CCEA GCSE DOUBLE AWARD SCIENCE

SCIENCE



EXAM QUESTION PACK

CHEMISTRY UNIT C1 HIGHER TIER GSD22 PAPERS

STEMUP

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2016–2017

Double Award Science: Chemistry

GSD22

Unit C1
Higher Tier

[GSD22]

THURSDAY 10 NOVEMBER 2016, MORNING

TIME

1 hour.

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 seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **3(d)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	

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1 Six particles are listed below.

Examiner Only	
Marks	Remark

Br_2 SO_2 He Mg^{2+} NH_4^+ Cl^-

From the list of particles above give an example of:

(a) an atom

_____ [1]

(b) a compound

_____ [1]

(c) a molecular ion

_____ [1]

(d) a halogen molecule

_____ [1]

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2 The table below gives information on the solubility of some gases at different temperatures.

Gas	Formula	Solubility at 10 °C g/100 g water	Solubility at 20 °C g/100 g water
argon	Ar	0.79	0.59
nitrogen	N_2	0.28	0.18
carbon dioxide	CO_2	0.25	0.17
oxygen	O_2	0.57	0.44
chlorine	Cl_2	1.00	0.71

Use the information in the table and your own knowledge to answer the questions that follow:

(a) (i) Describe the trend in solubility for these gases as the temperature increases.

_____

_____ [1]

(ii) Which gas is the most soluble at 20 °C?

_____ [1]

(iii) Which gas is the least soluble at 10 °C?

_____ [1]

(iv) Which gas had the smallest change in its solubility as the temperature increased?

_____ [1]

(v) List the gases in the table which are diatomic.

_____ [2]

(vi) Which gas, listed in the table, is toxic?

_____ [1]

Examiner Only

Marks | Remark

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Examiner Only	
Marks	Remark

(b) Warm water from a factory was discharged into a local river. There were reports of fish dying.

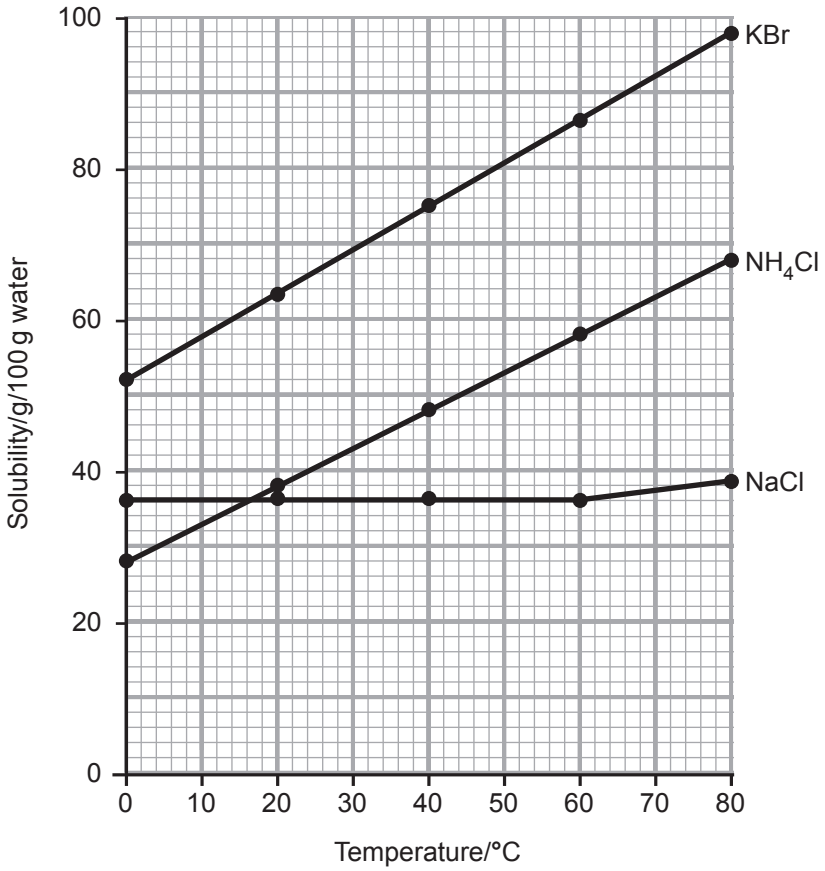
Complete the sentences by adding the missing words:

(i) This can be described as _____ pollution. [1]

(ii) The fish die because they do not have

enough _____. [1]

(c) The graphs below show the solubility curves for three solids.



Two of these graphs show the normal trend for the solubility of solids.

(i) What is this trend?

_____

_____ [1]

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(ii) What mass of potassium bromide (KBr) is dissolved in a saturated solution, in 100 g water, at 35 °C?

_____ g [1]

(iii) A saturated solution of potassium bromide (KBr) in 50 g water is cooled from 35 °C to 14 °C.
Calculate the mass of crystals that will be deposited at 14 °C.

Show your working.

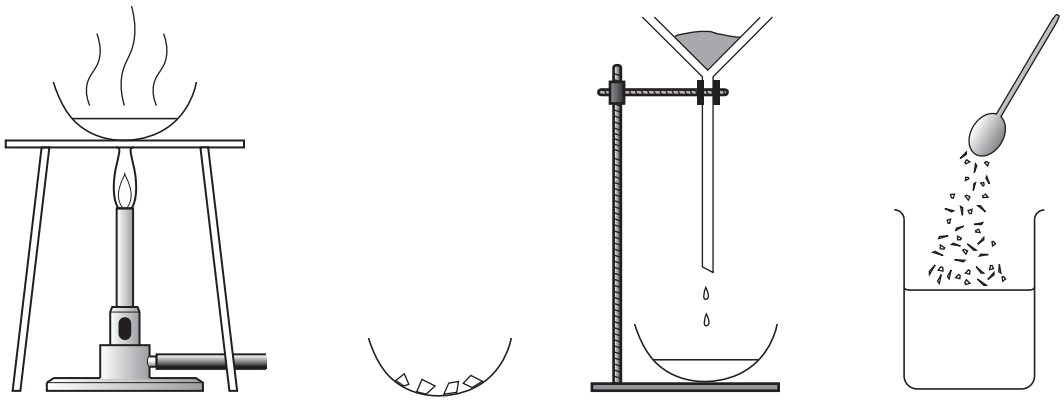
Answer _____ g [3]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

3 **(a)** The diagrams below show different stages in the production of copper sulfate crystals from copper oxide and warm dilute sulfuric acid. They are **not** in the correct order.



A **B** **C** **D**

Stage **D** happens first and involves adding copper oxide to warm dilute sulfuric acid. Give the correct order for the three stages which follow stage **D**:

D then _____ then _____ then _____ [1]

(b) Complete the symbol equation for the reaction between sulfuric acid and copper oxide.

$H_2SO_4 + CuO \rightarrow \quad +$

[2]

(c) Copper carbonate also reacts with sulfuric acid to produce copper sulfate crystals.

(i) What colour is solid copper carbonate?

_____ [1]

(ii) What gas is formed when copper carbonate reacts with sulfuric acid?

_____ [1]

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(d) Starting with copper oxide and warm dilute sulfuric acid, describe fully how you would produce a sample of copper sulfate crystals by carrying out the four stages shown in part **(a)**.

Your answer should include:

- the names of all pieces of apparatus used
- an explanation of the steps you would take
- any safety precautions required
- the colours of all substances involved

You will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only	
Marks	Remark

4 The table below gives information about particles P, Q, R, S and T.
Use this information to answer the questions that follow.

Particle	Number of protons	Number of electrons	Number of neutrons
P	6	6	8
Q	18	18	22
R	6	6	6
S	11	10	12
T	17	17	20

(a) Which particle P, Q, R, S or T is a noble gas?

_____ [1]

(b) Which particle P, Q, R, S or T is an ion?

_____ [1]

(c) Which two particles are isotopes of the same element?

_____ and _____ [1]

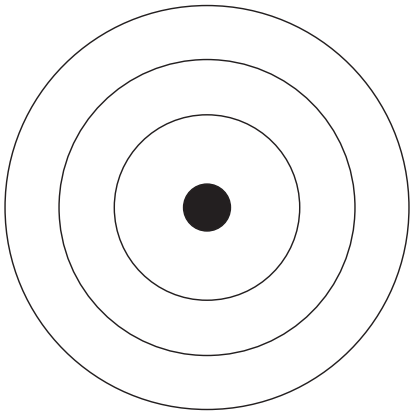
(d) What is the atomic number of particle T?

_____ [1]

(e) What is the mass number of particle S?

_____ [1]

(f) Use the diagram below to draw the electronic structure of particle T.



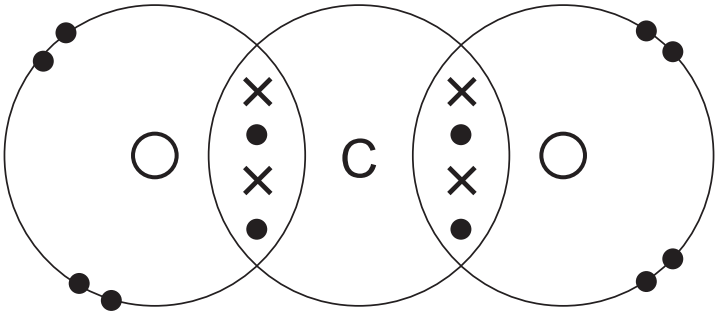
[1]

Examiner Only

Marks	Remark

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5 The diagram below shows the electronic arrangement in a molecule of carbon dioxide. Only the outer electrons are shown.



(a) (i) How many **lone pairs** of electrons does this molecule have?

_____ [1]

(ii) How many **shared pairs** of electrons are shown?

_____ [1]

(iii) What name is given to the type of bonding in carbon dioxide?

_____ [1]

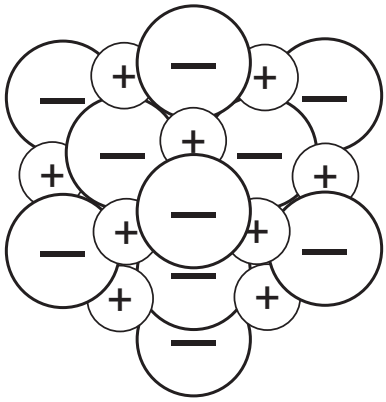
(b) Use a dot cross diagram to show **all** the electrons in the bonding of nitrogen gas.

[3]

Examiner Only

Marks	Remark

6 The diagram shows the arrangement of the particles in solid X.



(a) Identify and explain the type of bonding in solid X.

_____

_____

_____

_____ [3]

(b) Predict and explain **two** physical properties you would expect solid X to have.

1. Property _____

Explanation _____

_____

2. Property _____

Explanation _____

_____ [4]

Examiner Only

Marks	Remark

(c) Magnesium forms compounds with a similar structure to X. Describe, in terms of the electrons, how magnesium forms a compound with sulfur.

[4]

(d) In the space below draw a labelled diagram to show the bonding in magnesium metal.

[3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

7 Lithium reacts with fluorine to form lithium fluoride.

(a) Write a balanced symbol equation for the reaction of lithium with fluorine.

_____ [3]

(b) Sodium also reacts with fluorine to produce a salt.
Explain why sodium and lithium react in a very similar way.

_____

_____

_____

_____ [3]

(c) Lithium and sodium metals can be obtained from their salts by electrolysis.

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

_____

_____ [2]

(ii) Graphite electrodes are used in the electrolysis of sodium salts and lithium salts.
Give two properties of graphite which make it suitable for its use as electrodes.

1. _____

2. _____ [2]

(d) Reactions take place at both electrodes during the electrolysis of lithium fluoride.

(i) Fluoride ions react at the anode. Write a balanced half equation for this reaction.

_____ [3]

(ii) Write the half equation for the reaction at the cathode.

_____ [2]

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Rewarding Learning

General Certificate of Secondary Education
2016–2017

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

THURSDAY 10 NOVEMBER 2016, MORNING

MARK SCHEME

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General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

					AVAILABLE MARKS
1	**(a)**	He		[1]	
	(b)	SO_2		[1]	
	(c)	NH_4^+		[1]	
	(d)	Br_2		[1]	4
2	**(a)**	**(i)**	(As the temperature rises) the solubility falls	[1]	
		(ii)	chlorine	[1]	
		(iii)	carbon dioxide	[1]	
		(iv)	carbon dioxide	[1]	
		(v)	nitrogen, oxygen and chlorine [2] any two correct **only** [1] two correct and one incorrect [0] if 4 gases given and 3 are correct [1]	[2]	
		(vi)	chlorine	[1]	
	(b)	**(i)**	thermal	[1]	
		(ii)	oxygen	[1]	
	(c)	**(i)**	As the temperature increases solubility also increases	[1]	
		(ii)	72 g	[1]	
		(iii)	72 – 60 = 12 g 12 ÷ 2 = 6 g **Method**: dividing by 2 [1] Taking the solubility at 14 °C away from the **(c)(ii)** answer [1] correct answer 6 g [3] answer of 12 g (no working) [1] answer of 12 g with working out [2]	[3]	14

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AVAILABLE MARKS

3 **(a)** C A B in correct order [1]

(b) $CuSO_4$ [1] + H_2O [1] [2]

(c) **(i)** green [1]

(ii) carbon dioxide [1]

(d) **Indicative content**

Apparatus used
- beaker
- spatula
- filter funnel
- filter paper
- evaporating basin/dish
- tripod
- Bunsen
- (retort) stand
- clamp
- (wire) gauze

Maximum [4] IPs for apparatus

Steps
- D idea of **adding until** no more solid dissolves
- C idea of **filtering** to remove excess solid/copper oxide/residue
- A **heating** to remove water/to evaporate
- B (idea of) cooling to produce crystals

Colours
- copper oxide – black
- copper sulfate – blue
- dilute sulfuric acid – colourless

Safety
- goggles/care in use of Bunsen burner or other

There is a maximum of [12] IPs – apparatus [4], steps [4], colours [3], safety [1]

Response	**Mark**
Candidates must use appropriate scientific terms throughout to describe the method of making the crystals using **9–12** of the points in the indicative content .They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use **6–8** points from the indicative content to describe the method of making the crystals using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates use **2–5** of the points from the indicative content to describe the method of making the crystals. They use limited spelling, punctuation and grammar and make little use of scientific terms. The form and style are of a limited standard.	[1]–[2]
One **1 or 0** indicative points correct. Response not worthy of credit	[0]

[6]

11

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				AVAILABLE MARKS
4	**(a)**	Q	[1]	
	(b)	S	[1]	
	(c)	P and R both required	[1]	
	(d)	17	[1]	
	(e)	23	[1]	
	(f)	correct 2,8,7 drawing	[1]	6
5	**(a)**	**(i)** 4	[1]	
		(ii) 4	[1]	
		(iii) covalent or double covalent	[1]	
	(b)	correct diagram of nitrogen molecule showing 3 pairs of shared electrons in centre. Correct sharing [1], correct total electrons (if sharing correct) [1] Dot cross diagram [1]	[3]	6
6	**(a)**	ionic bonding [1] made up of positive and negative ions/oppositely charged ions [1] electrostatic/strong attraction between oppositely charged ions/positive ions and negative ions [1] 3rd marking must not be wrong	[3]	
	(b)	Property: high melting point [1] Explanation: large amount of energy needed to break bonds [1] Property: does not conduct electricity [1] Explanation: ions are not free to move [1] accept converse for molten or dissolved Property: brittle [1] Explanation: idea ions of same charge repel when aligned [1] Property: hard [1] Explanation: idea of strong bonds (unless wrongly qualified) [1] or other correct	[4]	
	(c)	electron transfer from magnesium → sulfur [1] magnesium loses 2 electrons **or** sulfur gains 2 electrons [1] formation of oppositely charged ions **or** formation of Mg^{2+} and S^{2-} [1] idea of attraction between oppositely charged ions [1]	[4]	
	(d)	correct diagram showing delocalised electrons [1] positive ions only [1] regular arrangement of positive ions only [1] for ionic structure – no marks if no labels max [2]	[3]	14

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			AVAILABLE MARKS
7	**(a)**	$2Li + F_2 \longrightarrow 2LiF$ correct LHS [1], correct RHS [1] correct balancing if all formulae correct [1] [3]	
	(b)	Sodium and lithium both have one electron/same number of electrons in their outer shells [1] they both lose this electron [1] to become stable/to have a complete outer shell [1] [3]	
	(c) **(i)**	The decomposition/breaking down of a substance [1] **NOT** separating by the passage of an electric current/using electricity [1] [2]	
	(ii)	(good) conductor of electricity [1] high melting point/or inert [1] [2]	
	(d) **(i)**	$2F^- \rightarrow F_2 + 2e^-$ or $2F^- - 2e \rightarrow F_2$ correct LHS [1] correct RHS [1] correct balancing [1] [3]	
	(ii)	$Li^+ + e^- \rightarrow Li$ LHS [1] RHS [1] If anode and cathode reactions are both given **but** the wrong way round penalise each answer by [1] [2]	15
		Total	**70**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015–2016

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

THURSDAY 19 MAY 2016, MORNING

TIME

1 hour.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **4**.
A Data Leaflet, which includes a Periodic Table of the elements is provided.

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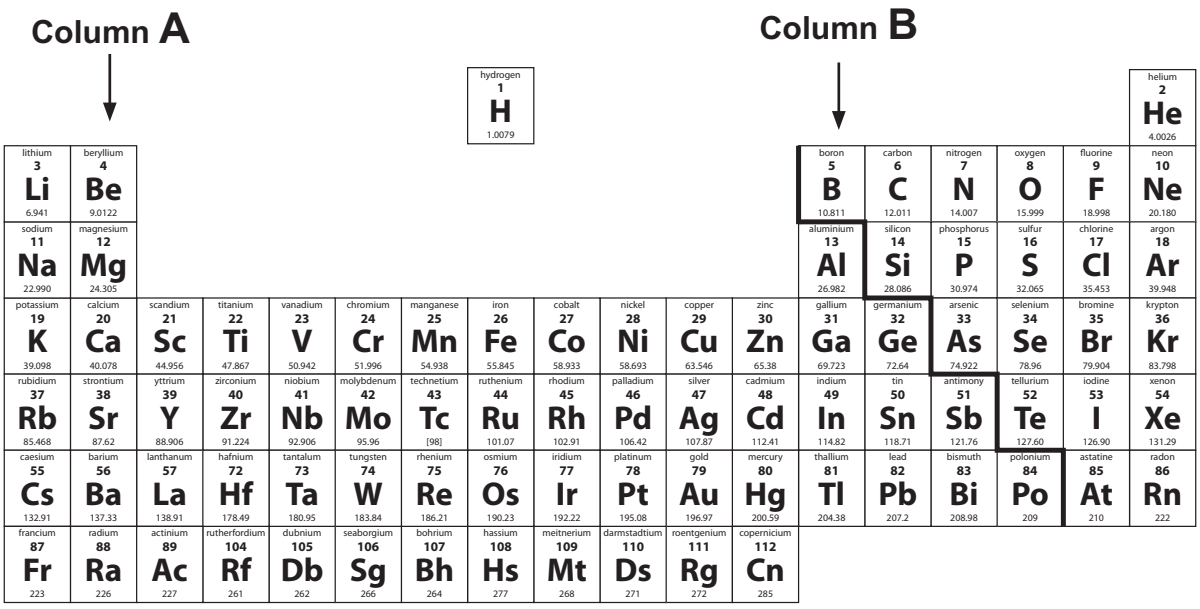
1 Many chemists contributed to the modern Periodic Table including Newlands and Mendeleev.

(a) Complete the table below to show the contribution of each chemist. Place a tick (✓) in each correct box.

Contribution	Newlands ***only***	Mendeleev ***only***	***Both*** Newlands and Mendeleev	***Neither*** Newlands nor Mendeleev
stated the Law of Octaves				
arranged elements in order of relative atomic mass				
included noble gases				
left gaps for undiscovered elements				

[4]

(b) A student is given a Periodic Table.



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For each of the five questions below three answers are given. Only one is correct. Circle the correct answer.

(i) The elements in **Column A** are:

alkali metals Group 2 Period 2

[1]

(ii) The physical state at room temperature of all the elements in **Column B** is:

solid liquid gas

[1]

(iii) The elements N, O, F, Cl, Br and I are all:

gases diatomic inert

[1]

(iv) The elements in **Column B** all have:

only 3 electrons 3 electrons in outer shell 3 electrons in first shell

[1]

(v) The solid black line separates:

metals and gases solids and liquids metals and non-metals

[1]

(c) **(i)** Name the element which is in Period 2 and Group 4.

_____ [1]

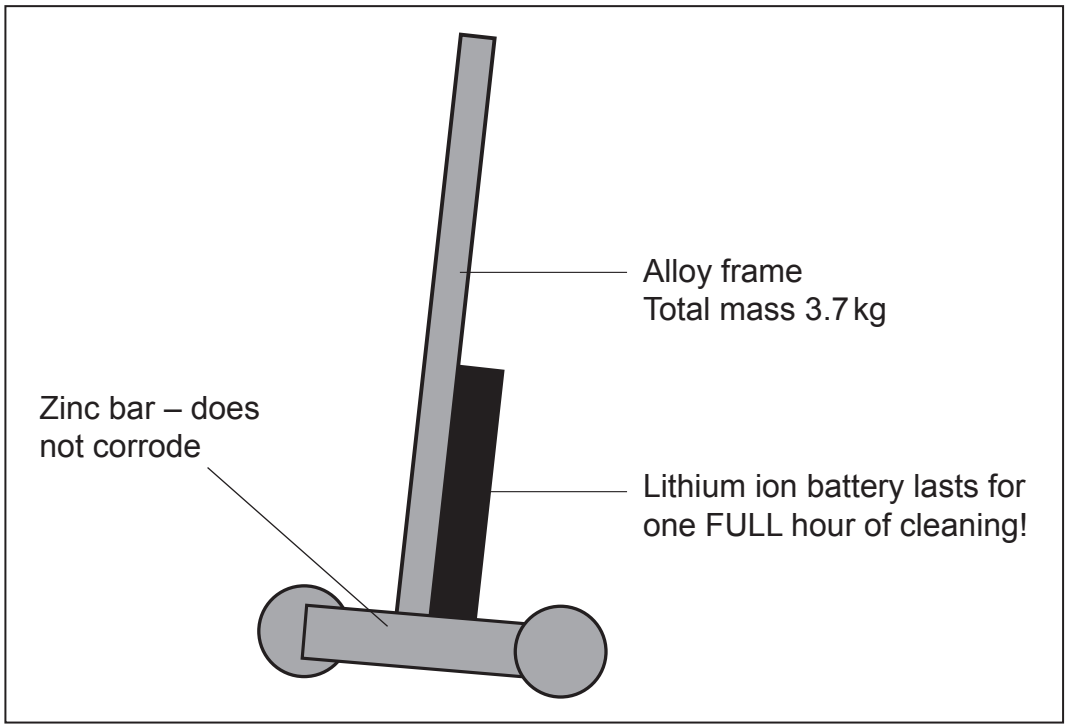
(ii) Name an element whose atoms have three shells and five electrons in the outer shell.

_____ [1]

[Turn over

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2 A labelled diagram, used in an advertisement for a cordless vacuum cleaner, is shown below.



(a) Give the symbol for a lithium ion.

_____ [1]

(b) What is an alloy?

_____

_____ [2]

(c) Give one property needed for the alloy used in the frame of the vacuum cleaner.

_____ [1]

3 Water has a melting point of 0 °C and is an excellent solvent.

(a) What is meant by the chemical terms:

(i) solvent?

_____

_____ [1]

(ii) melting point?

_____

_____

_____ [2]

(b) Give two physical properties of water apart from the fact that it has a melting point of 0 °C and is an excellent solvent.

1. _____

2. _____ [2]

Compound A is soluble in water. It has a solubility of 2.9 g/100 g of water at 20 °C.

(c) Why must the temperature be stated when giving the solubility of a substance in water?

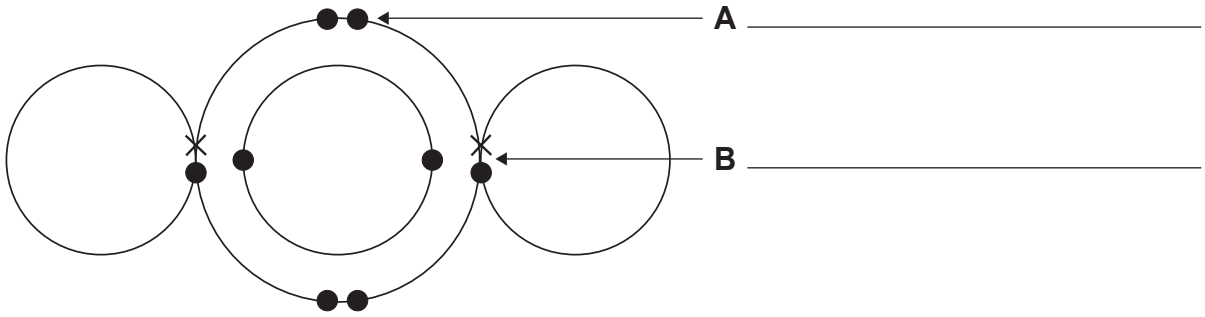
_____

_____ [1]

[Turn over

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(d) A dot and cross diagram of the bonding in water is shown below.



(i) Fill in the correct labels for the pairs of electrons labelled **A** and **B**. [2]

(ii) Name the type of bonding in water.

_____ [1]

(iii) Choose two compounds from the list below which have the same type of bonding as water.

Tick (✓) the two correct boxes.

potassium iodide ☐

carbon dioxide ☐

copper sulfate ☐

calcium carbonate ☐

hydrogen sulfide ☐

[2]

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4 In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

Magnesium forms a 2^+ ion and oxygen forms a 2^- ion.
Compare and contrast the Mg^{2+} ion and the O^{2-} ion.

You should include information about:

- the number and type of the particles present in each ion
- the electron configuration of each ion and
- how the ions are formed from their atoms.

[6]

[Turn over

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5 Metal oxides and metal carbonates will react with acids to form salts.

(a) Complete the word equation for the reaction between copper oxide and sulfuric acid.

copper oxide + sulfuric acid → + [2]

(b) Balance the symbol equation below.

HCl + CuO → $CuCl_2$ + H_2O [1]

(c) Write a balanced symbol equation for the reaction between copper carbonate and hydrochloric acid.

_____ [3]

(d) The reaction between sodium hydroxide and hydrochloric acid is known as a neutralisation reaction. Write an **ionic** equation to describe this neutralisation. Include state symbols.

_____ [3]

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6 Air is a mixture of gases including nitrogen, N_2, and very small amounts of methane, CH_4.

Draw **dot and cross** diagrams to show the bonding in a molecule of methane and a molecule of nitrogen.
Show the outer electrons only.

methane

[2]

nitrogen

[3]

[Turn over

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7 **(a)** Complete the table below which gives information about the physical properties of the halogens.

Name	Formula	State at room temperature	Colour
bromine			red-brown
chlorine		gas	
fluorine		gas	yellow
iodine			grey-black

[5]

(b) Complete the sentence below which describes the trend in melting points of the halogens as Group 7 is descended.

The melting points of halogens _____ as Group 7 is descended. [1]

(c) Explain why the halogens all form ions with a single negative charge.

_____

_____ [2]

(d) When chlorine is bubbled through a solution of sodium iodide the colour of the solution darkens.

(i) Write a balanced symbol equation for the reaction of chlorine with sodium iodide.

_____ [3]

(ii) Explain why the colour of the solution darkens in this reaction.

_____

_____ [2]

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(Questions continue overleaf)

8 Calcium metal can be produced by passing an electric current through molten calcium fluoride, CaF_2, using graphite rods known as electrodes.

(a) What name is given to this process?

_____ [1]

(b) Explain why molten calcium fluoride can conduct electricity.

_____

_____ [2]

(c) What happens to the molten calcium fluoride as the electricity passes through?

_____ [1]

Calcium is produced at the cathode.

(d) (i) Why is calcium produced at the **cathode**?

_____

_____ [2]

(ii) Explain, **in words**, in terms of the electrons involved, **how** the calcium is produced at the cathode during the electrolysis.

_____

_____

_____

_____ [3]

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(e) Graphite is a suitable material for the electrodes as it is a good conductor of electricity.
Give two other properties of graphite which make it suitable for use as electrodes.

1. _____

_____

2. _____

_____ [2]

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Question Number	Marks
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8	
Total Marks	

Examiner Number

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Rewarding Learning

General Certificate of Secondary Education
2015–2016

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

THURSDAY 19 MAY 2016, MORNING

MARK SCHEME

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General Marking Instructions

Introduction

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The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

1 **(a)**

Contribution	Newlands ***only***	Mendeleev ***only***	***Both*** Newlands and Mendeleev	***Neither*** Newlands or Mendeleev
stated the Law of Octaves	✓ [1]			
arranged elements in order of relative atomic mass			✓ [1]	
included noble gases				✓ [1]
left gaps for undiscovered elements		✓ [1]		

[4]

(b) **(i)** Group 2 [1]

(ii) solid [1]

(iii) diatomic [1]

(iv) 3 electrons in outer shell [1]

(v) metals and non-metals [1]

(c) **(i)** Carbon (accept the symbol C) [1]

(ii) Phosphorus (accept the symbol P) [1] 11

2 **(a)** Li^+ also allow Li^{+1} or Li^{1+} but not li^+ [1]

(b) For any credit the word "mixture" must be given and must not be wrongly qualified; i.e. if mixture not explicit 0 marks, if mixture given but e.g. answer also refers to bonding/joining, etc. then 0 marks.
The only 2 mark answer must communicate the 2 ideas below.
An alloy is a mixture of elements [1] at least one of which is a metal [1]
1 mark answers are:
an alloy is a mixture of metals [1]
a mixture of metals and non-metals [1]
a mixture of metals and elements [1] [2]

(c) Lightness/strength/hardness/durability/resistance to corrosion [1]
Do not credit sturdy/malleable/high melting point and other answers which are correct properties of metals but not relevant to this use.
Mark as wrong answers which refer to conducts electricity/conducts heat
Not rust (ignore if given as a second property) [1] 4

AVAILABLE MARKS

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					AVAILABLE MARKS
3	(a)	(i)	Idea that a solvent is a substance in which something (else) dissolves NOT reacts with the solute NOT a solution which dissolves NOT anything can dissolve in it	[1]	
		(ii)	the temperature [1] at which a solid changes to a liquid [1] 2 errors [0] marks are independent	[2]	
	(b)		Any **two** from: boils at 100 °C – units needed colourless ignore clear/transparent liquid (at RT) odourless density of 1g/cm^3 – units needed tasteless ACCEPT conducts heat or poor heat conductor NOT good heat conductor ACCEPT does not conduct electricity (well) ACCEPT immiscible with oil Reference to pH ignore 2 × [1]	[2]	
	(c)		idea that solubility **changes** with temperature. Do not credit “rate”	[1]	
	(d)	(i)	A lone pair (of electrons) [1] accept non bonded pair B bonded /shared pair of electrons/bonded pair/shared electrons/ bonded electrons/(single) covalent bond/bond – unless wrongly qualified [1]	[2]	
		(ii)	Bonding: covalent Do not credit “molecular” covalent	[1]	
		(iii)	carbon dioxide hydrogen sulfide	[2]	11

AVAILABLE MARKS

4 Indicative content

- magnesium ion has 12 protons
- oxide ion has 8/magnesium ion has 4 more protons
- magnesium ion has 12 neutrons
- oxide ion has 8 neutrons/magnesium ion has 4 more neutrons than oxide ion
- magnesium ion has the electronic configuration 2,8
- oxide ion has the electronic configuration 2,8
  (for both ions have the same electronic configuration or both ions have 10 electrons unstated allow 1IP instead of 2)
- magnesium ion is formed from its atom by losing electrons
- oxide ion is formed from its atom by gaining electrons
- 2 electrons lost/gained

Response	Mark
Candidates make reference to **7–9** of the main points above to compare and contrast the two ions. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates make reference to **4–6** of the main points above to compare and/or contrast the two ions. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates make reference to **2–3** of the main points above using limited spelling, punctuation and grammar. The form and style are of limited standard and they have made no use of specialist terms.	[1]–[2]
Response not worthy of credit.	[0]

[6] 6

5 (a) copper oxide + sulfuric acid → copper sulfate [1] + water [1] [2]

(b) $2HCl + CuO \rightarrow CuCl_2 + H_2O$ [1]

(c) $CuCO_3 + 2HCl \rightarrow CuCl_2 + H_2O + CO_2$
LHS [1] RHS [1]
[1] balancing – if all formulae correct [3]

(d) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
LHS [1] RHS [1]
state symbols [1] [3] 9

6 CH_4
Correct sharing [1]
correct number of electrons in the valence shell of all five atoms [1]
second mark dependent on first
N_2
correct sharing [1]
correct number of electrons in the valence shell of both N atoms [1]
second mark dependant on first
dot and cross notation correct in both diagrams [1] [5]

AVAILABLE MARKS

5

7 **(a)**

Name	Formula	State at room temperature	Colour
bromine	**Br_2**	**liquid** [1]	red-brown
chlorine	**Cl_2**	gas	**green** [1] accept pale green/yellow-green/green-yellow
fluorine	**F_2**	gas	yellow
iodine	**I_2**	**solid** [1]	grey-black

Formulae: All symbols correct [1] all diatomic [1] [5]
Do not credit for incorrect symbols, e.g. Br^-, Cl^-

(b) Increase [1]

(c) 1. All have seven electrons in their outer shell [1]
2. all gain one electron [1]
3. to have a full outer shell/ to be stable [1] max 2 × [1]
marking points 1 and 2 or 2 and 3 will gain max 2 marks [2]

(d) **(i)** $Cl_2 + 2NaI \rightarrow 2NaCl + I_2$
LHS [1] RHS[1]
[1] balancing – if all formulae correct [3]

(ii) chlorine **displaces** iodine/iodine formed [1] NOT iod**ide**
idea that iodine is darker in colour/dark in colour/grey-black/brown (in solution) [1] [2]
For the second marking point answers which suggest that iodine is a reactant gain no credit.

13

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				AVAILABLE MARKS
8	**(a)**	Electrolysis	[1]	
	(b)	(Oppositely charged) **ions** are free to move [1] and carry the charge/current [1]	[2]	
	(c)	It decomposes/breaks down (accept calcium **and** fluor**ine** formed) NOT separates/splits up/splits into ions/breaks up	[1]	
	(d) **(i)**	The calcium **ions** are positively charged [1] accept it is a cation idea that they are **attracted** to the **negative** cathode/electrode [1]	[2]	
	(ii)	(Each) calcium **ion** [1] gains **2** electrons [1] and is discharged/forms a calcium atom [1] correct equation max [2] $Ca^{2+} + 2e^- \rightarrow Ca$ incorrect equation [0]	[3]	
	(e)	inert/unreactive [1] (very) high melting point [1]	[2]	11
			Total	**70**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015–2016

Double Award Science: Chemistry

GSD22

Unit C1
Higher Tier

[GSD22]

THURSDAY 25 FEBRUARY 2016, MORNING

TIME

1 hour.

