



General Certificate of Secondary Education  
2011

## Science: Chemistry

Paper 1  
Higher Tier

[G1403]

FRIDAY 27 MAY, MORNING

StudentBounty.com

71

Candidate Number



G1403

### TIME

1 hour 30 minutes.

### INSTRUCTIONS TO CANDIDATES

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

Write your answers in the spaces provided in this question paper.

Answer **all five** questions.

### INFORMATION FOR CANDIDATES

The total mark for this paper is 120.

Quality of written communication will be assessed in question 2(c).

Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.

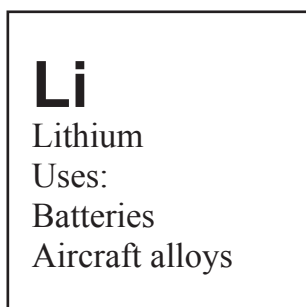
A Data Leaflet which includes a Periodic Table of the Elements is provided.

For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
<b>Total Marks</b>	



6344

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



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

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

[4]

Examiner Only	
Marks	Remark

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

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

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

[6]

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

\_\_\_\_\_ [1]

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

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

[4]

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

**hydroxides    acidic    neutral    oxides    basic**

Most metals burn in oxygen to form \_\_\_\_\_ which are \_\_\_\_\_.

[2]

Examiner Only

Marks Remark

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

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

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

\_\_\_\_\_ [1]

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

Colour: \_\_\_\_\_

State: \_\_\_\_\_ [2]

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

Name: \_\_\_\_\_ Charge: \_\_\_\_\_ [2]

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

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [1]

Examiner Only

Marks

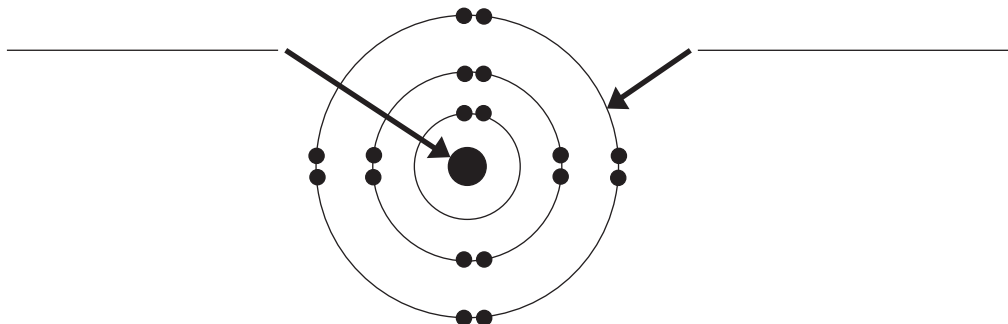
Remark

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**(Questions continue overleaf)**

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

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



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

(ii) Explain why atoms are electrically neutral.

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [2]

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

\_\_\_\_\_

\_\_\_\_\_ [1]

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

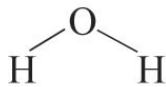
Relative mass	Relative charge	Name of subatomic particle
	0	
$\frac{1}{1840}$	-1	
1		

[5]

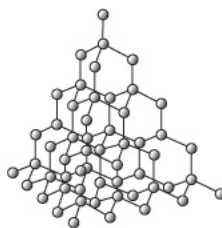
Examiner Only

Marks Remark

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



Water



Diamond

© GCSE Chemistry for CCEA by T Lavery, page 20, published by Hodder & Stoughton, 2003. ISBN 9780340858240. Reproduced by permission of Hodder Education.

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

[3]

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

\_\_\_\_\_  
\_\_\_\_\_ [2]

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

water \_\_\_\_\_

diamond \_\_\_\_\_ [2]

Examiner Only

Marks Remark

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

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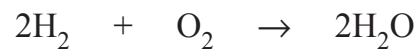
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[4]

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



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

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[5]

**Quality of Written Communication** [2]

Examiner Only	
Marks	Remark



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**(Questions continue overleaf)**

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

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

\_\_\_\_\_ [3]

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

[5]

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

\_\_\_\_\_ [2]

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

\_\_\_\_\_  
\_\_\_\_\_

\_\_\_\_\_ [2]

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

\_\_\_\_\_ [1]

Examiner Only

Marks Remark

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

\_\_\_\_\_ [3]

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [3]

