



Rewarding Learning

General Certificate of Secondary Education  
2015–2016

Centre Number

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Candidate Number

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# Double Award Science: Chemistry

Unit C1  
Higher Tier

MV18

[GSD22]

**THURSDAY 12 NOVEMBER 2015, MORNING**

## Time

1 hour, plus your additional time allowance.

## 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 at the end of each question 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.

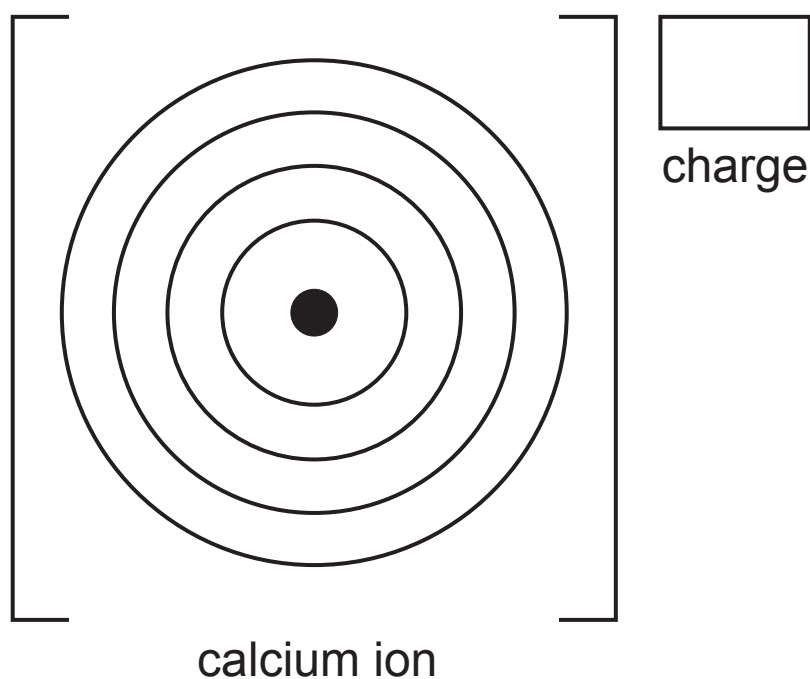
1 Some tap water contains dissolved calcium chloride ( $\text{CaCl}_2$ ) and dissolved calcium hydrogen carbonate,  $\text{Ca}(\text{HCO}_3)_2$ .

(a) Give two reasons why calcium hydrogen carbonate and calcium chloride could be **ionic** compounds. [2 marks]

1. \_\_\_\_\_

2. \_\_\_\_\_

(b) Draw the electronic configuration of the calcium **ion** and give the charge. [2 marks]



(c) How many oxygen atoms are there in the formula  $\text{Ca}(\text{HCO}_3)_2$ ? [1 mark]

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

**(d)** Write the formulae for magnesium sulfate and potassium carbonate. [2 marks]

magnesium sulfate \_\_\_\_\_

potassium carbonate \_\_\_\_\_

**(e)** What colour are solid magnesium sulfate and solid potassium carbonate? [1 mark]

\_\_\_\_\_

**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 mark]

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**(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	Ca		Ti	V	Cr	Mn	Fe
Cu	Zn			As	Se	Br	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. [6 marks]

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

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

(a) What is the pH range of a strong acid? [1 mark]

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Copper oxide reacts with sulfuric acid.

(b) (i) Complete the **word** equation below for this reaction. [2 marks]

copper oxide + sulfuric acid  $\longrightarrow$  +

(ii) Why can this reaction be described as a neutralisation reaction? [2 marks]

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(iii) What colour change is observed **in the solution** as this reaction is happening? [2 marks]

from \_\_\_\_\_ to \_\_\_\_\_

Sodium oxide reacts with hydrochloric acid.

