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]

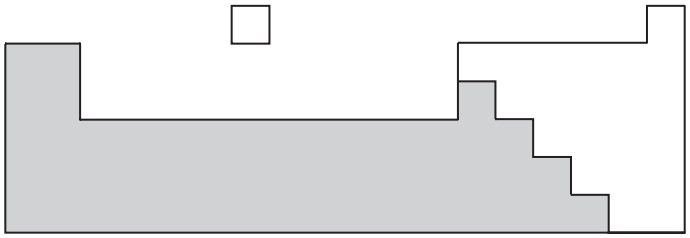
(d) What names are given to the rows and columns of elements in the modern Periodic Table?

(i) rows _____ [1]

(ii) columns _____ [1]

Examiner Only	
Marks	Remark

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



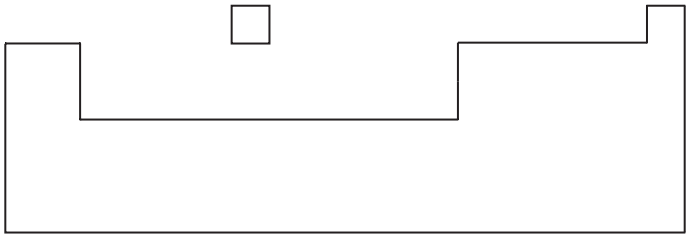
The elements in the shaded area in the diagram have similar physical properties. Give two physical properties of the elements in this area.

1. _____ [1]

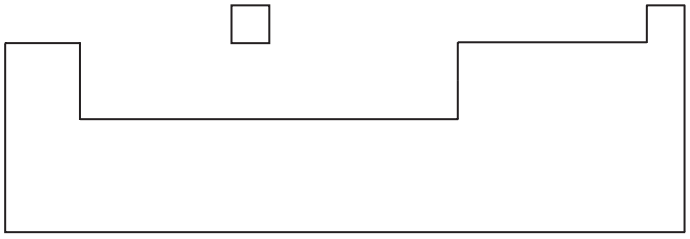
2. _____ [1]

(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]

(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

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)

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]

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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