CCEA GCSE CHEMISTRY (2003 SPECIFICATION)

CHEMISTRY



EXAM QUESTION PACK

PAPER 1 HIGHER TIER G1403 PAPERS

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Rewarding Learning

General Certificate of Secondary Education
2012

Science: Chemistry

Paper 1
Higher Tier

[G1403]

TUESDAY 12 JUNE, MORNING

MARK SCHEME

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AVAILABLE MARKS

1 **(a)**

Element	metal or non-metal or semi-metal
Carbon	non-metal [1]
Silicon	semi-metal [1]
Germanium	semi-metal [1]
Tin	metal [1]

[4]

(b) **(i)**

Isotope	Number of protons	Number of electrons	Number of neutrons
^{12}C	6	6	6
^{13}C	6	6	7
^{14}C	6	6	8

[1] each column [3]

(ii) atoms of the same element/same atomic number/same number of protons [1]
different number of neutrons/different mass number [1] [2]

(c) **(i)** different forms/structures of the same element [1]
in the same (physical) state [1] [2]

(ii) A and B [1]

(iii) covalent [1]

(iv)

Substance	Type of structure
A (diamond)	giant (covalent)/macromolecular [1]
B (graphite)	giant (covalent)/macromolecular [1]
C (silicon dioxide)	giant (covalent)/macromolecular [1]
D (carbon dioxide)	molecular/simple (covalent) [1]

[4]

(d) **(i)** weak forces between **layers** [1]
layers slide **off** [1] [2]

(ii) 2,8,1 [1]
2,8,7 [1]
Na^+ [1] 2,8 [1]
Cl^- [1] 2,8,8 [1]
idea that ions held by attraction between opposite charges [1]
Maximum [6]

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				AVAILABLE MARKS
	(e)	**(i)**	regular arrangement [1] or evident in diagram of positive ions [1] or **labelled** in diagram sea of delocalised electrons [1] or **labelled** in diagram attraction between ions and electrons is the metallic bond [1] Maximum [3]	
		(ii)	conducts electricity/malleable/ductile or other correct [1]	
		(iii)	conducts electricity/soft/reference to colour/or other correct [1]	30
2	**(a)**	**(i)**	$2Na + Cl_2 \rightarrow 2NaCl$ [3]	
		(ii)	any **two** from: high melting point/high boiling point soluble (in water) does not conduct electricity **when solid** conducts **electricity** when molten/dissolved (in water)/aqueous/as a liquid crystalline/brittle [2]	
		(iii)	shiny/grey/lustrous [1]	
		(iv)	goes dull/tarnishes [1]	
		(v)	under/in oil [1]	
	(b)	**(i)**	lower density **than water** [1]	
		(ii)	(the sodium) melts [1]	
		(iii)	alkaline [1] solution sodium hydroxide/OH^-/hydroxide ions produced [1] [2]	
		(iv)	$2Na + 2H_2O \rightarrow 2NaOH + H_2$ [3]	
	(c)	**(i)**	sodium chloride [1]	
			sodium aluminate [1] [2]	
		(ii)	$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$ [3]	
		(iii)	amphoteric [1]	21

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					AVAILABLE MARKS
3	(a)	(i)	carbon dioxide	[1]	
		(ii)	decreases	[1]	
		(iii)	citric acid/ascorbic acid/carbonated water	[1]	
		(iv)	Solubility = mass [1] of solid which saturates [1] 100 g water [1] at a particular temperature [1] allow idea of **maximum** mass for saturate	[4]	
	(b)	(i)	water which does not lather with soap [1] water which does not lather **readily** with soap [2]	[2]	
		(ii)	B [1] contains largest calcium and/or magnesium **ion** concentration/mass [1]	[2]	
		(iii)	equal volumes of mineral water [1] **add soap and shake** [1] most soap/most scum/least lather = hardest water [1]	[3]	
			Quality of written communication	[2]	
		(iv)	pH paper/Universal Indicator [1] compare to colour chart [1]	[2]	
		(v)	C [1] lowest pH [1]	[2]	
		(vi)	any compound containing one positive and one negative ion from the lists below: positive ions: calcium/magnesium/sodium/potassium negative ions: hydrogen carbonate/chloride/sulphate/nitrate [1] correct formula of named compound [1]	[2]	
	(c)	(i)	calcium ions/Ca^{2+} [1] in the hard water [1] replaced/swapped [1] with sodium ions/Na^{+} [1] from ion exchanger [1]	[4]	
		(ii)	hydrated [1] sodium carbonate [1]	[2]	
		(iii)	all nitrates are soluble/no insoluble nitrate	[1]	
		(iv)	fertilisers	[1]	30

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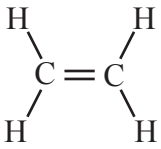
AVAILABLE MARKS

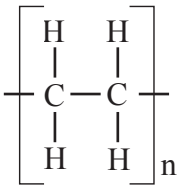
4 **(a)** **(i)** does not break/lighter [1]

(ii) a long chain molecule [1] made from many repeating units/monomers [1] [2]

(iii) liver damage/poor coordination/other suitable [1]

(b) **(i)**

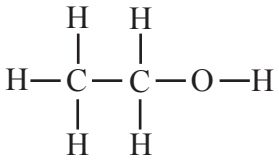
	Ethene	
Molecular formula	C_2H_4	[1]
Structural formula (showing all bonds)		[1]
Physical state at room temperature	gas	[1]

(ii) 

correct structure with no double C=C bond [1]
repeat indicated n or min 2 repeating units [1] [2]

(iii) any **one** from:
global warming
ice caps melt
flooding
rise in sea level
climate change [1]

(c) **(i)**

	Ethanol	
Molecular formula	C_2H_5OH	[1]
Structural formula (showing all bonds)	 if —OH shown award [1]	[2]
Physical state at room temperature	liquid	[1]

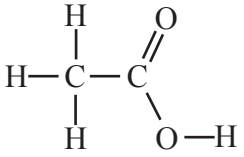
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(ii) yeast [1]

(iii) carbon dioxide [1]

(iv) warm/absence of air [1]

(d) (i)

	Ethanoic acid
Molecular formula	CH_3COOH [1]
Structural formula (showing all bonds)	 [2] if —OH shown award [1]
Physical state at room temperature	liquid [1]

(ii) $CaCO_3 + 2CH_3COOH \rightarrow (CH_3COO)_2Ca + H_2O + CO_2$ [3]

(iii) bubbles/effervescence [1]
heat released [1]
calcium carbonate/solid disappears [1]
solution remains colourless [1] Maximum [2]

26

AVAILABLE MARKS

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5 **(a)** **(i)** halogens [1]

(ii) solid [1]

(iii) 7 [1]

(iv) astatide [1]
1–/– [1] [2]

(b) **(i)** $Cl_2 + 2KBr \rightarrow 2KCl + Br_2$ [3]

(ii) yellow-green gas dissolves [1]
solution changes from colourless [1] to brown [1] Maximum [2]

(c)

Name of compound	Formula of compound
aluminium chloride	$AlCl_3$ [1]
sodium hypochlorite	NaOCl [1]
iron(III) chloride [2] iron chloride = [1]	$FeCl_3$

Maximum [3]

Total

AVAILABLE MARKS

13

120

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Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2011

Science: Chemistry

Paper 1
Higher Tier

G1403

[G1403]

FRIDAY 27 MAY, MORNING

TIME

1 hour 30 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 five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 120.
Quality of written communication will be assessed in question **2(c)**.
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	
Total Marks	

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Examiner Only	
Marks	Remark

1 Periodic Tables are available which show the symbol of each element and some of its uses. Two elements from such a Periodic Table are shown below.

Li
Lithium
Uses:
Batteries
Aircraft alloys

Be
Beryllium
Uses:
Golf clubs
Watch springs

(a) Complete the table below by inserting the name of the element beside its use and state the group number to which the element belongs.

Use	Element name	Group number
Bleach for cotton and linen		
Gas used in food packaging		

[4]

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(b) Elements in the Periodic Table are arranged in groups and periods.

Examiner Only

Marks	Remark

(i) The table below gives details of some of the groups of the Periodic Table. Complete the table.

Group number	Name of group	Number of electrons in the outer shell of an atom
I		
	the halogens	
		8

[6]

(ii) Name the element found in Period IV (4) and Group VII (7) of the Periodic Table.

_____ [1]

(c) Complete the table below by placing a tick (✓) in the correct column, to identify the element as a metal, a non-metal or a semi-metal. Place only one tick per row.

Element	Metal	Non-metal	Semi-metal
Sodium			
Silicon			
Bromine			
Phosphorus			

[4]

(d) Choose words from the box below to complete the sentence.

hydroxides	**acidic**	**neutral**	**oxides**	**basic**

Most metals burn in oxygen to form _____ which

are _____. [2]

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(e) Many trends in reactivity and physical properties are apparent as a group is descended. The table shows some properties of Group VII (7) elements.

Element	Colour	State at room temperature	Melting point (°C)
Chlorine	green	gas	–101
Bromine	red brown	liquid	–7.2
Iodine	dark grey	solid	114

(i) Name the most reactive element in the table above.

_____ [1]

(ii) Astatine is found at the bottom of Group VII (7). Predict its colour and state at room temperature and pressure.

Colour: _____

State: _____ [2]

(iii) Suggest the name and charge of the simple ion formed from astatine.

Name: _____ Charge: _____ [2]

(iv) Explain why atomic size increases down Group VII (7).