- (c) (i)** Complete a balanced symbol equation for the reaction between sodium oxide and hydrochloric acid. [3 marks]



- (ii)** Sodium oxide is an alkali. Why could sodium oxide be described as an alkali? [2 marks]

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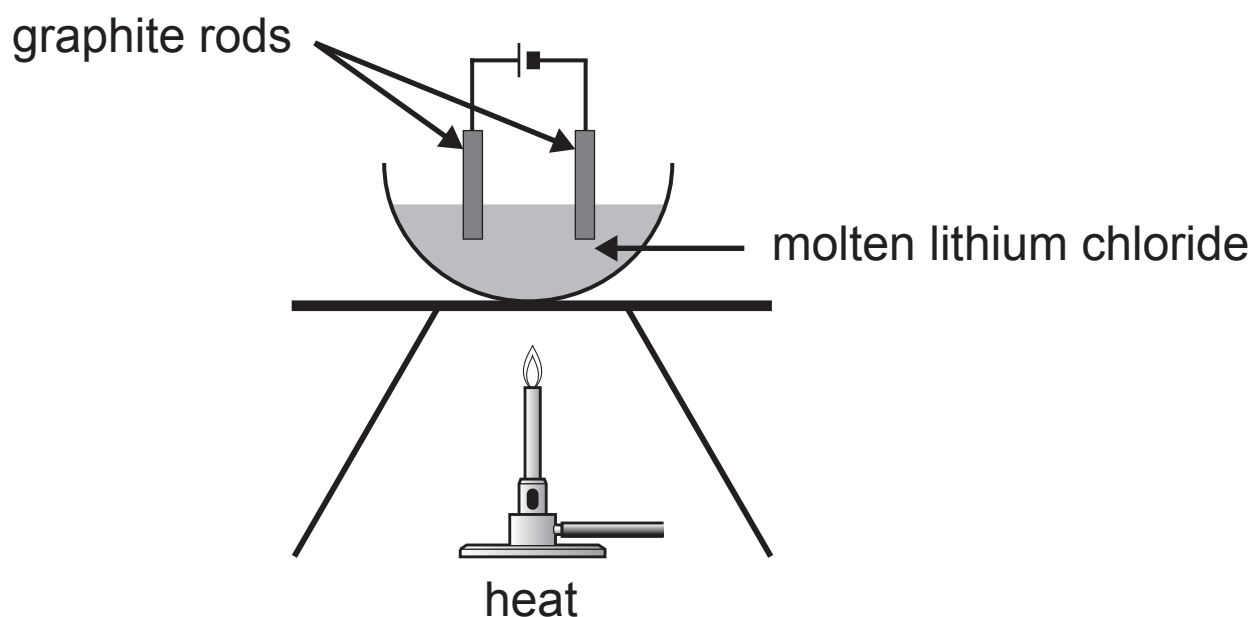


4 Metals, such as copper, are good conductors of electricity. Metal compounds, such as sodium chloride will conduct electricity when they are molten or dissolved in water.

(a) Complete the table below which gives information about how copper and sodium chloride solution conduct electricity. [4 marks]

<b>Name of conductor</b>	Name of the <b>type</b> 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		

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



**(b) (i)** Give one reason why graphite is used to make these electrodes. [1 mark]

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**(ii)** Write a half equation for the reaction which happens at the cathode when molten lithium chloride undergoes electrolysis. [2 marks]

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

**(c) (i)** How is alumina produced? [2 marks]

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**(ii)** Give two reasons why cryolite is used in the extraction of aluminium. [2 marks]

1. \_\_\_\_\_

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 mark]

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**(e)** Give two reasons why recycling aluminium is preferable to having to extract even more of the metal by electrolysis. [2 marks]

1. \_\_\_\_\_

2. \_\_\_\_\_

**5** This question is about covalent structures and covalent bonding.

**(a)** What is a covalent bond? [1 mark]

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**(b)** Draw a dot and cross diagram to show the covalent bonding in a molecule of hydrogen chloride (HCl). Show outer electrons only. [3 marks]

**(c)** Complete the paragraph below which explains why giant covalent structures have much higher melting points than molecular covalent structures. [3 marks]

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 \_\_\_\_\_.

