



Rewarding Learning

General Certificate of Secondary Education  
2013–2014

Centre Number

71

Candidate Number

## Double Award Science: Chemistry

Unit C1

Higher Tier

[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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1 The balanced symbol equation below includes state symbols.



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  $\text{K}_2\text{CO}_3$ .

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]

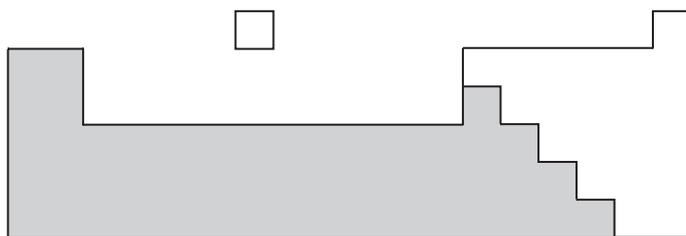
(d) What names are given to the rows and columns of elements in the modern Periodic Table?

(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]

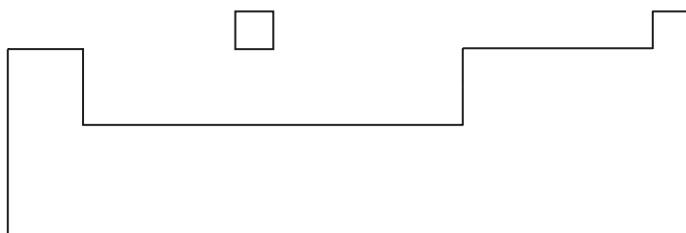
2. \_\_\_\_\_ [1]

- (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 ( $^{12}_6\text{C}$ ) 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 ( $^{14}_6\text{C}$ ) and carbon-12 ( $^{12}_6\text{C}$ ) are isotopes of carbon.

Compare, in terms of the particles in the atoms, an atom of carbon-14 ( $^{14}_6\text{C}$ ) with an atom of carbon-12 ( $^{12}_6\text{C}$ ).

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[3]

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

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

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[2]

(ii) Draw a dot and cross diagram of a molecule of methane ( $\text{CH}_4$ ). Show the outer electrons only.

[2]

Examiner Only

Marks Remark

- (iii) Draw a dot and cross diagram of a molecule of carbon dioxide (CO<sub>2</sub>). 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<sub>2</sub>CO<sub>3</sub> 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

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.



(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]

Examiner Only	
Marks	Remark

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

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[2]

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

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[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.

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[1]

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

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[3]

Examiner Only

Marks Remark



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**(Questions continue overleaf)**

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:

	<b>potassium bromide solution</b>	<b>potassium chloride solution</b>	<b>potassium iodide solution</b>
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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Marks Remark







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