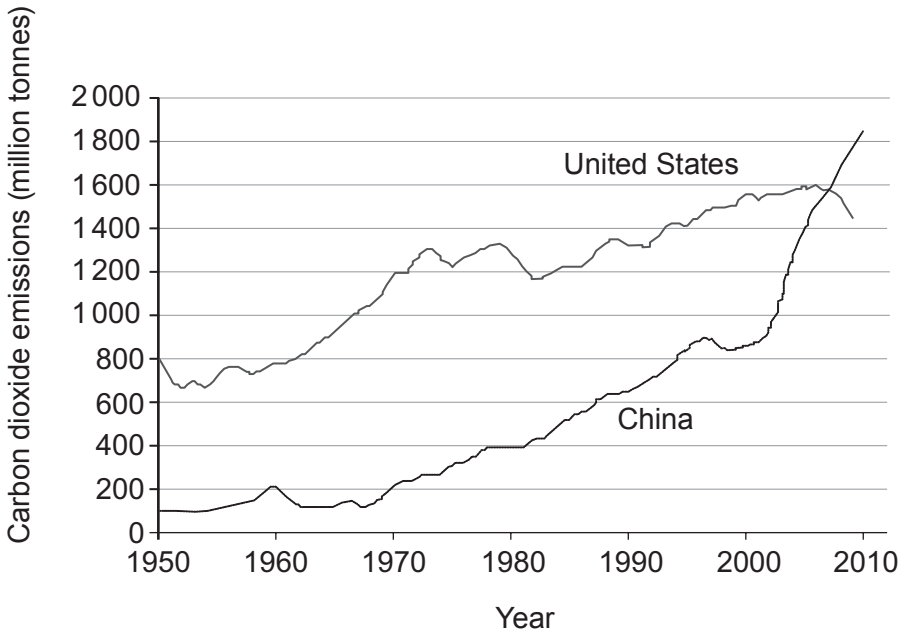
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(c) The graphs below show the carbon dioxide emissions from the combustion of fossil fuels in the United States and China between 1950 and 2009.



(i) Use data from the graph to compare the increase in carbon dioxide emissions in the United States and China between 1950 and 2009. [3]

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(ii) Explain how the information in the graph could be used to support the argument that the combustion of fossil fuels is playing a significant part in causing global warming in recent years. [2]

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12

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Turn over.

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8. Explain how, without using indicators, sodium carbonate, sodium chloride and sodium hydroxide can be identified.

Use the names of any products formed and relevant equations to support your answer.
[6 QWC]

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END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

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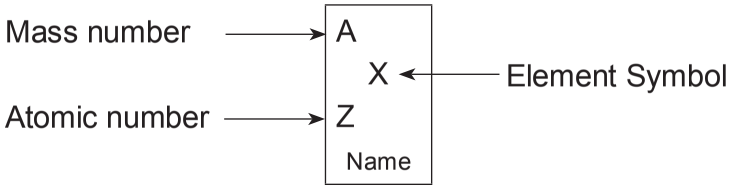
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PERIODIC TABLE OF ELEMENTS

20

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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(4462-02)

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GCSE MARKING SCHEME

JANUARY 2016

SCIENCE – CHEMISTRY C1
4462/ 01/02

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INTRODUCTION

This marking scheme was used by WJEC for the January 2016 examination. It was finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conference was held shortly after the paper was taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conference was to ensure that the marking scheme was interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conference, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about this marking scheme.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		(a)	(i)		1	electron			
			(ii)		1	nucleus			
		(b)	(i)		1	CH_4	H_4C		
			(ii)		1	 ignore relative sizes			
		(c)	(i)		1	1			
			(ii)		1	6			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			2	oxygen (1) carbon dioxide (1)	O_2 CO_2	O	
		(b)	(i)		3	**B** (1) **C** (1) **A** (1)		all references to animals, plants or fossil fuels	
			(ii)		1	global warming		greenhouse effect / climate change	

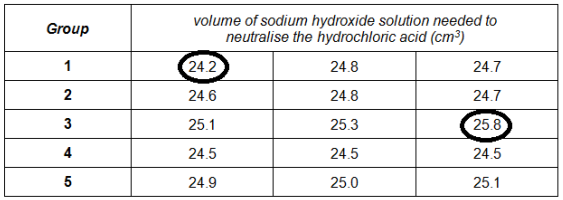
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)	(i)		1	lithium oxide			
			(ii)		1	lithium and oxygen – **both** required		Li and O	oxide
		(b)			2	iodine, $I_{2,}$ is a compound (1) the symbol for iron is FE (1)	accept any indication of the incorrect statements		
		(c)	(i)		2	**D** (1) Do not conduct electricity **and** is not shiny (1)	**C** for (1) if linked to not conducting electricity		
			(ii)		2	**B** (1) it conducts electricity but does not react with water – **both** needed (1)	is a metal but does not react with water	does not react with water	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			1	 **both** needed			
		(b)			2	pH will increase / go up / rise (1) green (1)	correct reference to pH numbers e.g. go from 1/2 to 7	pH will be 7	
		(c)	(i)		1	water	H_2O		acid
			(ii)		1	sodium chloride	NaCl	common salt	
		(d)			1	sodium sulfate water – **both** needed	Na_2SO_4 H_2O		

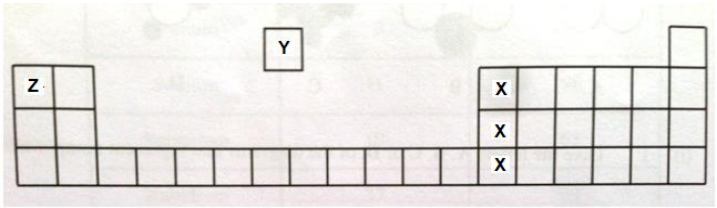
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)	I	1	kerosene	paraffin	150 to 250 11 - 15	
				II	1	petrol		20 to 100 4 - 12	
			(ii)		1	11 or 12	both correct answers	named fractions	
			(iii)		1	the greater the number of carbon atoms, the higher the boiling point	any expression of 'longer chain = higher boiling point'	it increases	
		(b)	(i)		4	**C** / burn them (with other waste) (1) releases toxic / poisonous fumes (1) **B** / send to landfill with other waste (1) insufficient / limited space (1)	CO_2 released **causing** global warming etc. smell / leakage / spoils landscape	dangerous fumes / reference to acid rain dangerous to animals / non-biodegradable	
			(ii)		2	waterproof (1) stronger / more durable / doesn't tear / doesn't rip (1)		reference to colour / recycling / flexibility / biodegradability	

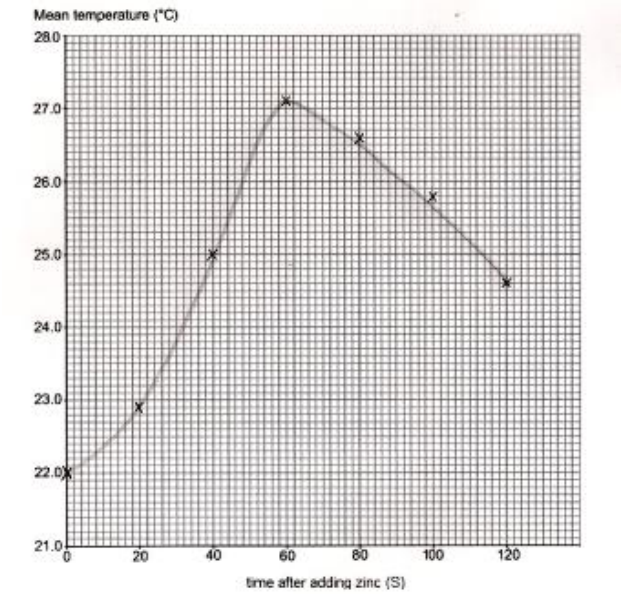
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6	1	(a)			3	 award (1) for each of **X**, **Y** and **Z**			
		(b)			2	**similarity –** arranged in groups / periods (1) **difference –** he had gaps / missing groups / more than one element in some spaces / arranged by mass not atomic number (1)	 more elements today	 reference to shape	arranged by mass/atomic number as a similarity
		(c)		(i)	1	CaO	$Ca^{2+}O^{2-}$ / OCa		
				(ii)	1	$Mg(OH)_2$	$Mg^{2+}(OH^-)_2$ / $Mg(HO)_2$ / $(OH)_2Mg$		

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	2	(a)			1	26.9	answer in table		
		(b)			3	 all points plotted correctly (2) 5 or 6 points plotted correctly (1) suitable line – **must** be curve going up (1)			
		(c)			2	22 (1) will return to room / starting temperature (1)	any value between 22.0 and 22.9	room temperature	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	2	(d)			2	any **two** of the following for (1) each • both sets of results showed the same pattern • repeated results are close together / consistent / similar • all results used in calculating averages / no anomalous results • plotted points are all close to the smooth curve		any reference to fair test	
		(e)			2	heat loss / insufficient insulation (1) put a lid on the cup / wrap in cotton wool or foil (1)	sensible alternative insulation method e.g. cup inside another cup	reference to stirring	
		(f)			1	$Zn + \boxed{2} AgNO_3 \rightarrow Zn(NO_3)_2 + \boxed{2} Ag$			

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Question Number			
FT	HT	Mark	Answer
8	3	6	**Indicative content** • the Earth's crust is made up of huge pieces called tectonic plates • these plates are continually moving due to convection currents in the mantle • plate movement causes continents to move Relevant detail relating to any one of the following types of boundary; they do not have to be named <u>Constructive boundary</u> • plates move apart • magma rises into the gap • cools and solidifies • new igneous rock is formed <u>Conservative boundary</u> • plates move in opposite directions (side by side) • they overcome friction and move suddenly • earthquake activity • rocks are deformed <u>Destructive boundary</u> • plates move towards each other • denser plate sinks and melts (destroyed) • less dense plate rises up forming mountain ranges (deformed) • any other relevant point e.g. subduction zone / volcanoes

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Question Number			
FT	HT	Mark	Answer
8	3	6	**5-6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	(a)			2	potassium (1) 100 °C is **above** the melting point but **below** the boiling point (1)	K between the melting point and boiling point		
		(b)			2	carbon – **high** melting point / boiling point (for a non-metal) (1) iodine – shiny (1)		melting point / boiling point appearance	
		(c)			2	chromium (1) high melting point **and** shiny / malleable (1)	melting point higher than 800 °C is equivalent to 'high melting point'	reference to boiling point or ductility	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		1	splitting a compound using electricity	separating the elements in a compound		
			(ii)		2	to lower the melting point of aluminium oxide (1) less **heat** energy needed to melt it (1)			
			(iii)		1	2 Al_2O_3 ⟶ 4 Al + 3 O_2			
		(b)			3	saving = £256.50 (3) if answer incorrect award (1) each for up to two correct steps with error carried forward throughout cost of extraction = £285 (1) 10% of cost = £28.50 (1) saving = £256.50 (1)	90/100 x £285 as alternative method		

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			3	**does not support the argument / supports and contradicts the argument / unable to say whether it supports the argument** (1) any **two** of following for (1) each – opinion **must** be given • there is no correlation /pattern between the level of fluoridation and DMFT • the countries with the lowest fluoridation have both the highest and lowest DMFT • the country with the highest fluoridation did not have the least DMFT • countries with the same/ similar fluoridation do not have the same DMFT	named countries or DMFT values in answers		supports the argument
		(b)			2	any **two** of following for (1) each • mass medication / removes freedom of choice • can get fluoride from elsewhere / from toothpaste etc. • **increased chance** of fluorosis / discolouring of teeth • **increased chance** of stomach cancer (or other related condition or illness)		no proof that it has a beneficial effect / evidence inconclusive reference to cost	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			4	carbon dioxide level decreased (1) photosynthesis in plants / absorbed into (carbonate) rocks in sea (1) water vapour level decreased (1) atmosphere cooled and condensed (to form the oceans) (1)		Earth cooled	
		(b)			3	photosynthesis takes in carbon dioxide and gives out oxygen – **both** needed (1) respiration takes in oxygen and gives out carbon dioxide – **both** needed (1) *final mark may only be credited when first two marks are awarded* opposite processes balance each other out / result in no overall change / maintain levels of both gases (1)	award (1) for reference to both processes and only one of the gases		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(c)	(i)		3	emissions from China are increasing more / at a faster rate than those from the USA (1) USA emissions have increased gradually / approximately doubled / gone from c.800 to c.1600 million tonnes (1) China emissions have increased dramatically / increased by approximately 20 times (1)	USA emissions are higher at the start but China emissions are higher at the end (1)	both are increasing	
			(ii)		2	fossil fuel use has risen / burning more fossil fuels (1) **more** carbon dioxide has led to **more** heat being trapped / **increased** greenhouse effect (1)		reference to higher temperatures	

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Question Number			
FT	HT	Mark	Answer
	8	6	**Indicative content** • add acid to each solution in turn • acid reacts with NaOH and Na_2CO_3 but not with NaCl • no temperature rise or fizzing with NaCl • temperature rises with NaOH and Na_2CO_3 • greater temperature rise with NaOH than with Na_2CO_3 • fizzing seen with Na_2CO_3 but not with NaOH • products named for given reactions • relevant equations (word and/or balanced symbol equations) **5-6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4462/02

S15-4462-02

SCIENCE A/CHEMISTRY

CHEMISTRY 1
HIGHER TIER

P.M. FRIDAY, 12 June 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**7**	
3.	**4**	
4.	**6**	
5.	**6**	
6.	**6**	
7.	**6**	
8.	**5**	
9.	**7**	
10.	**6**	
Total	**60**	

4462 020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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Answer **all** *questions.*

1. The following table contains some information about five elements, **A**, **B**, **C**, **D** and **E**.

Element	Melting point (°C)	Boiling point (°C)	Electrical conductivity
A	113	445	poor
B	−39	357	good
C	3550	4828	poor
D	−101	−35	poor
E	1540	2750	good

(a) Give the **letter** of the element, **A-E**, that is a liquid at 20 °C. Explain your choice. [3]

.....

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(b) State which element could be iron and explain your choice. [3]

.....

.....

.....

(c) State **one** property of iron that is not mentioned in the table. [1]

.....

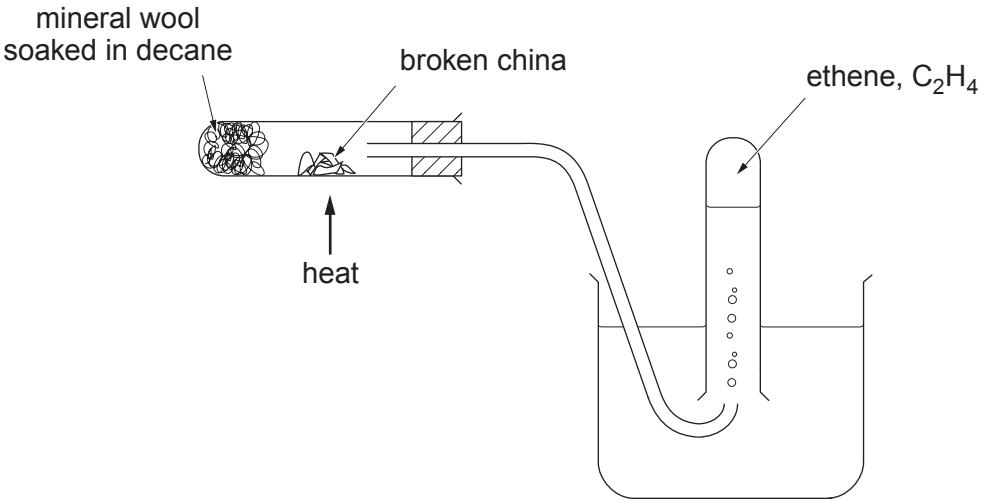
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2. *(a)* The following diagram shows an experiment that could be carried out in the laboratory to obtain ethene from decane, $C_{10}H_{22}$.



(i) Complete the following **symbol** equation for the reaction taking place. [1]

$$C_{10}H_{22} \longrightarrow \text{.....} + C_2H_4$$

(ii) Name the process which has taken place. [1]

.....

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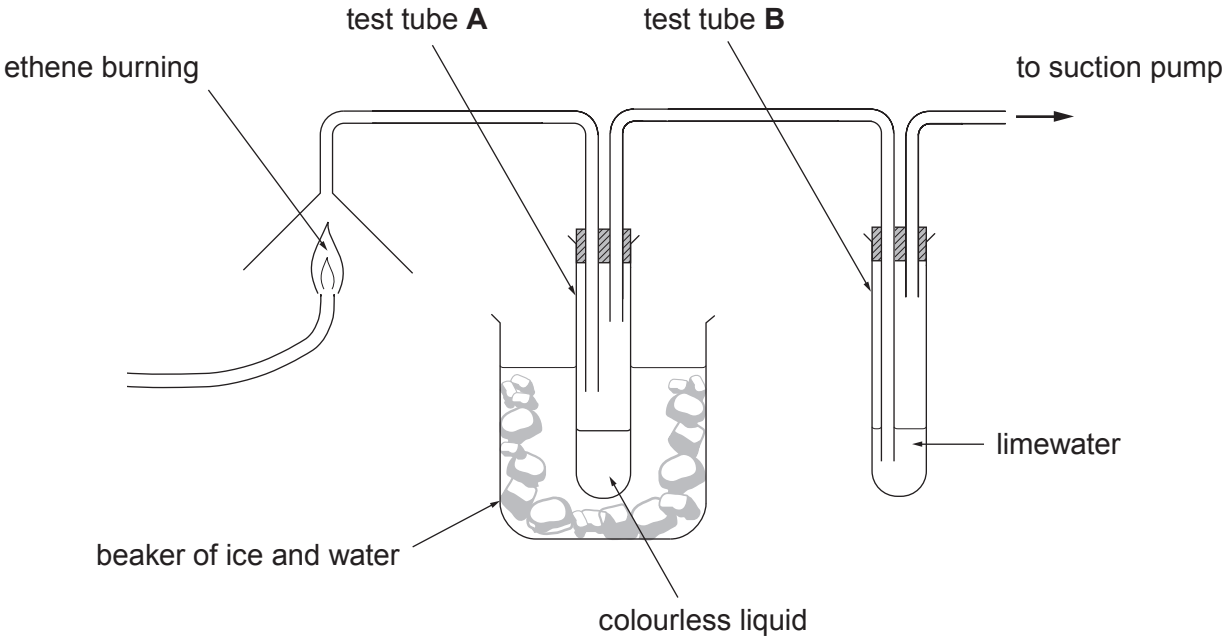
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(b) Ethene is a hydrocarbon.

The following diagram shows apparatus that can be used to investigate the products formed when ethene is burned.



(i) State what you would expect to happen to the limewater in test tube **B** and give the reason for your answer. [1]

.....

.....

(ii) The experiment was repeated with hydrogen being burned instead of ethene.

I. State what would be seen in test tube **A**. Give a reason for your answer. [2]

.....

.....

II. State and explain what would be seen in test tube **B**. [2]

.....

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3. The table below gives information about the concentration of ions in drinking water from four different locations.

Location	Concentration of ions (mol / m^3 of water)					
	Na^+	NH_4^+	Mg^{2+}	F^-	SO_4^{2-}	NO_3^-
A	3.4	2.1	2.0	2.1	2.5	2.3
B	0.2	0.6	2.7	4.4	0.0	0.1
C	0.0	0.3	0.4	0.4	0.2	0.0
D	0.1	0.4	0.0	0.0	0.4	0.2

(a) (i) Sodium sulfate can be formed from the ions found in water at location **A**. [1]

Write the formula of sodium sulfate. .....

(ii) Suggest the names of **two** compounds that could be formed from the ions present in the water at location **C**. [1]

Compound 1 .....

Compound 2 .....

(b) State the location where you would expect to find the least amount of tooth decay. Give a reason for your choice. [2]

.....

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4

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4. Fossil fuels such as coal release sulfur dioxide into the atmosphere when burned. This causes acid rain. Describe how acid rain is formed and its effects on the environment. [6 QWC]

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5. Copper(II) sulfate was made by reacting copper(II) carbonate with an acid.

(a) Give the name of the acid used. [1]

.....

(b) The first stage of the preparation is the addition of excess copper(II) carbonate to the acid. Give **two** observations that show a reaction is taking place. [2]

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(c) Describe how you would prepare copper(II) sulfate crystals from the mixture in part *(b)*. [2]

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(d) A different salt can be made by reacting copper(II) oxide with dilute hydrochloric acid. Complete the **word** equation for the reaction that takes place. [1]

copper(II) oxide + hydrochloric acid ⟶ ..... + ...

6

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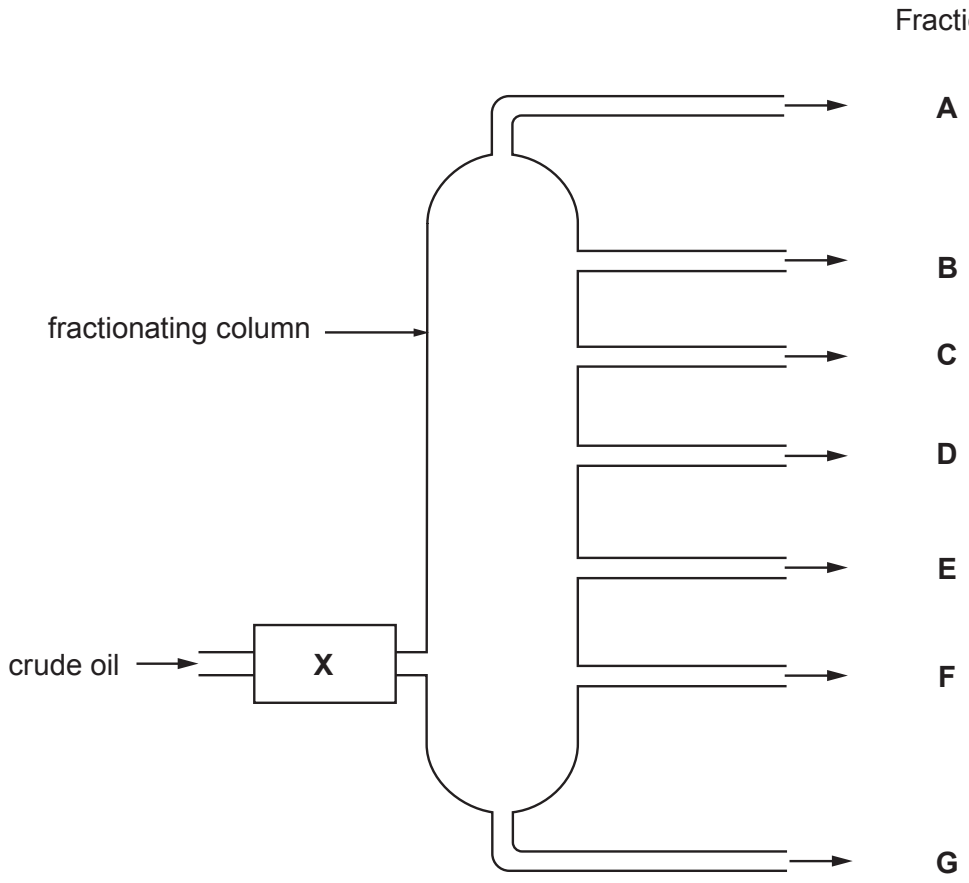
6. *(a)* Crude oil is a source of some very important fuels. State how crude oil was formed. [2]

.....

.....

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(b) Crude oil is a mixture of compounds called hydrocarbons. They are separated into different fractions in a fractionating column.



(i) State what happens to the crude oil in **X** before it is allowed to enter the fractionating column. [1]

.....

(ii) State the property of hydrocarbons which allows them to be separated using this method. [1]

.....

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(c) A similar process can also be used to separate gases from air.

The table below shows the boiling points of three gases that can be obtained from air.

Gas	Boiling point (°C)
argon	−186
nitrogen	−196
oxygen	−182

To separate the gases, air is compressed and cooled to become liquid air. The liquid air is then allowed to warm up slowly.

State which of the three gases boils first when liquid air warms up and give the reason for your answer. [2]

.....

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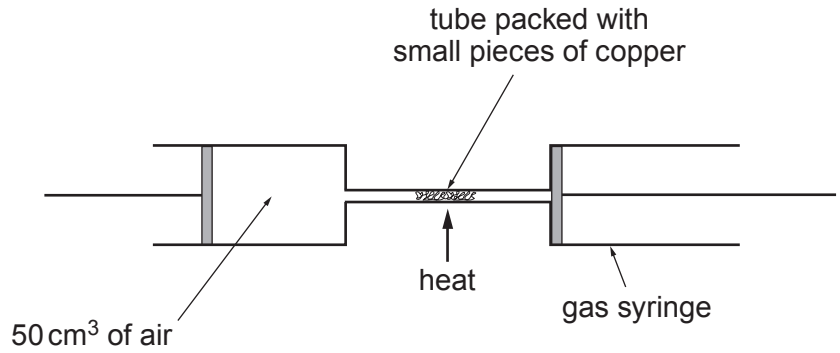
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7. *(a)* The percentage of oxygen in air can be found by using the apparatus shown below.



50 cm^3 of air was trapped in one of the syringes. The air was passed forwards and backwards over the heated copper. The copper reacted with the oxygen in the air producing solid copper(II) oxide. The final volume of gas was recorded when the apparatus had cooled to room temperature.

Results

Volume of air before heating	50.0 cm^3
Volume of air after heating and cooling	40.5 cm^3

(i) Use the results to calculate the percentage of oxygen in air. [2]

Percentage of oxygen in air = ... *%*

(ii) Suggest why the value for the percentage of oxygen in air calculated in part (i) is lower than the expected value. [1]

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(iii) State what happens to the amount of carbon dioxide inside the apparatus during the experiment. Give the reason for your answer. [2]

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(b) Copper(II) oxide can be formed by heating copper(II) nitrate.

Balance the equation for the reaction. [1]

$$\square\ Cu(NO_3)_2 \longrightarrow \square\ CuO + \square\ NO_2 + O_2$$

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8. *(a)* Complete the following table. [3]

Positive ion	Negative ion	Formula
Na^+	Br^-	NaBr
Ba^{2+}	OH^-	.....
.....	SO_4^{2-}	$Fe_2(SO_4)_3$
K^+	.....	K_2HPO_4

(b) Explain how a sodium atom and a bromine atom form ions when they react to make sodium bromide. [2]

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9. *(a)* Aluminium can be extracted by the electrolysis of molten aluminium oxide.

(i) State what is added to aluminium oxide to reduce its melting point. [1]

.....

(ii) Aluminium metal is released at the cathode according to the following electrode equation.

$$Al^{3+} + 3e^- \longrightarrow Al$$

Balance the electrode equation for the reaction that takes place at the anode. [1]

$$\square\ O^{2-} - \square\ e^- \longrightarrow O_2$$

(b) Lead can be produced by the electrolysis of molten lead(II) bromide, $PbBr_2$.

(i) Complete the balanced electrode equation for the reaction that takes place at the cathode. [2]

..... + ... $\longrightarrow$ Pb

(ii) Explain the formation of bromine during the electrolysis of molten lead(II) bromide. [3]

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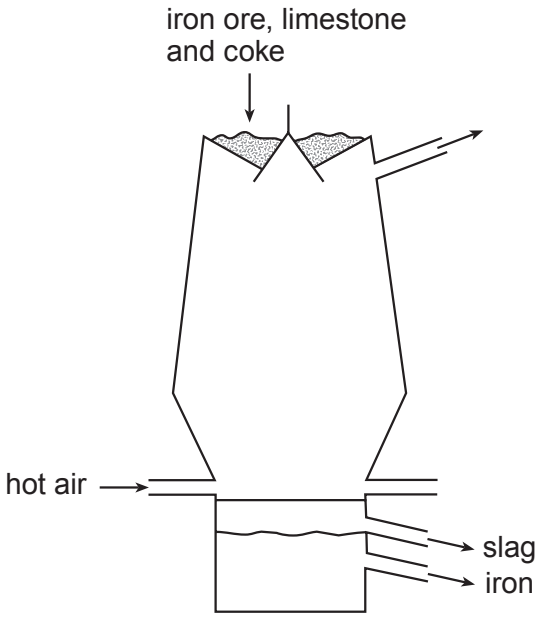
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10. The diagram below shows the blast furnace which is used to extract iron.



