



General Certificate of Secondary Education  
2019

Centre Number

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Candidate Number

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# GCSE Chemistry

Unit 1

Foundation Tier

**MV18**

**[GCM11]**

**TUESDAY 28 MAY, AFTERNOON**

## 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.

**You must answer the questions in the spaces provided.**

**Do not write on blank pages.**

Complete in black ink only.

Answer **all five** questions.

## Information for Candidates

The total mark for this paper is 60.

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 **5(a)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is included in this question paper.

1 The element sulfur is found on the Earth's surface particularly in volcanic regions such as Sicily. The atomic number of sulfur is 16.

(a) (i) What is meant by the term element? [1 mark]

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(ii) What is meant by the term atomic number?  
[1 mark]

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(b) A sample of sulfur from a volcanic rock was analysed to give the following percentage abundance of its isotopes.

Isotope	Percentage abundance
$^{32}\text{S}$	95.02
$^{33}\text{S}$	0.76
$^{34}\text{S}$	4.22

(i) Calculate the relative atomic mass for the sample of sulfur. [2 marks]  
Show your working out.

Relative atomic mass = \_\_\_\_\_

(ii) What is meant by the term isotopes? [2 marks]

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(c) Complete the table below. [2 marks]

Atom/ion	Number of protons	Number of neutrons	Number of electrons
$^{32}\text{S}$			
$^{34}\text{S}^{2-}$			

2 The elements of Period 2 are listed below.

lithium

beryllium

boron

carbon

nitrogen

oxygen

fluorine

neon

(a) Lithium burns in air to form lithium oxide.

(i) Write a balanced symbol equation for the reaction which occurs when lithium burns in air. [3 marks]

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(ii) Describe, in words and by writing electronic configurations, how lithium atoms react with oxygen atoms to form lithium oxide. State the charges of the ions formed. [6 marks]

(iii) Explain why lithium oxide conducts electricity when molten. [1 mark]

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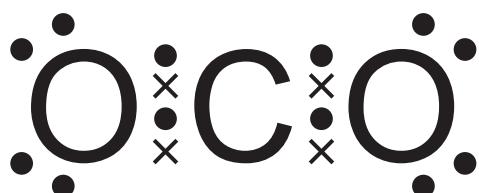
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(b) Carbon reacts with oxygen to form carbon dioxide.

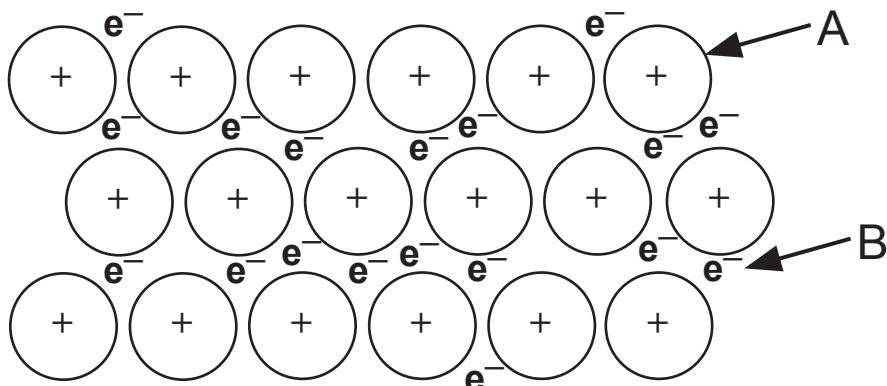
(i) Write a balanced symbol equation for this reaction.  
[2 marks]

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(ii) The dot and cross diagram for the bonding in carbon dioxide is shown below. Label one **lone pair of electrons** in the diagram. [1 mark]



(c) The diagram below shows the bonding in lithium metal.



What labels should be placed at A and B? [2 marks]

A \_\_\_\_\_

B \_\_\_\_\_

3 Chlorine and hydrated aluminium sulfate,  $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$ , are both used in water treatment to make fresh water potable.

(a) (i) What is potable water? [1 mark]

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(ii) Why is chlorine used in water treatment? [1 mark]

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(iii) Describe the test for chlorine gas. [3 marks]

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(iv) Why is aluminium sulfate used in water treatment? [1 mark]

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(b) The following method may be used to prepare hydrated aluminium sulfate.