_____

_____

_____ [1]

Examiner Only

Marks	Remark

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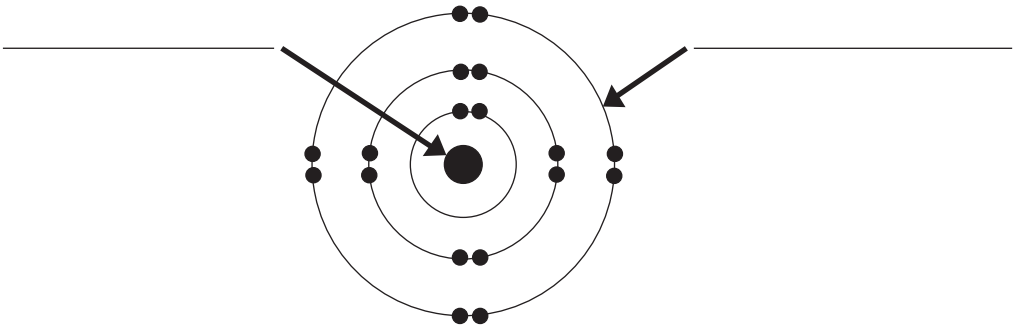
(Questions continue overleaf)

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Examiner Only	
Marks	Remark

2 The reactivity of non-metal atoms depends on the arrangement of their electrons. Many non-metal atoms can form covalent bonds with other non-metal atoms.

(a) The diagram below shows an atom of argon. Atoms are electrically neutral.



(i) Complete the two labels on the diagram above. [2]

(ii) Explain why atoms are electrically neutral.

_____

_____

_____ [2]

(iii) Using the diagram above, explain why atoms of argon are unreactive.

_____

_____ [1]

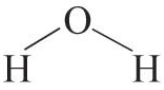
(iv) Complete the table below with the missing details of the subatomic particles.

Relative mass	Relative charge	Name of subatomic particle
	0	
$\frac{1}{1840}$	–1	
1		

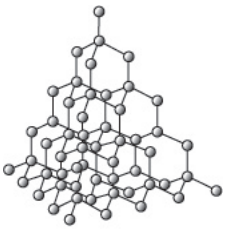
[5]

Examiner Only	
Marks	Remark

(b) Water and diamond contain only non-metal atoms and single covalent bonds. The diagrams below represent these two covalent substances. The melting point of water is 0 °C whereas the melting point of diamond is 3552 °C.



Water



Diamond

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(i) Draw a diagram to show the covalent bonding in a water molecule. You should show outer electrons only.

[3]

(ii) Explain what is meant by a single covalent bond.

_____

_____ [2]

(iii) Water and diamond have different types of structure. State the type of structure found in each.

water _____

diamond _____ [2]

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(iv) Explain as fully as possible why the melting point of diamond is very high compared to water.

_____

_____

_____

_____

_____

_____ [4]

(c) Hydrogen reacts with oxygen to form water as shown in the balanced symbol equation below. This reaction is exothermic.

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

Explain in terms of bond breaking and bond making why this reaction is exothermic.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [5]

Quality of Written Communication [2]

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Marks	Remark

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

3 Magnesium is a reactive Group II metal. It burns readily in air.

(a) Write a balanced symbol equation for the reaction of magnesium burning in air.

_____ [3]

(b) **(i)** Magnesium metal reacts very slowly with cold water but readily with steam. Draw a labelled diagram of the assembled apparatus used to react magnesium with steam **and** to collect the gaseous product.

[5]

(ii) Write a balanced symbol equation for the reaction of magnesium with steam.

_____ [2]

(iii) Describe what would be observed during this reaction.

_____

_____

_____ [2]

(iv) Name a metal which **does not** react with cold water but does react with steam.

_____ [1]

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(c) **(i)** Write a balanced symbol equation for the reaction of magnesium with dilute hydrochloric acid.

_____ [3]

(ii) Describe what is observed when a strip of magnesium metal is added to dilute hydrochloric acid.

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

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(d) A student was asked to identify three unknown metal compounds, A, B and C. Several tests were carried out on the compounds and the results are shown in the table below.

Test	Compound		
	A	B	C
Flame test	lilac flame		brick red flame
Add dilute hydrochloric acid	fizzing observed due to carbon dioxide gas being produced		no visible change
Add dilute sodium hydroxide solution to a solution of the metal compound	no visible change	white ppt forms which dissolves in excess sodium hydroxide solution	
Add compound to dilute nitric acid and then add silver nitrate solution			yellow precipitate forms

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Marks	Remark

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

Examiner Only

Marks	Remark

(i) Write the name and formula of compound A.

Name: _____ [2]

Formula: _____ [1]

(ii) Identify a metal ion which may be present in compound B.

_____ [1]

(iii) Carbon dioxide gas was produced when dilute hydrochloric acid was added to compound A. Describe a test the student could carry out to confirm the presence of carbon dioxide gas and state the result for a positive test.

_____

_____

_____

_____

_____ [2]

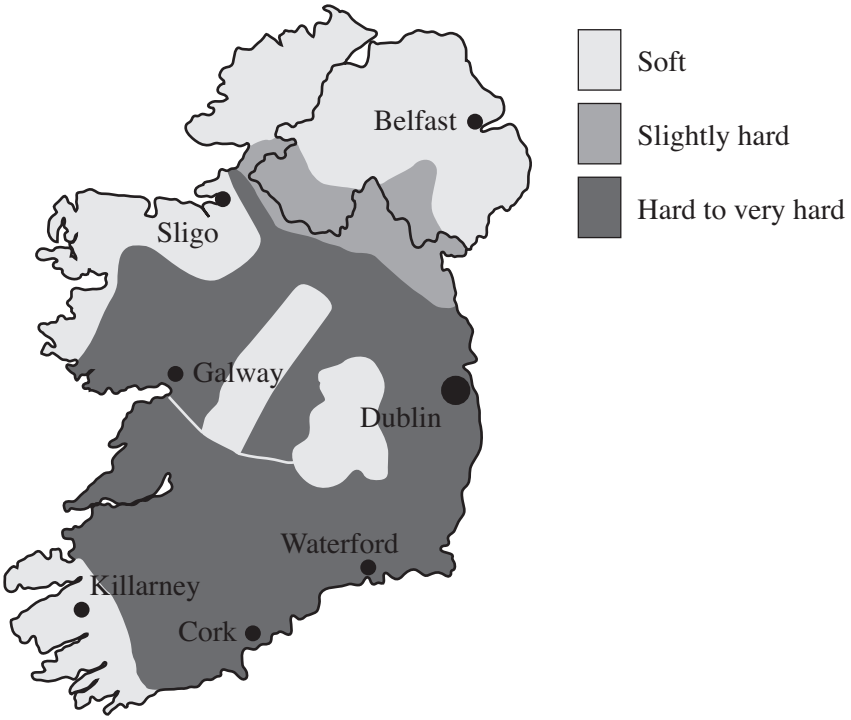
(iv) Write the symbols, including charges, for the cation and anion present in compound C.

Cation: _____

Anion: _____ [2]

Examiner Only	
Marks	Remark

4 **(a)** Various regions of Ireland have hard water. The map below shows the hardness of water throughout Ireland.



(i) What is meant by the term hard water?

_____

_____ [2]

(ii) State two physical features you would expect to find in a hard water region.

_____

_____ [2]

(iii) Explain, giving practical details, how you would test a sample of tap water to prove that it was hard water.

_____

_____

_____

_____ [3]

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(iv) State one disadvantage of hardness in water.

_____ [1]

(b) Hard water is used for brewing beer. In soft water regions a soluble calcium compound is added to the water used for brewing to make it hard.

Dut to copyright, an image of a beer bottle has been removed which is not essential to answer this question.

(i) Name one soluble calcium compound which could be added to the soft water to make it hard.

_____ [1]

(ii) Apart from brewing beer, state another advantage of hardness in water.

_____ [1]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(c) Hydrated sodium carbonate was added to a large sample of permanent hard water. The sample was filtered and a residue was observed on the filter paper. This residue was found to be a precipitate of calcium carbonate.

(i) What is the common name for hydrated sodium carbonate?

_____ [1]

(ii) What do you understand by the term precipitate?

_____

_____ [2]

(iii) State the colour of the precipitate.

_____ [1]

(iv) Write an **ionic** equation for the formation of calcium carbonate when hydrated sodium carbonate is added to hard water.

_____ [2]

(v) Apart from adding hydrated sodium carbonate, state one other method of removing permanent hardness from water.

_____ [1]

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Marks	Remark

5 Sulphuric acid is used in car batteries. Many garages keep a "Battery Acid Spill Kit" on the premises to deal with any battery acid spillage. The acid neutraliser in the "Battery Acid Spill Kit" is anhydrous sodium carbonate, Na_2CO_3.



(a) (i) A mechanic dissolved 3.71 g of anhydrous sodium carbonate in distilled water and made it up to a total volume of 250 cm^3. Calculate the number of moles of anhydrous sodium carbonate present in the 250 cm^3 of solution.
(Relative Atomic Masses: C = 12; O = 16; Na = 23)

[2]

(ii) Calculate the concentration of the sodium carbonate solution in mol/dm^3.

[2]

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Examiner Only	
Marks	Remark

(b) A titration was carried out to determine the concentration of sulphuric acid in dilute battery acid. 25.0 cm^3 of dilute battery acid were placed in a conical flask and a few drops of phenolphthalein indicator were added.

Sodium carbonate solution of concentration 0.16 mol/dm^3 was then added slowly to the conical flask until the end point was obtained.

31.25 cm^3 of sodium carbonate solution were required to neutralise the sulphuric acid in the dilute battery acid.

(i) Name the piece of apparatus used to accurately measure the 25.0 cm^3 of dilute battery acid.

_____ [1]

(ii) What colour change was observed at the end point?

From _____ to _____ [2]

(iii) A burette was used to add the sodium carbonate solution to the dilute battery acid. Describe in detail, stating precautions to ensure accuracy, the steps which should be taken to prepare the burette for use in this titration.

_____

_____

_____

_____

_____

_____

_____ [4]

(iv) Calculate the number of moles of sodium carbonate used in this titration.

[2]

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The equation for the reaction is

$$Na_2CO_3 + H_2SO_4 \rightarrow Na_2SO_4 + CO_2 + H_2O$$

(v) Use the equation to calculate the number of moles of sulphuric acid which reacted with the sodium carbonate solution.

[2]

(vi) Calculate the concentration of the sulphuric acid in mol/dm^3.

[2]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

(c) Sodium carbonate may be formed by the thermal decomposition of sodium hydrogen carbonate.
Solid sodium hydrogen carbonate decomposes when heated according to the following equation

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

3.36 g of sodium hydrogen carbonate were placed in a test tube and heated in a Bunsen flame.

