Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2024–2025

Double Award Science: Chemistry

Unit C1

Higher Tier

[GDW22]

GDW22

MONDAY 19 MAY 2025, 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 in black ink only. **Do not write with a gel pen.**
Answer **all eight** questions.

INFORMATION FOR CANDIDATES

The total mark for this paper is 70.
Figures in brackets printed down the right-hand side of pages indicate the marks awarded to each question or part question.
Quality of written communication will be assessed in Question **2(b)**.
You may use a scientific calculator.
A Data Leaflet, which includes a Periodic Table of Elements, is included in this question paper.

14823

20GDW2201

1 **(a)** The Periodic Table was developed by Mendeleev. The sentences below describe the features of Mendeleev's Table. Complete the sentences below by **circling** the correct option in bold.

Mendeleev developed his Periodic Table in 1869. His Periodic Table placed

the elements in order of increasing **atomic number/atomic mass**. He included

some groups but did not include the **halogens/noble gases**.

He **left gaps/did not leave gaps** for undiscovered elements. [3]

(b) Part of the modern Periodic Table is shown below.

							H										
Li													C	N	O	F	
Na													Si	P	S	Cl	Ar
K							Fe			Cu				As		Br	
																I	
											Hg						

Using **only** the symbols of the elements in the table above, identify the following:

a solid in Group 5 _____

the most reactive alkali metal _____

a gas in period 2 _____ [3]

(c) Sodium, Na, reacts vigorously with water. Apart from using safety goggles, state **two** safety precautions that should be taken when carrying out this reaction.

1. _____

2. _____ [2]

(d) Bromine is found in Group 7. When bromine is added to a solution of potassium iodide, a displacement reaction occurs.

bromine + potassium iodide $\longrightarrow$ potassium bromide + iodine

(i) Write the ionic equation for this reaction.

_____ [3]

(ii) What colour change will be observed when bromine is added to potassium iodide solution?

_____ to _____ [2]

2 The mass number and atomic number can be used to work out the number of subatomic particles in an atom.

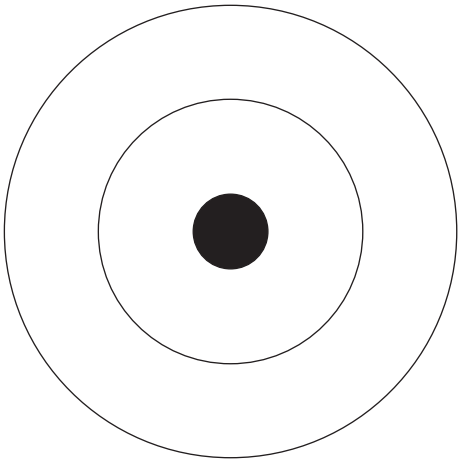
You may find your Data Leaflet useful when answering this question.

(a) (i) Define the term **atomic number**.

_____

_____ [1]

(ii) The electronic configuration of an atom or ion gives the number of electrons found in each shell. Complete the diagram below to give the electronic configuration and charge of an oxide ion.



Charge _____

[2]

(b) Chlorine has two isotopes, chlorine-35 and chlorine-37. Define the term isotopes and describe the atoms of these isotopes. In your answer you should:

- define the term isotopes
- state the position of protons, neutrons and electrons in an atom of chlorine
- state the number of protons, neutrons and electrons in an atom of chlorine-35 and in an atom of chlorine-37

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

define the term isotopes

state the position of protons, neutrons and electrons in an atom of chlorine

state the number of protons, neutrons and electrons in an atom of chlorine-35 and in an atom of chlorine-37

[6]

[Turn over

3 **(a)** The table below shows the symbols or formulae for some elements and compounds.

$Mg(HCO_3)_2$	CO	H_2
HCl	NaCl	$CaCO_3$
CO_2	Na	O_2

Use the table to answer the following questions:

Give the **formula** of a diatomic gas which contains two different elements.

_____

Give the total number of oxygen atoms in **all** the elements and compounds in the table.

_____

How many compounds contain molecular ions?

_____ [3]

(b) Give the **name** of two compounds from the table which react with an acid to produce carbon dioxide gas.

1. _____

2. _____ [2]

(c) Give the formulae from the table for the two products of the reaction between sodium and hydrochloric acid.

