



General Certificate of Secondary Education
2024–2025

Centre Number

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Candidate Number

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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.

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- (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]

[Turn over



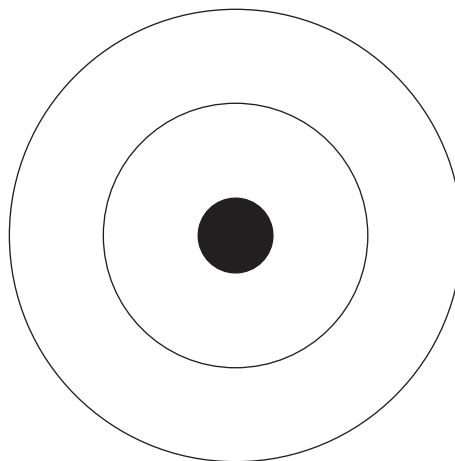
- 2 The mass number and atomic number can be used to work out the number of subatomic particles in an atom.

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.

$\text{Mg}(\text{HCO}_3)_2$	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)

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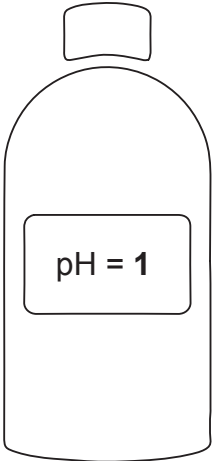
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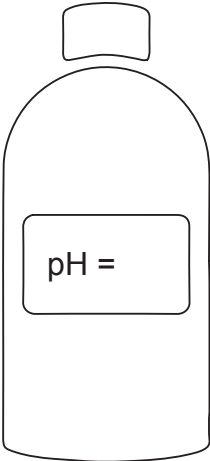
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- 4 (a) Universal indicator is used to test the pH of substances. The diagram below shows three bottles. Two pH values are missing.

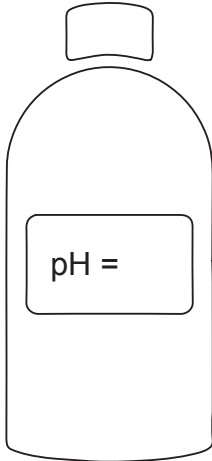
Write an appropriate pH value in the **space** provided on each of the two labels.



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]

[Turn over



- 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.

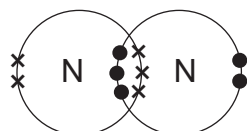
[3]



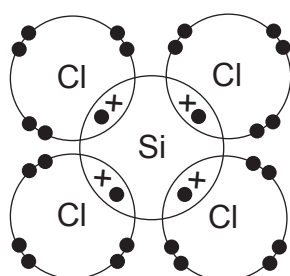
(b) Below are **three** dot and cross diagrams representing covalent molecules.
Use **lines** to match each diagram to the correct description.

Dot and cross diagram

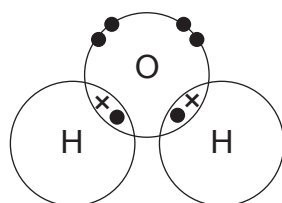
Description



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, $\text{Mg}(\text{NO}_3)_2$

relative formula mass = _____ [2]

(b) (i) Calculate the percentage of iron in iron(III) carbonate, $\text{Fe}_2(\text{CO}_3)_3$.

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

(Relative formula mass (M_r): $\text{Fe}_2(\text{CO}_3)_3 = 292$)

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.



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): $\text{FeCl}_3 = 162.5$)

Show your working out.

mass = _____ g [3]

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

_____ [1]

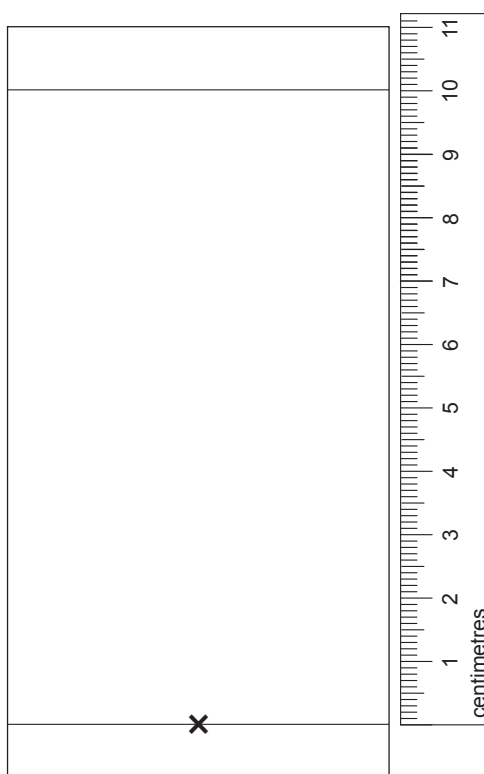
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- 7 The values in the table below show the distance moved by four dyes **D1**, **D2**, **D3** and **D4** on a chromatogram. R_f values are also given.

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]

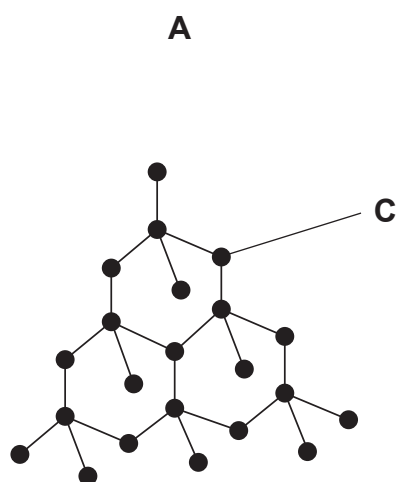
- (f) What would you use to place a concentrated spot of dye on the chromatogram at position X?

_____ [1]

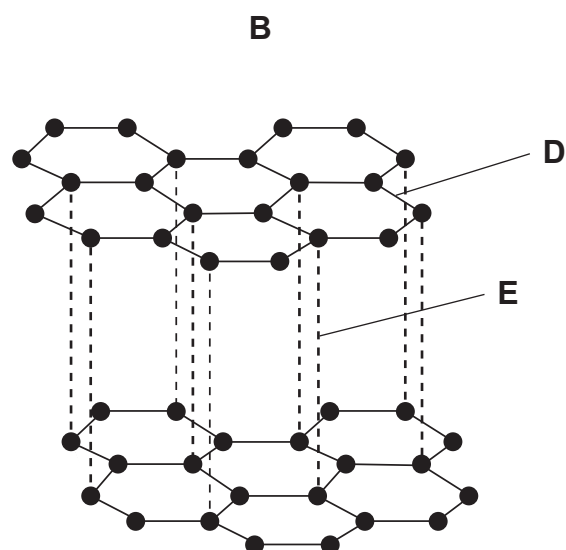
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8 (a) (i) Name substances **A** and **B** represented in the diagrams below.



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	
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4	
5	
6	
7	
8	

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

Group

1	H	Hydrogen	1
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† 90 – 103 Actinium series

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