(i) Calculate the mass of sodium carbonate formed.
(Relative atomic masses: H = 1; C = 12; O = 16; Na = 23)

[5]

(ii) Calculate the volume of carbon dioxide produced in this reaction.
(1 mole of gas occupies 24 dm^3 at room temperature and pressure)

[3]

THIS IS THE END OF THE QUESTION PAPER

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Rewarding Learning

General Certificate of Secondary Education
2011

Science: Chemistry

Paper 1
Higher Tier

[G1403]

FRIDAY 27 MAY, MORNING

MARK SCHEME

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Guidelines for marking equations

Equations where the stoichiometry is 1 gain [2] maximum

[1] for correct formula of reactant/s
[1] for correct formula of product/s

e.g. $CaO + H_2O \rightarrow Ca(OH)_2$ [2]
[1] [1]

$CaO + \mathbf{2}H_2O \rightarrow Ca(OH)_2$ [1]
[0] [1]

However:
$2CaO + 2H_2O \rightarrow 2Ca(OH)_2$ [2]
[1] [1]

Equations where the stoichiometry is more than 1 gain [3]

[1] for correct formula of reactant/s
[1] for correct formula of product/s
[1] for correct balancing

e.g. $2Na + 2H_2O \rightarrow 2NaOH + H_2$
[1] [1]

+ [1] for balancing = [3]

$2Na + H_2O \rightarrow 2NaOH + H_2$
[1] [1]

No balancing mark = [2]

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AVAILABLE MARKS

1 **(a)** Chlorine [1] 7/VII [1]
Nitrogen [1] 5/V [1] or argon [1] 0/8/VIII [1]
Apply CM for group of incorrect element [4]

(b) **(i)**

Group number	Name of group	Number of electrons in the outer shell of an atom
I	**alkali metals** [1]	**1** [1]
7/VII [1]	the halogens	**7** [1]
8/0/VIII [1]	**noble gases** [1]	8

[6]

(ii) bromine/Br/Br_2 [1]

(c)

Element	Metal	Non-metal	Semi-metal
Sodium	✓ [1]		
Silicon			✓ [1]
Bromine		✓ [1]	
Phosphorus		✓ [1]	

[4]

(d) oxides [1]
basic [1] [2]

(e) **(i)** chlorine/Cl/Cl_2 [1]

(ii) Colour: black [1] State: solid [1] [2]

(iii) Name: astatide [1] Charge: –/–1/1– [1] [2]

(iv) more shells (of electrons) [1]

23

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AVAILABLE MARKS

2 **(a)** **(i)** Label on left = nucleus [1]
Label on right = shell [1] [2]

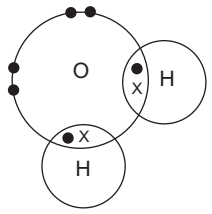
(ii) equal number [1]
of *protons and electrons* [1] [2]

(iii) idea of full outer shell (of electrons) [1]

(iv)

Relative mass	Relative charge	Name of subatomic particle
1 [1]	0	**neutron** [1]
$\frac{1}{1840}$	–1	**electron** [1]
1	**+1** [1]	**proton** [1]

[5]

(b) **(i)** 

[1] for correct sharing of electrons
[1] for 2 H each having 1 electron } depends on the 1st mark
[1] for 1 O having 6 electrons }

[3]

(ii) sharing of electrons [1]
idea of a pair of electrons [1] [2]

(iii) water: molecular/simple [1]
diamond: giant/macromolecular [1] [2]

(iv) strong(er) bonds in diamond [1]
weak(er) bonds **between molecules** in water [1]
lot of energy needed to break the bonds (in diamond) [1]
less/little energy needed to break bonds (in water) [1] [4]

(c) bonds broken in hydrogen and oxygen [1]
energy required to break bonds/bond breaking is endothermic [1]
bonds formed in water [1]
energy released when bonds form/bond making is exothermic [1]
more energy released than required [1] [5]

Example: The energy required to break the bonds [1]
in hydrogen and oxygen [1]
is less than [1]
the energy released when the bonds are formed [1]
in water [1]

Quality of Written Communication [2]

28

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AVAILABLE MARKS

3 **(a)** $2Mg + O_2 \rightarrow 2MgO$ [3]

(b) **(i)** magnesium in boiling tube or suitable container
mineral wool soaked in water
heat
} max [2] for all 3 labels

delivery tube [1] } [1] for connection

collection vessel [1]
collection over water [1] } [2] for collection [5]

(ii) $Mg + H_2O \rightarrow MgO + H_2$ [2]

(iii) (silvery) *grey* [1] metal changes to white [1]
solid/powder/ash [1] white light [1] max [2]

(iv) zinc/aluminium/iron [1]

(c) **(i)** $Mg + 2HCl \rightarrow MgCl_2 + H_2$ [3]

(ii) bubbles/ gas given off [1]
heat released [1]
colourless solution [1]
magnesium disappears [1] max [3]

(d) **(i)** potassium [1] carbonate/hydrogen carbonate [1] [2]
K_2CO_3 or $KHCO_3$(apply CM from name) [1]

(ii) aluminium/Al^{3+}/zinc/Zn^{2+} [1]

(iii) (bubble gas through) limewater [1]
(colourless solution) changes to milky [1] [2]

(iv) cation: Ca^{2+} [1]
anion: I^- [1] [2]

correct ion formula, incorrectly allocated = 1

27

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AVAILABLE MARKS

4 **(a)** **(i)** water which does not lather readily with soap [2]
water which does not lather with soap [1] [2]

(ii) caves/stalactites/stalagmites/limestone pavements
any two [2]

(iii) add soap [1]
shake [1]
no (immediate) lather/scum forms/a lot of soap needed to form a lather/correct comparison [3]

(iv) wastes soap/limescale/furring inside (hot water) pipes [1]

(b) **(i)** calcium nitrate/calcium chloride/calcium sulphate [1]

(ii) good for teeth and bones/tastes better/reduce heart disease/tanning leather [1]

(c) **(i)** washing soda [1]

(ii) idea of solid [1] appearing when two solutions are mixed [1] [2]

(iii) white [1]

(iv) $Ca^{2+} + CO_3^{2-} \quad CaCO_3$ [2]

(v) ion exchange [1] 17

			AVAILABLE MARKS
5	(a) (i)	moles = $\frac{3.71}{106\ [1]}$ = 0.035 [1] [2]	
	(ii)	concentration = $\frac{0.035}{250}$ × 1000 [1] = 0.14 [1] mol/dm^3 [2]	
	(b) (i)	pipette [1]	
	(ii)	colourless [1] to pink [1] (wrong way round award [1]) [2]	
	(iii)	rinse with (deionised) water [1] rinse with sodium carbonate/solution [1] fill with sodium carbonate/solution [1] ensure jet is filled/no air bubbles allow bottom of meniscus to fall to 0/read volume at bottom of meniscus [1] max [4]	
	(iv)	moles = $\frac{31.25 \times 0.16}{1000}$ [1] = 0.005 [1] [2]	
	(v)	mole ratio Na_2CO_3:H_2SO_4 = 1:1 [1] moles of H_2SO_4 = 0.005 [1] [2]	
	(vi)	concentration = $\frac{0.005}{25}$ × 1000 [1] = 0.2 [1] mol/dm^3 [2]	
	(c) (i)	moles $NaHCO_3$ = $\frac{3.36}{84\ [1]}$ = 0.04 [1] moles Na_2CO_3 = $\frac{0.04}{2}$ = 0.02 [1] mass of Na_2CO_3 = 0.02 × 106 [1] = 2.12 [1] g [5]	
	(ii)	moles of CO_2 = 0.02 [1] volume of CO_2 = 0.02 × 24 = 0.48 [1] dm^3 [1] (or 0.02 × 24000 = 480 [1] cm^3 [1]) [3]	25
		Total	**120**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2010

Science: Chemistry

Paper 1
Higher Tier

[G1403]

G1403

WEDNESDAY 26 MAY, MORNING

TIME

1 hour 30 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 five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 120.
Quality of written communication will be assessed in question **5(c)**.
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	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** The modern Periodic Table has been in use for over 100 years. Its development included the work of several chemists including John Newlands and Dmitri Mendeleev.

(i) What name was given to the law developed by John Newlands?

_____[1]

(ii) State **three** features of the Periodic Table developed by Mendeleev which are different from the modern Periodic Table.

1. _____

_____

2. _____

_____

3. _____

_____[3]

(b) The modern Periodic Table is made up of Groups and Periods. What name is given to the following Groups?

Group I _____

Group VII _____[2]

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(c) Often a short form of the Periodic Table like the one shown below is used.

Group	I	II	III	IV	V	VI	VII	0
	H							He
	Li	Be	B	C	N	O	F	Ne
	Na	Mg	Al	Si	P	S	Cl	Ar
	K	Ca	Ga	Ge	As	Se	Br	Kr

Using ONLY the elements in the table above:

(i) Name one noble gas.

_____ [1]

(ii) Name one element which is a liquid at room temperature and pressure.

_____ [1]

(iii) Name one diatomic gas.

_____ [1]

(iv) Name one non-metal which is a solid at room temperature and pressure.

_____ [1]

(v) Name one element which forms a simple ion with a charge of 2–

_____ [1]

(vi) Suggest one reason why hydrogen may be placed in Group I.

_____

_____ [1]

Examiner Only

Marks	Remark

(d) Group III of the Periodic Table contains the elements boron, aluminium and gallium.

Group III
$^{11}_{5}B$
$^{27}_{13}Al$
$^{70}_{31}Ga$

All of these elements form compounds with oxygen and chlorine.

(i) Write the formula of aluminium oxide.

_____ [1]

(ii) Write a balanced symbol equation for the reaction of aluminium with chlorine.

_____ [3]

(iii) In which period of the Periodic Table is gallium found?

_____ [1]

(iv) Suggest why boron would have different physical properties to the other elements of Group III.

_____ [1]

(v) The elements of Group III can form a simple ion with a 3+ charge. Name one other element, apart from those in Group III, which forms an ion with a 3+ charge. You may use your Data Leaflet to help answer this question.