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 seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **2**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** Give an accurate definition of the term **solubility**.

Solubility is _____

_____

_____

_____ [4]

The table below gives information on whether some salts are soluble (S) or insoluble (I) in water.

anion / cation	**nitrate**	**carbonate**	**chloride**	**sulfate**
magnesium	S	I	S	S
potassium	S	S	S	S
lead	S	I	I	I
calcium	S	I	S	S
ammonium	S	S	S	S

(b) Use the information in the table to deduce rules for the solubility of salts by completing the sentences:

(i) **Cations:** All _____ and

_____ salts are soluble.

Anions: Most sulfates are _____ except

for _____.

All **metal** _____ are soluble. [5]

(ii) Predict whether each of the following salts is soluble (S) or insoluble (I) in water.

potassium iodide _____

lead bromide _____

copper nitrate _____ [3]

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(c) The chemical formula for ammonium sulfate is $(NH_4)_2SO_4$.

(i) How many elements are present in ammonium sulfate?

_____ [1]

(ii) How many oxygen atoms are present in the formula $(NH_4)_2SO_4$?

_____ [1]

(iii) How many atoms are present in the formula $(NH_4)_2SO_4$?

_____ [1]

(iv) Give the formula of a molecular ion present in ammonium sulfate.

_____ [1]

Examiner Only	
Marks	Remark

2 The modern Periodic Table of the elements has been developed over many years. Newlands and Mendeleev were both involved in finding patterns between the elements and Mendeleev prepared the first Periodic Table.

Describe:

- The key feature of the pattern found by Newlands
- Key features of Mendeleev's Periodic Table
- Ways in which the modern Periodic Table differs from the one proposed by Mendeleev

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

3 **(a)** Draw diagrams to show the electronic arrangements for a hydrogen atom and a chlorine atom. **All** electrons should be shown.

hydrogen atom **chlorine atom**

[2]

(b) Explain fully, in terms of the electrons, how hydrogen and chlorine combine to form the gas hydrogen chloride. Your answer should include the type of bonding.

[3]

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Examiner Only	
Marks	Remark

4 Read the information given below about smart phones and then answer the questions that follow. You may find your Data Leaflet helpful.

The screen on a smart phone is made of a mixture of tin oxide and indium oxide. It is transparent and is able to conduct electricity. The glass underneath is made of aluminium oxide and silicon dioxide and is strengthened with potassium ions. The electrical components are made from copper, silver and gold. The wiring is copper.

Nickel is used in the microphone. Some rare elements including neodymium and gadolinium are used in the magnets of the microphone and in the speaker. Magnesium compounds are used to make phone cases. The batteries contain lithium compounds and carbon.

(a) Name one element, from each of the following Groups in the Periodic Table, which is mentioned in the passage:

Group 1 _____ Group 2 _____

Group 3 _____ Group 4 _____ [4]

(b) Copper, nickel, silver and gold are all found in the same block or section of the Periodic Table.
What name is given to this block?

_____ [1]

(c) Give the chemical **symbol** for an element, mentioned in the passage, which is found in the Lanthanum series of the Periodic Table.

_____ [1]

(d) Indium is in the same Group as aluminium. Predict the formula for indium oxide.

_____ [1]

(e) Explain fully, in terms of its structure, why copper is a suitable element to use for the wiring of the phone.

_____

_____

_____

_____ [3]

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5 Draw dot and cross diagrams to show how **all** the electrons are arranged in the bonding of:

Examiner Only

Marks	Remark

(a) methane CH_4

[3]

(b) carbon dioxide CO_2

[3]

(c) Label a double bond, and a lone pair on the carbon dioxide diagram. [2]

(d) Describe fully in terms of the movement of electrons how magnesium bonds with oxygen.

_____

_____

_____

_____

_____ [4]

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6 The table below gives information about the salts formed when four metal oxides react with acids.

metal oxide	acid used	formula of cation in salt	formula of anion in salt	formula of salt produced
magnesium oxide	sulfuric acid		SO_4^{2-}	$MgSO_4$
	hydrochloric acid	Na^+		NaCl
copper oxide		Cu^{2+}		$CuSO_4$
calcium oxide	nitric acid		NO_3^-	

(a) Complete the table. [4]

(b) Each of these four reactions can be described as neutralisation. Write an ionic equation, including state symbols, for a neutralisation reaction.

_____ [3]

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

_____ [3]

(ii) Describe the test used to identify the gas produced in this reaction.

_____

_____ [2]

Examiner Only

Marks	Remark

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

7 This question is about the halogens.

An experiment was carried out to compare the reactivity of the elements of Group 7. The elements were added to aqueous solutions of three halides. The results are shown in the table below.

solution / halogen	**sodium chloride**	**sodium bromide**	**sodium iodide**
chlorine	no reaction	reaction and colour change	reaction and colour change
bromine	no reaction	no reaction	reaction and colour change
iodine	no reaction	no reaction	no reaction
X	reaction	reaction and colour change	reaction and colour change

(a) Use your knowledge and the information in the table to answer the following questions.

(i) Which of the four halogens in the table is the most reactive?

_____ [1]

(ii) Which halogen in the table is the least reactive?

_____ [1]

(iii) Describe and explain the colour changes you would observe when chlorine is added to sodium iodide solution.

_____

_____

_____

_____ [3]

(b) Write a balanced symbol equation for the reaction between bromine and sodium iodide.

_____ [3]

(c) Predict the name of the halogen **X**.

_____ [1]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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114853

Rewarding Learning

General Certificate of Secondary Education
2015–2016

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

THURSDAY 25 FEBRUARY 2016, MORNING

MARK SCHEME

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General Marking Instructions

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				AVAILABLE MARKS
1	(a)	The mass of solid/solute [1] required to saturate [1] 100 g of water [1] at a particular temperature [1] **or** The **maximum** mass of solid/solute [1] which will dissolve in [1] 100 g of water [1] at a particular temperature [1] allow 'amount' as equivalent to 'mass'	[4]	
	(b) (i)	Cations – potassium [1] and ammonium [1] (either order) – not sodium Anions: soluble [1] lead [1] – not barium nitrates [1] If potassium, ammonium and sodium are given and then lead and barium are given only penalise once	[5]	
	(ii)	potassium iodide – soluble/S [1] lead bromide – insoluble/I [1] copper nitrate – soluble/S [1]	[3]	
	(c) (i)	4	[1]	
	(ii)	4	[1]	
	(iii)	15	[1]	
	(iv)	NH_4^+ **or** SO_4^{2-}	[1]	16

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2 Indicative content

AVAILABLE MARKS

Newlands:
- idea of Law of Octaves/repeating pattern of eight

Mendeleev:
- arranged in order of atomic mass
- left gaps
- included Groups and Periods
- no noble gases/no actinides/no lanthanides
- Hydrogen in Group 1

or other correct

Modern:
- arranged by atomic number
- idea of block of transition elements
- more elements

or other correct

Response	Mark
Candidates must use appropriate scientific terms throughout to describe the development of the Periodic Table using **7–9** of the points in the indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use **4–6** of the points in the indicative content to describe the development of the Periodic Table using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates use **2–3** of the points in the indicative content to describe the development of the Periodic Table. They use limited spelling, punctuation and grammar and make little use of scientific terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit.	[0]

[6] 6

3 (a) correct hydrogen atom [1]
correct chlorine atom, i.e. 2, 8, 7 arrangement [1] [2]

(b) **shared pair** of electrons [1]
idea of chlorine and hydrogen each contributing 1 electron by sharing [1]
bonding is covalent [1]
but
if sharing not explicit, then maximum [1/3] for covalent bonding [3] 5

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AVAILABLE MARKS

4 **(a)** Group 1 – potassium or lithium [1]
Group 2 – magnesium [1]
Group 3 – aluminium or indium [1]
Group 4 – carbon or silicon or tin [1] [4]

(b) transition elements [1]

(c) Nd **or** Gd [1]

(d) In_2O_3 [1]

(e) idea that there are delocalised/free electrons [1]
which (move and) carry the charge [1]
idea that (it can be made into wires or is ductile because) layers (of ions) can slide over one another [1] – explanation needed [3]

10

5 **(a)** correct diagram for methane: bonds correct [1]
total number of outer electrons [1] dot and cross [1] [3]
N.B. number of outer electrons dependent on correct bonding

(b) correct diagram for carbon dioxide: double bonds [1]
total number of outer electrons [1] correct inner electrons [1] [3]
N.B. number of outer electrons dependent on correct bonding

(c) correctly labelled double bond [1] lone pair [1] [2]

(d) idea of electron transfer from magnesium to oxygen [1]
idea that two electrons are transferred [1]
explicit that a magnesium ion and an oxygen/oxide ion are formed [1]
ions are held together by electrostatic attraction [1] [4]

12

6 **(a)**

metal oxide	acid used	formula of cation in salt	formula of anion in salt	formula of salt produced
magnesium oxide	sulfuric acid	**Mg^{2+}**	SO_4^{2-}	$MgSO_4$
sodium oxide	hydrochloric acid	Na^+	**Cl^-**	NaCl
copper oxide	**sulfuric acid**	Cu^{2+}	**SO_4^{2-}**	$CuSO_4$
calcium oxide	nitric acid	**Ca^{2+}**	NO_3^-	**$Ca(NO_3)_2$**

7 correct = [4]; 5 or 6 correct = [3]; 3 or 4 correct = [2]; 2 correct = [1] [4]

(b) $H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$
Correct LHS [1]; correct RHS [1]; correct state symbols [1] [3]

(c) **(i)** $Mg + 2HCl \rightarrow MgCl_2 + H_2$
correct LHS [1]; correct RHS [1]; correct balancing [1] [3]

(ii) Use a burning/lit splint [1]
squeaky pop [1] [2]

12

					AVAILABLE MARKS
7	**(a)**	**(i)**	X or fluorine	[1]	
		(ii)	iodine **not** iodide	[1]	
		(iii)	solution changes from colourless [1] to yellow/brown or yellow or brown [1] – not orange **iodine** is displaced (by chlorine) [1]	[3]	
	(b)		$2NaI + Br_2 \rightarrow 2NaBr + I_2$ LHS [1] RHS [1] balancing [1]	[3]	
	(c)		fluorine	[1]	9
				Total	**70**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2015–2016

Double Award Science: Chemistry

GSD22

Unit C1
Higher Tier

[GSD22]

THURSDAY 12 NOVEMBER 2015, MORNING

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **2(b)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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

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Examiner Only	
Marks	Remark

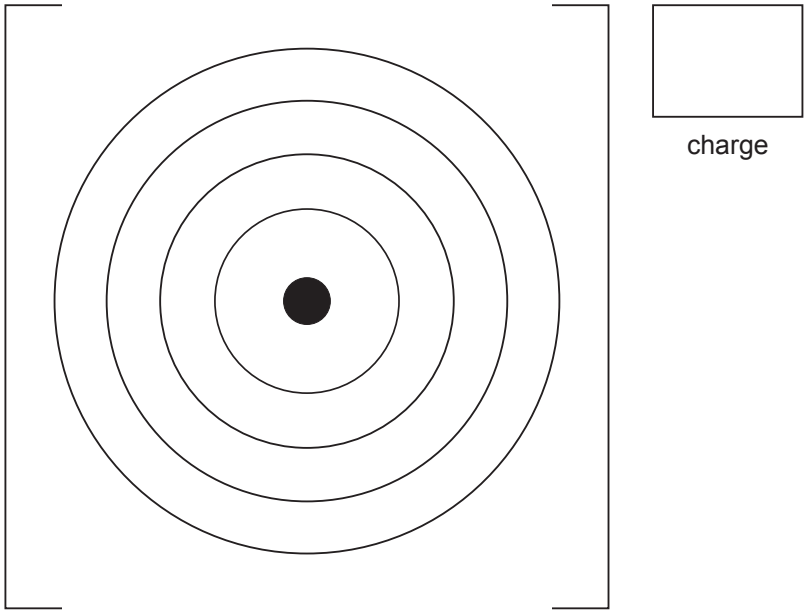
1 Some tap water contains dissolved calcium chloride ($CaCl_2$) and dissolved calcium hydrogen carbonate, $Ca(HCO_3)_2$.

(a) Give two reasons why calcium hydrogen carbonate and calcium chloride could be **ionic** compounds.

1. _____

2. _____ [2]

(b) Draw the electronic configuration of the calcium **ion** and give the charge.



calcium ion

[2]

(c) How many oxygen atoms are there in the formula $Ca(HCO_3)_2$?

_____ [1]

Some tap water can contain dissolved magnesium sulfate or dissolved potassium carbonate.

(d) Write the formulae for magnesium sulfate and potassium carbonate.

magnesium sulfate _____

potassium carbonate _____ [2]

(e) What colour are solid magnesium sulfate and solid potassium carbonate?

_____ [1]

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Examiner Only	
Marks	Remark

2 The Periodic Table is used by chemists to help them understand the reactions of the elements. John Newlands was one of the first chemists to notice repeating patterns in the properties and reactions of the elements.

(a) What name did Newlands give to the repeating pattern observed in the properties of the elements?

_____ [1]

(b) Almost a decade after Newlands, Dmitri Mendeleev produced a Periodic Table, part of which is shown below.

H							
Li	Be	B	C	N	O	F	
Na	Mg	Al	Si	P	S	Cl	
K Cu	Ca Zn		Ti	V As	Cr Se	Mn Br	Fe Co Ni

Using your knowledge and understanding, describe the main differences between the Modern Periodic Table and the Periodic Table developed by Mendeleev. In your answer make it clear which version of the Periodic Table you are referring to.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

3 Metal oxides are bases. They react with strong acids to form salts.

(a) What is the pH range of a strong acid?

_____ [1]

Copper oxide reacts with sulfuric acid.

(b) (i) Complete the **word** equation below for this reaction.

copper oxide + sulfuric acid → + [2]

(ii) Why can this reaction be described as a neutralisation reaction?

_____

_____ [2]

(iii) What colour change is observed **in the solution** as this reaction is happening?

from _____ to _____ [2]

Sodium oxide reacts with hydrochloric acid.

(c) (i) Complete a balanced symbol equation for the reaction between sodium oxide and hydrochloric acid.

Na_2O + HCl → + [3]

(ii) Sodium oxide is an alkali. Why could sodium oxide be described as an alkali?

_____

_____ [2]

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

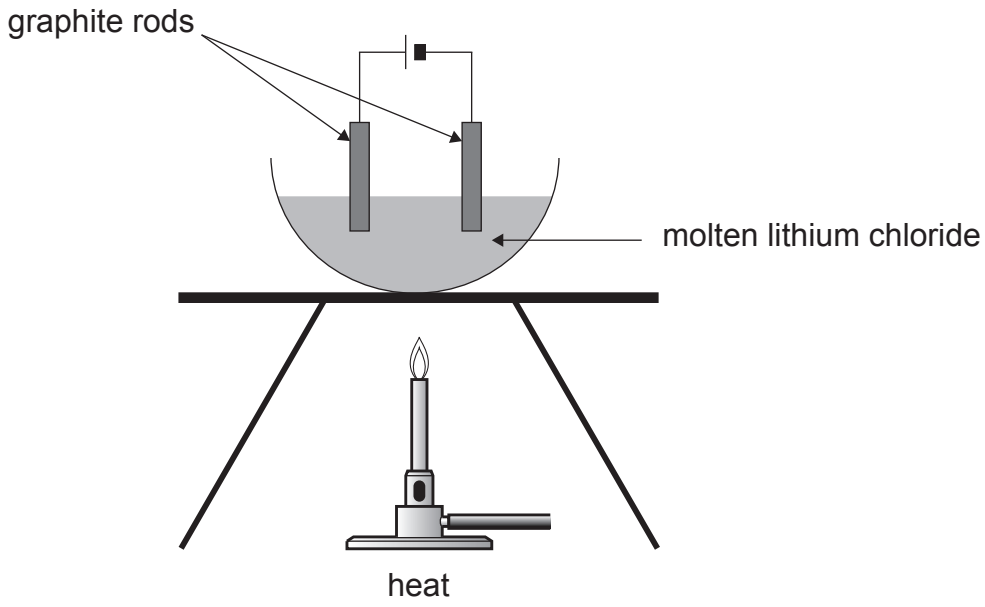
4 Metals, such as copper, are good conductors of electricity. Metal compounds, such as sodium chloride will conduct electricity when they are molten or dissolved in water.

(a) Complete the table below which gives information about how copper and sodium chloride solution conduct electricity.

Name of conductor	Name of the **type** of particle which moves and carries the charge	Effect of the passage of electricity on the conductor (A) No effect (B) Conductor breaks down (C) The conductor melts
copper		
sodium chloride solution		

[4]

The diagram below shows the apparatus used in the laboratory for the electrolysis of molten lithium chloride.



© CCEA

(b) (i) Give one reason why graphite is used to make these electrodes.

_____ [1]

(ii) Write a half equation for the reaction which happens at the cathode when molten lithium chloride undergoes electrolysis.

_____ [2]

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Aluminium is extracted from its ore by passing electricity through a molten mixture of alumina and cryolite.

Examiner Only	
Marks	Remark

(c) (i) How is alumina produced?

_____ [2]

(ii) Give two reasons why cryolite is used in the extraction of aluminium.

1. _____

2. _____ [2]

During the process a crust of aluminium oxide is formed on the top of the molten mixture.

(d) Give one advantage of this crust.

_____ [1]

(e) Give two reasons why recycling aluminium is preferable to having to extract even more of the metal by electrolysis.

1. _____

2. _____ [2]

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Examiner Only	
Marks	Remark

5 This question is about covalent structures and covalent bonding.

(a) What is a covalent bond?

_____ [1]

(b) Draw a dot and cross diagram to show the covalent bonding in a molecule of hydrogen chloride (HCl). Show outer electrons only.

[3]

(c) Complete the paragraph below which explains why giant covalent structures have much higher melting points than molecular covalent structures.

There are extremely strong forces of attraction between

the _____ in a giant covalent structure which

take a lot of heat energy to _____. There are

weak forces of attraction between the _____ in

a molecular covalent structure which do not require a lot of

energy to _____. [3]

(d) Choose the **two** properties, from the list below, which are typical of many molecules which have molecular covalent or giant covalent structures. Place a tick (✓) in the two correct boxes.

can be compressed	☐
insoluble in water	☐
ductile	☐
non-conductors of electricity	☐
colourless gases	☐

[2]

6 The table below summarises the observations made when solutions of the halogens are added to solutions of the halide ions.

halide solution / halogen	potassium chloride solution	potassium bromide solution	potassium iodide solution
chlorine		colourless solution becomes orange-brown	colourless solution becomes dark brown
bromine	no reaction		colourless solution becomes dark brown
iodine	no reaction	no reaction	

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(a) Explain why bromine solution does not react with potassium chloride solution.

_____

_____ [2]

(b) Name the **type** of reaction that takes place between potassium bromide and chlorine.

_____ [1]

(c) Write a balanced **symbol** equation for the reaction between chlorine and potassium iodide.

_____ [3]

(d) Explain in terms of their electronic structures why the halogens have similar chemical properties.

_____

_____ [2]

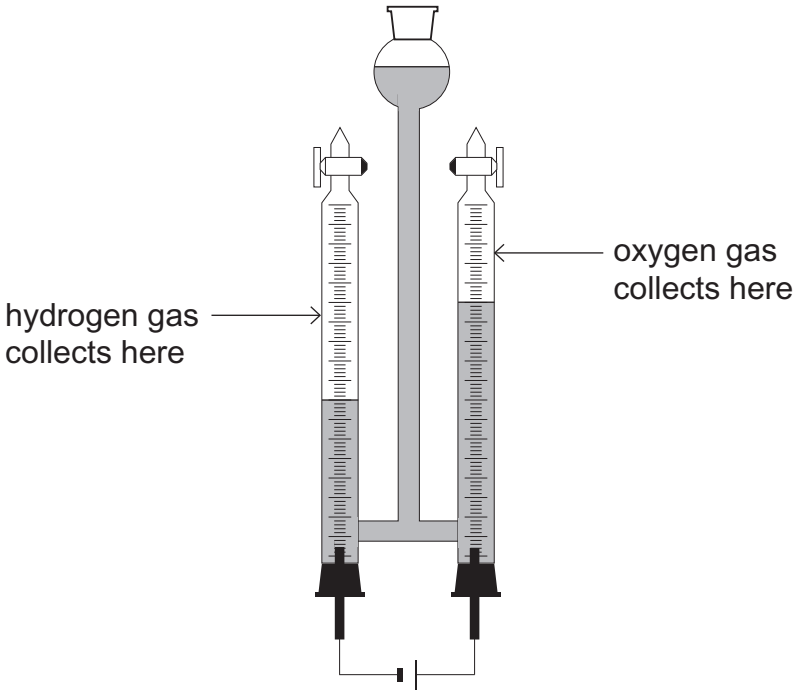
Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

7 The apparatus shown below may be used in the laboratory to demonstrate that water (H_2O) is a compound made from the elements hydrogen and oxygen.



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(a) Describe a **chemical** test for water.

_____

_____

_____ [3]

In one demonstration the water decomposed to form 10 cm^3 of hydrogen gas and 5 cm^3 of oxygen gas.

(b) Explain why the volume of hydrogen formed was exactly twice as much as the volume of oxygen formed.

_____

_____ [1]

(c) Describe a test for hydrogen.

_____

_____ [2]

Examiner Only	
Marks	Remark

8 When a hot saturated solution of copper(II) sulfate is allowed to cool, crystals of hydrated copper(II) sulfate form.

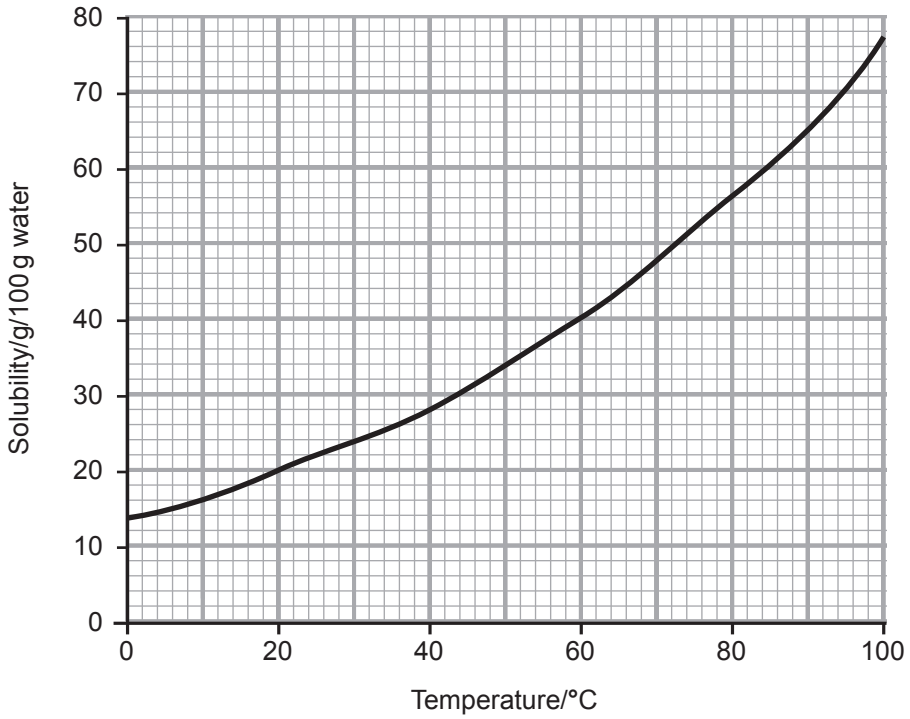
(a) Explain why crystals form when the solution is cooled.

_____

_____

_____ [2]

The solubility curve for copper(II) sulfate is shown below.



(b) Calculate the mass of copper(II) sulfate which will crystallise when a saturated solution, in 20 g water, is cooled from 82 °C to 30 °C.

_____ g [4]

THIS IS THE END OF THE QUESTION PAPER

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114853

Rewarding Learning

General Certificate of Secondary Education
2015–2016

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

THURSDAY 12 NOVEMBER 2015, MORNING

MARK SCHEME

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General Marking Instructions

Introduction

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			AVAILABLE MARKS
1	**(a)**	soluble (in water)/idea that they dissolve [1] idea of being formed from a metal and a non-metal [1] [2]	
	(b)	candidates draw the electronic configuration of a calcium ion 2,8,8 [1] charge +2 (This should be placed in the box provided but mark it correct wherever it is placed.) [1] [2]	
	(c)	6 [1]	
	(d)	$MgSO_4$ [1] K_2CO_3 [1] [2]	
	(e)	white [1]	8
2	**(a)**	The Law of Octaves [1]	
	(b)	**Indicative content** • Modern Periodic Table arranged in order of atomic number • Mendeleev's Periodic Table arranged in order of atomic mass • Mendeleev's Periodic Table placed more than one element in a space/ Modern Periodic Table places only one element in a space • Modern Periodic Table has no gaps/Mendeleev's Periodic Table had gaps • Idea that modern Periodic Table places transition elements in a separate block • Mendeleev's Periodic Table had no Noble gases/modern Periodic Table has Noble gases • Modern Periodic Table has more elements/has actinides/has lanthanides • Correct idea of elements moved e.g. H or e.g. I_2/Te exchanged	

Response	**Mark**
Candidates make reference to **6–8** of the main points above to describe the main differences between Mendeleev's Periodic Table and the modern Periodic Table. They use good spelling, punctuation and grammar and the form and style are of a high standard. It must be clear which table the candidate is referring to.	[5]–[6]
Candidates make reference to **4–5** of the main points above to describe the main differences between Mendeleev's Periodic Table and the modern Periodic Table. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard. It must be clear which table the candidate is referring to.	[3]–[4]
Candidates make reference to **2–3** of the main points above using limited spelling, punctuation and grammar. The form and style are of a limited standard and they have made no use of specialist terms. It must be clear which table the candidate is referring to.	[1]–[2]
Candidates make no reference to the main points and offer no other suitable response.	[0]

[6] 7

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AVAILABLE MARKS

3 **(a)** 0–2 (NOT 1–2) [1]

(b) **(i)** copper sulfate [1] water [1] any order [2]

(ii) it (is a reaction between an acid and a base which) forms a salt and water [1] only (clearly implied) [1]
idea of hydrogen ions forming water gets [1] [2]

(iii) colourless [1] to blue [1] [2]

(c) **(i)** $Na_2O + 2HCl \rightarrow 2NaCl + H_2O$
correct formula of NaCl [1]
correct formula of H_2O [1]
if a third product is given maximum mark is [1]
balancing [1] [3]

(ii) it is a base [1] it is soluble [1] [2]

12

4 **(a)**

Name of conductor	Name of the **type** of particle which moves and carries the charge	Effect of the passage of electricity on the conductor (A) No effect (B) Conductor breaks down (C) The conductor melts
copper	electron [1]	(A)/no effect [1]
sodium chloride solution	ion [1]	(B)/conductor breaks down [1]

[4]

(b) **(i)** graphite is a (good) conductor of electricity
or idea that graphite is inert
or high melting point [1]

(ii) $Li^+ + e^- \rightarrow Li$
L.H.S. [1] R.H.S. [1] [2]

(c) **(i)** bauxite [1] is purified [1] (2nd mark dependent on first)
for aluminium ore purified allow [1] [2]

(ii) lowers the melting point (of the aluminium oxide)/lowers the operating temperature [1]
NOT lowers melting point of aluminium
increases the (electrical) conductivity (of the aluminium oxide) [1] [2]

(d) it prevents heat loss/conserves energy [1]

(e) idea of saving waste
idea of requiring less energy to recycle than to extract/recycling is cheaper
idea of conserving resources [2]
Any 2 × [1] out of 3

14

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				AVAILABLE MARKS
5	**(a)**	sharing (a pair of) electrons unless wrongly qualified e.g. not elements sharing electrons	[1]	
	(b)	correct sharing between one hydrogen atom and one chlorine atom [1] correct number of outer electrons for each atom [1] this mark is awarded only when 1st mark is given correct dot and cross representation [1]	[3]	
	(c)	atoms [1] break* molecules [1] break* * [1] if break given twice	[3]	
	(d)	candidates tick insoluble in water [1] non-conductors of electricity [1]	[2]	9
6	**(a)**	bromine is less reactive than chlorine [1] or vice versa and idea that it cannot displace chlorine [1]	[2]	
	(b)	displacement	[1]	
	(c)	$Cl_2 + 2KI \rightarrow I_2 + 2KCl$ L.H.S. [1] R.H.S. [1] balancing [1]	[3]	
	(d)	they have 7 electrons in their outer shell [1] they need to gain one electron [1] to form a full outer shell/to become stable [1] max 2 × [1] 'to become stable' is dependent on gaining one electron	[2]	8
7	**(a)**	anhydrous copper(II) sulfate [2] If only copper(II) sulfate [1] ((II) not required in the name) turns (from white to) blue [1]	[3]	
	(b)	idea that there is a 2:1 ratio of hydrogen to oxygen <u>in water</u>/there are two hydrogen atoms for every 1 oxygen atom <u>in water</u>	[1]	
	(c)	(apply a) lighted splint [1] (hydrogen burns with a squeaky) pop [1]	[2]	6

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				AVAILABLE MARKS
8	**(a)**	the solid becomes less soluble in water [1] idea that some of the solid in the solution can no longer dissolve and comes out of solution [1]	[2]	
	(b)	solubility at 82 °C = 58 [1] g/100 g water solubility at 30 °C = 24 [1] g/100 g water difference in solubility = 58 – 24 = 34 [1] g $\frac{34}{5}$ = 6.8 [1] g	[4]	6
			Total	**70**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2014–2015

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

THURSDAY 14 MAY 2015, MORNING

TIME

1 hour.

INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.
You must answer the questions in the spaces provided.
Do not write outside the boxed area on each page or on blank pages.
Complete in blue or black ink only. **Do not write with a gel pen.**
Answer **all nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **5(a)**.
A Data Leaflet, which includes a Periodic Table of the elements is provided.

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1 Five particles are listed below:

Na^+ H_2 HCO_3^- Ne H_2O

Write down, from the list of particles above, an example of:

(a) an atom _____ [1]

(b) a cation _____ [1]

(c) a compound _____ [1]

(d) a molecular ion _____ [1]

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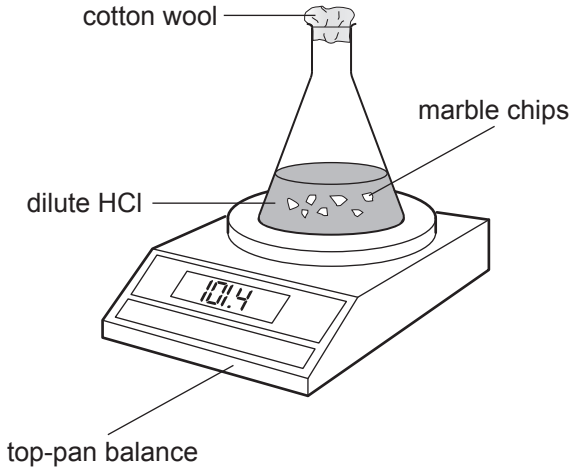
(Questions continue overleaf)

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2 A pupil investigated the reaction between calcium carbonate (marble chips) and dilute hydrochloric acid. He used excess calcium carbonate.

The equation for this reaction is:

$$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$$



The student measured the mass of the flask and its contents every minute for 8 minutes. The results are shown in the table below.

Mass/g	102.8	101.4	100.3	99.5	99.3	99.2	99.1	99.0	99.0
Time/min	0	1	2	3	4	5	6	7	8

(a) What is the name of the salt produced during the reaction?

_____ [1]

(b) What caused the mass of the flask and contents to decrease?

_____ [1]

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(c) Suggest why the student used **excess** calcium carbonate.

_____

_____ [1]

(d) Give an **accurate** way of checking that the resulting solution was neutral.

_____ [1]

(e) Another student in the same class used calcium oxide instead of calcium carbonate. He observed no drop in mass. Explain why this would be the case.

_____

_____ [2]

[Turn over

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3 The following table shows the solubilities of three gases in water, at different temperatures:

Gas	solubility (mg per 100 g water)* at:			
	0 °C	20 °C	40 °C	50 °C
carbon dioxide	348	169	97	76
nitrogen	2.9	1.9	1.5	1.2
oxygen	7.0	4.3	3.0	2.7

* mg = milligrams

(a) What is the solubility of carbon dioxide at 20 °C?

_____ mg/100 g water. [1]

(b) Which gas is **least** soluble at 50 °C?

_____ [1]

(c) How does the solubility of the three gases change as the temperature increases?

_____ [1]

(d) Use the table to help you explain why fish may die if the water in a river becomes too warm.

_____

_____

_____

_____ [2]

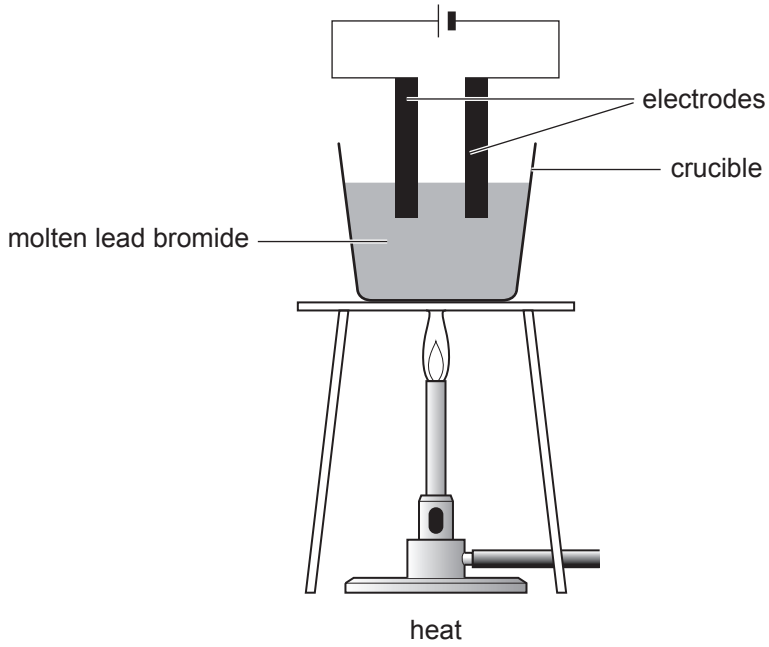
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(Questions continue overleaf)

4 The diagram below shows the apparatus used to pass an electric current through molten lead bromide.



(a) What name is given to the process which happens in the crucible?

_____ [1]

(b) What is the **electrolyte** in this experiment?