Examiner Only

Marks Remark

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

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

Examiner Only	
Marks	Remark

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

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

Name: \_\_\_\_\_ [2]

Formula: \_\_\_\_\_ [1]

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

\_\_\_\_\_ [1]

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

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [2]

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

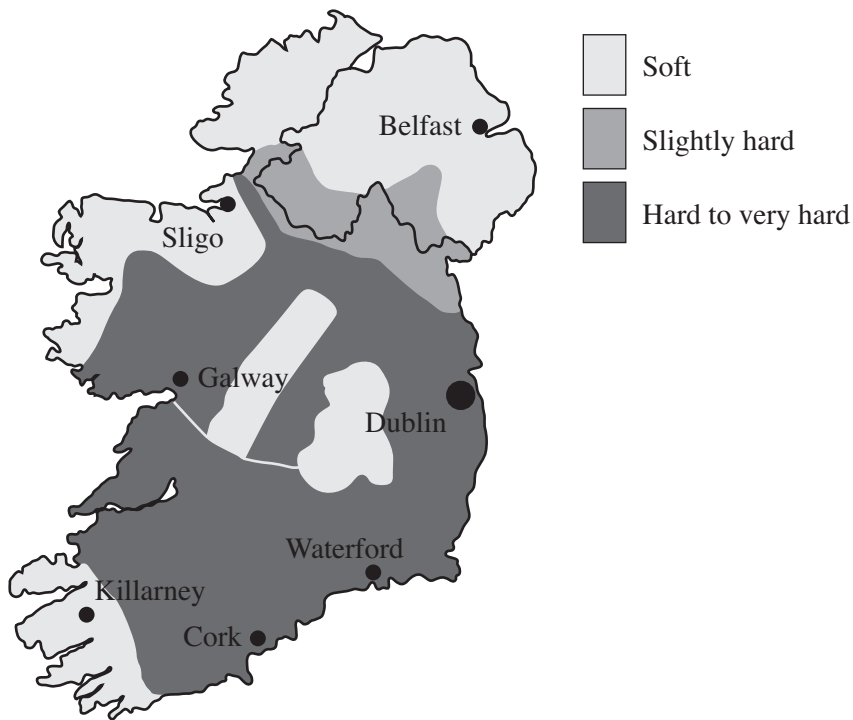
Cation: \_\_\_\_\_

Anion: \_\_\_\_\_ [2]

Examiner Only

Marks Remark

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



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

\_\_\_\_\_

\_\_\_\_\_ [2]

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

\_\_\_\_\_

\_\_\_\_\_ [2]

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

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_ [3]

Examiner Only	
Marks	Remark

(iv) State one disadvantage of hardness in water.

\_\_\_\_\_ [1]

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

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

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

\_\_\_\_\_ [1]

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

\_\_\_\_\_ [1]

Examiner Only	
Marks	Remark

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

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

\_\_\_\_\_ [1]

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

\_\_\_\_\_  
\_\_\_\_\_ [2]

(iii) State the colour of the precipitate.

\_\_\_\_\_ [1]

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

\_\_\_\_\_ [2]

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

\_\_\_\_\_ [1]

Examiner Only

Marks Remark



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**(Questions continue overleaf)**

- 5 Sulphuric acid is used in car batteries. Many garages keep a “Battery Acid Spill Kit” on the premises to deal with any battery acid spillage. The acid neutraliser in the “Battery Acid Spill Kit” is anhydrous sodium carbonate,  $\text{Na}_2\text{CO}_3$ .



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

[2]

- (ii) Calculate the concentration of the sodium carbonate solution in  $\text{mol/dm}^3$ .

[2]

Examiner Only	
Marks	Remark

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

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

31.25 cm<sup>3</sup> of sodium carbonate solution were required to neutralise the sulphuric acid in the dilute battery acid.

**(i)** Name the piece of apparatus used to accurately measure the 25.0 cm<sup>3</sup> of dilute battery acid.

\_\_\_\_\_ [1]

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

From \_\_\_\_\_ to \_\_\_\_\_ [2]

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

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_ [4]

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

[2]

Examiner Only	
Marks	Remark

The equation for the reaction is



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

[2]

- (vi) Calculate the concentration of the sulphuric acid in mol/dm<sup>3</sup>.

[2]

Examiner Only	
Marks	Remark

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



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

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

[5]

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

[3]

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**THIS IS THE END OF THE QUESTION PAPER**

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Marks Remark





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