_____ [1]

Examiner Only

Marks	Remark

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

2 Some substances dissolve very well in water and are said to have high solubility.

(a) Explain what is meant by the term solubility.

_____

_____

_____

_____ [4]

(b) To determine the solubility of potassium chloride in water, 20 g of potassium chloride were placed in a beaker.

40 cm^3 of water were added to the beaker and warmed until all the potassium chloride had dissolved.

The beaker was then allowed to cool. The temperature at which crystals first appeared was recorded.

The experiment was repeated five more times adding an extra 5 cm^3 of water each time.

The results obtained are shown in the table below.

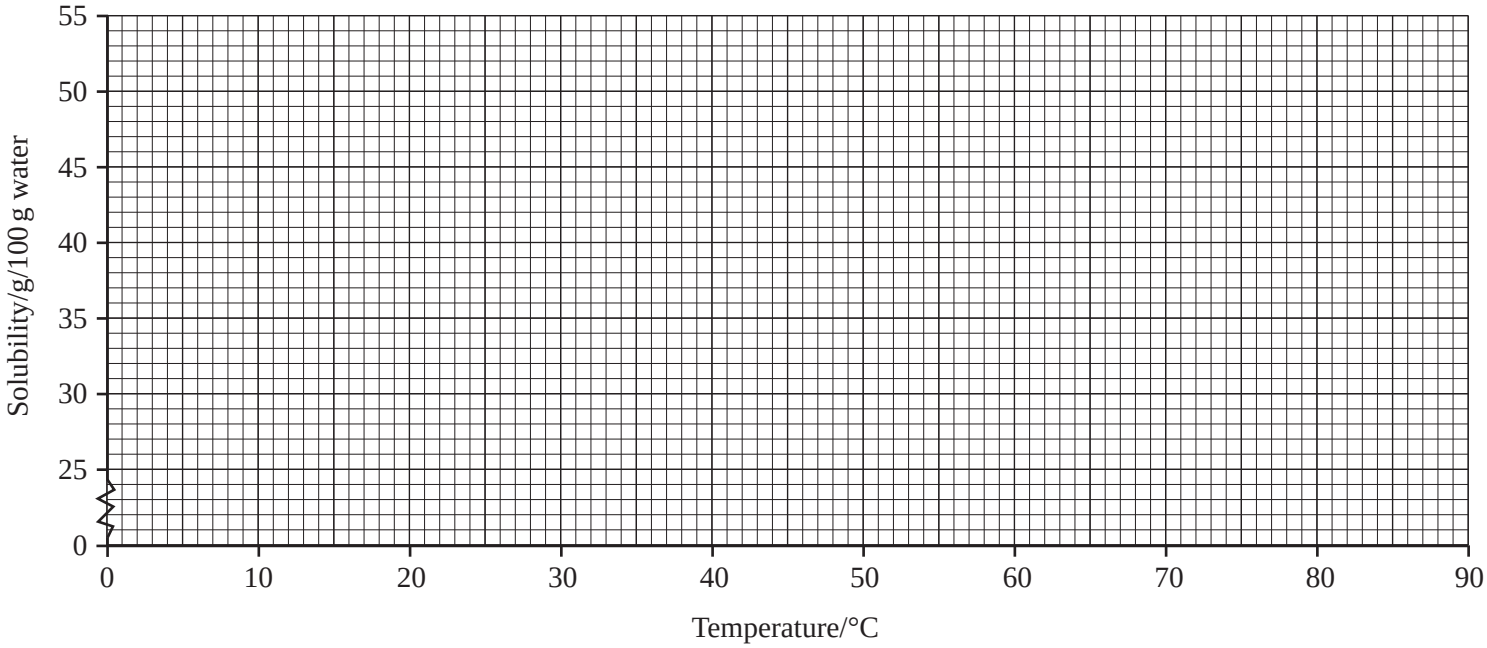
Mass of potassium chloride (g)	Volume of water (cm^3)	Temperature at which crystals first appear (°C)	Solubility (g/100 g water)
20	40	80	50.0
20	45	59	44.4
20	50	41	
20	55	27	36.4
20	60	15	33.3
20	65	5	30.8

(i) Calculate the solubility of potassium chloride at 41 °C and insert the value in the table.

Solubility_____ g/100 g water [1]

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(ii) Use the results table to plot a solubility curve for potassium chloride on the graph provided below.



[4]

(iii) How does the solubility of potassium chloride vary with increasing temperature?

_____ [1]

(iv) Using your graph, determine the solubility of potassium chloride at 10 °C.

_____ [1]

(v) If a saturated solution of potassium chloride containing 50 g of water is cooled from 80 °C to 5 °C, what mass of potassium chloride will crystallise out of solution?

_____ g [3]

Examiner Only	
Marks	Remark

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(c) The solution of potassium chloride was tested for the presence of chloride ions.
Name a suitable reagent that could be used to test for the presence of chloride ions and state the observations for a positive test.

Suitable reagent _____

Observations _____

_____ [3]

(d) Many substances, such as sodium hydroxide and anhydrous calcium chloride interact with moist air.

(i) Describe the observations made when some pellets of sodium hydroxide are left on a watch glass in the laboratory for several days.

_____

_____

_____

_____ [3]

(ii) Explain what you understand by the term anhydrous.

_____

_____ [2]

Examiner Only	
Marks	Remark

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(e) Bottles of sodium hydroxide often have a white crust around their neck. This crust forms when sodium hydroxide reacts with carbon dioxide in the air.



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(i) Write the chemical name of the white crust.

_____ [1]

(ii) Write a balanced symbol equation to show the formation of the white crust.

_____ [3]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

3 Sulphur is a non-metallic element which occurs native in the Earth's crust. It is an important raw material in the chemical industry.

(a) Sulphur undergoes combustion when heated in air.

(i) Write a balanced symbol equation for the combustion of sulphur.

_____ [2]

(ii) Describe what would be observed when sulphur is heated in air.

_____

_____

_____ [3]

(b) Air pollution is caused by the presence of substances which are bad for health. One of the main pollutants in air is sulphur dioxide.

(i) Name one source of sulphur dioxide pollution.

_____ [1]

(ii) Sulphur dioxide reacts with water vapour in the air to form acid rain. Write a balanced symbol equation for this reaction.

_____ [2]

(iii) Acid rain is a weak acid. Suggest the pH value of a sample of acid rain.

_____ [1]

(iv) State two effects of acid rain.

1. _____

_____

2. _____

_____ [2]

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(v) Suggest two ways of preventing the formation of acid rain.

1. _____

_____

2. _____

_____[2]

(c) Sulphur is used in the manufacture of sulphuric acid. The first stage in this process is the combustion of sulphur to form sulphur dioxide. The second stage is the conversion of sulphur dioxide to sulphur trioxide using a catalyst.

(i) Write a balanced symbol equation for the conversion of sulphur dioxide to sulphur trioxide.

_____[3]

(ii) Name the catalyst used in this reaction.

_____[1]

(d) Concentrated sulphuric acid is a dehydrating agent.

(i) Explain the meaning of the term dehydrating agent.

_____

_____[1]

(ii) Describe what you would observe when concentrated sulphuric acid is added to sugar.

_____

_____

_____

_____[3]

Examiner Only	
Marks	Remark

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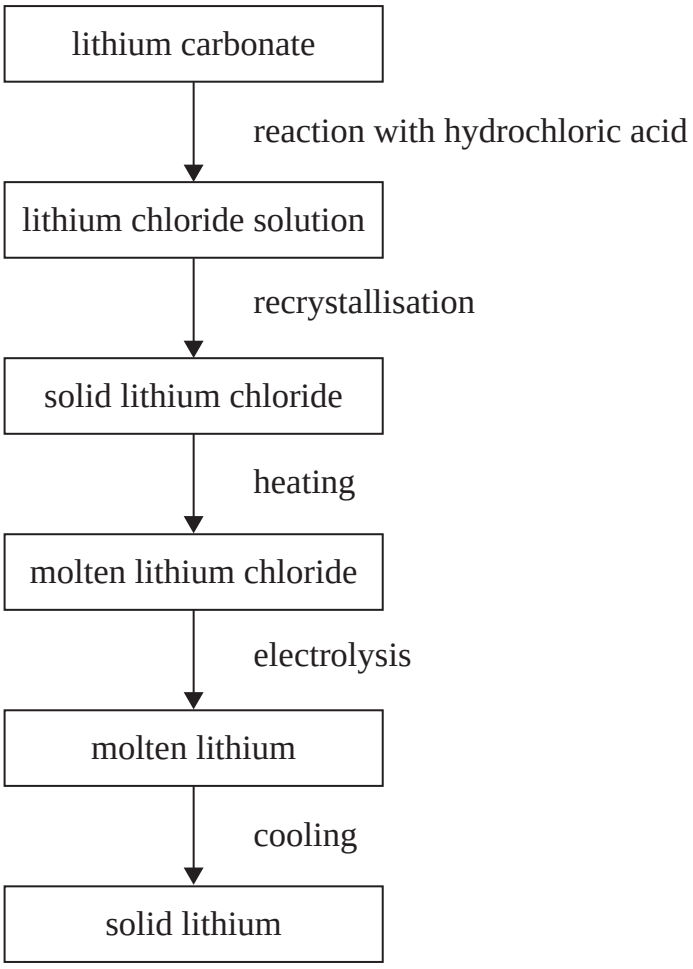
Examiner Only	
Marks	Remark

4 Lithium is a metal which is used in LCD televisions, computer monitors and mobile phones.



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(a) Most lithium is obtained from lithium carbonate. The diagram below shows how solid lithium is produced from lithium carbonate.



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(i) Write a balanced symbol equation for the reaction of lithium carbonate with hydrochloric acid.

_____[3]

(ii) Explain what is meant by the term electrolysis.

_____

_____[2]

(b) Complete the table below by placing a tick (✓) to indicate if the substance conducts electricity or does not conduct electricity. Place only one tick for each substance.