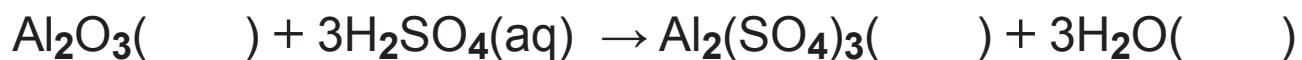
- Measure out  $25\text{ cm}^3$  of dilute sulfuric acid into a beaker
- Warm the acid and add spatula measures of aluminium oxide until it is in excess
- Remove the excess aluminium oxide by filtration
- Slowly evaporate the aluminium sulfate solution

(i) What piece of apparatus is used to measure out  $25\text{ cm}^3$  of dilute sulfuric acid? [1 mark]

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(ii) Draw a labelled diagram of the assembled apparatus used for the filtration step. [3 marks]

(iii) Complete the balanced symbol equation for the reaction by adding the correct state symbols.  
[1 mark]



(c) In an experiment, 12.60 g of hydrated aluminium sulfate crystals,  $\text{Al}_2(\text{SO}_4)_3 \cdot x\text{H}_2\text{O}$ , were heated to constant mass. The anhydrous aluminium sulfate formed had a mass of 6.84 g.

(i) Calculate the mass of water removed on heating to constant mass. [1 mark]

mass of water = \_\_\_\_\_ g

(ii) Calculate the number of moles of water removed on heating to constant mass. [1 mark]

moles of water = \_\_\_\_\_

(iii) Draw a labelled diagram of the assembled apparatus used to heat the hydrated aluminium sulfate crystals to constant mass. [2 marks]

(iv) Hydrated aluminium sulfate has the formula  $\text{Al}_2(\text{SO}_4)_3 \cdot 16\text{H}_2\text{O}$ . Calculate the relative formula mass ( $M_r$ ) of hydrated aluminium sulfate. [1 mark]

relative formula mass ( $M_r$ ) = \_\_\_\_\_

4 When experimenting with manganese(IV) oxide and compounds of the elements yttrium and indium, scientists accidentally discovered a new blue pigment. The new blue colour was named 'YInMn blue' after the elements it contained. It is being used as a new colour for crayons.

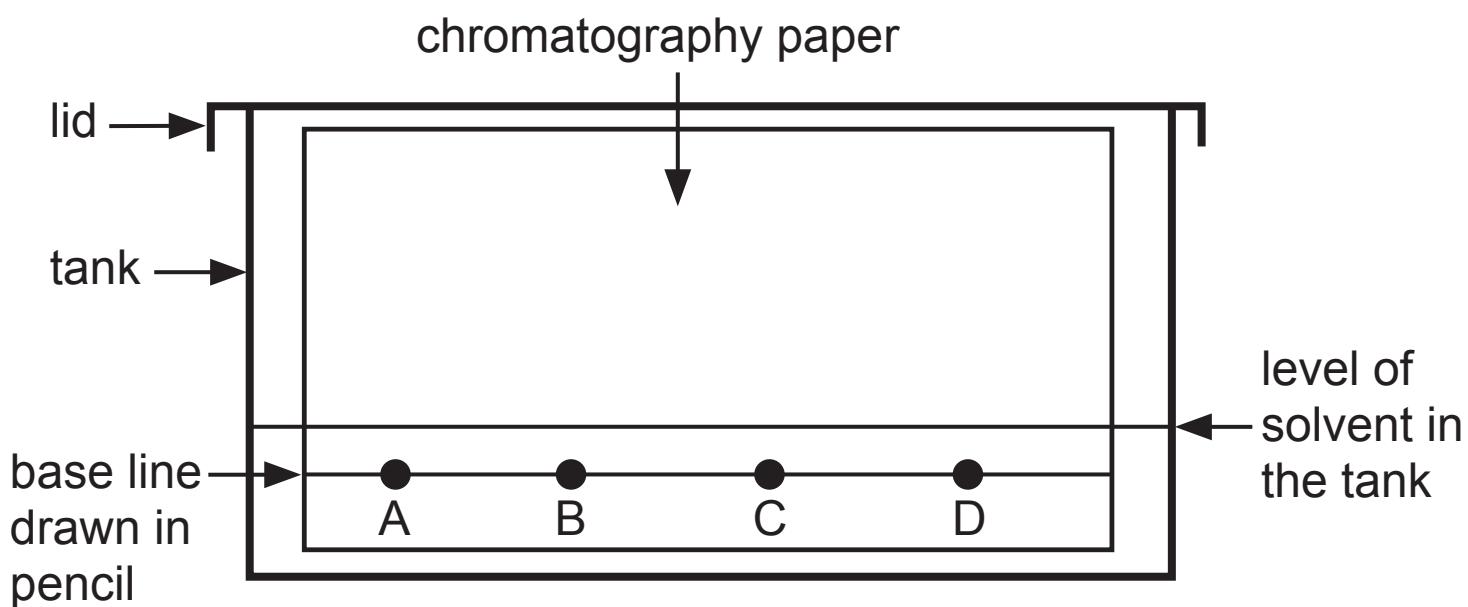
(a) Name the block of elements in the Periodic Table which form coloured compounds. [1 mark]

