



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.

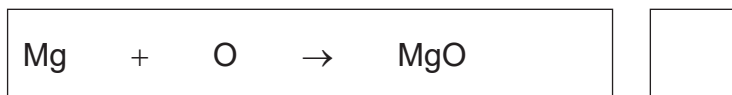
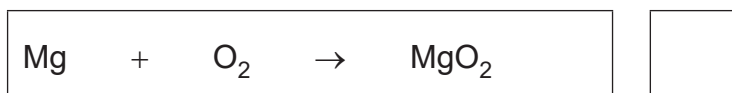
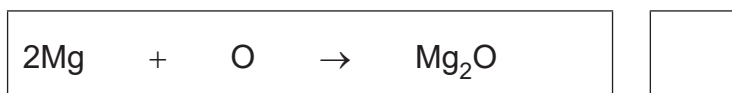
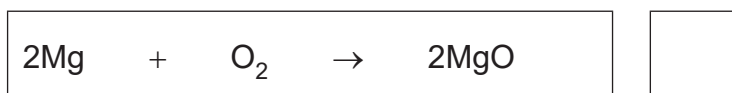
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16GCM1101

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.

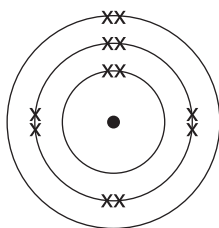
[3]



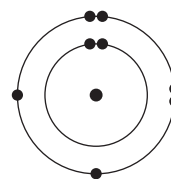
- (ii) The bonding in magnesium oxide is ionic bonding. Explain what is meant by ionic bonding.

[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)

14541

[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]



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

[illegible]

[6]

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16GCM1107

(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.

$2\text{K} + 2\text{H}_2\text{O} \rightarrow 2\text{KOH} + \text{_____}$ [1]

(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 ⁻	9	
H ⁺		0
Ca ²⁺		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
A	hydrochloric acid
B	ammonia solution
C	ethanoic acid
D	sodium hydroxide
E	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]

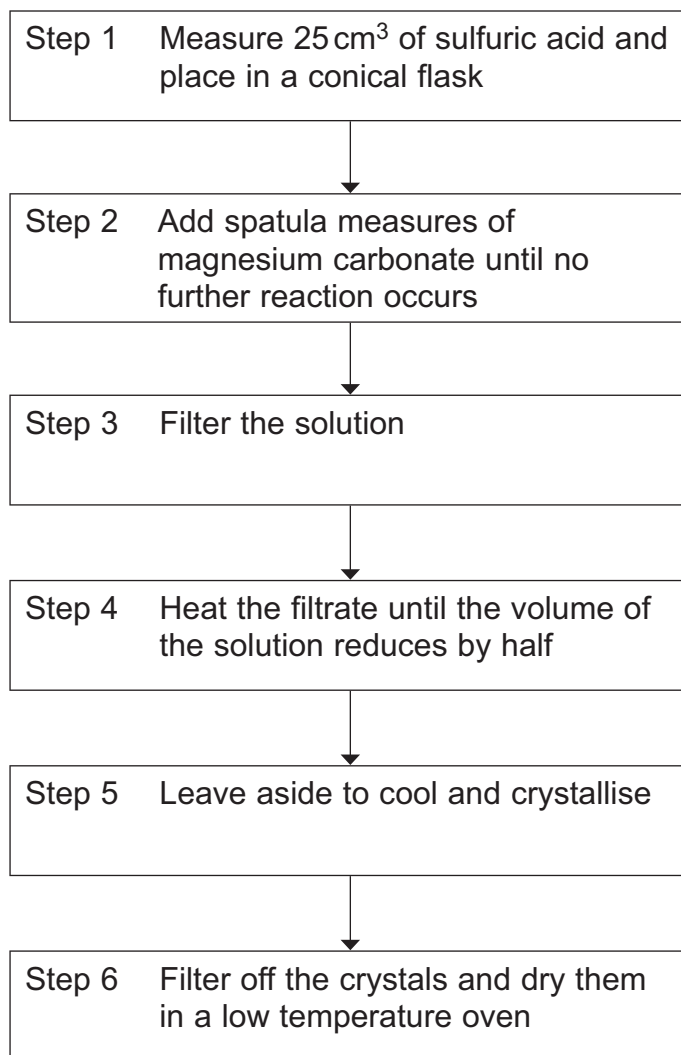
(iv) Write a balanced symbol equation for the reaction which occurs between **A** and **D**.

_____ [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^3 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	Al_2O_3	$\text{Al}(\text{NO}_3)_3$	H_2O
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]

THIS IS THE END OF THE QUESTION PAPER



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Question Number	Marks
1	
2	
3	
4	
5	

Total Marks	
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Examiner Number

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SYMBOLS OF SELECTED IONS

Positive ions

Name	Symbol
Ammonium	NH_4^+
Chromium(III)	Cr^{3+}
Copper(II)	Cu^{2+}
Iron(II)	Fe^{2+}
Iron(III)	Fe^{3+}
Lead(II)	Pb^{2+}
Silver	Ag^+
Zinc	Zn^{2+}

Negative ions

Name	Symbol
Butanoate	$\text{C}_3\text{H}_7\text{COO}^-$
Carbonate	CO_3^{2-}
Dichromate	$\text{Cr}_2\text{O}_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	HCOO^-
Nitrate	NO_3^-
Propanoate	$\text{C}_2\text{H}_5\text{COO}^-$
Sulfate	SO_4^{2-}
Sulfite	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

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

1

H

Hydrogen

1

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



a = relative atomic mass (approx)
x = atomic symbol
b = atomic number

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