Give a detailed description of the extraction of iron. [6 QWC]

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END OF PAPER

6

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

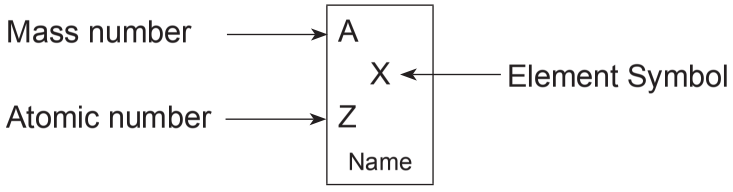
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
									$^{1}_{1}$H Hydrogen								$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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(4462-02)

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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2015

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2015 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
C1	1
C2	17
C3	32

GCSE Mark Scheme - Chemistry 1

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
1		(a)			3	A (1) D (1) C (1)			
		(b)			2	NH_3 (1) Mg^{2+} (1)	ammonia magnesium		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			1	calcium and chlorine - both needed		Ca and Cl	chloride
		(b)			1	sodium/magnesium/aluminium	Na/Mg/Al		
		(c)	(i)		1	nitrogen		N	
			(ii)		2	eg hydrogen  carbon  (1)  (1) {atoms need to touch}			
		(d)			1	H_2CO_3	CO_3H_2		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			3	**A** nitrogen (1) **B** oxygen (1) **C** argon (1)	N_2 O_2 Ar	N O	
		(b)	(i)		2	coke (1) slag (1)	carbon/C calcium silicate	coal impurities	
			(ii)		1	oxygen	O_2	O	
			(iii)		1	2 + 3 - both needed (1)			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		(a)			1	to use up / to neutralise / remove (all) the acid	to react with **all** the acid		to use **it** all up
		(b)			2	(filter) funnel (1) magnesium oxide (1)	 MgO	filter solid	
		(c)			1	mark credited for process **or** how it is carried out i.e. evaporate **or** leave on window sill / in a warm place / leave for a length of time	heat / boil	leave it	
		(d)			1	magnesium sulfate + water	$MgSO_4 + H_2O$		
		(e)			1	$MgCl_2$			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			2	biodegradable (1) reduces land fill problems (1)		 litter / recycled	
		(b)			2	starts to soften at 50°C (1) food would get 'covered' / contaminated with the plastic / plastic would melt on the food / container would lose its shape (1) **or** easy to cut with a knife (1) breaking the container (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			3	pH = 5 (1) weak acid / not very acidic (1) since grapes are eaten (1)	pH = 1 **and** acidic – 1 mark only safe to eat		
		(b)	(i)		3	all five points plotted correctly - 2 marks four points plotted correctly - 1 mark smooth curve - 1 mark	straight lines joining points (since biological data is used)		
			(ii)		1	4.4			
			(iii)		1	55 minutes - from graph ±1	if line not extrapolated accept value in the range 52-60		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)			3	B (1) m pt lower than room temperature/20°C (1) b pt higher than room temperature/20°C (1)	D m pt < 20 (1) A/C/E b pt > 20 (1)	m pt low / b pt high	
		(b)			3	E (1) good conductor of electricity (1) high m pt/b pt (1)	C high m pt/b pt (1) B good conductor (1)		
		(c)			1	malleable / ductile / high density / good conductor of heat / shiny / (generally) hard / sonorous / magnetic	rust / strong	good conductor / heavy / density	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	(a)	(i)		1	C_8H_{18}		octane	
			(ii)		1	cracking			
		(b)	(i)		1	goes milky/cloudy/white because carbon dioxide is given off			
			(ii)	I	2	(colourless) liquid / water (1) forms when hydrogen burns (1)			
				II	2	no change (1) no carbon dioxide given off because no carbon present in fuel / hydrogen does not burn to give carbon dioxide (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	(a)	(i)		1	Na_2SO_4			
			(ii)		1	ammonium fluoride ammonium sulfate magnesium fluoride magnesium sulfate - any two for one mark	NH_4F $(NH_4)_2SO_4$ MgF_2 $MgSO_4$		
		(b)			2	B (1) contains the most fluoride (1)		**lot** of fluoride	fluorine

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Question Number			
FT	HT	Mark	Answer
10	4	6	**Indicative content** Many fossil fuels contain impurities including sulfur. The sulfur produces sulfur dioxide during combustion which can eventually produce sulfuric acid resulting in acid rain. Lakes can then become acidic damaging aquatic life. Forests and vegetation gets damaged. Limestone buildings are badly affected. Acid rain also attack metal structures such as bridges. **5-6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)			1	sulfuric	H_2SO_4		
		(b)			2	any 2 of 3 points for (1) each bubbles / fizzing / effervescence (1) blue solution / colour change (1) temperature increases (1)			
		(c)			2	filter (1) evaporate water / evaporate **some** of solution / evaporate overnight / evaporate in warm place (1)	leave for **length of time** in **warm place**		
		(d)			1	copper(II) chloride + water	$CuCl_2 + H_2O$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			2	remains of sea / marine organisms / small sea animals / small plants (1) from millions of years ago / under the effect of heat/pressure / no oxygen (1)			
		(b)	(i)		1	evaporated / vaporised	boiled		
			(ii)		1	different boiling points			
		(c)			2	nitrogen (1) it has the lowest boiling point (1) do **not** award second mark if incorrect gas named			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)	(i)		2	volume of oxygen = 50.0 - 40.5 = 9.5 (1) percentage of oxygen = 9.5 x 100 = 19 50 (1) [correct answer only - 2 marks]			
			(ii)		1	not all the oxygen used up / too little copper in the tube / reaction incomplete / air not passed over enough times		leaks / apparatus not fully cooled	
			(iii)		2	remains the same / no change (1) carbon dioxide not used up /produced / does not react with Cu (1)	percentage increases because the volume of air decreases (2)		
		(b)			1	2 → 2 4			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			3	$Ba(OH)_2$ (1) Fe^{3+} (1) HPO_4^{2-} (1)			
		(b)			2	sodium loses an electron (1) bromine gains an electron (1)	electrons transferred (1)		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)	(i)		1	cryolite			
			(ii)		1	2 4			
		(b)	(i)		2	Pb^{2+} (1) + 2e (1)			
			(ii)		3	any 3 of 4 points for (1) each bromide ions are negative (1) bromide ions attracted to the anode/+ve electrode (1) loss of electrons (1) two bromide ions / bromine atoms form a bromine molecule (1) award credit for above points in suitable equations max (2) if reference to 'bromine ions' or 'bromide atoms'			award 0 if bromide ions are described as positive ions

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Question Number			
FT	HT	Mark	Answer
	10	6	**Indicative content** Temperature very high. Coke is oxidized to carbon monoxide. ($2C + O_2 \rightarrow 2CO$) Carbon monoxide reduced the iron ore to iron. ($3CO + Fe_2O_3 \rightarrow 2Fe + 3CO_2$) Molten iron flows to the bottom of the furnace. Limestone is decomposed by heat to calcium oxide and carbon dioxide. The calcium oxide reacts with the impurities (sand/silica) to form slag which flows to the bottom of the furnace and floats on the molten iron. **5-6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4462/02

W15-4462-02

SCIENCE A/CHEMISTRY

CHEMISTRY 1
HIGHER TIER

A.M. TUESDAY, 13 January 2015

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**10**	
3.	**6**	
4.	**6**	
5.	**11**	
6.	**7**	
7.	**6**	
8.	**6**	
Total	**60**	

4462
020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

If you run out of space, use a standard 4-page continuation booklet. Number the question(s) clearly and put your continuation booklet in this question-and-answer booklet. No other style of answer booklet should be used.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

Assessment will take into account the quality of written communication (QWC) in your answers to questions **3** and **8**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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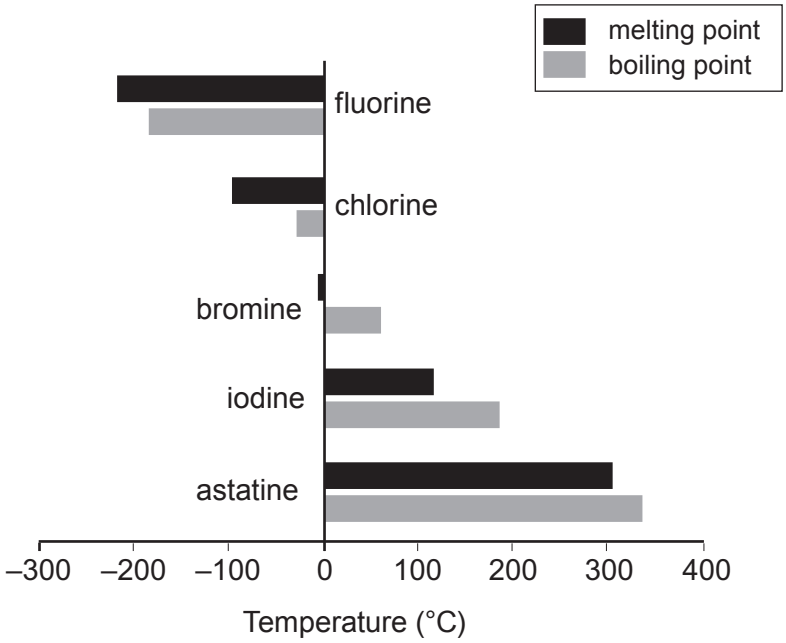
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Answer **all** *questions*.

1. *(a)* The following chart shows the melting points and boiling points of the elements in Group 7.



Give the state (solid, liquid or gas) of bromine at room temperature giving the reasons for your answer. [2]

.....

.....

.....

(b) The following table shows the observations made when some Group 7 elements react with hydrogen.

Element	Observations
chlorine	explodes in sunlight
bromine	violent reaction when heated
iodine	reacts when heated strongly

Describe the trend in reactivity within the group and use this trend to predict how astatine would react with hydrogen. [2]

.....

.....

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(c) Group 7 elements also react with iron. Balance the following symbol equation that shows the reaction of iron and fluorine. [1]

$$\square\ Fe + \square\ F_2 \longrightarrow \square\ FeF_3$$

(d) Chlorine and iodine can be extracted from seawater by electrolysis.

(i) Balance the following electrode equation showing how chlorine is formed. [1]

$$\square\ Cl^- - \square\ e^- \longrightarrow Cl_2$$

(ii) Chlorides make up 55% of the salts present in seawater and it is therefore economically viable to extract chlorine from seawater. Suggest a reason why iodine is no longer extracted in this way. [1]

.....

.....

(iii) State the property of chlorine and iodine that make them suitable for use in disinfectants and antiseptics. [1]

.....

8

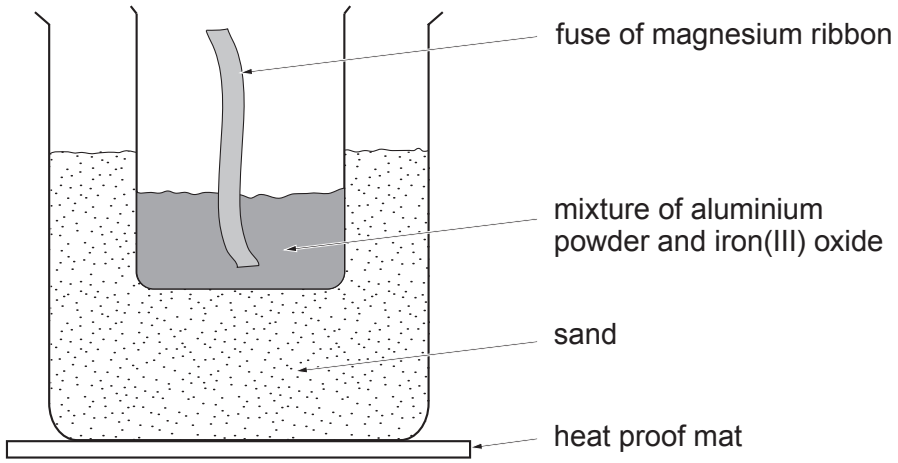
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2. *(a)* When a mixture of iron(III) oxide and aluminium powder (thermite) is heated in the apparatus shown below, there is a violent reaction. There is a bright flame, sparks are produced and molten iron is formed.



(i) Write a **word** equation for the reaction taking place. [2]

..... + ... ⟶ ..... + ...

(ii) Explain this reaction in terms of reactivity. [2]

.....

.....

.....

(iii) State how the observations would be different if the mixture were replaced with a mixture of copper powder and aluminium oxide. [1]

.....

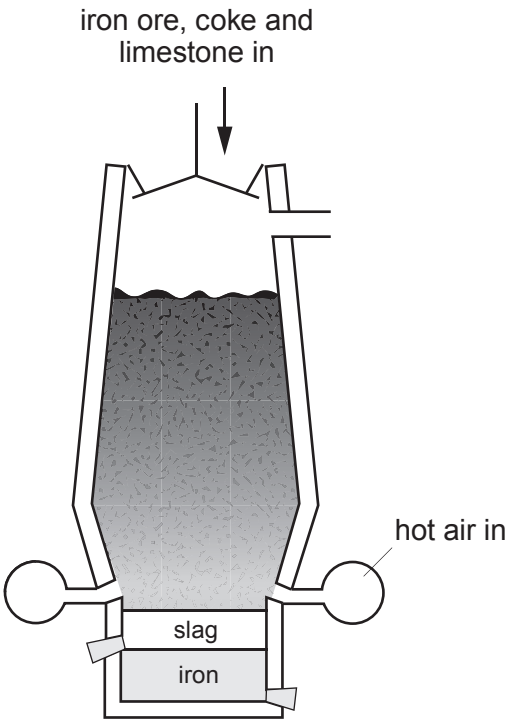
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(b) Iron is extracted from its ore in a blast furnace.



(i) State the purpose of the following raw materials. [3]

Iron ore

.....

.....

Coke

.....

.....

Limestone

.....

.....

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(ii) The following equation shows the reaction taking place.

$$Fe_2O_3 + \square\ CO \longrightarrow \square\ Fe + \square\ CO_2$$

I. Balance the equation. [1]

II. Iron(III) oxide is reduced during the reaction. Give the meaning of *reduction*. [1]

.....

.....

10

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3. Describe the properties of metals and relate these properties to the uses of **two** metals of your choice. [6 QWC]

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4. The diagram below shows the early form of the Periodic Table developed by Dmitri Mendeleev.

I	II	III	IV	V	VI	VII			
H 1.01									
Li 6.94	**Be** 9.01	**B** 10.8	**C** 12.0	**N** 14.0	**O** 16.0	**F** 19.0			
Na 23.0	**Mg** 24.3	**Al** 27.0	**Si** 28.1	**P** 31.0	**S** 32.1	**Cl** 35.5		VIII	
K 39.1	**Ca** 40.1		**Ti** 47.9	**V** 50.9	**Cr** 52.0	**Mn** 54.9	**Fe** 55.9	**Co** 58.9	**Ni** 58.7
Cu 63.5	**Zn** 65.4			**As** 74.9	**Se** 79.0	**Br** 79.9			
Rb 85.5	**Sr** 87.6	**Y** 88.9	**Zr** 91.2	**Nb** 92.9	**Mo** 95.9		**Ru** 101	**Rh** 103	**Pd** 106
Ag 108	**Cd** 112	**In** 115	**Sn** 119	**Sb** 122	**Te** 128	**I** 127			
Ce 133	**Ba** 137	**La** 139		**Ta** 181	**W** 184		**Os** 194	**Ir** 192	**Pt** 195
Au 197	**Hg** 201	**Ti** 204	**Pb** 207	**Bi** 209					
			Th 232		**U** 238				

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(a) State what information Mendeleev used to arrange the elements. [2]

.....

.....

.....

(b) State **one** difference and **one** similarity in the appearance of Mendeleev's table and today's Periodic Table. [2]

Similarity

.....

.....

Difference

.....

.....

(c) Complete the following table that shows the position of some elements in the modern Periodic Table. [2]

Element	Symbol	Group	Period
helium	.....	0	1
chlorine	Cl	7	.....
calcium	Ca	.....	.....

6

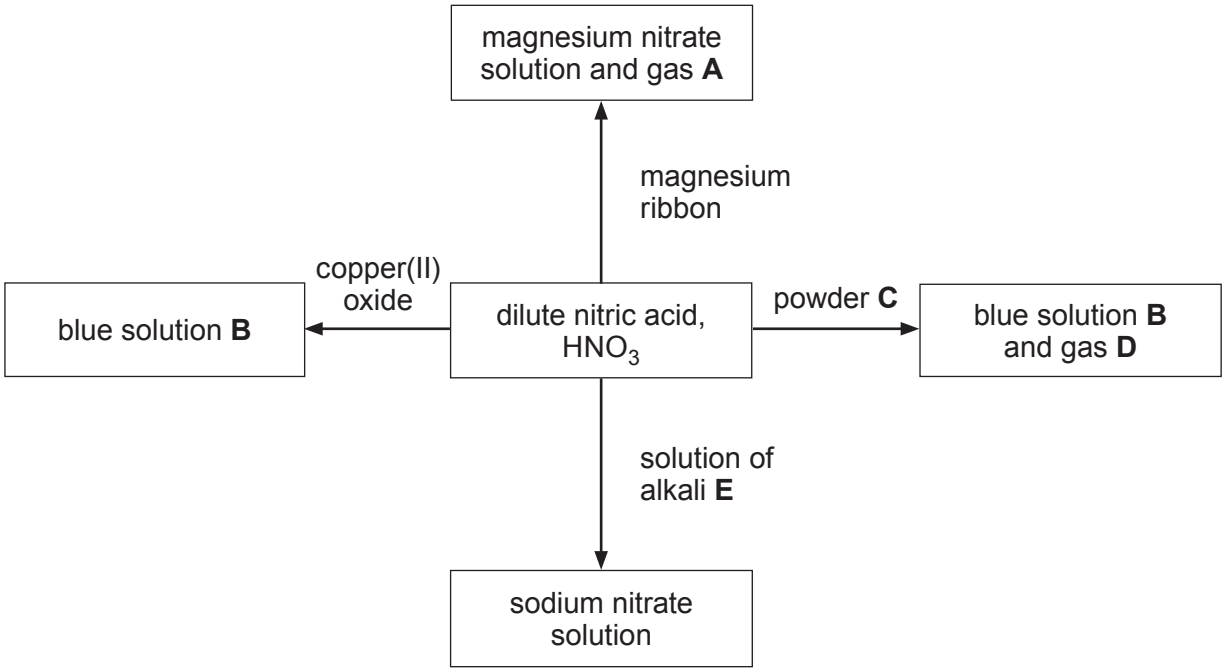
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5. *(a)* The following diagram shows some reactions of dilute nitric acid.



(i) Name the following substances. [3]

Powder **C** .....

Solution **B** .....

Alkali **E** .....

(ii) Name gases **A** and **D** and describe how they can be identified. [4]

Gas **A**

.....

.....

Gas **D**

.....

.....

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(b) When sodium hydroxide reacts with sulfuric acid a solution of sodium sulfate is produced.

(i) Give the formula of sodium sulfate. ..... [1]

(ii) Describe how crystals of sodium sulfate can be obtained from a solution of sodium sulfate. [2]

.....

.....

.....

(c) Phosphoric acid can be used to remove rust, Fe_2O_3. Balance the equation for the reaction taking place. [1]

$$Fe_2O_3 + \square\ H_3PO_4 \longrightarrow \square\ FePO_4 + \square\ H_2O$$

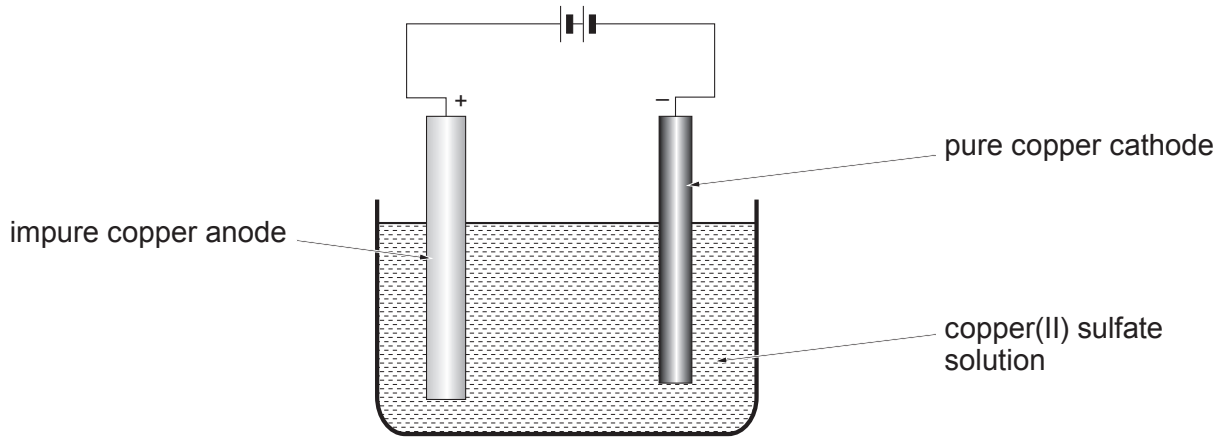
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6. Copper can be purified by electrolysis using the apparatus shown below.



(a) During the process copper(II) ions move to the cathode where they become copper atoms.

(i) Explain why copper(II) ions move towards the cathode. [2]

.....

.....

(ii) Complete and balance the following electrode equation that shows how copper forms at the cathode. [1]

..... + $\square$ e^- ⟶ Cu

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(b) A student carried out an investigation to find out how the amount of copper deposited on the cathode varied with the voltage used. He weighed the cathode at the beginning and then after 1 minute. He repeated the experiment 3 times at 5 different voltages. The results obtained are shown below.

Voltage (V)	Mass of copper deposited after 1 minute (g)			
	1	2	3	Mean
1.0	0.12	0.13	0.11	0.12
2.0	0.13	0.13	0.14	0.13
3.0	0.16	0.10	0.16	0.16
4.0	0.18	0.18	0.17	0.18
5.0	0.19	0.21	0.29	.....

(i) Using only the reliable results, calculate the mean mass of copper deposited on the cathode at 5.0 V. [1]

Mean mass of copper deposited = ... g

(ii) Calculate the percentage error of the unreliable result at 5.0 V. [1]

$$\text{Percentage error} = \frac{\text{difference between result and mean}}{\text{mean result}} \times 100\,\%$$

Percentage error = ... %

(iii) Use the results to predict the mass of copper deposited after 1 minute when a voltage of 8.0 V is applied. Give a reason for your answer. [2]

Mass deposited ..... g

Reason .....

.....

7

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7. Crude oil can be separated into fractions using fractional distillation.

(a) Explain why it is possible to separate crude oil using this process. [2]

.....

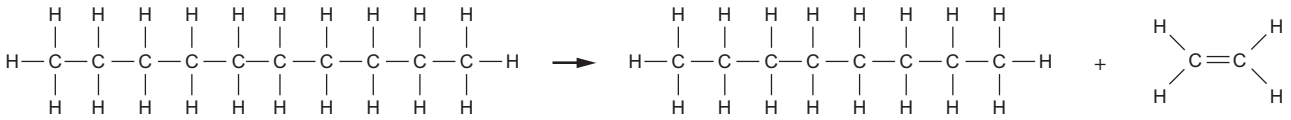
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(b) Naphtha is one fraction not usually used as a fuel. It contains decane, $C_{10}H_{22}$, which can be further processed by cracking as shown below.

decane ⟶ octane + ethene

$C_{10}H_{22}$ ⟶ C_8H_{18} + C_2H_4



State how the process is carried out and explain why it is important. [4]

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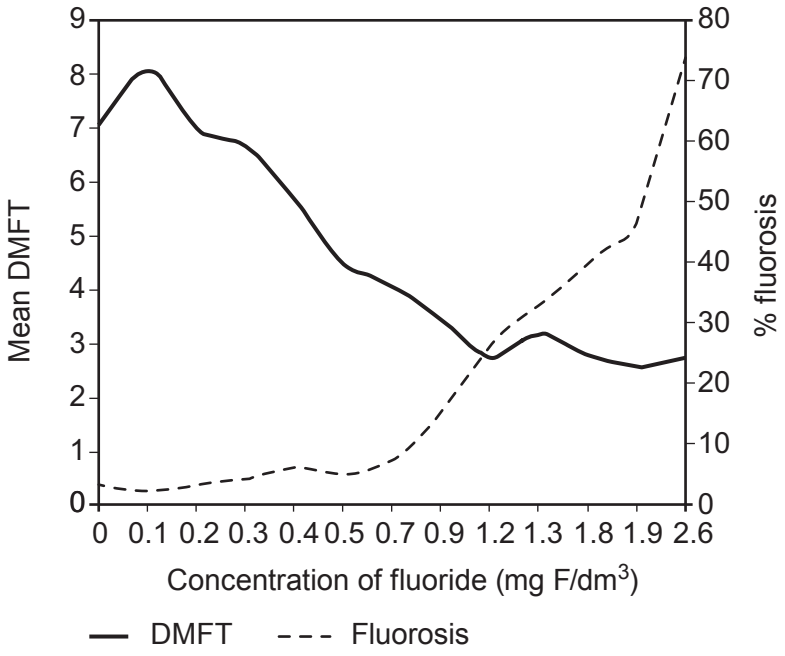
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8. Sodium fluoride is added to drinking water in some areas.

The following graph shows the effect of different levels of fluoride in drinking water on the number of decayed, missing and filled teeth (DMFT) as well as the percentage of people suffering from dental fluorosis.



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Use the graphs to discuss whether fluoride should be added to drinking water. [6 QWC]

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END OF PAPER

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

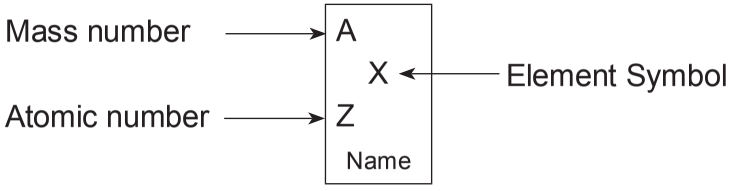
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PERIODIC TABLE OF ELEMENTS

Group 1	2											3	4	5	6	7	0
																	$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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(4462-02)

GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

JANUARY 2015

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2015 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

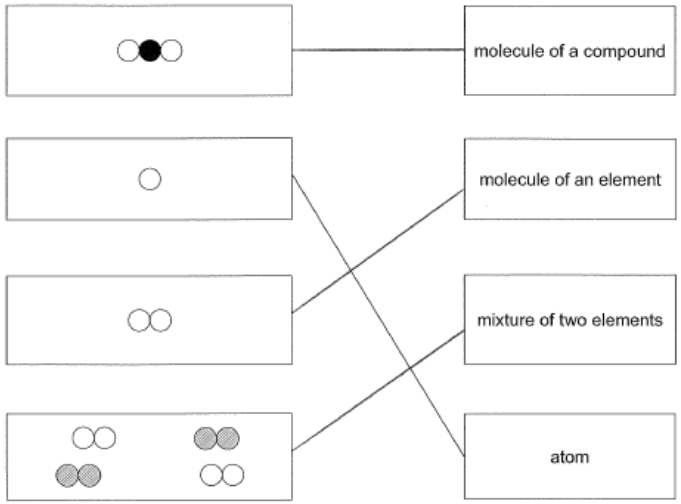
It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
C1	1
C2	15

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		*(a)*			2	 all three correct for (2) any one for (1)			
		(b)			2	A electron negative B nucleus positive all four correct for (2) any two for (1)			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
2		*(a)*			3	today's atmosphere has • less water vapour lower • less carbon dioxide lower • no / less sulfur dioxide • more nitrogen • contains oxygen / more oxygen any three for (1) each – comparison required if no credit gained, award (1) for quoting amounts of carbon dioxide **and** nitrogen in volcano and atmosphere	converse	water disappeared amounts quoted	
		(b)			2	photosynthesis (1) respiration (1)	combustion	breathing burning	
		(c)			2	carbon dioxide (1) sulfur dioxide / oxides of nitrogen (1)	formulae	methane	

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		*(a)*			4	calcium oxide (1) 2 (1) copper and sulfur (1) Na_2O (1)			
		(b)			2	● hydrogen ○ oxygen ● carbon all three correct for (2) any two for (1)		symbols	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		*(a)*	(i)		1	lemon juice			
			(ii)		1	saliva			
		(b)	(i)		2	magnesium chloride (1) water (1)	formulae		
			(ii)		2	carbon dioxide (1) gas must be correct to award test mark turns limewater milky (1)			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		*(a)*	(i)		1	compound that contains hydrogen and carbon only			mixture
			(ii)		2	decaying / remains of / dead (marine) organisms (1) heat / pressure over millions of years (1) must have reference to organisms/correct context to award second mark			
		(b)	(i)		1	bitumen and naphtha	recalled knowledge e.g. wax		
			(ii)		2	22 % (2) award (1) for 156 or 44 ecf possible for incorrect addition (must divide by 2)			
			(iii)	I	1	cracking			
				II	1	polymerisation			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		*(a)*			1	nitrogen	N_2		
		(b)			1	have the same / similar boiling points / both have boiling point of –154°C			
		(c)			2	solid (1) must be correct to award second mark cooled to below 0 °C / below its freezing point / water freezes at 0 °C (1)		water is frozen	
		(d)			1	unreactive / inert		noble non-flammable	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
7	1	*(a)*			2	liquid (1) must be correct to award second mark melting point below **and** boiling point above room temperature / 20°C (1)			
		(b)			2	less reactive down the group (1) no / very slow reaction (1)	converse		
		(c)			1	$2Fe + 3F_2 \rightarrow 2FeF_3$			
		(d)	(i)		1	$2Cl^- - 2e^- \rightarrow Cl_2$			
			(ii)		1	concentration of iodide in seawater is too low / very low	electricity too expensive		
			(iii)		1	toxic / kills bacteria		gets rid of bacteria	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	*(a)*	(i)		2	iron(III) oxide + aluminium → iron + aluminium oxide (1) for **both** reactants (1) for **both** products	correct chemical equation	powder	magnesium as reactant
			(ii)		2	aluminium more reactive than iron (1) must be correct to award second mark takes oxygen from iron / reduces iron(III) oxide (1)			
			(iii)		1	no reaction			
		(b)	(i)		3	iron ore – provides the iron (1) coke – reduces iron oxide / fuel / burns to produce heat / forms carbon monoxide (1) limestone – removes impurities (1)		makes iron source of heat forms slag	
			(ii)	I	1	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$			
				II	1	loss of oxygen / gain of electrons			

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Question Number			
FT	HT	Mark	Answer
9	3	6	**Indicative content**: e.g. **aluminium:** low density – used to build aircraft; good heat conductor – saucepans; good electrical conductor and low density – overhead power cables etc. **copper:** good electrical conductor – electrical wires; good heat conductor – saucepan bases etc. **titanium:** strong with low density – rotors on helicopters, hip replacements etc. credit can be awarded for correct uses and properties of metals not described in the specification **5–6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	4	*(a)*			2	atomic masses (1) reactions / properties of elements (1)		'relative' mass number	
		(b)			2	similarity – groups / periods (1) difference – gaps / two elements in some blocks / some elements in different groups / no noble gases or transition elements in early table (1)	no atomic number in early table / named examples of elements that have changed position	properties columns / rows	
		(c)			2	He 3 2 4 all four correct for (2) any 2 for (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	*(a)*	(i)		3	copper(II) carbonate (1) copper(II) nitrate (1) sodium hydroxide (1)	formulae		
			(ii)		4	**A** – hydrogen (1) must be correct to award second mark pop with lighted splint (1) **D** – carbon dioxide (1) must be correct to award second mark limewater turns milky (1)	H_2 CO_2	H 'pop test'	
		(b)	(i)		1	Na_2SO_4			
			(ii)		2	heat until half volume / remove some water (1) leave to form crystals (1)	evaporate	 filtration	to dryness
		(c)			1	$Fe_2O_3 + 2H_3PO_4 \rightarrow 2FePO_4 + 3H_2O$			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	*(a)*	(i)		2	Cu ions are positively charged (1) must be correct to award second mark opposite charges attract / attracted to negative electrode (1)	Cu^{2+}		
			(ii)		1	$Cu^{2+} + 2e^{-} \rightarrow Cu$			
		(b)	(i)		1	0.20			
			(ii)		1	45 % error carried forward (ecf) possible from (i)			
			(iii)		2	0.26 (1) increase of approximately 0.02 g per 1.0 V / last 3 results increase by 0.02 g per 1.0V (1) ecf possible from (i)			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	7	*(a)*			2	fractions have different length of hydrocarbon / chains / relative mass / M_r (1) must be correct to award second mark which have different boiling points (1)			
		(b)			4	conditions – heat / catalyst (1) explanation • breaks down large / less useful fractions into smaller more useful ones • increases amount of fuels obtained from the crude oil • produces raw materials or monomers for use in making plastics • less waste / more profit any three for (1) each up to max 3	break bonds between C atoms products more useful than reactants		

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Question Number			
FT	HT	Mark	Answer
	8	6	**Indicative content**: reasons for: strengthens tooth enamel and prevents tooth decay reasons against: causes fluorosis in large concentrations graph shows no further benefit above a concentration of 0.9 but increasing occurrence of fluorosis after 0.7 conclusion: should add from 0.4-0.7 as reduces DMFT but no increase in fluorosis **5–6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4462/02

SCIENCE A/CHEMISTRY

CHEMISTRY 1
HIGHER TIER

A.M. THURSDAY, 12 June 2014

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**7**	
2.	**4**	
3.	**7**	
4.	**6**	
5.	**6**	
6.	**5**	
7.	**11**	
8.	**4**	
9.	**4**	
10.	**6**	
Total	**60**	

4462
020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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Answer **all** *questions.*

1. *(a)* The table below shows some properties of three elements in the Periodic Table.

Element	Melting point (°C)	Boiling point (°C)	Appearance	Malleable or brittle?	Electrical conductivity
aluminium	660	2519	shiny solid	malleable	good
silicon	1414	3265	shiny solid	brittle	semiconductor
phosphorus	44	280	white solid	brittle	poor

Describe how the information in the table shows that silicon is difficult to classify as a metal or a non-metal. [2]

.....

.....

.....

(b) Give the **symbol** of the element which is found in Group 2 and Period 3 of the Periodic Table. [1]

.....

(c) (i) The chemical formula of copper(II) nitrate is $Cu(NO_3)_2$. Give the number of nitrogen atoms in the formula $Cu(NO_3)_2$. [1]

.....

(ii) Give the chemical formula of silver oxide. [1]

.....

(d) Nano-scale silver particles are added to socks to reduce the effects of smelly feet. Recent research has found that these particles can easily leak into waste water during washing.

(i) State the property of nano-scale silver particles that makes them useful in socks.

..... [1]

(ii) Suggest a reason why some scientists are concerned about nano-scale silver particles entering waste water. [1]

.....

.....

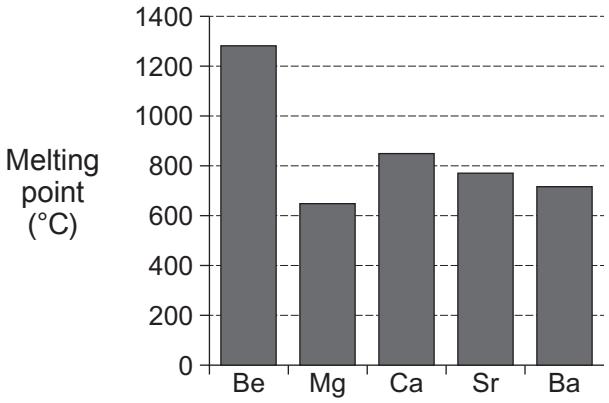
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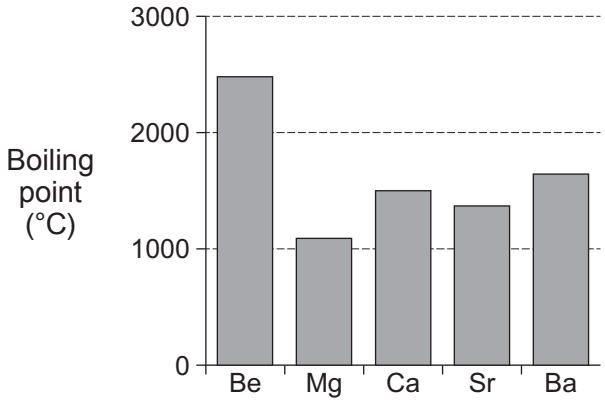
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2. *(a)* The graphs below show the melting points and boiling points of Group 2 elements.





Use the information in the graphs to describe the trends, if any, in the melting point and boiling point of Group 2 elements. [2]

Melting point .....

.....

Boiling point .....

.....

(b) The table below describes the reactions of Group 2 elements when added to cold water.

Group 2 Element	Reaction when added to cold water
beryllium	no reaction
magnesium	very slow reaction
calcium	fairly vigorous reaction
strontium	very fast reaction

Barium lies below strontium in Group 2. State, giving a reason, how you would expect barium to react with cold water. [2]

.....