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(b) Complete the table below to give the colour of some substances. [3 marks]

Substance	Colour
copper(II) oxide powder	
copper(II) nitrate solution	
calcium chloride solution	

(c) A student used chromatography to analyse a coloured pigment. The student set up the apparatus as shown in the diagram below. A is a coloured pigment and B, C and D are spots of pure dyes.



The student made an error in setting up the experiment. Identify the error and state the effect it would have.

[2 marks]

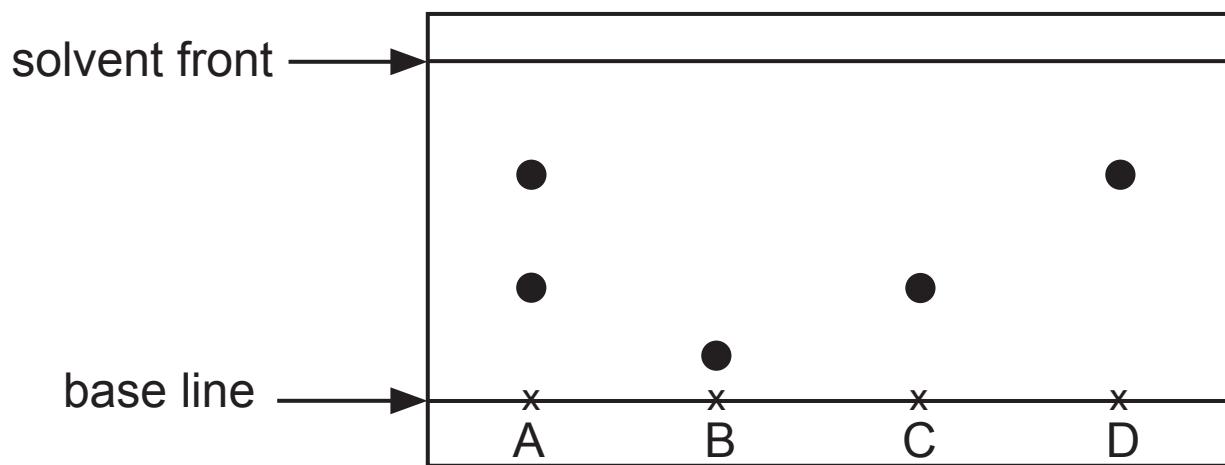
Error \_\_\_\_\_

\_\_\_\_\_

Effect \_\_\_\_\_

\_\_\_\_\_

(d) A different student set up the same experiment correctly and obtained the results shown in the chromatogram below.



(i) What do the results tell you about the composition of the coloured pigment A? [1 mark]

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(ii) Using a ruler, take the following measurements from the chromatogram and use them to calculate an  $R_f$  value for the spot at C: [3 marks]

Distance moved by spot C

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Distance moved by solvent front

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$R_f$  value for spot C

$R_f$  value = \_\_\_\_\_

(iii) Which pure dye (B, C or D) is least soluble in the solvent? Explain your answer. [2 marks]

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5 (a) An investigation was carried out into the displacement reactions of the halogens. Bromine was added to a test tube containing sodium iodide solution and in a separate test tube chlorine was added to sodium bromide solution. A reaction occurred in both test tubes.

State and explain what the student found out. In your answer you should include: [6 marks]

- word equations for the chemical reactions
- an order of reactivity, from most reactive to least reactive, of the halogens shown by these reactions
- an explanation of the order of reactivity of the halogens in terms of electronic configuration.