_____ [1]

(c) Give **two** reasons why graphite is a suitable material for making the electrodes.

1. _____

2. _____ [2]

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(d) Complete the table below by predicting the products and observations at the electrodes for the molten salts given.

name of substance	observations at anode	observations at cathode	product at anode	product at cathode
lead bromide		beads of metal	bromine	lead
lithium chloride	bubbles of greenish/ yellow gas	beads of metal		lithium
potassium iodide	bubbles/purple vapour			

[5]

(e) Write a half equation for the reaction which happens at the anode when an electric current is passed through molten lithium chloride.

_____ [2]

[Turn over

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5 **(a)** Describe in words the structure of an atom of carbon with an atomic number of 6 and a mass number of 14.

Your answer should include the number and position of all the different particles in this carbon atom.

You will be assessed on your written communication skills including the use of specialist science terms.

[6]

(b) Carbon also has atoms with a mass number of 12.
What name is given to atoms with the same atomic number but different mass numbers?

[1]

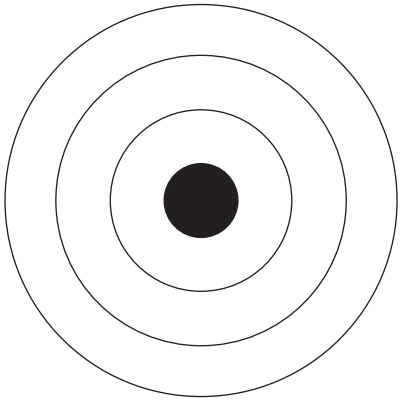
(c) When carbon atoms join together to form molecules they share electrons.
What name is given to this type of bonding?

[1]

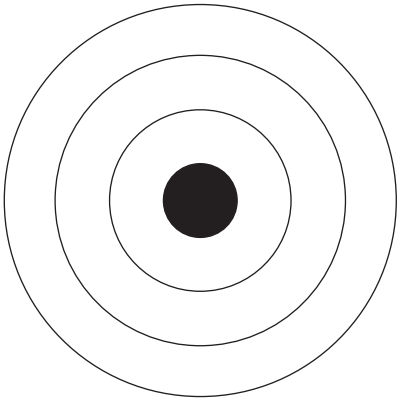
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6 Magnesium reacts with sulfur to form the compound magnesium sulfide.

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



magnesium atom



sulfur atom

[2]

(b) **(i)** In the space below draw the electronic arrangements for the ions formed when magnesium and sulfur bond together.
Your answer should include the charges on the ions.

magnesium ion **sulfide ion**

[4]

(ii) What is the chemical formula for magnesium sulfide?

_____ [1]

[Turn over

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7 **(a)** What type of bonding is typical of non-metallic elements and compounds?

_____ [1]

(b) Draw dot and cross diagrams to show the outer electrons only in a molecule of water.

[3]

(c) Oxygen is a diatomic molecule which has a double bond.

Draw a diagram to show all the electrons in a molecule of oxygen.

Label:

(i) the double bond **(ii)** a lone pair

[4]

(d) What is meant by the term diatomic?

_____ [1]

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8 When the elements sodium and potassium react with water very similar chemical reactions take place. However there are some noticeable differences.

(a) Give three ways in which the reactions of sodium and potassium with water are similar.

1. _____

2. _____

3. _____ [3]

(b) Explain fully, in terms of their electron arrangements, why sodium and potassium react in such similar ways.

_____

_____

_____ [2]

(c) Give two ways in which the reactions of sodium and potassium with water are different.

1. _____

2. _____ [2]

(d) Complete and balance the symbol equation for the reaction of potassium with water.

$$K + H_2O \longrightarrow \quad + \quad$$

[3]

(e) When sodium reacts with bromine it forms the compound sodium bromide. Write a balanced symbol equation for this reaction.

_____ [3]

[Turn over

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9 The table below gives some information about five substances **A**, **B**, **C**, **D** and **E**.

Substance	Boiling point °C	Melting point °C	Electrical conductivity when solid	Electrical conductivity when liquid
A	1760	327	good	good
B	69	– 95	poor	good
C	1499	777	poor	good
D	4828	3551	poor	poor
E	2751	1539	good	good

(a) (i) Which **two** substances **A**, **B**, **C**, **D** or **E** have delocalised electrons?

_____ and _____ [1]

(ii) Explain your answer. _____

_____

_____ [2]

(b) Explain why substance **D** could be diamond.

_____

_____

_____ [2]

(c) Explain why substance **C** can be used as an electrolyte.

_____

_____

_____ [2]

10081

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

Examiner Number

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Double Award Science: Chemistry

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[GSD22]

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				AVAILABLE MARKS
1	**(a)**	Ne	[1]	
	(b)	Na^+	[1]	
	(c)	H_2O	[1]	
	(d)	HCO_3^-	[1]	4
2	**(a)**	calcium chloride	[1]	
	(b)	the gas/carbon dioxide **leaves the flask**/escapes **Not:** gas released; **not** given off	[1]	
	(c)	idea of making sure all the acid was used up/neutralised	[1]	
	(d)	use a pH meter/sensor/probe **Not:** pH paper/scale	[1]	
	(e)	No gas would be formed [1] a salt and water is produced [1] **or** No gas would be formed [1] ∴ nothing could escape [1] **or** It would **only** produce a salt and water [2] – only is explicit	[2]	6
3	**(a)**	169 (mg per 100 g water)	[1]	
	(b)	nitrogen	[1]	
	(c)	it decreases	[1]	
	(d)	explicit idea that fish need **oxygen** to breathe/respire [1] allow idea of suffocation idea that warm water contains less **oxygen** (not less gas) [1]	[2]	5

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AVAILABLE MARKS

4 **(a)** electrolysis [1]

(b) (molten) lead bromide [1]

(c) conducts **electricity** [1]
does not react/idea of high melting point [2]

(d)

name of substance	observations at anode	observations at cathode	product at anode	product at cathode
lead bromide	***bubbles of reddish brown gas** [1]	beads of metal	bromine	lead
lithium chloride	bubbles of greenish/yellow gas	beads of metal	**chlorine** [1]	lithium
potassium iodide	bubbles/purple vapour	**beads of metal** [1]	**iodine** [1]	**potassium** [1]

*Allow: brown/orange-brown/yellow-brown/orange
Not: yellow; **not** red

[5]

(e) $2Cl^- - 2e \rightarrow Cl_2$ [1] [1] **or** $2Cl^- \rightarrow Cl_2 + 2e$ [1] [1] [2]

$Cl^- - e \rightarrow Cl$ [1] **or** $Cl^- \rightarrow Cl + e$ [1]

$2Cl \rightarrow Cl_2$ [1] second mark dependent on first

11

AVAILABLE MARKS

5 (a) Indicative Content

- Protons
- Electrons
- Neutrons
- Correct numbers of protons
- Correct number of electrons
- Correct number of neutrons
- Protons in nucleus
- Neutrons in nucleus
- Electrons in shells

Response	Mark
Candidates must use appropriate scientific terms throughout to describe the structure of a carbon atom using 7–9 of the points in the indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use 5 or 6 points from the indicative content to describe the structure of a carbon atom using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates use 3 or 4 of the points from the indicative content to describe the structure of a carbon atom. They use limited spelling, punctuation and grammar and make little use of scientific terms.	[1]–[2]
Response not worthy of credit.	[0]

[6]

(b) isotopes [1]

(c) covalent
Not: simple molecular; **not**: simple covalent; **not**: giant covalent [1]

8

6 (a) 2,8,2 arrangement [1]
2,8,6 arrangement [1] [2]

(b) correct ion structure for magnesium [1]
correct ion structure for sulfide [1]
correct charge on magnesium ion [1]
correct charge on sulfide ion [1] [4]

MgS
Allow Mg^{2+} S^{2-}
Allow correct product of equation [1]

7

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			AVAILABLE MARKS
7	**(a)**	covalent **Not**: simple molecular; **not**: simple covalent; **not** giant covalent [1]	
	(b)	correct sharing [1] – for H_2O correct outer electrons for oxygen and hydrogen [1] this mark dependent on first mark dot/cross [1] [3]	
	(c)	correct sharing [1] for oxygen molecule correct electrons i.e. inner and outer [1] this mark dependent on sharing mark correctly labelled double bond [1] correctly labelled lone pair [1] [4]	
	(d)	two atoms (in a molecule) Allow idea of two atoms unless wrongly qualified, e.g. don't allow idea of same atoms or an element [1]	9
8	**(a)**	They both: • float • react very quickly • melt/form a ball • form alkaline solutions/hydroxide/colourless solution • give off a gas/produce hydrogen • dissolve/disappear/get smaller • produce heat/exothermic • can ignite/catch fire • idea of moving or other correct (Any 3 × [1]) [3]	
	(b)	Sodium and potassium both have 1 electron in the outer shell [1] they both lose 1 electron [1] **or** they both lose 1 electron [1] to form a stable arrangement [1] **Not**: just idea of same number of electrons; **not** both group 1 [2]	
	(c)	Flame colour – potassium lilac or purple/sodium yellow **or** sodium no flame [1] or idea that only potassium catches fire [1] speed of reaction – potassium faster/sodium slower/idea of potassium more reactive [1] or other correct (Any 2 × [1]) [2]	
	(d)	**2**K + **2** H_2O → **2** KOH + H_2 [1] [1] i.e. each correct product [1] correct balancing [1] if all formulae correct [3]	
	(e)	2 Na + Br_2 → 2NaBr correct LHS [1] correct RHS[1] correct balancing [1] if all formulae correct [3]	13

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					AVAILABLE MARKS
9	**(a)**	**(i)**	A and E	[1]	
		(ii)	conduct (electricity) when solid [1] delocalised electrons carry the charge/idea that both are metals [1]	[2]	
	(b)		(very) high melting point [1] doesn't conduct (electricity) [1]	[2]	
	(c)		C is ionic [1] idea that electrolytes must have ions to carry the charge **or** ions can move when molten or in solution [1] if ions not explicit **no** credit	[2]	7
				Total	**70**

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Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2014–2015

Double Award Science: Chemistry

GSD22

Unit C1
Higher Tier

[GSD22]

WEDNESDAY 25 FEBRUARY 2015, MORNING

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **3**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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

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1 This question is about atomic structure.

(a) Use your knowledge of atomic structure to complete the table below.

Atom/ion	Mass number	Number of protons	Number of electrons	Number of neutrons
A		3	3	3
B	27	13	13	
C	11		5	6
D		11	10	12
E		17	18	18

[5]

(b) Give the chemical symbol for each of the particles A, D and E.
They may be atoms or ions.

	Symbol
A	
D	
E	

[3]

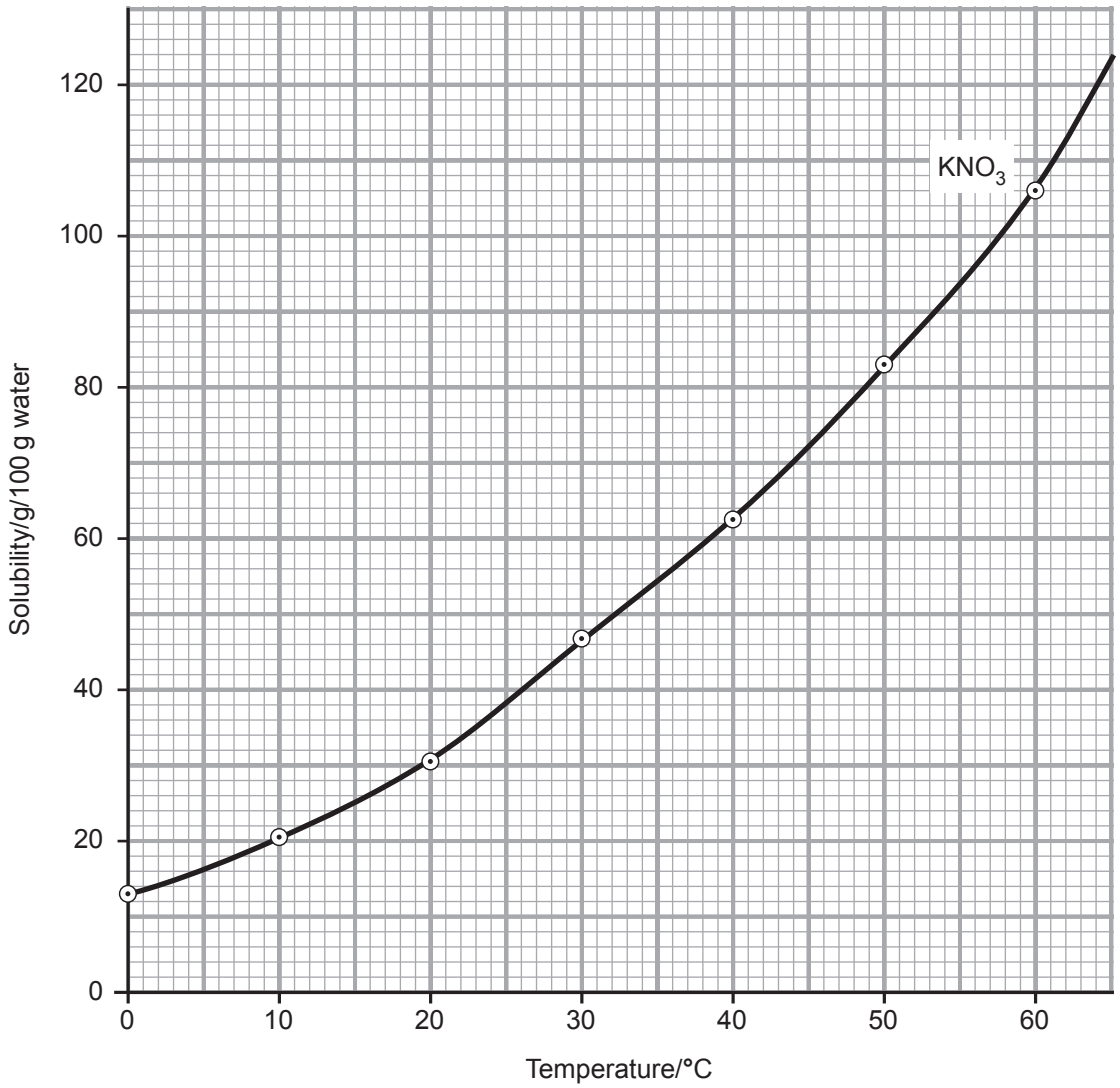
Examiner Only

Marks	Remark

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2 The graph below shows the solubility curve for potassium nitrate, KNO_3.

Examiner Only	
Marks	Remark



(a) Use the data given in the table below to plot a solubility curve for potassium chloride, KCl, on the same grid as the solubility curve for potassium nitrate.

Temperature/°C	0	10	20	30	40	50	60
Solubility of potassium chloride/g/100 g water	28	31	33	36	39	42	45

[3]

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(b) Describe and compare the trends in solubility for potassium nitrate and potassium chloride.

_____

_____

_____

_____ [2]

(c) At what temperature do both salts have the same solubility?

_____ [1]

(d) **(i)** What is the solubility of potassium nitrate in 100 g of water at 43 °C?

_____ [1]

(ii) Calculate the difference in solubility between potassium nitrate and potassium chloride in 100 g of water at 43 °C.

_____ [2]

(e) Calculate the amount that would crystallise out if a saturated solution of potassium nitrate in 100 g of water was cooled from 56 °C to 25 °C.

_____ [3]

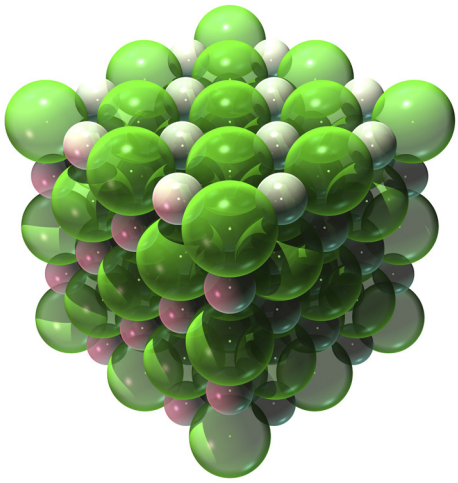
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Marks	Remark

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Examiner Only	
Marks	Remark

3 Sodium chloride has an ionic crystal lattice structure like that shown in the diagram below.



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In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

Predict and explain the physical properties you would expect sodium chloride to have.

[6]

4 The table below gives information about the salts formed when metal carbonates react with acids.

Metal carbonate	Acid used	Cation in salt	Anion in salt	Formula of salt produced
calcium	hydrochloric	Ca^{2+}		$CaCl_2$
sodium		Na^+	SO_4^{2-}	
	sulfuric	Cu^{2+}		$CuSO_4$
magnesium	nitric			$Mg(NO_3)_2$

(a) Complete the table. [4]

(b) One of the reactions shown in the table involves a colour change. Give the **colours** of the starting metal carbonate and the salt solution produced:

metal carbonate colour: _____

colour of salt solution produced: _____ [2]

(c) All of the reactions shown in the table produce the same gas. Name this gas and describe a test that is used to identify it.

Name: _____

Test: _____

_____

_____ [3]

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Marks	Remark

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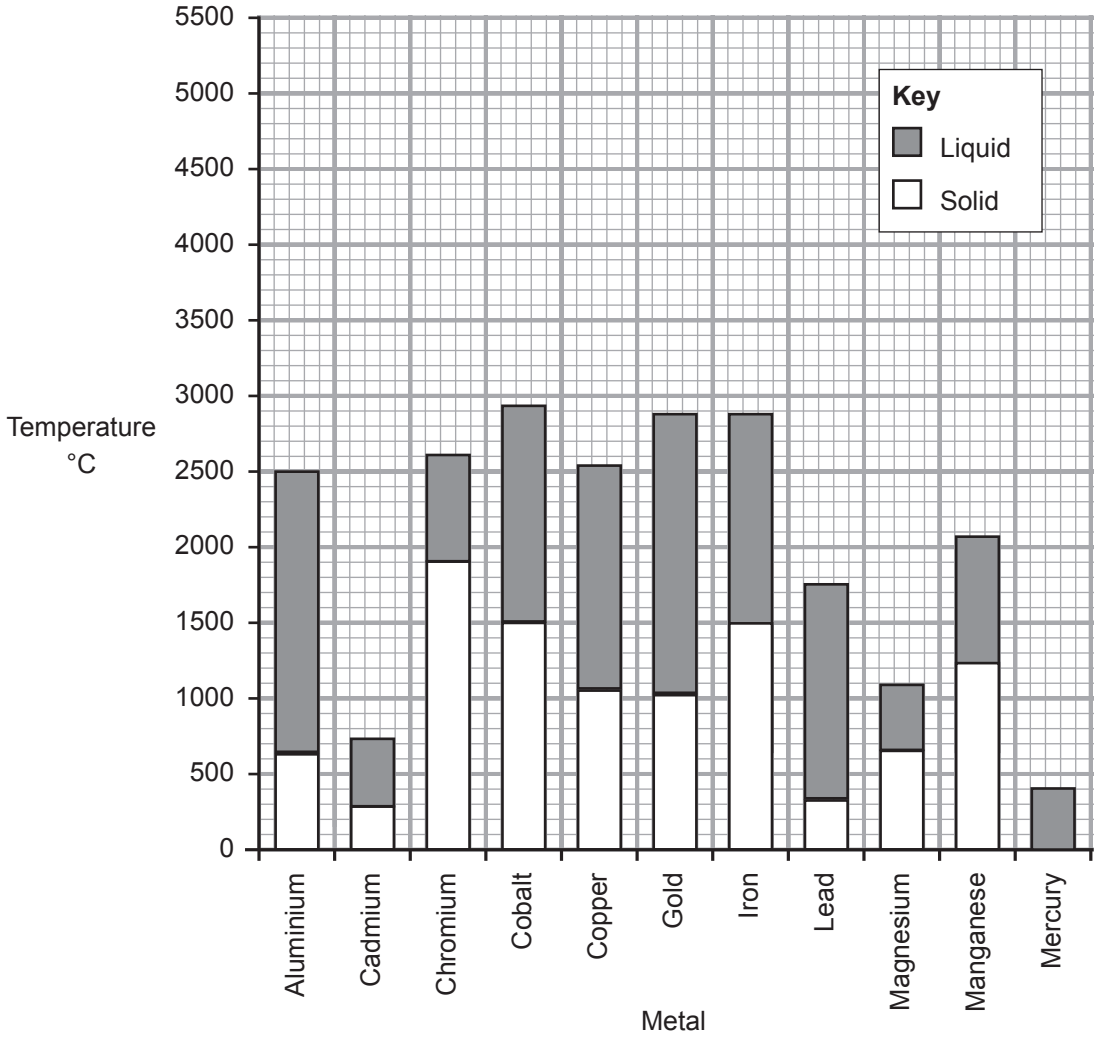
Examiner Only	
Marks	Remark

5 **(a)** What is meant by the term **melting point**?

Melting point is: _____

_____ [1]

(b) The data shown below gives information about the melting and boiling points of some metals.



(i) Which metal, in the table, has the lowest boiling point?

_____ [1]

(ii) Which metal, in the table, has the highest melting point?

_____ [1]

(iii) From the data in the table, in what way are gold and aluminium very similar?

_____

_____ [1]

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(c) The following table gives information about the relative ductility and malleability of some metals.

Most ductile ↓ Least ductile

Ductility	Malleability
gold	gold
iron	aluminium
copper	copper
aluminium	tin
zinc	lead
tin	zinc
lead	iron

Most malleable ↓ Least malleable

Describe similarities and differences you can notice in the relative ductility and malleability of these seven metals.

[3]

(d) Explain, in terms of their electrons and positive ions, how the structure of all metals allows them to be both malleable and ductile.

[4]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

6 **(a)** What do you understand by the term **covalent bond**?

_____

_____ [1]

(b) **(i)** Draw a dot and cross diagram to show the bonding in a molecule of carbon dioxide, CO_2. Show outer electrons only.

[3]

(ii) Draw a dot and cross diagram to show the bonding in a molecule of ammonia, NH_3. Show outer electrons only.

[2]

(iii) On your diagram of the molecule of ammonia above label a lone pair of electrons. [1]

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7 The table below gives information about four members of the halogens.

element	ion	physical state at room temperature	colour	formula of molecule	toxicity
fluorine	F^-	gas	yellow	F_2	high
chlorine	Cl^-	gas	green	Cl_2	high
bromine	Br^-	liquid	reddish -brown	Br_2	high
iodine	I^-	solid	grey-black	I_2	high

(a) Describe the trends in physical state at room temperature and colour as you move down the group of halogens.

_____

_____ [2]

(b) Explain why all the halogens form ions with a charge of minus one.

_____

_____ [2]

(c) Astatine, At, is the fifth member of the halogens.

(i) Using the data given predict the following properties of astatine.

Physical state at room temperature: _____

Colour: _____

Toxicity: _____

Formula of ion: _____

Formula of molecule: _____ [2]

(ii) What would you predict to be the name of the compound formed when sodium reacts with astatine?

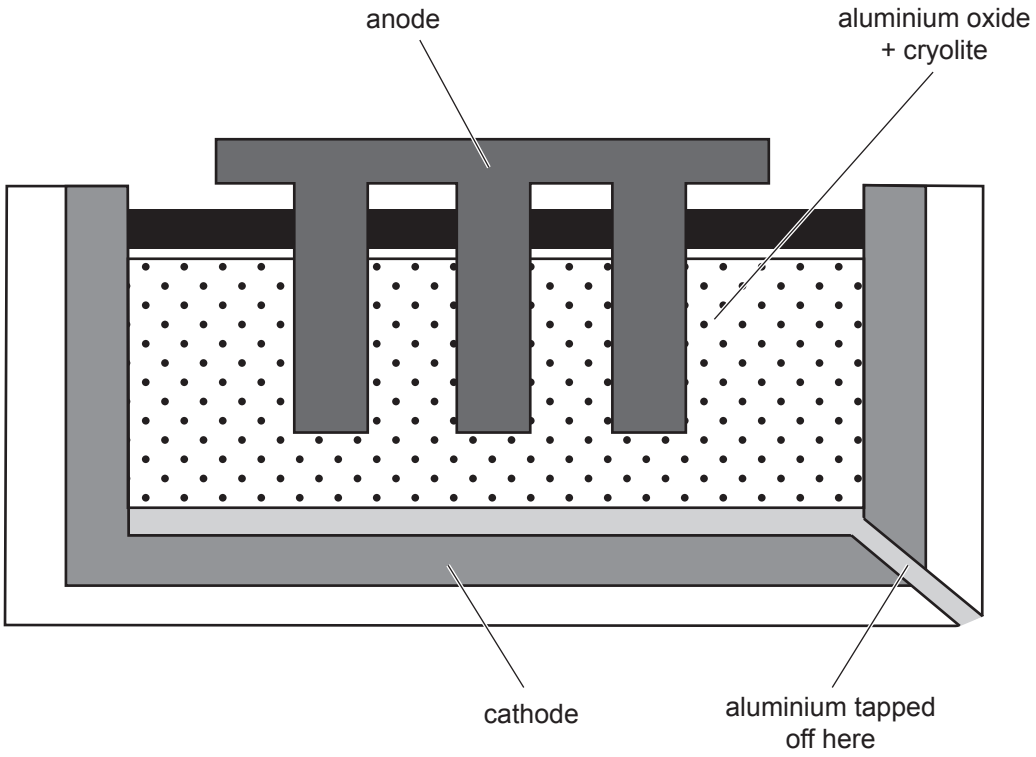
_____ [1]

Examiner Only

Marks	Remark

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8 The diagram below shows how aluminium is extracted from its ore.



(a) What is the name of the aluminium ore used in this extraction process?

_____ [1]

(b) Write a half equation to show what happens at the cathode.

_____ [2]

(c) Explain why the anodes need to be replaced periodically during this process.

_____

_____

_____ [3]

Examiner Only	
Marks	Remark

(d) The extraction process of aluminium is very expensive.
Give **two** ways in which cryolite helps reduce costs.

1. _____

_____

2. _____

_____ [2]

(e) State **two** factors which should be taken into account when siting an aluminium extraction plant.

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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113159

Rewarding Learning

General Certificate of Secondary Education
2014–2015

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

WEDNESDAY 25 FEBRUARY 2015, MORNING

MARK SCHEME

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General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

				AVAILABLE MARKS

1 **(a)**

Atom/ion	Mass number	Number of protons	Number of electrons	Number of neutrons
A	**6** [1]	3	3	3
B	27	13	13	**14** [1]
C	11	**5** [1]	5	6
D	**23** [1]	11	10	12
E	**35** [1]	17	18	18

[5]

(b) A – Li [1]
D – Na^+ [1]
E – Cl^- [1] [3] 8

2 **(a)** six or seven points correctly plotted [2]
four or five correct [1]
appropriate line through points [1] [3]

(b) As temperature increases, solubility increases [1]
potassium nitrate increases more steadily
idea potassium chloride increases steadily/slightly [1] [2]

(c) 22 ± 0.5 °C [1]

(d) **(i)** 68 g/100 g H_2O [1]

(ii) 68–40 [1] 28 [1] g [1]
Any two from three. Unit dependent on 1st/2nd mark
in (ii) apply ecf, e.g. 65/66 – 39 [1] → 26/27 [1] g [1] [2]

(e) 96 [1] – 38 [1] = 58 [2] 58 g [3]
i.e. Award [2] for 58
[3] for 58 g
Some candidates have already been penalised for misreading temperature in (d)
If so then in (e) allow, e.g.:
89 [1] – 34 [1] = 55 [2] 55 g [3]
unit mark awarded if method shown [3] 12

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		AVAILABLE MARKS
3	**Indicative Content**	

Prediction

- High melting point
- Solid
- Conducts electricity when molten/in solution [1]
- Doesn't conduct as solid
- Soluble in water
- Brittle

Explanation

High melting point

- Strong forces of attraction between ions

Electric conductivity

- Ions can carry charge
- Ions free to move in molten/aqueous state
- Ions not free to move in solid state

Response	Mark
Candidates must use appropriate scientific terms throughout to describe the physical properties, using 7 or more of the points in the indicative content, in a logical sequence. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates use 4 to 6 points from the indicative content to describe the physical properties in a logical sequence using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates use 1–3 of the points from the indicative content to describe the physical properties. However these are not presented in a logical sequence. They use limited spelling, punctuation and grammar and make little use of scientific terms. The form and style are of a limited standard.	[1]–[2]
Response not worthy of credit.	[0]

[6] 6

4 **(a)**

Metal carbonate	Acid used	Cation in salt	Anion in salt	Formula of salt produced
calcium	hydrochloric	Ca^{2+}	**Cl^-**	$CaCl_2$
sodium	**sulfuric**	Na^+	SO_4^{2-}	**Na_2SO_4**
copper	sulfuric	Cu^{2+}	**SO_4^{2-}**	$CuSO_4$
magnesium	nitric	**Mg^{2+}**	**NO_3^-**	$Mg(NO_3)_2$

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

(b) metal carbonate – green [1]
salt solution – blue [1] [2]

(c) carbon dioxide [1]
limewater [1] turns milky [1] [3]

9

5 **(a)** The temperature at which a solid is changed to a liquid.
Accept temperature at which liquid is changed to solid. [1]

(b) **(i)** mercury [1]

(ii) chromium [1]

(iii) idea that they both have a similar difference between melting point and boiling point or they are both liquid over a similar temperature range. [1]

(c) idea that gold is the most ductile and malleable [1]
idea that gold and copper both have the same level of malleability and ductility [1]
iron is very high on the ductility list but low on malleability [1]
The other metals have very similar levels in both [1]
i.e. 3 distinctly different points 3 × [1] [3]

(d) positive ions are in rows/layers/regular arrangements [1]
surrounded by delocalised electrons [1]
idea that they can be pulled into wires or hammered into sheets [1]
idea that layers slide over one another [1]
without disrupting the bond [1] any 4 × [1] [4]

11

6 **(a)** Shared (pair of) electrons [1]

(b) **(i)** Correct sharing [1]
Correct number of electrons [1]
Dot and cross diagram [1] [3]

(ii) Correct sharing for ammonia [1]
Correct number of electrons [1] [2]

(iii) Correctly labelled lone pair on ammonia [1]

7

AVAILABLE MARKS

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				AVAILABLE MARKS
7	**(a)**	state at room temperature changes from gas (to liquid) to solid as you move down the group [1] the colour becomes gradually darker as you move down the group [1] idea of darkening must be explicit	[2]	
	(b)	They all gain one electron [1] to become stable/have a full outer shell/they all have seven electrons in their outer shell [1]	[2]	
	(c) **(i)**	state – solid colour – very dark – black toxicity – high At^- At_2 five correct [2] 3 or 4 correct [1]	[2]	
	(ii)	sodium astatide	[1]	7
8	**(a)**	bauxite	[1]	
	(b)	$Al^{3+} + 3e^- = Al$ LHS [1] RHS [1]	[2]	
	(c)	Are made of carbon [1] They react with the oxygen produced [1] to form carbon dioxide [1]	[3]	
	(d)	Cryolite lowers melting point (of the ore) [1] **Not** lowers melting point of aluminium Cryolite improves the conductivity [1]	[2]	
	(e)	Transportation/infrastructure availability of electrical power/energy costs water supply skilled workforce waste disposal availability of raw material, e.g. near a port or other correct idea Any 2 × [1]	[2]	10
			Total	**70**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2014–2015

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

THURSDAY 13 NOVEMBER 2014, MORNING

TIME

1 hour.

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 seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **6**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	

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Examiner Only	
Marks	Remark

1 The element carbon has 3 naturally occurring isotopes, ^{12}C, ^{13}C and ^{14}C.

(a) Draw a **labelled** diagram of an atom of the ^{13}C isotope showing the **number and position** of the protons, neutrons and electrons.

[4]

(b) Explain why an atom of ^{13}C has no electrical charge.

[2]

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(c) The electronic configurations of the atoms of 5 different elements, A, B, C, D and E, are shown below.

element	electronic configuration
A	2,8,8
B	2,8,8,1
C	2,6
D	2,1
E	2,8,2

Using the letters A, B, C, D or E choose:

(i) an unreactive element

_____ [1]

(ii) two elements found in the same Group of the Periodic Table

_____ and _____ [1]

(iii) an element whose atoms will form ions with a charge of 2^-.

_____ [1]

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Marks	Remark

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2 Sulfuric acid is a strong acid. It reacts with sodium hydroxide according to the word equation below:

sodium hydroxide + sulfuric acid → sodium sulfate + water

(a) Write a balanced symbol equation to describe the reaction between sodium hydroxide and sulfuric acid.

_____ [3]

(b) Why is this reaction described as a **neutralisation** reaction?

_____

_____ [2]

(c) Why is sulfuric acid described as a **strong** acid?

_____

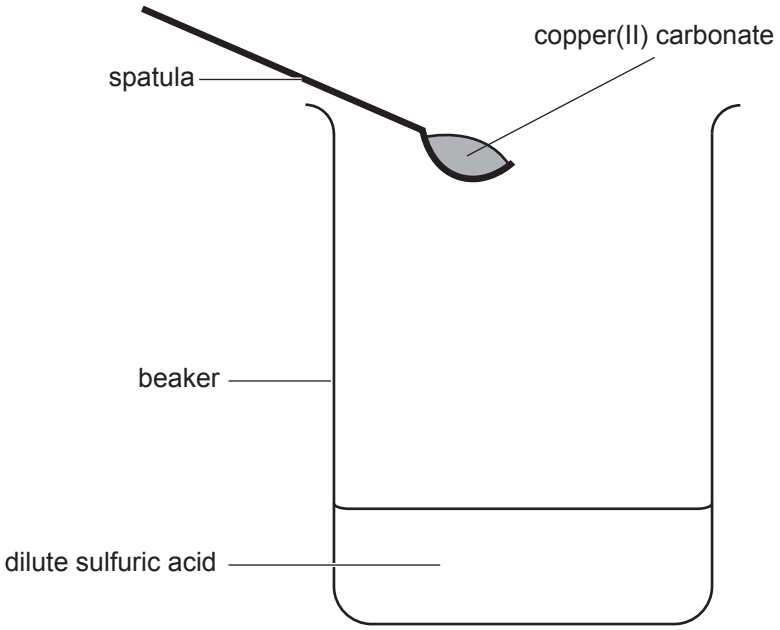
_____ [1]

Examiner Only

Marks	Remark

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(d) A sample of solid copper(II) carbonate is added to dilute sulfuric acid as shown in the diagram below.



(i) What is the colour of solid copper(II) carbonate?

_____ [1]

(ii) Describe what can be observed happening in the beaker after the copper(II) carbonate is added to the dilute sulfuric acid.

_____

_____

_____

_____

_____ [4]

(e) Sulfuric acid reacts with magnesium to produce hydrogen gas. Describe a test for hydrogen gas.