Substance	Conducts electricity	Does not conduct electricity
solid lithium		
molten lithium		
solid lithium chloride		
lithium chloride solution		

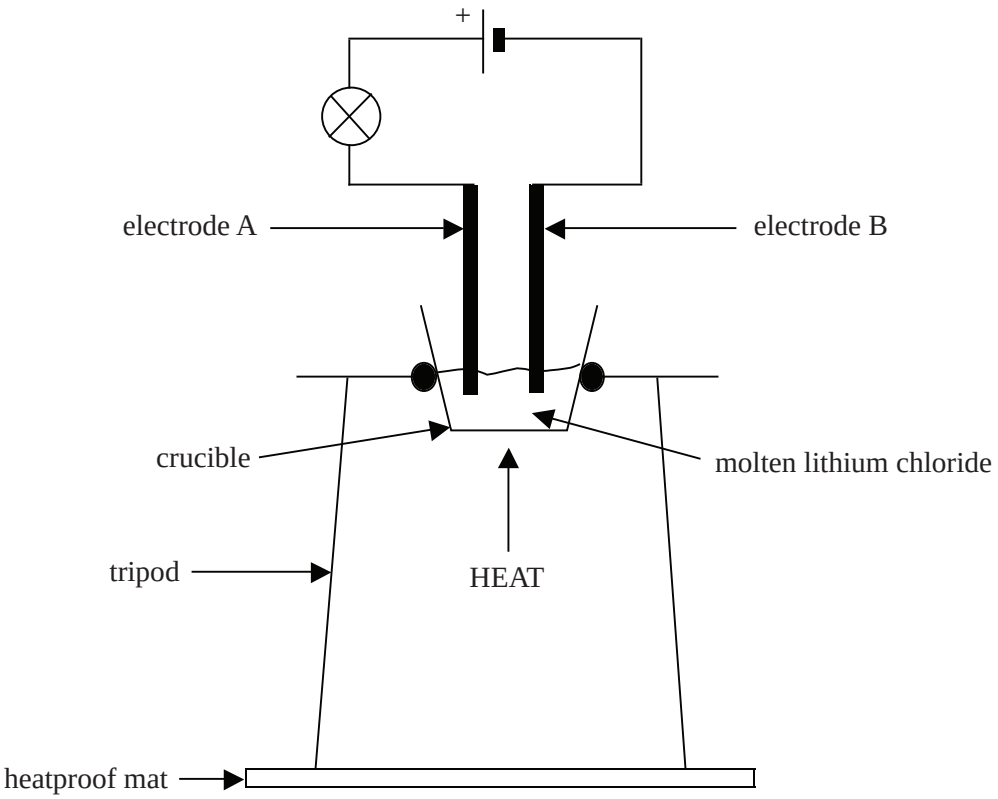
[4]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(c) The electrolysis of molten lithium chloride may be carried out using the apparatus shown below. Molten lithium chloride is the electrolyte.



(i) What is meant by the term electrolyte?

_____

_____

_____ [3]

(ii) Name electrode A and electrode B.

Electrode A _____

Electrode B _____ [2]

(iii) What material is used to make the electrodes?

_____ [1]

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(iv) State one reason why this material is chosen to make the electrodes.

_____[1]

(v) At which electrode, A or B, is lithium produced?

_____[1]

(vi) What would you observe at the other electrode?

_____

_____[2]

(vii) Write half equations for the reactions which are occurring at each electrode.

Electrode A _____[3]

Electrode B _____[2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

5 Ethene is a very important and versatile organic compound.

(a) (i) Name the homologous series to which ethene belongs.

_____[1]

(ii) Complete the table below giving the molecular formula, structural formula and physical state of ethene at room temperature and pressure.

Molecular formula of ethene	
Structural formula of ethene	
Physical state of ethene at room temperature and pressure	

[3]

(iii) Ethene is described as an unsaturated molecule. Explain what is meant by the term unsaturated.

_____

_____[1]

(b) One use of ethene in industry is in the manufacture of ethanol.

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

_____[2]

(ii) Draw the full structural formula of ethanol, showing all bonds.

[2]

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(c) The ethanol present in alcoholic drinks is made by fermentation. Describe in detail how ethanol is produced by fermentation. Include:

- names of the reactants
- names of the products (other than ethanol)
- necessary conditions

_____

_____

_____

_____

_____

_____ [5]

Quality of written communication [2]

(d) Wine and other alcoholic drinks are often used in cooking during which the ethanol may undergo combustion.

(i) Write a balanced symbol equation for the complete combustion of ethanol.

_____ [3]

(ii) What colour is the flame when ethanol burns?

_____ [1]

Examiner Only

Marks	Remark

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(e) If a bottle of wine is left open to the atmosphere for a number of days it is oxidised by oxygen in the air and a solution of ethanoic acid forms.

(i) Explain what you understand by the term oxidation.

_____

_____[2]

(ii) Draw the full structural formula of ethanoic acid showing all bonds.

[2]

(iii) A solution of ethanoic acid is widely used as a food flavouring. By what name is this solution more commonly known?

_____[1]

(f) Ethanoic acid reacts as a typical dilute acid.

(i) State what you would observe when a strip of magnesium metal is dropped into a solution of ethanoic acid.

_____

_____

_____[2]

(ii) Write a balanced symbol equation for the reaction between magnesium metal and ethanoic acid.

_____[3]

Examiner Only	
Marks	Remark

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THIS IS THE END OF THE QUESTION PAPER

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1847-030-1

GCSE

Science: Chemistry

Summer 2010

Mark Schemes

Issued: October 2010

Rewarding Learning

General Certificate of Secondary Education
2010

Science: Chemistry

Paper 1
Higher Tier

[G1403]

WEDNESDAY 26 MAY, MORNING

MARK SCHEME

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					AVAILABLE MARKS
1	**(a)**	**(i)**	(law of) octaves	[1]	
		(ii)	**any three from** no noble gases/fewer groups gaps (for undiscovered elements) order of atomic mass no mass number no atomic number some elements in different position no lanthanides/no actinides/no f-block less elements no **block** of transition metals/no d-block	[3]	
	(b)		alkali metals [1] halogens [1]	[2]	
	(c)	**(i)**	helium/neon/argon/krypton	[1]	
		(ii)	bromine	[1]	
		(iii)	hydrogen/nitrogen/oxygen/fluorine/chlorine	[1]	
		(iv)	boron/carbon/silicon/phosphorus/sulphur/arsenic/selenium	[1]	
		(v)	oxygen/sulphur/selenium	[1]	
		(vi)	forms H^+ ion/valency = 1/forms HX with halogens/1 e^- in outer shell	[1]	
	(d)	**(i)**	Al_2O_3	[1]	
		(ii)	$2Al + 3Cl_2 \rightarrow 2AlCl_3$	[3]	
		(iii)	4	[1]	
		(iv)	it is a non-metal	[1]	
		(v)	iron/chromium/vanadium/scandium	[1]	19

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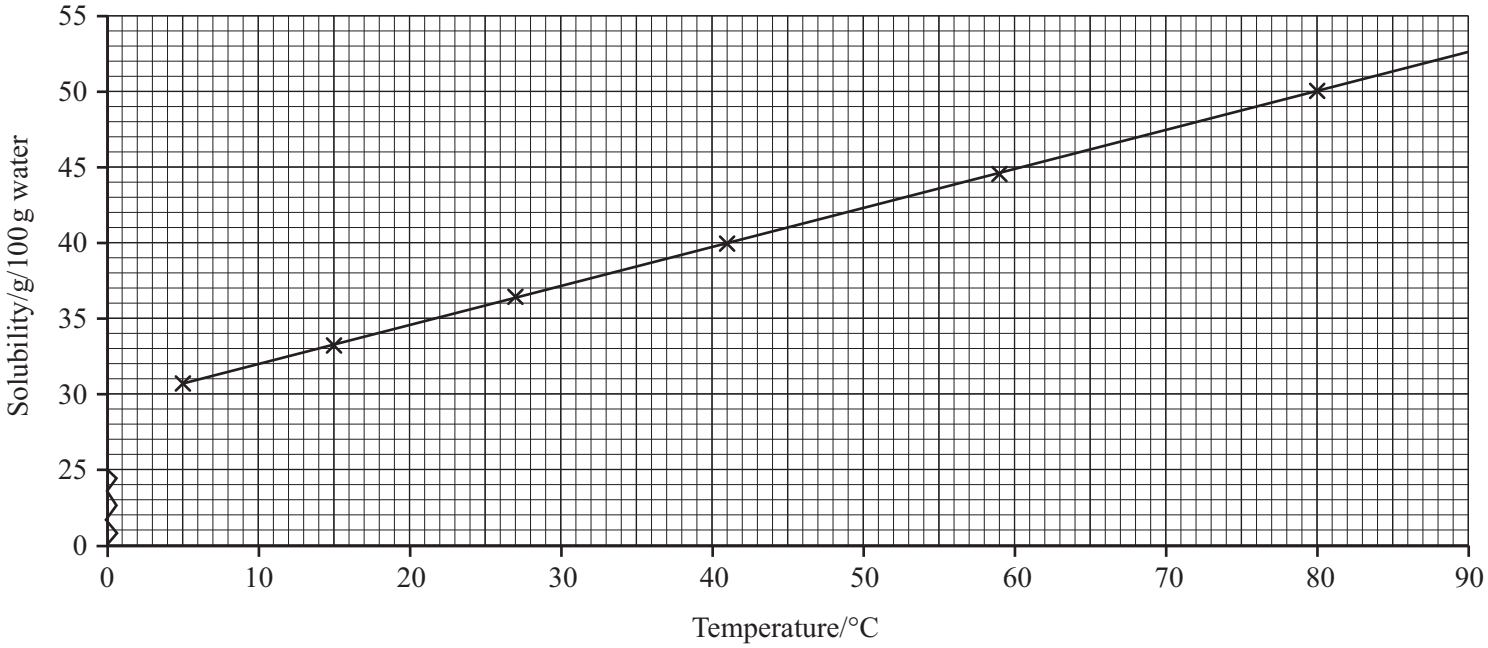
AVAILABLE MARKS