_____ [1]

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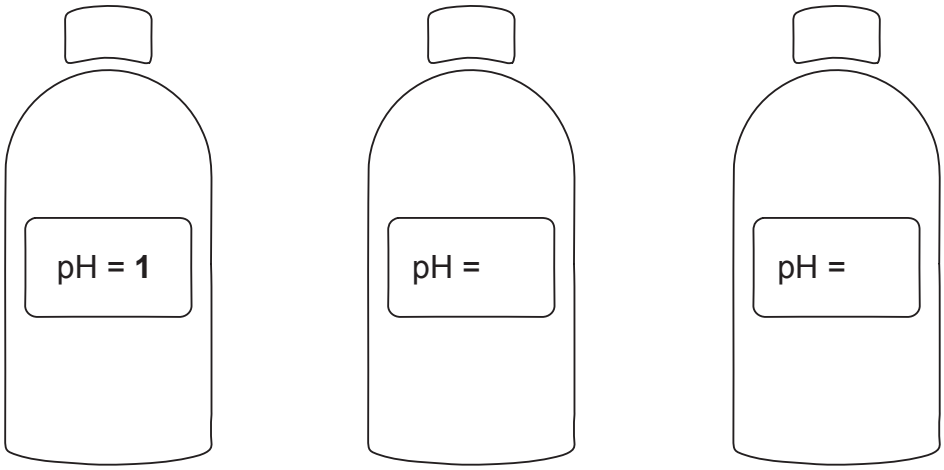
(Questions continue overleaf)

4 **(a)** Universal indicator is used to test the pH of substances. The diagram below shows three bottles. Two pH values are missing.

Write an appropriate pH value in the **space** provided on each of the two labels.



Hydrochloric acid **Ethanoic acid** **Sodium hydroxide**

[2]

(b) Complete the table below using the numbers 1, 2 and 3.

Substance	**pH**	**Rank order of hydrogen ion concentration (1 being the highest concentration and 3 being the lowest)**
lemon juice	4	
shampoo	6	
battery acid	1	

[1]

(c) The base magnesium oxide reacts with hydrochloric acid in a neutralisation reaction.

Write the balanced symbol equation for the reaction between magnesium oxide and hydrochloric acid.

_____ [3]

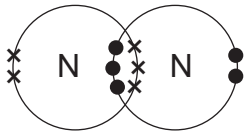
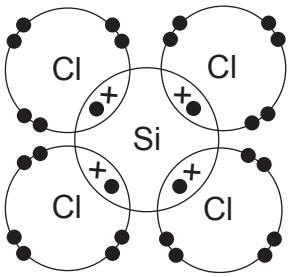
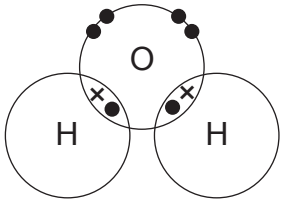
(d) Give the **formula** of the **ion** that all alkalis produce when dissolved in water.

_____ [1]

5 **(a)** In the space below draw a dot and cross diagram to show the covalent bonding in a molecule of methane, CH_4. Show outer electrons only.

[3]

(b) Below are **three** dot and cross diagrams representing covalent molecules.
Use **lines** to match each diagram to the correct description.

Dot and cross diagram	**Description**
	**has four covalent bonds**
	**has the same number of lone pairs as shared pairs of electrons**
	**has a triple covalent bond**
	has no lone pairs

[3]

(c) Describe metallic bonding.

_____

_____

_____ [3]

[Turn over

6 **(a)** Calculate the relative formula mass (M_r) of the following compounds:

(Relative atomic mass (A_r): N = 14; O = 16; Mg = 24; Al = 27)

aluminium oxide, Al_2O_3

relative formula mass = _____

magnesium nitrate, $Mg(NO_3)_2$

relative formula mass = _____ [2]

(b) **(i)** Calculate the percentage of iron in iron(III) carbonate, $Fe_2(CO_3)_3$.

(Relative atomic mass (A_r): C = 12; O = 16; Fe = 56)

(Relative formula mass (M_r): $Fe_2(CO_3)_3$ = 292)

Show your working out.

percentage of iron = _____ % [2]

(ii) 14.6 g of iron(III) carbonate reacts with excess hydrochloric acid as shown in the following balanced symbol equation.

$$Fe_2(CO_3)_3 + 6HCl \longrightarrow 2FeCl_3 + 3CO_2 + 3H_2O$$

Calculate the number of moles in 14.6 g of iron(III) carbonate.

moles = _____ [1]

(iii) Using your answer to **(b)(ii)** and the balanced symbol equation, calculate the mass of iron(III) chloride, $FeCl_3$, produced when 14.6 g of iron(III) carbonate react with excess hydrochloric acid. Give your answer to **one decimal place**.

(Relative formula mass (M_r): $FeCl_3$ = 162.5)

Show your working out.

mass = _____ g [3]

(iv) Give one reason why the percentage yield of a product may be less than 100%.