.....

4

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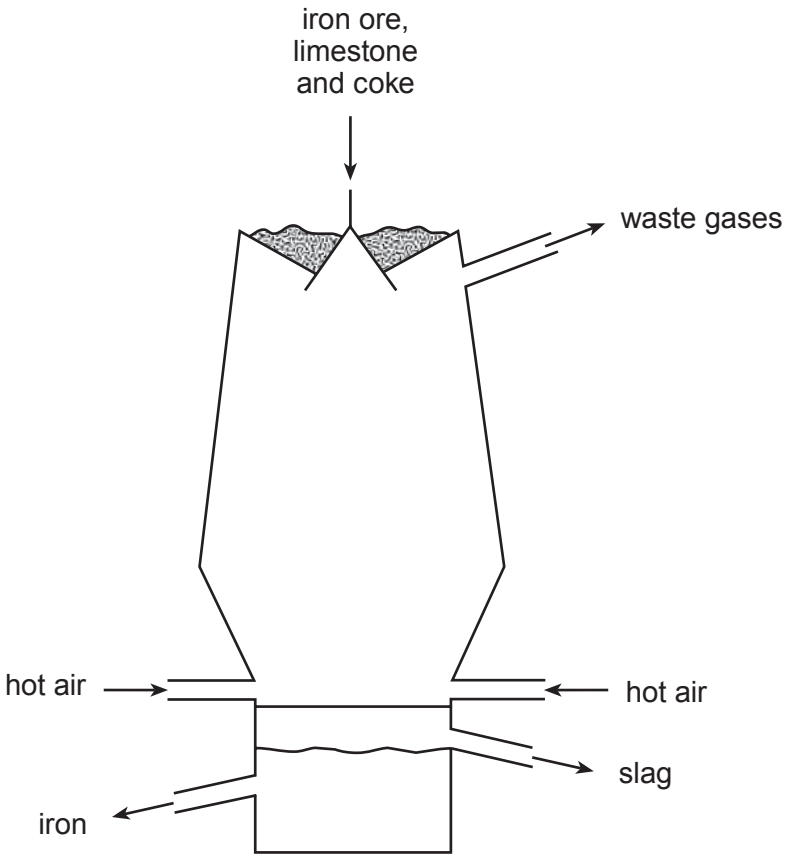
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3. *(a)* Iron is extracted in the blast furnace. Iron ore, limestone, coke and hot air are the raw materials.



(i) Give the reason for adding each of the following to the furnace:

I coke; [1]

.....

II limestone. [1]

.....

(ii) I Balance the symbol equation that represents the main reaction occurring in the furnace. [1]

Fe_2O_3 + ☐ CO ⟶ ☐ Fe + ☐ CO_2

II Give the chemical name of the substance which is reduced in the furnace. [1]

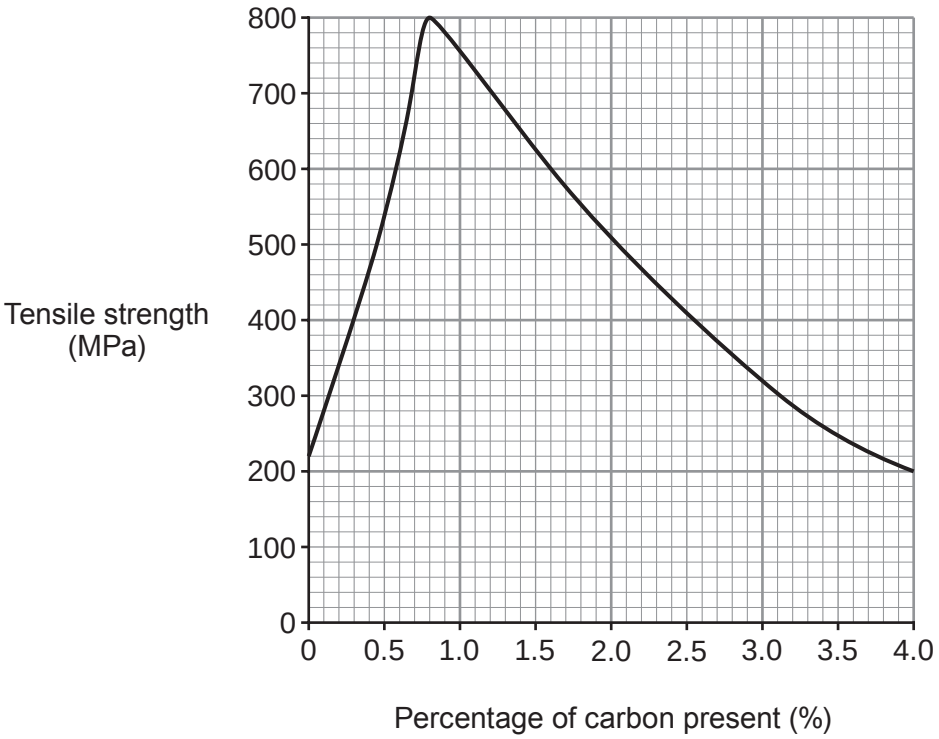
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(b) The graph below shows how the tensile strength of iron alloys changes with the percentage of carbon present.



(i) Describe how the tensile strength changes as the percentage of carbon present increases. [2]

.....

.....

(ii) The table below shows the percentage of carbon present in some iron alloys.

Alloy of iron	Percentage of carbon present in the alloy (%)
wrought iron	0.1
mild steel	0.3
high-carbon steel	0.9
cast iron	3.6

Use the information in the table and the graph to name the alloy which has the **lowest** tensile strength. [1]

.....

7

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4. Explain, giving examples, why plastics have replaced traditional materials such as iron, glass and wood for making many everyday things. [6 QWC]

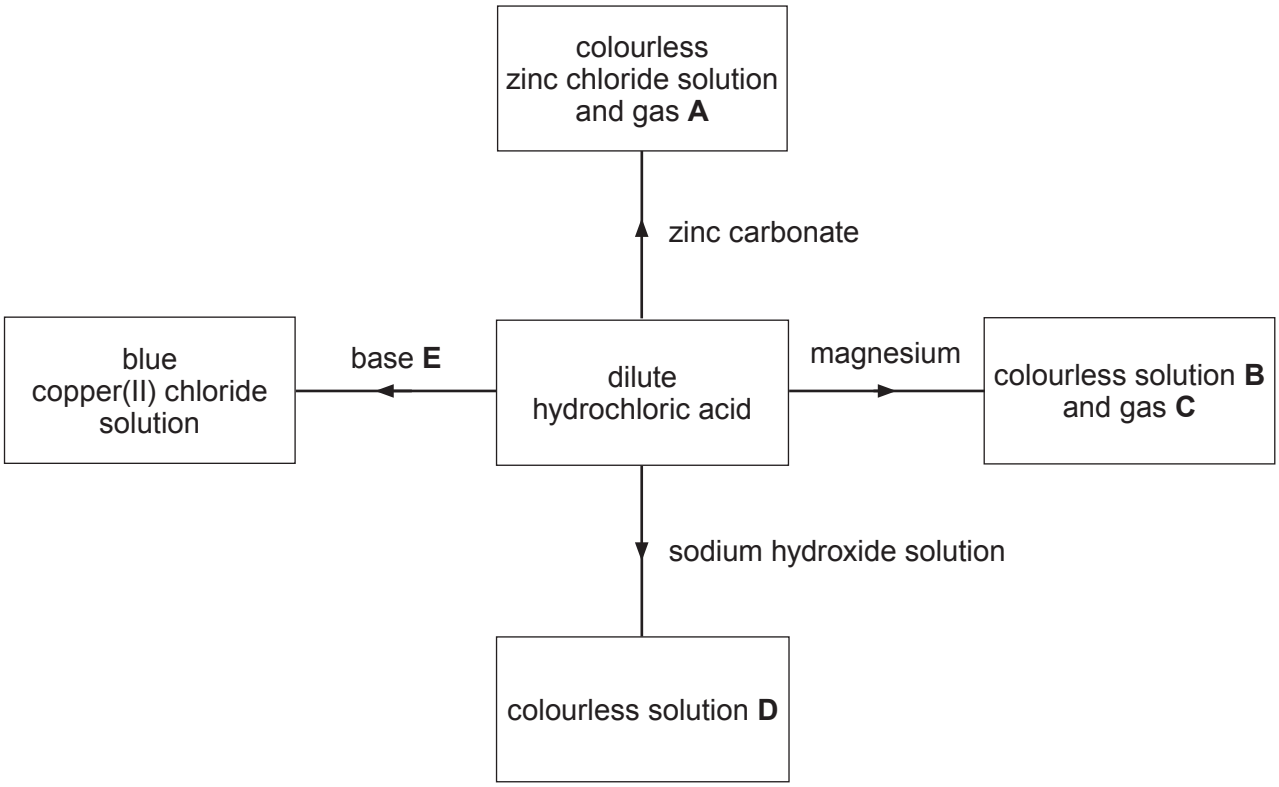
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5. The diagram below shows some reactions of dilute hydrochloric acid.



(a) Give the names of each of the substances **A** to **E**. [5]

A .....

B .....

C .....

D .....

E .....

(b) Give the chemical formula of zinc chloride. [1]

.....

6

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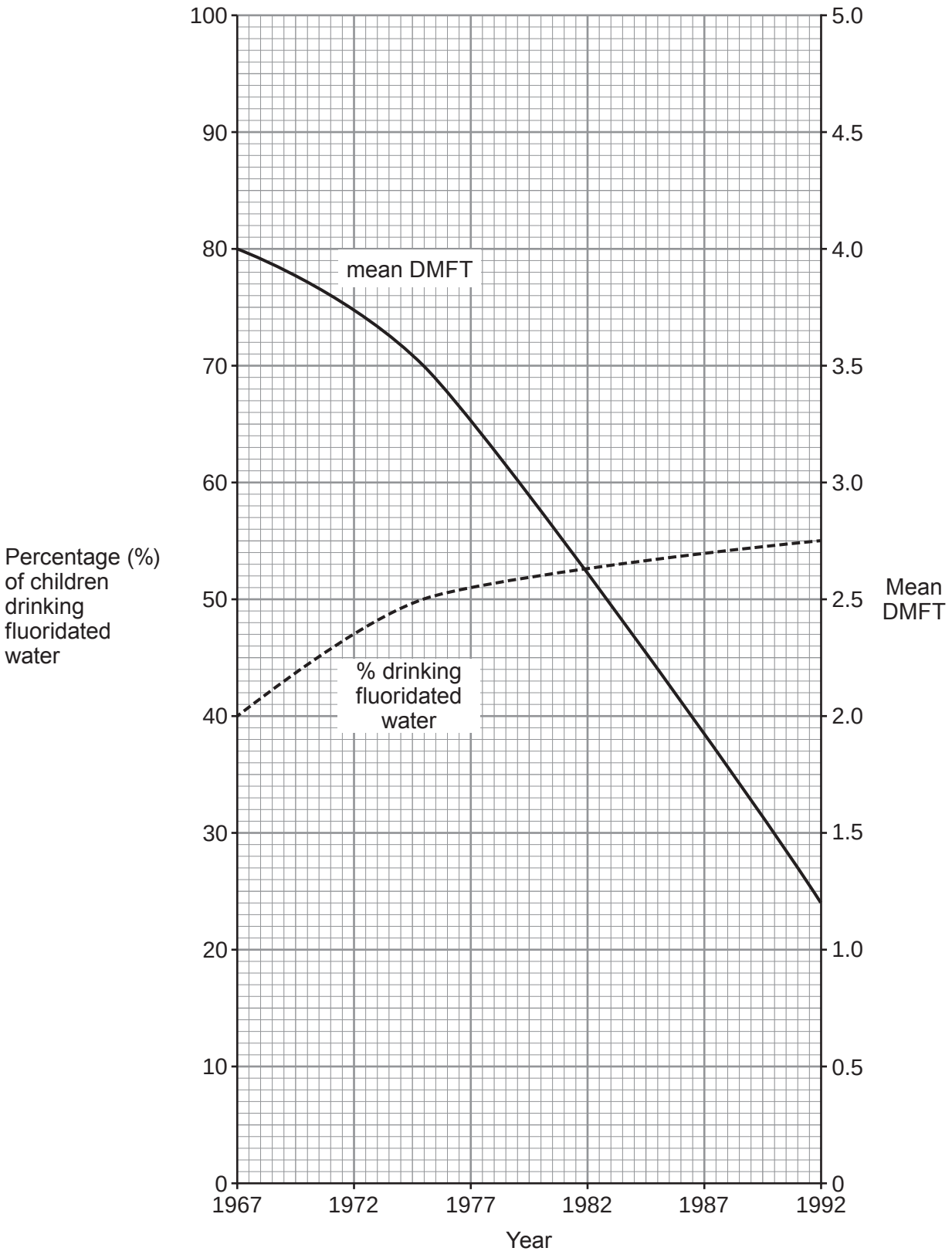
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6. The graphs below show the results of research on the effect of water fluoridation on the teeth of children aged 12 years in the United States.

(DMFT = number of decayed, missing or filled teeth)



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(a) Calculate the percentage decrease in the mean DMFT between 1967 and 1992. [2]

Percentage decrease in the mean DMFT = ... %

(b) Apart from drinking water, give **one** *other* source of fluoride which could reduce tooth decay. [1]

.....

(c) In your opinion, do the advantages of the fluoridation of drinking water outweigh the disadvantages? Explain your reasoning. [2]

Opinion (**Yes** or **No**) .....

Explanation

.....

.....

.....

5

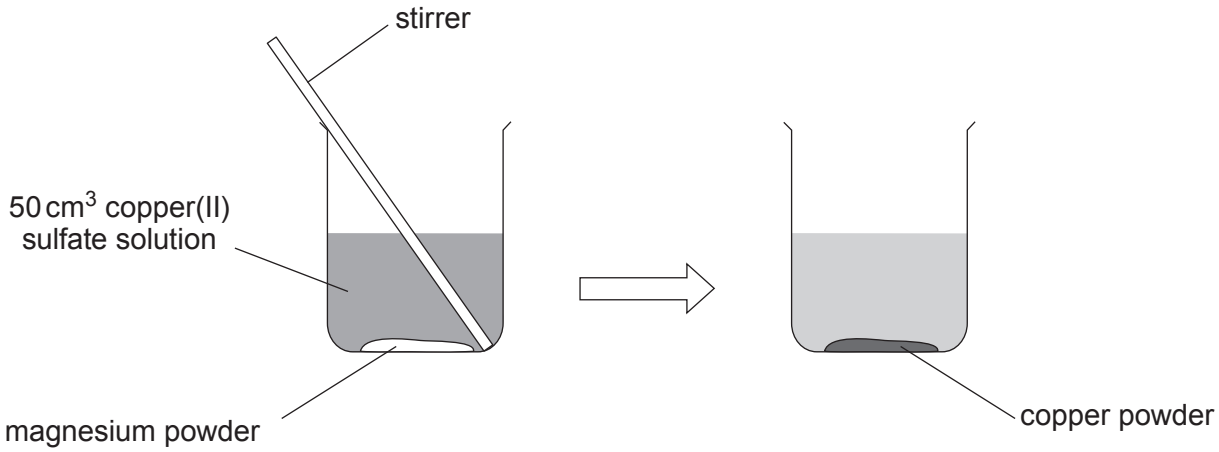
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7. Three students individually investigated the mass of copper formed when increasing amounts of magnesium powder were added to 50 cm^3 of copper(II) sulfate solution.



- Each pupil added 0.10 g of magnesium to 50 cm^3 of copper(II) sulfate solution and stirred the mixture until no more magnesium remained.
- They filtered, dried and weighed the copper formed.
- They repeated the experiment using 0.15, 0.20 and 0.25 g of magnesium powder and a new 50 cm^3 of copper(II) sulfate solution each time.
- The results are shown below.

Mass of magnesium added (g)	Mass of copper formed (g)			
	Student **A**	Student **B**	Student **C**	Mean
0.10	0.15	0.10	0.17	0.14
0.15	0.25	0.21	0.23	0.23
0.20	0.37	0.36	0.32	0.35
0.25	0.37	0.42	0.38	0.39

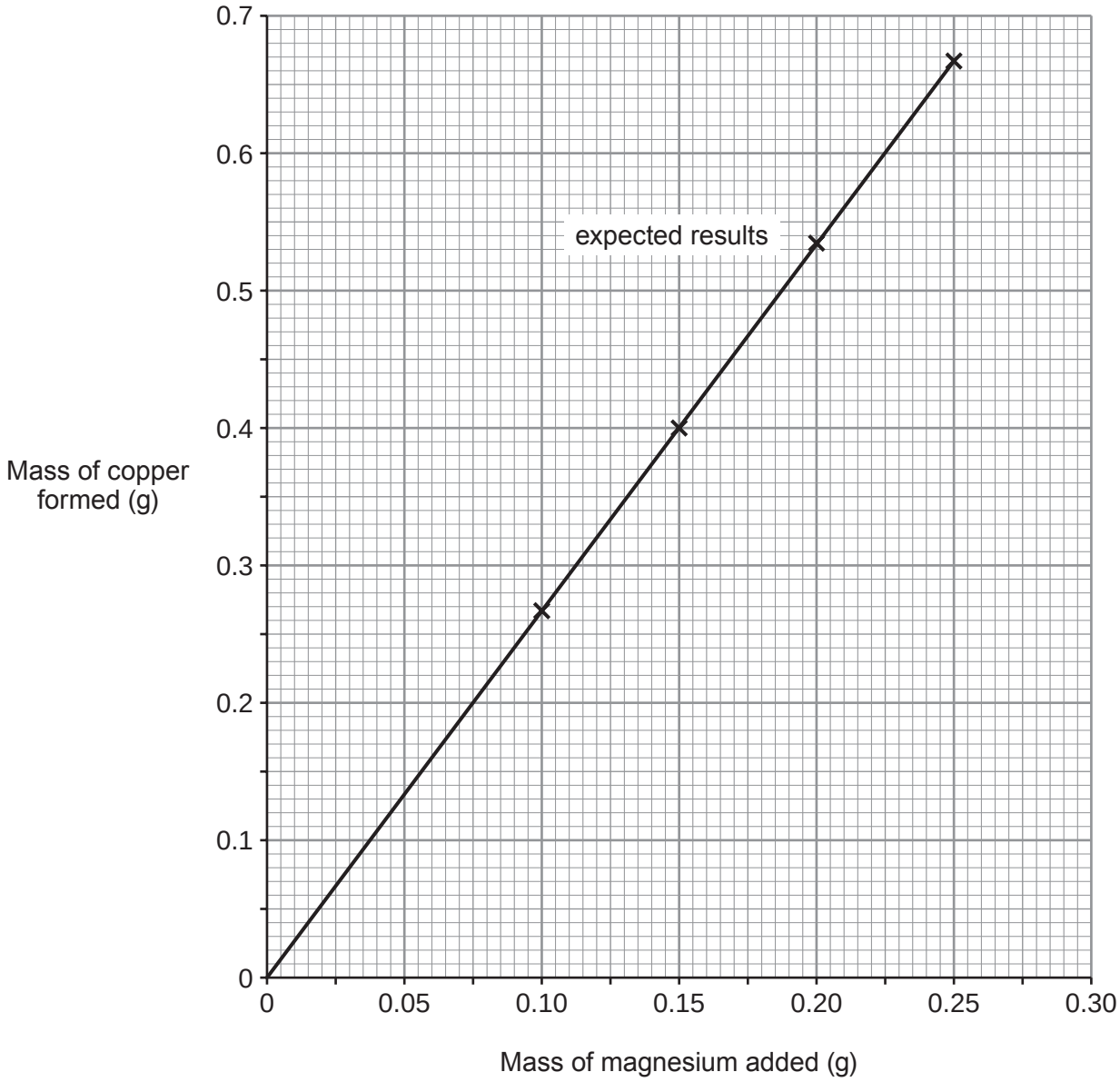
The graph opposite shows the masses of copper that **should** be formed.

(a) On the same grid plot the mean mass of copper formed against the mass of magnesium added. Draw a suitable line. [3]

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(b) Describe the **main** difference between the expected graph and the one plotted using the experimental results. [1]

.....

(c) Suggest **two** possible reasons for the difference in the graphs. [2]

.....

.....

.....

.....

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(d) On Anglesey there is a large copper mine called Parys Mountain. Unwanted rock from the mining process has been dumped forming waste tips. As rainwater passes through the waste tips it dissolves copper salts. One of the salts is copper(II) sulfate.

During the 18th century large shallow pits were dug all over the mountain. These filled with rainwater. Scrap iron was placed into the water and after a few months the pits were drained and a copper-rich solid sludge was collected.



Explain the reaction taking place in the pits. [3]

.....

.....

.....

.....

(e) Copper is a good electrical conductor and is therefore used to make electrical wiring. Give a **different** property of copper and **one** use which relies on this property. [2]

Property .....

Use .....

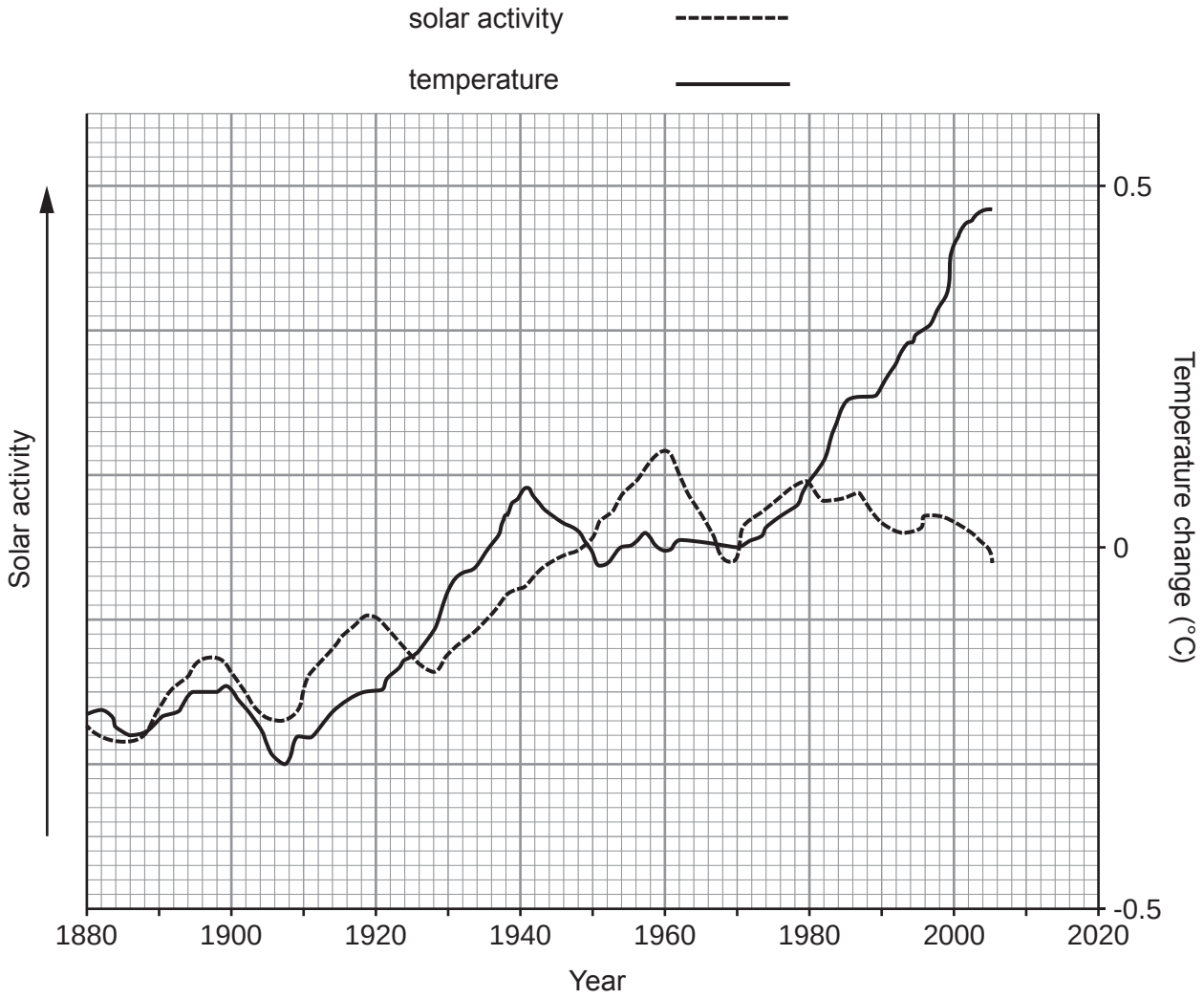
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8. *(a)* A small minority of scientists believe that it is changes in solar activity (i.e. changes in the brightness and warmth of the sun) that causes global warming. The graphs below show the changes in solar activity and atmospheric temperature since 1880.



Using the information from the graphs, state how well the evidence supports the argument that solar activity is the cause of global warming. [2]

.....

.....

(b) Most scientists believe the main cause of global warming is the increase in carbon dioxide levels in the atmosphere.

(i) State the **main** cause of this increase in carbon dioxide levels. [1]

.....

(ii) Describe **one** method of reducing current atmospheric carbon dioxide levels. [1]

.....

4

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9. The table below shows the relative *'supply of'* and *'demand for'* some fractions obtained from a sample of crude oil from the North Sea.

Fraction	% mass of fraction	
	In crude oil *(supply of)*	Market demand *(demand for)*
C_1-C_4	2	5
C_5-C_8	12	28
C_9-C_{12}	7	20
C_{13}-C_{16}	15	25
C_{17}-C_{20}	35	15
C_{21}-C_{24}	19	5
C_{25}+	10	2

(a) Give a reason why market demand for the C_5-C_8 fraction is high. [1]

.....

(b) The supply of the C_5-C_8 fraction is less than the market demand. Explain how oil companies overcome this problem. [2]

.....

.....

.....

(c) One hydrocarbon found in the C_1-C_4 fraction is propane. Propane burns in air forming carbon dioxide and water.

Balance the symbol equation that represents this reaction. [1]

C_3H_8 + ☐ O_2 ⟶ ☐ CO_2 + ☐ H_2O

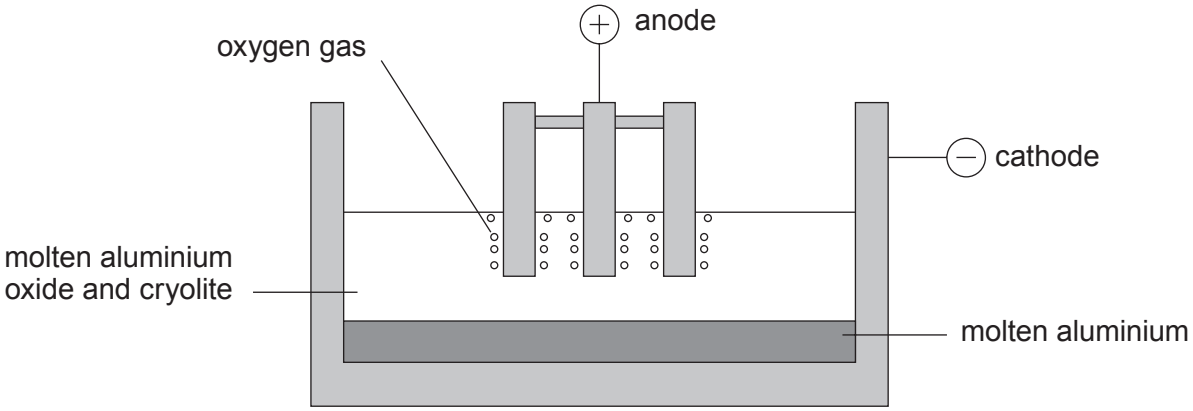
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10. The diagram below shows an electrolysis cell used in the extraction of aluminium.



Outline the industrial extraction of aluminium. [6 QWC]

END OF PAPER

6

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	Formula	Name	Formula
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

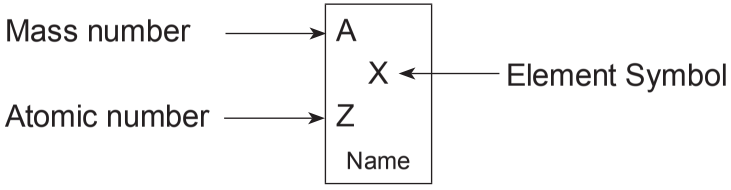
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2014

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2014 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
C1	1
C2	19
C3	36

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Chemistry 1 – Foundation tier only questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
1		*(a)*			1	copper oxide / (black) solid remains copper oxide / (black) solid stops reacting		an excess blue solution	
		(b)	(i)		1	filter / filtration / filtering			
			(ii)		1	water / H_2O (ignore incorrect formula if given with correct name)			
		(c)	(i)		1	copper oxide / CuO (ignore incorrect formula if given with correct name)			
			(ii)		1	copper sulfate / $CuSO_4$ (ignore incorrect formula if given with correct name)		water	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		*(a)*			1	oxygen	O_2	air O	
		(b)			2	sulfur dioxide (1) carbon (1)	SO_2 C	SO	
		(c)			3	(wood) burns forming carbon dioxide / combustion produces carbon dioxide (1) trees take in carbon dioxide/ photosynthesis uses carbon dioxide (1) 3rd marking point can only be awarded when first two are given carbon dioxide kept in balance (1)	 woods / forests / plants cancels out / remains equal	 'the wood'	

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
3		*(a)*			2	resists corrosion (1) lasts longer than iron (1) – linked to 1st mark or low density (1) easier to install (1) – linked to 1st mark	less maintenance / weather resistant	iron rusts doesn't rust forms oxide layer	
		(b)	(i)		1	oxide / O^{2-}			oxygen O_2^-
			(ii)		1	aluminium oxide → aluminium + oxygen	$Al_2O_3 \rightarrow Al + O_2$ (ignore any attempt to balance)	reference to 'molten' aluminium oxide and oxygen 'gas'	
			(iii)		1	liquid / l			
			(iv)		1	lot / large amount of electricity used lot / large amount of energy used electricity is expensive		a lot of heat needed	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		*(a)*	(i)		1	sodium and chloride Na^+ and Cl^-			chlorine Na / Cl
			(ii)		1	NaCl	Na^+Cl^-		
		(b)			1	too little present / concentration very small / concentration of iodide ions much smaller than that of chloride / it would take a lot of seawater to get a small amount of iodide from it	reference to chlorine / iodine	reference to cost or energy quoting numbers from table	

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
5		*(a)*	(i)		1	any value in the range 40-100		a range within the range given e.g. 50-90	
			(ii)		1	15	C_{15}		
			(iii)		1	range of boiling points / range of numbers of carbon atoms / chain lengths			all fractions have different boiling points
		(b)			1	10 (ignore any number written in box)			
		(c)			1	cracking			

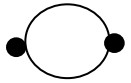
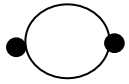
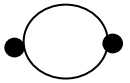
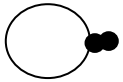
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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		*(a)*			1	2.8			2.6
		(b)			1	can agree or disagree with statement – mark awarded for reason Yes …. as percentage fluoridation increases, the mean DMFT decreases or No ….. the mean DMFT decreased most sharply during years when the increase in percentage of children drinking fluoridated water was at its lowest			
		(c)			2	any 2 for (1) each up to 2 max (may) cause cancer / bone cancer discolours teeth / fluorosis poisonous at high concentration / (may cause) brittle bones / (may cause) IBS / (may cause) thyroid problems mass medication / takes away freedom of choice / unethical can get fluoride from toothpaste / mouthwash			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7		*(a)*	(i)		1	electrolysis			
			(ii)	I	2	all points plotted correctly ± ½ square (1) straight line through all points - ruler must be used (1)			
				II	2	straight line (ruler used) from (0,0) to (10,10) (2) or straight line from (0,0) and anywhere below hydrogen line (1)			
		(b)			2	 correct representation of a water molecule (1)  two water molecules shown (1)	H—O—H 2 		

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Chemistry 1 – Common questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	1	*(a)*			2	(silicon difficult to classify) because it has metallic and non-metallic properties (1) response clearly indicating one or more metallic property and contrasting non-metallic property, e.g. it has a high melting point/boiling point like a metal but is brittle like a non-metal (2)	semi-metal / metalloid		it is a metal and a non-metal
		(b)			1	Mg (ignore atomic number / mass number)		magnesium	
		(c)	(i)		1	2			
			(ii)		1	Ag_2O	$Ag^{+}{}_2O^{2-}$		
		(d)	(i)		1	antibacterial / antiviral / antifungal	kills germs / kills bacteria / antiseptic	disinfectant reduces smells	
			(ii)		1	silver nanoparticles can get into drinking water / water supplies / lakes / rivers could be dangerous to health / harmful / toxic don't know the effect / long term effect not known *uncertainty* must *be implied*		reference to the air / atmosphere / rain pollutes water / the environment	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	2	*(a)*			2	melting points decrease (down the group) / decrease but Mg doesn't fit the pattern (1) boiling points have no trend (1)		 boiling points go up and down	
		(b)			2	extremely fast / explosively / even faster than strontium .....*must imply greater than 'very fast'* (1) reactivity increases down Group 2 / reactivity increases down the group / reaction gets quicker down the group (1)		 barium lies below strontium / reaction gets stronger down the group	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
10	3	*(a)*	(i)	I	1	to burn / act as fuel / heat the furnace to form carbon monoxide	 to reduce iron ore / iron oxide		
				II	1	remove impurities / sand / silica react with impurities / sand / silica		to form slag purify the iron	
			(ii)	I	1	$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$			
				II	1	iron oxide / iron(III) oxide		Fe_2O_3 iron ore / haematite	Fe
		(b)	(i)		2	*basic comment* it increases then decreases (1) *higher level comment with use of numerical data* it increases to a maximum with 0.8 (% carbon) then decreases / it increases up to 800 (MPa) then decreases (2)			
			(ii)		1	cast iron		3.6	

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Question Number			
FT	HT	Mark	Answer
11	4	6 QWC	Indicative content Reference to useful properties of plastics compared with properties of traditional materials Plastic properties: low density, thermal insulator, electrical insulator, waterproof, strong, easily coloured, non-biodegradable (doesn't corrode, erode or rot), cheap, can now be made biodegradable Properties of plastics vs properties of traditional materials for uses, such as: window frames, electrical wire covering, saucepan handles, drain pipes, buckets, carrier bags, bottles etc. 5-6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.