2 **(a)** mass [1] of substance
that (dissolves in and) saturates [1]
<u>100 g of water</u> [1]
at a particular temperature [1]
or
maximum [1] mass [1] of a substance that
dissolves in <u>100 g of water</u> [1] at a
particular temperature [1] [4]

(b) **(i)** $20 \times 2 = 40$ [1] g/100 g water [1]

(ii) 4 or 5 correct plots [3]
2 or 3 correct plots [2]
1 correct plot [1]

straight line [1]



[4]

(iii) increases [1]

(iv) 32 ± 1 [1]

(v) 50 – 30.8 = 19.2 g [1] subtraction = [1]; division by 2 = [1]
19.2 ÷ 2 [1] = 9.6 g [1] answer = [1] [3]

(c) silver nitrate [1]
precipitate [1]
white [1] only award white if **one** of first two present [3]

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				AVAILABLE MARKS
	(d)	**(i)**	white pellets/solid/substance [1] colourless [1] solution/liquid [1] forms white crust/flakes/powder [1] max [3]	
		(ii)	contains no water [1] contains no water of crystallisation [2] max [2]	
	(e)	**(i)**	sodium carbonate [1]	
		(ii)	$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$ [3]	26
3	**(a)**	**(i)**	$S + O_2 \rightarrow SO_2$ [2]	
		(ii)	yellow [1] solid [1] melts/liquid formed [1] dark red/brown [1] blue [1] flame [1] more viscous [1] colourless/misty [1] pungent/bad smell [1] gas [1] max [3]	
	(b)	**(i)**	fossil fuels burning/vehicle exhausts/power stations/volcanic gases/ burning rubber tyres [1]	
		(ii)	$SO_2 + H_2O \rightarrow H_2SO_3$ [2]	
		(iii)	3–6 [1]	
		(iv)	corrodes limestone statues and buildings [1] kills fish (in rivers and lakes)/acidifies waterways [1] defoliates trees/damages vegetation [1] max [2]	
		(v)	remove sulphur from fuels before use [1] treat emissions from power stations and factories [1] burning less fossil fuels/use renewable fuels/use alternative energy sources [1] catalytic converters [1] max [2]	
	(c)	**(i)**	$2SO_2 + O_2 \rightarrow 2SO_3$ [3]	
		(ii)	vanadium(V) oxide/vanadium pentoxide [1]	
	(d)	**(i)**	removes water [1]	
		(ii)	white [1] solid swells/rises [1] in the container reaction is not immediate [1] heat is released [1] distinct caramel smell [1] pungent odour [1] black [1] solid remains hissing sound [1] porous solid/gas/vapour [1] max [3]	21

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AVAILABLE MARKS

4 **(a)** **(i)** $Li_2CO_3 + 2HCl \rightarrow 2LiCl + CO_2 + H_2O$ [3]

(ii) decomposition [1]
using (a direct current of) electricity [1] [2]

(b)

Substance	Conducts electricity	Does not conduct electricity
solid lithium	✓ [1]	
molten lithium	✓ [1]	
solid lithium chloride		✓ [1]
lithium chloride solution	✓ [1]	

[4]

(c) **(i)** liquid [1]
which conducts electricity [1]
and is decomposed by it [1] [3]

(ii) A = anode [1]
B = cathode [1] [2]

(iii) graphite/carbon/platinum/titanium [1]

(iv) unreactive/(good) conductor of electricity [1]

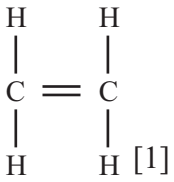
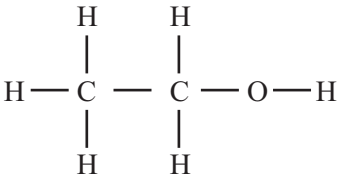
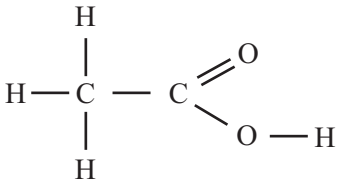
(v) B/cathode [1]

(vi) yellow-green [1]
pungent [1]
gas/bubbles [1] max [2]

(vii) electrode A $2Cl^- \rightarrow Cl_2 + 2e^-$ or $2Cl^- - 2e^- \rightarrow Cl_2$ [3]

electrode B $Li^+ + e^- \rightarrow Li$ [2] 24

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				AVAILABLE MARKS
5	**(a)**	**(i)**	alkenes [1]	
		(ii)	C_2H_4 [1]	
			 [1]	
			gas [1] [3]	
		(iii)	contains one or more C ═ C bonds [1]	
	(b)	**(i)**	$C_2H_4 + H_2O \rightarrow C_2H_5OH$ [2]	
		(ii)	 [2] [1] if — OH [2]	
	(c)		*Sugar/starch [1] solution mixed with yeast [1] warm [1] conditions *essential absence of oxygen [1] *carbon dioxide [1] [5]	
			Quality of written communication [2]	
	(d)	**(i)**	$C_2H_5OH + 3O_2 \rightarrow 2CO_2 + 3H_2O$ [3]	
		(ii)	blue [1]	
	(e)	**(i)**	addition [1] of oxygen [1] (**or** loss [1] of electrons [1] **or** loss [1] of hydrogen [1]) [2]	
		(ii)	 [2] [1] if —OH [2]	
		(iii)	vinegar [1]	
	(f)	**(i)**	bubbles/fizzing/gas produced [1] heat given out [1] metal disappears [1] colourless solution forms [1] max [2]	
		(ii)	$2CH_3COOH + Mg \rightarrow (CH_3COO)_2Mg + H_2$ [3]	30
			Total	**120**

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Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2009

Science: Chemistry

Paper 1
Higher Tier

[G1403]

G1403

THURSDAY 4 JUNE, MORNING

TIME

1 hour 30 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 five** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 120.
Quality of written communication will be assessed in question **4(d)(iii)**.
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	
Total Marks	

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Marks	Remark

1 **(a)** All playstations and games consoles contain a microchip made from the **element** silicon which has the symbol Si and **atomic number** 14.



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(i) What is meant by the term **element**?

_____

_____ [2]

(ii) What is meant by the term **atomic number**?

_____ [1]

(b) An atom of silicon contains protons, electrons and neutrons. Complete the table below to show the relative mass and relative charge of each particle.

Particle	Relative mass	Relative charge
proton		
electron		
neutron		

[3]

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(c) Silicon has 3 stable **isotopes**, ^{28}Si, ^{29}Si and ^{30}Si.

(i) Complete the table below to give the number of protons, electrons and neutrons present in one atom of each of the isotopes of silicon.

Isotope	Number of protons	Number of electrons	Number of neutrons
^{28}Si			
^{29}Si			
^{30}Si			

[3]

(ii) Explain what you understand by the term **isotope**.

_____

_____ [2]

(d) Silicon is rarely found in nature in its uncombined form, but is found as silicon dioxide (quartz) or in minerals called silicates, many of which contain the silicate(IV) ion.

(i) Complete the table to give information about silicon dioxide, SiO_2 (quartz).

Type of bonding present in silicon dioxide	
Type of structure of silicon dioxide	

[2]

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(ii) Given that the formula of the silicate(IV) ion is SiO_4^{4-}, write the formula of sodium silicate.

_____ [1]

(iii) The structure of sodium silicate is a giant ionic lattice.
State **two** physical properties of sodium silicate.

1. _____

2. _____ [2]

(e) Very pure silicon is needed to make microchips. One method originally used to produce pure silicon involved reacting silicon tetrachloride, $SiCl_4$, with metallic zinc at 950 °C. The word equation for this reaction is:

silicon tetrachloride + zinc → silicon + zinc chloride

(i) Write a balanced symbol equation for this reaction.

_____ [3]

(ii) Describe the structure and bonding in zinc metal. You may use a labelled diagram to help answer this question.

_____

_____

_____ [3]

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Marks	Remark

(f) Another method of producing silicon in industry is by the reaction of silicon dioxide with charcoal in an electric arc furnace.

$$SiO_2 + C \rightarrow Si + CO_2$$

The carbon reduces the silicon dioxide. The reaction is exothermic.

(i) Explain in terms of **bond breaking and bond making** why this reaction is exothermic.

_____

_____

_____

_____

_____

_____

_____

_____

_____ [5]

(ii) Explain why SiO_2 is described as being reduced in this reaction.

_____

_____

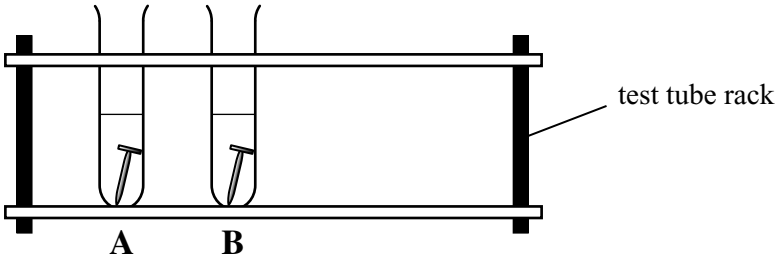
_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

2 **(a)** Two iron nails were placed in separate test tubes containing water. The nail in test tube **A** was galvanised, but the nail in test tube **B** was not. After a few days, the nail in test tube **B** had rusted.



(i) State **one** observation which would indicate that rusting is a chemical reaction.

_____

_____ [1]

(ii) What material is used to galvanise iron?

_____ [1]

(iii) State **two** other methods which could be used to prevent iron from rusting.

1. _____ [1]

2. _____ [1]

(iv) The chemical name for rust is hydrated iron(III) oxide. What is meant by the term **hydrated**?

_____

_____ [1]

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(b) Many chemical rust removers contain acids such as sulphuric acid. The rust is removed in a chemical reaction.

A rusty iron nail is placed in a solution of sulphuric acid for a few days. The rust disappears and the solution changes colour.

(i) Write a balanced symbol equation for the reaction of iron(III) oxide with sulphuric acid.

_____ [3]

(ii) The nail was removed from the solution and a few drops of aqueous ammonia solution were added to the remaining solution. What would you observe?

