CCEA GCSE SCIENCE: DOUBLE AWARD (NON-MODULAR)

SCIENCE



EXAM QUESTION PACK

PAPER 2 HIGHER TIER G8405 PAPERS

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012

Science: Double Award (Non-Modular)

Paper 2
Higher Tier

[G8405]

G8405

TUESDAY 12 JUNE, MORNING

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 120.
Quality of written communication will be assessed in Question **9(b)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet which includes a Periodic Table of the Elements is provided.

For Examiner's use only	
Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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Examiner Only	
Marks	Remark

1 Some students compared the reactivity of four metals. They looked to see if each metal reacted with the nitrate solutions of each of the other three metals. Their results are given in the table below.

nitrate solution / metal	lead nitrate	copper(II) nitrate	silver nitrate	zinc nitrate
lead		reaction	reaction	no reaction
copper	no reaction		reaction	no reaction
silver	no reaction	no reaction		no reaction
zinc	reaction	reaction	reaction	

(a) Using the information in the table, arrange the four metals in order of reactivity with the **most reactive** metal first.

1. _____

2. _____

3. _____

4. _____ [2]

(b) What is the name given to the **type** of exothermic reactions shown in the table above?

Type of reaction _____ [1]

(c) Zinc will also react with dilute sulphuric acid. Complete the word equation for this reaction.

zinc + sulphuric acid → + [2]

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Examiner Only	
Marks	Remark

2 Calcium is a reactive Group II metal.

(a) Describe **three** things you would observe when **calcium** reacts with water.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(b) Name the solution formed when calcium reacts with water.

_____ [1]

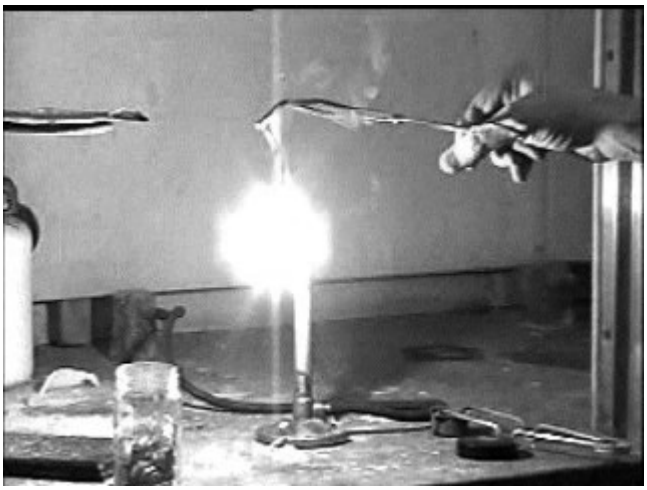
(c) Give **one** safety precaution which should be taken when carrying out the reaction between calcium and water.

_____ [1]

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Examiner Only	
Marks	Remark

3 Magnesium ribbon burns in air with a bright white flame as shown below. The product of the reaction is magnesium oxide.



© Mr K A Boudreaux, Angelo State University, San Angelo, Texas

(a) (i) Describe the appearance of magnesium oxide.

_____

_____ [2]

(ii) Explain why the burning of magnesium in air is described as **oxidation**.

_____

_____ [1]

(b) Magnesium reacts very slowly with cold water but reacts more quickly with steam. Complete the word equation to show the reaction between magnesium and steam.

magnesium + steam → + [2]

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4 Some students investigated the thermal decomposition of calcium carbonate. They heated 10 g calcium carbonate and noted the mass of solid remaining at different times. Their results are shown in the table below.

Time (min)	0	3	6	9	12	15
Mass of solid (g)	10	8.9	6.7	5.8	5.6	5.6

(a) Why did the students stop heating the calcium carbonate after fifteen minutes?

_____ [1]

(b) Name the gas given off during the thermal decomposition of calcium carbonate.

_____ [1]

(c) Calcium oxide, obtained from the thermal decomposition of calcium carbonate, is used by farmers to neutralise acidic soil.

(i) Complete the word equation for the reaction between hydrochloric acid and calcium oxide.

calcium oxide + hydrochloric acid → + [2]

(ii) Name the solution that is formed when calcium oxide is added to water.

_____ [1]

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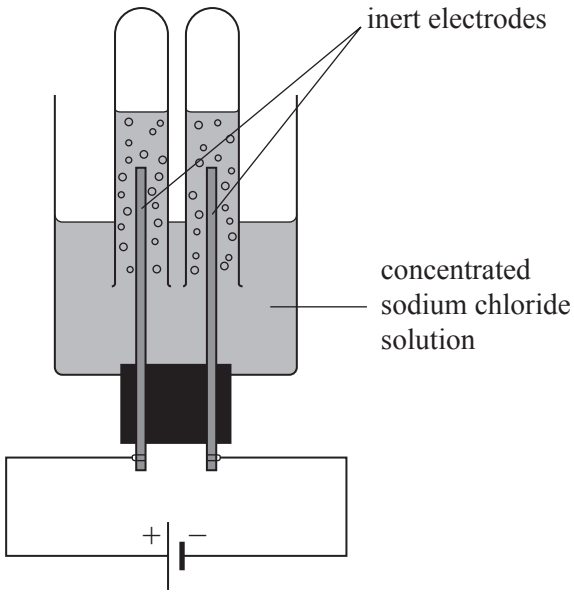
Marks	Remark

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Examiner Only	
Marks	Remark

5 Electrolysis of concentrated sodium chloride solution is used to manufacture two gases and another useful substance.

The diagram below shows the apparatus used in the laboratory for the electrolysis of concentrated sodium chloride solution.



(a) Name a suitable material for the inert electrodes.

_____ [1]

(b) Name the gas produced at the **cathode**.

_____ [1]

(c) Write a balanced **ionic** equation to show what happens at the **anode**.

_____ [3]

(d) What substance is formed in solution during this electrolysis?

_____ [1]

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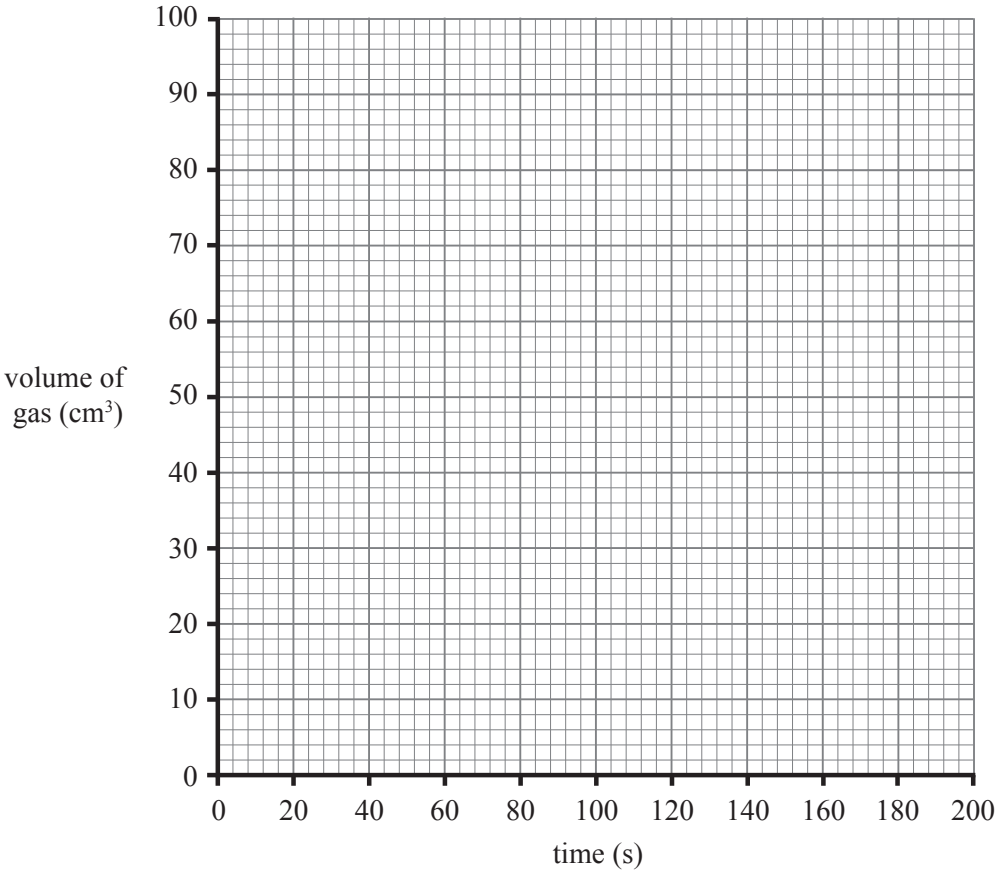
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Examiner Only	
Marks	Remark

6 Some students investigated the rate of reaction between magnesium ribbon and excess dilute sulphuric acid. The total volume of gas produced was measured at 20 second intervals and recorded in the table below.

Time (s)	0	20	40	60	80	100	120	140	160	180
Volume (cm^3)	0	30	48	64	74	82	88	90	90	90

(a) On the grid below, plot the results given in the table. Draw a curve of best fit. [3]



(b) Use your graph to help you answer the questions which follow.

(i) What volume of gas had been collected at 50 seconds?

_____ [1]

(ii) At what time did the reaction stop?

_____ [1]

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(c) Using your answer from **(b)(ii)**, work out the average rate of reaction in cm^3/s.

Examiner Only

Marks	Remark

Answer _____ cm^3/s [1]

7 Problems involving a fixed mass of gas can be solved using the relationship

$$\frac{PV}{T} = \text{constant}$$

A fixed mass of gas of volume 750 cm^3 had its pressure changed from 2000 Pa to 4000 Pa and its temperature increased from 300 K to 450 K.

Calculate the new volume of gas.

Show your working out.

Answer _____ cm^3 [3]

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Examiner Only	
Marks	Remark

8 When sodium hydrogencarbonate is heated it decomposes to form sodium carbonate, water and carbon dioxide as shown in the equation below.

$$2NaHCO_3 \rightarrow Na_2CO_3 + CO_2 + H_2O$$

(relative atomic masses: Na = 23, C = 12, O = 16, H = 1)

(a) Calculate the relative formula mass of $NaHCO_3$.

Answer _____ [1]

(b) Calculate the relative formula mass of Na_2CO_3.