_____

_____

_____ [2]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

3 **(a)** Describe the structure and bonding in a metal such as calcium.

Structure: _____

_____

_____

_____

_____

Bonding: _____

_____ [4]

(b) Calcium reacts with fluorine to form the ionic compound, calcium fluoride.

(i) Ions are either cations or anions. Explain what is meant by the term **cation**.

_____ [1]

(ii) What is the electronic structure (electronic configuration) of a calcium ion and of a fluoride ion?

calcium ion: _____

fluoride ion: _____ [2]

(iii) What is the formula of the compound calcium fluoride?

_____ [1]

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(c) (i) Draw a dot and cross diagram to show the bonding in a **molecule** of oxygen.

[3]

(ii) Explain why oxygen has a low boiling point.

_____

_____

_____

_____ [3]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

4 The solubility of a substance is defined as the maximum mass of a substance which will dissolve in 100 g of water at a given temperature.

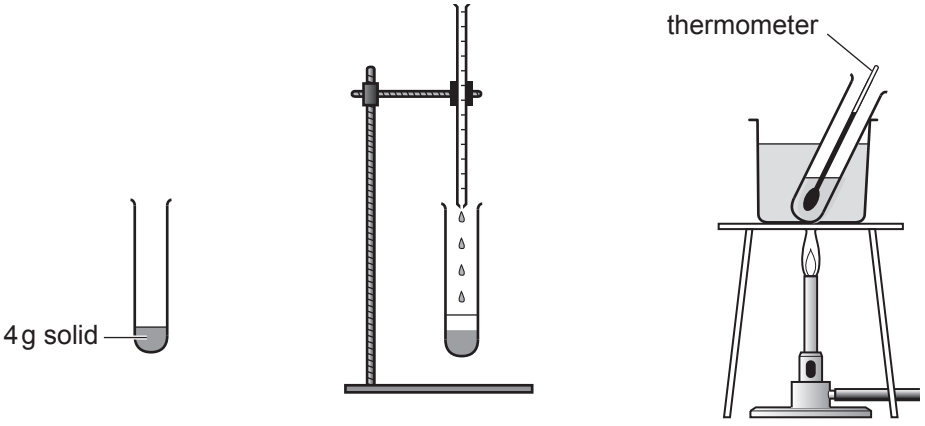
(a) Why is it essential to state the **temperature of the water** when giving the solubility of a substance?

_____

_____ [1]

(b) The first three steps in an investigation to find the solubility of a solid in water at different temperatures are shown in the diagrams below.

Complete the instructions which set out the seven practical steps needed to carry out the investigation.



Step 1 **Step 2** **Step 3**

Step 1 Place 4 g of solid into a boiling tube.

Step 2 Add _____

_____ [2]

Step 3 Place the boiling tube into a water bath and heat until all the solid has dissolved.

Step 4 Remove the boiling tube from the water bath and then wait

until _____

_____ [1]

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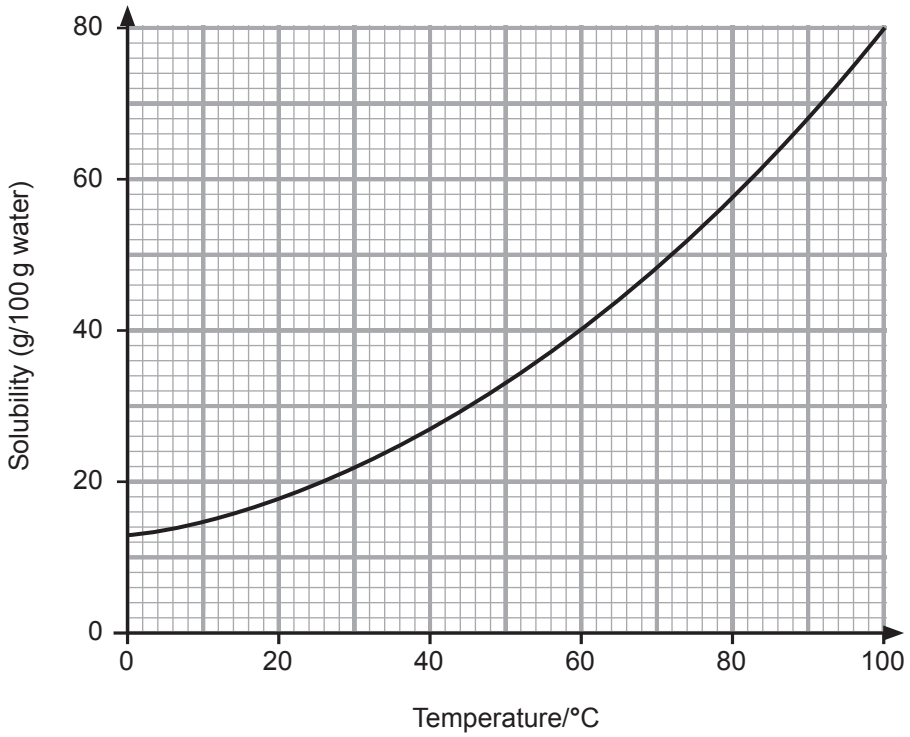
Step 5 Record the temperature.

Step 6 Add _____

_____ [2]

Step 7 Repeat steps 3 to 6 five times.

(c) Use the solubility curve for copper(II) sulfate shown below to answer the questions which follow.



(i) What is the solubility of copper(II) sulfate at 60 °C?

_____ g/100 g H_2O [1]

(ii) State whether the following mixture contains a **saturated** or **unsaturated** solution and explain your answer.

Mixture: 18 g of copper(II) sulfate added to 50 g of water at 40 °C.

Saturated or unsaturated? _____

Explanation: _____

_____

_____ [3]

Examiner Only

Marks	Remark

Examiner Only

Marks	Remark

5 The table below gives information about the melting point, boiling point and electrical conductivity of 4 substances, A, B, C and D.
Use the information in the table to answer the questions which follow.

substance	melting point/°C	boiling point/°C	electrical conductivity	
			solid	molten
A	–182	–161	does not conduct	does not conduct
B	660	2500	conducts	conducts
C	808	1465	does not conduct	conducts
D	3652	4200	conducts	conducts

(a) Identify the substance A, B, C or D which:

(i) is a gas at room temperature

_____ [1]

(ii) exists as oppositely charged ions in a giant ionic lattice

_____ [1]

(iii) exists as small molecules

_____ [1]

(iv) could be aluminium

_____ [1]

(b) Graphite has a giant covalent structure.
Explain why the melting point of graphite is extremely high.

_____

_____

_____

_____ [3]

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(c) Explain why graphite can conduct electricity.

_____

_____

_____ [2]

(d) Diamond and graphite are allotropes of the element carbon.

What are allotropes?

Allotropes are _____

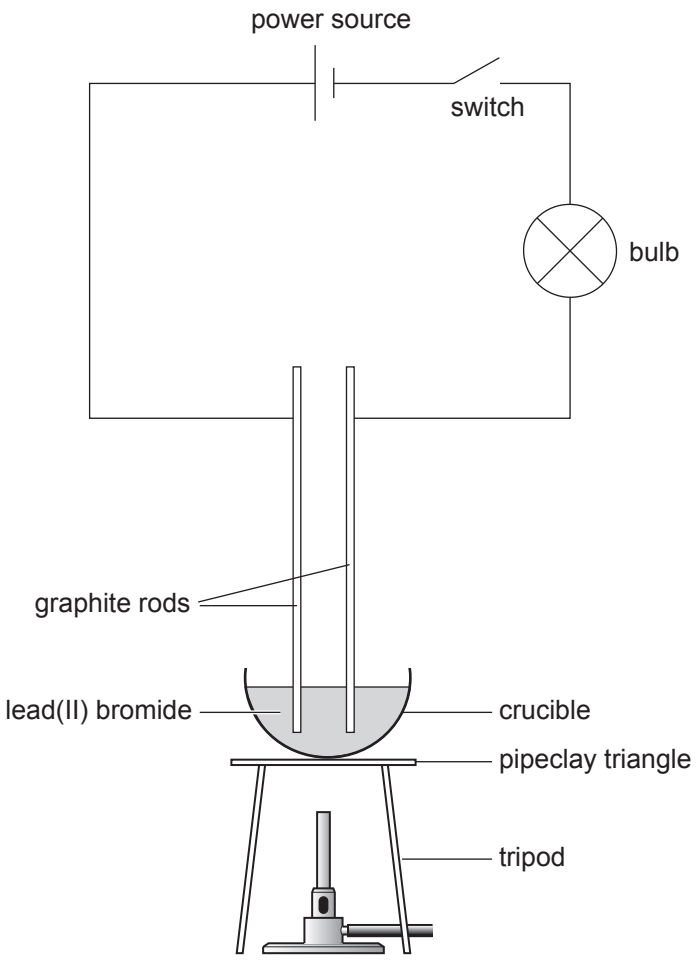
_____

_____ [2]

Examiner Only

Marks	Remark

6 The diagram below represents the assembled apparatus used to investigate the conductivity of lead(II) bromide.



Examiner Only	
Marks	Remark

A sample of solid lead(II) bromide is placed in the crucible. The switch is moved to the ON position **before** the solid lead(II) bromide is heated.

Describe and **explain** the observations made:

- in the electric circuit
- at the anode

as the lead(II) bromide is being heated.

In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

[6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

7 When chlorine gas is bubbled into a colourless solution of potassium iodide, a coloured solution is formed.

(a) Name the **type** of reaction which takes place between chlorine and potassium iodide.

_____ [1]

(b) Explain why a coloured solution is formed in the reaction.

_____

_____

_____ [3]

(c) Write an **ionic** equation for the reaction between chlorine and potassium iodide.

_____ [3]

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Rewarding Learning

General Certificate of Secondary Education
2014–2015

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

THURSDAY 13 NOVEMBER 2014, MORNING

MARK SCHEME

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General Marking Instructions

Introduction

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			AVAILABLE MARKS
1	**(a)**	6 electrons drawn as 2,4 in shells around the nucleus [1] 6 protons [1] 7 neutrons [1] both neutrons and protons in the nucleus[1] the mark for electrons can be awarded without a label but labels or a key are necessary to distinguish between the protons and neutrons [4]	
	(b)	idea of equal number of protons and electrons [2] for idea that the charges cancel each other out allow [1] **or** that there are equal numbers of positive and negative charges [1] [2]	
	(c)	**(i)** A [1]	
		(ii) B and D both needed [1]	
		(iii) C [1]	9
2	**(a)**	$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + 2H_2O$ LHS [1], RHS [1], balancing [1] [3]	
	(b)	neutralisation reaction involves an acid and a base/alkali [1] reacting to form a salt and water (only) [1] **or** hydrogen ions plus hydroxide ions [1] provide water [1] for this answer second mark depends on first [2]	
	(c)	sulfuric acid has a pH in the range 0–2 (which is the pH of a strong acid) accept fully dissociates into ions **not just** low/very low pH [1]	
	(d)	**(i)** green [1]	
		(ii) idea solid disappears/dissolves [1] fizzing/bubbles/gas given off [1] colourless liquid [1] becomes blue/blue solution formed [1] gas is colourless [1] idea of exothermic reaction [1] Any 4 × [1] [4]	
	(e)	apply a lighted splint [1] burns with a (squeeky) pop [1] [2]	13

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				AVAILABLE MARKS
3	(a)	structure: regular arrangement [1] **not just** rows or layers of positive ions [1] in a sea of delocalised electrons [1] bonding: the attraction between the electrons and the positive ions [1]	[4]	
	(b)	(i) a positive ion	[1]	
		(ii) calcium ion 2,8,8 [1] fluoride ion 2,8 [1]	[2]	
		(iii) CaF_2	[1]	
	(c)	(i) correct sharing showing two bonded pairs [1] correct number of electrons (dependent on 1st mark) [1] dot and cross notation [1]	[3]	
		(ii) there are **weak** forces of attraction [1] between the molecules (of oxygen) [1] which require little energy to break [1] second mark depends on first	[3]	14
4	(a)	solubility changes with temperature	[1]	
	(b)	step 2 (add) a known volume [1] of water [1] Max 20 cm^3 step 4 (wait until) crystals form [1] step 6 (add) another known volume [1] of water [1] accept or another known mass [1] of solid [1] no credit if both water and solid added	[5]	
	(c)	(i) 40	[1]	
		(ii) Saturated [1] 100 g of water is saturated when 27 g of solid is added [1]; idea that 50 g is saturated when 13.5 g of solid is added **or** idea that there would be 36 g of $CuSO_4$ added to 100 g of water [1]	[3]	10
5	(a)	(i) A	[1]	
		(ii) C	[1]	
		(iii) A	[1]	
		(iv) B	[1]	
	(b)	**strong** (covalent) bonds [1] between atoms/in a giant structure [1] bonds require a lot of energy to break [1]	[3]	
	(c)	delocalised electrons **can move** [1] and carry the charge [1] – must refer to electrons	[2]	
	(d)	different forms of the same element [1] in the same physical state [1] second mark dependent on first	[2]	11

6 Indicative content

DESCRIPTION
- when $PbBr_2$ is solid the bulb does not light
- $PbBr_2$ melts
- when the $PbBr_2$ is liquid the bulb lights
- bubbles/gas evolved/effervescence
- brown (gas)
- pungent smell

EXPLANATION
- the bulb lights because the circuit is complete/the liquid conducts but the solid does not
- when molten the ions are free to move
- and carry the charge
- bromide ions move to the anode
- they are discharged/lose electrons at anode
- bromine gas formed

Band	Response	Mark
A	Candidates make reference to 9–12 of the main points above to describe **and** explain the observations made during the experiment. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
B	Candidates make reference to 5–8 of the main points above to describe **and/or** explain the observations made during the experiment. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
C	Candidates make reference to 1–4 of the main points above using limited spelling, punctuation and grammar. The form and style are of limited standard and they have made no use of specialist terms.	[1]–[2]
D	Candidates make no reference to the main points and offer no other suitable response.	[0]

AVAILABLE MARKS: 6

7 (a) displacement – accept redox [1]

(b) chlorine is more reactive than iodine [1]
iodine is displaced/formed [1]
iodine is brown [1] – accept – yellow-orange-brown or combinations. Not red
iodine dissolves (in water) [1]
Any 3 × [1] [3]

(c) $Cl_2 + 2I^- \rightarrow I_2 + 2Cl^-$

LHS [1] RHS [1] balancing [1] [3]

AVAILABLE MARKS: 7

Total **70**

Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2013–2014

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

THURSDAY 15 MAY 2014, MORNING

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **7**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

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

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Examiner Only	
Marks	Remark

1 Potassium is a soft metal which can be cut with a knife. It reacts violently with chlorine to form potassium chloride.

(a) Complete and balance the symbol equation below for the reaction of potassium with chlorine.

$$K \quad + \quad Cl_2 \quad \rightarrow$$

[2]

(b) Describe the appearance of a piece of freshly cut potassium.

_____

_____ [1]

(c) What happens to the freshly cut potassium when it is left in the air for a few minutes?

_____

_____ [1]

(d) Why is potassium stored under oil in the laboratory?

_____

_____ [1]

(e) Before reacting Group 1 elements with water a risk assessment is carried out.
Give two safety precautions, apart from wearing safety glasses, which must be included in the risk assessment.

1. _____

_____

2. _____

_____ [2]

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(f) Equal sized pieces of three Group 1 metals are added to separate troughs of water which contain universal indicator.
The observations made are recorded in the table below.

Name of Group 1 metal	Observation when the metal is added to water	Colour of universal indicator
potassium	• catches fire • burns with a lilac flame on the surface of the water • quickly disappears	• changes colour from green to blue
lithium	• floats • moves about the surface of the water • eventually disappears	• changes colour from green to blue
sodium	• melts into a silvery ball on the surface of the water • disappears	• changes colour from green to blue

Read the information in the table carefully.

(i) What happens to the reactivity of the Group 1 elements as the Group is descended? You may find your Data Leaflet helpful.

_____ [1]

(ii) Explain fully why the universal indicator changed colour from green to blue.

_____

_____

_____

_____ [3]

(iii) Give one more observation which could be added to the table for **all three** reactions.

_____ [1]

(iv) Write a **word** equation to describe the reaction between sodium and water.

_____ [2]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

2 Mendeleev was one of the scientists involved in the development of the Periodic Table.

(a) He placed elements which reacted in a similar way into Groups. Explain what is meant by the term **element**.

_____

_____ [1]

Complete the sentence.

(b) In his Periodic Table, Mendeleev arranged the elements in order of

increasing _____ . [1]

(c) Complete the table below which gives information about two elements in Group 5 of the Periodic Table.

Name	Symbol	Metal/Non-metal
phosphorus		
	Bi	

[2]

(d) Nitrogen is also a Group 5 element. What Period is nitrogen in?

Period _____ [1]

(e) Element X has an electronic configuration 2, 8, 7. Explain why it is **not** an element in Group 5 of the Periodic Table.

_____

_____

_____ [2]

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

3 Magnesium chloride is produced in one type of fire extinguisher by the reaction of acid A and the base, magnesium hydroxide.

(a) Name acid A which reacts with magnesium hydroxide to produce magnesium chloride.

_____ [1]

(b) Suggest a reason why magnesium hydroxide is described as a base and not as an alkali.

_____ [1]

(c) Explain why the reaction between acid A and magnesium hydroxide is a neutralisation reaction.

_____

_____ [1]

Magnesium chloride is also formed by the reaction of magnesium oxide and acid A.

(d) What would you expect to observe when acid A is added to magnesium oxide?

_____

_____ [2]

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(e) A solution of 0.05 mol/dm^3 acid Y was tested using a pH meter and universal indicator paper. The results are recorded in the table below.

Test	Result
pH meter	pH = 3.03
Universal indicator	orange pH = 3

(i) Explain how the colour of universal indicator is used to give a pH value.

_____

_____ [1]

(ii) How do the results show that acid Y is a weak acid?

_____

_____ [1]

(iii) Give one example of a weak acid.

_____ [1]

(iv) Which property of the acid is measured in the units mol/dm^3? Circle the correct answer.

mass **volume** **concentration** **strength**

[1]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

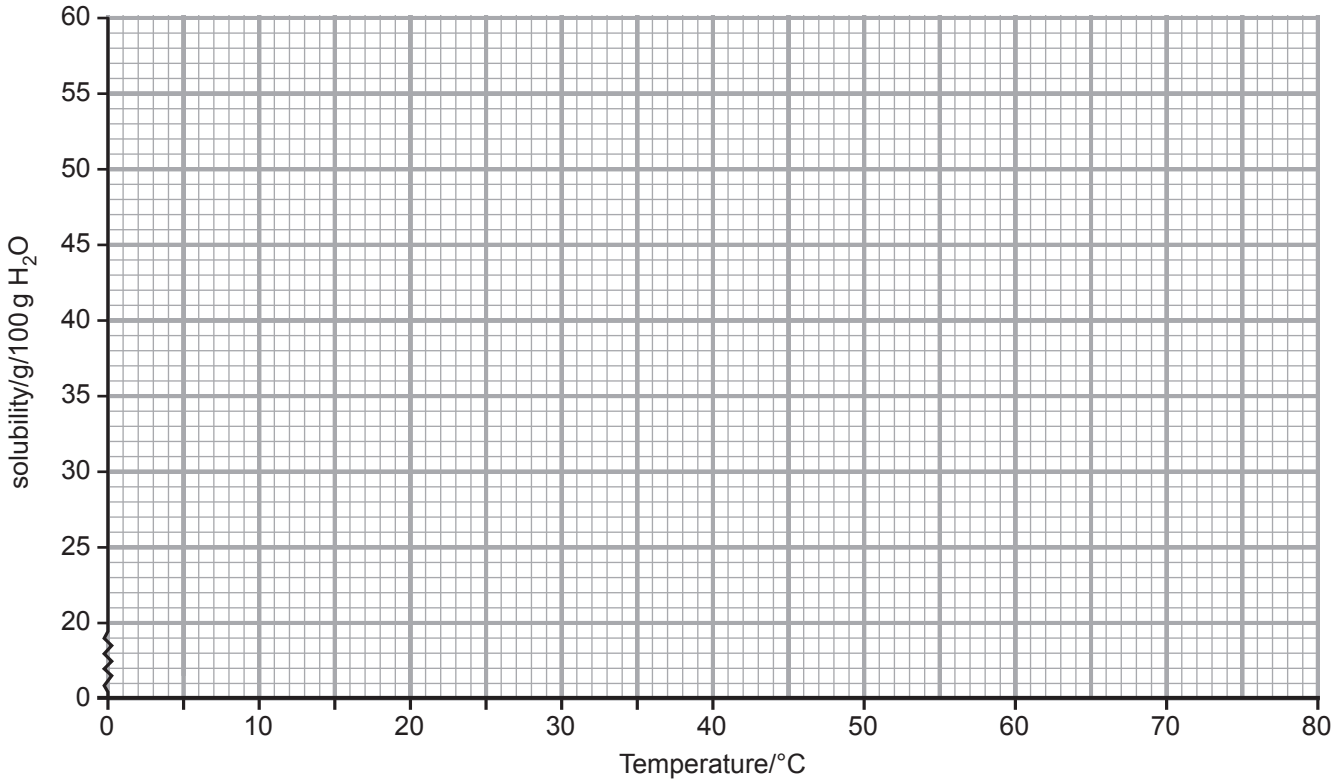
4 **(a)** An investigation was carried out to find the solubility (g/100 g H_2O) of potassium chloride at different temperatures. The results are given in the table below.

Temperature (°C)	0	10	20	30	40	50	60	80
Solubility (g/100 g H_2O)	27.8	30.9	34.0	37.1	40.0	42.9	45.8	51.2

(i) At 70 °C, 12.1 g of potassium chloride will saturate 25 g of water. Calculate the solubility of potassium chloride at 70 °C.
(You must show your working out.)

_____ g/100 g H_2O [1]

(ii) On the grid below draw the solubility curve for potassium chloride. [3]



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(b) The table below gives the solubility (g/100 g H_2O) at different temperatures for four **solid** compounds, A, B, C and D.

Solid	Solubility (g/100 g H_2O)						
	0 °C	10 °C	20 °C	30 °C	40 °C	60 °C	80 °C
A	60.0	66.7	73.9	81.8	88.7	106.0	132.0
B	12.3	16.4	18.6	25.0	31.6	40.4	49.0
C	0.22	0.24	0.25	0.26	0.26	0.24	0.23
D	79.2	85.4	94.2	105.0	119.0	158.0	187.0

(i) Use the data in the table to complete the following general rule.

For most solids the solubility _____ as the

temperature _____. [1]

(ii) One of the compounds in the table does not follow this solubility rule.
Describe fully what happens to the solubility of this solid as the temperature is increased from 0 °C to 80 °C.

_____

_____

_____

_____ [2]

(iii) Calculate the mass of solid B which will crystallise when a saturated solution of B, in 50 g of water, is cooled from 60 °C to 10 °C.
(You must show your working out.)

Answer _____ g [2]

Examiner Only	
Marks	Remark

5 The formula for sodium oxide is Na_2O.

Examiner Only	
Marks	Remark

(a) Draw diagrams to show how two sodium ions and an oxide ion are formed when two sodium atoms react with an oxygen atom.

[4]

(b) Explain how the **ions** are held together in the compound, sodium oxide.

_____

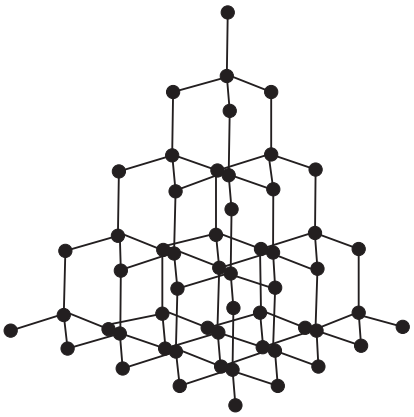
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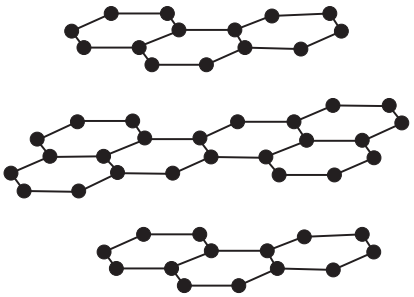
_____ [2]

Examiner Only	
Marks	Remark

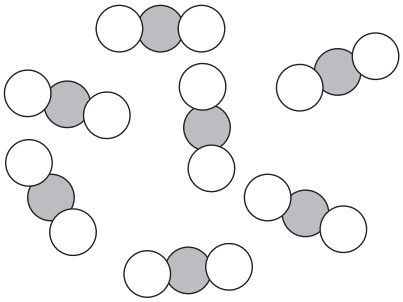
6 The diagrams below represent the structures of two allotropes of carbon, diamond and graphite, and of carbon dioxide. The atoms of each substance are held together by covalent bonds.



diamond



graphite



carbon dioxide

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(a) What are **allotropes**?

Allotropes are _____

_____

_____ [2]

(b) Explain how a **covalent bond** is formed.

_____

_____

_____ [1]

(c) Draw a dot and cross diagram to show the bonding in a molecule of carbon dioxide. **(Show all the electrons)**

[3]

(d) Complete the table below, by adding the name of the type of structure of each substance. The first one is done for you.

Substance	Type of structure
diamond	giant covalent
graphite	
carbon dioxide	

[2]

Graphite is used in pencil leads.

(e) Explain, with reference to the structure of graphite, why it is used in pencil leads.

_____

_____

_____

_____ [2]

Examiner Only

Marks	Remark

7 Describe the structure and bonding in a metal and explain why metals are ductile.

You will be assessed on your written communication skills including the use of specialist science terms.

[6]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

8 Metals, such as lead, conduct electricity in the solid state. Electrolytes, such as lead(II) bromide, conduct electricity when molten.

(a) Complete the table below which gives information about how lead and lead(II) bromide conduct electricity.

Substance	Name of particle which moves and carries the charge	Effect on the substance due to the passage of electricity
lead		
lead(II) bromide		

[4]

(b) The following questions are about the reaction that happens at the anode during the electrolysis of molten lead(II) bromide.

(i) What is an anode?

_____ [1]

(ii) Write a half equation to describe the reaction at the anode.

_____ [2]

(iii) What can be observed at the anode?

_____

_____ [2]

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2013–2014

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

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AVAILABLE MARKS

1 **(a)** **2**K + Cl_2 → **2KCl**
[1] mark for formula of product
[1] mark for balancing [2]

(b) cut surface is shiny or similar Accept silver/silvery [1]

(c) tarnishes (quickly)/goes dull Accept idea of reacting unless wrongly qualified
Not melting **Not** fizzes [1]

(d) Idea that it reacts with water vapour and/or oxygen/air
Not just 'it reacts' [1]

(e) any suitable safety precaution **particular to this reaction** except wearing safety goggles, e.g.
- use small piece of metal
- use a safety screen/idea of standing well back from experiment
- handle with tongs **Not** do not handle with fingers **Not** wear gloves
Not wear lab coat **Not** tie hair back [2]

(f) **(i)** (as Group 1 is descended) the reactivity increases [1]

(ii) idea that at the beginning the universal indicator is green because it is in a neutral liquid [1]
liquid/water/solution is neutral [1]
the **reaction** produces alkaline solution [1]
clear and explicit that indicator is blue in alkaline solution [1] [3]

(iii) idea that a gas is produced/bubbles/fizzing
or other correct [1]

(iv) sodium + water → sodium hydroxide [1] + hydrogen [1]
Allow [1] if both products given correctly but no reactants given [2]

14

2 **(a)** an element contains only one type of atom/an element cannot be broken down into anything simpler (by chemical means) [1]

(b) (relative) atomic mass
Not atomic mass number **Not** mass number **Not** mass [1]

(c)

Name	Symbol	Metal/Non-metal
phosphorus	**P**	**non-metal**
bismuth	Bi	**metal**

4 correct = [2] 2–3 correct = [1] [2]

(d) Period 2 [1]

(e) clear and explicit idea that group is determined by number of electrons in outer shell [1]
link between 7 electrons and group 7 **or** 5 electrons and group 5 [1]
2nd mark dependent on the first [2]

7

				AVAILABLE MARKS
3	(a)	hydrochloric acid	[1]	
	(b)	it is not soluble in water (alkalis are soluble in water)	[1]	
	(c)	produces a salt **and** water (only) Accept H^+ ions and OH^- ions produce water Accept ionic equation for neutralisation	[1]	
	(d)	idea that MgO disappears [1] accept dissolves colourless solution remains [1] allow idea of heat given out [1] Max. [2] out of [3] **Not** idea of bubbles if idea of gas produced is given Max. mark is [1]	[2]	
	(e) (i)	idea of comparison to a colour chart	[1]	
	(ii)	pH of a weak acid is in the range 3–6/orange universal indicator (indicates a weak acid) Allow simple answers such as pH is 3 (3.03)	[1]	
	(iii)	ethanoic acid/vinegar/or other correct named weak acid, e.g. citric acid	[1]	
	(iv)	concentration	[1]	9
4	(a) (i)	12.1 × 4 = 48.4g/100 g H_2O	[1]	
	(ii)	7–8 tabulated points correctly drawn = [2] 4–6 points correctly drawn = [1] smooth curve/line [1]	[3]	
	(b) (i)	for most solids the solubility **increases** as the temperature **increases** both needed	[1]	
	(ii)	the solid becomes more soluble up to 30 °C [1] between 30 °C and 40 °C the solubility is constant [1] idea that above 40 °C the solid becomes less soluble [1] Any two out of three idea of solubility rising then decreasing [1] reference to temperature(s) needed for both marks	[2]	
	(iii)	40.4 – 16.4 = 24.0 g [1] $\frac{24}{2}$ = 12 g [1] Correct answer on its own gets [2]	[2]	9
5	(a)	2 sodium atoms drawn as 2,8,1 and one oxygen atom drawn as 2,6 [1] transfer of e^- from Na to O [1] transfer of 1 electron from both Na atoms to oxygen [1] 2 sodium ions and 1 oxide ion [1] mark can be implied	[4]	
	(b)	attraction between/electrostatic attraction [1] (between) oppositely charged ions/sodium ions and oxide ions [1] 2nd mark dependent on 1st	[2]	6

		AVAILABLE MARKS
6	**(a)** allotropes are different forms of the same element [1] in the same (physical) state [1] 2nd mark dependent on 1st [2]	
	(b) sharing (a pair of) electrons [1]	
	(c) correct sharing of two pairs of electrons [1] in 2 double bonds correct number of electrons [1] dependent on 1st mark dot and cross [1] [3]	

(d)

Substance	Type of structure
diamond	giant covalent
graphite	**giant covalent/ macromolecular** [1]
carbon dioxide	**molecular covalent/ simple molecular** [1]

[2]

(e) idea the layers can slide over one another (easily) [1]
and leave a (visible) mark [1] [2] 10

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7 Indicative content

AVAILABLE MARKS

structure

- positive ions
- in a regular arrangement **or** lattice – unless wrongly qualified
- **surrounded** by a sea of delocalised electrons

bonding

- attraction between the positive ions or metal ions and the electrons

ductility

- the (positive) ions/atoms can move/slide over each other. Not just layers moving/sliding
- without disrupting the bond

Response	Mark
Candidates make reference to **5–6** of the indicative points above to describe the structure and bonding and ductility of metals. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5–6]
Candidates make reference to **3–4** of the indicative points above to describe the structure and/or bonding and ductility of metals. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3–4]
Candidates make reference to **1–2** of the indicative points above using limited spelling, punctuation and grammar. The form and style are of limited standard and they have made no use of specialist terms.	[1–2]
Candidates make no reference to the indicative points and offer no other suitable response.	[0]

[6] 6

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8 (a)

Substance	Name of particle which moves and carries the charge	Effect on the substance due to the passage of electricity
lead	**electrons** [1]	**no effect** Allow idea of heating up unless wrongly qualified [1]
lead(II) bromide	**ions** [1] **Not** cations **Not** anions **Allow** cations **and** anions	**decomposes/ broken down** Idea of: • lead formed or • bromine formed or • forms its elements **Not** splits up **Not** separates **Not** breaks up [1]

[4]

(b) (i) a positive electrode [1]

(ii) $2Br^- - 2e \rightarrow Br_2$ **or** $2Br^- \rightarrow Br_2 + 2e$
[1] [1] [1] [1] [2]

Allow $Br^- \rightarrow Br + e^-$ [1]

(iii) bubbles [1]
of brown gas Allow red-brown, orange-brown, yellow-brown, orange [1]
Not red **Not** yellow
with a characteristic smell [1]
any two × [1] [2]
e.c.f.: If product shown in **(ii)** is lead award candidate 1 e.c.f. mark for correct observation related to lead, e.g. silvery metal

Total

AVAILABLE MARKS

9

70

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2013–2014

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

TUESDAY 25 FEBRUARY 2014, MORNING

TIME

1 hour.

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 seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **4(b)**.
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	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** The table below gives data on the solubility of some salts. Use this information to identify patterns for these salts and answer the questions that follow.

Anion \ Cation	Cu^{2+}	Na^{+}	Pb^{2+}	Ca^{2+}
Cl^{-}	soluble	soluble	insoluble	soluble
SO_4^{2-}	soluble	soluble	insoluble	slightly soluble
CO_3^{2-}	insoluble	soluble	insoluble	insoluble
NO_3^{-}	soluble	soluble	soluble	soluble

(i) What is the solubility rule for **sodium** salts?

_____ [1]

(ii) What is the solubility rule for **chloride** salts?

_____ [2]

(iii) Which **anion** always produces soluble salts?

_____ [1]

(b) Use the information you have gained from the table to predict the solubility of the following compounds:

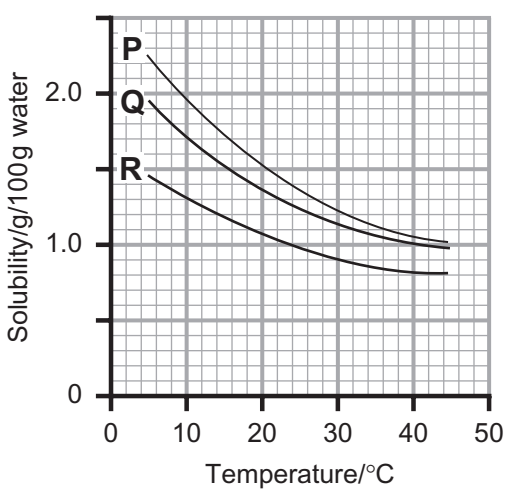
zinc nitrate _____

sodium sulfite _____

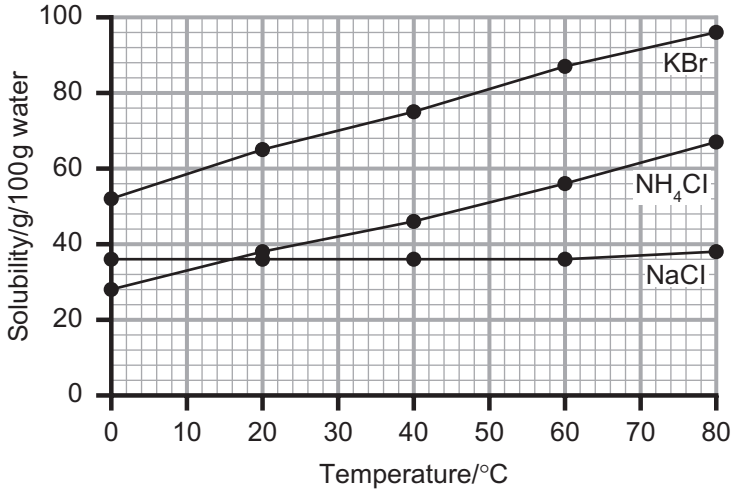
magnesium chloride _____ [3]

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2 **(a)** Look at the two graphs below showing solubilities.



graph X



graph Y

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Examiner Only	
Marks	Remark

(i) Describe the **trend** in solubility shown by the substances **P**, **Q** and **R** in graph **X**.