(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. [2 marks]

can be compressed

insoluble in water

ductile

non-conductors of electricity

colourless gases

- 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	

- (a) Explain why bromine solution does not react with potassium chloride solution. [2 marks]

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- (b) Name the **type** of reaction that takes place between potassium bromide and chlorine. [1 mark]

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(c) Write a balanced **symbol** equation for the reaction between chlorine and potassium iodide. [3 marks]

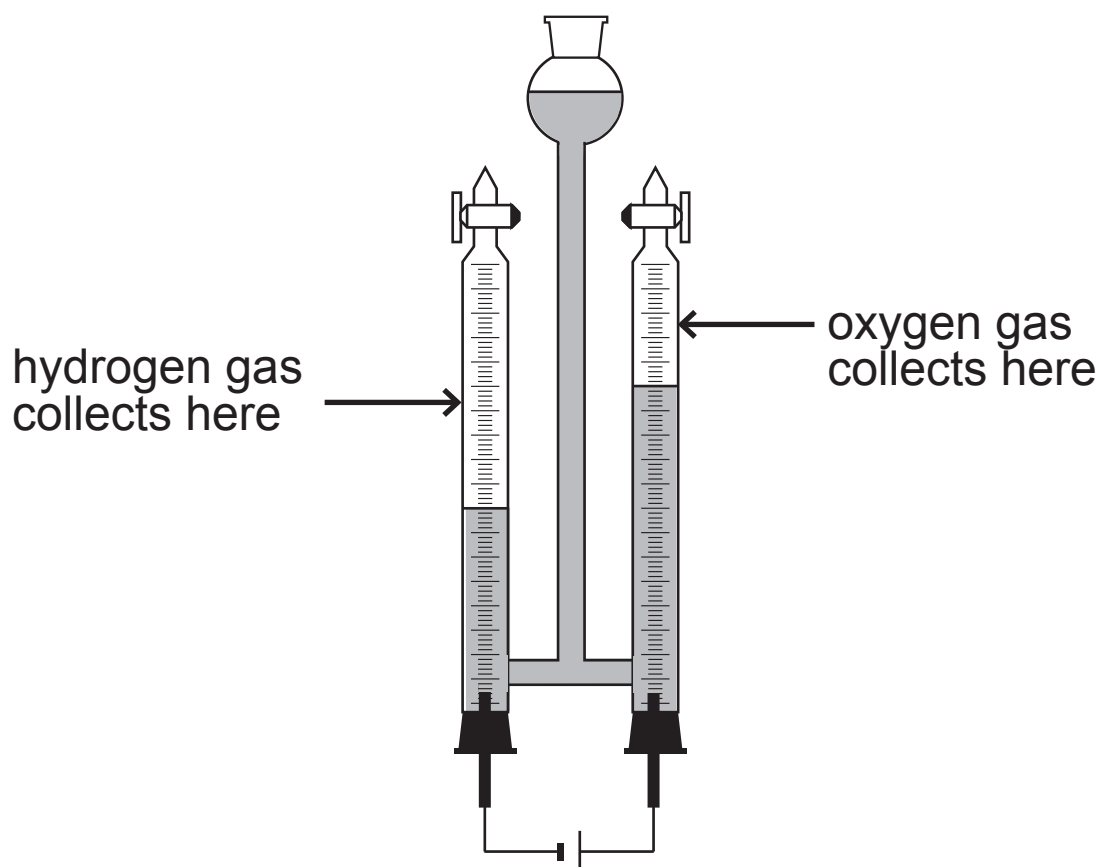
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(d) Explain in terms of their electronic structures why the halogens have similar chemical properties. [2 marks]

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- 7 The apparatus shown below may be used in the laboratory to demonstrate that water ( $\text{H}_2\text{O}$ ) is a compound made from the elements hydrogen and oxygen.



(a) Describe a **chemical** test for water. [3 marks]

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In one demonstration the water decomposed to form  $10\text{ cm}^3$  of hydrogen gas and  $5\text{ cm}^3$  of oxygen gas.