Answer _____ [1]

(c) Using your answer to part **(a)** calculate the number of moles in 8.4 g of $NaHCO_3$.

Answer _____ moles [1]

(d) How many moles of Na_2CO_3 can be produced from 8.4 g of $NaHCO_3$?

Answer _____ moles [1]

(e) Calculate the mass of Na_2CO_3 produced from 8.4 g of $NaHCO_3$.

Answer _____ g [1]

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9 **(a)** Complete the table below about the properties of chlorine, nitrogen and helium.

Gas	Lighter or heavier than air	Reactive or unreactive	Colour	Poisonous
chlorine	heavier			yes
nitrogen	lighter	unreactive		
helium			colourless	no

[3]

This part of the question is about the reaction between sulphur and iron.

(b) When a mixture of sulphur and iron is heated a chemical reaction takes place. Describe what you would observe and state what happens in this reaction. Your answer should include:

- a clear description of what a mixture of iron and sulphur looks like
- a safety precaution that should be taken when heating iron and sulphur
- a clear description of what you would observe when the iron and sulphur are heated
- the name and the chemical formula of the product formed

[7]

Quality of written communication [1]

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Marks	Remark

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Marks	Remark

(c) This part of the question is about carbon, carbon monoxide and carbon dioxide.

It is important to have coal or gas burning stoves regularly serviced. Incomplete combustion of coal or gas means that carbon monoxide is formed as well as carbon dioxide.



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(i) Explain why carbon monoxide is so dangerous.

_____

_____ [2]

(ii) Explain why it is important to have coal or gas burning stoves regularly serviced.

_____

_____ [1]

(iii) Give one harmful environmental effect caused by carbon dioxide.

_____ [1]

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(d) When chlorine is bubbled through a solution of potassium iodide a displacement reaction occurs.

Examiner Only

Marks	Remark

(i) Explain why this reaction must be carried out in a fume cupboard.

_____ [1]

(ii) What colour change is seen when chlorine is bubbled through a solution of potassium iodide?

from _____ to _____ [2]

(iii) Balance the symbol equation for the reaction between chlorine and potassium iodide solution.

Cl_2 + KI → I_2 + KCl [1]

(iv) Name another **halogen** that can be displaced by bubbling chlorine through the potassium halide solution.

_____ [1]

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Examiner Only	
Marks	Remark

10 (a) Mendeleev was responsible for much of the early development of the Periodic Table.

(i) Give **three** features of the Periodic Table developed by Mendeleev.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(ii) Describe **three** ways in which the modern Periodic Table, as shown in your Data Leaflet, is different from the one Mendeleev developed.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(b) Complete the table below, which gives some information about elements, their Groups, Periods and electronic structures. You may find your Data Leaflet useful.

Element	Group	Period	Electronic structure
potassium		4	
magnesium	II		
		3	2, 8, 6

[6]

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(c) **(i)** Why do the elements in Group I have similar chemical properties?

_____ [1]

(ii) How does the reactivity of the elements vary as Group II is descended?

_____ [1]

(iii) Which of the Group VII elements, fluorine, chlorine, bromine or iodine is **least** reactive?

_____ [1]

(iv) Describe how the reactivity of the elements in Period 3 varies across the period from sodium to argon.

_____

_____

_____

_____

_____ [3]

(d) Magnesium sulphate is an ionic compound, which can be made by reacting a base with an acid.

(i) Name a suitable base which may be used to prepare magnesium sulphate.

_____ [1]

(ii) Name the acid needed to prepare magnesium sulphate.

_____ [1]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

11 (a) Water and ammonia are both covalent molecules.

(i) What does the term **covalent** mean?

_____ [1]

(ii) What does the term **molecule** mean?

_____

_____ [2]

(iii) Using outer shell electrons only, draw a diagram to show how the electrons are arranged in an ammonia molecule, NH_3.

[2]

(iv) How many covalent bonds are there in a **water** molecule?

_____ [1]

(v) Explain why substances with a simple covalent structure have low melting points.

_____

_____

_____ [2]

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(b) Copper is a very good conductor of electricity and it is ductile. It is used for electrical wiring.

(i) Draw a **labelled** diagram to show the bonding in a metal such as copper.

[4]

(ii) What does the term **ductile** mean?

_____ [1]

(iii) Use your understanding of metallic bonding to explain why copper is ductile.

_____

_____

_____ [2]

(iv) Give one other physical property of copper.

_____ [1]

Examiner Only

Marks	Remark

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The two types of plastics, thermosoftening and thermosetting, have different structures.

Examiner Only	
Marks	Remark

(c) (i) Polythene is a thermosoftening plastic. What is a **thermosoftening** plastic?

_____

_____ [1]

(ii) Melamine is a thermosetting plastic. Draw a simple diagram to show the structure of a **thermosetting** plastic.

[2]

(iii) Which one of the plastics below is also a **thermosetting** plastic? Circle the correct answer.

polystyrene **Bakelite** **PVC** [1]

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

12 **(a)** The hydrocarbons methane, ethane, propane and butane are four members of a homologous series.

(i) What elements are hydrocarbons made from?

_____ [1]

(ii) Which homologous series do these hydrocarbons belong to?

_____ [1]

(iii) Give **two** features of a homologous series.

1. _____

2. _____ [2]

Ethene and propene are members of another homologous series. Ethene can be used to manufacture ethanol.

(b) **(i)** What other reactant is needed to make ethanol from ethene?

_____ [1]

(ii) Name another method for manufacturing ethanol.

_____ [1]

(iii) Give the molecular and structural formula for ethanol.

Molecular Formula	Structural Formula

[2]

(iv) Explain why ethanol is **not** a hydrocarbon.

_____

_____ [1]

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(v) Write a balanced symbol equation for the complete combustion of ethanol in a plentiful supply of air.

_____ [3]

(c) Ethanol can be oxidised to form ethanoic acid.

(i) What pH would you expect ethanoic acid to have?

_____ [1]

(ii) Ethanoic acid has the properties of a typical acid. Describe what you would observe if solid copper(II) oxide is added to a sample of ethanoic acid in a test tube and heated. Name the salt formed in this reaction.

_____

_____

_____ [2]

Name of salt: _____ [1]

(d) **(i)** Complete the following word equation for the reaction between ethanoic acid and ethanol.

ethanoic acid + ethanol → ethyl ethanoate + [1]

(ii) Choose **three** words from those given below to describe ethyl ethanoate.

Put a circle around each of the three words you have selected.

colourless	**odourless**	**liquid**
solid	**green**	**white**
orange	**gas**	**sweet-smelling**

[3]

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Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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Rewarding Learning

General Certificate of Secondary Education
2012

Science: Double Award (Non-Modular)

Paper 2
Higher Tier

[G8405]

TUESDAY 12 JUNE, MORNING

MARK SCHEME

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				AVAILABLE MARKS
1	**(a)**	zinc, lead, copper, silver Allow [1] if order correct but reversed	[2]	
	(b)	displacement allow redox	[1]	
	(c)	zinc sulphate [1] hydrogen [1]	[2]	5
2	**(a)**	Any **three** from: calcium sinks **or** sinks and rises bubbles/gas evolved/fizzing/gas given off idea of reaction getting faster **not** reaction is fast **not** reaction is slow idea of solution going cloudy calcium gets smaller/dissolves/disappears idea of heat given out/exothermic allow alkaline solution **Ignore** reference to hissing or noise Mark idea of moving across the surface of the water as wrong Any idea of catching fire or flame **wrong** Accept moves **in** the water and **not** just moves (3 × [1])	[3]	
	(b)	calcium hydroxide/limewater	[1]	
	(c)	fume cupboard/safety screen/eye protection/small amounts (of calcium)	[1]	5
3	**(a)** **(i)**	white or grey **not** dark grey – dependent on idea of solid product [1] ash/powder/solid [1]	[2]	
	(ii)	idea that oxygen has been added/gained **or** allow loss of electrons do not allow idea of burning in oxygen **not** loss of hydrogen	[1]	
	(b)	magnesium oxide [1] hydrogen [1]	[2]	5
4	**(a)**	reaction complete/constant mass	[1]	
	(b)	carbon dioxide	[1]	
	(c) **(i)**	calcium chloride [1], water [1]	[2]	
	(ii)	limewater/calcium hydroxide (solution)	[1]	5
5	**(a)**	graphite/platinum **Accept** carbon	[1]	
	(b)	hydrogen	[1]	
	(c)	$2Cl^-$ [1] $\rightarrow Cl_2 + 2e^-$ [1] balanced [1] third mark depends on first two	[3]	
	(d)	sodium hydroxide	[1]	6

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				AVAILABLE MARKS
6	**(a)**	9/10 points correct [2]/7/8 points correct [1] curve correct (**not** ruler) [1]	[3]	
	(b)	**(i)** $56 \pm 1\,cm^3$ Penalise lack of units	[1]	
		(ii) 140 s allow 132–140 s Penalise lack of units apply CM	[1]	
	(c)	90/140 [= 0.64 (cm^3/s) (± 0.04)] (i.e. 90/**(b)(ii)** answer) allow 90/140 or equivalent	[1]	6
7	$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$ or any correct method step [1]			
	$\frac{2000 \times 750}{300} = \frac{4000 \times V_2}{450}$			
	Second mark must involve computation rather than just substitution [1]			
	$\frac{2000 \times 750 \times 450}{300 \times 4000}$	working out constant/mark $\frac{2000 \times 750}{300} = 5000$		
	Answer 562.5 (cm^3) Correct answer gains [3]	maximum 2 method marks	[3]	3
8	**(a)**	84	[1]	
	(b)	106	[1]	
	(c)	8.4/84 = 0.1 mole apply CM	[1]	
	(d)	0.05 (moles) apply CM	[1]	
	(e)	5.3 (g) apply CM i.e. 106 × **(d)** **or** answer **(b)** × answer **(d)**	[1]	5