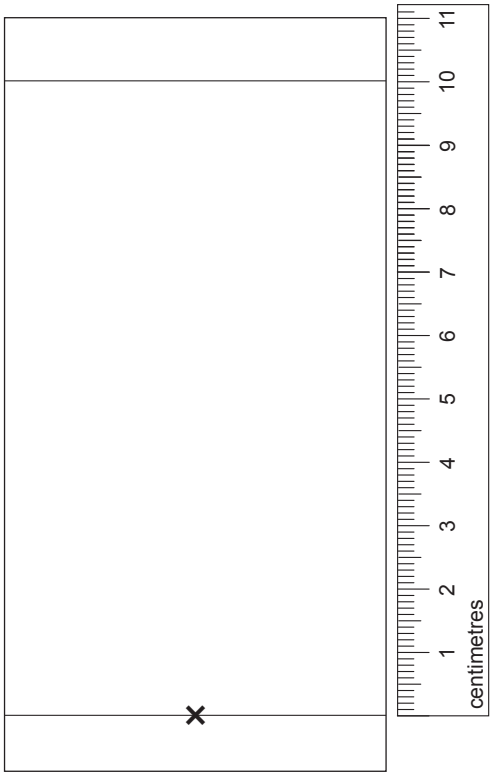
_____ [1]

[Turn over

7 The values in the table below show the distance moved by four dyes **D1**, **D2**, **D3** and **D4** on a chromatogram. R_f values are also given.

Dye	Distance moved /cm	R_f value
D1	2	0.2
D2	3	0.3
D3	6	0.6
D4	7	0.9

(a) Use the information in the table to place a **spot** at the correct distance moved by dye **D2** on the chromatogram below.



[1]

(b) Label the base line on the chromatogram above. [1]

(c) One of the R_f values in the table has been incorrectly calculated. Which dye has an incorrect value?

_____ [1]

(d) What name is given to the line at 10 cm on the chromatogram?

_____ [1]

(e) Which dye is least soluble in the solvent?

_____ [1]

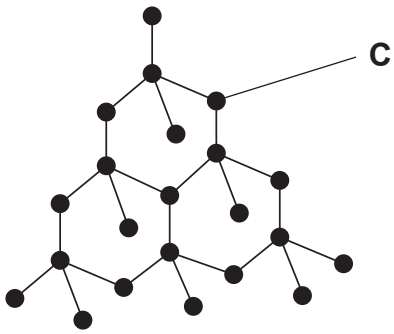
(f) What would you use to place a concentrated spot of dye on the chromatogram at position **X**?

_____

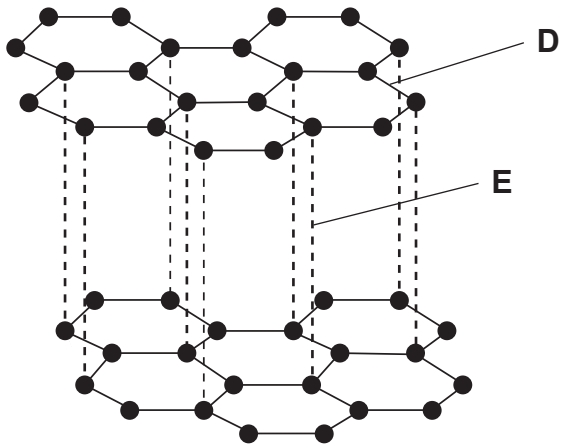
_____ [1]

8 **(a)** **(i)** Name substances **A** and **B** represented in the diagrams below.

A



B



A _____ **B** _____

[2]

(ii) What is represented by the black dot labelled **C**?

_____ [1]

(iii) What is represented by the black line labelled **D**?

_____ [1]

(iv) What is represented by the dotted line labelled **E**?

_____ [1]

(b) **(i)** Sodium chloride is a white solid. Explain why sodium chloride has a high melting point.

_____

_____ [2]

(ii) Explain why sodium chloride conducts electricity when molten.

_____

_____ [2]

(c) **(i)** Nanomaterials, such as the silver nanotubes found in antiseptic dressings, are made up of nanoparticles. State the range in size of a nanoparticle.

_____ nm [1]

(ii) Suggest one risk of using nanoparticles.

_____ [1]

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Sources:
Question 4(a) . . . . . ©AdobeStock
Question 5(c) . . . . . Principal Examiner
Question 7(a) . . . . . Principal Examiner
Question 8(a)(i). . . . Principal Examiner

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Question Number	**Marks**
1	
2	
3	
4	
5	
6	
7	
8	
Total Marks	

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	$C_3H_7COO^-$
Carbonate	CO_3^{2-}
Dichromate	$Cr_2O_7^{2-}$
Ethanoate	CH_3COO^-
Hydrogencarbonate	HCO_3^-
Hydroxide	OH^-
Methanoate	$HCOO^-$
Nitrate	NO_3^-
Propanoate	$C_2H_5COO^-$
Sulfate	SO_4^{2-}
Sulfite	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

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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

gcse examinations

chemistry

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THE PERIODIC TABLE OF ELEMENTS

Group

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

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

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

a X b

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

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