_____ [2]

(c) Copper metal is used for roofing. Copper reacts over time forming copper(II) oxide which reacts further with carbon dioxide in the air to form copper(II) carbonate. Acids will react with copper(II) carbonate.

(i) Write a balanced symbol equation for the reaction of copper with oxygen in the air forming copper(II) oxide.

_____ [3]

(ii) Write a balanced symbol equation for the reaction of copper(II) oxide with carbon dioxide forming copper(II) carbonate.

_____ [2]

(iii) State the colours of:

copper _____

copper(II) oxide _____

copper(II) carbonate _____ [3]

(iv) Name the acid which reacts with copper(II) carbonate to form a solution of copper(II) sulphate.

_____ [1]

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Marks	Remark

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(d) Magnesium reacts with copper(II) sulphate solution according to the equation

$$Mg + CuSO_4 \rightarrow MgSO_4 + Cu$$

The reaction may be described as a redox reaction.

Explain in terms of electrons why this reaction may be described as a redox reaction. You may use ionic equations to help answer this question.

_____

_____

_____

_____

_____

_____

_____ [7]

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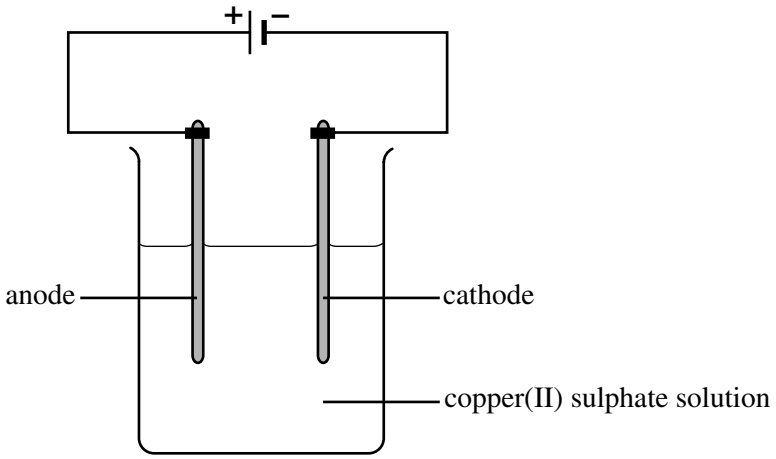
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Marks	Remark

3 **(a)** The diagram below shows the apparatus used to carry out the electrolysis of copper(II) sulphate solution. Graphite electrodes are used.



(i) What is meant by the term **electrolysis**?

_____

_____

_____ [2]

(ii) During the electrolysis of copper(II) sulphate solution, the ions present in the solution are attracted to the electrodes where they may be discharged.

The table below gives some of the details of the ions and the electrode to which they are attracted. Complete the table.

You may find your Data Leaflet useful in answering this question.

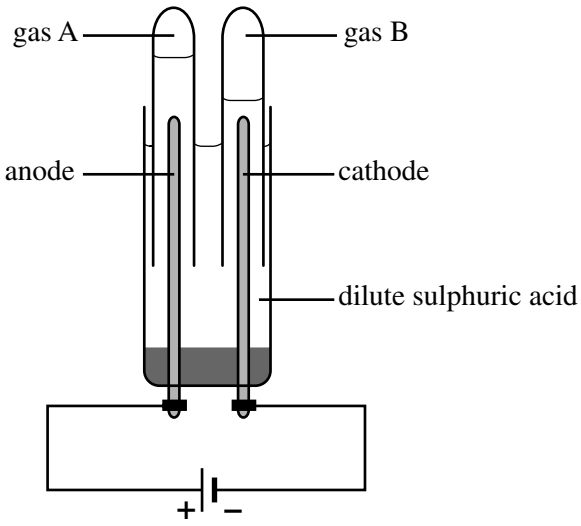
Name of ion	**Formula of ion (including charge)**	**Attracted to positive electrode**	**Attracted to negative electrode**
Copper(II)		✗	✓
	SO_4^{2-}		
	H^+		
Hydroxide		✓	✗

[6]

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Marks	Remark

(b) The apparatus shown below is used to carry out the electrolysis of dilute sulphuric acid using platinum electrodes.



(i) Name gases A and B.

Gas A _____

Gas B _____ [2]

(ii) Write half equations for the reactions occurring at the anode and the cathode during the electrolysis of dilute sulphuric acid.

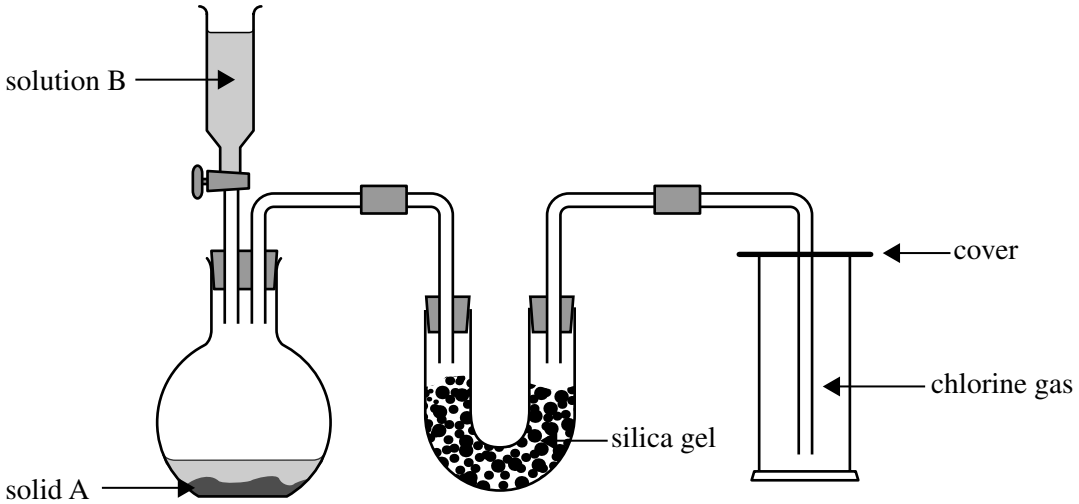
Anode _____ [3]

Cathode _____ [3]

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4 In the laboratory, gases are made from the reaction between a solid and a solution. Two such gases are chlorine and hydrogen chloride.

(a) The diagram below shows apparatus used to prepare chlorine gas in the laboratory.



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Marks	Remark

(i) Name solid A and solution B.

Solid A _____ [1]

Solution B _____ [2]

(ii) Suggest the purpose of the silica gel.

_____ [1]

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(b) Chlorine gas reacts with hydrogen gas to form hydrogen chloride.

(i) Write a balanced symbol equation for the reaction between chlorine gas and hydrogen gas.

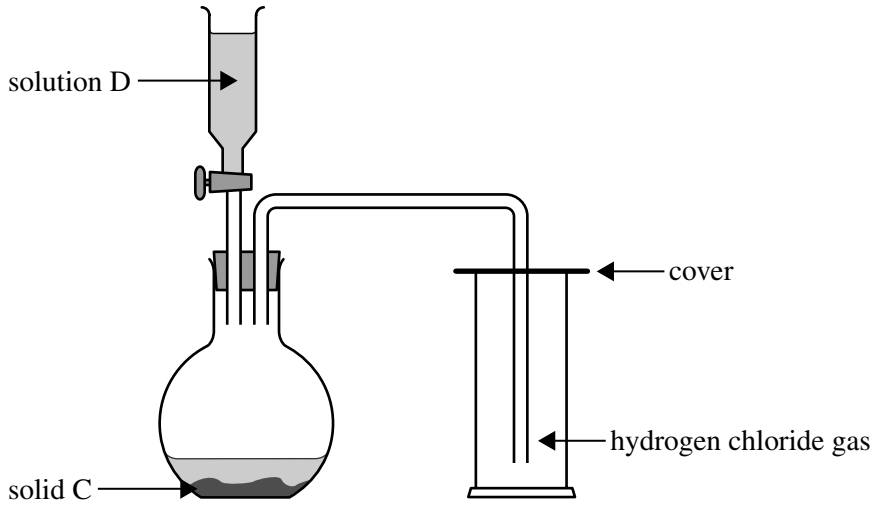
_____ [3]

(ii) Suggest **two** safety measures which should be taken when carrying out the reaction.

1. _____

2. _____ [2]

(c) The diagram below shows the apparatus commonly used to produce hydrogen chloride gas in the laboratory.



(i) Name solid C and solution D.

Solid C _____ [1]

Solution D _____ [2]

(ii) Describe what would be observed during the reaction.

_____

_____ [2]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

(d) In industry, ammonia gas is made from the reaction between nitrogen gas and hydrogen gas in the Haber Process.

(i) Write a balanced symbol equation for the production of ammonia gas in the Haber Process.

_____ [3]

(ii) Complete the table below, giving the operating conditions used in the Haber Process.

Name of catalyst	
Temperature (°C)	
Pressure (atm)	

[3]

(iii) Describe a chemical test for ammonia gas and state the result for a positive test.

_____

_____

_____

_____

_____ [4]

Quality of written communication [2]

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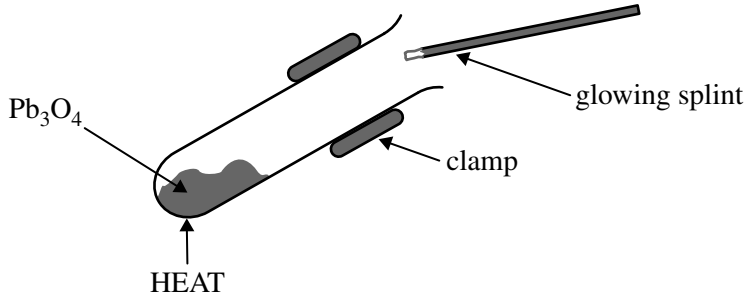
Examiner Only	
Marks	Remark

5 Oxides and hydroxides of metals are solids at room temperature and pressure. Many oxides of non-metals are gases.

(a) 2.74 g of a sample of solid oxide of lead, Pb_3O_4, decomposes when heated according to the equation below.

$$2Pb_3O_4(s) \rightarrow 6PbO(s) + O_2(g)$$

The decomposition is carried out in a fume cupboard using the apparatus shown below.