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					AVAILABLE MARKS
9	**(a)**	chlorine:	reactive **and** green or yellow-green [1]		
		nitrogen:	colourless **and** no (poisonous) [1]		
		helium:	lighter **and** unreactive [1]	[3]	
	(b)	*Appearance:*	Grey/yellow [1] solid (mixture) [1] **or** grey solid iron [1]/ yellow powder/solid sulphur [1]		
		Safety precaution:	Wear safety goggles/carry out in fume cupboard [1]		
		Description:	Mixture **glows** when heated [1]		
			Pungent smell [1] bad, choking, rotten eggs **not** strong		
			Continues to glow when removed from heat [1] allow burns with blue flame [1] allow idea of sulphur melts [1]		
			Grey/black solid forms [1]		
		Product:	Iron sulphide/iron(II) sulphide [1] FeS [1]		
		(7 × [1]) Allow up to [6] for the appearance, safety and description At least one product mark needed for [7]		[7]	
		Quality of written communication		[1]	
	(c)	**(i)**	toxic/poisonous gas/stops oxygen getting to the body [1] odourless/colourless [1]	[2]	
		(ii)	idea of needing good supply air/oxygen/for complete combustion/ **or** other correct Prevents leaks of carbon monoxide/poisonous gas **or** to prevent incomplete combustion **not** idea of clogging up (**not** idea of formation of carbon monoxide)	[1]	
		(iii)	idea of global warming/greenhouse effect	[1]	
	(d)	**(i)**	chlorine is poisonous	[1]	
		(ii)	colourless [1] to brown [1]/yellow brown orange brown red-brown	[2]	
		(iii)	$Cl_2 + \mathbf{2}KI \rightarrow I_2 + \mathbf{2}KCl$	[1]	
		(iv)	bromine	[1]	20

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AVAILABLE MARKS

10 (a) (i) Any **three** of:
he left spaces
elements arranged in order of atomic mass **not** mass or mass number
idea that it had a relatively small number of elements
elements were arranged in Groups
elements were arranged in Periods
metals were separated from non-metals
or other correct e.g. Hydrogen in Group I
Maximum (3 × [1]) [3]

(ii) Any **three** of:
elements arranged in order of increasing atomic number
more elements/more periods
no spaces
idea of some elements having their position changed
(as long as incorrect answer is not given)
noble gases included
Accept idea of actinides **Accept** lanthanides
transition metals between Groups II and Group III or in a block
or other correct e.g. Hydrogen not in Group I
Maximum (3 × [1]) [3]

(b)

Element	Group	Period	Electronic structure
potassium	**I** [1]	4	**2,8,8,1** [1]
magnesium	II	**3** [1]	**2,8,2** [1]
sulphur [1]	**VI** [1]	3	2,8,6

[6]

(c) (i) all have same number of electrons in their outer shells/all have one electron in their outer shell [1]

(ii) reactivity increases [1]

(iii) iodine [1]

(iv) decreases [1] then increases [1] then decreases for argon [1] [3]
Allow [1] for decreases but **not** for increase alone

(d) (i) magnesium hydroxide **or** magnesium oxide or magnesium carbonate [1]

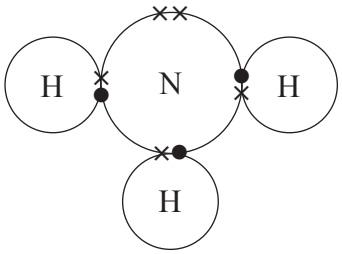
(ii) sulphuric acid [1] 20

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11 (a) (i) idea of shared electrons [1]

(ii) two or more group of atoms [1] (covalently) bonded/joined together [1] [2]

(iii)



correct sharing [1]
all electrons included correctly, second mark dependent on first [1] [2]

(iv) two [1]

(v) bonds/forces **between the molecules** are weak [1]
idea of little energy needed to break bonds/forces [1] [2]

(b) (i) diagram to show:
regular arrangement [1]
metal **cations** given positive charge – no negative ions [1]
idea of delocalised electrons [1]
labels [1] at least 2 correct labels [4]

(ii) can be drawn into wires [1]

(iii) layers of metal **ions/atoms** [1] can slide over one another [1] [2]

(iv) malleable/high melting point/good conductor of heat/lustrous/sonorous/hard/dense/strong
not low density, **not** conductor of electricity [1]

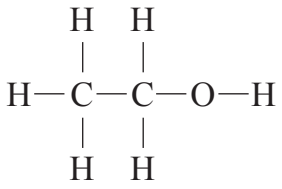
(c) (i) it can be heated and remoulded [1]

(ii) diagram showing at least 3 long chain molecules [1] with cross links in between [1] [2]

(iii) Bakelite [1] 20

AVAILABLE MARKS

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				AVAILABLE MARKS
12	**(a)**	**(i)**	hydrogen and carbon (both needed) [1]	
		(ii)	alkane [1]	
		(iii)	Any **two** of: same general formula same/similar chemical properties/chemical reactivity gradation in physical properties **not** similar physical peoperties accept same functional group/which differ by a CH_2 group (2 × [1]) [2]	
	(b)	**(i)**	steam/H_2O (**not** water) [1]	
		(ii)	fermentation **or** anaerobic respiration of yeast [1]	
		(iii)	<table><tr><th>Molecular Formula</th><th>Structural Formula</th></tr><tr><td>C_2H_5OH **or** CH_3CH_2OH [1]</td><td> [1]</td></tr></table> If both correct but wrong way round award [1] [2]	
		(iv)	idea that ethanol does not contain **only** hydrogen and carbon atoms [1]/ also contains oxygen atom [1] [1]	
		(v)	$C_2H_5OH + 3O_2$ [1] → $2CO_2 + 3H_2O$ [1] balanced [1] [3] third mark depends on first two	
	(c)	**(i)**	pH 3–6 [1]	
		(ii)	black solid [1] reacts to form **blue solution** [1] or colourless solution [1] turns blue [1] or black solid [1] disappears/dissolves [1] (2 × [1]) [2] copper ethanoate [1] or copper II ethanoate [1]	
	(d)	**(i)**	ethanoic acid + ethanol → ethyl ethanoate + **water** [1]	
		(ii)	**colourless** [1] odourless **liquid** [1] solid green white orange gas **sweet-smelling** [1] [3]	20
			Total	**120**

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71	

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Paper 2
Higher Tier

[G8405]

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FRIDAY 27 MAY, MORNING

TIME

1 hour 45 minutes.

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Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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Examiner Only	
Marks	Remark

1 In chemistry particular words or terms are often used to describe reactions.

Six types of chemical reaction are:

A Reduction
B Thermal Decomposition
C Combustion
D Displacement
E Neutralisation
F Hydration

For each of the following reactions choose the appropriate letter **A, B, C, D, E** or **F** to describe the type of reaction. The first one has been done for you.

$Mg + FeSO_4 \rightarrow MgSO_4 + Fe$ **D**

(a) $2Zn + O_2 \rightarrow 2ZnO$ _____ [1]

(b) $HCl + KOH \rightarrow KCl + H_2O$ _____ [1]

(c) $CuSO_4 + 5H_2O \rightarrow CuSO_4.5H_2O$ _____ [1]

(d) $CaCO_3 \rightarrow CaO + CO_2$ _____ [1]

2 There is more iron manufactured each year than any other metal. Give **three** different reasons why so much iron is manufactured.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

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3 The table below gives some information about the structure of atoms. Complete the table.

Symbol	Number of protons	Number of neutrons	Number of electrons	Mass number	Electron arrangement
Na		12	11	23	2,8,1
O	8	8		16	
Ca	20	20	20		2,8,8,2
Al	13		13	27	

[6]

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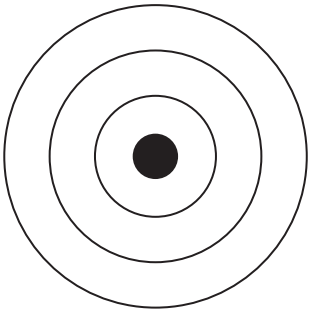
Marks	Remark

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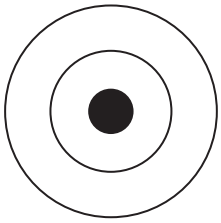
Examiner Only	
Marks	Remark

4 Magnesium reacts with fluorine to form the compound magnesium fluoride.

(a) Complete the diagrams below to show the arrangement of **all** the electrons in a magnesium atom and a fluorine atom.



magnesium atom



fluorine atom [2]

(b) Explain, in terms of the atoms involved, how the electron arrangements change when magnesium fluoride is formed from magnesium and fluorine.

_____

_____

_____

_____

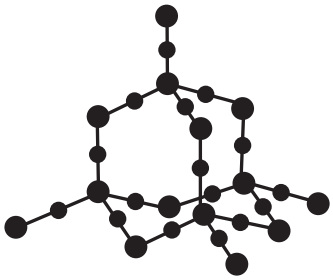
_____

_____ [3]

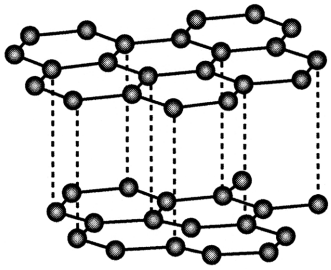
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5 The structures of two giant covalent compounds are given below.

Examiner Only	
Marks	Remark



quartz



graphite

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Quartz is a giant covalent molecule made up of silicon atoms and oxygen atoms. Graphite is made up of carbon atoms.

(a) Name another giant covalent molecule which is made up of carbon atoms only and has a similar structure to quartz.

_____ [1]

(b) Why can quartz **not** conduct electricity?

_____

_____ [1]

(c) Both quartz and graphite have very high melting points. Why is it difficult to melt molecules which have a giant covalent structure?

_____

_____

_____ [2]

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Examiner Only	
Marks	Remark

6 **(a)** When uranium-238 decays it loses an alpha particle. Complete the nuclear equation for this reaction. (You may find your Data Leaflet useful).

$$^{238}_{92}\text{U} \rightarrow \qquad + \qquad \text{[4]}$$

(b) Uranium-238 has a very large half-life of 4.5×10^9 years. How long would it take 20 g of ^{238}U to decay to 2.5 g?

_____ years [2]

7 This question is about the causes and effects of hard water and how it can be softened.

Examiner Only	
Marks	Remark

(a) Temporary hard water contains calcium hydrogencarbonate.

Explain how soluble calcium hydrogencarbonate is formed from calcium carbonate.

_____

_____

_____

_____

_____ [2]

(b) Explain, in terms of ions involved, how the addition of washing soda (sodium carbonate) can soften hard water.

_____

_____

_____

_____

_____ [3]

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8 This question is about the amount of iron that can be produced from a certain amount of iron(III) oxide. The equation for the reaction is given below.