_____

_____ [2]

(ii) In what physical state would you expect the substances **P**, **Q** and **R** to be?

_____ [1]

(iii) Describe the **trends** in solubility for the substances in graph **Y**.

_____

_____

_____

_____ [2]

(iv) At what temperature do NaCl and NH_4Cl have the same solubility?

_____ [1]

Read the following passage and answer the questions that follow.

The river Bush is good for salmon fishing. In summer, after a spell of hot weather, heavy rain caused water from a nearby car park to run into the river. This water was warmed by the hot tarmac and it increased the river water temperature by several degrees.

(b) (i) What effect would increased water temperature have on the oxygen levels in the river water?

_____

_____ [1]

(ii) Explain how salmon could be affected if the temperature in the river rises.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

3 Aluminium is combined with small amounts of some other elements to produce a new material called **X**. This new material has improved properties making it tougher and stronger than pure aluminium. It has excellent corrosion resistance and very good resistance to seawater.

The table below gives some information about material **X**.

elements used to make X	% by weight	relative atomic mass
aluminium		27
magnesium	0.8	24
silicon	0.6	28
iron	0.7	56
zinc	0.2	65
copper	0.4	64

(a) Why can **X** be described as an alloy?

_____

_____ [2]

(b) **(i)** Calculate the **total** percentage by weight of all the other elements added to aluminium in this alloy.

_____ [1]

(ii) Calculate the percentage by weight of aluminium in this alloy. Show your working.

_____% [2]

(c) (i) From the information given in the passage opposite and your own knowledge, explain why **X** would be very suitable in the manufacture of aircraft.

_____

_____

_____

_____ [2]

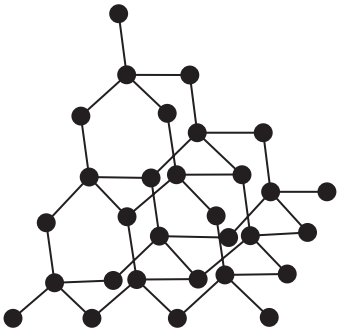
(ii) Suggest another use for **X** based on the information in the passage and the table.

_____ [1]

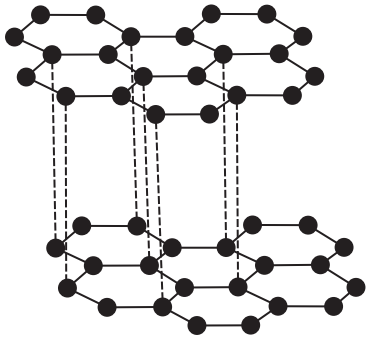
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Marks	Remark

Examiner Only	
Marks	Remark

4 Two structural models are shown below.



A



B

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(a) (i) Name a substance which has:

Structure **A** _____

Structure **B** _____ [2]

(ii) What do the black dots in the structural models represent?

_____ [1]

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In part (b) you will be assessed on your written communication skills including the use of specialist scientific terms.

Examiner Only	
Marks	Remark

(b) Compare and contrast the physical properties of the substances which have structures **A** and **B**.

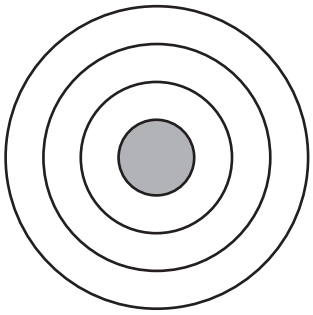
Your answer should include similar physical properties and physical properties which are different.

[6]

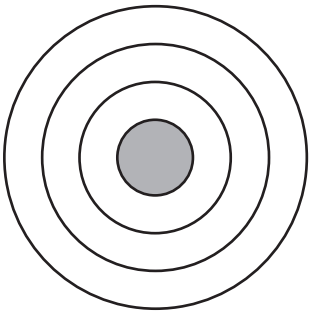
Examiner Only	
Marks	Remark

(c) (i) Sodium reacts with sulfur to form a compound called sodium sulfide.

Complete the diagrams below to show **all** the electrons in a sodium atom and in a sulfur atom.

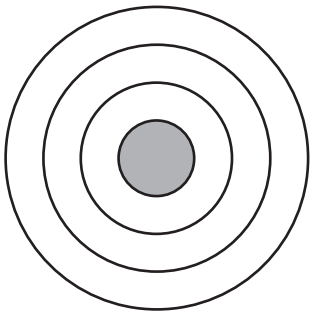


sodium atom

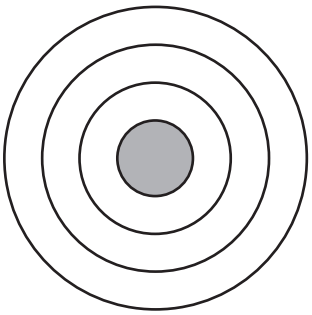


sulfur atom [2]

(ii) In the space below draw diagrams to show **all** the electrons in a sodium ion and in a sulfide ion.



sodium ion



sulfide ion [2]

(iii) How are the ions held together in sodium sulfide?

_____ [1]

(iv) What is the chemical formula for sodium sulfide?

_____ [1]

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

5 **(a)** **(i)** Draw a dot and cross diagram to show how **all** the electrons are arranged in a molecule of water.

[3]

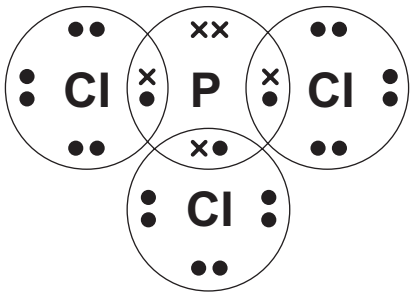
(ii) Describe a **chemical** test for water.

_____

_____ [2]

(b) When phosphorus reacts with chlorine it forms phosphorus trichloride.

The diagram shows a molecule of phosphorus trichloride. Use this diagram to answer the questions which follow.



(i) How many covalent bonds does this molecule have?

_____ [1]

(ii) How many lone pairs are there in this molecule?

_____ [1]

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(c) Draw a dot and cross diagram to show how **all** the electrons are arranged in a molecule of nitrogen, N_2.

[2]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

6 **(a)** **(i)** Describe, in terms of the electrons involved, how calcium and chlorine are able to form the stable compound calcium chloride.

[4]

(ii) Explain fully why all the halogens have similar chemical properties.

[2]

(b) When chlorine is bubbled into potassium bromide solution a colour change takes place.

(i) Describe and explain the colour change that takes place in the solution.

[3]

(ii) Write a balanced chemical equation for the reaction between chlorine and potassium bromide.

[3]

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Examiner Only	
Marks	Remark

7 **(a)** When calcium hydroxide reacts with hydrochloric acid a neutralisation reaction occurs. Write a balanced symbol equation for this reaction.

_____ [3]

(b) Write an **ionic** equation, **including state symbols**, to describe the process of neutralisation.

_____ [3]

(c) Molten calcium fluoride, CaF_2, can be used to produce calcium metal by the process of electrolysis.

Write a half equation for the reaction that takes place:

(i) at the cathode. _____ [2]

(ii) at the anode. _____ [2]

THIS IS THE END OF THE QUESTION PAPER

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114854

Rewarding Learning

General Certificate of Secondary Education
2013–2014

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

TUESDAY 25 FEBRUARY 2014, MORNING

MARK SCHEME

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General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

					AVAILABLE MARKS
1	**(a)**	**(i)**	all soluble	[1]	
		(ii)	idea of nearly all soluble [1] except lead [1]	[2]	
		(iii)	nitrate **or** NO_3^-	[1]	
	(b)		soluble [1] soluble [1] soluble [1]	[3]	7
2	**(a)**	**(i)**	They (all) decrease in solubility [1] as the temperature rises [1] second mark dependent on first; idea of negative correlation, unqualified gains [1]	[2]	
		(ii)	gases	[1]	
		(iii)	They increase in solubility with temperature [1] NaCl stays the same or increases only slightly with temperature [1]	[2]	
		(iv)	16° C ± 0.5 units needed	[1]	
	(b)	**(i)**	oxygen levels decrease	[1]	
		(ii)	salmon depend on oxygen for breathing/respiration [1] they will have less energy/could die [1]	[2]	9
3	**(a)**		Metal X is a mixture of more than two elements [1] it includes metal elements [1]	[2]	
	(b)	**(i)**	addition of all other elements = 2.7%	[1]	
		(ii)	100 – 2.7 [1] e.c.f. 97.3% [1] (for correct method but wrong answer award [1])	[2]	
	(c)	**(i)**	good corrosion resistance/stronger [1] low atomic mass/lighter [1] any suitable	[2]	
		(ii)	ships, cars, any suitable linked to properties given in the passage and the table	[1]	8

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AVAILABLE MARKS

4 **(a)** **(i)** A – diamond [1] B – graphite [1] [2]

(ii) (carbon) atoms [1]

(b) **Indicative content**

Compare

- High melting point for diamond
- High melting point for graphite
- Insolubility in water
- Solids

Contrast

- Graphite conducts electricity
- Diamond does not
- Diamonds hard
- Graphite soft

Or other correct

Band	Response	Mark
A	Candidates use 5 or more indicative points above to describe the properties of both diamond and graphite. They use appropriate specialist terms and the spelling, punctuation and grammar and form and style are of a good standard.	[5]–[6]
B	Candidates use 3–4 indicative points above to describe the properties of diamond and graphite. They use appropriate specialist terms and the spelling, punctuation and grammar and form and style are of a satisfactory standard.	[3]–[4]
C	Candidates make reference to 1–2 indicative points above using limited spelling, punctuation and grammar and the form and style are of limited standard and they have made no use of specialist terms.	[1]–[2]
D	Candidates make no reference to the points above and offer no other suitable response.	[0]

[6]

(c) **(i)** sodium 2,8,1 arrangement [1]
sulfur 2,8,6 arrangement [1] [2]

(ii) correct sodium ion 2,8 arrangement [1]
correct sulfide ion 2,8,8 arrangement [1] [2]

(iii) electrostatic attraction/forces of attraction between oppositely charged ions [1]

(iv) Na_2S [1]

15

					AVAILABLE MARKS
5	**(a)**	**(i)**	dot/cross [1] correct sharing [1] correct total number of electrons [1]	[3]	
		(ii)	add anhydrous copper sulfate [1] colour change (from white) to blue [1] **or** anhydrous cobalt chloride/cobalt chloride paper [1] turns pink [1]	[2]	
	(b)	**(i)**	3 covalent bonds	[1]	
		(ii)	10 lone pairs	[1]	
	(c)		correct sharing [1] correct total number of electrons [1]	[2]	9
6	**(a)**	**(i)**	idea of correct transfer [1] calcium loses 2 electrons [1] chlorine gains 1 electron [1] idea of need for 2 chlorines [1]	[4]	
		(ii)	idea all halogens have 7 electrons/same number of electrons in outer shell [1] all halogens need to gain 1 electron/(to become stable) [1]	[2]	
	(b)	**(i)**	colourless solution (of potassium bromide) [1] turns yellow/orange [1] (not brown unqualified) as bromine is released [1]	[3]	
		(ii)	$2KBr + Cl_2 \rightarrow 2KCl + Br_2$ left-hand side [1] right-hand side [1] balancing [1]	[3]	12
7	**(a)**		$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$ LHS [1] RHS [1] Balancing [1]	[3]	
	(b)		$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$ LHS [1] RHS [1] State symbols [1]	[3]	
	(c)	**(i)**	$Ca^{2+} + 2e^- \rightarrow Ca$ [1] [1]	[2]	
		(ii)	$2F^- - 2e^- \rightarrow F_2$ **or** $2F^- \rightarrow F_2 + 2e^-$ [1] [1] [1] [1]	[2]	10
				Total	**70**

Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2013–2014

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

THURSDAY 14 NOVEMBER 2013, MORNING

TIME

1 hour.

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 six** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **5**.
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	
Total Marks	

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Examiner Only	
Marks	Remark

1 The balanced symbol equation below includes state symbols.

$$K_2CO_{3\,(s)} + 2\,HCl_{(aq)} \rightarrow 2\,KCl_{(aq)} + H_2O_{(l)} + CO_{2\,(g)}$$

Look at the equation carefully and answer the questions which follow.

(a) **Name** the product which is dissolved in water.

_____ [1]

(b) **Name** the solid reactant.

_____ [1]

(c) Suggest two observations which can be made when the reactants are added together.

1. _____ [1]

2. _____ [1]

(d) Complete the table below to give information about the elements present in a substance which has the formula K_2CO_3.

Name of element	Number of atoms of the element in the formula

[3]

Examiner Only	
Marks	Remark

2 By the 1860s chemists had discovered about 60 elements and were attempting to organise them by looking for patterns. Today, over 100 elements are known and they are arranged in a particular way in the modern Periodic Table.

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

_____

_____

_____ [1]

(b) One suggested pattern was called "The Law of Octaves".

(i) Name the chemist who developed "The Law of Octaves".

_____ [1]

(ii) Complete the sentence to explain what is meant by "The Law of Octaves".

When elements are arranged in order of their _____

every eighth element has _____ [2]

(c) In what order are the elements arranged in the modern Periodic Table?

_____ [1]

(d) What names are given to the rows and columns of elements in the modern Periodic Table?

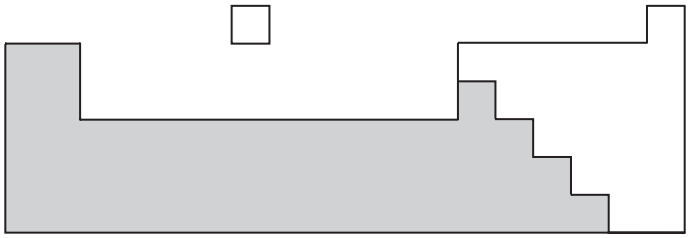
(i) rows _____ [1]

(ii) columns _____ [1]

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Examiner Only	
Marks	Remark

(e) The diagram below shows an outline of part of the modern Periodic Table with a shaded area.



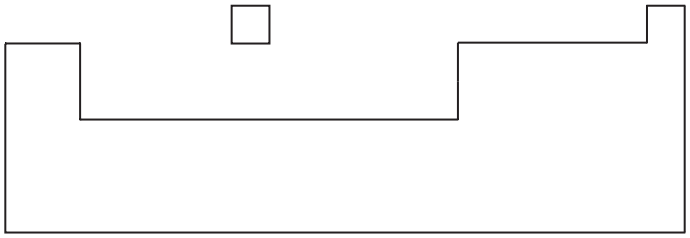
The elements in the shaded area in the diagram have similar physical properties. Give two physical properties of the elements in this area.

1. _____ [1]

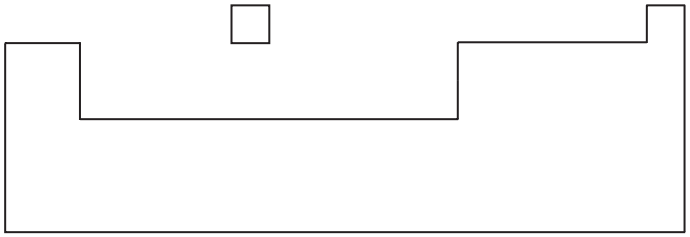
2. _____ [1]

(f) On the outlines of the Periodic Tables below shade in the area where the:

(i) halogens can be found.



(ii) alkaline earth metals can be found.



[2]

Examiner Only	
Marks	Remark

3 Carbon-12 ($^{12}_{6}C$) atoms have 6 electrons, 6 protons and 6 neutrons.

(a) Complete the table to show the relative charge and mass of the different particles found in an atom.

Particle	Relative charge	Relative mass
electron		
proton		
neutron		

[3]

(b) Carbon-14 ($^{14}_{6}C$) and carbon-12 ($^{12}_{6}C$) are isotopes of carbon.

Compare, in terms of the particles in the atoms, an atom of carbon-14 ($^{14}_{6}C$) with an atom of carbon-12 ($^{12}_{6}C$).

[3]

(c) Methane and carbon dioxide are molecules which contain carbon.

(i) Explain what is meant by the term **molecule**.

[2]

(ii) Draw a dot and cross diagram of a molecule of methane (CH_4). Show the outer electrons only.

[2]

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(iii) Draw a dot and cross diagram of a molecule of carbon dioxide (CO_2). Show the outer electrons only.

[3]

(iv) On your diagram of the molecule of carbon dioxide above label a lone pair of electrons. [1]

(v) Give two typical physical properties of molecules such as methane and carbon dioxide.

1. _____ [1]

2. _____ [1]

(d) When carbon dioxide dissolves in water it forms carbonic acid, H_2CO_3 with a pH range of 4–5.

(i) What is the formula of the ion which is present in all acids?

_____ [1]

(ii) Why is carbonic acid described as a weak acid?

_____ [1]

Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

4 Aluminium is produced on an industrial scale by the electrolysis of aluminium oxide.

(a) A mixture of aluminium oxide and substance X is melted at the start of the process. The mixture has a lower melting point than the pure aluminium oxide.

(i) Balance the symbol equation below which describes the production of aluminium from aluminium oxide.

$$Al_2O_3 \rightarrow Al + O_2$$ [2]

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

_____

_____

_____ [2]

Substance X lowers the melting point of aluminium oxide.

(iii) Name substance X.

_____ [1]

(iv) Give one other reason why substance X is added to the aluminium oxide.

_____

_____ [1]

(b) As the process continues aluminium ions move to the cathode.

(i) Draw a diagram showing the electronic structure of the aluminium **ion** and give the charge.

[2]

(ii) Why do the aluminium ions move to the cathode?

_____

_____ [2]

(iii) Explain, **in words**, what happens to the aluminium ions at the cathode.

_____

_____

_____ [3]

(c) The **structure** of aluminium metal can be described as a regular arrangement of aluminium ions surrounded by a sea of delocalised electrons.

(i) Describe the **metallic bonding** in a sample of aluminium metal.

_____

_____ [1]

(ii) Explain, in terms of its **structure**, why aluminium can be drawn into thin wires i.e. is ductile.

_____

_____

_____

_____ [3]

Examiner Only

Marks	Remark

5 In this question you will be assessed on your written communication skills including the use of specialist scientific terms.

Potassium and sodium both react with water. Describe similarities and differences between these reactions.

[6]

Examiner Only	
Marks	Remark

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

6 Displacement reactions of the halogens can be used to work out a reactivity series for the elements in Group 7.

(a) Explain what is meant by a displacement reaction.

_____

_____ [1]

(b) A student investigated the trend in reactivity within Group 7 (bromine, chlorine and iodine).
Firstly, a small amount of chlorine solution was added to potassium bromide solution in a test tube and the mixture was shaken.
The solution in the test tube turned an orange-brown colour showing that a reaction had taken place.
The investigation was continued by mixing different halogen solutions with different halide solutions, e.g. iodine solution with potassium chloride.

The results are summarised in the table below:

	potassium bromide solution	**potassium chloride solution**	**potassium iodide solution**
bromine solution		no reaction	reaction
chlorine solution	reaction		reaction
iodine solution	no reaction	no reaction	

(i) Why does the solution turn orange-brown when chlorine solution is mixed with potassium bromide solution?

_____

_____ [1]

(ii) Using the results in the table, which of the three halogens, bromine, chlorine or iodine, is the most reactive?

_____ [1]

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Examiner Only	
Marks	Remark

(iii) Based on the trend in reactivity found in the investigation, predict the reactivity of fluorine and put the **four** halogens, bromine, chlorine, iodine and fluorine in order of reactivity, most reactive first.

_____

_____

_____

_____ [2]

(c) Explain, in terms of their electronic configuration, why the halogens have similar chemical properties.

_____

_____

_____

_____ [2]

(d) Iodine is a flaky dark grey solid which does not conduct electricity and which sublimes easily when warmed.
Put a tick (✓) beside the type of structure which is most likely to represent solid iodine.

For **each** of the other three structure types give one reason why it is not correct for solid iodine.

ionic lattice _____

_____ [1]

molecular covalent _____

_____ [1]

giant covalent _____

_____ [1]

metallic _____

_____ [1]

THIS IS THE END OF THE QUESTION PAPER

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Rewarding Learning

General Certificate of Secondary Education
2013–2014

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

THURSDAY 14 NOVEMBER 2013, MORNING

MARK SCHEME

STEMUP.CO.UK

General Marking Instructions

Introduction

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		AVAILABLE MARKS
1	**(a)** potassium chloride [1]	
	(b) potassium carbonate [1]	
	(c) idea that solid disappears/dissolves [1] bubbles/fizzing [1] heat given off [1] *colourless* solution formed [1] any *two* [2]	
	(d)	

Name of element	Number of atoms of the element in the formula
potassium	2
carbon	1
oxygen	3

[3] 7

6 correct = [3]; 4 or 5 correct = [2]; 2 or 3 correct = [1]
Number of atoms depends on correct element

2 **(a)** an element is a substance which has only one type of atom/ cannot be broken down into anything simpler (by chemical means) [1]

(b) **(i)** (John) Newlands [1]

(ii) When elements are arranged in order of (relative) **atomic mass** [1]
(NOT *mass number)*/every 8th element has **similar properties**. [1] [2]

(c) atomic number [1]

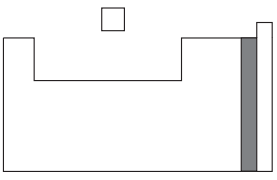
(d) **(i)** periods [1]

(ii) groups (apply cm) [1]

(e) any 2 suitable general physical properties of a metal
e.g. conduct heat, conducts electricity, ductile, malleable, sonorous, high melting point, shiny NOT hard, NOT dense, NOT solid, NOT high B.P. [2]

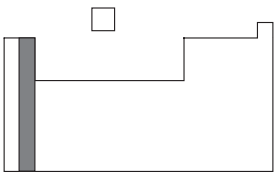
(f)

(i)



halogens [1]

(ii)



alkaline earth metals [1]

[2] 11

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AVAILABLE MARKS

3 **(a)**

Particle	Relative charge	Relative mass
electron	–1	(almost) 0*
proton	+1	1
neutron	0	1

[3]

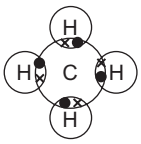
row *allow $\frac{1}{1800} - \frac{1}{2000}$

6 correct = [3], 4 or 5 correct = [2], 2 or 3 correct = [1]

(b) idea that each atom has 6 electrons and 6 protons/same number of protons and electrons [1]
carbon–14 has more neutrons or carbon–12 has fewer neutrons [1]
carbon–14 has 2 (more neutrons) or carbon–12 has (2) fewer neutrons [1] [3]

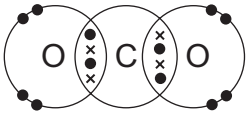
(c) **(i)** a molecule is a substance which contains two or more atoms [1]
which are covalently bonded [1] [2]

(ii)



correct sharing [1]
correct total number of electrons [1] [2]

(iii)



correct sharing [1]
correct total number of electrons [1]
dot and cross in <u>BOTH</u> **c(ii)** and **c(iii)** [1] [3]

(iv) candidate must indicate at least 1 pair of non-bonded electrons. [1]

(v) have low boiling points/do not dissolve in water/do not conduct electricity any 2 NOT low melting point [2]

(d) **(i)** H^+ [1]

(ii) Idea that its pH in range 4–5 (i.e. a weak acid)
or does not contain many H^+ ions
NOT because of its pH – unless qualified [1]

18

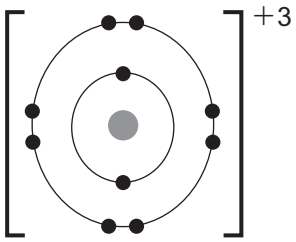
AVAILABLE MARKS

4 **(a)** **(i)** $2Al_2O_3 \rightarrow 4Al + 3O_2$
[1] [1] [2]

(ii) idea that electrolysis is the decomposition/breaking down of a substance/compound [1] using electricity [1]
allow idea of molten/in solution as long *BOTH* are given [2]

(iii) cryolite [1]

(iv) cryolite also increases the (electrical) conductivity (of the electrolyte)/decreases cost *NOT* lowers melting point [1]

(b) **(i)** 

electron configuration [1]
charge [1]
[2]

(ii) idea that cathode is negative/negatively charged [1]
aluminium ions are positively charged/are attracted to the cathode [1] [2]

(iii) the aluminium ions gain electrons [1] 3 electrons (gained) [1] to become an (aluminium) atom [1]
(for $Al^{3+} + 3e^- \rightarrow Al$ allow [1]) [3]

(c) **(i)** idea of *attraction* between positive ions and (negative)/ delocalised electrons [1]

(ii) (layers of) aluminium ions/atoms [1] can slide/move over one another [1] without disruption to the bond [1]
NOT just 'layers' [3]

17

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5 Indicative content

AVAILABLE MARKS

Comparisons
- both products are hydroxides (this can be expressed in several different ways)
- both dissolve/disappear
- both leave colourless solutions
- both form a ball
- move on surface
- both form alkaline solutions
- both float on water
- both produce bubbles/fizzing/effervescence
- both produce hydrogen
- both vigorous/fast/violent
- both exothermic
- or other correct

Maximum number of comparisons allowed is 5.

Contrasts
- K catches fire immediately/very quickly
- lilac flame
- Na may catch fire
- yellow/orange flame
- K is more reactive than Na (more vigorous)
- or other correct

Maximum number of contrasts allowed is 5.

Response	Mark
Candidates must use appropriate specialist terms to compare the reaction of sodium and potassium with water using 7–10 indicative points. They use good spelling, punctuation and grammar and the form and style are of a high standard.	5–6
Candidates use 4–6 indicative points to compare the reaction of sodium and potassium with water. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	3–4
Candidates make reference to 1–3 indicative points using limited spelling, punctuation and grammar. The form and style is of limited standard and they have made no use of specialist terms.	1–2
Candidates make no reference to the main points above and offer no other suitable response.	0

[6] 6

		AVAILABLE MARKS
6	**(a)** idea that a more reactive (halogen) element takes the place of/ replaces a *less reactive* (halogen) element (from a halide compound) [1]	
	(b) **(i)** Idea that bromine is present [1]	
	(ii) chlorine [1]	
	(iii) Fluorine chlorine bromine iodine [2] Fluorine most reactive [1] other three in correct order (1) award [1] for iodine bromine chlorine fluorine i.e. wrong way round [2]	
	(c) all halogens have seven outer electrons/same number of electrons on the outer shell [1] require one electron to form a full outer shell [1] [2]	
	(d) ionic lattice – idea that iodine does not have ions or other correct [1] molecular covalent ✓ [1] giant covalent – idea that iodine does not have high melting/boiling point [1] e.g. iodine sublimes *easily* metallic – idea that iodine does not conduct electricity [1] [4]	11
	Total	**70**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012–2013

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

MONDAY 20 MAY 2013, AFTERNOON

TIME

1 hour.

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 seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **3(b)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
Total Marks	

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Examiner Only	
Marks	Remark

1 Graphene is a form of the element carbon. It consists of a single layer of carbon atoms joined together by covalent bonds. It is 200 times stronger than steel. It conducts electricity as efficiently as copper and is a good conductor of heat. It is almost completely transparent with possibly the highest melting point known.

(a) Explain why graphene is said to be an element.

_____

_____ [1]

(b) Give two pieces of information from the passage which suggest that graphene might be thought to be **metallic**.

1. _____

_____

2. _____

_____ [2]

(c) Give two pieces of information from the passage which suggest graphene might be thought to be **non-metallic**.

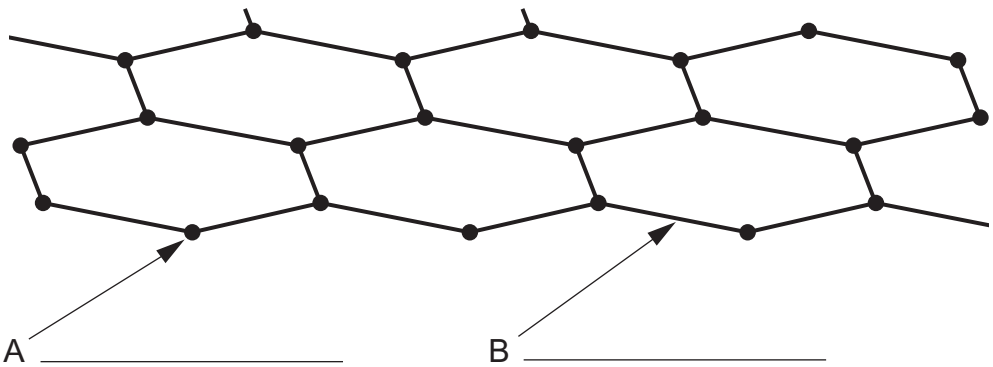
1. _____

_____

2. _____

_____ [2]

(d) Using the information in the passage, label A and B in the diagram of graphene below.



[2]

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

2 A small piece of sodium metal was added, using tongs, to a trough of water to which a few drops of universal indicator had been added.

(a) How is sodium stored in the laboratory?

_____ [1]

(b) Why was a **small** piece of sodium added to the water?

_____ [1]

(c) Why was the sodium handled with tongs instead of using fingers to lift it?

_____

_____

_____ [2]

(d) Choose **three** statements which describe what happens when sodium is placed into the water.

Put a tick (✓) in the three correct boxes.

bubbles of carbon dioxide gas form	☐	melts into a silvery ball	☐
burns with a lilac flame	☐	sinks to the bottom then floats to the top	☐
moves quickly across the surface of the water	☐	eventually disappears	☐

[3]

At the end of this reaction the universal indicator had turned purple.

(e) What does this tell you about the product of the reaction?

_____

_____ [1]

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Sodium is a Group 1 metal.

Examiner Only	
Marks	Remark

(f) Explain, in terms of electrons, why all Group 1 metals react in a similar way.

_____

_____ [1]

(g) Suggest why rubidium is **not** used in the school laboratory instead of sodium to demonstrate the reaction of Group 1 metals with water.

_____

_____

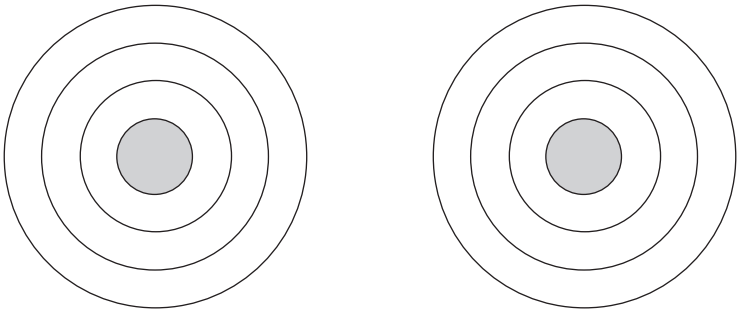
_____ [1]

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Examiner Only	
Marks	Remark

3 Hot magnesium metal will burn in chlorine gas to form magnesium chloride.

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



magnesium atom chlorine atom [2]

In part (b) you will be assessed on your written communication skills including the use of specialist scientific terms.

(b) Explain fully, **in terms of electrons**, how the atoms of magnesium and chlorine react together to form magnesium chloride.

Include in your answer the charges on the ions and an explanation of how the ions are held together in the compound.

[6]

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(c) Using a **dot and cross** diagram, draw a molecule of hydrogen.

[2]

(d) Describe a test for hydrogen gas.

_____

_____

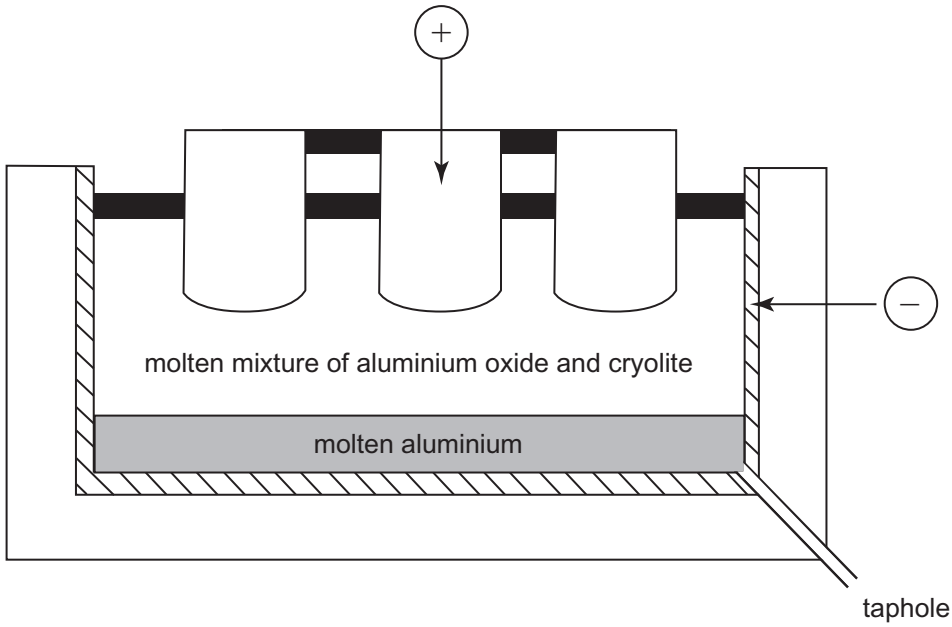
_____ [2]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

4 Aluminium is extracted from its ore by the electrolysis of a molten mixture of alumina (aluminium oxide) and cryolite.



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

_____

_____

_____ [2]

(b) Name the ore of aluminium which is purified to produce alumina.

_____ [1]

(c) Give two reasons why cryolite is added to the alumina.

1. _____

_____

2. _____

_____ [2]

Aluminium is produced at the cathode.

(d) Write a half equation for the production of aluminium at the cathode.

_____ [2]

(e) Explain, in words, what happens to the oxide ions at the anode in the **electrolysis process**.