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Chemistry 1 – Higher tier only questions

Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	*(a)*			5	A carbon dioxide / CO_2 B magnesium chloride / $MgCl_2$ C hydrogen / H_2 D sodium chloride / NaCl E copper(II) oxide / CuO copper(II) hydroxide / $Cu(OH)_2$	copper oxide copper hydroxide		$CuCO_3$
		(b)			1	$ZnCl_2$	$Zn^{2+}Cl^{-}_2$ $Zn(Cl)_2$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	*(a)*			2	4.0-1.2 = 2.8 (1) $\frac{2.8}{4.0} \times 100 = 70\,\%$ (1) consequential marking correct answer only (2)	65 % for 2nd mark		2.6
		(b)			1	toothpaste / mouthwash / fortified milk drinks / fortified yogurt			
		(c)			2	no mark for opinion answer includes simple reference to one disadvantage or advantage (1) statement conveys why advantage outweighs disadvantage or vice versa – must reference opposite viewpoint (1) e.g. Yes – reduces tooth decay but many think it is unethical – 2 marks No – mass medication although it does prevent tooth decay – 2 marks			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	7	*(a)*			3	all points plotted correctly (2) any 3 correct (1) line of best fit from the origin (0,0) (using a ruler) (1)			
		(b)			1	experimental results below expected ones / experimental results not on a straight line	less copper formed	reference to accuracy erratic results	
		(c)			2	any 2 sensible possible errors in procedure for (1) each e.g. • not all magnesium reacted / insufficient stirring • magnesium not clean / had reacted before experiment / turned to oxide • not all copper retrieved / copper left behind in beaker / filter • not drying sufficiently • inaccurate weighing (2) max			

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(d)			3	displacement / iron removes copper from solution / copper reduced and iron oxidised (1) products named (could be in equation) iron sulfate and copper $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ (1) explanation in terms of reactivity e.g. iron more reactive / higher in reactivity series than copper (1)			
(e)			2	property (1) use (1) *must relate to property* e.g. (good) thermal conductor .....saucepans high melting point..... saucepans does not corrode.....coins/jewellery does not react with water.....(water) pipes malleable ……. pipes/jewellery ductile …….. wiring shiny/coloured/lustrous …… jewellery sonorous …….. bells			electrical conductivity

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	*(a)*			2	evidence is initially strong then not (1) increase in solar activity accompanied by increase in temperature / upward trend in both followed by breakdown of trend (1)			
		(b)	(i)		1	increase in the burning of (fossil) fuels / increase in the use of (fossil) fuels	'fuels' = named fuels e.g. coal, petrol, etc.	deforestation	
			(ii)		1	• carbon capture • burning less (fossil) fuels *any sensible method of using less fossil fuels* *e.g. walking instead of using the car, switching off lights, etc* • use alternative energy sources *accept a named alternative energy source* *e.g. solar (panels), wind (turbines), etc* • reduce deforestation / plant more trees			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	*(a)*			1	they are used as fuels / it is the petrol fraction / they are easier to burn			C_5-C_8 produces more energy
		(b)			2	cracking (1) converting large molecules into smaller ones / converting large molecules into more useful ones (1)			
		(c)			1	$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$			

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Question Number			
FT	HT	Mark	Answer
	10	6 QWC	Indicative content Reference to reasons relating to choice of process, rationale for conditions, reasons why products are formed at electrodes, electrode equations e.g. aluminium high in reactivity series / aluminium is a reactive metal aluminium oxide stable ∴ electrolysis used molten electrolyte necessary to allow ions to move electrolysis expensive due to high amount of electricity needed cryolite added to reduce melting point ∴ reduce amount of energy needed Al^{3+} ions attracted to cathode (– electrode) and O^{2-} ions attracted to anode (+ electrode) electrode equations / overall equation 5-6 marks The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3-4 marks The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1-2 marks The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4462/02

SCIENCE A/CHEMISTRY

CHEMISTRY 1
HIGHER TIER

A.M. TUESDAY, 14 January 2014

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**9**	
3.	**4**	
4.	**6**	
5.	**8**	
6.	**8**	
7.	**5**	
8.	**9**	
9.	**6**	
Total	**60**	

4462
020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correcting fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **9**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

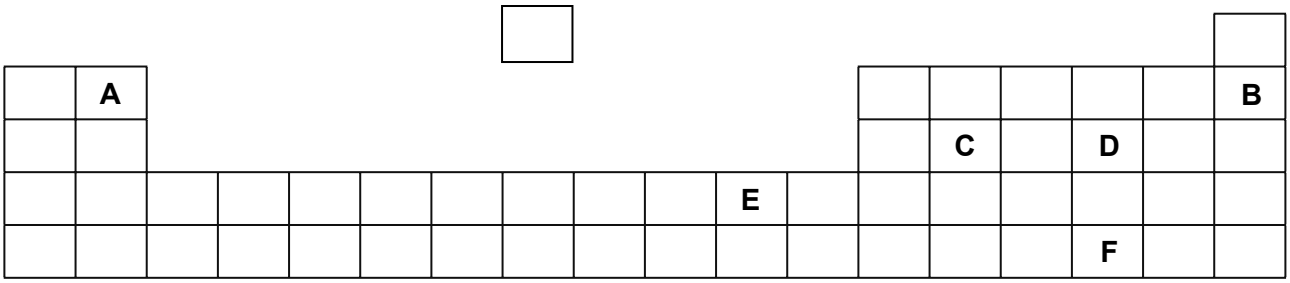
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Examiner only

Answer **all** questions.

1. The following diagram shows an outline of the Periodic Table.
The letters shown are NOT the chemical symbols of the elements.



(a) Give the **letter** of the element which is found in Group 0 and Period 2. [1]

.....

(b) Give the **letters** of the **two** elements which you would expect to have similar chemical properties. Give a reason for your choice.

Letters ..... and .....

Reason ..... [2]

(c) The table below shows the properties of three elements **1**, **2** and **3**.

Element	Properties			
	Melting Point (°C)	Boiling Point (°C)	Appearance	Malleable or brittle
1	1084	2927	shiny brown solid	malleable
2	1414	2900	shiny grey solid	brittle
3	115	445	yellow solid	brittle

State, giving reasons, which of elements **1**, **2** or **3** could be element **C** in the Periodic Table above. [2]

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5

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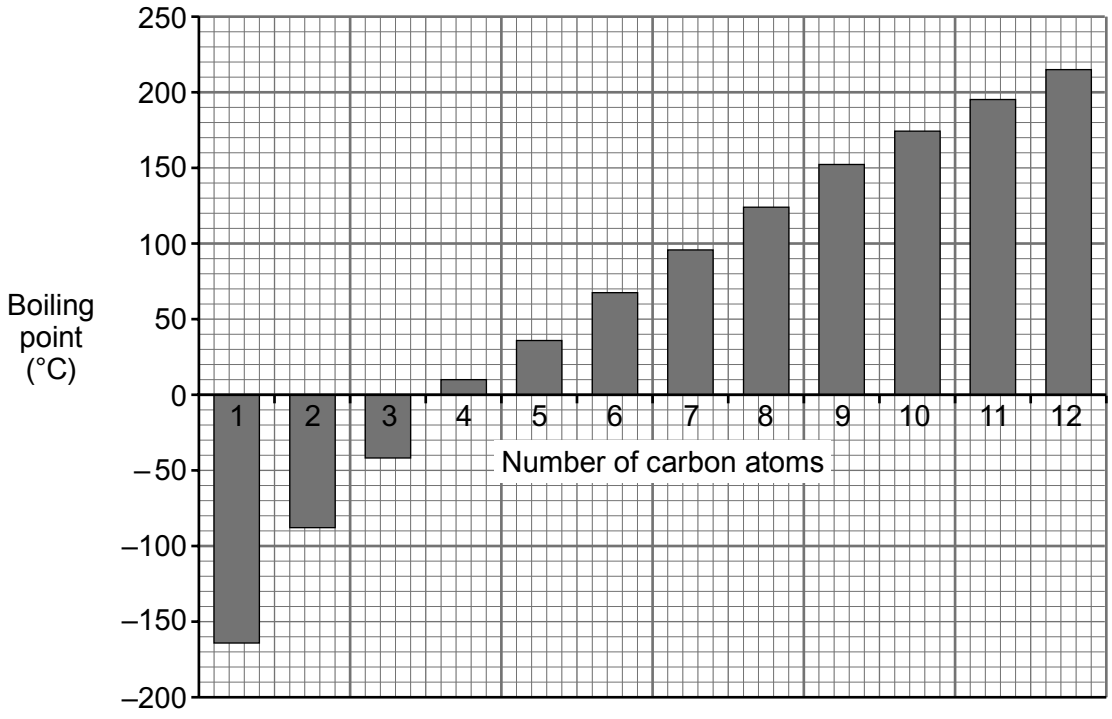
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Examiner only

2. *(a)* Crude oil can be separated into simpler mixtures, called fractions, which contain hydrocarbon compounds with boiling points within a similar range.

The graph below shows the boiling points of hydrocarbons containing 1 to 12 carbon atoms.



(i) Give the number of carbon atoms in the hydrocarbon which has the **lowest** boiling point. [1]

.....

(ii) State how the boiling point changes as the number of carbon atoms increases. [1]

.....

(iii) A company wants to produce a fraction with a boiling point in the range 120–140 °C.
Give the number of carbon atoms present in the hydrocarbons found in this fraction. [1]

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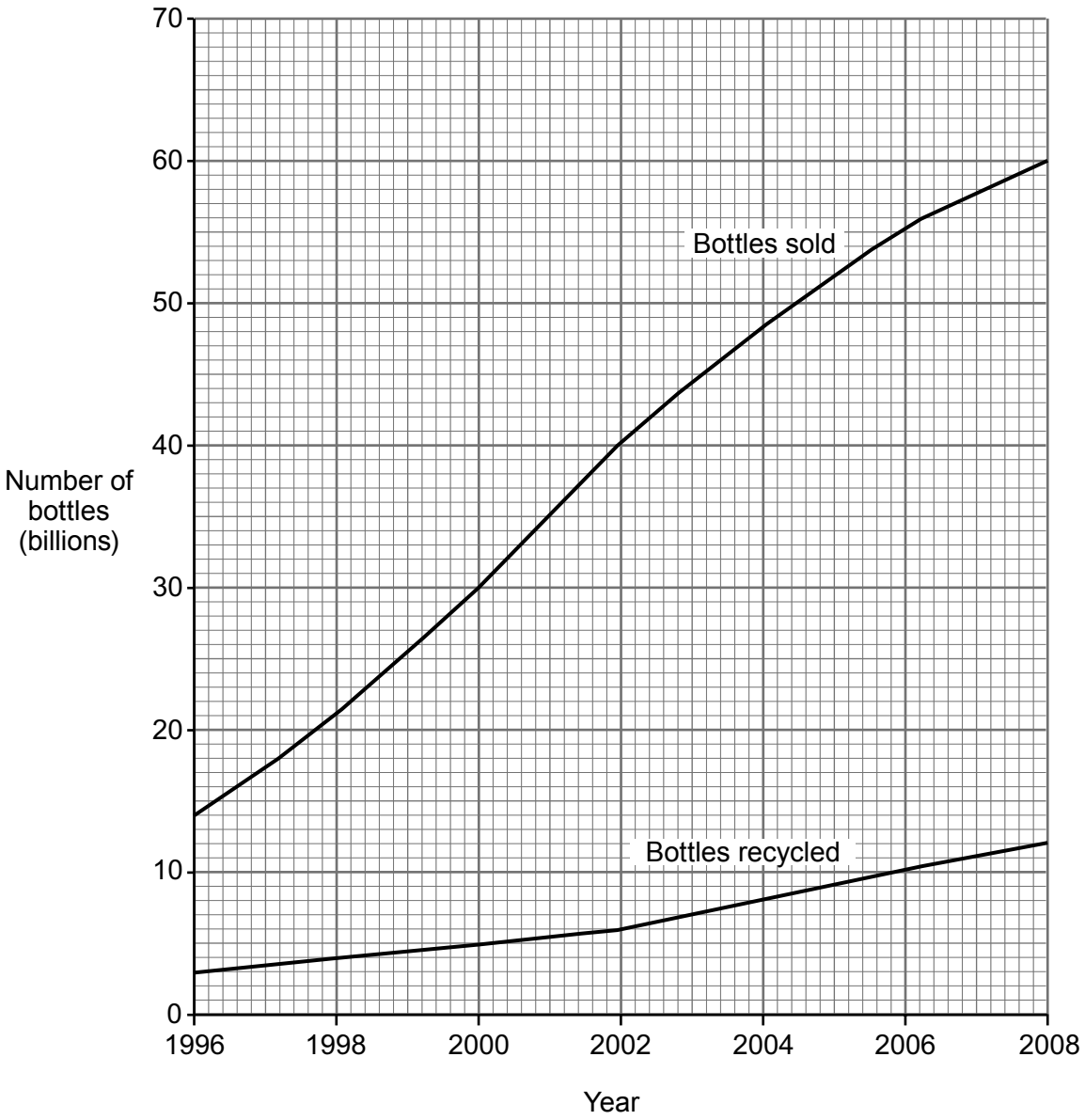
(b) Plastic has replaced glass for making some drink bottles.
Apart from cost, give **one** property of plastic that makes it a more suitable material for making drink bottles. [1]

.....

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(c) The graph below shows the number of plastic drink bottles sold and recycled in the United States between 1996 and 2008.



Calculate the percentage (%) of plastic bottles sold in 2008 that were recycled. [2]

Percentage recycled = ... %

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(d) State and explain the advantages of recycling plastic. [3]

.....

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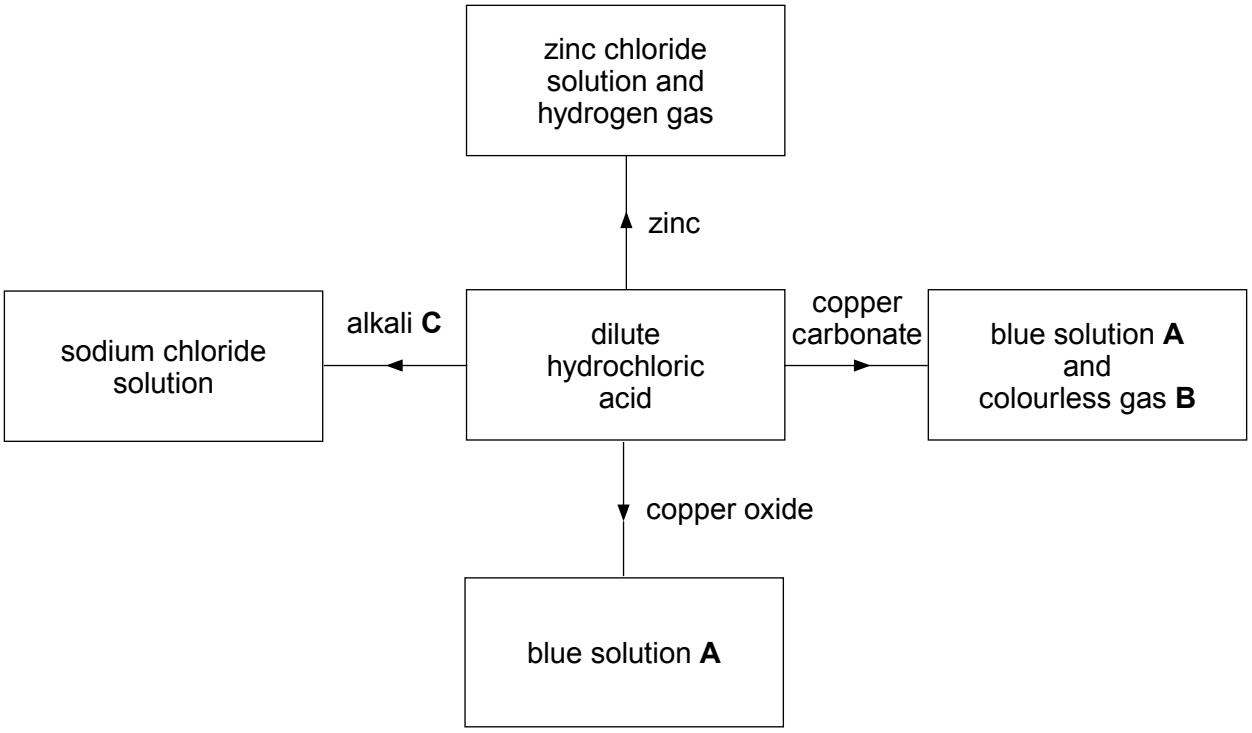
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3. The diagram below shows some reactions of dilute hydrochloric acid.



(a) Name the following substances.

blue solution **A** .....

colourless gas **B** .....

alkali **C** ..... [3]

(b) Balance the **symbol** equation for the reaction between zinc and dilute hydrochloric acid. [1]

$$Zn + \square HCl \longrightarrow ZnCl_2 + H_2$$

4

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4. All water supplies in the UK are chlorinated but only some are fluoridated.

State why each process is carried out and outline why some people are opposed to the fluoridation of drinking water but no one opposes chlorination. [6 QWC]

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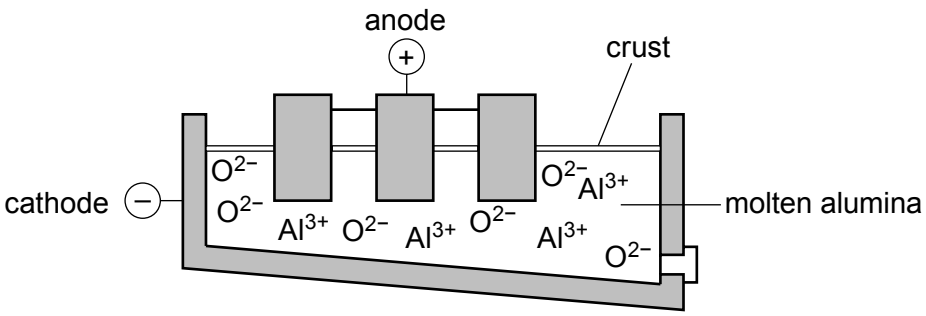
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5. *(a)* Aluminium is obtained by the electrolysis of molten alumina.



The electrode equations below show how the products are formed.

$$Al^{3+} + 3e \longrightarrow Al$$

$$2O^{2-} - 4e \longrightarrow O_2$$

(i) Choose from the equations above

an ion, ...

an atom, ...

a molecule. ..... [2]

(ii) At which electrode is aluminium formed? Give the reason for your answer. [2]

.....

.....

(iii) Use the information in the diagram above to give the chemical name and formula of alumina. [2]

Chemical name .....

Formula .....

(iv) State **one** environmental problem associated with the **electrolysis** of molten alumina. [1]

.....

(b) Aluminium is a good electrical conductor and is therefore used to make overhead power cables.

Give a **different** property of aluminium and **one** use which relies on this property. [1]

.....

.....

8

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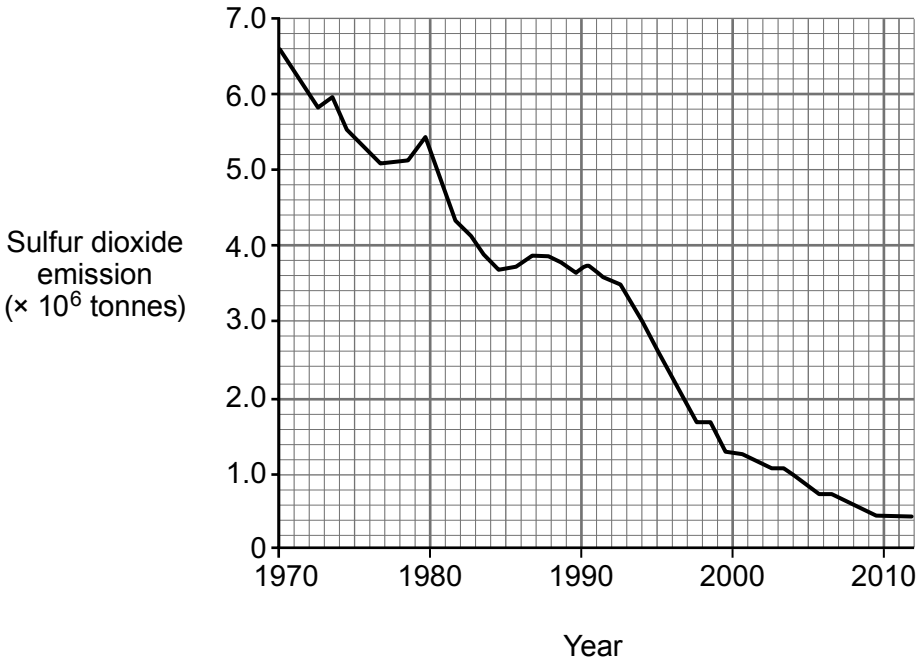
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Turn over.

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6. *(a)* The graph below shows the total sulfur dioxide emissions in the UK between 1970 and 2012.



(i) Use the graph to calculate the decrease in sulfur dioxide emissions in **tonnes** between 1994 and 2004. [1]

Decrease in sulfur dioxide emissions = ... tonnes

(ii) Suggest and explain a possible reason for the trend shown in the graph. [2]

.....

.....

.....

(iii) Balance the symbol equation below which shows a reaction that can lead to the formation of sulfuric acid in the atmosphere. [1]

$$\square\ SO_2 + \square\ H_2O + O_2 \longrightarrow \square\ H_2SO_4$$

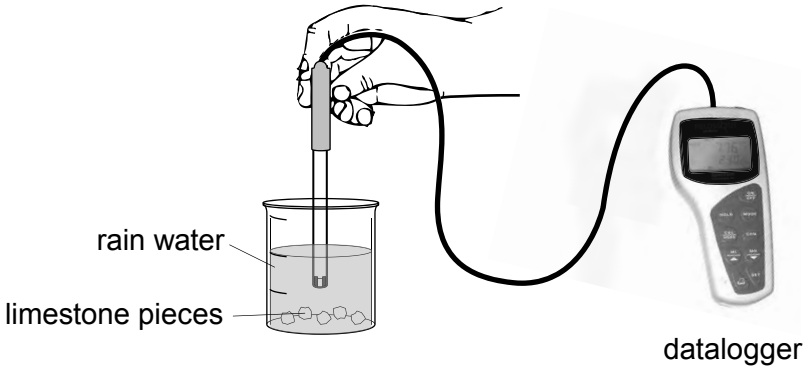
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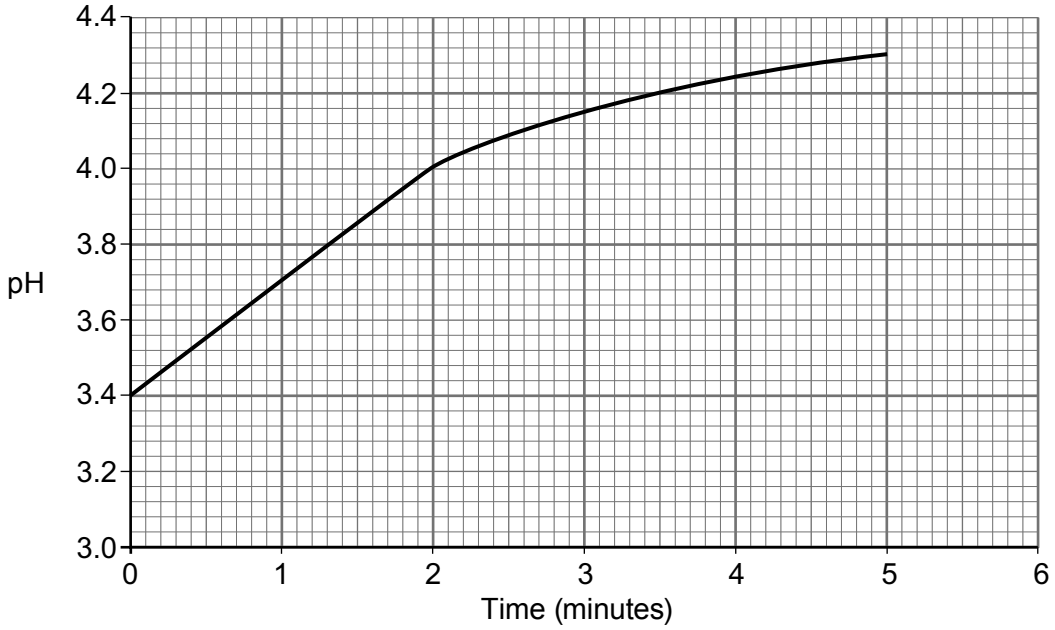
(b) A group of pupils investigated the pH change which occurs when limestone reacts with acid rain. The group collected rain water during a rain shower.

They used the apparatus shown below.



They added limestone pieces to the rain water and recorded the pH of the mixture for 5 minutes. The data collected was then downloaded to a computer.

The graph below shows the results recorded.



(i) Name the type of reaction taking place. [1]

.....

(ii) Limestone affects the acidity of acid rain. Describe how the graph supports this statement. [2]

.....

.....

(iii) Apart from destroying limestone buildings and statues, give **one** *other* problem associated with acid rain. [1]

.....

8

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7. Satellite images are used to show the area of Arctic sea ice.



Photograph: National Snow and Ice Data Centre, Colorado.

(a) The shrinking of the ice cap is interpreted by environmental groups as the result of global warming. State and explain the **main** cause of global warming. [2]

.....

.....

.....

.....

(b) Give **one** consequence of the reduction of Arctic sea ice. [1]

.....

(c) Scientists are currently developing a process called ***carbon capture and storage (CCS)*** to reduce the problem of global warming. There are three main steps to CCS. Firstly, carbon dioxide is trapped and separated from other gases produced in coal-powered electricity plants. The captured carbon dioxide is transported to a storage location and finally stored far away from the atmosphere (underground or deep in the ocean).

Use this information to suggest **two** reasons why some scientists do not support the use of CCS. [2]

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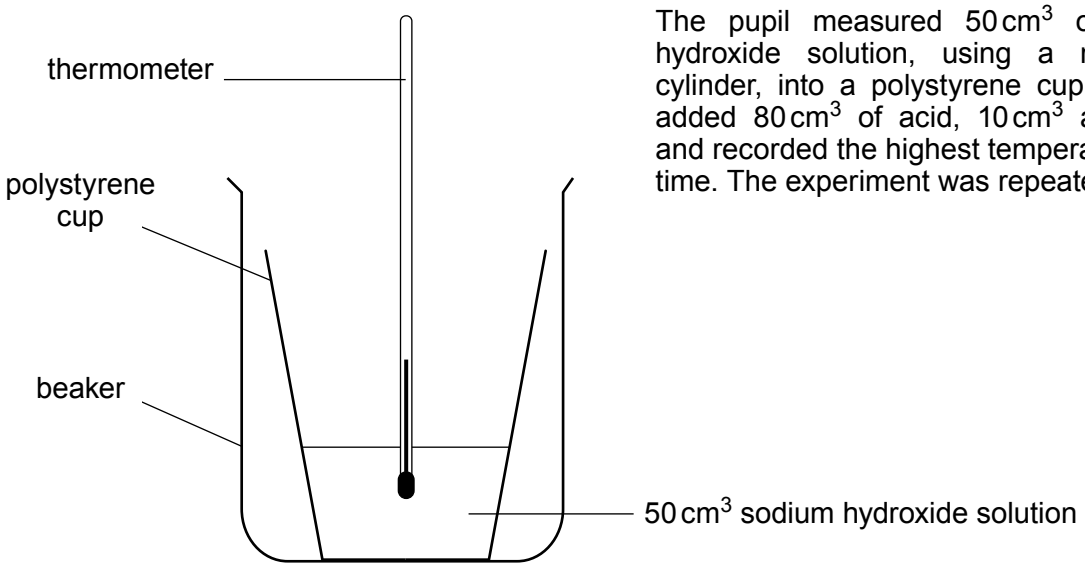
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8. A pupil used the apparatus below to carry out an investigation to find the temperature change which occurs when dilute hydrochloric acid reacts with dilute sodium hydroxide solution.



The pupil measured 50 cm^3 of sodium hydroxide solution, using a measuring cylinder, into a polystyrene cup. He then added 80 cm^3 of acid, 10 cm^3 at a time, and recorded the highest temperature each time. The experiment was repeated.

Volume of acid added (cm^3)	Temperature (°C)		
	Experiment 1	Experiment 2	Mean
0	21.0	21.0	21.0
10	22.1	23.5	22.8
20	24.9	23.5	24.2
30	28.0	22.8	25.4
40	26.0	26.8	26.4
50	27.4	26.6	27.0
60	26.6	26.8	26.7
70	26.2	26.2	26.2
80	25.5	25.7	25.6

(a) From the data in the **table**, state the volume of acid where the temperature readings appear to be incorrect. Give the reason for your choice. [2]

.....

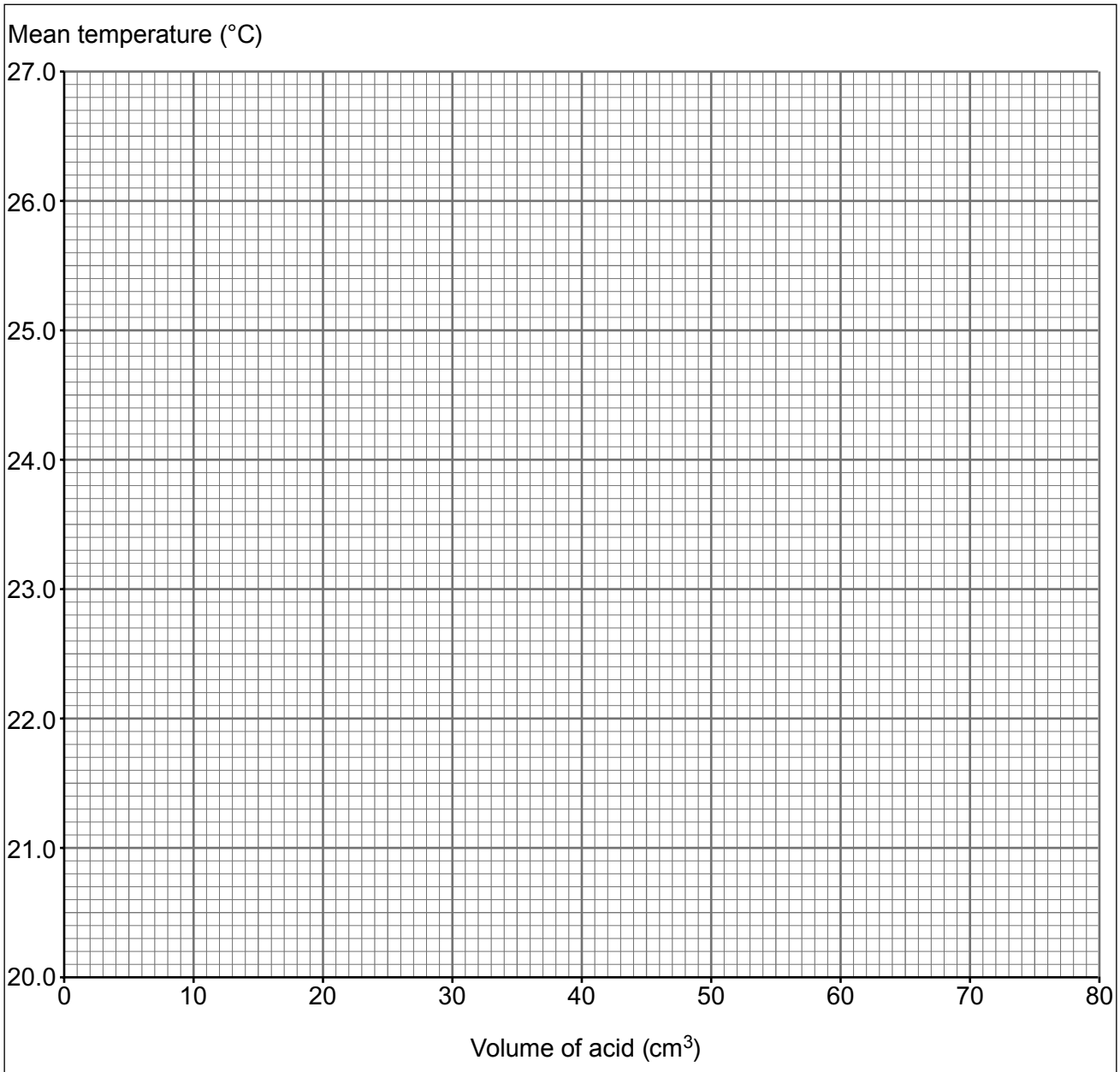
.....

