



Rewarding Learning

General Certificate of Secondary Education  
2025

Centre Number

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Candidate Number

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# GCSE Chemistry

Unit 1

Foundation Tier



[GCM11]

\*GCM11\*

**MONDAY 19 MAY, MORNING**

## TIME

1 hour.

## 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 outside the boxed area on each page or on blank pages.**

Complete questions in black ink and use a dark HB pencil for drawings and graphs.

**Do not write with a gel pen.**

Answer all **five** questions.

## INFORMATION FOR CANDIDATES

The total mark for this paper is 60.

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

You may use a scientific calculator.

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.

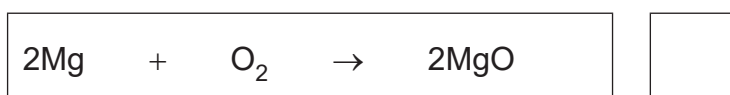
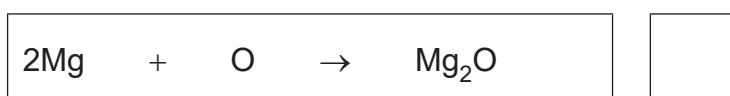
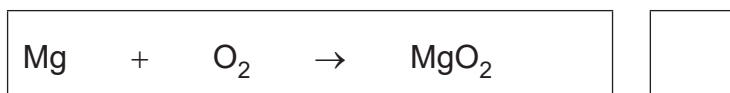
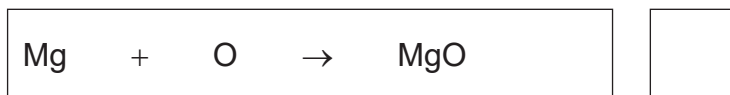
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\*16GCM1101\*

1 Magnesium reacts with oxygen to form magnesium oxide.

(a) Which one of the following shows the correct balanced symbol equation for the reaction of magnesium with oxygen? Tick (✓) the box on the right to indicate your choice.



[1]

(b) The table below shows some properties of magnesium, oxygen and magnesium oxide.

Physical property	Magnesium	Oxygen	Magnesium oxide
Melting point /°C	650	-218	2852
Boiling point /°C	1090	-183	3600
State at room temperature (25°C)			
Colour at room temperature (25°C)			

(i) Complete the table above.

[3]



(ii) The bonding in magnesium oxide is ionic bonding. Explain what is meant by ionic bonding.

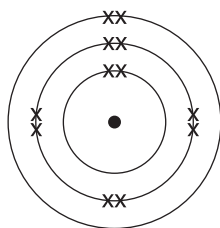
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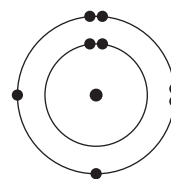
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[1]

(iii) Complete the dot and cross diagram below by drawing the electronic configurations of the ions formed and write the formulae of the ions.



magnesium atom



oxygen atom

magnesium ion

oxide ion

Formula \_\_\_\_\_

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



(iv) A dot and cross diagram for a molecule of oxygen is shown below.



For the molecule shown, complete the following:

Total number of electrons shown \_\_\_\_\_

Number of lone pairs of electrons \_\_\_\_\_

Number of electrons in covalent bonds \_\_\_\_\_ [3]

(c) Magnesium oxide is also formed when magnesium reacts with carbon dioxide.

(i) Write the formula for carbon dioxide.

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

(ii) Draw a dot and cross diagram to show the bonding in a molecule of carbon dioxide.

[1]





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**(Questions continue overleaf)**

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**[Turn over**



\*16GCM1105\*

- 2 A version of the Periodic Table devised by Dmitri Mendeleev is shown below. Some elements, such as zinc, are in different positions in Mendeleev's Periodic Table compared to the modern Periodic Table.