Examiner Only	
Marks	Remark

$$Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$$

(i) What is the relative formula mass of Fe_2O_3?

(Relative atomic masses Fe = 56, O = 16)

relative formula mass = _____ [1]

(ii) Use your answer to part **(i)** to calculate the number of moles of Fe_2O_3 in 100 grams of the compound.

_____ moles [1]

(iii) How many moles of iron can be produced from 100 grams of Fe_2O_3?

_____ moles [1]

(iv) What mass of iron can be produced from 100 g Fe_2O_3?

_____ g [1]

(v) How many moles of carbon monoxide would be needed to react with 100 g Fe_2O_3?

_____ moles [1]

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(vi) What mass of carbon monoxide would be needed to react with 100 g Fe_2O_3?

(The relative formula mass of carbon monoxide is 28.)

_____ g [2]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

9 This question is about some non-metals and their compounds.

(a) Hydrogen is a gas.

(i) Give **two** other **physical** properties of hydrogen.

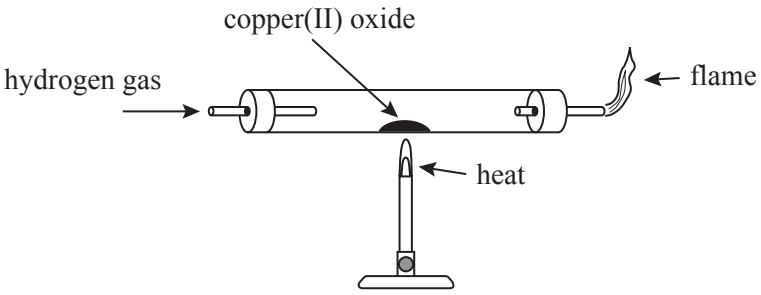
1. _____ [1]

2. _____ [1]

(ii) Give **one** use of hydrogen.

_____ [1]

The diagram below shows how hydrogen can be used to reduce copper(II) oxide.



(iii) Write a balanced symbol equation for the reaction of hydrogen with copper(II) oxide.

_____ [2]

(b) Sulphur is an impurity in coal and oil. When these fuels burn they produce an acidic gas which causes acid rain.

(i) Name this acidic gas which causes acid rain.

_____ [1]

(ii) Circle the pH value which you would expect a lake to have which has been polluted by acid rain.

0 **3** **7** **9** **13** [1]

(iii) Give **one** harmful effect of acid rain.

_____ [1]

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Power stations must control their emissions of acidic gases.



© Greenpeace / Hunt

(iv) Give one way of controlling the emission of gases from power stations.

_____ [1]

(c) The land around Ballymoney, in County Antrim, is very rich in a fuel called lignite. To obtain the lignite a type of mining is used where the surface soil and earth is removed so that the lignite can be taken out.

Describe the advantages and disadvantages of having a lignite mine close to the town of Ballymoney. You will also be marked on the quality of your written communication.

Advantages: _____

_____

_____

_____

Disadvantages: _____

_____

_____

_____ [6]

Quality of written communication [1]

Examiner Only

Marks	Remark

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(d) Two causes of water pollution are the presence of nitrates and phosphates.

(i) Give a main source of nitrates in water.

_____ [1]

(ii) Give a main source of phosphates in water.

_____ [1]

Filtration and chlorination are used in water treatment plants to ensure the water is clean and safe to drink.

(iii) What type of impurities in water cannot be removed by filtration?

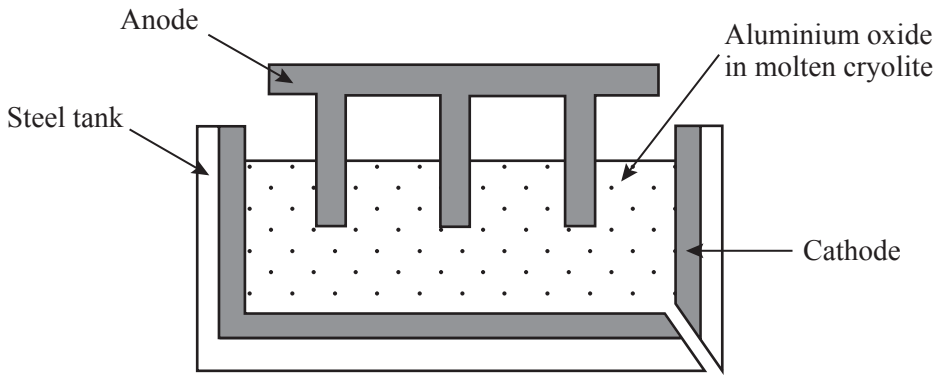
_____ [1]

(iv) How does chlorination help to make water safe to drink?

_____ [1]

Examiner Only	
Marks	Remark

10 Aluminium is manufactured by the electrolysis of molten aluminium oxide as shown in the diagram below.



(a) (i) What material is used to make the electrodes in this electrolysis?

_____ [1]

(ii) State the products of this electrolysis at the anode and the cathode.

Anode _____ Cathode _____ [1]

(iii) Which electrode must be replaced regularly? Explain why this is necessary.

Electrode _____

Explanation _____

_____

_____ [3]

Examiner Only

Marks	Remark

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(b) This part of the question is about some reactions of Group I metals with water.

Group I
Li
Na
K

(i) What name is given to the Group I metals?

_____ [1]

(ii) What do you observe happening when a small amount of sodium is added to water?

_____

_____

_____

_____

_____

_____ [4]

(iii) Why is the reaction in part **(ii)** carried out with a **small** amount of sodium?

_____ [1]

(iv) Complete the word equation for the reaction of sodium with water.

sodium + water → + [2]

(v) In what way would you expect the reaction of lithium with water to be different to the reaction of sodium with water and why would it be different?

_____

_____ [2]

Examiner Only

Marks	Remark

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(c) This part of the question is also about Group II metals and their compounds.

Examiner Only

Marks	Remark

(i) When calcium reacts with water the water goes cloudy. What compound has been formed which makes the water go cloudy?

_____ [1]

(ii) Complete the symbol equation below for the reaction of calcium carbonate with hydrochloric acid.

$CaCO_3 + 2HCl \rightarrow$ _____ + _____ + CO_2 [2]

(iii) Magnesium oxide is an ionic solid. This means it will have a high melting point. Give **two** other physical properties you expect a typical ionic solid to have.

_____

_____ [2]

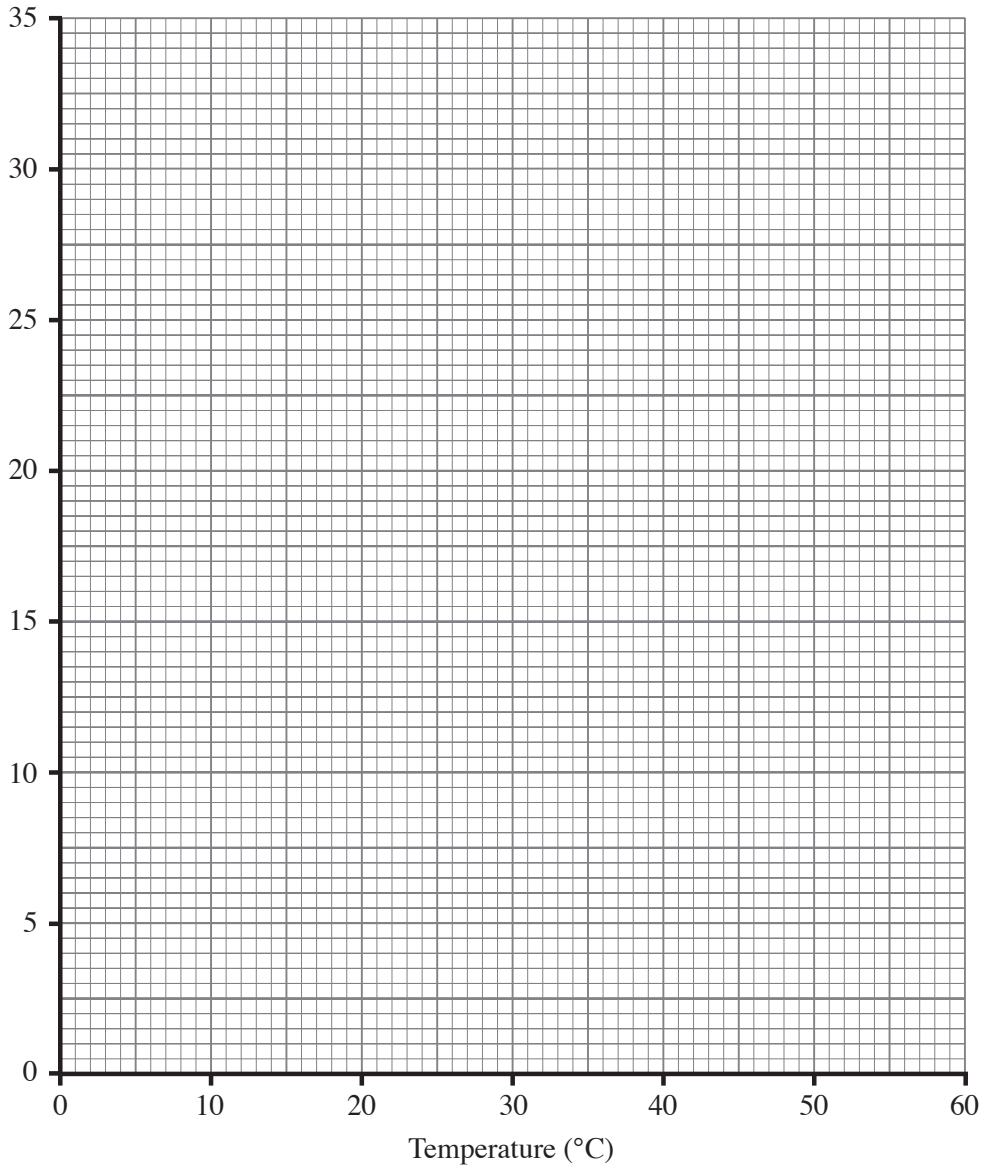
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Examiner Only	
Marks	Remark

11 (a) A group of students, investigating the solubility of potassium chlorate in water, obtained the following results:

Temperature (°C)	8	18	30	39	50	60
Solubility of potassium chlorate (g/100 g H_2O)	5.5	7.5	11.0	14.0	20.0	25.5

(i) On the grid below, label the **y-axis** and plot a solubility curve for potassium chlorate.