(b) On the grid opposite plot the volume of acid against the **mean** temperature and draw a suitable line. [3]

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(c) Using your graph, state why the incorrect temperature readings identified in part *(a)* might not have been noticed by the pupil. [1]

.....

.....

(d) Describe and explain the shape of the graph in relation to the chemical reaction taking place. [3]

.....

.....

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9

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9. Many car companies are manufacturing hydrogen-fuelled cars.
Describe and explain the advantages and disadvantages of hydrogen as a replacement for petrol and diesel to fuel cars. [6 *QWC*]

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6

END OF PAPER

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

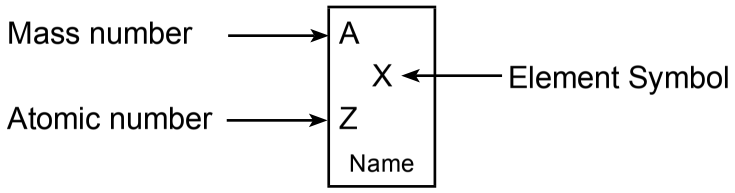
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

JANUARY 2014

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2014 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

	Page
C1	1
C2	15

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Chemistry 1 - Foundation Tier only questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
1		(a)	(i)		1	 *atoms must be touching*			
			(ii)		1	NH_3	H_3N		
		(b)	(i)		1	O_2 / He / Ne *any **two***	oxygen / helium / neon		O
			(ii)		1	CO_2 / CH_4 / SO_2 *any **two***	carbon dioxide / methane / sulfur dioxide		
		(c)	(i)		1	1			
			(ii)		1	5			
		(d)	(i)		1	Mg^{2+} Cl^- ***both*** *ions needed (including charges)*	$2Cl^-$		Cl^-_2
			(ii)		1	NaOH	Na^+OH^-		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			2	iron ore ——— source of iron limestone ——— acts as a fuel coke ——— removes impurities All **three** correct (2) Any **one** correct (1)			
		(b)			1	carbon + oxygen → carbon dioxide			air coke
		(c)			2	**A** (1) oxygen removed / oxygen loss (1)	iron oxide is reduced oxygen lost by iron oxide gains **both** marks	reference to 'oxide'	oxygen lost by **iron**
		(d)			1	mixture			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			3	all points plotted correctly (2) any 8 points plotted correctly (1) curve of best fit ....judgement by eye *i.e. smooth continuous single line* (1)	±½ square		 ruler used in drawing 'curve'
		(b)	(i)		1	5.5 follow through error from graph (ft)			
			(ii)		1	50 ±1 ft			
		(c)			2	using a polystyrene cup (1) use a lid / closed top use two polystyrene cups / use thicker polystyrene cup add the acid quickly (1)	beaker **traps air** form of further insulation around beaker	beaker	
		(d)			1	exothermic			

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
4		(a)			1	magnesium sulfate + copper	magnesium sulfate *solution* / copper *solid* / copper *metal*		
		(b)			1	displacement			
		(c)			2	equal to 80.6 (1) (in a chemical reaction) atoms are not created or destroyed / (in a chemical reaction) atoms are re-arranged / nothing has entered / left the beaker (1) [Marks linked (unless **no** box ticked) i.e. second mark cannot be awarded if first is not]		'it is a sealed container'	
		(d)			1	sodium magnesium copper	Na Mg Cu		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			1	91	±½ square		
		(b)	(i)		2	(SO_2 emissions) decreasing / go from 1.3 → 0.4 (1) (SO_2 emissions) below international targets (1)	 idea of 'levelling out'		
			(ii)		2	Any **two** from: • more electricity generated / used • increased fuel consumption / more coal burned / more oil burned / more gas burned • harsh winter / colder weather *Any **two** for (1) each*			
		(c)	(i)		2	pH: increases (1) acidity: decreases (1)	 gets weaker		stronger
			(ii)		2	**B** (1) (pH readings recorded) **continuously** / **remotely** / without someone being there / (pH) readings can be **stored** (1)	 over a long period of time	 'graph plotted automatically'	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6	**1**	(a)			1	**B**	Ne / neon		
		(b)			2	**D** and **F** (1) **both** needed *either order* (**D** and **F**) are in the same group / (**D** and **F**) are both in Group 6 (**D** and **F**) both have 6 electrons in their outer shell (1) [Marks linked (unless **no** letters given)]			
		(c)			2	Set of properties: **2** (1) **both** metallic **and** non-metallic properties / metalloid / semi-metal [If referring to specific properties from table it must clearly convey the idea that one (or more) is a metallic property and another is a non-metallic property, e.g. high m.p. and b.p. (like a metal) and brittle (like a non-metal); no credit for a simple list of all properties] (1) [Marks linked (unless **no** number is given) i.e. second mark cannot be awarded if first is not]	'high m.p., b.p. and shiny **BUT** brittle'	Reference to Group 4	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	**2**	(a)	(i)		1	1			
			(ii)		1	increases			
			(iii)		1	8	C_8		
		(b)			1	lighter / lower density doesn't break (as easily) / not brittle / flexible	not dangerous when broken	can be recycled strong / durable can be coloured	
		(c)			2	12/60 (1) 12/60 × 100 = 20 % (1) 2 marks for correct answer only (cao)			
		(d)			3	Advantages reducing amount of plastic for disposal (1) conservation of raw materials/crude oil (1) Further (1) mark for development of any link to either advantage, e.g. less plastic going to landfill so fewer sites needed; less plastic litter which is unsightly / harms wildlife; burning plastics produces toxic gases; crude oil is a finite resource; crude oil can be used for other things.			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	**3**	(a)			3	copper chloride (1) carbon dioxide (1) sodium hydroxide (1)	$CuCl_2$ CO_2 NaOH		
		(b)			1	2			

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Question Number			
FT	HT	Mark	Answer
9	**4**	6 QWC	**Indicative content:** **Fluoridation** **Chlorination** **Reasons why:-** **Reasons why:-** reduce tooth decay / kill bacteria/ sterilisation reduce teeth extractions / reduce number of general anaesthetics **Reasons for opposition** **Reasons for no opposition** mass medication / freedom of choice makes water safe to drink / excess fluoride discolours teeth / causes fluorosis / poisonous couldn't drink the water otherwise may also cause brittle bones / IBS / not added for medical reasons thyroid problems / cancer / bone cancer **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)	(i)		2	an ion: Al^{3+} / O^{2-} an atom: Al a molecule: O_2 All **three** correct (2) Any **one** correct (1)	$2O^{2-}$		
			(ii)		2	cathode / negative / – (1) Al^{3+} / aluminium ions / positive ions attracted to cathode / negative electrode (1)	'go to **opposite charge**'	'go to'	attach
			(iii)		2	aluminium oxide (1) Al_2O_3 (1)	$Al^{3+}{}_2O^{2-}{}_3$		
			(iv)		1	*problem to be associated with electrolysis process **not** the extraction of the ore* fluoride emission / acid rain / global warming / climate change		reference to carbon dioxide / greenhouse gas	
		(b)			1	heat conductor e.g. saucepans low density e.g. aeroplanes malleable e.g. cans corrosion resistance e.g. window frames ductile e.g. over-head power cables shiny e.g. mirrors *correct property must be linked with an appropriate use to gain mark*			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)	(i)		1	2×10^6	2000000 2 million		2
			(ii)		2	***(1) for a reason and (1) for linked explanation*** sulfur scrubbing / react with lime / with sea water ….removes sulfur dioxide / neutralises sulfur dioxide use cleaner fuels …….remove sulfur from oil / gas / fuel use coal / fuel containing less sulfur use less coal ……greater use of alternative energy sources which do not produce sulfur dioxide			
			(iii)		1	$\mathbf{2}SO_2 + \mathbf{2}H_2O + O_2 \longrightarrow \mathbf{2}H_2SO_4$			
		(b)	(i)		1	neutralisation		exothermic	
			(ii)		2	(adding limestone) increases the pH (1) (higher the pH the) lower the acidity (1) *i.e. relationship between pH and acidity*	goes from 3.4 → 4.3 'weaker' the acidity		
			(iii)		1	increased lake acidity /decreased pH of lakes increased soil acidity / decreased pH of soil destruction of trees / fish killed / destruction of food chains / destruction of food webs increased metal corrosion (e.g. bridges)	lakes = reservoirs / ponds / rivers	'harmful to nature' 'marine life'	drinking water

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			2	**increased** (fossil) fuel consumption / **burning more** (fossil) fuels causes (1) **increased** carbon dioxide emissions / **more** carbon dioxide formed (1) [Credit (1) for 'burning (fossil) fuels forms carbon dioxide' when no reference made to **increase**]	accept named fossil fuel	deforestation	reference to 'ozone layer' or 'acid rain'
		(b)			1	Any **one** from: sea level rises / flooding destruction of habitats / kills wildlife	accept named animal e.g. polar bears decrease in number / nowhere for polar bears to live		
		(c)			2	Any **two** sensible disadvantages, e.g. separation issues: cost (of separation) transport issues: road – burns fuels pipeline – cost, hazards storage issues: leakage back into the atmosphere / dissolves into the sea / increases acidity unproven only power stations – other sources not addressed other options available			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			2	30 cm^3 (1) too much variation between readings (for experiment 1 and 2) (1)	other sensible answer, e.g. 10 cm^3 or 20 cm^3 on the basis that they have the same temperature reading in experiment 2		
		(b)			3	all 9 points plotted correctly (2) any 8 points plotted correctly (1) appropriate curve of best fit – judgement by eye (1)	±½ square		
		(c)			1	when plotted the mean value does not highlight the unreliability in the individual readings unreliability in individual readings cancelled out / mean follows the pattern			
		(d)			3	Three marking points: • (temperature rise due to) neutralisation reaction / exothermic reaction (1) • temperature **peaks** when neutralisation completed / reaction is completed / reaction is over / one reactant used up / both reactants used up (1) • (temperature falls because) dilution causes cooling / cold liquid added causes cooling / cools to room temperature over time (1)	implication of 'peak' by reference to increase followed by decrease		

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Question Number			
FT	HT	Mark	Answer
	9	6 QWC	**Indicative content:** Description / explanation of advantages and disadvantages of hydrogen gas as fuel for cars e.g. **Disadvantages** **Production**: requires a lot of electricity (electrolysis), therefore relatively more expensive *NB Electricity generation might form carbon dioxide, therefore contributes to global warming* **Storage**: pressurised gas containers (relatively larger tank for equivalent distance travelled by petrol) **Reactivity**: explosive mixture with air **Distribution and infrastructure**: limited at present **Use in fuel cells requires catalysts**: most often platinum which is extremely rare and expensive **Advantages** **Combustion product**: only water, therefore cleaner (doesn't contribute to global warming) **Availability**: plentiful supply of water so **renewable** resource **Energy release on burning**: large **Efficiency**: good **Ignition:** easy *A 'full answer' should address at least **two** advantages and **two** disadvantages.* **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

GCSE

4462/02

SCIENCE A/CHEMISTRY

CHEMISTRY 1
HIGHER TIER

A.M. THURSDAY, 13 June 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**9**	
2.	**6**	
3.	**3**	
4.	**6**	
5.	**4**	
6.	**5**	
7.	**6**	
8.	**7**	
9.	**8**	
10.	**6**	
Total	**60**	

4462
020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.
Do not use gel pen or correction fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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Answer **all** *questions.*

1. The table below shows some information about elements **A-F**. The letters are not the chemical symbols of the elements.

Element	Colour	Melting point (°C)	Boiling point (°C)	Conducts electricity	Density (g/cm^3)
A	dull grey	1414	2900	yes	2.03
B	pale yellow	–219	–188	no	0.0017
C	orange brown	–7	59	no	3.10
D	shiny brown	1084	2927	yes	8.92
E	shiny grey	1538	2861	yes	7.87
F	colourless	–157	–153	no	0.0033

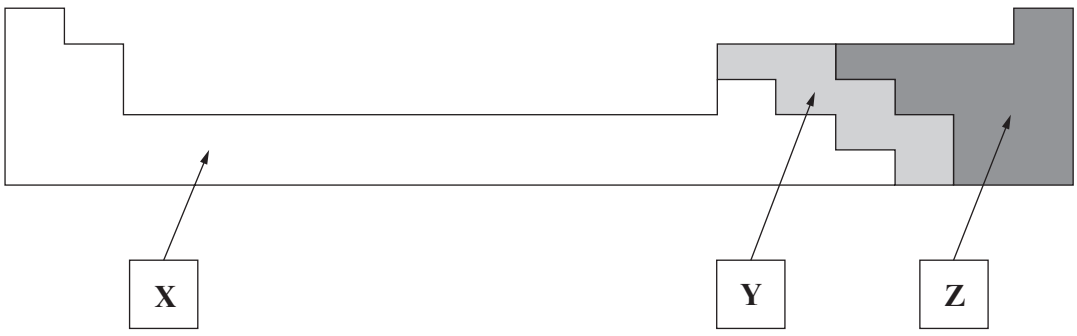
(a) State which of the elements **A-F** are gases at room temperature. [1]

.....

(b) Give the letter of the element **A-F** that has the biggest difference between melting point and boiling point. [1]

.....

(c) The following diagram shows an outline of the Periodic Table.



(i) Element **A** is found in area **Y** of the Periodic Table. Explain how the information in the table supports this. [2]

.....

.....

(ii) From elements **B-F**, identify **all** that would be found in area **X**. [1]

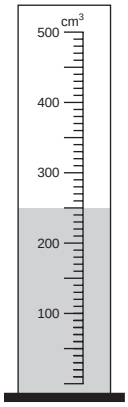
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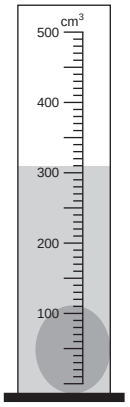
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(d) A student has a sample of element **D** of mass 540 g. She measures its volume using a measuring cylinder as shown below.



Measuring cylinder before adding sample of element **D**



Measuring cylinder after adding sample of element **D**

(i) Using the information given above and the equation below, calculate the density of the sample of element **D**. [2]

$$\text{density} = \frac{\text{mass}}{\text{volume}}$$

Density of sample of element **D** = ... g/cm^3

(ii) Another pupil obtained a value of 9.10 g/cm^3. Suggest why this value is different to that given in the table. [2]

.....

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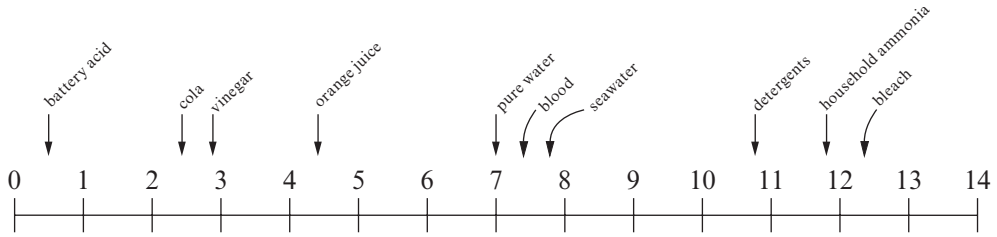
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2. The following diagram shows the pH scale and the pH values of some common substances.



(a) From the substances above, name

(i) the strongest acid, ... [1]

(ii) the weakest alkali, ... [1]

(iii) a neutral substance. ..... [1]

(b) John was studying the reactions of acids with three different substances, **A**, **B** and **C**. He recorded his observations and temperature changes in the table shown below.

Substance added to acid	Observations	Temperature change (°C)
A	bubbles of gas produced, gas collected turns limewater milky, substance reacts to produce blue solution	+4
B	no gas produced, substance reacts to produce a blue solution	0
C	no visible change	+8

Identify **A**, **B** and **C** from the substances in the box below. [3]

copper carbonate	**copper oxide**	**magnesium**
sodium chloride	**sodium hydroxide**	

A .....

B .....

C .....

6

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3. Nano-silver particles can be used in socks, plasters and disinfectant sprays.

Explain why nano-silver is suitable for use in these examples and state why some people are concerned about the use of nanoparticles in everyday life. [3]

.....

.....

.....

.....

3

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4. Copper and titanium are important metals. The following table shows some of their uses.

Metal	Uses
copper	electrical wiring, water pipes, saucepan bases, jewellery
titanium	hip replacements, rotors on helicopters, pipes in chemical industry

Describe how the properties of copper and titanium make them suitable for these uses.

[6 QWC]

6

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5. *(a)* Complete the table below that shows information about four ionic compounds. [3]

Compound	Formula	Elements present
aluminium oxide	Al_2O_3	aluminium and oxygen
calcium hydroxide	$Ca(OH)_2$	.....
sodium carbonate	.....	sodium, carbon and oxygen
calcium nitrate	.....	calcium, nitrogen and oxygen

(b) Sodium oxalate occurs naturally in many plants. It can be made from oxalic acid. Oxalic acid contains two hydrogen atoms, two carbon atoms and four oxygen atoms.

Use this information to write the formula of oxalic acid. [1]

Formula of oxalic acid .....

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6. The table below shows some properties of the elements in Group 0 – the noble gases.

Element	Atomic mass	Density (g/dm^3)	Melting point (°C)	Boiling point (°C)
helium	4	0.18	–272	–269
neon	20	0.9	–249	–246
argon	40	1.8	.....	–186
krypton	84	3.7	–157	–152
xenon	131	5.9	–112	–105

(a) Describe the trend in the melting point going down the group. [1]

.....

.....

(b) Use the data in the table to estimate the melting point of argon. [1]

..... °C

(c) All Group 0 elements are gases at room temperature. State how the information in the table supports this. [1]

.....

.....

(d) Helium is used to fill party balloons. Give **one** property **not shown** in the table that makes helium suitable for this purpose. [1]

.....

(e) Under certain conditions, xenon can be made to burn in oxygen to form xenon trioxide, XeO_3. Balance the following symbol equation for the reaction. [1]

$$\square\ Xe + \square\ O_2 \longrightarrow \square\ XeO_3$$

5

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7. *(a)* State how the burning of coal results in the production of sulfur dioxide and why this leads to environmental problems when released into the atmosphere. Include in your answer **one** example of the resulting environmental damage. [3]

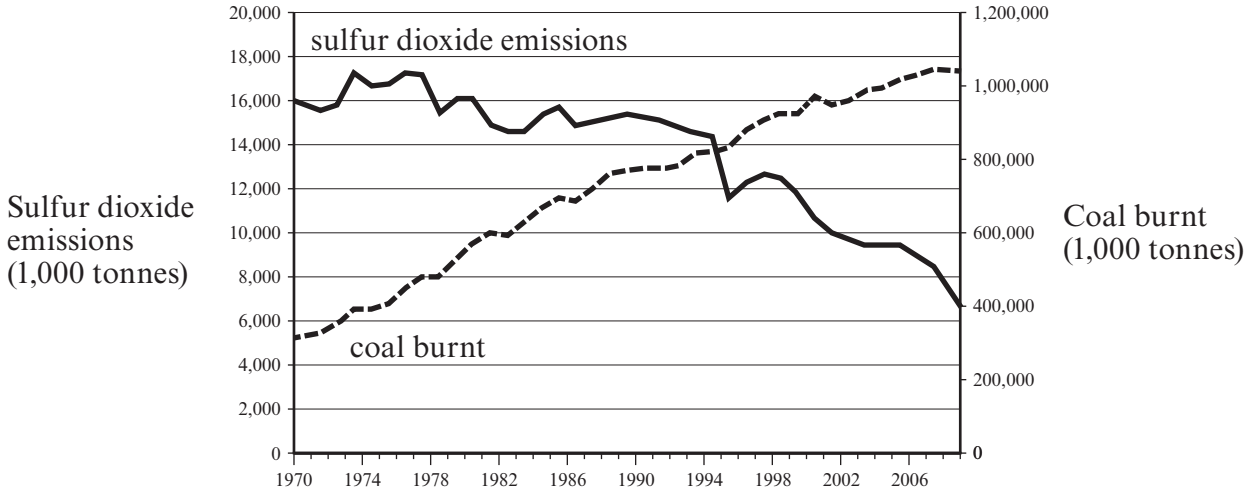
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(b) The following graph shows the amount of coal burnt and sulfur dioxide emissions in the USA between 1970 and 2008.



(i) State why the data shown in this graph is not as expected. [2]

.....

.....

.....

(ii) Suggest a possible reason for the unexpected data. [1]

.....

.....

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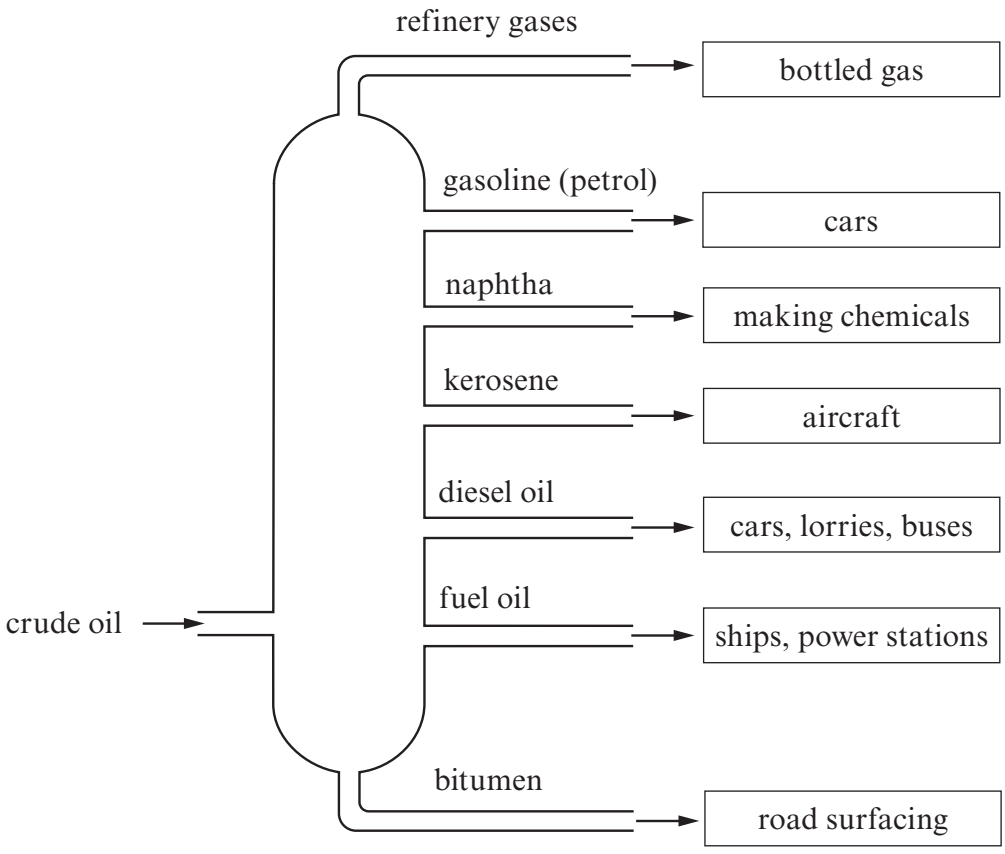
8. Crude oil is a mixture of hydrocarbons that is formed from the remains of simple marine organisms.

(a) State what is meant by a *hydrocarbon*. [1]

.....

.....

(b) Crude oil is separated into fractions in a process called fractional distillation.



State why the fractions obtained are not single compounds. [1]

.....

.....

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(c) Most fractions are used as fuels. However, others are converted into small reactive molecules that can be used to form plastics.

Name the process used to

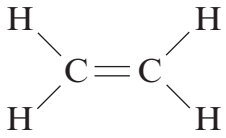
(i) produce the small reactive molecules,

..... [1]

(ii) make plastics from these small reactive molecules.

..... [1]

(d) Ethene is an example of a monomer. It is used to produce polythene. The structure of ethene is shown below.



Describe what happens to ethene molecules in the production of polythene. [2]

.....

.....

(e) Give **one** disadvantage of the use of plastics such as polythene. [1]

.....

7

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9. The electrolysis of water can be used to produce hydrogen. The following table shows the results of an experiment carried out to determine the effect of current on the volume of hydrogen produced after 30 seconds.

	Volume of hydrogen produced after 30 seconds (cm^3)			
Current (mA)	Experiment 1	Experiment 2	Experiment 3	Mean
100	0.7	0.2	0.6	.....
200	1.0	0.8	1.0	0.93
300	1.4	1.3	1.2	1.30
400	1.6	1.6	1.6	1.60
500	2.3	2.2	2.1	2.20

(a) Using only the reliable results, calculate the mean volume of hydrogen produced using a current of 100 mA. [1]

Mean volume of hydrogen = ... cm^3

(b) Describe the relationship between the current and the mean volume of hydrogen produced. [1]

.....

.....

(c) Using the results for a current of 300 mA and the following equation, calculate the percentage error in these measurements. [2]

$$\text{percentage error} = \frac{\text{furthest volume from mean volume} - \text{mean volume}}{\text{mean volume}} \times 100\%$$

Percentage error = ... %

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(d) Balance the following electrode equations showing the electrolysis of water. [2]

$$\square\ H^+ + \square\ e^- \longrightarrow H_2$$

$$\square\ O^{2-} - \square\ e^- \longrightarrow O_2$$

(e) In your opinion, do the advantages of using hydrogen as a fuel outweigh the disadvantages? Give reasons to support your answer. [2]

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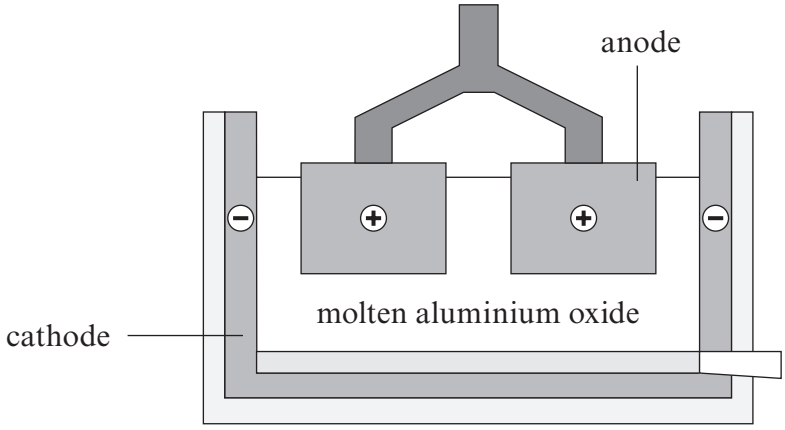
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10. Aluminium is extracted using electrolysis. The diagram below shows the apparatus used.



Describe and explain how electrolysis can be used to extract aluminium from its ore.

[6 QWC]

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END OF PAPER

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

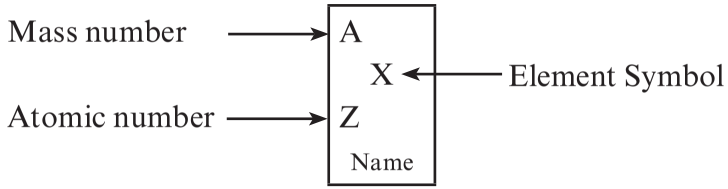
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}$H Hydrogen									$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2013 examination in GCSE SCIENCE - CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

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Unit C2	17
Unit C3	34

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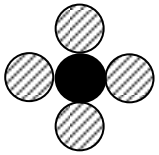
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Chemistry 1 - Foundation Tier only questions

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
1		(a)			1	helium	He		
		(b)			2	chlorine (1) iodine (1)	Cl_2 / Cl I_2 / I		
		(c)			2	chlorine (1) iodine (1)	Cl_2 / Cl I_2 / I		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			3	calcium and chlorine (1) copper(II) oxide / copper oxide (1) $MgBr_2$ (1)		Ca and Cl / Cl_2	
		(b)	(i)		1	carbon ● oxygen ○ both needed			
			(ii)	I	1				
				II	1		follow through (ft) from (b)(i)		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)			2	7 + 27 + 20 + 11 (1) 100 – 65 = 35% (1) correct answer only (cao) (2)			
		(b)			2	increased temperature of Earth's atmosphere / global warming (1) ice caps melting **faster** /climate change / **more** flooding / **more** extreme weather / changing weather patterns (1)			
		(c)			1	any **one** from: use renewable energy sources e.g. solar panels / wind turbines / hydroelectric / tidal / biomass nuclear power carbon capture and storage	use less electricity e.g. by using power saving light bulbs – **must give example**		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			1	magnesium zinc copper (must be correct order)	Mg Zn Cu		
		(b)			2	copper (metal) (1) magnesium sulfate (solution) (1)	Cu $MgSO_4$		
		(c)			1	$ZnSO_4$			
		(d)	(i)		1	2 PbO 2 Pb **both** needed			
			(ii)		2	carbon (1) as it gains oxygen (1)	C loses electrons	 reacts with oxygen	
			(iii)		1	any **one** from: aluminium is more reactive (than carbon) aluminium is too reactive carbon is less reactive (than aluminium) carbon is not reactive enough	Al is above C in reactivity series	Al is very reactive	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)			1	the greater the percentage drinking fluoridated water the lower the DMFT – must clearly link graphs			
		(b)			2	sodium fluoride is used as a rat poison / toxic bone cancer (in high concentrations) brittle bones discolours teeth / fluorosis can be taken in other ways e.g toothpaste, mouthwash mass medication / takes away individual's choice credit (1) for mention of any of above up to (2) max or (2) for one point and some detail	unethical		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)	(i)		1	flexible / low density / water proof		non-toxic light	unreactive
			(ii)		1	rigid / non-toxic / low density / good insulator		unreactive	easily squashed
		(b)			3	they are non-biodegradable / don't rot (1) build up in landfill (1) burning produces toxic / harmful fumes (1) can harm wildlife (1) - up to (2) max recycling / reusing / use biodegradable plastics (1)	reference to oil being finite resource	litter 'bags for life'	
		(c)			4	reactive (1) monomer (1) polymerisation (1) polymer (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)			1	**B** and **F** (**both** needed)			
		(b)			1	**D**			
		(c)	(i)		2	it is a semi metal / metalloid / shows properties of both metal and non-metal (1) must give example of one property of a metal and one of non-metal e.g. conducts electricity but low density etc. (1)	idea of conflicting properties	**A**	
			(ii)		1	**D** and **E** (**both** needed)			
		(d)	(i)		2	310 – 250 (1) 540 / 60 = 9 g / cm^3 (1) cao (2)			
			(ii)		2	measurements are inaccurate / not precise / incorrect credit (1) for basic idea and additional (1) for sensible reason e.g. measuring cylinder not precise enough, only measures to nearest $10cm^3$ (2) accept any other sensible answers e.g. sample is impure / oxidised or volume (liquid or solid) changes with temperature		human error	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	(a)	(i)		1	battery acid			
			(ii)		1	blood			
			(iii)		1	**pure** water			
		(b)			3	**A** copper carbonate (1) **B** copper oxide (1) **C** sodium hydroxide (1)	$CuCO_3$ CuO NaOH		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3				3	nanosilver has antibacterial / antiviral / antifungal properties / kills germs (1) could be absorbed through skin / breathed in (1) long term effects **unknown** (1)	toxic could be released into environment		**can** cause ...