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

[1 mark]

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**(c)** Describe a test for hydrogen. [2 marks]

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

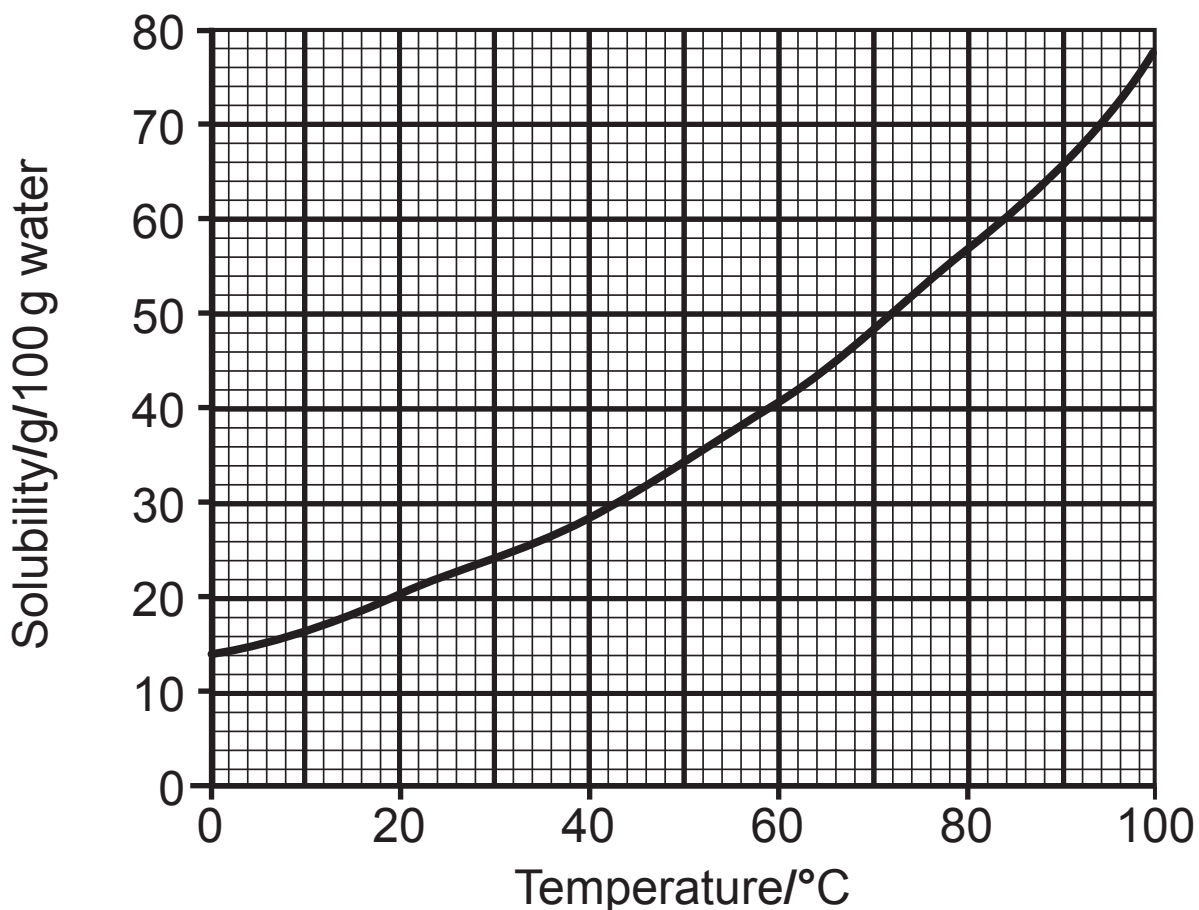
(a) Explain why crystals form when the solution is cooled.  
[2 marks]

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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. [4 marks]

\_\_\_\_\_g

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

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## Sources

Pg 9 Q4 Diagram of apparatus to conduct electricity through molten lithium chloride © CCEA

Pg 14 Q6 Table summaries observation when solutions are added © CCEA

Pg 16 Q7 Apparatus used to show water compounds © CCEA

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

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