[4]

(ii) At what temperature will 12 g potassium chlorate form a saturated solution in 100 g water?

_____ °C [1]

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(iii) From your solubility curve find the solubility of potassium chlorate at:

1. 11 °C _____ g/100 g H_2O [1]

2. 55 °C _____ g/100 g H_2O [1]

(iv) What mass of potassium chlorate will crystallise out if a saturated solution of potassium chlorate in **50 g** of water at 55°C is cooled to 11°C?

Answer _____ g [2]

(b) Ammonia is prepared industrially in the Haber-Bosch Process from nitrogen and hydrogen gases.

(i) Give a temperature and a pressure which are suitable for the Haber-Bosch Process and name the catalyst used.

Temperature: _____

Pressure: _____

Catalyst: _____ [3]

(ii) Write a balanced symbol equation for the formation of ammonia from nitrogen and hydrogen.

_____ [3]

(iii) Give **one** reason why the Haber-Bosch Process cannot be demonstrated in a school laboratory.

_____

_____ [1]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(c) It is estimated that, in the UK, the effects of rusting cost £6 billion every year. Galvanising iron with zinc is an important method of protecting iron objects such as gates. This method is an example of **sacrificial protection**.

(i) What is the full chemical name for rust?

_____ [2]

(ii) Explain why a zinc coating stops iron from rusting even when it is scratched or broken.

_____

_____

_____

_____ [2]

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

12 Alkenes are a homologous series of unsaturated hydrocarbons. All members of the same homologous series have the same general formula.

(a) (i) What is the general formula of alkenes?

_____ [1]

(ii) What is an **unsaturated hydrocarbon**?

_____

_____

_____ [3]

(iii) Complete the table below to show the molecular and structural formulae and physical state at room temperature for propene, the second member of the alkene homologous series.

hydrocarbon	molecular formula	structural formula	physical state at room temperature
propene			

[3]

(b) Polythene is an important and useful plastic made from ethene molecules.

Give the **full** name for the **type** of reaction that is used to produce polythene from ethene.

_____ [2]

(c) Another important reaction of ethene is its reaction with steam to form ethanol.

(i) Write a balanced symbol equation for the reaction of ethene and steam.

_____ [2]

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(ii) Name another way to make ethanol.

_____ [1]

(iii) Draw the **structural** formula for ethanol.

[1]

(iv) Give **one** use of ethanol.

_____ [1]

(d) Ethanol can be oxidised to form ethanoic acid.

(i) What is the **molecular** formula of ethanoic acid?

_____ [1]

(ii) Ethanoic acid is a weak acid and reacts with magnesium. Give **two** things that you would observe if a piece of magnesium ribbon was added to dilute ethanoic acid.

1. _____

2. _____ [2]

(e) Ethanoic acid and ethanol react together to form an ester which has the formula $CH_3COOC_2H_5$.

(i) What is the chemical name of the ester $CH_3COOC_2H_5$?

_____ [1]

(ii) What is the appearance of the ester $CH_3COOC_2H_5$?

_____ [2]

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Marks	Remark

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THIS IS THE END OF THE QUESTION PAPER

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111287

Rewarding Learning

General Certificate of Secondary Education
2011

Science: Double Award (Non-Modular)

Paper 2
Higher Tier

[G8405]

FRIDAY 27 MAY, MORNING

MARK SCHEME

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			AVAILABLE MARKS
1	**(a)** C	[1]	
	(b) E	[1]	
	(c) F	[1]	
	(d) B	[1]	4
2	Any three of: it has a wide range of uses OR specific named bulk use idea that it is not expensive idea of being easy to make availability of raw materials **NOT** availability of iron **NOT** iron readily available accept idea that it can last a long time strength only one mark may be linked to use (3 × [1])	[3]	3

3

Symbol	Number of protons	Number of neutrons	Number of electrons	Mass number	Electron arrangement
Na	**11 [1]**	12	11	23	2,8,1
O	8	8	**8 [1]**	16	**2,6 [1]**
Ca	20	20	20	**40 [1]**	2,8,8,2
Al	13	**14 [1]**	13	27	**2,8,3 [1]**

[6] 6

4	**(a)** correct 2,8,2 representation for magnesium [1] correct 2,7 representation for fluorine [1]	[2]	
	(b) loss of 2 electrons by magnesium [1] gain of 1 electron by fluorine [1] idea that 2 fluorine atoms are needed (for each magnesium) [1] reference to loss or gain of atoms loses 1 mark/sharing electrons negates first 2 marks	[3]	5
5	**(a)** diamond	[1]	
	(b) idea that quartz does not have delocalised electrons [1]	[1]	
	(c) clear idea of having strong (covalent) **bonds** which are difficult to break	[1] [1]	4

			AVAILABLE MARKS
6	**(a)**	$^{238}_{92}U \rightarrow {}^{234}_{90}Th + {}^{4}_{2}He$ there are six marking points: 6 correct = [4]; 5 correct = 3; 3 or 4 correct = [2]; 2 correct = [1]; 0 or 1 correct = [0]; accept the alpha symbol for He [4]	
	(b)	1.35×10^{10} years [2] incorrect answer with 3 half-lives gains 1 method mark accept 13.5×10^{9} for [2] [2]	6
7	**(a)**	Carbon dioxide dissolves in water (forming carbonic acid) [1] idea that carbonic acid reacts with calcium carbonate/limestone (forming calcium hydrogen carbonate) [1] OR $CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$ [1] [1] [2]	
	(b)	idea that Ca^{2+} (calcium ions) **react** [1] with CO_3^{2-} (carbonate ions) [1] and that an **insoluble** calcium compound is formed/calcium ions removed from solution [1] (idea of Ca^{2+} ions being precipitated as calcium carbonate is worth [2]) OR $Ca^{2+}(aq) + CO_3^{2-}(aq) \rightarrow CaCO_3(s)$ [1] [1] correct state symbols [1] [3]	5
8	**(a)**	**(i)** 160 [1]	
		(ii) 0.625 moles i.e. 100 ÷ **(a)(i)** answer – apply CM [1]	
		(iii) 1.25 moles i.e. 2 × **(a)(ii)** answer – apply CM [1]	
		(iv) 70 g i.e. 56 × **(a)(iii)** answer – apply CM [1]	
		(v) 1.875 moles i.e. **(a)(ii)** answer × 3 – apply CM [1]	
		(vi) 52.5 g [2] up to 1 method mark i.e. **(a)(v)** answer × 28 – apply CM [2]	7
9	**(a)**	**(i)** Any two of: colourless/odourless/low density/insoluble in water/or other correct (2 × [1]) no marks relating to mp or bp [2]	
		(ii) meteorological balloons/rocket engines/(clean) fuel or other correct, e.g. Haber Process or hydrogenation of fats [1]	
		(iii) $CuO + H_2 \rightarrow Cu + H_2O$ LHS [1] RHS [1] [2]	

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				AVAILABLE MARKS
(b)	**(i)**	sulphur dioxide	[1]	
	(ii)	3	[1]	
	(iii)	kills fish/corrodes or damages stonework or buildings (**NOT** erodes)/destroys or damages or kills vegetation/leaches nutrients from the soil or other correct, e.g. corrodes metal	[1]	
	(iv)	idea of scrubbers/filters/use low sulphur fuels/desulphonation **NOT** use of alternative energy sources	[1]	
(c)		Advantages (allow up to four of): use of lignite as a fuel/providing jobs/e.g. cheap (fuel)/helping local economy/allow improved transport links/or other correct Disadvantages (allow up to four of): loss of habitat/eyesore/noise pollution/dust pollution/using up natural resource or other correct (max 6 × [1]) QWC mark for clear articulation – **NOT** just list [1]	[7]	
(d)	**(i)**	fertilisers/slurry	[1]	
	(ii)	fertilisers/detergents	[1]	
	(iii)	soluble or dissolved allow bacteria	[1]	
	(iv)	idea of killing bacteria/germs **NOT** cleaning accept sterilises	[1]	20
10 **(a)**	**(i)**	carbon/graphite	[1]	
	(ii)	anode – oxygen, cathode – aluminium both needed	[1]	
	(iii)	anode [1] idea that it reacts with oxygen [1] forming carbon dioxide [1] **NOT** wears away/erodes	[3]	
(b)	**(i)**	alkali metals **NOT** alkaline	[1]	
	(ii)	Any four of: bubbles/effervescence/fizzing **NOT** just "gas"/hissing or similar sound metal floating/on surface forming a ball/melting or similar metal getting smaller/disappearing/dissolving moving around idea of catching fire/sparks/yellow-orange flame exothermic reaction idea of alkaline solution remaining/turns purple with indicator idea of very vigorous reaction (4 × [1])	[4]	

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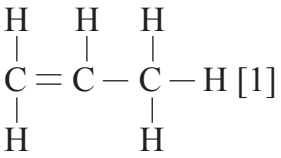
					AVAILABLE MARKS
		(iii)	idea of reactivity of sodium	[1]	
		(iv)	sodium + water → sodium hydroxide [1] + hydrogen [1]	[2]	
		(v)	slower or similar [1] lithium is less reactive [1] correct reference to position in Group 1 [1] any 2 points of 3	[2]	
	(c)	**(i)**	calcium hydroxide or slaked lime	[1]	
		(ii)	$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$ [1] [1]	[2]	
		(iii)	Any two of: hard/brittle/crystalline/doesn't conduct electricity when solid/or other correct allow idea of soluble in water (2 × [1])	[2]	20
11	**(a)**	**(i)**	solubility of potassium chlorate (g/100 g H_2O) [1] 6 correct points [2] (for 4 or 5 correct award [1]) correct curve [1]	[4]	
		(ii)	33.5 °C ± 0.5 °C	[1]	
		(iii)	6 ± 0.3 [1] 22.5 ± 0.5 [1]	[2]	
		(iv)	(answer **(iii)** 2 – answer **(iii)** 1)/2 [2] award up to 1 method mark i.e. 8.25 g ± 0.4 – apply CM	[2]	
	(b)	**(i)**	temperature – 250 °C–500 °C range [1] pressure – 150 atm–400 atm range [1] catalyst – iron [1]	[3]	
		(ii)	$N_2 + 3H_2 \rightarrow 2NH_3$ LHS [1] RHS [1] balancing mark (if other 2 marks gained) [1]	[3]	
		(iii)	idea that pressure needed cannot be easily obtained/lack of appropriate apparatus [1] accept qualified danger or qualified cost	[1]	
	(c)	**(i)**	hydrated [1] iron(III) oxide [1]	[2]	
		(ii)	clear idea that zinc is more reactive than iron [1] idea that zinc reacts first (**NOT** faster) [1]	[2]	20