Examiner Only

Marks	Remark

_____

_____

_____

_____

_____

_____ [3]

(f) Explain why the anodes need to be replaced regularly.

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

5 Diamond and graphite are two allotropes of carbon. Carbon dioxide is one of the many compounds of carbon.

(a) Complete the table below which gives information about the bonding, structure and melting points of diamond and carbon dioxide.

	Bonding	**Type of structure**	**Melting point /°C**
Diamond	covalent		3350
Carbon dioxide	covalent		–78

[2]

(b) What are allotropes?

_____

_____ [2]

(c) **(i)** **Suggest** a melting point for graphite.

_____ [1]

(ii) Explain your answer to **(c)(i)**.

_____

_____ [1]

(d) Explain, in terms of its structure, why diamond has an extremely high melting point.

_____

_____

_____ [3]

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(e) Explain, in terms of its structure, why carbon dioxide has a very low melting point.

_____

_____

_____ [3]

(f) Explain, in terms of its structure, why diamond cannot conduct electricity.

_____

_____ [1]

Examiner Only	
Marks	Remark

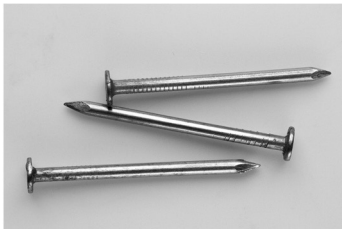
Examiner Only	
Marks	Remark

6 Nails made from iron rust easily. The rust can be removed using phosphoric acid.



rusty nails

© Charles D. Winters / Science Photo Library



nails after using phosphoric acid

© Charles D. Winters / Science Photo Library

The word equation for the reaction is given below.

phosphoric acid + iron oxide ⟶ iron phosphate + water

(a) Name the **base** in the word equation above.

_____ [1]

(b) Explain why this reaction is a neutralisation reaction.

_____

_____ [2]

The symbol for the phosphate ion is PO_4^{3-}

(c) Use this information to write the formula for phosphoric acid.

_____ [2]

Aluminium can be added to the iron to make an **alloy** which will not rust.

(d) What is an alloy?

_____

_____ [2]

Examiner Only	
Marks	Remark

7 Copper(II) oxide reacts with sulfuric acid to form copper(II) sulfate and water.

(a) Write a balanced symbol equation for the reaction between copper(II) oxide and sulfuric acid.

_____ [2]

(b) Describe what you observe happening during this reaction.

_____

_____

_____ [3]

Copper(II) sulfate can also be produced by the reaction of copper(II) carbonate with sulfuric acid.

(c) Write a balanced symbol equation for the reaction between copper(II) carbonate and sulfuric acid.

_____ [2]

(d) Describe two ways in which the reaction of copper(II) carbonate with sulfuric acid is different to the reaction of copper(II) oxide with sulfuric acid.

1. _____

2. _____ [2]

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Rewarding Learning

General Certificate of Secondary Education
2012–2013

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

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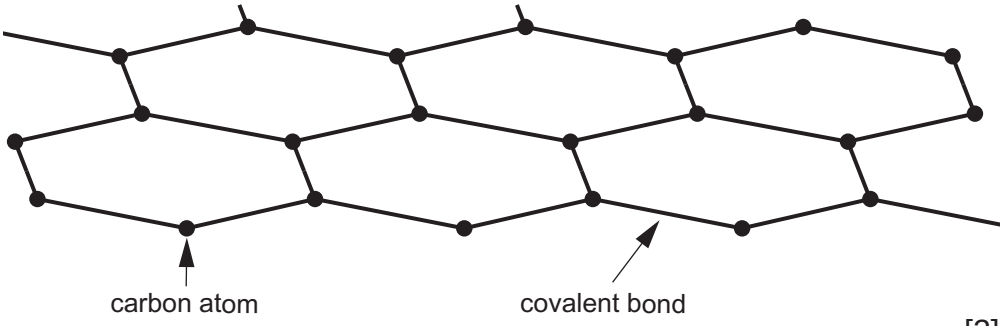
AVAILABLE MARKS

1 **(a)** It contains **only** carbon atoms/It contains one **type** of atom
Idea that it is a form of (the element) carbon [1]

(b) It is a (good) conductor of electricity [1]
it is a (good) conductor of heat [1] [2]
Allow [1] for (good) conductor on its own

(c) Carbon is a **non-metallic** element/It is transparent/It has an extremely/very high melting point/It has covalent bonds.
(Any **two** × [1]) [2]
not it is an allotrope of carbon
not it is a form of carbon

(d)



[2] 7

2 **(a)** Under oil [1]

(b) Idea that a large piece could pose a danger or idea that sodium is **very** reactive **or** idea of safety reason. [1]

(c) Idea of cause burning/being corrosive (to skin) [1]; idea that using tongs prevents this [1] idea of reacting with moisture on skin [1]
(Any **two** × [1]) [2]

(d) Moves quickly across the surface of the water [1] melts into a silvery ball [1] eventually disappears [1] [3]

(e) The product is an alkali/the product is soluble in water not just base [1]

(f) All have one electron in their outer shell/all need to lose one electron/ all have same number of electrons in their outer shell [1]

(g) Idea that rubidium is **too** reactive/**too** dangerous [1] 10
not idea of cost
not very reactive
not more reactive

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AVAILABLE MARKS

3 **(a)** Candidates draw a magnesium atom with an electronic configuration 2,8,2 [1]
and a chlorine atom with the electronic configuration 2,8,7 [1] [2]

(b) Indicative content

- Idea of electron transfer from magnesium to chlorine
- Magnesium loses 2 electrons
- To 2 chlorine atoms/forms $MgCl_2$
- To become a magnesium ion with a charge of 2+/to form Mg^{2+}
- Each chlorine atom gains one electron
- To become a chloride ion with a charge of 1−/to become Cl^-
- The ions are held together by electrostatic forces/oppositely charged ions are attracted

Response	Mark
Candidates make correct reference to 6–7 of the indicative points shown. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates make correct reference to 4–5 of the indicative points shown. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3]–[4]
Candidates make correct reference to 1–3 of the indicative points shown using limited spelling, punctuation and grammar. The form and style are of limited standard and they have made no use of specialist terms.	[1]–[2]
Candidates make no reference to the main points above and offer no other suitable response.	[0]

[6]

(c) Molecule must be recognisable H_2 for credit [2]
Correct sharing, dot and cross, correct total electrons [2]
Correct sharing, dot and cross, incorrect total electrons [1]
Correct sharing, not dot and cross, correct total electrons [1]
Correct total electrons is dependent on correct sharing

(d) Apply a lighted splint [1]
a popping sound is heard if hydrogen is present [1] [2]

12

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			AVAILABLE MARKS
4	**(a)**	The decomposition/breaking down of a compound/substance [1] due to the passage of/using electricity [1] [2]	
	(b)	Bauxite [1]	
	(c)	To reduce the melting point [1] (**not** if wrongly qualified, e.g. of aluminium) to reduce the operating temperature [1] to increase the (electrical) conductivity [1] reduces costs/saves energy [1] (max 2 × [1]) [2]	
	(d)	$Al^{3+} + 3e^- \longrightarrow Al$ [1] [1] [2]	
	(e)	2 oxide ions [1] lose 2 electrons each [1] to form a molecule of oxygen [1] [3] **or** an oxide ion loses 2 electrons [1] to form an oxygen atom [1] 2 oxygen atoms combine to form oxygen (gas) [1]	
	(f)	Carbon/graphite (anode) reacts with [1] (oxygen formed at the anode) to produce carbon dioxide (gas) [1] [2]	12
5	**(a)**	Diamond – giant covalent/macromolecular [1] Carbon dioxide molecular covalent/simple covalent [1] [2] (Accept simple molecular)	
	(b)	Allotropes are different forms of the same element [1] in the same (physical) state [1] [2] second mark dependent on first i.e. 'the same element'	
	(c) **(i)**	In the range 3000 °**C**–4000 °**C** [1]	
	(ii)	Idea that graphite has a similar structure to diamond (therefore will have a similar melting point) **or** idea of giant covalent/macromolecular structure [1]	
	(d)	Atoms are held together by covalent bonds [1] idea of a giant structure/tetrahedral arrangement [1] These bonds require a lot of energy to break [1] [3] **NOT JUST** hard to break	
	(e)	Molecules [1] are held together by weak (van der Waals) forces [1] which require a small amount of energy to break [1] **or** Idea of weak attractive forces [1] Idea of these being between molecules [1] Idea of these forces needing little energy to break [1] If hard to break given in **(d)** don't penalise easy to break in **(e)** [3]	
	(f)	Diamond does not have free electrons **not** if incorrectly qualified [1]	13

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				AVAILABLE MARKS
6	**(a)**	Iron oxide	[1]	
	(b)	In **this** reaction a base reacts with an acid [1] to form water [1] **not** alkali	[2]	
	(c)	H_3PO_4 allow [1] for HPO_4 or H_2PO_4, or H_4PO_4 or PO_4H_3	[2]	
	(d)	An alloy is a **mixture** of two or more elements [1] at least one of which is a metal [1]	[2]	7
7	**(a)**	$CuO + H_2SO_4 \longrightarrow CuSO_4 + H_2O$ [1] [1]	[2]	
	(b)	Black solid [1] solid disappears [1] blue (solution) formed [1] allow idea of exothermic reaction **or** Idea of **blue** (solution) formed [1] solid dissolves or disappears [1] either solid was black or solution was colourless or heat is given out [1]	[3]	
	(c)	$CuCO_3 + H_2SO_4 \longrightarrow CuSO_4 + H_2O + CO_2$ [1] [1]	[2]	
	(d)	idea that copper [II] carbonate reacts more quickly idea of gas formed (with copper(II) carbonate) [1] idea that copper(II) carbonate is green [1] idea that CuO needs heat before it reacts [1] **or** other correct (Any **two** × [1]) N.B. formation of gas is wrong	[2]	9
			Total	**70**

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Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012–2013

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

TUESDAY 26 FEBRUARY 2013, MORNING

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in question **3(b)**.
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	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** Indicators can change colour in acid and alkaline solutions. Indicators can be made from plant material such as red cabbage.

The table below gives information about three different indicators. Use this information to answer the questions that follow.

Substance	Colour of universal indicator paper	Colour of red litmus paper	Colour of red cabbage solution	pH range
hydrochloric acid	red	red	red	1–2
sodium hydroxide	dark blue	blue	yellow	12–14
water	green	red	purple	7
ethanoic acid	orange	red	red	3–6

(i) Why is red litmus paper **not** a suitable indicator for testing pH?

_____

_____ [1]

(ii) Explain why red cabbage solution can be described as an indicator.

_____

_____

_____

_____ [2]

(iii) Why is universal indicator a better indicator than red cabbage solution for testing acids?

_____

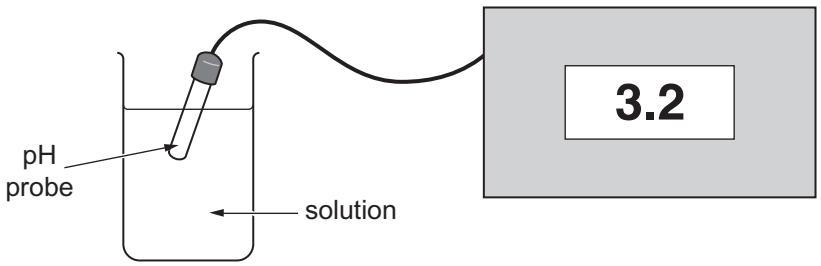
_____

_____ [1]

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Examiner Only	
Marks	Remark

(b) The diagram below shows a way of measuring pH.



Give an advantage of using a pH probe instead of an indicator solution to measure pH.

_____ [1]

(c) When copper(II) carbonate reacts with an acid it forms copper(II) sulfate. Complete the word equation for this reaction.

copper(II) carbonate + → copper(II) sulfate + +

[3]

(d) The colour of copper(II) sulfate crystals changes as they are heated.

The colour and formulae of three types of copper(II) sulfate are given in the table below.

Colour	Formula
blue	$CuSO_4.5H_2O$
green	$CuSO_4.H_2O$
white	$CuSO_4$

(i) Give the formula of the type of copper(II) sulfate that would be best to test for the presence of water.
Explain your answer.

Formula: _____ [1]

Explanation: _____

_____ [2]

(ii) What word is used to describe white copper(II) sulfate?

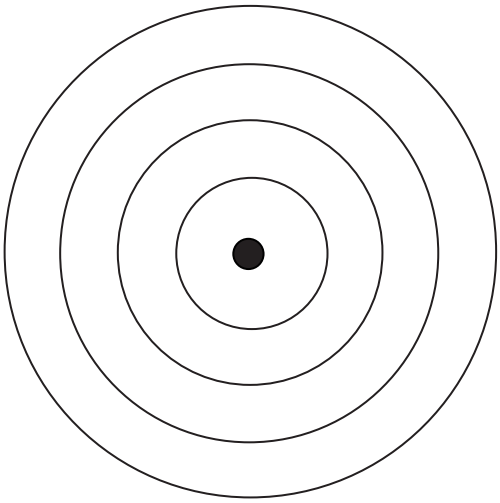
_____ [1]

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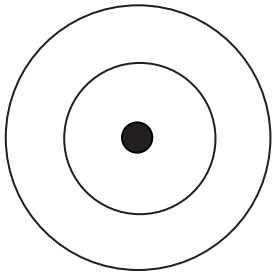
Examiner Only	
Marks	Remark

2 Potassium and fluorine react violently together to form the compound potassium fluoride.

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



potassium atom



fluorine atom

[2]

(b) Describe how a potassium atom becomes an ion and how a fluorine atom becomes an ion. You should state the formula of each ion.

[4]

(c) How are the ions held together in potassium fluoride?

[1]

(d) What is the formula for potassium fluoride?

[1]

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Examiner Only	
Marks	Remark

3 **(a)** Give an accurate definition of the term solubility.

_____

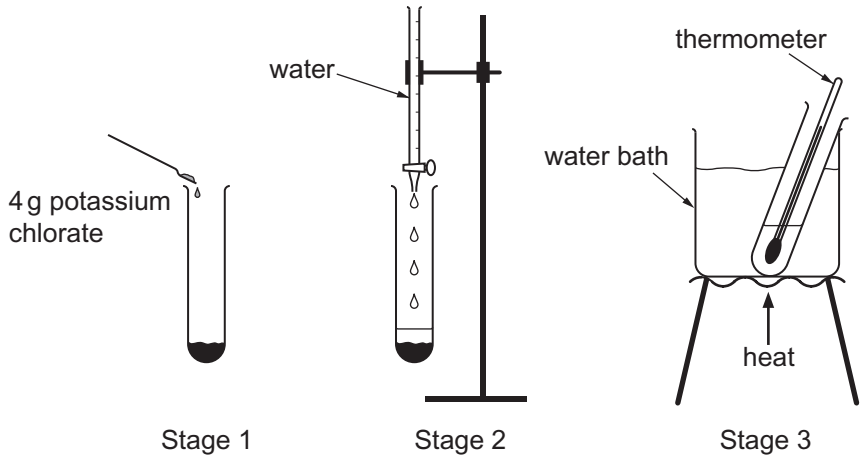
_____

_____

_____ [4]

In part (b) you will be assessed on your written communication skills including the use of specialist scientific terms.

(b) A student wanted to obtain results to plot a solubility graph for potassium chlorate. The first three stages of the method used are shown below.



Stage 1: 4 g of potassium chlorate are placed in a boiling tube.

Stage 2: 10 cm^3 of water are added.

Stage 3: The boiling tube is placed in a water bath and heated until all the potassium chlorate has dissolved. The boiling tube is then removed from the water bath.

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Describe, in detail, how you would **continue** this experiment in order to obtain a set of results from which you could draw a solubility graph.

[6]

(c) In a similar experiment a student obtained the following results. She used 2 g of potassium chlorate each time.

Mass of water (g)	Temperature at which crystals formed (°C)	Solubility in water (g/100 g)
4	92	50.0
8	63	25.0
12	48	
16	35	12.5

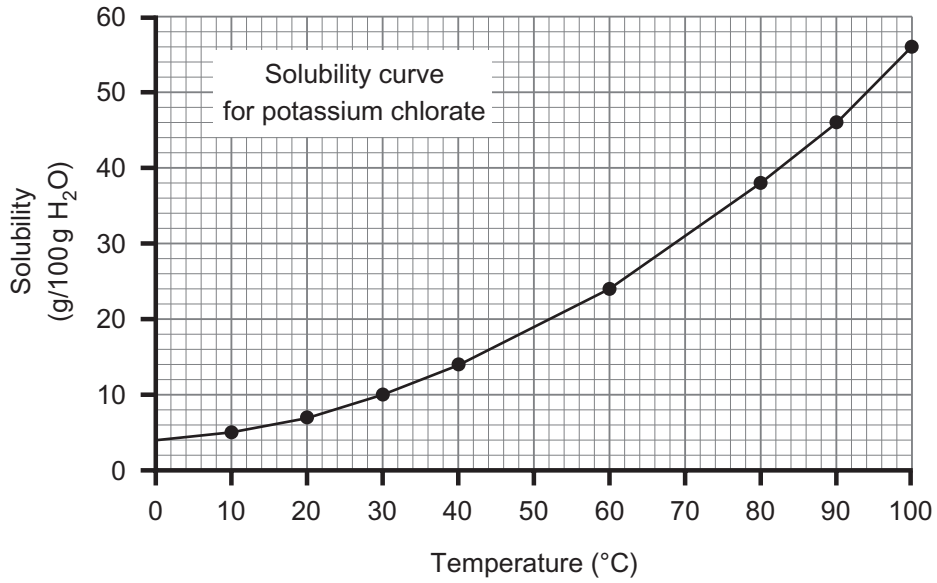
Calculate the solubility which is missing in the table. **You must show your working out.**

_____ g/100 g water [3]

Examiner Only

Marks	Remark

(d) A solubility curve for potassium chlorate is shown below.



(i) Describe the trend in solubility shown by the graph above.

_____

_____

_____ [2]

(ii) What is the solubility of potassium chlorate at 69 °C?

_____ [1]

Examiner Only

Marks	Remark

4 Complete the table below about chemical formulae.

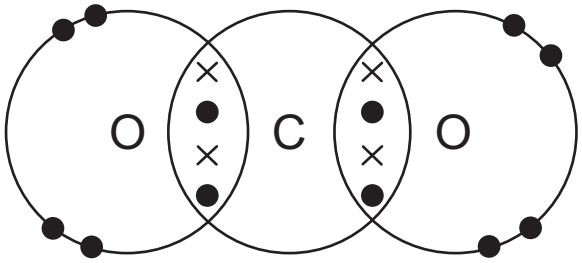
Chemical formula	Name of non-metal ion	Number of oxygen atoms in the formula	Total number of atoms in the formula
Na_2CO_3	carbonate	3	
$Fe(OH)_3$	hydroxide		7
$Cu(NO_3)_2$		6	9
$Mg(HCO_3)_2$	hydrogencarbonate		

[5]

Examiner Only	
Marks	Remark

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5 Covalent bonds form when atoms share electrons.
The diagram below shows the outer electrons in a molecule of carbon dioxide.



(a) On the diagram above, label using arrows:

(i) a double covalent bond

(ii) a lone pair. [2]

(b) Draw a dot and cross diagram for a molecule of ammonia NH_3. Show only the **outer** electrons.

[2]

(c) Most molecular covalent substances are insoluble in water. Give **two** other typical properties of molecular covalent substances.

1. _____

2. _____ [2]

Examiner Only

Marks	Remark

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

6 John Newlands was a chemist who organised the chemical elements into a table.

(a) Part of Newlands' table is shown below. Use this table to help you answer parts **(a)(ii)** and **(a)(iii)**.

H	Li	Be	B	C	N	O
F	Na	Mg	Al	Si	P	S
Cl	K	Ca	Cr	Ti	Mn	Fe

(i) What name is given to the repeating pattern that was noticed by John Newlands?

_____ [1]

(ii) Give the symbols of **three** elements that Newlands correctly placed together in the same column.

_____ [1]

(iii) Newlands' table had seven groups. Which group of elements is missing?

_____ [1]

(iv) Give one other uncertainty or limitation of Newlands' theory.

_____ [1]

(b) Dmitri Mendeleev developed a more detailed Periodic Table.

What were the main features of his Periodic Table?

_____

_____

_____ [3]

(c) What does the position of an element in the modern Periodic Table tell you about its detailed atomic structure?

1. _____

_____

2. _____

_____

3. _____

_____ [3]

Examiner Only	
Marks	Remark

7 Substances can be classified by their structures as ionic lattice, molecular covalent, giant covalent or metallic.

Substance	Melting point (°C)	Boiling point (°C)	Electrical conductivity	
			Solid	Liquid
A	−210	−196	does not conduct	does not conduct
B	600	2350	conducts	conducts
C	808	1465	does not conduct	conducts
D	114	184	does not conduct	does not conduct
E	3550	4827	does not conduct	does not conduct

(a) Which substance, A, B, C, D or E, is a gas at room temperature?

_____ [1]

(b) Which substance, A, B, C, D or E, has an ionic lattice structure?

_____ [1]

(c) Which substances, A, B, C, D or E, have a molecular covalent structure?

_____ and _____ [1]

(d) Which substance, A, B, C, D or E, is most likely to be soluble in water?

_____ [1]

(e) Substance E can be used in cutting tools.

Name substance E and give a **physical** property which makes it suitable for use in cutting tools.

name: _____ [1]

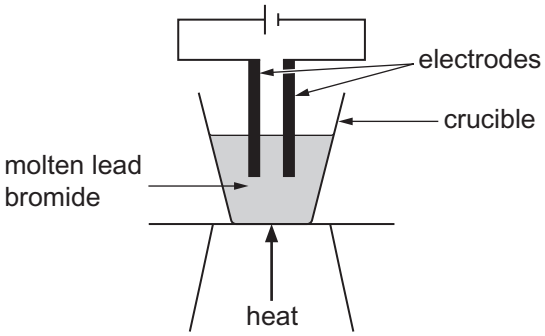
physical property: _____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

8 The diagram below shows the apparatus used to pass an electric current through molten lead bromide.



(a) What name is given to the process shown in the diagram?

_____ [1]

(b) The electrodes are made of graphite. Explain fully why graphite is a suitable material for this reaction.

_____

_____

_____ [2]

(c) Write a half equation (ionic equation) for the reaction that takes place at the **anode**.

_____ [2]

(d) The table below gives the melting points of four metal halides.

Metal halide	Melting point (°C)
sodium chloride	801
potassium chloride	772
lead bromide	367
calcium chloride	782

Suggest why lead bromide is chosen, in preference to the other three halides, to demonstrate the process shown in the diagram on the previous page.

[2]

Examiner Only

Marks	Remark

THIS IS THE END OF THE QUESTION PAPER

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113854

Rewarding Learning

General Certificate of Secondary Education
2012–2013

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

TUESDAY 26 FEBRUARY 2013
9.30 am–10.30 am

MARK SCHEME

STEMUP.CO.UK

General Marking Instructions

Introduction

Mark schemes are published to assist teachers and students in their preparation for examinations. Through the mark schemes teachers and students will be able to see what examiners are looking for in response to questions and exactly where the marks have been awarded. The publishing of the mark schemes may help to show that examiners are not concerned about finding out what a student does not know but rather with rewarding students for what they do know.

The Purpose of Mark Schemes

Examination papers are set and revised by teams of examiners and revisers appointed by the Council. The teams of examiners and revisers include experienced teachers who are familiar with the level and standards expected of students in schools and colleges.

The job of the examiners is to set the questions and the mark schemes; and the job of the revisers is to review the questions and mark schemes commenting on a large range of issues about which they must be satisfied before the question papers and mark schemes are finalised.

The questions and the mark schemes are developed in association with each other so that the issues of differentiation and positive achievement can be addressed right from the start. Mark schemes, therefore, are regarded as part of an integral process which begins with the setting of questions and ends with the marking of the examination.

The main purpose of the mark scheme is to provide a uniform basis for the marking process so that all the markers are following exactly the same instructions and making the same judgements in so far as this is possible. Before marking begins a standardising meeting is held where all the markers are briefed using the mark scheme and samples of the students' work in the form of scripts. Consideration is also given at this stage to any comments on the operational papers received from teachers and their organisations. During this meeting, and up to and including the end of the marking, there is provision for amendments to be made to the mark scheme. What is published represents this final form of the mark scheme.

It is important to recognise that in some cases there may well be other correct responses which are equally acceptable to those published: the mark scheme can only cover those responses which emerged in the examination. There may also be instances where certain judgements may have to be left to the experience of the examiner, for example, where there is no absolute correct response – all teachers will be familiar with making such judgements.

					AVAILABLE MARKS
1	**(a)**	**(i)**	Idea that it only has two colours/it can <u>only</u> indicate an alkali	[1]	
		(ii)	It has different colours [1] for acid, alkali (and neutral) [1]	[2]	
		(iii)	It can indicate the strength of the acid/it can indicate pH	[1]	
	(b)		Gives a (more) accurate reading	[1]	
	(c)		sulphuric acid [1] water [1] carbon dioxide [1]	[3]	
	(d)	**(i)**	$CuSO_4$ [1] It is white [1] and will change to blue [1] when water is added apply cm	[1] [2]	
		(ii)	anhydrous	[1]	12
2	**(a)**		2,8,8,1 structure [1] 2,7 structure [1]	[2]	
	(b)		potassium loses one electron [1] fluorine gains one electron [1] K^+ [1] F^- [1]	 [4]	
	(c)		electrostatic attraction/attraction between oppositely charged ions	[1]	
	(d)		KF	[1]	8

AVAILABLE MARKS

3 **(a)** mass of solid [1] required to saturate [1]
100 g of water [1] at a particular temperature [1] [4]

(b) **Indicative content**

- allow to cool
- Note appearance of crystals
- Record temperature at which they form
- Add another small given volume of water
- Idea of repeating stage 3
- Idea of repeat until a set of results are obtained
- Idea of carrying out appropriate calculations

Response	Mark
Candidates must use appropriate scientific terms throughout to describe the experimental procedure, using 5 or 6 of the points in the indicative content, in a logical sequence. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[5–6]
Candidates use 3 or 4 points from the indicative content to describe the experimental procedure in a logical sequence using some scientific terms. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[3–4]
Candidates use 1 or 2 of the points from the indicative content to describe the experimental procedure. However these are not presented in a logical sequence. They use limited spelling, punctuation and grammar and make little use of scientific terms. The form and style are of a limited standard.	[1–2]
Response not worthy of credit.	[0]

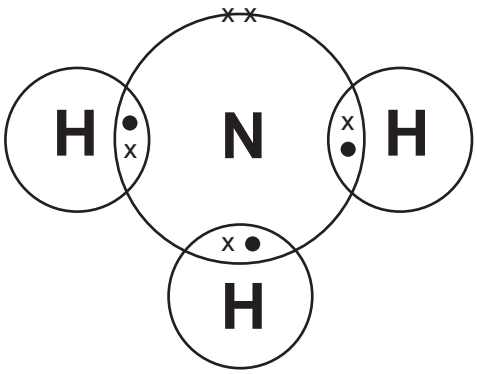
[6]

(c) 100/12 [1] 100/12 × 2 [1] = 16.7 [1] [3]

(d) **(i)** The solubility of potassium chlorate rises [1] as the temperature increases [1] [2]

(ii) 30 (g/100 g water)
[allow 30 g–30.5 g/100 g water] [1] 16

4 6 [1]
3 [1]
nitrate [1]
6 [1] 11 [1] 5

				AVAILABLE MARKS
5	(a)	(i)	correctly labelled double bond [1]	
		(ii)	correctly labelled lone pair [1] [2]	
	(b)			
			correct sharing [1] correct total electrons [1] [2]	
	(c)		low melting/boiling point [1] non conductor of electricity [1] idea of soluble in organic solvents [1] **any 2 out of 3** [2]	6
6	(a)	(i)	law of octaves [1]	
		(ii)	Li, Na and K or Be, Mg and Ca [1]	
		(iii)	noble gases/Group 8/O [1]	
		(iv)	he assumed that all elements had been discovered/no gaps were left for undiscovered elements/grouped dissimilar elements together/placed 2 elements in 1 position/did not use all elements known at the time/it did not work for all elements any 1 [1]	
	(b)		left gaps for undiscovered elements [1] arranged in order of (relative) atomic mass (not mass number) [1] elements in groups [1] elements in periods [1] metals separated from non metals [1] **any 3** **not** no noble gas [3]	
	(c)		number of electrons in outer shell [1] number of protons [1] number of electrons [1] number of electron shells [1] **any 3** [3]	10

				AVAILABLE MARKS
7	**(a)**	A	[1]	
	(b)	C	[1]	
	(c)	A and D both required	[1]	
	(d)	C	[1]	
	(e)	diamond [1] hardness [1]	[2]	6
8	**(a)**	electrolysis	[1]	
	(b)	inert/unreactive [1] good conductor of electricity [1]	[2]	
	(c)	$2\,Br^- - 2e^- \longrightarrow Br_2$ [1] [1]	[2]	
	(d)	Idea that it is ● easiest to melt/can be melted using a Bunsen [1] ● idea that this temp can be maintained safely or easily (in the school lab) [1] ● forming an unreactive metal [1] ● easily identified gaseous product [1] **any 2**	[2]	7
			Total	**70**

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New Specification

Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2012–2013

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

TUESDAY 13 NOVEMBER 2012, MORNING

GSD22

TIME

1 hour.

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 seven** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **4**.
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	
Total Marks	

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Examiner Only	
Marks	Remark

1 In the 1860s, John Newlands and Dmitri Mendeleev were two of the scientists who tried to bring order to the vast amount of information known at that time about the elements.

(a) Newlands stated that when the elements were arranged in order of atomic mass similar properties occurred every 8th element.

(i) What is the name of this law stated by Newlands?

_____ [1]

(ii) Give **one** reason why this pattern was not taken seriously by many scientists.

_____

_____ [1]

Mendeleev also arranged the elements in order of atomic mass but his pattern was taken more seriously than that of Newlands.

(b) Give **two** reasons why the table of elements prepared by Mendeleev was better than the one prepared by Newlands.

1. _____

_____

2. _____

_____ [2]

The modern Periodic Table contains more elements than the Periodic Table developed by Mendeleev.

(c) Give **two** other differences between the modern Periodic Table and Mendeleev's Periodic Table.

1. _____

_____

2. _____

_____ [2]

Part of the modern Periodic Table is shown below.

H							He
	Be				O		Ne
Na			Si		S	Cl	
K							

(d) Use **only** the elements shown above to answer the following questions.

(i) Give the symbol for a non-metal element which is a gas at room temperature and is green in colour.

_____ [1]

(ii) Which **two** elements are stored under oil?

_____ and _____ [1]

(iii) Name the element which has four electrons in its outer shell.

_____ [2]

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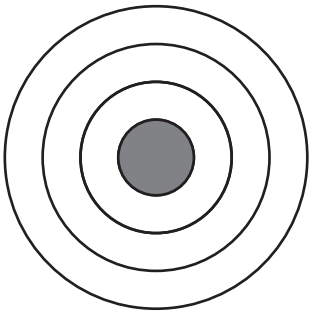
Marks	Remark

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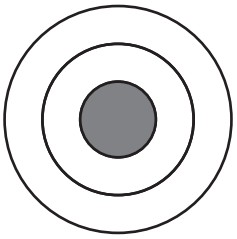
Examiner Only	
Marks	Remark

2 Sodium oxide is an ionic compound which can be formed by the reaction between sodium and oxygen.

(a) Complete the diagrams below to show **all** the electrons in a sodium atom and an oxygen atom.



sodium atom



oxygen atom [2]

(b) Explain how an oxide ion is formed from an oxygen atom.

_____

_____

_____ [2]

(c) What is the charge on a sodium ion?

_____ [1]

(d) How many sodium atoms react with one atom of oxygen?

_____ [1]

(e) Use your answer to part **(d)** to write the formula for the compound sodium oxide.

_____ [1]

(f) Sodium oxide is a typical ionic solid.

Give **two** physical properties you expect sodium oxide to have.

1. _____

2. _____ [2]

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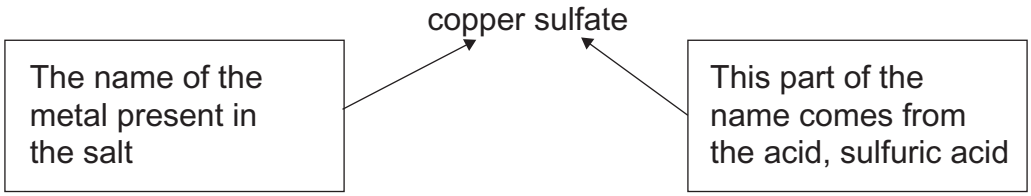
(Questions continue overleaf)

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Examiner Only	
Marks	Remark

3 Read the following information carefully.

Copper oxide, a black solid, reacts with sulfuric acid and ethanoic acid to form two different salts. Salt is a general name given to one of the compounds formed when an acid is neutralised. The salt formed between copper oxide and sulfuric acid is called copper sulfate.



Name of acid	Name of salt produced when the acid reacts
hydrochloric acid	chloride
nitric acid	nitrate
sulfuric acid	sulfate
phosphoric acid	phosphate
ethanoic acid	ethanoate

(a) Name the salt formed when copper oxide reacts with ethanoic acid.

_____ [1]

(b) What is the name given to the type of reaction between an acid and a base to form a salt and water only?

_____ [1]

(c) Write a balanced symbol equation for the reaction between copper oxide and sulfuric acid.

_____ [2]

(d) Describe what you would observe when copper oxide reacts with sulfuric acid.

_____

_____

_____ [2]

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(e) Name the acid which will react with copper oxide to form copper nitrate.

_____ [1]

Copper oxide reacts faster with 1 mol/dm^3 of sulfuric acid than with 1 mol/dm^3 of ethanoic acid.

(f) What does this tell you about the strength of sulfuric acid and ethanoic acid of the same concentration?

_____

_____ [2]

Examiner Only	
Marks	Remark

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In Question 4 you will be assessed on your written communication skills including the use of specialist science terms.

Examiner Only	
Marks	Remark

4 Aluminium is manufactured by the electrolysis of a mixture of molten aluminium oxide and cryolite.

Describe and explain, using half equations for the reactions at the electrodes, the industrial production of aluminium.

Include in your answer reasons for the addition of cryolite and the replacement of the anode.