H 1										
Li 7	Be 9	B 11	C 12	N 14	O 16	F 19				
Na 23	Mg 24	Al 27	Si 28	P 31	S 32	Cl 35.5				
K 39	Ca 40		Ti 48	V 51	Cr 52	Mn 55	Fe 56	Co 59	Ni 59	
Cu 64	Zn 65			As 75	Se 79	Br 80				
Rb 86	Sr 88	Y 89	Zr 91	Nb 93	Mo 96		Ru 101	Rh 103	Pd 106	
Ag 108	Cd 112	In 115	Sn 119	Sb 122	Te 128	I 127				

- (a) Suggest one reason why Mendeleev placed zinc in the same group as calcium and magnesium.

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





(c) Using the Periodic Table in your Data Leaflet, identify the elements below from the information given.

(i) A transition metal which forms a black oxide and a green carbonate.

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

(ii) The most reactive halogen.

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

(iii) The element in Period 2 and Group 5.

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

(iv) The element with atomic number 18.

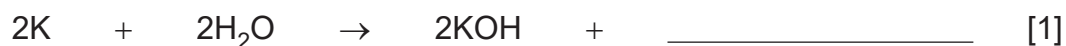
\_\_\_\_\_ [1]

(d) Group 1 elements react with water.

(i) State the name given to Group 1.

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

(ii) Complete the balanced symbol equation below for the reaction of potassium with water.



(iii) When potassium reacts with water, heat is released and the potassium eventually disappears with a crackle forming a colourless solution. State two other observations made when potassium reacts with water.

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

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



3 (a) Many elements exist as isotopes.

Which two of the following statements are true for isotopes? Tick (✓) the boxes on the right to indicate your choices.

Isotopes have the same number of protons but a different number of neutrons

Isotopes have the same number of protons but a different number of electrons

Isotopes have the same atomic number but a different mass number

Isotopes have the same mass number but a different atomic number

[1]

(b) The table below gives some information about the atomic structure of five different atoms and ions.

Complete the table.

Atom/ion	Number of protons	Number of electrons
Li	3	
F <sup>-</sup>	9	
H <sup>+</sup>		0
Ca <sup>2+</sup>		18
	17	18

[5]

[Turn over



4 Acids react with alkalis and with metal carbonates to form salts.

(a) The reactions of acids occur because of the presence of hydrogen ions in solution.

(i) Write the formula of a hydrogen ion.

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

(ii) **Name** the ion present in all alkalis.

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

(iii) The hazard symbol below is often found on bottles of acids and alkalis.



© Getty Images

What do you understand by this symbol?

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



(b) The table below shows some common laboratory chemicals.

	Chemical
<b>A</b>	hydrochloric acid
<b>B</b>	ammonia solution
<b>C</b>	ethanoic acid
<b>D</b>	sodium hydroxide
<b>E</b>	deionised water

(i) Which one of the chemicals (**A**, **B**, **C**, **D** or **E**) would have the highest pH?

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

(ii) Which one of the chemicals (**A**, **B**, **C**, **D** or **E**) would have the lowest pH?

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

(iii) What colour is observed when phenolphthalein is added to **D**?