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Question Number			
FT	HT		
10	4		**Indicative content:** **copper** – good conductor of electricity = electrical wiring; good conductor of heat = saucepan bases; malleable = water pipes; ductile = electrical wiring; attractive colour and lustre = jewellery **titanium** – hard and strong = hip replacements and rotor blades; low density = rotor blades; resistant to corrosion = rotor blades / hip replacements / pipes in chemical industry; high melting point = rotor blades. **5–6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5	(a)			3	calcium, oxygen and hydrogen (1) Na_2CO_3 (1) $Ca(NO_3)_2$ (1)			
		(b)			1	$H_2C_2O_4$	symbols in any order		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)			1	melting point increases (down group)			
		(b)			1	value between –248 and –187			
		(c)			1	**all** boiling points are below 20°C / below room temperature	**all** boiling points are negative values / below 0°C	low boiling points	
		(d)			1	unreactive / inert / not flammable		any property from table non-toxic	
		(e)			1	2 3 2	other correct multiples		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			3	coal contains sulfur impurities (1) (impurities burn to produce sulfur dioxide) which dissolves in rainwater to produce **acid rain** (1) acid rain kills fish / trees / erodes limestone statues or buildings / causes metals to rust quicker (1)		kills **marine** life	ozone layer global warming
		(b)	(i)		2	as the amount of coal burnt increases the emission of sulfur dioxide decreases / more coal used as time goes on but less sulfur dioxide released (1) would expect more sulfur dioxide to be released as more coal is burnt (1)			
			(ii)		1	(introduction of techniques to remove sulfur dioxide from smoke) e.g. sulfur scrubbing coal burnt has lower sulfur content	sulfur dioxide neutralised / reacted with limestone	new technology	carbon capture and storage

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			1	a compound containing hydrogen and carbon **only**			mixture
		(b)			1	each fraction collected across a range of temperatures / several compounds have similar boiling points		melting points	
		(c)	(i)		1	(catalytic) cracking			
			(ii)		1	polymerisation			
		(d)			2	double bond breaks / turns in to single bond (1) molecules join together to form (long) chains (1)			
		(e)			1	non-biodegradable / increased use of landfill / depletion of raw materials produce toxic / harmful gases when burned	can harm wildlife	‘harmful’ – unless linked to burning	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)			1	0.65			
		(b)			1	the greater the current, the more hydrogen produced			
		(c)			2	difference to mean = 0.1 (1) (0.1 ÷ 1.3) × 100 = 7.7 % (1) cao (2)			
		(d)			2	2, 2 (1) 2,4 (1)			
		(e)			2	**must clearly imply an opinion** if yes – award (1) each for up to two advantages if no – award (1) each for up to two disadvantages advantages = doesn't produce carbon dioxide / doesn't contribute to global warming / water is only product / readily available / renewable disadvantages = explosive / storage issues / availability / extraction costs (need for electricity)	don't know – (1) each for one advantage and one disadvantage (2) if opinion given and clearly states that one advantage outweighs one disadvantage (or vice versa)		

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Question Number		
FT	HT	Answer
	10	**Indicative content:** definition of electrolysis i.e. use of electricity to split compounds; anode is positive electrode; cathode is negative electrode; electrolyte is substance being broken down; electrolyte conducts electricity; needs to be molten for ions to move freely; positive aluminium ions attracted to cathode where they gain electrons to form aluminium atoms; negative oxide ions attracted to anode where they lose electrons to form oxygen gas; electrode equations **5–6 marks:** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3–4 marks:** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1–2 marks:** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks:** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

New GCSE

4462/02

SCIENCE A
HIGHER TIER
CHEMISTRY 1

A.M. MONDAY, 14 January 2013

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**6**	
2.	**6**	
3.	**6**	
4.	**6**	
5.	**4**	
6.	**6**	
7.	**6**	
8.	**8**	
9.	**6**	
10.	**6**	
Total	**60**	

4462
020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correcting fluid.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **10**.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

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Answer **all** *questions.*

1. The following table shows some information about some Group 7 elements.

Name	Formula	State at room temperature (20 °C)	Colour of vapour	Melting point (°C)
chlorine	Cl_2	gas	yellow-green	–101
bromine	.....	liquid	orange-brown	–7
iodine	I_2	solid	purple	114

(a) Give the formula for bromine. ..... [1]

(b) A pupil predicted the **boiling point** of chlorine to be –10 °C.

Using the information in the table, suggest **two** reasons why the pupil gave this value. [2]

.....

.....

.....

(c) Chlorine is a poisonous gas.

State **one** use of chlorine which relates to its poisonous nature. [1]

.....

(d) Fluorine is above chlorine in this group of the Periodic Table.

Use the information in the table to predict **two** properties of fluorine. [2]

.....

.....

.....

6

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2. The following table shows the main products formed during the burning of coal and hydrogen.

Fuel	Main product(s) of burning
coal	carbon dioxide sulfur dioxide water
hydrogen	water

(a) (i) Name the **three** elements that must be present in coal to give the products shown in the table. [1]

.....

(ii) Coal is a finite (non-renewable) resource.

State what is meant by a *finite resource*. [1]

.....

.....

(b) (i) Balance the symbol equation for the burning of hydrogen in air. [1]

$$\square\ H_2 + O_2 \longrightarrow \square\ H_2O$$

(ii) State the chemical test for hydrogen gas and give the expected result. [1]

.....

.....

(iii) Give **two** disadvantages of using hydrogen as a fuel. [2]

1. .....

.....

2. .....

.....

6

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3. *(a)* Crude oil is a mixture of hydrocarbons.

State how it was formed. [2]

.....

.....

(b) The table below shows properties of some fractions that can be obtained from crude oil.

Fraction	Size of molecule (number of carbon atoms)	Boiling point range (°C)	Colour of fraction	Viscosity at room temperature	How it burns
fuel gas	C_1-C_4	–160 to 20	colourless		very easily with a clean yellow flame
petrol	C_5-C_{10}	20 to 70	pale yellow	runny	easily with a clean yellow flame
naphtha	C_8-C_{12}	70 to 120	yellow	fairly runny	quite easily with a yellow flame and some soot
kerosene	C_{10}-C_{16}	120 to 240	dark yellow	quite viscous	harder to burn with quite a smoky flame
diesel oil and lubricating oil	C_{15}-C_{30}	240 to 350	brown	viscous	hard to burn and a smoky flame

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Use the information in the table opposite to answer parts (i) and (ii).

(i) Describe how any **two** properties of crude oil fractions depend on the size of the molecule. [2]

.....

.....

.....

(ii) Two fuels used in caravans are propane, C_3H_8, and butane, C_4H_{10}. Both fuels are used in the summer but propane is preferred during the winter.

Explain why. [2]

.....

.....

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6

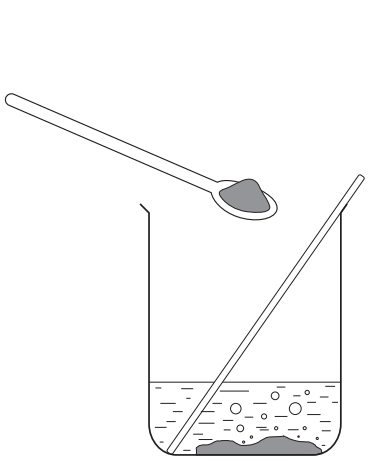
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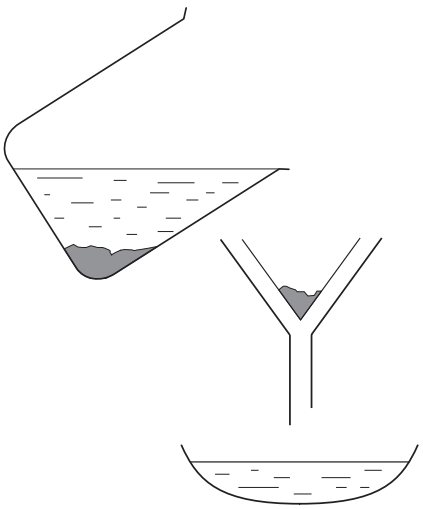
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4. Copper sulfate crystals can be prepared by reacting copper carbonate with dilute sulfuric acid.

The unlabelled diagrams below show two of the three stages involved.





Describe the preparation of copper sulfate crystals by this method. [6 QWC]
Include in your answer what you would expect to **see** at each stage.

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5. Complete the following table. [4]

Name of compound	Formula of positive ion	Formula of negative ion	Formula of compound
ammonium hydroxide	.....	OH^-	NH_4OH
lithium sulfate	Li^+	SO_4^{2-}	.....
lead nitrate	Pb^{2+}	NO_3^-	.....
calcium hydrogencarbonate	Ca^{2+}	.....	$Ca(HCO_3)_2$

4

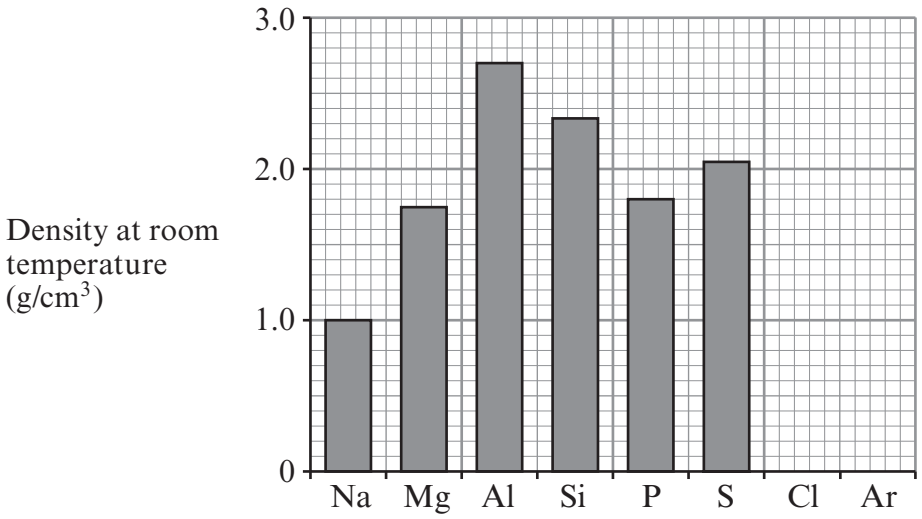
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6. *(a)* A bar chart of the densities *at room temperature* of all the elements in Period 3 of the Periodic Table is shown below.



(i) Name **all** the **metals** in this period. [1]

.....

(ii) Name the element in this period that has both metallic and non-metallic properties. [1]

.....

(iii) Give the reason that the bars for chlorine and argon are too small to be seen. [1]

.....

.....

(iv) Give the trend in the densities of the **metals** going across this period. [1]

.....

.....

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(b) The table below gives the melting points of all the elements in Period 3.

Element	Na	Mg	Al	Si	P	S	Cl	Ar
Melting point (°C)	98	650	660	1410	44	113	–101	–189

How well does the evidence in the table support the following statement?

'The melting points of non-metals ***decrease*** *from left to right across the Periodic Table.'*
[2]

.....

.....

.....

.....

.....

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7. The order of reactivity of some elements is shown below.

Most reactive	sodium
	calcium
	magnesium
	aluminium
	carbon
	zinc
	iron
	hydrogen
	lead
	copper
	silver
Least reactive	gold

Predict, giving a reason for your answer, whether the following pairs of substances react and give any expected observation(s).

(a) Iron and copper sulfate solution [2]

.....

.....

.....

.....

(b) Magnesium and dilute hydrochloric acid [2]

.....

.....

.....

.....

(c) Aluminium oxide and carbon [2]

.....

.....

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.....

6

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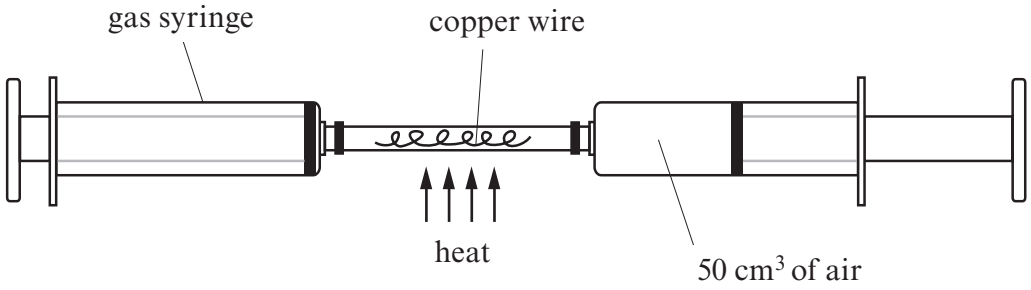
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8. Two gas syringes, containing a total 50 cm^3 of air, were connected as shown in the diagram below. The copper wire was heated strongly and the air passed over it five times. The hot copper reacted with the oxygen in the air. The apparatus was then allowed to cool to room temperature before the volume of gas remaining in the syringes was measured.



Results

Initial volume of air	50 cm^3
Final volume of gas	41 cm^3

(a) Gases expand when heated. State why the apparatus was allowed to cool to room temperature before taking the final reading. [1]

.....

.....

(b) (i) Calculate the percentage of oxygen in the air using the results from the above experiment. [2]

Percentage of oxygen = ... %

(ii) The actual percentage of oxygen in the air is 21%. Assuming no leakages in the apparatus give **one** possible reason why the experiment did not give this expected value. [1]

.....

.....

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(c) (i) During the experiment the shiny brown copper reacted and turned black. Name this black substance.

.....

[1]

(ii) What change would you expect in the mass of the solid during the experiment? Give a reason for your answer. [1]

.....

.....

(d) (i) Name the gas that makes up the biggest proportion of that remaining in the syringes. [1]

.....

(ii) Name the very unreactive gas used to fill light bulbs that is also present in the syringes. [1]

.....

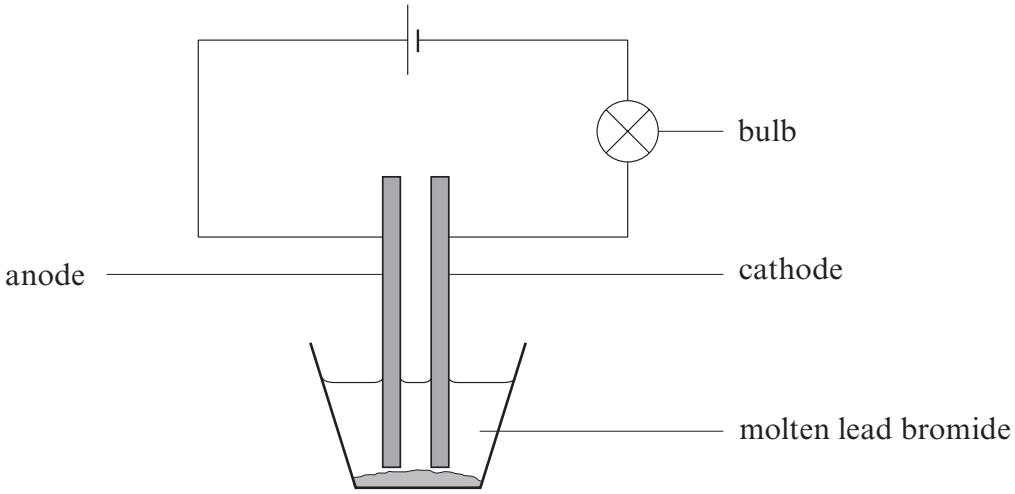
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9. The diagram below shows the apparatus used during the electrolysis of molten lead bromide.



(a) For electricity to flow the lead bromide must be molten. Give the reason for this. [1]

.....

.....

(b) Balance the electrode equation which takes place at the anode. [1]

$\square\ Br^- - \square\ e^- \longrightarrow Br_2$

(c) (i) State, **in terms of electrons**, what happens to the lead ions at the cathode. [1]

.....

.....

(ii) Describe what you would expect to observe at the cathode. [1]

.....

.....

(iii) Electrolysis is allowed to continue for some time before the apparatus is cooled to room temperature. The bulb remains lit. Explain this observation. [2]

.....

.....

.....

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10. Explain how natural processes keep the carbon dioxide and oxygen content of the atmosphere approximately constant. Discuss how human activities are changing the balance between these gases. [6 QWC]

6

END OF PAPER

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^-
Ammonium	NH_4^+	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^-
Calcium	Ca^{2+}	Fluoride	F^-
Copper(II)	Cu^{2+}	Hydroxide	OH^-
Hydrogen	H^+	Iodide	I^-
Iron(II)	Fe^{2+}	Nitrate	NO_3^-
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^+	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^+		
Silver	Ag^+		
Sodium	Na^+		
Zinc	Zn^{2+}		

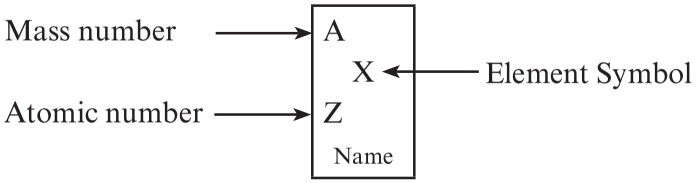
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
																	$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY (NEW)

JANUARY 2013

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the year examination in GCSE SUBJECT. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

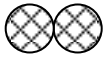
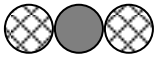
Unit	Page
C1 (NEW)	1
C2 (NEW)	17

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GCSE SCIENCE - CHEMISTRY (NEW)

C1 Mark Scheme - January 2013

Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
1		(a)	(i)		1	aluminium and sodium (both needed)	Al and Na		
			(ii)		1	nitrogen dioxide and water (both need)	NO_2 and H_2O		
			(iii)		1	crude oil			
		(b)	(i)		1	A			
			(ii)	I	1				
				II	1				
			(iii)	I	1	1			
				II	1	6			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)			1	pH value of 1			
		(b)			1	nitric, hydrochloric etc	HNO_3, HCl etc		
		(c)			1	carbon dioxide	CO_2		
		(d)			2	the gas is denser / heavier than air (1) does not support combustion or burning / extinguishes or puts out a flame (1)	gas doesn't burn / is not flammable	flame goes out – unless qualified	

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
3		(a)			1	gives heat / energy to the mixture	burns very hot	ignites / flammable	
		(b)	(i)		1	aluminium oxide + iron	Al_2O_3 + Fe – ignore balancing		
			(ii)		1	iron oxide is reduced since oxygen is removed / lost			
		(c)	(i)		1	$TiCl_4 + 4Na \longrightarrow Ti + 4NaCl$			
			(ii)		1	titanium is less reactive than sodium		titanium is unreactive / not very reactive	
			(iii)		1	prevent the sodium reacting with air or oxygen / stops the sodium burning / argon not reactive / inert			
			(iv)		1	sodium is very expensive / lots of heat or energy needed	needs high temperature to work		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)			2	increase (1) carbon dioxide given out during breathing / respiration (1)		breathing	
		(b)			2	decrease (1) carbon dioxide removed during photosynthesis / plants take in carbon dioxide (1)			
		(c)			2	increase (1) carbon dioxide given out during combustion / burning (of fuels) (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5					3	sodium bromide (1) hydrogen, sulfur and oxygen (1) K_2O (1)		H, S and O	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
6		(a)			1	copper sulfate (solution)	$CuSO_4$		
		(b)			1	anode			
		(c)	(i)		1	0.8			
			(ii)		3	plotting six correct points (2) five correct points (1) smooth line of best fit (1)			
			(iii)		1	0.66 (graph) ±0.02			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	1	(a)			1	Br_2			
		(b)			2	gas at room temperature therefore bp < 20 ^{o}C (1) above the mp / –101 ^{o}C (1)			
		(c)			1	treatment of water supply or swimming pool / sterilise water / toilet cleaners / bleach / disinfectant		clean water / water supply – needs to be qualified	poison gas
		(d)			2	gas (at room temperature) pale (yellow) colour / coloured acceptable predicted value for the melting point i.e. < –101 °C any two for (1) each	 any colour ‘diatomic’	F_2 low melting point	 colourless

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	2	(a)	(i)		1	carbon, sulfur and hydrogen	C, S and H	H_2 oxygen	
			(ii)		1	(fuels that) cannot be replaced (when they are used up) / (fuels that) will run out		'limited amount' needs qualification	
		(b)	(i)		1	$2H_2 + O_2 \rightarrow 2H_2O$			
			(ii)		1	produces a '(squeaky) pop' noise when tested with a lighted splint		'pop test'	
			(iii)		2	(large amount of) electricity required to produce hydrogen (1) (storage problem due to its) explosive nature (1)	availability of hydrogen e.g. lack of service stations for vehicles	highly flammable / unsafe / unstable / expensive	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
9	3	(a)			2	over millions of years (1) remains of marine organisms (1)	 missing ‘marine’ reference if pressure / heat mentioned		
		(b)	(i)		2	as the molecule size increases - the boiling point (range) increases / (colour) darkens / becomes more viscous / more difficult to burn / flame becomes more smoky any two for (1) each	inverse statement		
			(ii)		2	temperature lower during the winter (1) propane easier to ignite (1) butane becomes liquid at low temperature / difficult or problems for the butane to flow (1) any two for (1) each			

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Question Number			
FT	HT	Mark	
10	4	6	Indicative content: a description of the reaction between the carbonate and the acid – apparatus named, effervescence, exothermic, the formation of blue coloured copper sulfate solution and the addition of excess of the copper carbonate. The removal of the excess copper carbonate by filtration. Obtaining the crystals by evaporation. Either allowing the solution to evaporate at room temperature or by heating the solution and allowing the remaining solution to evaporate naturally to dryness. Credit to be given for word/symbol equation. 5 – 6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3 – 4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1 – 2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number								
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	5				4	NH_4^+ (1) Li_2SO_4 (1) $Pb(NO_3)_2$ (1) HCO_3^- (1)	 $Li^+{}_2SO_4^{2-}$ $Pb^{2+}(NO_3^-)_2$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)	(i)		1	sodium, magnesium and aluminium (ignore 'silicon')	Na, Mg and Al		
			(ii)		1	silicon	Si		
			(iii)		1	both gases (at room temperature)		very low density	
			(iv)		1	density of the metals increases across the period			
		(b)			2	the evidence supports the statement for P, Cl, Ar and/or S, Cl, Ar (1) P is lower than S/P or S does not follow the trend (1) need to look at data for other periods (1) any two for (1) each	if Si is included in their list		

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	7	(a)			2	reaction takes place since iron is higher in the series / more reactive than copper (1) brown solid formed / solution becomes colourless / decolourises (1)			
		(b)			2	reaction takes place since magnesium is higher in the series than hydrogen (1) effervescence / bubbling / temperature rise / exothermic (1)	magnesium disappears		
		(c)			2	no reaction takes place (1) aluminium is higher in the series / more reactive than carbon (1)	no displacement		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)			1	allows a valid comparison of the two volumes	apparatus was initially at room temperature	health and safety answers	
		(b)	(i)		2	volume of oxygen = 50 – 41 = 9 (1) % of oxygen = $\frac{9}{50} \times 100 = 18$ % (1) - correct answer only (2)			
			(ii)		1	some unreacted oxygen still left in the air / the air has not been passed over the copper sufficient number of times / not enough copper to remove all the oxygen / some of the copper unreacted			
		(c)	(i)		1	copper oxide	CuO		
			(ii)		1	increase in mass since the solid or copper has joined or reacted with oxygen			
		(d)	(i)		1	nitrogen	N_2	N	
			(ii)		1	argon	Ar		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)			1	allows the ions to be mobile / move		allows electricity to flow	
		(b)			1	$2Br^- - 2e^- \longrightarrow Br_2$			
		(c)	(i)		1	lead ions would gain electrons			
			(ii)		1	shiny or grey substance		lead – needs qualifying	
			(iii)		2	lead metal formed would link the two electrodes (1) lead/metals conduct electricity (1)			

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Question Number			
FT	HT	Mark	
	10	6	Indicative content: a description of photosynthesis and respiration producing and removing oxygen and removing and producing carbon dioxide respectively. Discussing combustion and how oxygen is reduced to produce carbon dioxide during this process. Discussing deforestation reduces the number of plants available to produce oxygen and to reduce the amount of carbon dioxide in the atmosphere which therefore increases the percentage of carbon dioxide in the air leading to global warming. 5 – 6 marks: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. 3 – 4 marks: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. 1 – 2 marks: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. 0 marks: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

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New GCSE

4462/02

SCIENCE A
HIGHER TIER
CHEMISTRY 1

A.M. TUESDAY, 12 June 2012

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**5**	
2.	**5**	
3.	**8**	
4.	**6**	
5.	**6**	
6.	**8**	
7.	**5**	
8.	**4**	
9.	**4**	
10.	**3**	
11.	**6**	
Total	**60**	

4462 020001

ADDITIONAL MATERIALS

In addition to this paper you will need a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded that assessment will take into account the quality of written communication used in your answer to questions **4** and **11**.

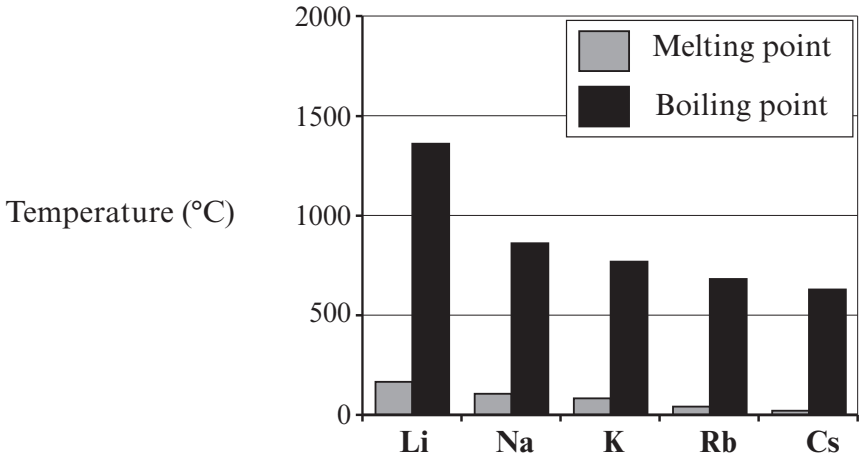
The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

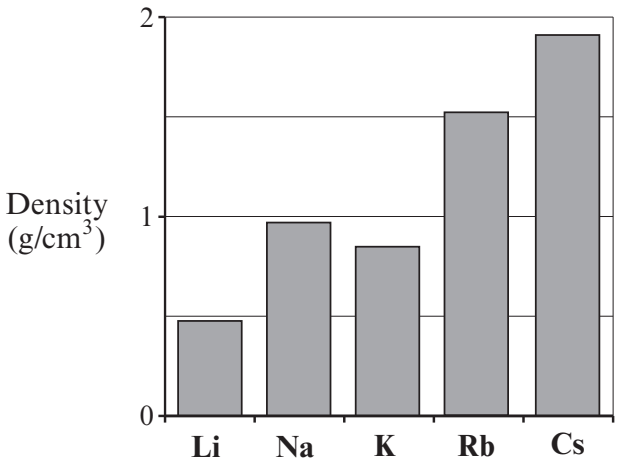
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Answer **all** *questions.*

1. The graphs below show the trends in melting points, boiling points and densities of Group 1 elements.





Use the information in the graphs to answer the following questions.

(a) Describe the trends in the melting points and densities of the elements going **down** the group. [2]

.....

.....

(b) Give the name of the element which has a property which does not fit a trend. [1]

.....

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(c) The table below shows the boiling points of Group 1 elements.

Group 1 element	Boiling point (°C)
lithium	1340
sodium	880
potassium	780
rubidium	690
caesium	670

Francium lies below caesium in Group 1.
Estimate, giving your reasoning, a value for the boiling point of francium. [2]

Value ..... °C

Reason for value .....

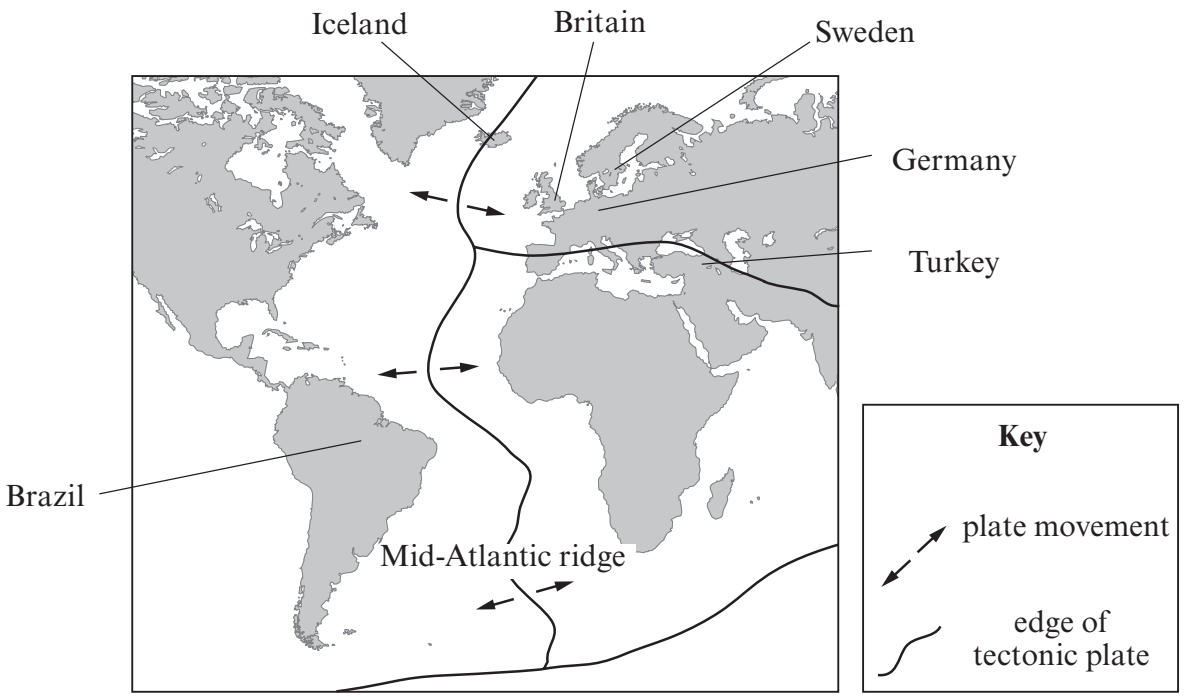
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2. The map below shows some information about tectonic plates.



(a) Choose the country, labelled on the map above, in which you would expect to have the **most** volcanic eruptions. Give a reason for your choice of country. [2]

.....

.....

(b) Wegener's theory of continental drift was not accepted by other scientists until several years after his death in 1930. In 1960 parts of the ocean floor were surveyed, at various distances from a plate boundary. The data below shows the age of the rocks.

Distance from the plate boundary (km)	500	1000	1500	2000	2500
Age of rock (millions of years)	24	46	71	90	113

(i) Describe the pattern in the results. [1]

.....

(ii) Using the data, state what conclusions can be drawn about what is happening at the plate boundary. [2]

.....

.....

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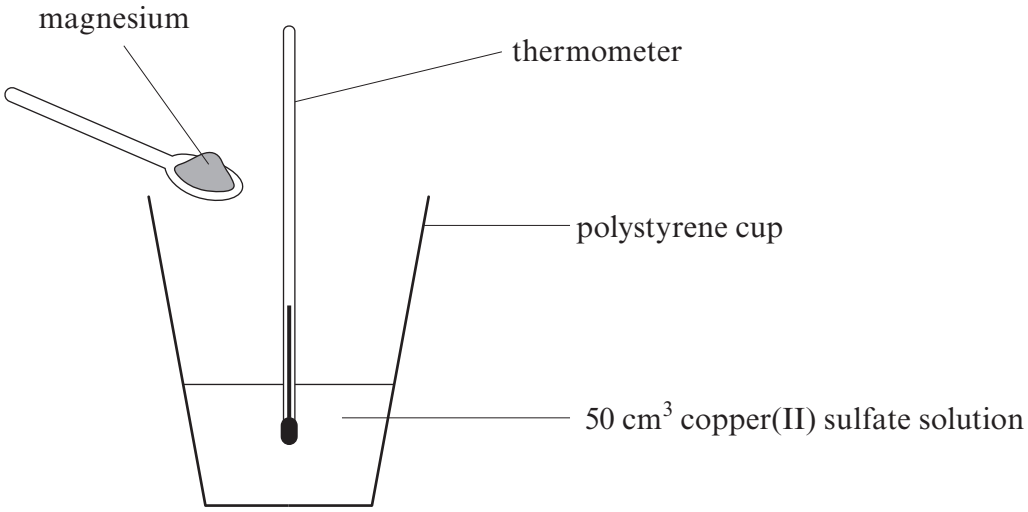
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3. Four pupils investigated the temperature change which occurred when increasing amounts of powdered magnesium were added to 50 cm^3 of copper(II) sulfate solution in a polystyrene cup as shown in the diagram below.