[9]

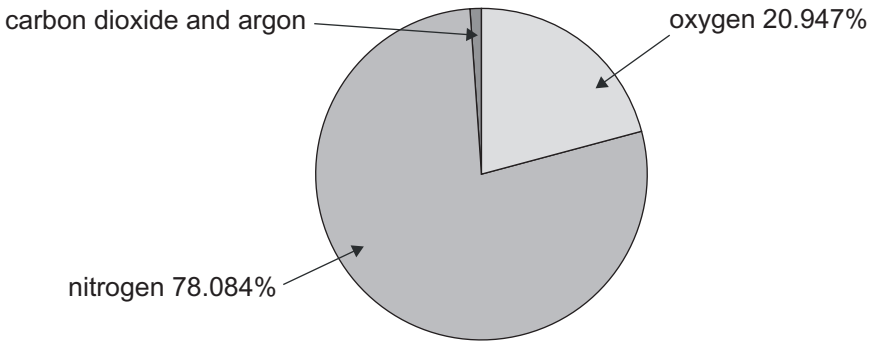
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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

5 The pie chart below shows the percentage (%) of the different gases in a sample of dry air.



(a) Calculate the percentage (%) of carbon dioxide and argon in this sample of dry air.

_____% [2]

(b) Carbon dioxide, oxygen and nitrogen are present as **diatomic** molecules with multiple bonds. Argon is present as an atom.

(i) What is meant by the term diatomic?

_____

_____ [1]

(ii) Explain, in terms of electrons, why argon is present as an atom.

_____

_____

_____ [2]

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(iii) Using a dot and cross diagram draw a molecule of nitrogen. Show the **outer electrons** only.

[3]

(iv) Label a lone pair of electrons on your diagram in **b(iii)** above.

[1]

Molecules of water are present in damp air.

(c) Draw a dot and cross diagram of a molecule of water. Show the **outer electrons** only.

[3]

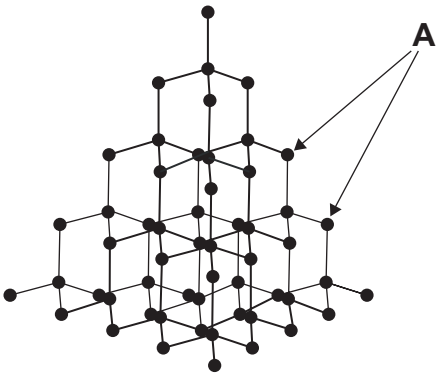
Examiner Only

Marks	Remark

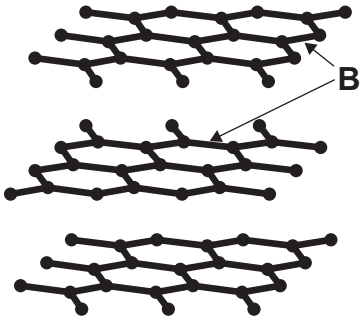
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Examiner Only	
Marks	Remark

6 The diagrams below show the structure of two **allotropes** of carbon, diamond and graphite. Diamond is a hard substance which is used in cutting tools. Graphite is a soft shiny grey substance which is used as pencil lead.



diamond



graphite

(a) What are allotropes?

_____

_____ [2]

(b) What is represented on the diagrams by:

(i) the black dots labelled **A**?

_____ [1]

(ii) the solid lines labelled **B**?

_____

_____ [1]

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(c) Using the structure of diamond and graphite explain why:

(i) diamond is used in cutting tools

_____

_____

_____

_____ [2]

(ii) graphite is used in pencil lead.

_____

_____

_____

_____ [2]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

7 Zinc is a metal. It will react with acids to produce hydrogen gas.

(a) Draw a **labelled** diagram of the structure of a metal such as zinc.

Use your diagram to explain the metallic bonding in zinc.

_____

_____

_____

_____ [4]

(b) Write a balanced symbol equation for the reaction between zinc and hydrochloric acid.

_____ [3]

(c) Give **two** ways you would know that a reaction between **excess** zinc and hydrochloric acid was completed.

_____

_____

_____ [2]

(d) Explain how you would test the gas produced to prove it was hydrogen.

_____

_____ [1]

(e) Write a balanced symbol equation for the reaction described in part **(d)**.

_____ [3]

THIS IS THE END OF THE QUESTION PAPER

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New Specification

Rewarding Learning

General Certificate of Secondary Education
2012–2013

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

TUESDAY 13 NOVEMBER 2012
9.15 am–10.15 am

MARK SCHEME

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				AVAILABLE MARKS
1	(a)	(i)	The law of Octaves [1]	
		(ii)	Newlands did not use all of the elements that were known at that time/he placed two elements into one space in his list Accept idea that he grouped elements which were not alike, or other correct, e.g. idea that pattern did not work for all the elements [1]	
	(b)		Mendeleev used all of the elements/he left gaps for undiscovered elements/he predicted the properties of undiscovered elements/he swapped elements from atomic mass order if the chemistry did not fit, e.g. I and Te or other correct, e.g. placing elements with similar properties in vertical columns (groups) any two × [1] [2]	
	(c)		Idea must be clear which version of The Periodic Table the candidate is referring to. The modern Periodic table is set out in atomic number order [1]/the transition metals occupy a separate area [1]/the noble gases [1]/lanthanides **OR** actinides [1] or other correct **NOT** just "there are transition metals" [2]	
	(d)	(i)	Cl [1]	
		(ii)	Na and K both needed [1]	
		(iii)	Silicon identification of element [1] correct name [1] (Si = [1]) [2]	10
2	(a)		Candidates draw the electronic configuration Na 2,8,1 and O 2,6 on the diagrams provided [2]	
	(b)		oxygen gains electrons [1] 2 electrons [1] [2]	
	(c)		+1/1+/Na^{+1}/Na^{+} **NOT** positive [1]	
	(d)		2 [1]	
	(e)		Na_2O [1]	
	(f)		Any two of: hard/brittle/non-conductor of electricity/soluble (in water)/ crystalline/high melting point/conducts electricity when liquid or in solution or other correct (2 × [1]) [2]	9

3	**(a)** copper ethanoate [1]		AVAILABLE MARKS
	(b) neutralisation [1]		
	(c) $CuO + H_2SO_4 \rightarrow CuSO_4 + H_2O$ LHS [1] RHS [1] [2]		
	(d) (black) solid disappears dissolves [1] blue solution (forms) [1] any [2] [2]		
	(e) nitric acid [1]		
	(f) valid comparison sulfuric acid is a stronger acid than ethanoic acid idea that **one** acid is stronger than the other [1] or idea that sulfuric acid is strong/ethanoic acid is weak [1] [2]		9

4

Response	Mark
Candidates access 9 or more of the marks in the indicative content to describe fully the manufacture of aluminium in a logical sequence. They use good spelling, punctuation and grammar and the form and style are of a high standard.	[7]–[9]
Candidates access 5–8 of the marks in the indicative content to describe the manufacture of aluminium in a logical sequence. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	[4]–[6]
Candidates access 1–4 of the marks in the indicative content using limited spelling, punctuation and grammar. The form and style is of limited standard and they have made no use of specialist terms.	[1]–[3]

Indicative content

- Cryolite is added to lower the melting point/reduce operating temp/ reduce costs
- Cryolite increases the conductivity
- Al produced at the cathode
- $Al^{3+} + 3e^- \rightarrow Al$ [2] ([1] for RHS/[1] for LHS)
- Oxygen produced at the anode
- $2O^{2-} - 4e^- \rightarrow 2O_2$ [2] ([1] for RHS/[1] for LHS)
- Anodes are made of carbon
- Oxygen reacts with the (carbon) anodes
- To produce carbon dioxide
- Al formed is molten/tapped off at bottom [9] 9

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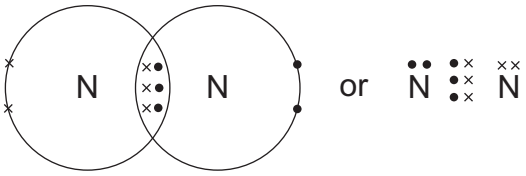
AVAILABLE MARKS

5 **(a)** 20.974 + 78.084 = 99.031 [1]
100 – 99.031 = 0.969% [1] [2]

(b) **(i)** Idea of two atoms joined together/two atoms in a molecule [1]

(ii) Argon has 8 electrons in its outer shell/has a full outer shell [1] this means it is stable/it does not need to lose or gain or share electrons/react with other atoms **not** unqualified stability [2]

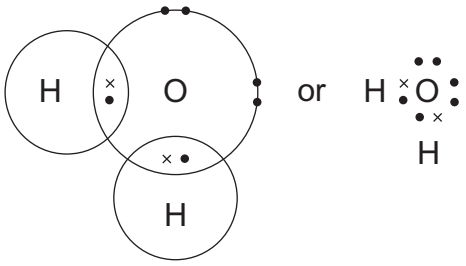
(iii)



correct sharing [2] correct number of electrons dependent on first mark [1]
if 6 electrons shared but poor diagram then award [1] of the [2] marks [3]

(iv) either lone pair correctly labelled [1]

(c)



correct sharing [1] correct number of electrons dependent on first mark [1] dot and cross diagram [1] [3] 12

6 **(a)** Allotropes are different forms of the same element [1] in the same physical state [1] [2]

(b) **(i)** (carbon) atoms [1]

(ii) covalent bonds not **giant** covalent [1]

(c) **(i)** Each carbon atom is (covalently) bonded to 4 others/idea of **giant covalent** structure [1] the (covalent) bonds are extremely strong/ difficult to break [1] any [2] points [2]

(ii) The layers (of atoms) can slide over one another [1] very easily/ leaving a (clear) mark on paper [1] [2] 8

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			AVAILABLE MARKS
7	**(a)**	Candidates draw and label clearly regular arrangement [1] of positive ions only [1] in a sea of delocalised electrons [1] Metallic bonding is the attraction [1] between the positive ions and the delocalised electrons. The marks for positive ions and delocalised electrons may be picked up in the written part of the answer or in the diagram [4]	
	(b)	$Zn + 2HCl \rightarrow ZnCl_2 + H_2$ [3]	
	(c)	Idea of effervescence stopping [1] some zinc remaining (in the reaction vessel) [1] [2]	
	(d)	Apply a lighted splint, it will pop [1]	
	(e)	$2H_2 + O_2 \rightarrow 2H_2O$ LHS [1] RHS [1] balancing [1] [3]	13
			70

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New Specification

Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2011–2012

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

MONDAY 21 MAY 2012, MORNING

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in question **2(c)**.
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	
Total Marks	

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Examiner Only	
Marks	Remark

1 **(a)** Two common isotopes of chlorine are $^{35}_{17}Cl$ and $^{37}_{17}Cl$.

(i) Complete the table below to show the numbers of protons, neutrons and electrons in the $^{37}_{17}Cl$ isotope.

Isotope	Protons	Neutrons	Electrons
$^{37}_{17}Cl$			

[3]

(ii) What are isotopes?

_____

_____

_____ [2]

(b) **(i)** Complete the table below which gives information about electronic structures and their relation to the Group number of the Periodic Table.

Element	Atomic number	Electronic configuration	Group of Periodic Table
A	17		7
B	5	2,3	
C		2,8,5	5
D	6		4

[4]

(ii) What is the name of the element in Group 2 Period 3?

_____ [1]

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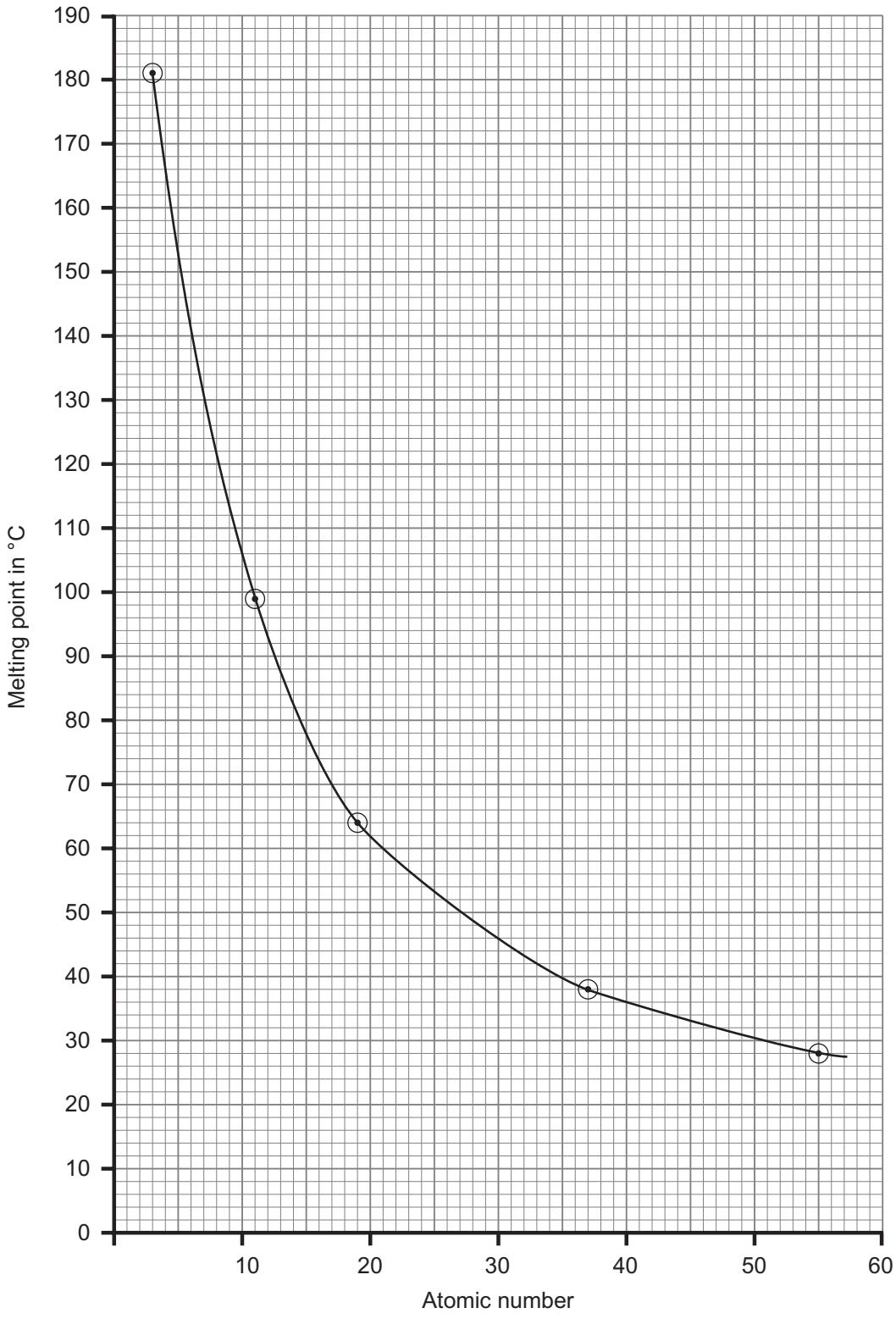
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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

2 The graph below shows how the melting points of the alkali metals change with increasing atomic number.



(a) Name the alkali metal with the highest melting point.

_____ [1]

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(b) What happens to the melting point of the alkali metals as the atoms increase in size?

_____

_____ [1]

In part (c) you will be assessed on your written communication skills including the use of specialist science terms.

(c) Describe how potassium is stored in the laboratory and the steps that need to be taken before adding it to water. Include in your answer its appearance at each stage and any safety precautions that need to be taken.

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____ [6]

(d) **(i)** Suggest why rubidium (Rb) is **not** used in the school laboratory to show the reactions of the alkali metals.

_____ [1]

(ii) How many electrons would you expect rubidium to have in its outer shell?

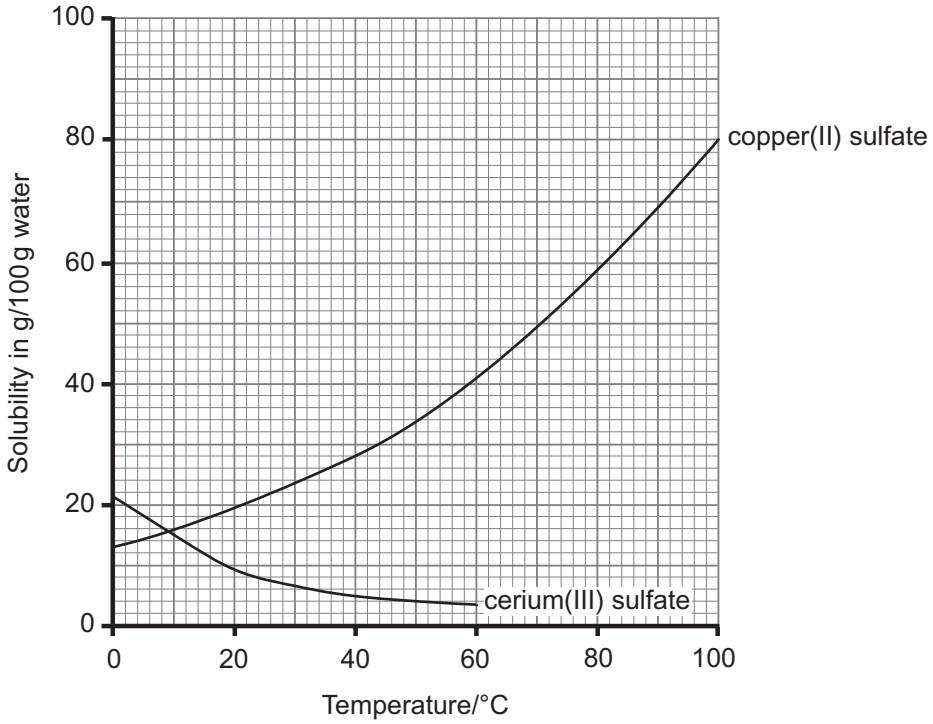
_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

3 The solubility curves for the solids copper(II) sulfate and cerium(III) sulfate are drawn below.



Use the solubility curves to answer the following questions.

(a) How does the solubility of the cerium(III) sulfate change as the temperature increases?

_____

_____ [1]

(b) What is the solubility of copper(II) sulfate at 26 °C?

_____ g/100 g water [1]

(c) At what temperature is the solubility of cerium(III) sulfate 8 g/100 g water?

_____ °C [1]

(d) At what temperature is the solubility of the cerium(III) sulfate equal to the solubility of copper(II) sulfate?

_____ °C [1]

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(e) Name the solid which is more soluble at 0 °C.

_____ [1]

(f) 500 g of water is saturated with copper(II) sulfate solution at 60 °C. The solution is cooled to room temperature (20 °C). What mass of copper(II) sulfate will crystallise from this solution?

_____ g [4]

Examiner Only	
Marks	Remark

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Examiner Only	
Marks	Remark

4 Copper(II) oxide reacts with sulfuric acid to form a solution of copper(II) sulfate in water.

(a) Explain why this reaction is a neutralisation reaction.

_____

_____ [2]

(b) What is the colour of copper(II) oxide?

_____ [1]

(c) What is the colour of the solution of copper(II) sulfate?

_____ [1]

(d) Write the formula of the ion which is always produced when an acid dissolves in water.

_____ [1]

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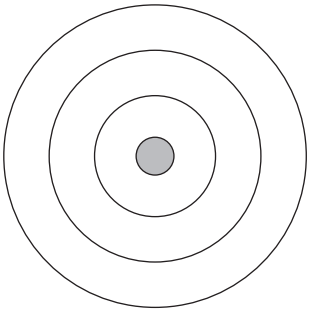
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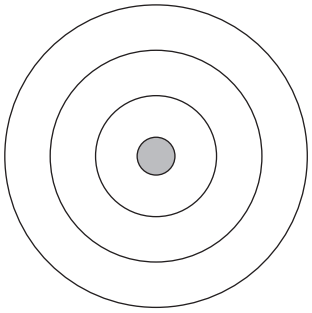
Examiner Only	
Marks	Remark

5 Magnesium reacts with chlorine to form an ionic compound, magnesium chloride. Hydrogen reacts with chlorine to form a covalent compound, hydrogen chloride.

(a) (i) Complete the diagrams below to show **all** the electrons in a magnesium atom and a chlorine atom.



magnesium atom



chlorine atom [2]

(ii) Explain how the atoms of magnesium and chlorine form **ions**.

_____

_____

_____ [2]

(iii) How many chlorine atoms react with one atom of magnesium?

_____ [1]

(iv) How are the ions held together in the compound magnesium chloride?

_____

_____ [1]

(b) The elements hydrogen and chlorine exist as **diatomic** molecules.

Explain the meaning of the term **diatomic**.

_____

_____ [1]

Examiner Only	
Marks	Remark

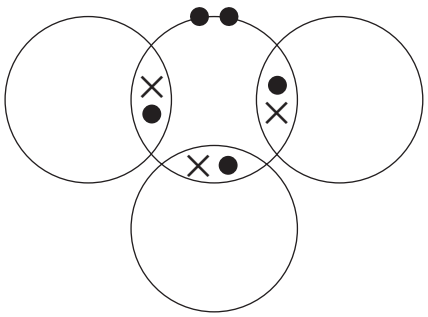
(c) **(i)** Using a **dot and cross** diagram draw a molecule of hydrogen chloride.

[3]

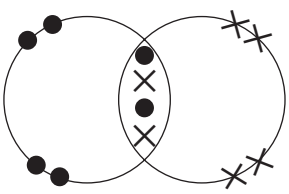
(ii) Label a lone pair of electrons in your diagram of hydrogen chloride. [1]

(d) The dot and cross diagrams below show the outer electrons in the atoms of five covalent molecules, A, B, C, D and E.

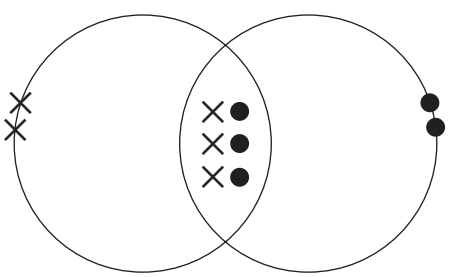
A



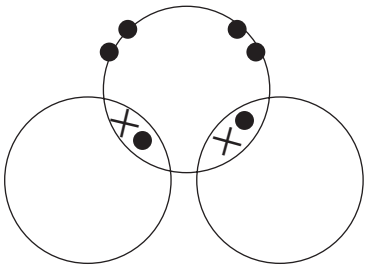
B



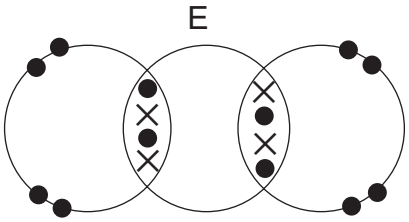
C



D



E



Choose the diagram, A, B, C, D or E, which shows a molecule with

(i) two single covalent bonds. _____ [1]

(ii) one double covalent bond. _____ [1]

Examiner Only	
Marks	Remark

6 Aluminium is a metal which is used in overhead cables because it is a good conductor of electricity and it is ductile.

(a) Describe the structure of a metal such as aluminium.

_____

_____

_____

_____ [3]

(b) Explain why aluminium is a good conductor of electricity.

_____

_____

_____ [2]

(c) The term ductile means that the metal can be stretched or drawn into thin wires.
Explain, in terms of its structure, why aluminium is ductile.

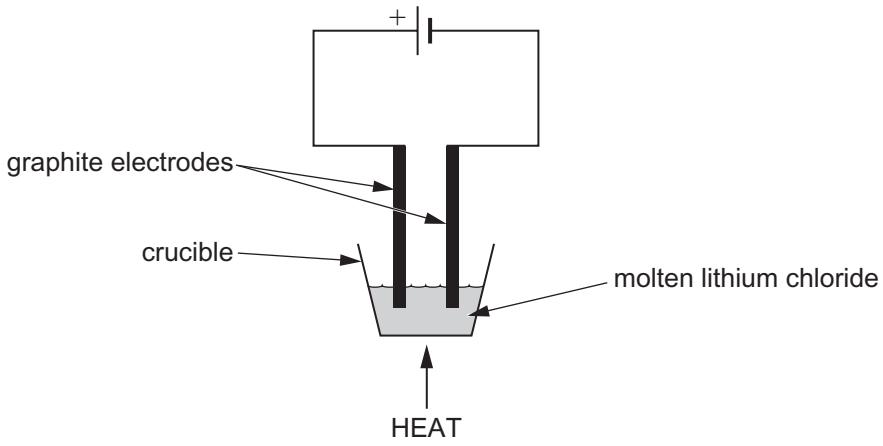
_____

_____ [1]

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Examiner Only	
Marks	Remark

7 Chlorine can be produced by passing an electric current through molten lithium chloride as shown in the diagram below.



(a) Explain why the lithium chloride will only conduct electricity when it is molten or in solution.

_____

_____

_____ [3]

(b) Give **two** reasons why graphite is used to make the electrodes.

1. _____

2. _____ [2]

(c) **(i)** Write an ionic equation to show the production of chlorine.

_____ [2]

(ii) Name the electrode at which chlorine is produced.

_____ [1]

(iii) Give **two** observations which can be made **at this electrode** during the electrolysis of lithium chloride.

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

8 The elements of Group 7 of the Periodic Table, the halogens, all react in a similar way.

(a) Explain, in terms of electrons, why the halogens all react in a similar way.

_____

_____ [1]

(b) In an experiment to compare the reactivity of the halogens, a solution of a halogen is added to a solution of a compound containing a different halogen. The more reactive halogen will displace a less reactive halogen from its compound.

The results of the experiment are shown in the table below.

Solution of potassium halide	Solution of halogen		
	chlorine	bromine	iodine
potassium chloride		no reaction	no reaction
potassium bromide	colourless solution darkens to orange brown		no reaction
potassium iodide	colourless solution darkens to brown	colourless solution darkens to brown	

(i) Using the information in the table write a reactivity series of the halogens beginning with the most reactive.

Most Reactive: _____

_____

Least Reactive: _____ [2]

(ii) Explain why a colour change occurs when chlorine is added to a solution of potassium bromide.

_____ [1]

(iii) Write a balanced chemical equation for the reaction between potassium bromide and chlorine.

_____ [3]

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New Specification

Rewarding Learning

General Certificate of Secondary Education
2011–2012

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

MONDAY 21 MAY 2012, MORNING

MARK SCHEME

STEMUP.CO.UK

1 **(a)** **(i)** 17 20 17 [3]

AVAILABLE MARKS

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

(b) **(i)**

Element	Atomic number	Electronic configuration	Group of Periodic Table
A	17	**2,8,7**	7
B	5	2,3	**3**
C	**15**	2,8,5	5
D	6	**2,4**	4

[4]

(ii) Magnesium [1] 10

2 **(a)** Lithium [1]

(b) Melting point decreases (as the size of the atoms increases) [1]

(c) Indicative content

- Potassium stored in oil } storage in the laboratory
- Idea that when freshly cut it is shiny
- Idea that as it is left in the air the freshly cut surface becomes dull } appearance
- Idea that before adding it to water dry the oil from the surface using a paper towel
- Idea of using small pieces/cut into small pieces } Preparative steps
- Handle with tongs
- Wear (safety) glasses/goggles
- Use (safety) screen } Safety

(award a max of 2 marks for safety)

Response	Mark
Candidates must use appropriate specialist terms throughout (at least 5 pts from the indicative content) to describe a minimum of 3 of the following; how potassium is stored in the laboratory, appearance, safety precautions and the preparative steps that need to be taken before potassium is added to water. They use good quality spelling, punctuation and grammar and the form and style are of a high standard.	[5]–[6]
Candidates must use some appropriate specialist terms throughout (3–4 pts from the indicative content) to describe a minimum of 2 of the following; how potassium is stored in the laboratory, appearance, safety precautions and the preparative steps that need to be taken before potassium is added to water. They use satisfactory spelling, punctuation and grammar and the form and style are of a high standard.	[3]–[4]
Candidates make reference to 1–2 of the main points shown above using limited spelling, punctuation and grammar. The form and style is of limited standard and they have made no use of specialist terms.	[1]–[2]
Candidates make no reference to the points above and offer no other suitable response.	[0]

[6]

(d) **(i)** Idea that rubidium is too reactive/(too) dangerous [1]

(ii) 1 (electron in the outer shell) [1]

AVAILABLE MARKS

10

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			AVAILABLE MARKS
3	**(a)**	Solubility decreases (as the temperature increases) [1]	
	(b)	22 g/100 g water [1]	
	(c)	22 °C (accept 22–24 °C) [1]	
	(d)	9 °C (accept 9–9.8 °C) [1]	
	(e)	Cerium(III) sulfate [1]	
	(f)	solubility at 60 °C = 41 solubility at 20 °C = 20 } [1] (accept 19) mass of crystallised solid from 100 g = 41 − 20 = 21 [1] mass of crystallised solid from 500 g = 21 × 5 [1] = 105 [1] [4]	9
4	**(a)**	idea of acid reacting with an alkali/base [1] to produce water [1] [2]	
	(b)	Black [1]	
	(c)	Blue [1]	
	(d)	H^+ [1]	5
5	**(a)**	**(i)** Draw electronic configurations magnesium 2,8,2 [1] chlorine 2,8,7 [1] [2]	
		(ii) Magnesium loses 2 electrons [1] chlorine gains 1 electron [1] [2]	
		(iii) 2 [1]	
		(iv) Electrostatic forces/attraction between opposite charges [1]	
	(b)	Two atoms (chemically) combined/two atoms in a molecule/two atoms covalently bonded [1]	
	(c)	**(i)** Correct sharing [1] correct number of outer electrons [1] dependant on first mark dot and cross diagram [1] [3]	
		(ii) Correctly labelled lone pairs [1]	
	(d)	**(i)** D [1]	
		(ii) B [1]	13

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				AVAILABLE MARKS
6	**(a)**	A regular arrangement [1] of positive ions/atoms [1] surrounded by a sea of delocalised electrons [1]	[3]	
	(b)	The sea of delocalised electrons can move [1] and carry the charge [1]	[2]	
	(c)	The (positive) ions/atoms can slip over one another (without disrupting the bond)	[1]	6
7	**(a)**	Idea of presence of ions [1] idea of moving particles [1] idea of moving particles carrying the charge [1] e.g. the ions are free to move and carry the charge	[3]	
	(b)	Is a (good) conductor of electricity [1] will not react/is inert [1]	[2]	
	(c) **(i)**	$2Cl^- - 2e^- \rightarrow Cl_2$ / $2Cl^- \rightarrow Cl_2 + 2e^-$	[2]	
	(ii)	Anode	[1]	
	(iii)	Bubbles [1] of green [1] gas distinctive odour of swimming pools [1] *any 2*	[2]	10
8	**(a)**	All of the halogens gain one electron	[1]	
	(b) **(i)**	Chlorine bromine iodine	[2]	
	(ii)	Chlorine displaces bromine/bromine is formed [1]	[1]	
	(iii)	$2KBr + Cl_2 \rightarrow 2KCl + Br_2$	[3]	7
		Total		**70**

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New Specification

Rewarding Learning

Centre Number

71	

Candidate Number

General Certificate of Secondary Education
2011–2012

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

TUESDAY 28 FEBRUARY 2012
11.00 am–12.00 noon

GSD22

TIME

1 hour.

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 eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **2(b)**.
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	
Total Marks	

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Examiner Only	
Marks	Remark

1 The box below shows the chemical symbols for some different types of ions.

K^+	S^{2-}	Mg^{2+}
Al^{3+}	Cl^-	NO_3^-
SO_4^{2-}	Na	N^{3-}

(a) From the box above choose

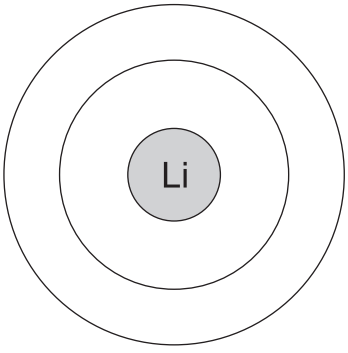
(i) a cation with a charge of 2 _____ [1]

(ii) a molecular ion _____ [1]

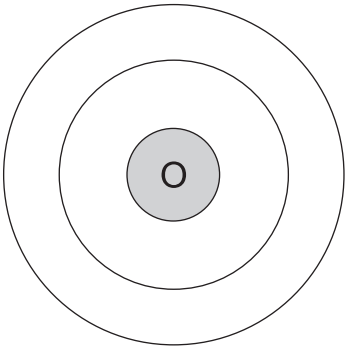
(iii) a symbol which is not an ion _____ [1]

(iv) the symbol for the nitrate ion _____ [1]

(b) Lithium reacts with oxygen to form lithium oxide, a solid white compound.
Draw diagrams to show all the electrons in an atom of lithium and an atom of oxygen.



lithium atom



oxygen atom

[2]

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(c) Explain how lithium and oxygen react to form the compound lithium oxide.

Examiner Only

Marks	Remark

_____

_____

_____

_____

_____ [3]

(d) Give **two** physical properties of the compound lithium oxide.

1. _____

2. _____ [2]

Examiner Only	
Marks	Remark

2 A selection of colourless solvents used in the laboratory is shown in the photograph below. One of the liquids is water.

Image of a selection of colourless solvents removed due to copyright.

(a) What is meant by the term solvent?

_____

_____ [1]

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In Part (b) you will be assessed on your written communication skills including the use of specialist science terms.

Examiner Only	
Marks	Remark

(b) Explain how you would identify which liquid is water. Give the full chemical name for any substance used to test the liquids.

[6]

Examiner Only	
Marks	Remark

3 Chemists have collected a vast amount of information about the atoms of elements and have displayed it on a table called the Periodic Table.

The table below gives information about the atomic number, group number and electronic configuration of the atoms of elements A, B, C and D.

Elements	Atomic Number	Electronic configuration	Group Number
A	12	2,8,2	
B	6		4
C		2,7	7
D	15		5

(a) Complete the table above. [4]

(b) How many electrons would you expect an atom of strontium to have in its outer shell?

_____ [1]

(c) Name the element in Group 6 and Period 3 of the Periodic Table.

_____ [1]

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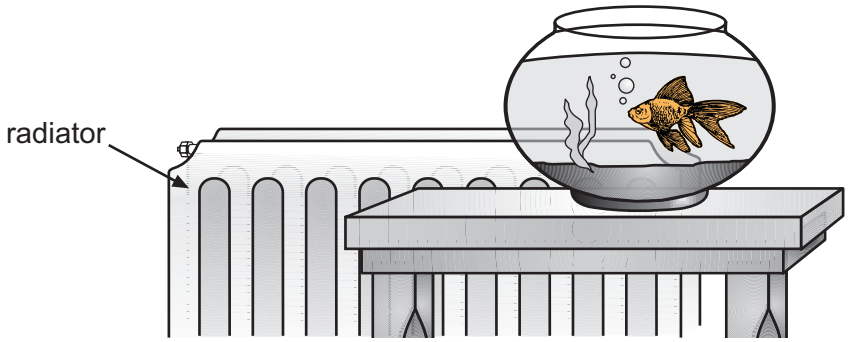
4 The table below shows the solubility of different substances in water at 15 °C and 20 °C.