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

**(b)** Some analytical tests were carried out to identify the ions present in several compounds. Write the **name** of the anion or cation present based on the results of the analytical tests given below.

**(i)** A white precipitate is produced on adding a few drops of barium chloride solution to a salt solution. [1 mark]

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**(ii)** On adding dilute nitric acid to the solid salt, a gas is produced which changes colourless limewater to milky. [1 mark]

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**(iii)** A flame test was carried out on a solid salt and a lilac flame was observed. [1 mark]

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**This is the end of the question paper**

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

Total Marks	

Examiner Number

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## SYMBOLS OF SELECTED IONS

## Positive ions

Name	Symbol
Ammonium	$\text{NH}_4^+$
Chromium(III)	$\text{Cr}^{3+}$
Copper(II)	$\text{Cu}^{2+}$
Iron(II)	$\text{Fe}^{2+}$
Iron(III)	$\text{Fe}^{3+}$
Lead(II)	$\text{Pb}^{2+}$
Silver	$\text{Ag}^+$
Zinc	$\text{Zn}^{2+}$

## Negative ions

Name	Symbol
Butanoate	$\text{C}_3\text{H}_7\text{COO}^-$
Carbonate	$\text{CO}_3^{2-}$
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	$\text{CH}_3\text{COO}^-$
Hydrogencarbonate	$\text{HCO}_3^-$
Hydroxide	$\text{OH}^-$
Methanoate	$\text{HCOO}^-$
Nitrate	$\text{NO}_3^-$
Propanoate	$\text{C}_2\text{H}_5\text{COO}^-$
Sulfate	$\text{SO}_4^{2-}$
Sulfite	$\text{SO}_3^{2-}$

SOLUBILITY IN COLD WATER OF COMMON SALTS,  
HYDROXIDES AND OXIDES

## Soluble

All sodium, potassium and ammonium salts

All nitrates

Most chlorides, bromides and iodides

EXCEPT silver and lead chlorides, bromides and iodides

Most sulfates EXCEPT lead and barium sulfates

Calcium sulfate is slightly soluble

## Insoluble

Most carbonates

EXCEPT sodium, potassium and ammonium carbonates

Most hydroxides

EXCEPT sodium, potassium and ammonium hydroxides

Most oxides

EXCEPT sodium, potassium and calcium oxides which react with water

New Specification

Data Leaflet  
Including the Periodic Table of the ElementsFor the use of candidates taking  
Science: Chemistry,  
Science: Double Award  
or Science: Single Award

Copies must be free from notes or additions of any kind. No other type of data booklet or information sheet is authorised for use in the examinations

gcse examinations

chemistry

# THE PERIODIC TABLE OF ELEMENTS

## Group

\* 58 – 71 Lanthanum series  
† 90 – 103 Actinium series

**a** = relative atomic mass  
(approx)

**a** = relative atomic mass  
(approx)  
**X** = atomic symbol  
**b** = atomic number

140 <b>Ce</b> Cerium 58	141 <b>Pr</b> Praseodymium 59	144 <b>Nd</b> Neodymium 60	145 <b>Pm</b> Promethium 61	150 <b>Sm</b> Samarium 62	152 <b>Eu</b> Europium 63	157 <b>Gd</b> Gadolinium 64	159 <b>Tb</b> Terbium 65	162 <b>Dy</b> Dysprosium 66	165 <b>Ho</b> Holmium 67	167 <b>Er</b> Erbium 68	169 <b>Tm</b> Thulium 69	173 <b>Yb</b> Ytterbium 70	175 <b>Lu</b> Lutetium 71
232 <b>Th</b> Thorium 90	231 <b>Pa</b> Protactinium 91	238 <b>U</b> Uranium 92	237 <b>Np</b> Neptunium 93	242 <b>Pu</b> Plutonium 94	243 <b>Am</b> Americium 95	247 <b>Cm</b> Curium 96	245 <b>Bk</b> Berkelium 97	251 <b>Cf</b> Californium 98	254 <b>Es</b> Einsteinium 99	253 <b>Fm</b> Fermium 100	256 <b>Md</b> Mendelevium 101	254 <b>No</b> Nobelium 102	257 <b>Lr</b> Lawrencium 103