- In the first experiment, each pupil weighed 0.2 g of magnesium.
- The pupils then measured out 50 cm^3 of copper(II) sulfate solution into a polystyrene cup and recorded the temperature of the solution.
- The pupils then added the magnesium to the solution, swirled the polystyrene cup and recorded the maximum temperature rise.
- They repeated the experiment using 0.4, 0.6, 0.8 and 1.0 g of magnesium powder, using a new 50 cm^3 of copper(II) sulfate solution each time.

The table below shows the results recorded.

Mass of magnesium powder (g)	Maximum temperature rise (°C)				
	Pupil **A**	Pupil **B**	Pupil **C**	Pupil **D**	Mean
0.2	3.5	3.5	3.7	3.7	3.6
0.4	6.0	5.9	6.1	6.0	6.0
0.6	7.8	8.2	8.0	8.0	8.0
0.8	9.1	9.0	3.0	8.9	9.0
1.0	8.8	9.2	8.9	9.1	9.0

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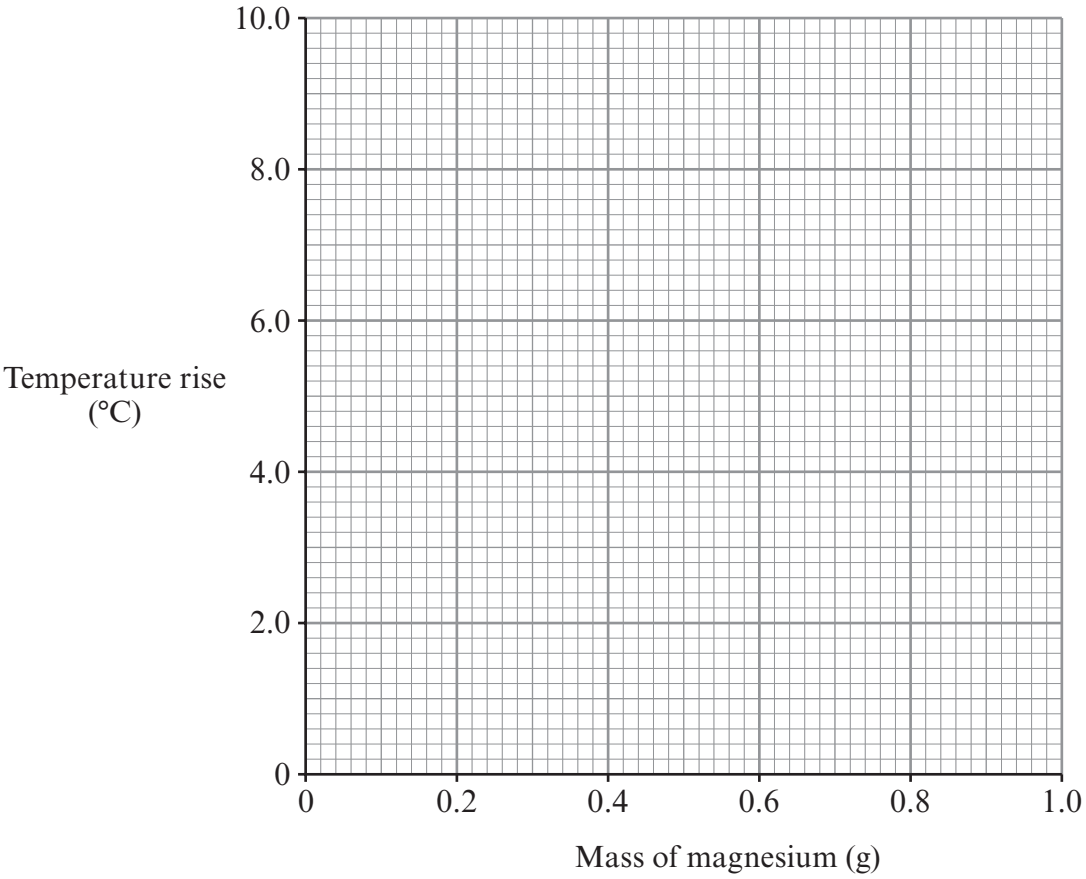
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(a) (i) **Circle** the anomalous result **not** used in calculating one of the mean temperature rises. [1]

(ii) Suggest **one** possible cause for this anomalous result. [1]

.....

(b) Using the grid provided, plot the mean temperature rise against the mass of magnesium added. Draw a line of best fit starting at the origin (0,0). [3]



(c) State why the line of best fit must be drawn to the origin (0,0). [1]

.....

(d) Use your graph to find the smallest mass of magnesium needed to react with **all** the copper(II) sulfate. Give the reason for your answer. [2]

.....

.....

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Turn over.

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4462 020007

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4. Most scientists believe that the increase in the level of carbon dioxide in the atmosphere during the last 150 years has resulted in global warming.

Briefly describe and explain your understanding of the term 'global warming'. [6 QWC]

In your answer you should refer to

- its cause(s)
- its consequence(s)
- what can be done to reduce its impact

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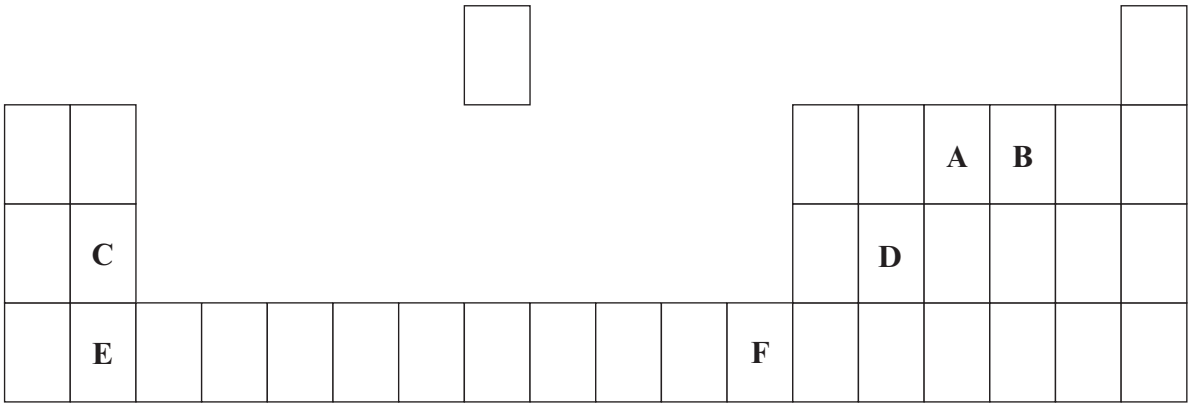
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5. *(a)* The diagram below shows part of the Periodic Table of Elements. The letters **A-F** represent six elements. *Letters **A-F** are not the chemical symbols for the elements.*



(i) Give the **letter** of the element in Group 2 and Period 3. ..... [1]

(ii) State **two** general physical properties that elements **C**, **E** and **F** have in common. [2]

.....

.....

(iii) The table below shows some properties of one of the six elements identified in the Periodic Table above.

Melting point (°C)	Boiling point (°C)	Appearance at 20 °C
1410	2355	shiny brittle solid

I. Give the **letter** of the element which you would expect to have these properties. [1]

.....

II. Give a reason for your choice. [1]

.....

(b) Mendeleev developed the modern Periodic Table of Elements at a time when not all the elements had been discovered.

State how Mendeleev overcame the problem of undiscovered elements. [1]

.....

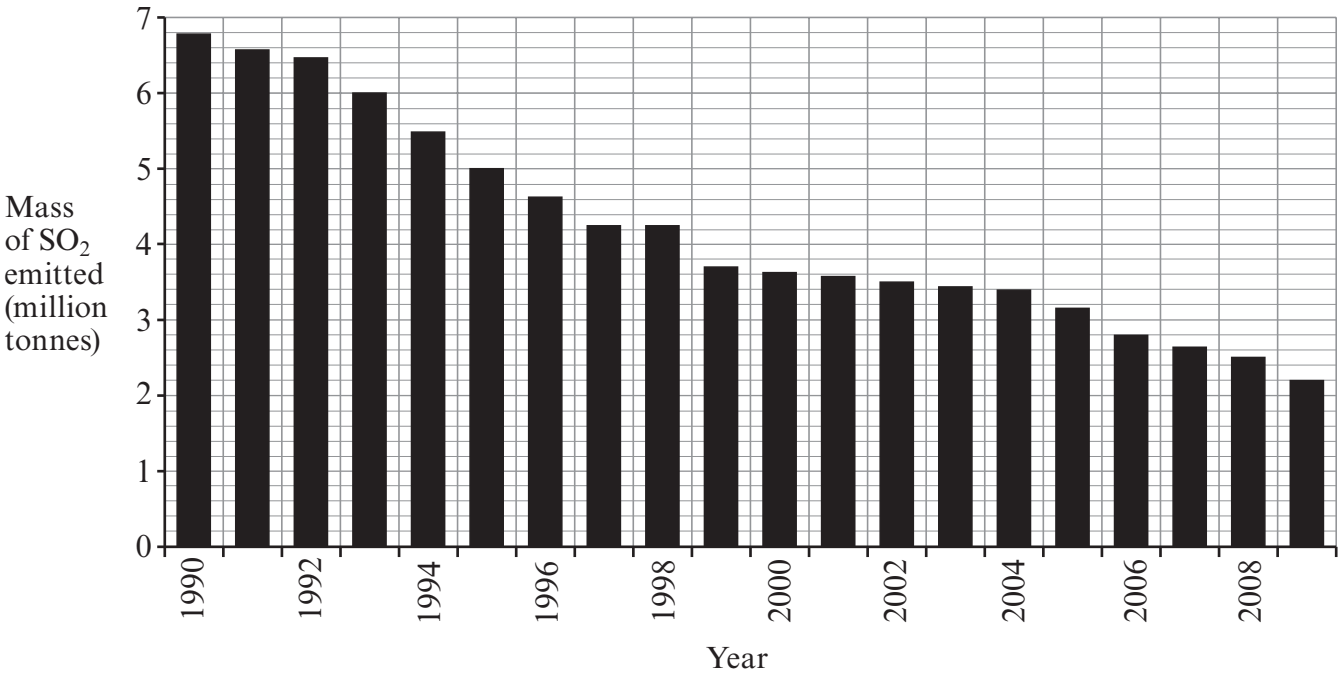
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6

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6. *(a)* The bar chart below shows the mass of sulfur dioxide emitted each year in the UK between 1990 and 2009.



(i) Describe the trend in sulfur dioxide emissions between 1990 and 2009. [1]

.....

(ii) Calculate the % decrease in sulfur dioxide emissions between 2008 and 2009. Show your workings. [3]

.....

.....

.....

(b) (i) One significant source of acid rain is coal-burning power stations. Explain how burning coal results in the formation of acid rain. [3]

.....

.....

.....

(ii) State **one** method of reducing sulfur dioxide emissions from coal-burning power stations. [1]

.....

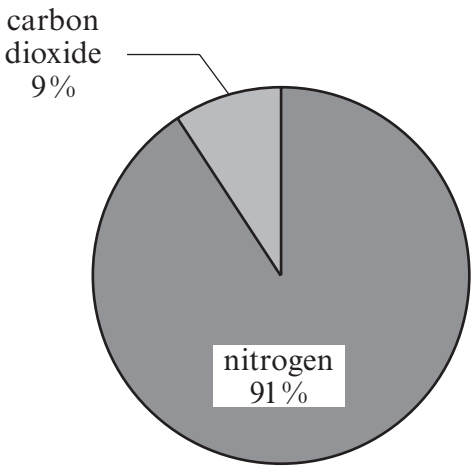
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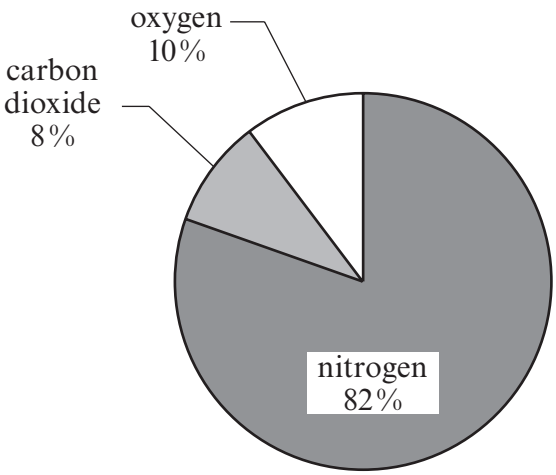
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7. *(a)* The pie charts below show the composition of the Earth's atmosphere at 3000 million and 2000 million years ago.



Composition of the Earth's atmosphere 3000 million years ago



Composition of the Earth's atmosphere 2000 million years ago

Describe how the percentages of carbon dioxide and oxygen have changed between 3000 million and 2000 million years ago. State and explain the reasons for these changes. [3]

.....

.....

.....

.....

(b) State the percentages of nitrogen, oxygen and carbon dioxide present in the atmosphere today. [2]

nitrogen ..... %

oxygen ..... %

carbon dioxide ..... %

5

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8. *(a)* Aqueous solutions of sodium carbonate, sodium chloride and sodium hydroxide are stored in three bottles labelled **A**, **B** and **C**, but not necessarily in that order.

A class of pupils was instructed to carry out the following procedures on each solution.

Procedure 1: Add three drops of universal indicator solution. Record the colour and pH.

Procedure 2: Add dilute hydrochloric acid. Record observations including any temperature change.

The results of one pupil are shown below.

Sodium solution	Procedure 1	Procedure 2
A	navy blue / pH 10	bubbles formed, temperature increase of 9 °C
B	purple / pH 14	no bubbles formed, temperature increase of 6 °C
C	green / pH 7	no bubbles formed, no temperature change

(i) Use the information above to identify solutions **A**, **B** and **C**. [2]

A is .....

B is .....

C is .....

(ii) Fill in the boxes to balance the symbol equation below. [1]

$$Na_2CO_3 + \square\ HCl \longrightarrow \square\ NaCl + H_2O + CO_2$$

(b) Use the table of formulae of common ions on the inside of the back cover of this examination paper to write the formula of copper(II) nitrate. [1]

.....

4

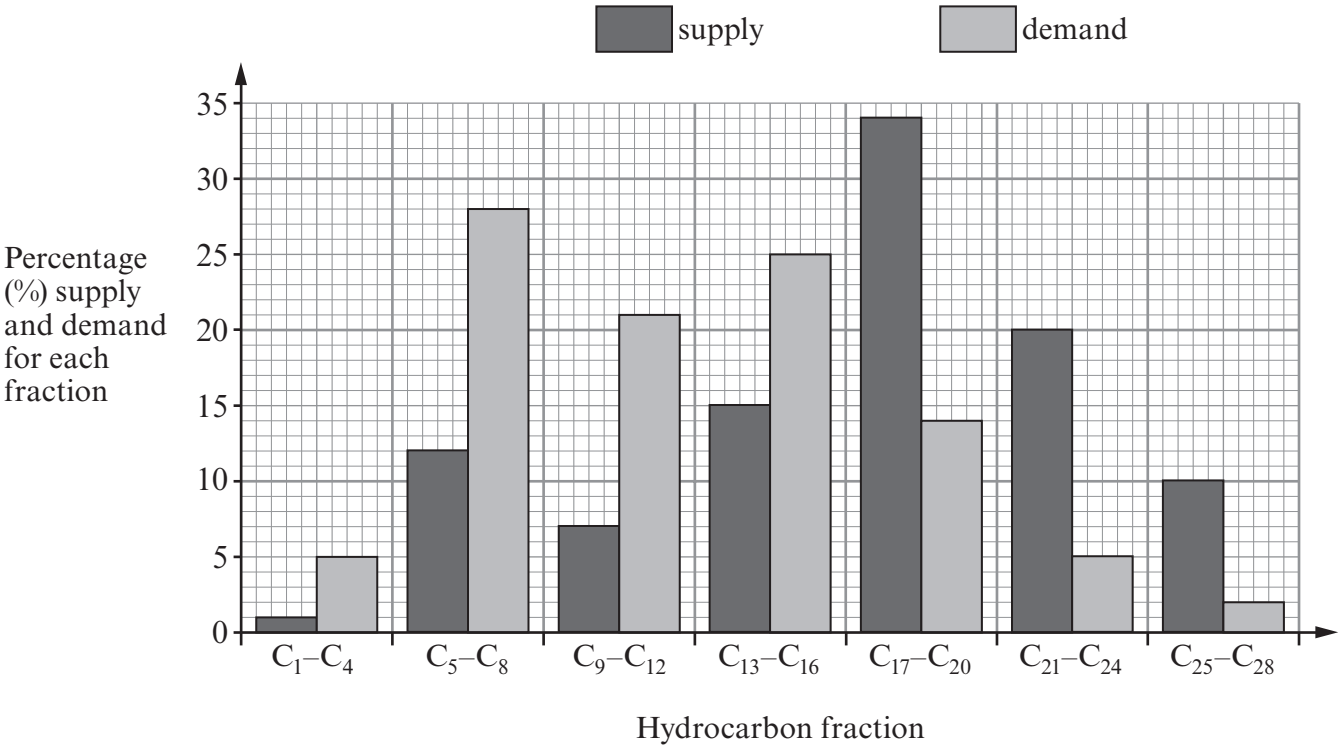
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9. Crude oil is a mixture of hydrocarbon compounds. Crude oil can be separated into simpler mixtures called fractions. Each fraction contains hydrocarbons of similar chain lengths.

The bar chart below shows the relative 'supply' and 'demand' for some fractions.



Use the bar chart to help you answer parts *(a)* and *(b)*.

(a) Describe how the **difference** between *supply* and *demand* for each fraction changes as chain length increases. [2]

.....

.....

(b) Oil companies have developed a process called cracking.
State the meaning of the term *cracking* and give the reason why it is an important process. [2]

.....

.....

.....

4

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10. During the electrolysis of molten aluminium oxide, aluminium ions travel to the cathode and oxide ions travel to the anode.

(a) The melting point of aluminium oxide is 2000 °C. Cryolite is added to lower this value to 950 °C. State why reducing the melting point of the electrolyte reduces the cost of the process. [1]

.....

(b) Give the reason why the ions move to the electrodes during electrolysis. [1]

.....

(c) Fill in the boxes to balance the anode equation. [1]

$$\square\ O^{2-} \quad - \quad \square\ e^{-} \longrightarrow \quad O_2$$

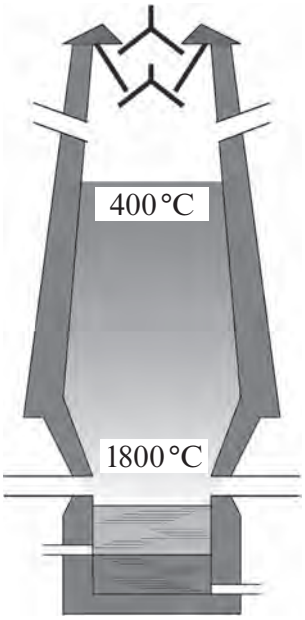
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11. The diagram below shows the blast furnace used to extract iron from its ore.



Outline the industrial extraction of iron from its ore. [6 QWC]

In your answer you should refer to the

- raw materials
- main reactions taking place
- products formed

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FORMULAE FOR SOME COMMON IONS

POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		
Zinc	Zn^{2+}		

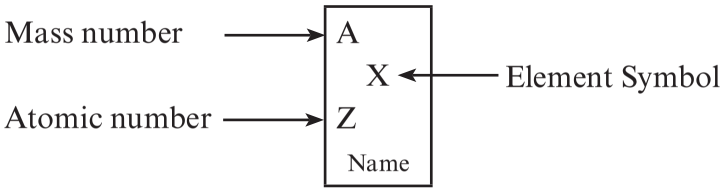
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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
									$^{1}_{1}$H Hydrogen								$^{4}_{2}$He Helium
$^{7}_{3}$Li Lithium	$^{9}_{4}$Be Beryllium											$^{11}_{5}$B Boron	$^{12}_{6}$C Carbon	$^{14}_{7}$N Nitrogen	$^{16}_{8}$O Oxygen	$^{19}_{9}$F Fluorine	$^{20}_{10}$Ne Neon
$^{23}_{11}$Na Sodium	$^{24}_{12}$Mg Magnesium											$^{27}_{13}$Al Aluminium	$^{28}_{14}$Si Silicon	$^{31}_{15}$P Phosphorus	$^{32}_{16}$S Sulfur	$^{35}_{17}$Cl Chlorine	$^{40}_{18}$Ar Argon
$^{39}_{19}$K Potassium	$^{40}_{20}$Ca Calcium	$^{45}_{21}$Sc Scandium	$^{48}_{22}$Ti Titanium	$^{51}_{23}$V Vanadium	$^{52}_{24}$Cr Chromium	$^{55}_{25}$Mn Manganese	$^{56}_{26}$Fe Iron	$^{59}_{27}$Co Cobalt	$^{59}_{28}$Ni Nickel	$^{64}_{29}$Cu Copper	$^{65}_{30}$Zn Zinc	$^{70}_{31}$Ga Gallium	$^{73}_{32}$Ge Germanium	$^{75}_{33}$As Arsenic	$^{79}_{34}$Se Selenium	$^{80}_{35}$Br Bromine	$^{84}_{36}$Kr Krypton
$^{86}_{37}$Rb Rubidium	$^{88}_{38}$Sr Strontium	$^{89}_{39}$Y Yttrium	$^{91}_{40}$Zr Zirconium	$^{93}_{41}$Nb Niobium	$^{96}_{42}$Mo Molybdenum	$^{99}_{43}$Tc Technetium	$^{101}_{44}$Ru Ruthenium	$^{103}_{45}$Rh Rhodium	$^{106}_{46}$Pd Palladium	$^{108}_{47}$Ag Silver	$^{112}_{48}$Cd Cadmium	$^{115}_{49}$In Indium	$^{119}_{50}$Sn Tin	$^{122}_{51}$Sb Antimony	$^{128}_{52}$Te Tellurium	$^{127}_{53}$I Iodine	$^{131}_{54}$Xe Xenon
$^{133}_{55}$Cs Caesium	$^{137}_{56}$Ba Barium	$^{139}_{57}$La Lanthanum	$^{179}_{72}$Hf Hafnium	$^{181}_{73}$Ta Tantalum	$^{184}_{74}$W Tungsten	$^{186}_{75}$Re Rhenium	$^{190}_{76}$Os Osmium	$^{192}_{77}$Ir Iridium	$^{195}_{78}$Pt Platinum	$^{197}_{79}$Au Gold	$^{201}_{80}$Hg Mercury	$^{204}_{81}$Tl Thallium	$^{207}_{82}$Pb Lead	$^{209}_{83}$Bi Bismuth	$^{210}_{84}$Po Polonium	$^{210}_{85}$At Astatine	$^{222}_{86}$Rn Radon
$^{223}_{87}$Fr Francium	$^{226}_{88}$Ra Radium	$^{227}_{89}$Ac Actinium															

Key:



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GCSE MARKING SCHEME

SCIENCE - CHEMISTRY

SUMMER 2012

INTRODUCTION

The marking schemes which follow were those used by WJEC for the Summer 2012 examination in GCSE SCIENCE-CHEMISTRY. They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
1		(a)	(i)		2	high mp / high bp / high density any 2 for (1) each all properties must have **high** values (2)		reference to numerical values	
			(ii)		2	tin (1) low mp and high bp / low mp and high density (1)			
		(b)			2	diag 1 description 1 diag 2 description 2 diag 3 description 3 diag 4 description 4 all correct (2) any 1 correct (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
2		(a)	(i)		1	breaking down/splitting a compound (into its elements) ..... using an electric current/electricity both statements needed			
			(ii)		1	water	H_2O		
			(iii)		2	it contains hydrogen and oxygen (1) the ratio of H:O is 2:1 (1)	it contains H and O there is twice as much hydrogen than oxygen - 2 marks	there is more hydrogen than oxygen	it contains H_2 and O_2
		(b)			2	water (1) contains two different atoms (joined together) / contains two elements (joined together) (1)	H_2O or diagram contains **both** elements		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
3		(a)	(i)		2	**both** Al^{3+} ions are shown going to the negative electrode (1) **all three** O^{2-} ions are shown going to the positive electrode (1)	one Al^{3+} **and** one O^{2-} for (1)		
			(ii)		1	2:4:3			
			(iii)		1	gains 3 electrons		gains electrons	
		(b)			2	aluminium (1) very good(electrical)conductor ***…..this answer required, plus either*** low density ***or*** (good) resistance to corrosion (1) **both needed** aluminium not identified but two correct properties given (1)	low density = light		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
4		(a)	(i)		2	filter (1) leave to ***evaporate*** (at room temperature) / leave in a basin on the side of the laboratory to ***evaporate*** / ***evaporate*** (some) water away and then leave to evaporate at room temperature / ***boil*** (some) water away and leave on the side of the laboratory any one for (1)	filtration ***heat*** water away and leave on the side of the laboratory		
			(ii)		1	limewater turns milky			
			(iii)		1	zinc oxide / zinc hydroxide	ZnO $Zn(OH)_2$		zinc
		(b)	(i)		1	1			
			(ii)		1	7			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
5		(a)	(i)	I	1	C_{13}-C_{16}			
				II	1	C_9-C_{12}		reference to diesel	
			(ii)		1	cracking			
		(b)			2	to reduce usage/make people use them again plastic (bags) are non-biodegradable / plastic (bags) take a long time to rot / plastic (bags) take a long time to decompose / plastic (bags) take a long time to break down reduce landfill conserves crude oil any two for (1) each		reference to recycling reference to raising money/ littering/pollution reduce waste conserves raw materials	

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
6		(a)	(i)		2	aluminium / Al zinc / Zn iron / Fe copper / Cu (1) more bubbles = more reactive (1)	 converse		
			(ii)		1	iron sulfate + hydrogen **both** needed	$FeSO_4$ + H_2		H hydrogen ***gas*** iron sulphate ***solution***
			(iii)		1	(sulfuric acid) is the acid found in acid rain / (sulfuric acid) causes acid rain			
			(iv)		1	**1**. damages marble statues **2**. destroys forests **both** needed	correct statements identified in any way		
		(b)	(i)		1	decreases			'decreases ***then stays the same***'
			(ii)		1	**more** industry / factories **more** coal power stations *'source' needed not 'reason'*	**more** combustion of fossil fuels	more people / cars 'developing countries'	

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
7	**1**	(a)			2	melting point decreases (1) density increases (1)			
		(b)			1	potassium	K		sodium
		(c)			2	values from 669–650°C (1) (francium boiling point) below that of caesium /boiling points decrease down the group below 670°C **and** above 650°C / no greater than 20°C below caesium's boiling point (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
8	**2**	(a)			2	Iceland (1) positioned on the mid-Atlantic ridge / mid-Atlantic ride passes through Iceland / positioned at a boundary where plates are moving apart / on constructive plate boundary			
		(b)	(i)		1	rocks furthest away (from the plate boundary) are the oldest			
			(ii)		2	new (igneous) rock formed (1) ocean floor moving / ocean floor spreading / rocks moving away from boundary / plates moving apart (1) constructive plate boundary (1) any 2 for (1) each	ocean floor = sea floor floor = rocks	new 'land' formed	plates move towards/past each other

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
9	**3**	(a)	(i)		1	circle around **3.0**			
			(ii)		1	incorrect ***mass of magnesium*** used / incorrect ***volume of copper(II) sulfate solution*** used / thermometer ***out of the reaction*** mixture when read any one		too much magnesium added	incorrect thermometer reading
		(b)			3	all points plotted correctly (2) one plotting error only (1) smooth curve of best fit (by eye) (1) *(line must be a single line and line must go to origin)*			points joined by straight lines
		(c)			1	no magnesium added = no temperature rise/ no magnesium added = no reaction			
		(d)			2	0.8(g) (1) consequential from graph temperature stops rising /graph stops rising (1)			

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Question Number			
FT	HT	Mark	Answer
10	**4**	6 QWC	**Indicative content:** Reference to the ***causes***, ***consequences*** and ***solutions*** of global warming e.g. Causes: burning fossil fuels / named fuels deforestation CO_2 in atmosphere increases CO_2 prevents heat escaping from atmosphere/ CO_2 is a greenhouse gas increased greenhouse effect = global warming/increase in atmospheric temperature Consequences: sea level increasing/ climate change/ extreme weather event/ increase in melting glaciers, sea ice & permafrost Ways of reducing impact: burn less fossil fuel/ reduce deforestation / alternative energy / reduce use of electricity (personal level) carbon capture and storage **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	5	(a)	(i)		1	**C**	Mg		
			(ii)		2	(good) electrical conductor (good) thermal conductor malleable / bends ductile / can be stretched into wire high mp / high bp high density hard shiny sonorous any two for 1 mark each	good conductor (1) thermal = heat dense	strong/durable	
			(iii)	I	1	**D**			
				II	1	brittle and yet has a high mp brittle and yet has a high bp brittle and yet is shiny has both metallic and non-metallic properties found on the boundary between metals and non-metals has intermediate properties any one	metalloid	reference to Group 4	
		(b)			1	(left) gaps			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	6	(a)	(i)		1	decreases			
			(ii)		3	2.5 (accept range 2.4-2.6) – 2.2 = **0.3** (1) **0.3/2.5** (1) *consequential marking* 0.3/2.5 × 100 = **12%** (1) *consequential marking*			
		(b)	(i)		3	coal contains **sulfur (**1) sulfur burns forming **sulfur dioxide** (1) SO_2 **reacts with rain** (water) forming (acid rain) (1)		reference to CO_2 and/or oxides of nitrogen	
			(ii)		1	use coal containing less sulfur / use sulfur scrubbers/neutralise the SO_2 before it leaves the power station		Use less coal/ power coal/ trap SO_2	use alternative energy resources

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	7	(a)			3	O_2 appears/increases **and** CO_2 decreases **both** needed (1) plants give out O_2 **and** plants take in CO_2 **both** needed (1) photosynthesis / evolution of green plants (1) CO_2 dissolved in oceans (1) any 3 for (1) each			
		(b)			2	nitrogen: 78-80 oxygen: 20-21 carbon dioxide: 0.03-0.04 all three correct (2) any two correct (1)			

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	8	(a)	(i)		2	**A** = sodium carbonate / carbonate **B** = sodium hydroxide / hydroxide **C** = sodium chloride / chloride all correct (2) any one (1)	Na_2CO_3 / CO_3^{2-} NaOH / OH^- NaCl / Cl^-		
			(ii)		1	correct balancing **2** HCl **and** **2** NaCl			
		(b)			1	$Cu(NO_3)_2$	$Cu^{2+}(NO_3^-)_2$		

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Question Number									
FT	HT	Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
	9	(a)			2	for shorter chains (C_1- C_{16}) demand > supply (1) for longer chains (C_{17} – C_{28}) demand < supply (1)			
		(b)			2	(cracking) is the breaking down of large chains/molecules/hydrocarbons into smaller ones (1) reduce unwanted fractions / use up less useful fractions/use up large chains make more useful fractions/ make more smaller chains / make more petrol / make more diesel / makes monomers (for polymerisation) more demand for smaller chains any one for 1 mark	example such as decane broken down to octane and ethene		

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Question Number		Sub-section			Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT								
	10	(a)			1	saves energy / reduces amount of electricity consumption (for **melting** aluminium oxide)		reference to electrolysis e.g. reduces amount of electricity for **electrolysis** reference to power/heat	
		(b)			1	(ions) ***attracted*** to ***oppositely*** charged electrodes	opposite charges attract		
		(c)			1	correct balancing **2** O^{2-} **and 4** e^{-}			

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Question Number			
FT	HT	Mark	Answer
	11	6 QWC	**Indicative content:** Reference to ***raw materials, reactions*** and ***products*** e.g. **Raw materials:** • **Iron ore:** source of iron • **Coke:** acts as a fuel/ burns/ forms carbon monoxide/ forms carbon dioxide • **Limestone:** removes impurities / forms slag • **Air:** source of oxygen **Reactions:** • coke/C burns forming CO/CO_2 • C/CO reacts with iron oxide forming iron / iron oxide reduced by C/CO • limestone decomposes forming lime / lime reacts with impurities **Products :** molten iron and slag ***Correct word and symbol equations will satisfy indicative content.*** ***Labelled diagram can be used to supplement written answer.*** **5-6 marks** The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3-4 marks** The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1-2 marks** The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks** The candidate does not make any attempt or give a relevant answer worthy of credit.