Substance	Solubility (g/100 g water)	
	at 15 °C	at 20 °C
salt	28.0	36.0
oxygen	0.005	0.004
carbon dioxide	0.18	0.14
sugar	176.0	204.0

(a) Which substances shown in the table decrease in solubility as the temperature increases?

_____ [1]

During spells of cold weather some goldfish owners place their goldfish near a warm radiator.



(b) Suggest, using the information in the table, why this may not be such a good idea.

_____

_____

_____ [3]

Examiner Only

Marks	Remark

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(c) An experiment was carried out to investigate the solubility of potassium chloride. Two grams of potassium chloride were added to different masses of hot water and the temperature at which crystals began to form on cooling was recorded.
The results are shown in the table below.

Mass of potassium chloride (g)	Mass of water (g)	Temperature at which crystals appear (°C)	Solubility (g/100 g water)
2.0	4.0	80	50.0
2.0	4.5	58	44.4
2.0	5.0	41	
2.0	5.5	28	36.4
2.0	6.0	16	33.3

(i) Complete the table by calculating the solubility of potassium chloride (g/100 g water) at 41 °C. **(Show your working).**

[2]

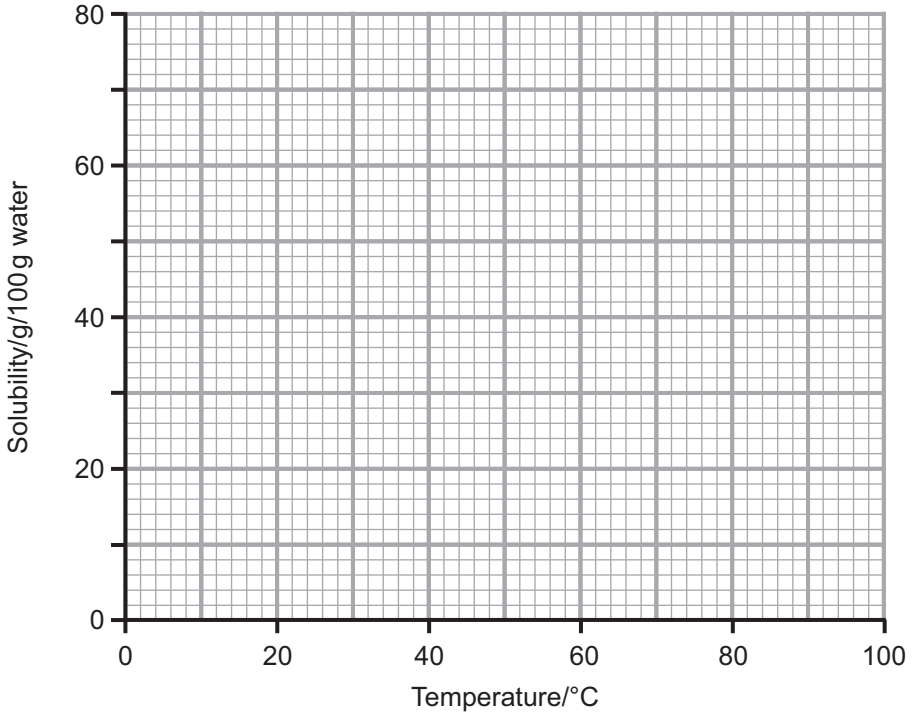
Examiner Only

Marks	Remark

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Examiner Only	
Marks	Remark

(ii) Plot a graph of solubility (g/100 g water) against temperature (°C) for potassium chloride below.



[3]

(d) Use your graph to answer the following questions.

(i) What is the solubility of potassium chloride at 50 °C?

_____ [1]

(ii) A solution of potassium chloride at 20 °C contains 30 g of potassium chloride dissolved in 100 g of water. State whether the solution is saturated or unsaturated.

_____ [1]

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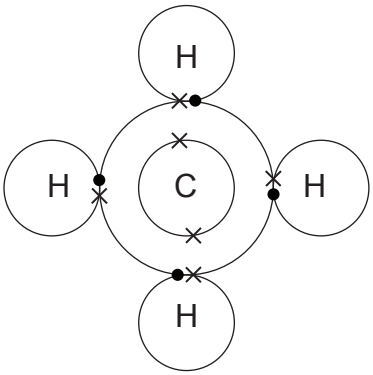
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Examiner Only	
Marks	Remark

5 Methane and ammonia are both covalent compounds with very similar bonding.

(a) The diagram below shows the electrons in carbon and hydrogen in a molecule of methane.

Methane



In the space below draw a dot and cross diagram to show how **all** the electrons are arranged in a molecule of ammonia.

(i) Ammonia

[3]

(ii) Label the lone pair of electrons in ammonia. [1]

(b) Some covalent compounds have multiple bonds.
In the space below draw a **dot and cross diagram** to show the multiple bonds in a molecule of carbon dioxide.
Draw the **outer electrons only**.

[3]

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Examiner Only	
Marks	Remark

6 Substances may be classified according to their physical properties. Use the table below to answer the following questions.

Substance	Melting point	Boiling point	Electrical conductivity	
			as solid	as liquid
A	650	1100	good	good
B	114	184	poor	poor
C	3550	4827	poor	poor
D	776	1500	poor	good
E	–79	–56	poor	poor
F	327	1760	good	good

(a) (i) Which substance A, B, C, D, E or F has a molecular covalent structure and is a solid at room temperature?

_____ [1]

(ii) Suggest a name for this substance.

_____ [1]

(b) Which substance A, B, C, D, E or F could be an electrolyte?

_____ [1]

(c) Which substance A, B, C, D, E or F is a metal with the lowest boiling point?

_____ [1]

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(d) **(i)** Describe the state and structure of substance E at room temperature.

_____

_____ [2]

(ii) Would you expect substance E to dissolve in water?

_____ [1]

(iii) Explain your answer to **(d)(ii)**.

_____

_____ [1]

Examiner Only	
Marks	Remark

Examiner Only	
Marks	Remark

7 Sulfuric acid is a strong acid. It will react with metal carbonates and will neutralise alkalis.

(a) State the pH range for a strong acid.

_____ [1]

(b) **(i)** Write a balanced chemical equation for the reaction between copper carbonate and sulfuric acid.

_____ [3]

(ii) Describe what you would observe during the reaction between copper carbonate and sulfuric acid. Include colour changes in your answer.

_____

_____

_____ [3]

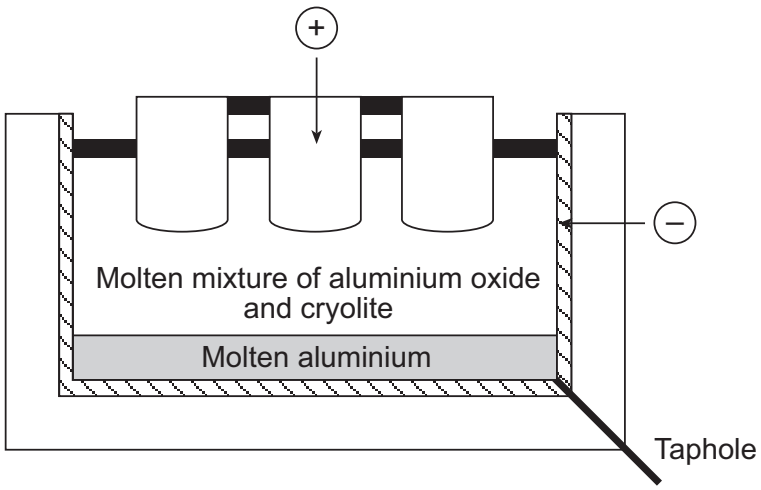
(c) Write a balanced ionic equation for the neutralisation reaction. Include state symbols in your answer.

_____ [3]

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Examiner Only	
Marks	Remark

8 Aluminium metal is extracted from its ore by the electrolysis of a molten mixture containing aluminium oxide and cryolite.



(a) What is the name of the ore of aluminium?

_____ [1]

(b) Give **two** reasons why cryolite is added to the aluminium oxide.

_____

_____

_____ [2]

(c) Write an ionic equation for the reaction which takes place at the cathode.

_____ [2]

(d) Explain why the anodes have to be replaced periodically.

_____

_____

_____ [3]

An increasing amount of aluminium products are produced from recycled aluminium.

(e) Give **two** reasons why aluminium is recycled.

_____

_____ [2]

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7716

New Specification

Rewarding Learning

General Certificate of Secondary Education
2011–2012

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

TUESDAY 28 FEBRUARY 2012
11.00 am–12.00 noon

MARK SCHEME

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General Marking Instructions and Mark Grids

Introduction
Mark schemes are intended to ensure that the GCSE examination is marked consistently and fairly. The mark schemes provide markers with an indication of the nature and range of candidates' responses likely to be worthy of credit. They also set out the criteria that they should apply in allocating marks to candidates' responses. The mark schemes should be read in conjunction with these marking instructions.

Quality of candidates' responses
In marking the examination papers, examiners should be looking for a quality response reflecting the level of maturity which may reasonably be expected of a 16-year-old which is the age at which the majority of candidates sit their GCSE examinations.

Flexibility in marking
Mark schemes are not intended to be totally prescriptive. No mark scheme can cover all the responses which candidates may produce. In the event of unanticipated answers, examiners are expected to use their professional judgement to assess the validity of answers. If an answer is particularly problematic, then examiners should seek the guidance of the Supervising Examiner.

Positive marking
Examiners must be positive in their marking, giving appropriate credit for description, explanation and analysis, using knowledge and understanding and for the appropriate use of evidence and reasoned argument to express and evaluate personal responses, informed insights and differing viewpoints. Examiners should make use of the whole of the available mark range of any particular question and be prepared to award full marks for a response which is as good as might reasonably be expected of a 16-year-old GCSE candidate.

Awarding zero marks
Marks should only be awarded for valid responses and no marks should be awarded for an answer which is completely incorrect or inappropriate.

Types of mark scheme
Mark schemes for questions which require candidates to respond in extended written form are marked on the basis of levels of response which take account of the quality of written communication.

Other questions which require only short answers are marked on a point for point basis with marks awarded for each valid piece of information provided.

					AVAILABLE MARKS
1	(a)	(i)	Mg^{2+}	[1]	
		(ii)	SO_4^{2-}/NO_3^-	[1]	
		(iii)	Na	[1]	
		(iv)	NO_3^-	[1]	
	(b)		Lithium structure showing 2,1 e.c. oxygen structure showing 2,6 e.c.	[1] [1]	
	(c)		Correct direction of transfer of electrons [1] Correct number transferred from lithium [1] Correct number transferred to oxygen/idea of 2:1 ratio [1] Idea of covalency = [0]	[3]	
	(d)		Any **two** from: • solid/white/solid white/crystalline [1] • high melting point (**not** high boiling point) [1] • soluble/dissolves (in water) [1] • does not conduct electricity (as a solid) [1] • will conduct electricity in liquid form [1] • brittle [1]	[2]	11

2 **(a)** Idea that a solvent is a substance that is capable of dissolving another substance [1]

AVAILABLE MARKS

(b)

Response	Mark
Candidates must use appropriate specialist terms throughout to describe fully the chemical identification of water in a logical sequence. They use good spelling, punctuation and grammar and the form and style are of a high standard.	([5]–[6])
Candidates use some appropriate specialist terms to describe the chemical identification of water in a logical sequence. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	([3]–[4])
Candidates make reference to 1–2 of the main points shown below using limited spelling, punctuation and grammar. The form and style is of limited standard and they have made no use of specialist terms.	([1]–[2])
Candidates make no reference to the main points below and offer no other suitable response.	([0])

Use of anhydrous [1] copper sulfate [1]
White [1] to blue [1]
Practical idea of addition of the $CuSO_4$ to water/testing each sample individually [1]
Idea that this result indicates water [1]

Alternative to first 4 marking points:
Anhydrous [1] cobalt chloride [1] (paper)
Blue [1] to pink [1]

Accept for a maximum of [2]
Boiling point = 100 °C [1]
Freezing point = 0 °C [1] [6]

7

					AVAILABLE MARKS
3	**(a)**				

Elements	Atomic Number	Electronic configuration	Group Number
A	12	2,8,2	**2** [1]
B	6	**2,4** [1]	4
C	**9** [1]	2,7	7
D	15	**2,8,5** [1]	5

[4]

(b) 2 (electrons) [1]

(c) Sulfur [1] 6

4 **(a)** Oxygen and carbon dioxide [1]

(b) Idea that fish require (dissolved) oxygen for survival [1]
As the temperature increases the dissolved oxygen (content of the water) decreases [1]
Link decreasing oxygen content to death of fish/distress [1] [3]

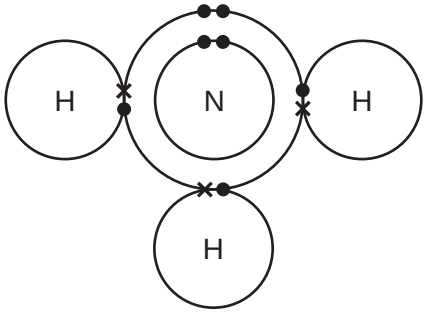
(c) **(i)** $\frac{2}{5} \times 100$ [1] = 40 [1] [2]

(ii) 5 points correctly plotted [2]
3 – 4 points correctly plotted [1]
curve drawn through the points [1] [3]

(d) **(i)** 42 g/100 g water (read from the graph) [1]

(ii) Unsaturated [1] 11

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					AVAILABLE MARKS
5	**(a)**	**(i)**	Ammonia  dot and cross [1] correct sharing [1] correct number of electrons [1] (last point dependent on 2nd) [3]		
		(ii)	Lone pair correctly labelled	[1]	
	(b)		 [1] [1]		
			Correct number of electrons [1] dependent on 1st two marks	[3]	7
6	**(a)**	**(i)**	B	[1]	
		(ii)	Iodine/sulfur/phosphorus	[1]	
	(b)		D	[1]	
	(c)		A	[1]	
	(d)	**(i)**	Gas at room temperature simple molecular structure/molecular covalent/simple covalent	[2]	
		(ii)	No	[1]	
		(iii)	Idea that simple covalent substances are generally insoluble in water	[1]	8
7	**(a)**		pH 0–2	[1]	
	(b)	**(i)**	$CuCO_3 + H_2SO_4 \rightarrow CuSO_4 + H_2O + CO_2$	[3]	
		(ii)	Essential: green (solid) [1] to blue (solution) [1] colourless liquid/bubbles produced/heat produced/solid disappearing [1]	[3]	
	(c)		$H^+(aq) + OH^-(aq) \rightarrow H_2O(l)$ [1] for reactants [1] for products [1] for state symbols	[3]	10

			AVAILABLE MARKS
8	**(a)**	Bauxite [1]	
	(b)	Reduces melting pt/reduces operating temperature [1] helps to improve the electrical conductivity [1] [2]	
	(c)	$Al^{3+} + 3e^- \rightarrow Al$ [2]	
	(d)	The oxygen produced at the anode [1] reacts with the carbon [1] anodes to produce carbon dioxide [1] [3]	
	(e)	Any **two** from: less energy is used (recycling aluminium than extracting it from its ore) [1]/ idea of saves resources [1]/reduces waste [1]/ reduces amount of CO_2 (therefore reducing carbon footprint)/idea of more cost effective [2]	10
		Total	**70**

New Specification

Rewarding Learning

Centre Number	
71	

Candidate Number

General Certificate of Secondary Education
2011–2012

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

GSD22

WEDNESDAY 9 NOVEMBER 2011
9.15 am–10.15 am

TIME

1 hour.

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 nine** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in **questions 5(b) and 9(a)**.

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	
Total Marks	

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Examiner Only	
Marks	Remark

1 The table below shows part of **Mendeleev's** Periodic Table.

I	II	III	IV	V	VI	VII			
H									
Li	Be	B	C	N	O	F			
Na	Mg	Al	Si	P	S	Cl			
K	Ca		Ti	V	Cr	Mn	Fe	Co	Ni
Cu	Zn			As	Se	Br			

(a) In what order did Mendeleev set out the elements?

_____ [1]

(b) **(i)** Name the Group of elements known today which is not in Mendeleev's table.

_____ [1]

(ii) Suggest a reason why this Group was not in Mendeleev's table.

_____ [1]

(c) Using the Data Leaflet and your knowledge, name one element that Mendeleev placed in the wrong position.

_____ [1]

(d) In what order are the elements set out in the modern Periodic Table?

_____ [1]

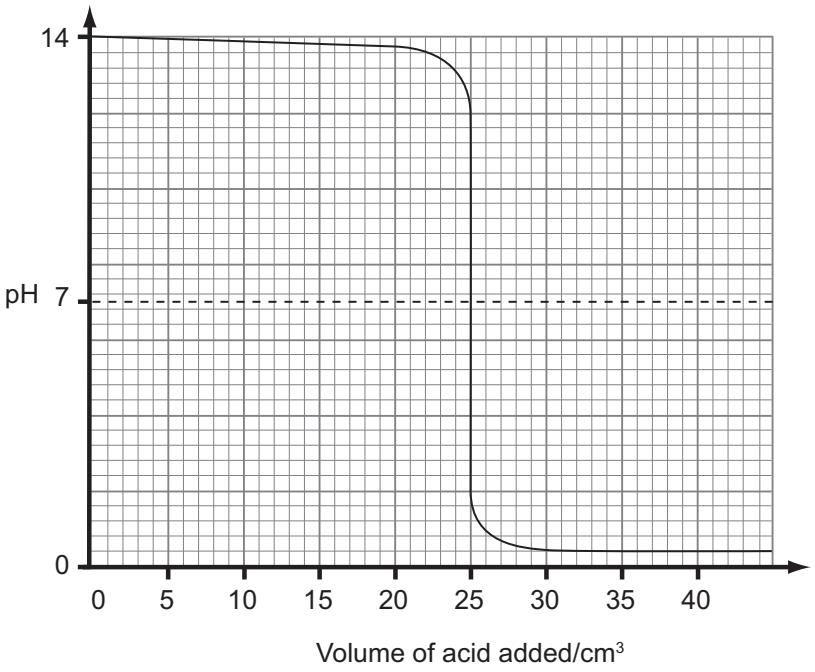
(e) Name another scientist who made a contribution to the development of the Periodic Table.

_____ [1]

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Examiner Only	
Marks	Remark

2 The pH changes during the reaction between sodium hydroxide and hydrochloric acid were measured using a pH meter. The following graph was produced.



(a) What was the pH value of the liquid in the flask at the start of the experiment?

_____ [1]

(b) What volume of acid was needed to cause a sudden drop in the pH value?

_____ [1]

(c) Explain why litmus paper could **not** be used instead of a pH meter for this experiment.

_____

_____ [1]

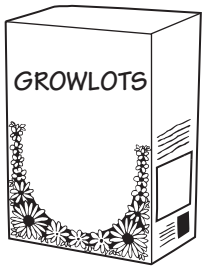
(d) Complete the symbol equation for this reaction:

$HCl + NaOH \longrightarrow \quad + \quad$ [2]

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Examiner Only	
Marks	Remark

3 GROWLOTS plant fertiliser is a blue powder. It is a mixture of two **hydrated** salts, copper(II) sulfate and iron(III) sulfate.



(a) **(i)** Suggest why Growlots fertiliser is blue in colour.

_____

_____ [1]

(ii) Explain the meaning of the term **hydrated**.

_____

_____ [1]

(b) The fertiliser is made up of two salts, copper(II) sulfate and iron(III) sulfate. Each salt can be made by reacting an acid with a base.

(i) Name the acid used to make the two salts in the fertiliser.

_____ [1]

(ii) What is the name given to this **type** of chemical reaction?

_____ [1]

(c) You may find your Data Leaflet helpful to answer this question.

(i) What is the formula of copper(II) sulfate?

_____ [1]

(ii) Circle the correct formula for iron(III) sulfate given in the list below.

$Fe_3(SO_4)_2$ $Fe_2(SO_4)_3$ $FeSO_4$ Fe_3SO_4 [1]

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(Questions continue overleaf)

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Examiner Only	
Marks	Remark

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

_____

_____

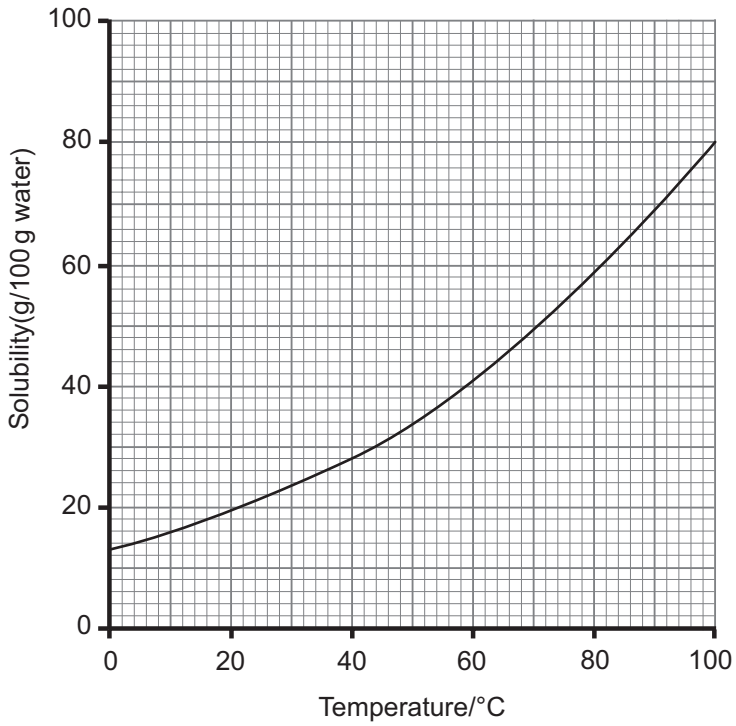
_____

_____

_____

_____ [4]

(b) The solubility curve for copper(II) sulfate is drawn below.



Use the solubility curve to answer the following questions.

(i) How does the solubility of copper(II) sulfate change as the temperature of the water increases?

_____

_____ [1]

(ii) What is the solubility of copper(II) sulfate at 76 °C?

_____ [1]

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(iii) State whether the following copper(II) sulfate solutions are saturated or unsaturated.

Solution			Saturated/unsaturated
Mass of $CuSO_4$ (g)	**Mass of water (g)**	**Temperature °C**	
45	100	60	
15	50	20	
125	500	40	

[3]

(iv) What mass of copper sulfate will crystallise from a saturated solution containing 100 g of water when the solution is cooled from 56 °C to 22 °C? You should show your working out clearly.

_____ g/100 g H_2O [4]

Examiner Only

Marks	Remark

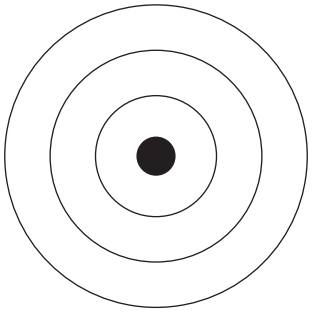
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Marks	Remark

5 Sodium reacts with chlorine to form the compound sodium chloride.

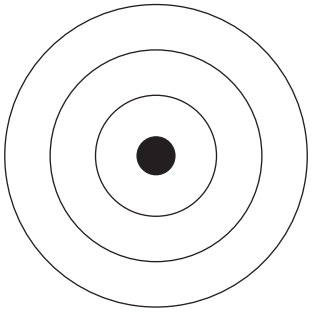
(a) Complete the diagrams below to show the arrangement of **all** of the electrons in a sodium atom and a chlorine atom.

(i) Sodium atom



[1]

(ii) Chlorine atom



[1]

In Part (b) you will be assessed on your written communication skills including the use of specialist science terms.

(b) Explain, using electronic structures, how sodium and chlorine bond to form the compound sodium chloride.

[6]

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(c) Sodium chloride has a high melting point. Give **two** other physical properties you would expect sodium chloride to have.

1. _____

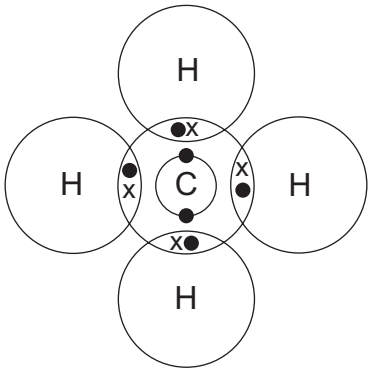
2. _____ [2]

Examiner Only	
Marks	Remark

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Marks	Remark

6 Methane, water and nitrogen occur as molecules.

The diagram below shows the electrons in the atoms of carbon and hydrogen in a molecule of methane.



(a) (i) Draw a dot and cross diagram to show the **outer electrons** of the atoms in a molecule of water.

[3]

(ii) Label the **lone pairs** of electrons in **your** diagram. [1]

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(b) Nitrogen is made up of **diatomic** molecules.

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

_____

_____ [1]

(ii) Draw a dot and cross diagram to show how the outer electrons are arranged in a molecule of nitrogen.

[3]

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Marks	Remark

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Marks	Remark

7 Substances may be classified in terms of their physical properties. Use the table below to answer the following questions.

Substance	Melting point °C	Boiling point °C	Electrical conductivity	
			As solid	As liquid
A	3550	4827	poor	poor
B	1540	2750	good	good
C	776	1500	poor	good
D	−95	69	poor	poor
E	327	1760	good	good

(a) Which substance, A, B, C, D or E, is an ionic compound? Explain your answer.

Substance _____

Explanation _____

_____ [2]

(b) Which substance, A, B, C, D or E, has a molecular covalent structure?

_____ [1]

(c) Which substance, A, B, C, D or E, is a metal with a low melting point?

Substance _____ [1]

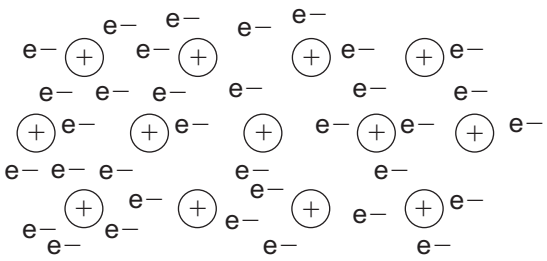
(d) Which substance, A, B, C, D or E, is an allotrope of carbon? Name the allotrope.

Substance _____

Name _____ [2]

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8 Sodium is a soft metal that conducts electricity and has a low melting point. A simple model of its structure is shown below.



Use your understanding of metallic bonding to answer the following questions.

(a) Explain why sodium is able to conduct electricity.

_____

_____

_____ [2]

(b) The melting point of sodium is low compared to many other metals. What does this tell you about the metallic bonds in sodium?

_____

_____ [1]

(c) Sodium, like all metals, is ductile. Explain why sodium is ductile.

_____

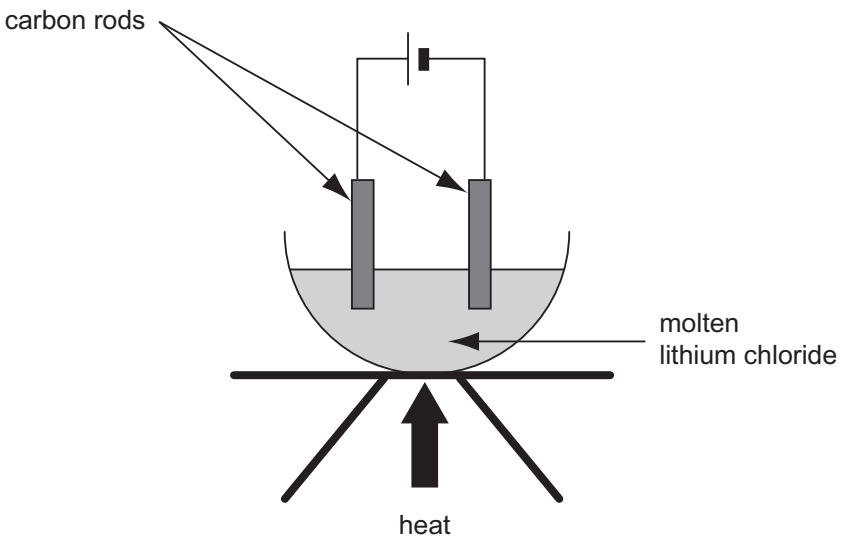
_____ [1]

Examiner Only

Marks	Remark

Examiner Only	
Marks	Remark

9 The diagram shows the laboratory apparatus used in the electrolysis of lithium chloride.



In Part (a) you will be assessed on your written communication skills including the use of specialist science terms.

(a) Describe fully how to carry out this electrolysis and state what you would observe during the reaction. Your answer should include:

- Safety measures to be taken.
- Reason for the use of heat.
- The colours and states of the products formed at each named electrode.

[6]

(b) Write a balanced **ionic** equation for the reaction occurring at the anode.

_____ [2]

(c) Aluminium is extracted from its ore by electrolysis. This is a very costly process.

Give **two** ways of helping to keep the costs to a minimum in this industrial process.

_____

_____

_____ [2]

(d) Suggest what factors need to be considered when deciding on the site for an aluminium extraction plant.

_____

_____

_____

_____ [2]

THIS IS THE END OF THE QUESTION PAPER

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New Specification

Rewarding Learning

General Certificate of Secondary Education
2011–2012

Double Award Science: Chemistry

Unit C1

Higher Tier

[GSD22]

WEDNESDAY 9 NOVEMBER 2011

9.15 am–10.15 am

MARK SCHEME

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				AVAILABLE MARKS
1	**(a)**	atomic mass order	[1]	
	(b)	**(i)** noble gases	[1]	
		(ii) not yet discovered	[1]	
	(c)	Any **one** from the following elements named Cu, Zn, Mn, Mg, Cr, V, Ti, Fe, Co, Ni	[1]	
	(d)	atomic number order	[1]	
	(e)	(John) Newlands	[1]	6
2	**(a)**	14	[1]	
	(b)	25 (cm^3)	[1]	
	(c)	It cannot give a pH value/idea that litmus paper can only indicate if liquid is an acid or an alkali	[1]	
	(d)	$NaCl + H_2O$	[2]	5
3	**(a)**	**(i)** The fertiliser contains copper sulfate (which is blue)	[1]	
		(ii) Idea that solid contains water **of crystallisation**	[1]	
	(b)	**(i)** sulfuric acid accept completely correct formula H_2SO_4	[1]	
		(ii) Neutralisation	[1]	
	(c)	**(i)** $CuSO_4$	[1]	
		(ii) Candidates circle $Fe_2(SO_4)_3$	[1]	6

AVAILABLE MARKS

4 **(a)** The solubility of a solid in water is the maximum mass [1]
of solid which will dissolve in [1]
100 g of water [1]
at a given temperature [1] [4]

(b) **(i)** Idea of as the temperature of the water increases the solubility increases [1]

(ii) 55 (g/100gH_2O) ± 1 [1]

(iii)

Solution			Saturated/ unsaturated
Mass of $CuSO_4$(g)	**Mass of water (g)**	**Temperature °C**	
45	100	60	**saturated**
15	50	20	**saturated**
125	500	40	**unsaturated**

[3]

(iv) Solubility at 56 °C 38 g/100 g H_2O [1]
Solubility at 22 °C 20 g/100 g H_2O [1]
38–20 [1] = 18 (g/100 g H_2O) [1] [4]

13

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AVAILABLE MARKS

5 **(a)** Candidates draw diagrams to show the electronic structures

(i) Na 2, 8, 1 [1]

(ii) Cl 2, 8, 7 [1]

(b) Indicative content

- Transfer
- Correct direction of transfer
- Correct number of electrons transferred
- Correct electronic structure for sodium ion
- Correct charge on either ion
- Correct electronic structure for chloride ion
- Reference to how the ions are held together [6]

Response	Mark
Candidates must use appropriate specialist terms throughout to describe fully using 5–7 of the points shown in the indicative content how the atoms of sodium and chlorine bond to form sodium chloride in a logical sequence. They use good spelling, punctuation and grammar and the form and style are of a high standard.	5–6
Candidates using 3–4 of the points shown in the indicative content partially describe how the atoms of sodium and chlorine bond to form sodium chloride in a logical sequence. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	3–4
Candidates make reference to 1–2 of the main points shown above using limited spelling, punctuation and grammar. The form and style is of limited standard and they have made little use of specialist terms.	1–2
Candidates make no reference to the main points below and offer no other suitable response. Response not worthy of credit.	0

(c) Any **two** from
Hard/brittle/does not conduct electricity as a solid/soluble (in water)/ conducts electricity when molten or dissolved in water [2]

10

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					AVAILABLE MARKS
6	**(a)**	**(i)**	dot and cross diagram [1] correct sharing [1] correct no. of electrons (dependent on correct sharing) [1]	[3]	
		(ii)	correctly labelled lone pairs	[1]	
	(b)	**(i)**	two atoms in a molecule	[1]	
		(ii)	[correctly drawn dot-cross triple bond] [2] [6 electrons] [1] in 3 pairs [1] correct number of electrons [1] (dependent on correct sharing)	[3]	8
7	**(a)**		C [1] conducts in liquid state but not in solid state [1] (2nd mark conditional on first)	[2]	
	(b)		D	[1]	
	(c)		E	[1]	
	(d)		Substance A [1] (2nd mark conditional on first) diamond [1]	[2]	6
8	**(a)**		mobile/delocalised electrons [1] can carry current [1]	[2]	
	(b)		Not strong	[1]	
	(c)		atoms, ions slide over each other	[1]	4

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9 (a) Indicative content

- Use fume cupboard because toxic gas is produced
- (Need to melt lithium chloride) so that ions are free to move/so that compound can conduct electricity
- Greenish–yellow gas – (chlorine)
- formed at anode
- Idea of Silvery beads of metal (lithium)
- formed at cathode [6]

Response	Mark
Candidates must use appropriate specialist terms throughout to describe, in a logical sequence, the electrolysis of lithium chloride using 5–6 of the points shown in the indicative content. They use good spelling, punctuation and grammar and the form and style are of a high standard.	5–6
Candidates use some appropriate specialist terms to describe partially, in a logical sequence, the electrolysis of lithium chloride using 3–4 of the points shown in the indicative content. They use satisfactory spelling, punctuation and grammar and the form and style are of a satisfactory standard.	3–4
Candidates make reference to 1–2 of the main points shown above using limited spelling, punctuation and grammar. The form and style is of a limited standard and they have made little use of specialist terms.	1–2
Response not worthy of credit.	0

(b) $2\,Cl^- \longrightarrow Cl_2 + 2e^- / 2\,Cl^- - 2e^- \longrightarrow Cl_2$ [2]

(c) Any **two** from
use cryolite to lower the temperature for melting the aluminium ore
(formation of) crust on electrolyte (reduces heat loss)
use a cost effective (cheap) source of electricity [2]

(d) Any **two** from
idea site near a cheap source of electricity (hydroelectric)
idea site must be serviced by good transport links
idea site must be serviced by a good water supply (for washing, cooling, steam generation)
site must have suitable waste disposal facilities
site must be in an area with access to a skilled workforce [2]

Total

AVAILABLE MARKS

12

70

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