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

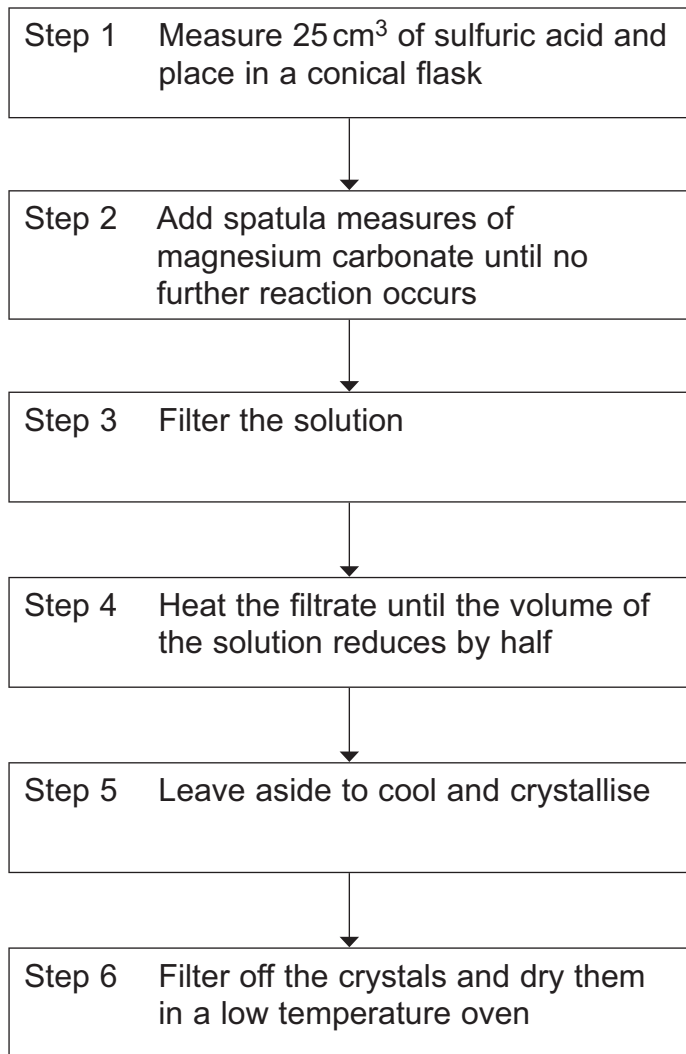
(iv) Write a balanced symbol equation for the reaction which occurs between **A** and **D**.

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

[Turn over



(c) The salt, magnesium sulfate, may be prepared using the steps shown in the flow scheme below.



(i) Apart from magnesium sulfate, name the other two products of the reaction between magnesium carbonate and sulfuric acid.

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



(ii) What piece of apparatus is used to measure out 25 cm<sup>3</sup> of sulfuric acid in Step 1?

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

(iii) How would you know that no further reaction was occurring in Step 2?

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

(iv) Name the three pieces of apparatus required to filter the solution in Step 3.

1. \_\_\_\_\_
2. \_\_\_\_\_
3. \_\_\_\_\_ [3]

(v) Explain why the solution is heated to half volume in Step 4.

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

(vi) State one other method which could be used to dry the crystals in Step 6.

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

[Turn over



**5** Aluminium forms a variety of compounds with non-metals.

**(a)** 0.81 g of aluminium reacted with sulfur and formed 2.09 g of a sulfide of aluminium.

**(i)** Calculate the mass of sulfur which reacted.

mass of sulfur = \_\_\_\_\_ g [1]

**(ii)** Calculate the number of moles of sulfur which reacted.

moles of sulfur = \_\_\_\_\_ [1]

**(iii)** Calculate the number of moles of aluminium which reacted.

moles of aluminium = \_\_\_\_\_ [1]



(b) Aluminium oxide reacts with nitric acid to form aluminium nitrate and water.

Complete the table below.

	Aluminium oxide	Aluminium nitrate	Water
Formula	$\text{Al}_2\text{O}_3$	$\text{Al}(\text{NO}_3)_3$	$\text{H}_2\text{O}$
Number of oxygen atoms in one formula	3		
Relative formula mass ( $M_r$ )		213	18

[3]

(c) A sample of hydrated aluminium nitrate,  $\text{Al}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ , was heated to remove all of the water of crystallisation.

(i) Complete the sentence below to explain what is meant by the term water of crystallisation.

Water of crystallisation is water which is chemically \_\_\_\_\_  
into the crystalline \_\_\_\_\_.

[2]

(ii) State how you would ensure all of the water of crystallisation was removed.