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Surname	Centre Number	Candidate Number
Other Names		0

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New GCSE

4462/02

SCIENCE A
HIGHER TIER
CHEMISTRY 1

A.M. WEDNESDAY, 18 January 2012

1 hour

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1	**7**	
2	**7**	
3	**6**	
4	**6**	
5	**6**	
6	**3**	
7	**7**	
8	**6**	
9	**6**	
10	**6**	
Total	**60**	

4462 020001

ADDITIONAL MATERIALS

In addition to this paper you may require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

You are reminded of the necessity for good English and orderly presentation in your answers.

The Periodic Table is printed on the back cover of the examination paper and the formulae for some common ions on the inside of the back cover.

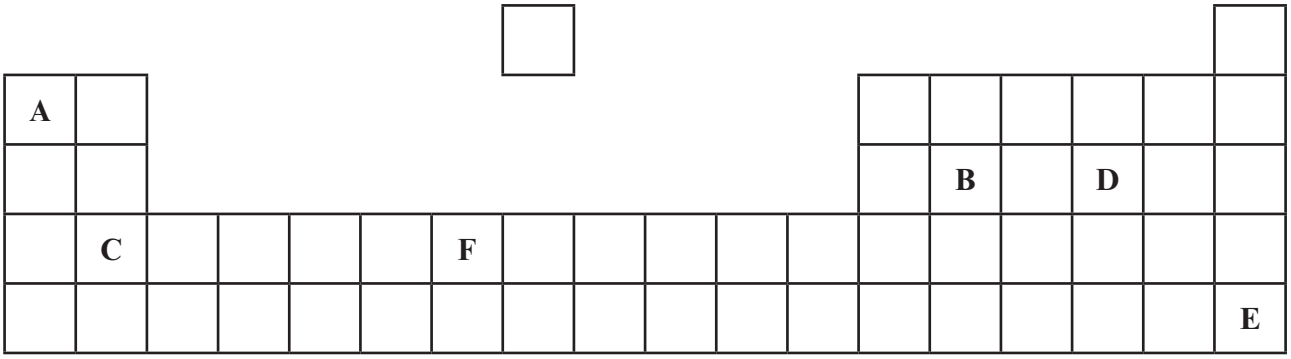
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Answer **all** *questions.*

1. *(a)* The following diagram shows an outline of the Periodic Table.

The letters shown are NOT the chemical symbols of the elements.



(i) Give the letters of the elements that represent metals and those that represent non-metals. [1]

Metals .....

Non-metals .....

(ii) One of the elements **A-F** shows properties of both metals and non-metals.

I. Give the letter that represents this element.

..... [1]

II. State the group and period to which this element belongs. [1]

Group .....

Period .....

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(b) The following table shows information about some of the elements in Group 7 of the Periodic Table.

Name of element	Symbol	Melting point / °C	Boiling point / °C	Reaction with hot sodium
fluorine	F	–219	–188	explosive
chlorine	Cl	–101	–34	very vigorous
bromine	Br	–7	59	vigorous
iodine	I	114	184	slow

(i) Fluorine is a gas at room temperature, 20 °C. Give the states of bromine and iodine at room temperature. [2]

	State at room temperature
bromine	
iodine	

(ii) Astatine is below iodine in this group of the Periodic Table. Use the information in the table to predict the properties of astatine. [2]

.....

.....

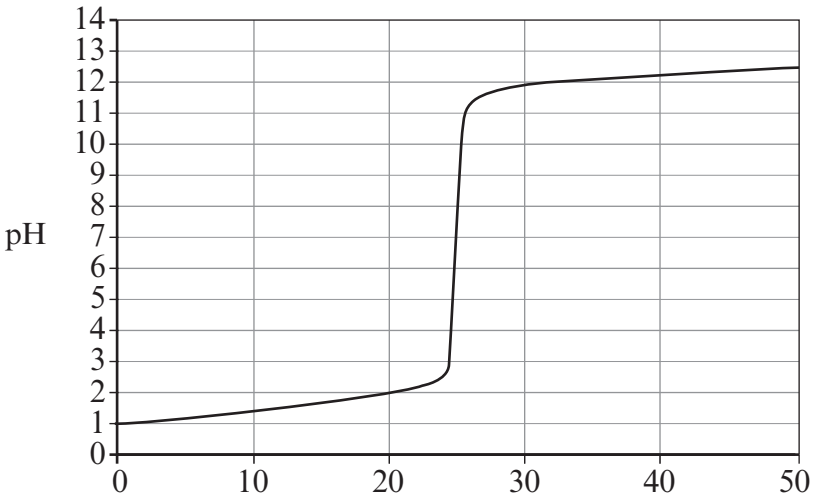
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2. Rebecca was asked to investigate how the pH changed during the reaction between hydrochloric acid and potassium hydroxide. She slowly added potassium hydroxide solution to 25 cm^3 of dilute hydrochloric acid and recorded the pH using a pH sensor. The results are shown in the graph below.



(a) (i) Use the graph to give

I. the pH of the hydrochloric acid **before** adding potassium hydroxide, [1]

.....

II. the volume of potassium hydroxide required to **neutralise** the acid. [1]

..... cm^3

(ii) Rebecca could also have investigated the pH change using universal indicator solution.

I. State the colour of universal indicator when the solution is neutral. [1]

.....

II. Give **one** advantage of using a pH sensor to investigate changes in pH. [1]

.....

.....

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Examiner only

(b) Acids also react with bases such as copper oxide.

Describe how a pure sample of copper sulfate crystals can be prepared from copper oxide. [3]

.....

.....

.....

.....

.....

.....

7

Turn over.

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3. The following diagram shows the 'periodic table' published by Dmitri Mendeleev in 1869.

I	II	III	IV	V	VI	VII	VIII		
H 1.01									
Li 6.94	**Be** 9.01	**B** 10.8	**C** 12.0	**N** 14.0	**O** 16.0	**F** 19.0			
Na 23.0	**Mg** 24.3	**Al** 27.0	**Si** 28.1	**P** 31.0	**S** 32.1	**Cl** 35.5			
K 39.1 **Cu** 63.5	**Ca** 40.1 **Zn** 65.4		**Ti** 47.9	**V** 50.9 **As** 74.9	**Cr** 52.0 **Se** 79.0	**Mn** 54.9 **Br** 79.9	**Fe** 55.9	**Co** 58.9	**Ni** 58.7
Rb 85.5 **Ag** 108	**Sr** 87.6 **Cd** 112	**Y** 88.9 **In** 115	**Zr** 91.2 **Sn** 119	**Nb** 92.9 **Sb** 122	**Mo** 95.9 **Te** 128	**I** 127	**Ru** 101	**Rh** 103	**Pd** 106
Cs 133 **Au** 197	**Ba** 137 **Hg** 201	**La** 139 **Tl** 204	**Pb** 207	**Ta** 181 **Bi** 209	**W** 184		**Os** 194	**Ir** 192	**Pt** 195

The modern version of the Periodic Table is shown on the back page of this examination paper.

Describe how Mendeleev constructed his table and how it compares with today's Periodic Table. [6 QWC]

In your answer you should refer to

- how Mendeleev arranged the elements in his table,
- differences and similarities between the two tables.

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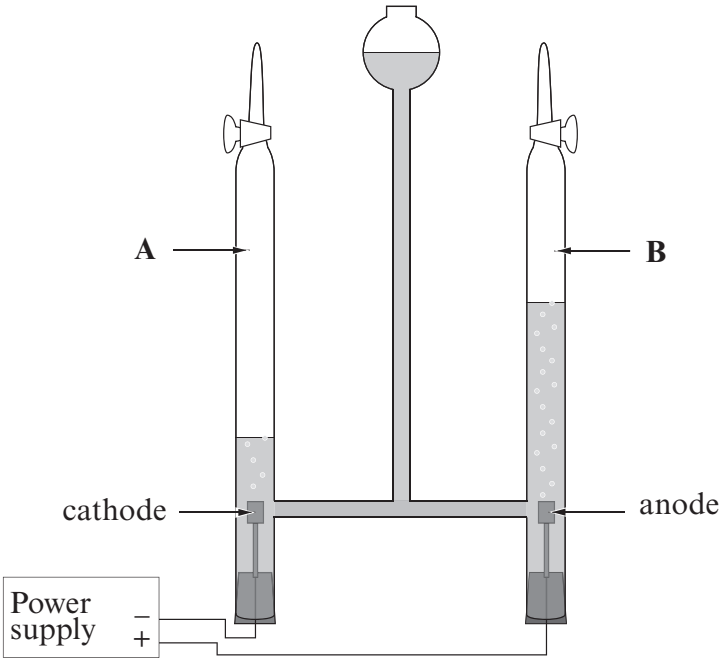
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Turn over.

Examiner only

4. *(a)* Hydrogen gas can be produced from water using electrolysis. The following diagram shows the apparatus that could be used in the laboratory to demonstrate the electrolysis of water.



Name gases **A** and **B**. Give the chemical test for each gas, giving the expected result in both cases. [3]

Gas **A** .....

Gas **B** .....

Test for gas **A** .....

.....

Test for gas **B** .....

.....

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(b) Hydrogen gas is used as a fuel. Give **one** advantage and **one** disadvantage of the use of hydrogen as a fuel. [2]

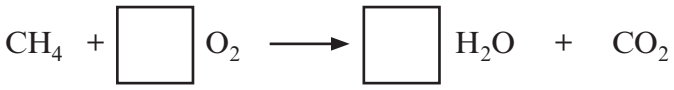
Advantage .....

.....

Disadvantage .....

.....

(c) Another gas that can be used as a fuel is methane. Fill in the boxes to balance the following symbol equation for the combustion of methane. [1]



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5. Crude oil is a mixture of compounds known as hydrocarbons. It can be separated into fractions using fractional distillation. The following table shows some properties of the main fractions collected.

Name of fraction	Carbon chain length range	Boiling point range /°C
refinery gas	1 - 4	below 60
petrol	.....	60 - 150
naphtha	8 - 12	150 - 200
kerosene	11 - 15	200 - 260
diesel	15 - 20	.....
lubricating oil	18 - 25	310 - 400
fuel oil	20 - 27	400 - 500
bitumen	above 35	above 500

(a) Complete the table to show

I. the range of carbon chain length in petrol, [1]

II. the boiling point range of diesel. [1]

(b) Give **two** reasons why the process of fractional distillation is important in everyday life. [2]

.....

.....

(c) Use the information in the table to explain why each fraction is collected over a temperature **range**. [2]

.....

.....

6

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6. Complete the following table by inserting the formulae of the missing ions and compounds.

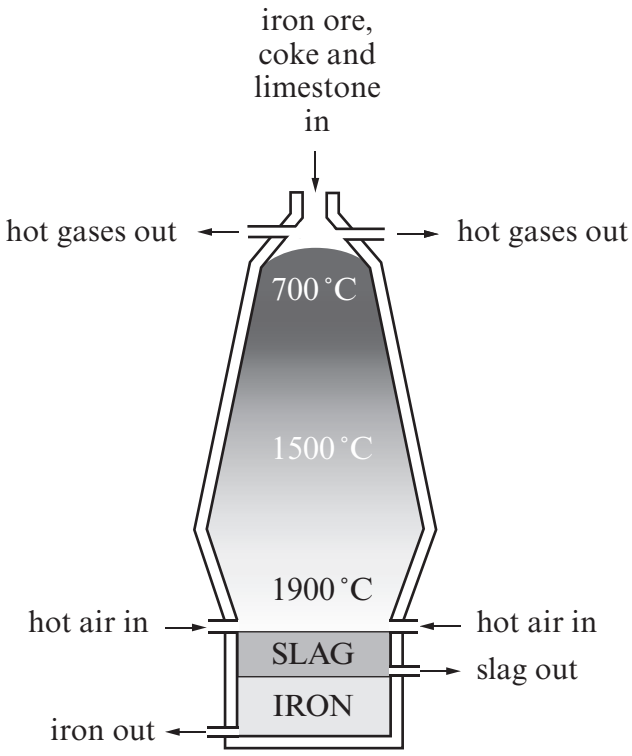
You may find it useful to refer to the table of formulae of common ions printed inside the back page of this examination paper. [3]

Name	Formula of positive ion	Formula of negative ion	Formula of compound
sodium chloride	Na^+	Cl^-	NaCl
calcium fluoride	.....	.....	CaF_2
sodium carbonate	Na^+	CO_3^{2-}	.....
magnesium hydroxide	Mg^{2+}	OH^-	.....

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7. Iron can be extracted from its ore in the blast furnace.



(a) Three raw materials used in this process are iron ore, coke and limestone. Explain why each of these materials is used in the blast furnance. [3]

.....

.....

.....

.....

.....

.....

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(b) One reaction that takes place in the blast furnace is shown below.

iron oxide + carbon monoxide ⟶ iron + carbon dioxide

(i) State which of the substances shown in the above equation is oxidised and which is reduced, giving reasons for your answers. [2]

.....

.....

.....

(ii) Fill in the boxes to balance the symbol equation for this reaction. [1]

Fe_2O_3 + ☐ CO ⟶ ☐ Fe + ☐ CO_2

(c) Most of the iron produced is converted into an alloy called steel before use.

State what is meant by an *alloy*. [1]

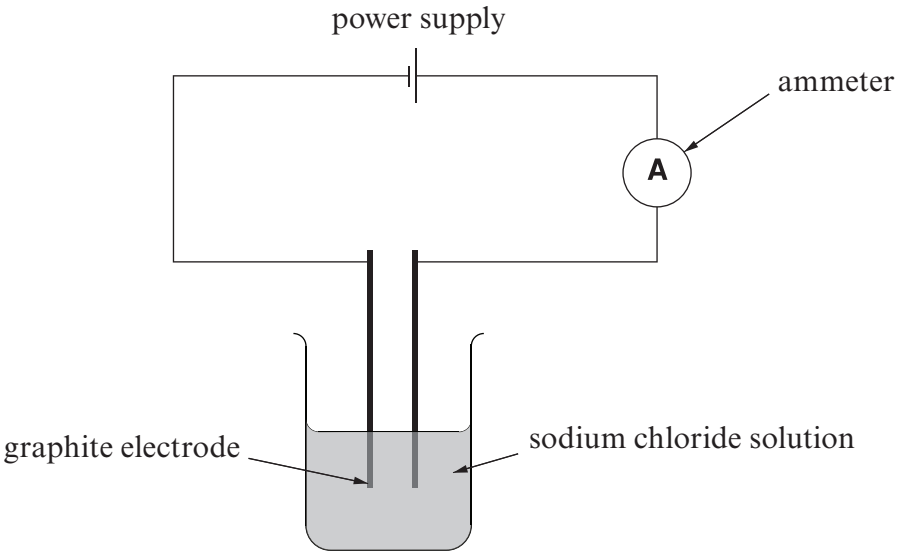
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7

Turn over.

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8. Three groups of students used the apparatus shown in the following diagram to investigate how the electric current that a sodium chloride solution conducts depends on the concentration of the solution. Each group prepared their own sodium chloride solutions by dissolving carefully weighed samples of sodium chloride in 50 cm^3 of water.



Their results are shown in the following table.

Group A		Group B		Group C	
Concentration / M	Current / A	Concentration / M	Current / A	Concentration / M	Current / A
0.1	0.07	0.1	0.06	0.1	0.06
0.2	0.14	0.2	0.12	0.2	0.13
0.3	0.20	0.3	0.19	0.3	0.20
0.4	0.28	0.4	0.26	0.4	0.27
0.5	0.35	0.5	0.33	0.5	0.34

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(a) Using the information in the table, describe the relationship between the concentration of the sodium chloride solution and the current that flows. [1]

.....

(b) Using the information in the table, state whether the evidence supporting your conclusion in part *(a)* is strong or weak, and give a reason for your answer. [1]

.....

.....

(c) (i) Calculate the mean value for the current measured using sodium chloride solution with a concentration of 0.5 M. [1]

.....

.....

(ii) Use the following formula to calculate the percentage variation in the current measured using this solution.

$$\frac{\text{(furthest value from mean value} - \text{mean value)}}{\text{mean value}} \times 100\%$$

[2]

.....

.....

(iii) Suggest a reason why each group obtained slightly different values for the current measured at this concentration. [1]

.....

.....

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9. *(a)* A student finds an unlabelled bottle containing a white powder. He suspects that the powder may be either sodium carbonate, sodium chloride or sodium hydroxide.

Describe how the student could identify the substance. [3]

Your answer must include the expected observations for **each** substance.

.....

.....

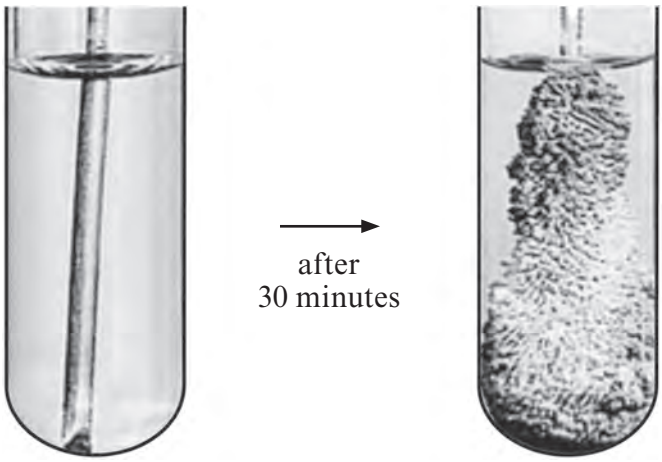
.....

.....

.....

.....

(b) When a copper rod is placed in a solution of silver nitrate, a chemical reaction takes place as shown in the following photographs.



(i) Give a **word** equation for the reaction taking place. [1]

..... + ... ⟶ ..... + ...

(ii) Explain why this reaction takes place. [2]

.....

.....

6

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10. The Earth's original atmosphere contained mainly carbon dioxide and water vapour with smaller amounts of other gases such as methane and ammonia. Describe the formation of the original atmosphere and explain how it changed to its present-day composition. [6 QWC]

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6

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FORMULAE FOR SOME COMMON IONS

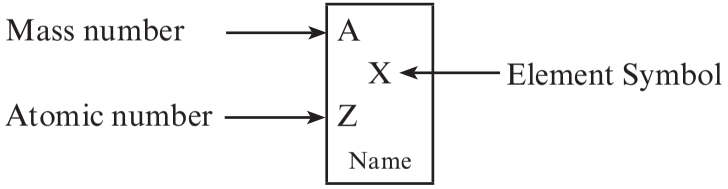
POSITIVE IONS		NEGATIVE IONS	
Name	**Formula**	**Name**	**Formula**
Aluminium	Al^{3+}	Bromide	Br^{-}
Ammonium	NH_4^{+}	Carbonate	CO_3^{2-}
Barium	Ba^{2+}	Chloride	Cl^{-}
Calcium	Ca^{2+}	Fluoride	F^{-}
Copper(II)	Cu^{2+}	Hydroxide	OH^{-}
Hydrogen	H^{+}	Iodide	I^{-}
Iron(II)	Fe^{2+}	Nitrate	NO_3^{-}
Iron(III)	Fe^{3+}	Oxide	O^{2-}
Lithium	Li^{+}	Sulfate	SO_4^{2-}
Magnesium	Mg^{2+}		
Nickel	Ni^{2+}		
Potassium	K^{+}		
Silver	Ag^{+}		
Sodium	Na^{+}		

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PERIODIC TABLE OF ELEMENTS

1	2	Group										3	4	5	6	7	0
								$^{1}_{1}H$ Hydrogen									$^{4}_{2}He$ Helium
$^{7}_{3}Li$ Lithium	$^{9}_{4}Be$ Beryllium											$^{11}_{5}B$ Boron	$^{12}_{6}C$ Carbon	$^{14}_{7}N$ Nitrogen	$^{16}_{8}O$ Oxygen	$^{19}_{9}F$ Fluorine	$^{20}_{10}Ne$ Neon
$^{23}_{11}Na$ Sodium	$^{24}_{12}Mg$ Magnesium											$^{27}_{13}Al$ Aluminium	$^{28}_{14}Si$ Silicon	$^{31}_{15}P$ Phosphorus	$^{32}_{16}S$ Sulfur	$^{35}_{17}Cl$ Chlorine	$^{40}_{18}Ar$ Argon
$^{39}_{19}K$ Potassium	$^{40}_{20}Ca$ Calcium	$^{45}_{21}Sc$ Scandium	$^{48}_{22}Ti$ Titanium	$^{51}_{23}V$ Vanadium	$^{52}_{24}Cr$ Chromium	$^{55}_{25}Mn$ Manganese	$^{56}_{26}Fe$ Iron	$^{59}_{27}Co$ Cobalt	$^{59}_{28}Ni$ Nickel	$^{64}_{29}Cu$ Copper	$^{65}_{30}Zn$ Zinc	$^{70}_{31}Ga$ Gallium	$^{73}_{32}Ge$ Germanium	$^{75}_{33}As$ Arsenic	$^{79}_{34}Se$ Selenium	$^{80}_{35}Br$ Bromine	$^{84}_{36}Kr$ Krypton
$^{86}_{37}Rb$ Rubidium	$^{88}_{38}Sr$ Strontium	$^{89}_{39}Y$ Yttrium	$^{91}_{40}Zr$ Zirconium	$^{93}_{41}Nb$ Niobium	$^{96}_{42}Mo$ Molybdenum	$^{99}_{43}Tc$ Technetium	$^{101}_{44}Ru$ Ruthenium	$^{103}_{45}Rh$ Rhodium	$^{106}_{46}Pd$ Palladium	$^{108}_{47}Ag$ Silver	$^{112}_{48}Cd$ Cadmium	$^{115}_{49}In$ Indium	$^{119}_{50}Sn$ Tin	$^{122}_{51}Sb$ Antimony	$^{128}_{52}Te$ Tellurium	$^{127}_{53}I$ Iodine	$^{131}_{54}Xe$ Xenon
$^{133}_{55}Cs$ Caesium	$^{137}_{56}Ba$ Barium	$^{139}_{57}La$ Lanthanum	$^{179}_{72}Hf$ Hafnium	$^{181}_{73}Ta$ Tantalum	$^{184}_{74}W$ Tungsten	$^{186}_{75}Re$ Rhenium	$^{190}_{76}Os$ Osmium	$^{192}_{77}Ir$ Iridium	$^{195}_{78}Pt$ Platinum	$^{197}_{79}Au$ Gold	$^{201}_{80}Hg$ Mercury	$^{204}_{81}Tl$ Thallium	$^{207}_{82}Pb$ Lead	$^{209}_{83}Bi$ Bismuth	$^{210}_{84}Po$ Polonium	$^{210}_{85}At$ Astatine	$^{222}_{86}Rn$ Radon
$^{223}_{87}Fr$ Francium	$^{226}_{88}Ra$ Radium	$^{227}_{89}Ac$ Actinium															

Key:



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GCSE MARKING SCHEME

SCIENCE – CHEMISTRY
SPEC A (NEW)

JANUARY 2012

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INTRODUCTION

The marking schemes which follow were those used by WJEC for the January 2012 examination in GCSE SCIENCE - CHEMISTRY SPEC A (NEW). They were finalised after detailed discussion at examiners' conferences by all the examiners involved in the assessment. The conferences were held shortly after the papers were taken so that reference could be made to the full range of candidates' responses, with photocopied scripts forming the basis of discussion. The aim of the conferences was to ensure that the marking schemes were interpreted and applied in the same way by all examiners.

It is hoped that this information will be of assistance to centres but it is recognised at the same time that, without the benefit of participation in the examiners' conferences, teachers may have different views on certain matters of detail or interpretation.

WJEC regrets that it cannot enter into any discussion or correspondence about these marking schemes.

SCIENCE –CHEMISTRY 1 – SPEC A (NEW)

Foundation only questions – January 2012

Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
1		(a)			1	aluminium and oxygen (both needed)		Al and O	
		(b)	(i)		1	galena	PbS lead sulfide		
			(ii)		1	cassiterite	SnO_2 tin oxide		
		(c)			1	found uncombined / on its own	native / found as element		
		(d)	(i)		1	2			
			(ii)		1	5			
		(e)	(i)		1	iron oxide	Fe_2O_3	the oxide	
			(ii)		1	losing / removal of oxygen	gain of electrons		

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
2		(a)			1	helium	He		
		(b)			1	oxygen	O_2	O	
		(c)			1	carbon dioxide	CO_2		CO
		(d)			2	carbon dioxide (1) water vapour (1)	CO_2 H_2O		CO
		(e)			1	oxygen	O_2	O	

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
3		(a)	(i)		1	4			
			(ii)		1	3			
		(b)			1	fewer decayed / filled / missing teeth in Town B / fluoridated area	converse		
		(c)			2	only two areas studied / insufficient evidence (1) unaware of other factors that may differ between two areas (1) only 5 year age range studied (1) - any 2 for (1) each	only looked at children		

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
4		(a)	(i)		1	millions			
			(ii)		1	hydrocarbons			
		(b)	(i)		2	2.9 + 21.0 + 8.6 + 0.6 + 3.7 + 1.2 = 38 (1) 42 – 38 = 4(.0) (1) correct answer only (2)	consequential for second mark		
			(ii)		2	21.0 ÷ 42.0 (1) ×100 = 50% (1) correct answer only (2)	0.5% (1)		

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
5		(a)	(i)		1	☐ ☐ ✓ ☐ tick in third box	any method of identifying correct order		
			(ii)		1	zinc can displace iron (from its oxide) but copper can't	correct reason based on prior knowledge		
		(b)			1	copper oxide + carbon → carbon dioxide + copper (1)	carbon monoxide		carbon oxide
		(c)	(i)		2	does not react (with water) (1) malleable (1) non toxic (1) - any 2 for (1) each	does not corrode can be bent	does not rust ductile	
			(ii)		1	electrical wiring / coins / jewellery / ornaments / saucepans			

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
6		(a)			1	continents have moved / drifted (apart)	continents were once joined	plate tectonics	
		(b)	(i)		3	fit together like jigsaw / complimentary (1) similar rocks (1) similar fossils (1)		shapes are the same	similar plants / animals
			(ii)		1	couldn't explain how continents moved		not enough evidence	

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
7	1	(a)	(i)		1	metals – A, C **and** F non-metals – D **and** E **all** must be correct		B (either as metal or non metal)	
			(ii)	I	1	B			
				II	1	Group = 4 Period = 3 **both** needed, consequential to answer in I			
		(b)	(i)		2	bromine – liquid (1) iodine – solid (1)			
			(ii)		2	melting point above 114 (1) boiling point above 184 (1) very slow (or no) reaction with sodium (1) - any 2 for (1) each	higher melting point / boiling point than iodine		

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
8	2	(a)	(i)	I	1	1			
				II	1	25 (cm^3)	range 24-26		
			(ii)	I	1	green			blue green
				II	1	more precise / continuous measurements / graph produced automatically		more accurate	
		(b)	(i)		3	(add excess) copper oxide to (dilute) sulfuric acid (1) filter to remove excess (1) heat until half volume remains / leave to crystallise (1)	excess could be implied by second marking point		evaporate / boil to dryness

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Question Number		
FT	**HT**	
9	3	**Indicative content**: elements originally arranged according to atomic masses, now arranged according to atomic number; **differences** such as gaps in original table, more than one element in some boxes, no noble gases, no transition metal block; **similarities** such as still arranged in groups and periods, 8 groups, certain elements in same group as today. **5 – 6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3 – 4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1 – 2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
10	4	(a)			3	A = hydrogen B = oxygen **both** needed (1) oxygen relights glowing splint (1) hydrogen ‘pop’ with lighted splint (1)	H_2 O_2 could be consequential if A/B incorrectly identified	H O	
		(b)			1	does not contribute to greenhouse effect / global warming / does not produce carbon dioxide / water is only product of combustion / does not cause acid rain	renewable	more environmentally friendly	

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		(b)			2	*Advantage* does not contribute to greenhouse effect / global warming / does not produce carbon dioxide / water is only product of combustion / does not cause acid rain (1) *Disadvantage* produces less energy per gram / storage problems / explosive gas / difficult to re-fuel hydrogen cars (1)	renewable	more environmentally friendly	
		(c)			1	$CH_4 + \boxed{2}\ O_2 \longrightarrow \boxed{2}\ H_2O + CO_2$			

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
	5	(a)	(i)	I	1	any of 3/4/5 - any of 7/8/9			
				II	1	260 - 310			
		(b)			2	important source of fuels (1) (some fractions can be cracked) to produce raw materials needed for plastic production(1)			
		(c)			2	fractions are a mixture of different hydrocarbons / are not pure substances (1) each substance within the fraction has a different boiling point (1)			

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
	6				3	Ca^{2+} **and** F^- (1) - **both** needed Na_2CO_3 (1) $Mg(OH)_2$ (1)			

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Question Number								
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
	7	(a)			3	iron ore is the raw material from which iron is obtained (1) coke is the reducing agent / forms carbon monoxide / is the fuel (1) limestone reacts with impurities / produces slag (1)	provides iron removes impurities		
		(b)	(i)		2	carbon monoxide / CO is oxidised iron oxide / Fe_2O_3 is reduced carbon monoxide / CO gains oxygen iron oxide / Fe_2O_3 loses oxygen - any 2/3 for (1) - all for (2)			
			(ii)		1	$Fe_2O_3 +$ [3] $CO \longrightarrow$ [2] $Fe +$ [3] CO_2			
		(c)			1	a mixture of (different) metals		reference to carbon	

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Question Number									
FT	**HT**	**Sub-section**			**Mark**	**Answer**	**Accept**	**Neutral answer**	**Do not accept**
	8	(a)			1	the higher the concentration the higher the current			
		(b)			1	the evidence for this conclusion is strong **because** each group has very similar results / results are reproducible each increase of 0.1M increases current by similar amount (any group) - or any reference to proportionality / linear relationship		results are repeatable / reliable / fair test	
		(c)	(i)		1	0.34 (A)			
			(ii)		2	0.01 (1) 3% (1) - ignore sig figs i.e. accept 2.9, 2.94 etc. correct answer only (2)	-3%		
			(iii)		1	variation in depth of electrode immersion / distance between electrodes / (surface) area of electrodes variation in voltage of power supply variation in concentration of solution e.g. volume of water added to each is slightly different, not all solid dissolved			

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Question Number					Mark	Answer	Accept	Neutral answer	Do not accept
FT	HT	Sub-section							
	9	(a)			3	add (hydrochloric) acid (1) bubbles produced (and temperature rise) with carbonate temperature rise with hydroxide no reaction if chloride - any 2 for (1) - all for (2) [accept universal indicator test and appropriate colours allocating marks as above]	other named acid		
		(b)	(i)		1	copper + silver nitrate → silver + copper nitrate $Cu + AgNO_3 \rightarrow Ag + Cu(NO_3)_2$ - ignore balancing	symbol equation		
			(ii)		2	copper is more reactive than silver (1) **displaces** silver from silver nitrate (1)			

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Question Number		
FT	**HT**	**Answer**
	10	**Indicative content**: Early atmosphere formed from volcanic outgassing; description / composition of present day atmosphere and explanation of changes i.e. water vapour cooled and condensed to form oceans, carbon dioxide dissolved in oceans and incorporated into carbonate rocks. Evolution of simple plants which photosynthesized using up carbon dioxide and producing oxygen. **5 – 6 marks**: The candidate constructs an articulate, integrated account correctly linking relevant points, such as those in the indicative content, which shows sequential reasoning. The answer fully addresses the question with no irrelevant inclusions or significant omissions. The candidate uses appropriate scientific terminology and accurate spelling, punctuation and grammar. **3 – 4 marks**: The candidate constructs an account correctly linking some relevant points, such as those in the indicative content, showing some reasoning. The answer addresses the question with some omissions. The candidate uses mainly appropriate scientific terminology and some accurate spelling, punctuation and grammar. **1 – 2 marks**: The candidate makes some relevant points, such as those in the indicative content, showing limited reasoning. The answer addresses the question with significant omissions. The candidate uses limited scientific terminology and inaccuracies in spelling, punctuation and grammar. **0 marks**: The candidate does not make any attempt or give a relevant answer worthy of credit.

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