



Rewarding Learning

General Certificate of Secondary Education
2025

Centre Number

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Candidate Number

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Double Award Science: Chemistry

Unit C2



Foundation Tier

[GDW51]

GDW51

FRIDAY 13 JUNE, MORNING

TIME

1 hour 15 minutes.

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 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.

You may use a scientific calculator.

Quality of written communication will be assessed in Question **3(a)**.

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

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20GDW5101

- 1 (a) (i) Using the following statements in bold, complete the table below to give an observation for each of the reactions of iron, magnesium and copper when heated in air.

	bright white light	lilac flame	orange sparks	glows red
Metal	Observation when heated in air			
iron				
magnesium				
copper				

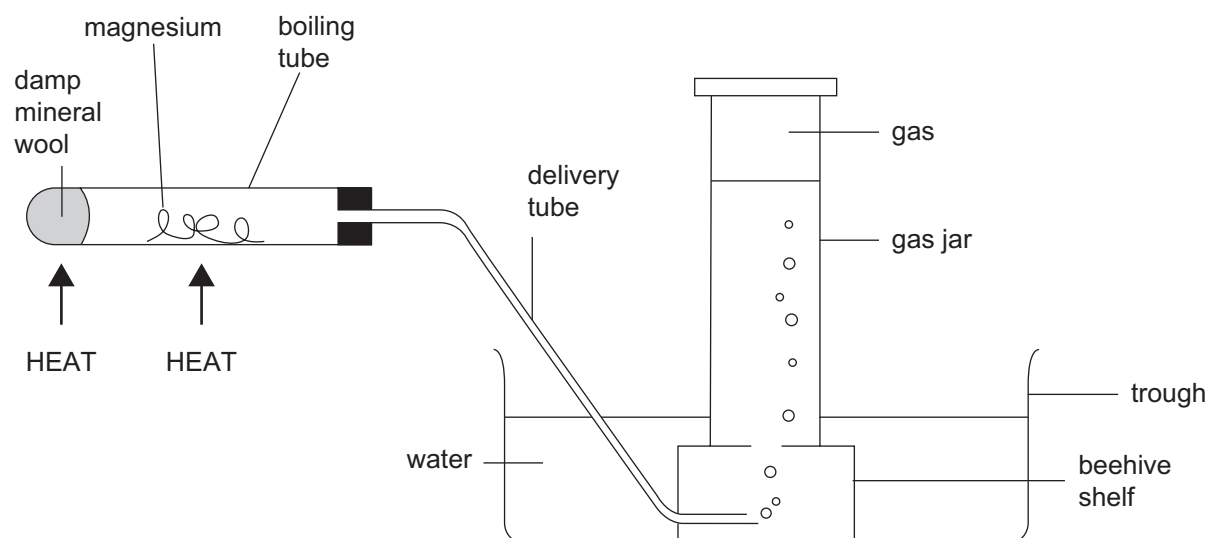
[3]

- (ii) Complete the word equation below for the reaction of magnesium with steam.

magnesium + steam → _____ + _____ [2]



(b) The diagram below shows the apparatus used in the reaction of magnesium with steam.



(i) What is the purpose of the damp mineral wool in the above apparatus?

[1]

(ii) What physical property of the gas allows it to be collected over water, as shown in the diagram?
Circle the correct answer below.

neutral

insoluble

soluble

colourless

[1]