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12 (a) (i) C_nH_{2n} [1]

(ii) a compound/substance of carbon and hydrogen [1] only (implied) [1] which has a (at least one) double (C=C) bond [1] [3]

(iii)

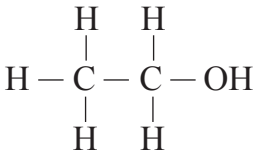
hydrocarbon	molecular formula	structural formula	physical state at room temperature
propene:	C_3H_6 [1]	 [1]	gas [1]

[3]

(b) addition **NOT** additional [1] polymerisation [1] [2]

(c) (i) $C_2H_4 + H_2O \rightarrow C_2H_5OH$
LHS [1] RHS [1] [2]

(ii) fermentation/anaerobic respiration by yeast [1]

(iii)  [1]

(iv) solvent, fuel, idea of (alcoholic) beverages or other correct
accept alcohol or antiseptic [1]

(d) (i) CH_3COOH [1]

(ii) Any two of:
bubbling or fizzing or gas given off/magnesium metal disappears or dissolves/colourless solution formed
exothermic reaction
idea of steady, or slow (not very vigorous) reaction
(2 × [1]) [2]

(e) (i) ethyl ethanoate [1]

(ii) colourless/sweet smelling/oily [1] liquid [1] [2]

Total

AVAILABLE MARKS

20

120

Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2010

Science: Double Award (Non-Modular)

Paper 2
Higher Tier

[G8405]

G8405

WEDNESDAY 26 MAY, MORNING

TIME

1 hour 45 minutes.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
Write your answers in the spaces provided in this question paper.
Answer **all twelve** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 120.
Quality of written communication will be assessed in question **2(b)**.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
A Data Leaflet which includes a Periodic Table of the Elements is provided.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
Total Marks	

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Examiner Only	
Marks	Remark

1 You may find your Data Leaflet helpful in this question.

(a) Give the common name for the Group VII elements.

_____ [1]

(b) Which of the elements, bromine, chlorine or iodine is most reactive?

_____ [1]

(c) Name an element which forms an **ion** with a charge of +1.

_____ [1]

(d) Which element is in Period 2 **and** Group IV?

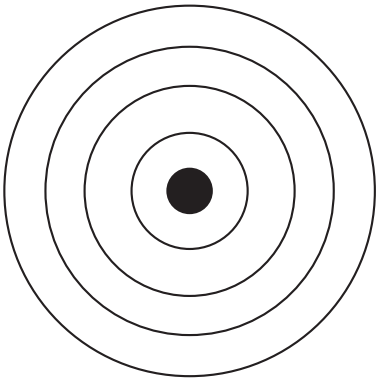
_____ [1]

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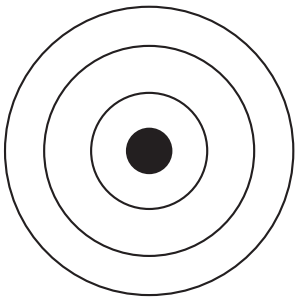
Examiner Only	
Marks	Remark

2 Calcium reacts with chlorine to form the compound calcium chloride.

(a) Complete the diagrams below to show the arrangement of **all** the electrons in a calcium atom and a chlorine atom.



a calcium atom



a chlorine atom [2]

(b) Explain how the electron arrangements change when calcium chloride is formed from calcium and chlorine.

_____

_____

_____

_____

_____

_____ [3]

Quality of written communication [1]

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Marks	Remark

3 Strontium (Sr) is a typical Group II element.

(a) Would you expect strontium to react more vigorously or less vigorously than calcium when put in water? Give a reason for your answer.

_____

_____

_____ [2]

(b) When strontium reacts with water an alkaline solution is formed and a gas is given off.

(i) Name the alkaline solution.

_____ [1]

(ii) What gas is given off?

_____ [1]

(c) What formula would you expect for the oxide formed when strontium reacts with oxygen?

_____ [1]

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Marks	Remark

4 Hard water is water which does not lather easily with soap.

(a) What effect does hard water have on detergents?

_____ [1]

(b) Give **two** advantages of hard water.

1. _____

2. _____ [2]

(c) Temporary hard water can be softened by boiling the water. Give one **other** way of making hard water soft.

_____ [1]

5 Aluminium is used to make electrical wiring because aluminium is ductile and a good conductor of electricity.

(a) Draw a **labelled** diagram to show the structure of a metal such as aluminium.

[4]

(b) Explain, in terms of metallic structure, why aluminium is ductile.

_____

_____

_____ [2]

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6 The reaction between hydrogen gas and oxygen gas is exothermic, i.e., heat is given out.

The equation below describes the reaction

$$2H_2 + O_2 \rightarrow 2H_2O$$

Explain, in terms of the bonds involved, why the reaction between hydrogen and oxygen is exothermic.

_____

_____

_____

_____

_____

_____

_____ [4]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

7 Magnesium nitrate decomposes on heating according to the equation:

$$2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$$

(a) What is the relative formula mass of MgO?

(Relative atomic masses Mg = 24 O = 16)

Relative Formula Mass = _____ [1]

(b) What is the relative formula mass of $Mg(NO_3)_2$?

(Relative atomic masses Mg = 24 N = 14 O = 16)

Relative Formula Mass = _____ [1]

(c) Use your answer to part **(a)** to calculate the number of moles in 5.0 grams of magnesium oxide.

Answer _____ moles [1]

(d) Use your answer to part **(c)** and the equation below to calculate the mass of magnesium nitrate required to produce 5.0 grams of magnesium oxide.

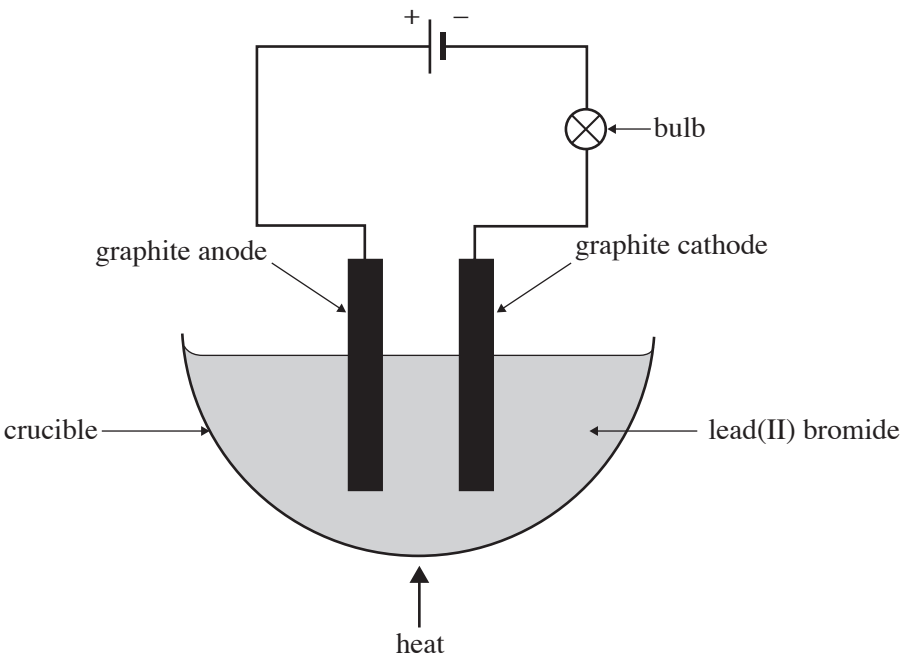
$$2Mg(NO_3)_2 \rightarrow 2MgO + 4NO_2 + O_2$$

Answer _____ g [2]

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Examiner Only	
Marks	Remark

8 The diagram below shows the apparatus used in the electrolysis of molten lead(II) bromide.



(a) Explain fully why lead bromide does not conduct electricity in the solid state.

_____

_____ [1]

(b) Why is the electrolysis of lead bromide carried out in a fume cupboard?

_____ [1]

(c) Describe what is formed at the **negative** electrode during the electrolysis of molten lead(II) bromide.

_____

_____ [1]

(d) Write an **ionic** equation for the reaction which takes place at the **anode** during the electrolysis of molten lead(II) bromide.

_____ [3]

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(Questions continue overleaf)

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Marks	Remark

9 **(a)** The table below gives some information about atomic and electronic structures.
Complete the table. You may find your Data Leaflet useful.

atom	number of protons	number of electrons	number of neutrons	atomic number	mass number
magnesium	12		12	12	
potassium		19		19	39
boron	5		6		11

[6]

(b) Chlorine is a reactive Group 7 element and is composed of **diatomic** molecules. It has two isotopes, ^{35}Cl and ^{37}Cl.

(i) Explain the meaning of the term **diatomic**.

_____

_____ [1]

(ii) Complete the table below to show the atomic structure of these two isotopes of chlorine.

Isotope	Number of electrons	Number of neutrons	Number of protons
^{37}Cl	17	20	17
^{35}Cl			

[3]

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(iii) When chlorine is passed into a solution of potassium bromide a displacement reaction takes place and potassium chloride and bromine are formed.

Describe the colour change which would be observed in this reaction.

Colour of solution at the start _____

Colour of solution at the end _____ [2]

(c) Burning fossil fuels containing sulphur produces a gas, **Z**, which causes acid rain.

(i) Name this gas, **Z**, that causes acid rain to be formed.

_____ [1]

(ii) Give **two** reasons why acid rain is a serious environmental problem.

1. _____

2. _____ [2]

(iii) Give **one** way that fossil fuel power stations can reduce the amount of gas, **Z**.