Adapted from: http://www.practicalchemistry.org/data/images/originals/heatingsolidstesttubes-76.jpg

(i) What would happen to the glowing splint?

_____ [1]

(ii) Calculate the mass of PbO which would be formed on heating 2.74 g of Pb_3O_4 to constant mass.
(Relative atomic masses: O = 16; Pb = 207)

[5]

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(iii) Calculate the volume of oxygen gas which would be produced by heating this sample to constant mass.
(1 mole of any gas occupies a volume of 24 000 cm^3)

Volume of oxygen gas = _____ cm^3 [2]

(b) Sulphur dioxide is an oxide of the non-metal sulphur. It can be produced in the reaction of sodium thiosulphate, $Na_2S_2O_3$, with hydrochloric acid, HCl.

$$Na_2S_2O_3 + 2HCl \rightarrow 2NaCl + S + SO_2 + H_2O$$

A solution of sodium thiosulphate is prepared by dissolving 5.53 g of $Na_2S_2O_3$ in deionised water. The hydrochloric acid has a concentration of 2 mol/dm^3 (moles per litre).

(i) Calculate the number of moles of sodium thiosulphate used.
(Relative atomic masses: Na = 23, S = 32, O = 16)

[2]

(ii) Calculate the number of moles of hydrochloric acid required to react with this number of moles of sodium thiosulphate in **(b)(i)**.

[2]

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Marks	Remark

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(iii) Calculate the volume of hydrochloric acid required to react completely with the sodium thiosulphate solution.

[2]

(c) An **insoluble unknown** metal hydroxide can be written $M(OH)_2$ where M represents the metal M.

3.0 g of solid $M(OH)_2$ is added to 50.0 cm^3 of 1 mol/dm^3 (moles per litre) hydrochloric acid with stirring. Some solid $M(OH)_2$ is observed lying at the bottom.

The solution is filtered and the residue washed with some water and dried. The mass of unreacted $M(OH)_2$ is 0.55 g.

(i) What mass of $M(OH)_2$ reacted with the hydrochloric acid?

_____ [1]

(ii) Calculate the number of moles of hydrochloric acid used.

[2]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(iii) Using the balanced symbol equation

$$M(OH)_2 + 2HCl \rightarrow MCl_2 + 2H_2O$$

Calculate the number of moles of $M(OH)_2$ required to react with the hydrochloric acid.

[2]

(iv) Using the answers to **(c)(i)** and **(c)(iii)** above, calculate the Relative Formula Mass (RFM) of $M(OH)_2$.

[2]

(v) Determine the Relative Atomic Mass (RAM) of M and identify it using your Periodic Table.

RAM of M _____

_____

Identity of M _____ [2]

THIS IS THE END OF THE QUESTION PAPER

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GCSE

Science: Chemistry

Summer 2009

Mark Schemes

Issued: October 2009

Rewarding Learning

General Certificate of Secondary Education
2009

Science: Chemistry

Paper 1
Higher Tier

[G1403]

THURSDAY 4 JUNE, MORNING

MARK SCHEME

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AVAILABLE MARKS

1 **(a)** **(i)** substance which consists of one type of atom [2]
or substance which cannot be broken down
(into anything simpler) [1]
by chemical means [1]

[2]

(ii) number of protons in an atom [1] [1]

(b)

Particle	Relative mass	Relative charge
proton	1	+1
electron	$\frac{1}{1840}$ accept range $\frac{1}{1800} \rightarrow \frac{1}{2000}$ or approximately zero **do NOT accept zero**	–1
neutron	1	0

[1] for each correct row [3]

(c) **(i)**

	Number of protons	Number of electrons	Number of neutrons
^{28}Si	14	14	14
^{29}Si	14	14	15
^{30}Si	14	14	16

[1] each row [3]

(ii) atoms of same element/with same atomic number/same number of protons [1]
different number of neutrons/different mass number [1] [2]

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AVAILABLE MARKS

(d) (i)

Type of bonding present in silicon dioxide	covalent [1]
Type of structure in silicon dioxide	giant/macromolecular [1]

[2]

(ii) Na_4SiO_4 [1]

(iii) high mpt/bpt/solid [1]
conducts electrity when molten/dissolved/does not conduct electricity when solid [1]
soluble in water [1]
brittle/easily cleaved [1] **max** [2]

(e) (i) $SiCl_4 + 2Zn \rightarrow Si + 2ZnCl_2$
[1] reactants [1] products [1] balancing [3]

(ii) regular arrangement [1]
of positive ions [1] **or** accept positive ions in diagram
surrounded by a sea of delocalised electrons [1] **or** accept electrons in diagram
the attraction between positive ions and electrons is the metallic bond [1]
any three [3]

(f) (i) energy released when bonds are made/band making is exothermic [1]
$Si/CO_2/Si$ and CO_2 [1]
is greater [1] than
energy required when bonds are broken/bond breaking is endothermic [1]
$C/SiO_2/C$ and SiO_2 [1]
accept heat = energy [5]

(ii) silicon dioxide loses oxygen [1]
loss of oxygen is reduction [1] [2]

29

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					AVAILABLE MARKS
2	**(a)**	**(i)**	colour change/reddish-brown (solid) forms	[1]	
		(ii)	zinc/Zn	[1]	
		(iii)	greasing/oiling/sacrificial protection/painting/suitable metal plating/plastic coating **any two**	[1] [1]	
		(iv)	contains water of crystallisation	[1]	
	(b)	**(i)**	$Fe_2O_3 + 3H_2SO_4 \rightarrow Fe_2(SO_4)_3 + 3H_2O$ [1] reactants [1] products [1] balancing	[3]	
		(ii)	red-brown [1] ppt [1]	[2]	
	(c)	**(i)**	$2Cu + O_2 \rightarrow 2CuO$ [1] reactants [1] products [1] balancing	[3]	
		(ii)	$CuO + CO_2 \rightarrow CuCO_3$ [1] reactants [1] products	[2]	
		(iii)	red-pink/red-brown [1] black [1] green [1]	[3]	
		(iv)	sulphuric acid	[1]	
	(d)		magnesium [1] loses electrons [1] **or** $Mg \rightarrow Mg^{2+} + 2e^-$ [2]/$Mg - 2e^- \rightarrow Mg^{2+}$ [2] oxidation is loss of electrons/magnesium is oxidised [1] copper ions [1] gain electrons [1] **or** $Cu^{2+} + 2e^- \rightarrow Cu$ [2] reduction is gain of electrons/copper ions reduced [1] oxidation and reduction both occurring in same reaction [1]	[7]	26

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AVAILABLE MARKS

3 **(a)** **(i)** decomposition/breakdown [1]
using electricity [1] [2]

(ii)

Name of ion	Formula of ion (including charge)	Attracted to positive electrode	Attracted to negative electrode
	Cu^{2+} [1]		
sulphate [1]		✓ [1]	–
hydrogen [1]		–	✓ [1]
	OH^- [1]		

[6]

(b) **(i)** Gas A is oxygen [1]
Gas B is hydrogen [1] [2]

(ii) Anode: $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$ [3]
or $4OH^- - 4e^- \rightarrow 2H_2O + O_2$

Cathode: $2H^+ + 2e^- \rightarrow H_2$ [3] 16

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AVAILABLE MARKS

4 **(a)** **(i)** solid A – potassium permanganate/manganese(IV) oxide [1]
solution B – concentrated [1] hydrochloric acid [1] [3]

(ii) dry the gas/remove moisture/remove water [1]

(b) **(i)** $H_2 + Cl_2 \rightarrow 2HCl$
[1] reactants [1] products [1] balancing [3]

(ii) safety glasses/fume cupboard/carry out in dark
any two [2]

(c) **(i)** solid C – sodium chloride/NaCl [1]
solution D – concentrated [1] sulphuric acid [1] [3]

(ii) bubbles/fizzing [1]
heat given off [1]
misty fumes [1]
immediate reaction [1]
solid disappears [1]
any two [2]

(d) **(i)** $N_2 + 3H_2 \rightarrow 2NH_3$ [3]

(ii)

Name of catalyst	Iron [1]
Temperature (°C)	450 °C (200–450 °C) [1]
Pressure (atm)	350 atm (200–1000 atm) [1]

[3]

(iii) glass rod [1] accept sensible method of application
dipped in concentrated [1] hydrochloric acid [1]
white [1] smoke [1] **max** [4]

Quality of written communication [2] 26

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					AVAILABLE MARKS
5	(a)	(i)	relights	[1]	
		(ii)	number of moles of $Pb_3O_4 = \frac{2.74}{685[1]} = 0.004$ [1] ratio Pb_3O_4:PbO = 2:6/moles of PbO = 0.004 × 3 = 0.012 [1] mass of PbO = 0.012 × 223 [1] = 2.676 [1] g	[5]	
		(iii)	ratio $Pb_3O_4:O_2$ = 2:1/moles of $O_2 = \frac{0.004}{2} = 0.002$ [1] volume of O_2 = 0.002 × 24 000 = 48 [1] cm^3	[2]	
	(b)	(i)	moles of $Na_2S_2O_3 = \frac{5.53}{158[1]} = 0.035$ [1]	[2]	
		(ii)	ratio $Na_2S_2O_3$:HCl = 1:2/moles of HCl = 0.035 × 2 [1] = 0.07 [1]	[2]	
		(iii)	volume of HCl = $\frac{0.07 \times 1000}{2}$ [1] = 35 [1] cm^3	[2]	
	(c)	(i)	3–0.55 = 2.45 [1] g	[1]	
		(ii)	moles of HCl = $\frac{50 \times 1}{1000}$ [1] = 0.05 [1]	[2]	
		(iii)	ratio HCl:$M(OH)_2$ = 2:1/moles of $M(OH)_2 = \frac{0.05}{2}$ [1] = 0.025 [1]	[2]	
		(iv)	RFM = $\frac{2.45}{0.025}$ [1] = 98 [1]	[2]	
		(v)	RAM of M = 98 – 34 = 64 [1] Identity of M = Cu [1]	[2]	23
				Total	**120**

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