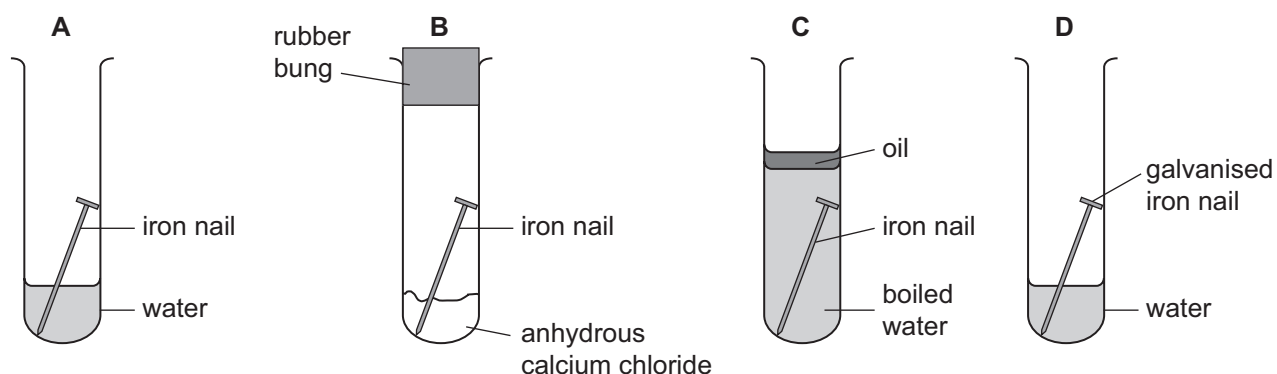


2 Iron reacts with oxygen and water to form a chemical, commonly known as rust.

(a) What is the chemical name for rust?

[2]

(b) The diagram below shows the apparatus set up to investigate the conditions for rusting.



(i) Circle the correct answer.

Which test tube has moisture removed?

A B C D

Which test tube has oxygen removed?

A B C D

Which test tube has a nail that rusts?

A B C D

[3]

(ii) When iron rusts heat is given out. Name the type of reaction in which heat is given out.

[1]

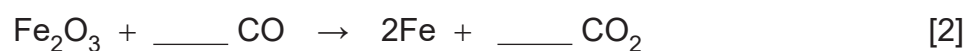


(c) (i) Iron is extracted from its ore using chemical reduction.

Circle the term which describes **reduction**.

loss of electrons gain of oxygen loss of hydrogen loss of oxygen [1]

(ii) Balance the following symbol equation for the extraction of iron from its ore.



[Turn over



3 (a) Aluminium is extracted from an ore which contains aluminium oxide, using electricity. Describe this process of extraction. Include the following in your answer:

- the name of the ore which contains aluminium oxide
- explain why aluminium oxide needs to be molten to conduct electricity
- explain why cryolite is added
- explain why the graphite anodes need to be replaced periodically

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

the name of the ore which contains aluminium oxide

explain why aluminium oxide needs to be molten to conduct electricity

explain why cryolite is added

explain why the graphite anodes need to be replaced periodically

[6]



(b) Complete the following sentence to give the definition of an electrolyte.

A liquid or solution that _____ electricity and is

_____ by it.

[2]

[Turn over

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20GDW5107

4 (a) A homologous series is a family of organic molecules.

(i) In the table below use a tick (✓) to identify **three** features of a homologous series.

Features of a homologous series	Use a tick (✓) to select three correct features
same general formula	
different chemical properties	
successive members differ by CH_3	
show gradation in their physical properties	
similar chemical properties	

[3]

(ii) Name the homologous series which has the general formula C_nH_{2n} .

_____ [1]

(iii) Use the general formula of the alkanes, $\text{C}_n\text{H}_{2n+2}$, to give the correct formula of an alkane with 12 carbon atoms.

_____ [1]



(b) The alkanes are hydrocarbons and are useful fuels. They can undergo complete and incomplete combustion.

(i) What is meant by the term **hydrocarbon**?

_____ [2]

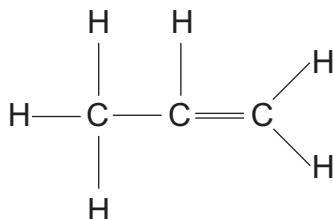
(ii) Give the **formulae** of the two products of the complete combustion of methane.

_____ [2]

(iii) If methane undergoes incomplete combustion a toxic gas is produced. Identify this gas.

_____ [1]

(c) The molecule below is an alkene.



(i) Circle the functional group in the molecule above. [1]

(ii) Name this alkene.

_____ [1]

(d) Name the polymer formed when ethene undergoes addition polymerisation.

_____ [1]

[Turn over]



5 This question is about a chemical found in rhubarb called oxalic acid.

(a) Select words from the list below to complete the passage about oxalic acid.

evaporation

anhydrous

saturated

hydrated

crystallisation

unsaturated

condensation

Oxalic acid is a solid acid.

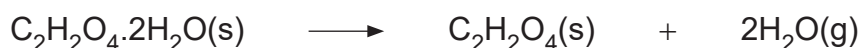
The _____ form contains water bonded into the crystal structure.

This water bonded into the crystal structure is known as water of _____.

The _____ form does not contain water bonded into the crystal structure.

[3]

(b) The equation below represents the removal of the water bonded into the crystal structure of oxalic acid by heating.



Calculate the relative formula mass (M_r) of $\text{C}_2\text{H}_2\text{O}_4 \cdot 2\text{H}_2\text{O}$ (oxalic acid).