_____

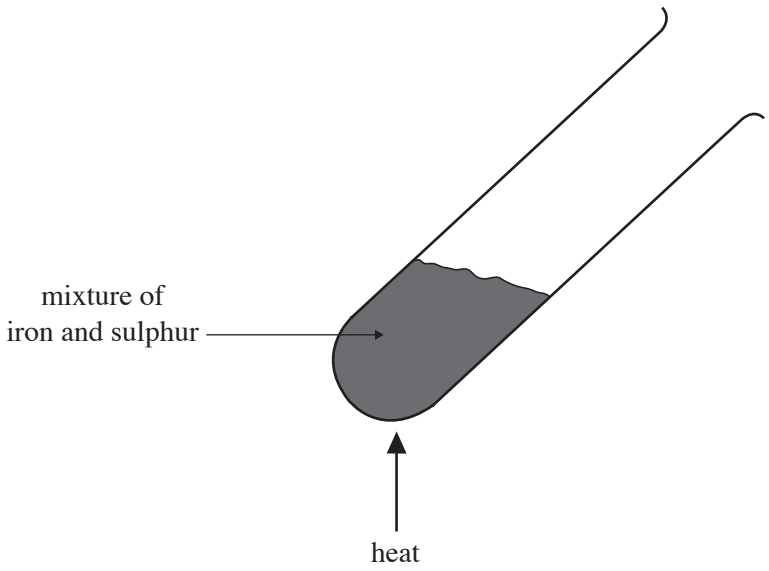
_____ [1]

Examiner Only

Marks	Remark

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(d) When sulphur and iron are heated they react to form a compound, iron(II) sulphide.



(i) Describe the appearance of sulphur.

_____ [2]

(ii) Give **two** things you would observe when iron reacts with sulphur.

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

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(Questions continue overleaf)

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Marks	Remark

10 This question is about metals and their compounds. You may find your data leaflet useful.

(a) Calcium and magnesium are both alkaline earth metals.

(i) To what Group in the Periodic Table do calcium and magnesium belong?

_____ [1]

(ii) Describe **two** things you would observe happening when a piece of magnesium ribbon is burned in air.

1. _____

2. _____ [2]

(iii) Complete the word equation for the reaction of magnesium with oxygen.

magnesium + oxygen → [1]

(b) Calcium metal reacts with water.

(i) Describe **three** things you would observe happening when calcium is added to water.

1. _____

_____

2. _____

_____

3. _____

_____ [3]

(ii) Give **one** safety precaution which should be taken when carrying out the reaction between calcium and water.

_____ [1]

(iii) Complete the word equation for the reaction of calcium with water.

calcium + water → + [2]

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(c) Magnesium reacts very slowly with water but it reacts quite vigorously with steam.

(i) What gas is formed when magnesium reacts with steam?

_____ [1]

(ii) What is the other product of the reaction of magnesium with steam?

_____ [1]

(d) Copper sulphate can be made by reacting solid green copper carbonate powder with dilute sulphuric acid.

(i) Describe **two** things you would observe happening when copper carbonate reacts with sulphuric acid.

1. _____

2. _____ [2]

(ii) Why can copper sulphate not be prepared by adding dilute sulphuric acid directly to copper?

_____ [1]

(e) Magnesium powder reacts quite quickly when stirred with copper(II) sulphate solution.

(i) Describe the colour change of the solution in this reaction.

From _____ to _____ [2]

(ii) Write a balanced **symbol** equation for the reaction of magnesium with copper(II) sulphate.

_____ [2]

(iii) What **type** of chemical reaction is the reaction between magnesium and copper sulphate?

_____ [1]

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Marks	Remark

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Marks	Remark

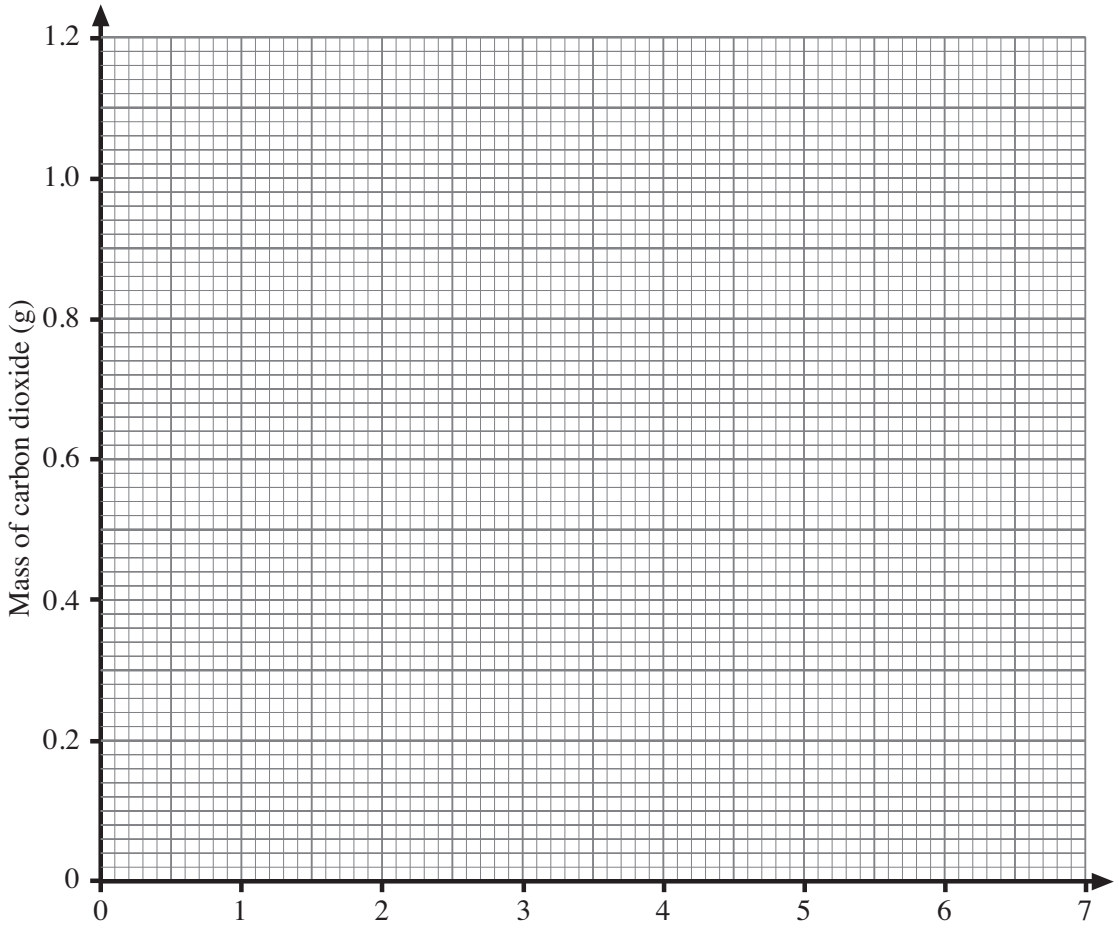
11 (a) Marble chips react with dilute hydrochloric acid as shown below:

$$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$$

A student measured the mass of carbon dioxide being produced over a period of time when very small marble chips were added to dilute hydrochloric acid. The marble chips were in excess.

The results are shown in the table below.

Mass of carbon dioxide (g)	0.0	0.40	0.68	0.85	0.96	1.02	1.04	1.04
Time (mins)	0	1	2	3	4	5	6	7



(i) Label the x-axis on the grid above. [1]

(ii) On the grid plot a curve to show the results. [3]

(iii) At what time did the reaction stop?

_____ [1]

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(iv) From your graph, how long did it take for 0.5 grams of carbon dioxide to be formed?

_____ [1]

(v) Use the idea of collisions to explain the effect of **increasing** the size of the marble chips on the rate of reaction.

_____

_____

_____

_____

_____ [3]

(vi) The student repeated the reaction using the same volume and concentration of dilute hydrochloric acid as before but this time using larger marble chips. How would using larger marble chips affect the total mass of carbon dioxide formed?

_____

_____ [1]

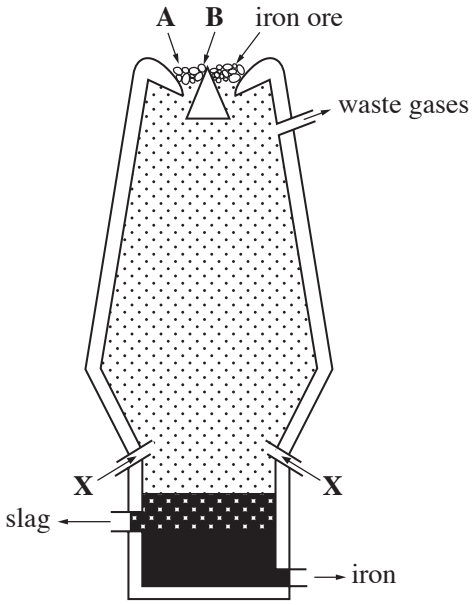
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Marks	Remark

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(b) Iron is obtained in the Blast Furnace from its ore, iron(III) oxide.

Examiner Only	
Marks	Remark



(i) Complete the table below about the raw materials, **A** and **B**, which are added at the top of the Blast Furnace.

substance	common name	chemical name
A		carbon
B		calcium carbonate

[2]

(ii) Name the substance, **X**, that is blasted in lower down the Blast Furnace.

_____ [1]

(iii) Carbon monoxide is the reducing agent in the Blast Furnace. Write a balanced symbol equation to show how carbon dioxide produced in the Blast Furnace is converted into carbon monoxide.

_____ [3]

(iv) Use a balanced symbol equation to show how carbon monoxide reduces iron(III) oxide to iron in the furnace.

_____ [3]

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(v) Give **one** environmental problem which can arise from iron manufacture.

_____

_____ [1]

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Marks	Remark

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Examiner Only	
Marks	Remark

12 Ethane and ethene are two important organic chemicals. They are both hydrocarbons but they belong to two different homologous series.

(a) (i) What does the term hydrocarbon mean?

_____

_____ [2]

Ethene can be obtained by **thermal cracking**.

(ii) Ethane is a saturated organic molecule. What does the term **saturated** mean?

_____ [1]

(iii) What is meant by **thermal cracking**?

_____

_____ [2]

(iv) Name the homologous series to which ethene belongs.

_____ [1]

(b) Complete the table below to show the molecular and structural formulae and physical state at room temperature of both ethane and ethene.

hydrocarbon	**molecular formula**	**structural formula**	**physical state at room temperature**
ethane			
ethene			

[4]

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(c) Describe a chemical test which you could carry out in the laboratory to distinguish between ethane and ethene. State what you would observe.

test	
observations with ethane	
observations with ethene	

[4]

(d) Ethene can be used to make ethanol, which can be used as a fuel.