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

[1]

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

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

<b>Total Marks</b>	
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**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	$\text{SO}_3^{2-}$



## Data Leaflet

### Including the Periodic Table of the Elements

For 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

### 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

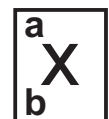
# gcse examinations chemistry

# THE PERIODIC TABLE OF ELEMENTS

## Group

												1 <b>H</b> Hydrogen 1							4 <b>He</b> Helium 2
		1	2											3	4	5	6	7	0
7 <b>Li</b> Lithium 3	9 <b>Be</b> Beryllium 4											11 <b>B</b> Boron 5	12 <b>C</b> Carbon 6	14 <b>N</b> Nitrogen 7	16 <b>O</b> Oxygen 8	19 <b>F</b> Fluorine 9	20 <b>Ne</b> Neon 10		
23 <b>Na</b> Sodium 11	24 <b>Mg</b> Magnesium 12											27 <b>Al</b> Aluminium 13	28 <b>Si</b> Silicon 14	31 <b>P</b> Phosphorus 15	32 <b>S</b> Sulfur 16	35.5 <b>Cl</b> Chlorine 17	40 <b>Ar</b> Argon 18		
39 <b>K</b> Potassium 19	40 <b>Ca</b> Calcium 20	45 <b>Sc</b> Scandium 21	48 <b>Ti</b> Titanium 22	51 <b>V</b> Vanadium 23	52 <b>Cr</b> Chromium 24	55 <b>Mn</b> Manganese 25	56 <b>Fe</b> Iron 26	59 <b>Co</b> Cobalt 27	59 <b>Ni</b> Nickel 28	64 <b>Cu</b> Copper 29	65 <b>Zn</b> Zinc 30	70 <b>Ga</b> Gallium 31	73 <b>Ge</b> Germanium 32	75 <b>As</b> Arsenic 33	79 <b>Se</b> Selenium 34	80 <b>Br</b> Bromine 35	84 <b>Kr</b> Krypton 36		
85 <b>Rb</b> Rubidium 37	88 <b>Sr</b> Strontium 38	89 <b>Y</b> Yttrium 39	91 <b>Zr</b> Zirconium 40	93 <b>Nb</b> Niobium 41	96 <b>Mo</b> Molybdenum 42	98 <b>Tc</b> Technetium 43	101 <b>Ru</b> Ruthenium 44	103 <b>Rh</b> Rhodium 45	106 <b>Pd</b> Palladium 46	108 <b>Ag</b> Silver 47	112 <b>Cd</b> Cadmium 48	115 <b>In</b> Indium 49	119 <b>Sn</b> Tin 50	122 <b>Sb</b> Antimony 51	128 <b>Te</b> Tellurium 52	127 <b>I</b> Iodine 53	131 <b>Xe</b> Xenon 54		
133 <b>Cs</b> Caesium 55	137 <b>Ba</b> Barium 56	139 <b>La</b> <sup>*</sup> Lanthanum 57	178 <b>Hf</b> Hafnium 72	181 <b>Ta</b> Tantalum 73	184 <b>W</b> Tungsten 74	186 <b>Re</b> Rhenium 75	190 <b>Os</b> Osmium 76	192 <b>Ir</b> Iridium 77	195 <b>Pt</b> Platinum 78	197 <b>Au</b> Gold 79	201 <b>Hg</b> Mercury 80	204 <b>Tl</b> Thallium 81	207 <b>Pb</b> Lead 82	209 <b>Bi</b> Bismuth 83	210 <b>Po</b> Polonium 84	210 <b>At</b> Astatine 85	222 <b>Rn</b> Radon 86		
223 <b>Fr</b> Francium 87	226 <b>Ra</b> Radium 88	227 <b>Ac</b> <sup>†</sup> Actinium 89	261 <b>Rf</b> Rutherfordium 104	262 <b>Db</b> Dubnium 105	266 <b>Sg</b> Seaborgium 106	264 <b>Bh</b> Bohrium 107	277 <b>Hs</b> Hassium 108	268 <b>Mt</b> Meitnerium 109	271 <b>Ds</b> Darmstadtium 110	272 <b>Rg</b> Roentgenium 111	285 <b>Cn</b> Copernicium 112								

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



**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