(i) What does ethene react with to make ethanol?

_____ [1]

(ii) What chemicals are formed when ethanol is burned in a plentiful supply of air?

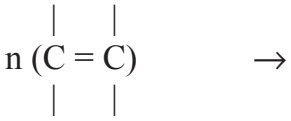
_____ [2]

(e) Polythene is a useful plastic made from ethene molecules.

(i) What plastic is made from propene molecules?

_____ [1]

(ii) Complete the diagram below which represents addition polymerisation.



[2]

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Marks	Remark

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GCSE

Science: Double Award (Non-Modular)

Summer2010

Mark Schemes

Issued: October 2010

Rewarding Learning

General Certificate of Secondary Education
2010

Science: Double Award (Non-Modular)

Paper 2
Higher Tier

[G8405]

WEDNESDAY 26 MAY, MORNING

MARK SCHEME

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				AVAILABLE MARKS
1	**(a)**	halogens **not** halides	[1]	
	(b)	chlorine	[1]	
	(c)	hydrogen, lithium, sodium, potassium Rb, Cs, Fr, Ag, Cu or other correct	[1]	
	(d)	carbon	[1]	4
2	**(a)**	correct 2,8,8,2 representation for calcium [1] correct 2,8,7 representation for chlorine [1] apply CM if not drawn but correct 2,8,8,2 and 2,8,7 given i.e. award [1] not [2]	[2]	
	(b)	loss of 2 electrons by calcium [1] gain of 1 electron by chlorine [1] idea that 2 chlorine atoms are needed (for each calcium) [1] reference to loss or gain of atoms/sharing electrons negates first 2 marks	[3]	
		QWC	[1]	6
3	**(a)**	More vigorously [1] Idea that reactivity increases down the Group or other correct [1] e.g. higher in reactivity series e.g. idea of (outer) electrons further away from nucleus	[2]	
	(b)	**(i)** strontium hydroxide [1]		
		(ii) hydrogen [1]	[2]	
	(c)	SrO [1]	[1]	5
4	**(a)**	none [1] produces lather	[1]	
	(b)	any **two** of: good for teeth/bones **not** just health **not** contains calcium ions tanning leather helps prevent heart disease brewing beer idea of nice taste (2 × [1])	[2]	
	(c)	ion exchange/distillation/addition of washing soda or other correct [1]	[1]	4

			AVAILABLE MARKS
5	**(a)** Diagram should show:– Positive ions but no negative ions [1] (PI) Regular arrangement of positive ions only [1] (RA) Sea/cloud of delocalised electrons [1] (DE) Further mark for labelled diagram – i.e. 2 or 3 of the points above labelled [1] (L)	[4]	
	(b) Idea of atoms/metal ions in **layers** [1] Which can **slide** over one another [1] mark each point separately	[2]	6
6	Idea that bonds in hydrogen and oxygen are broken (i.e. named reactants) [1] Idea that bond breaking requires energy/is endothermic [1] Idea that bonds in water are made (i.e. named product) [1] Idea that bond making gives out energy/is exothermic [1] Maximum [3] Clear idea that reaction is exothermic because **more energy is given out than is taken in not** just that it is exothermic because energy is given out [1] e.g. The energy given out on making bonds in water is more than the energy needed to break the bonds in hydrogen and oxygen [4]	[4]	4
7	**(a)** 40 [1]	[1]	
	(b) 148 [1]	[1]	
	(c) 0.125 (moles) apply CM [1]	[1]	
	(d) 18.5 g [2] one method mark available for incorrect answer but with one correct step e.g. no of moles $Mg(NO_3)_2$ = no of moles MgO or work which shows ans (c) X ans (b) apply CM	[2]	5
8	**(a)** Idea that ions are not free to move [1]	[1]	
	(b) Idea of poisonous nature of bromine [1] Toxic, not dangerous, not harmful	[1]	
	(c) Metal/silvery beads forming **not** bubbles of gas [1] allow lead/grey solid/grey metal	[1]	
	(d) $2Br^- \rightarrow Br_2 + 2e^-$ [1] [1] balancing mark if other [2] gained [1] $2Br^- - 2e^- \rightarrow Br_2$	[3]	6

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AVAILABLE MARKS

9 **(a)**

Atom	Number of protons	Number of electrons	Number of neutrons	Atomic number	Mass number
magnesium	12	**12** [1]	12	12	**24** [1]
potassium	**19** [1]	19	**20** [1]	19	39
boron	5	**5** [1]	6	**5** [1]	11

[6]

(b) **(i)** idea of containing 2 **atoms** [1] [1]

(ii)

Isotope	Number of electrons	Number of neutrons	Number of protons
^{37}Cl	17	20	17
^{35}Cl	**17** [1]	**18** [1]	**17** [1]

[3]

(iii) Colour at start – colourless [1] **not** "clear"
Colour at end yellow/yellow-orange/orange [1] [2]
allow yellow/orange/brown/red-brown or combinations
but **not** red

(c) **(i)** sulphur dioxide [1] [1]

(ii) any **two** of:
Kills fish/(allow damages) corrodes stonework or buildings (**not** erodes)/destroys or damages or kills vegetation/leaches nutrients from the soil **not** destroys habitats, **not** pollutes, **not** makes lakes acidic
Or other correct (2 × [1]) [2]

(iii) idea of scrubbers/desulphonation or low sulphur fuels **not** use alternative fuels [1] [1]
not catalytic converters **not** burn less fossil fuels

(d) **(i)** yellow [1] solid/powder or similar [1]
i.e. colour [1] physical state [1] [2]

(ii) any **two** of:
Idea of mixture glowing/continuing to glow when removed from heat/Grey or black solid formed or other correct (2 × [1]) [2]
allow idea of pungent smell
allow idea that yellow colour disappears
not exothermic, yellow colour disappears

20

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AVAILABLE MARKS

10 (a) (i) Group 2 [1] [1]

(ii) any **two** of:
Bright (white) light/white or grey ash or powder or solid formed/
(very) vigorous reaction/allow smoke unless wrongly qualified
exothermic reaction (2 × [1]) magnesium ribbon disappears [2]

(iii) magnesium oxide [1] [1]

(b) (i) any **three** of:
Calcium sinks **or** sinks and rises
Bubbles/gas evolved/fizzing
idea of reaction getting faster **not** reaction is fast
Idea of solution going cloudy
Calcium gets smaller/dissolves/disappears
Idea that solution formed is alkaline [3]
Idea of reaction vessel getting warm/exothermic (3 × [1])
ignore reference to hissing or noise
mark idea of moving across the surface of the water as wrong
accept moves **in** the water and **not** just moves

(ii) Wear goggles/use a screen/use a fume cupboard/only small amount of Ca [1] [1]

(iii) calcium + water → calcium hydroxide [1] + hydrogen [1] [2]
apply CM for formula equation from 4a(iii)

(c) (i) Hydrogen [1] [1]

(ii) Magnesium oxide [1] [1]
allow hydrogen through CM if magnesium oxide given in (i)

(d) (i) Any **two** of:
Copper carbonate dissolving/disappearing/getting smaller
Blue solution formed
Bubbles/gas evolved/fizzing/CO_2 given off
Exothermic reaction
idea of vigorous/fast reaction
(2 × [1]) [2]

(ii) Idea that it does **not** react [1]
i.e. that copper is not reactive [1]

(e) (i) blue [1] to colourless [1] **not** clear [2]

(ii) $Mg + CuSO_4 \rightarrow MgSO_4 + Cu$
[1] [1] [2]

(iii) displacement [1] allow redox [1]

20

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AVAILABLE MARKS

11 (a) (i) time (min) [1] units needed [1]

(ii) 7–8 points correct [2], 5–6 points correct [1] appropriate hand-drawn curve [1]
Do not award curve mark for points joined by a ruler [3]

(iii) $5\frac{1}{2}$ – 6 minutes [1] [1]

(iv) 1.25 – 1.4 minutes i.e. 1 min 15 sec – 1 min 24 sec [1]

(v) Clear idea that increasing size of marble chips decreases the surface area [1]
there are fewer collisions [1]
the reaction slows down/takes longer [1] [3]

(vi) no effect on mass of CO_2 [1] [1]

(b) (i)

substance	common name	chemical name
A	**Coke** [1]	carbon
B	**Limestone** [1]	calcium carbonate

[2]

(ii) air [1] **not** oxygen [1]

(iii) $CO_2 + C \rightarrow 2CO$
[1] [1] balancing mark if other 2 gained [1] [3]

(iv) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
[1] [1] balancing mark if other 2 gained [1] [3]

(v) Idea of slag heaps or other correct [1] [1]
e.g. idea of effect on landscape
noise pollution
dust pollution
air pollution e.g. waste gases pollute/greenhouse effect/ acid rain

20

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AVAILABLE MARKS

12 (a) (i) A compound made up of carbon and hydrogen atoms [1] only [1] the "only" should be implied i.e. made up of carbon and hydrogen atoms can gain both marks unless wrongly qualified [2]
If answer just "carbon and hydrogen only" award [1]

(ii) idea that each carbon has four single bonds only/no C=C double bond [1] accept idea of no addition reactions [1]

(iii) breaking down of long chain (less useful) hydrocarbons into short chain (more useful) hydrocarbons [1] using heat/with the formation of an alkene [1] [2]

(iv) alkenes [1] [1]

(b)

	molecular formula	**structural formula**	**state at room temperature**
ethane	C_2H_6	Structural formula	Gas
ethene	C_2H_4	Structural formula	Gas

6 correct = [4]; 5 correct = [3]; 3–4 correct = [2]; 2 correct = 1 [4]

(c)

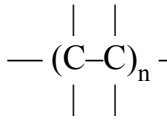
Test	Bromine **Water** [1] or bromine solution not **bromine**
Ethane	solution remains yellow/orange/brown/ red-brown or any combination or no change/no reaction [1]
Ethene	yellow/orange/brown/red-brown or any combination [1] turns colourless [1]

allow the "colour" mark for either ethane or ethene do not allow red [4]

(d) (i) steam [1] **not** water **not** H_2O, accept $H_2O_{(g)}$ [1]

(ii) carbon dioxide [1]; water [1] [2]

(e) (i) polypropene [1] [1]

(ii)

— [2] one mark for showing single C–C bond second mark for rest of diagram correct [2]

20

Total **120**

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