(Relative atomic masses (A_r): H = 1; C = 12; O = 16)

relative formula mass = _____ [1]



(c) Water bonded into the crystal structure of a solid can be removed by heating.

Draw a **labelled** diagram of the **assembled** apparatus that a student would use to remove the water bonded into the crystal structure of a solid.

Include the following apparatus:

**Bunsen
burner**

**evaporating
dish**

tripod

gauze

[4]

[Turn over

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20GDW5111

- 6 (a) (i) The table below gives some information about three common gases. Complete the table.

Gas	Formula	Use
nitrogen		food packaging
	H ₂	
carbon dioxide		fire extinguisher

[4]

- (ii) Circle the correct percentage of **nitrogen** gas in the atmosphere.

78%

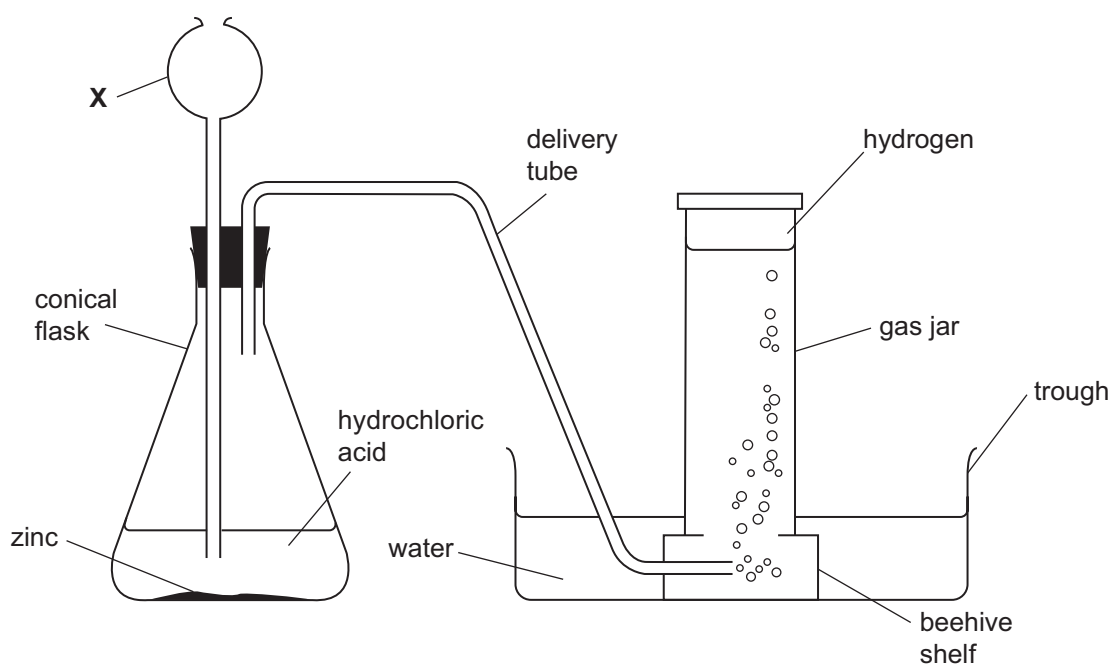
21%

1%

0.04%

[1]

- (b) The laboratory preparation of hydrogen is shown in the diagram below.



- (i) Name the piece of apparatus labelled **X**.

[1]



(ii) Name another metal which could be used, to **safely** produce hydrogen in the laboratory.

_____ [1]

(iii) Write the balanced symbol equation for the reaction of hydrogen with oxygen to form water.

_____ [3]

(iv) Describe the test for hydrogen gas and give the result for a positive test.

_____ [2]

[Turn over]



- 7 (a) Four reactions were carried out using excess sodium thiosulfate and different concentrations of hydrochloric acid P, Q, R and S.

The time taken for a precipitate to completely form in each reaction is given in the table below:

Reaction	Concentration of hydrochloric acid	Time /s
1	P	107
2	Q	19
3	R	83
4	S	60

- (i) Calculate the rate of reaction for **Reaction 2**.

$$\text{Rate} = \frac{1}{\text{time}}$$

Give your answer to 3 decimal places.

rate = _____ s⁻¹ [2]

- (ii) Which **one** of the following shows the concentrations of hydrochloric acid in order from highest to lowest?

Circle the correct answer.

PQRS

QSPR

RPQS

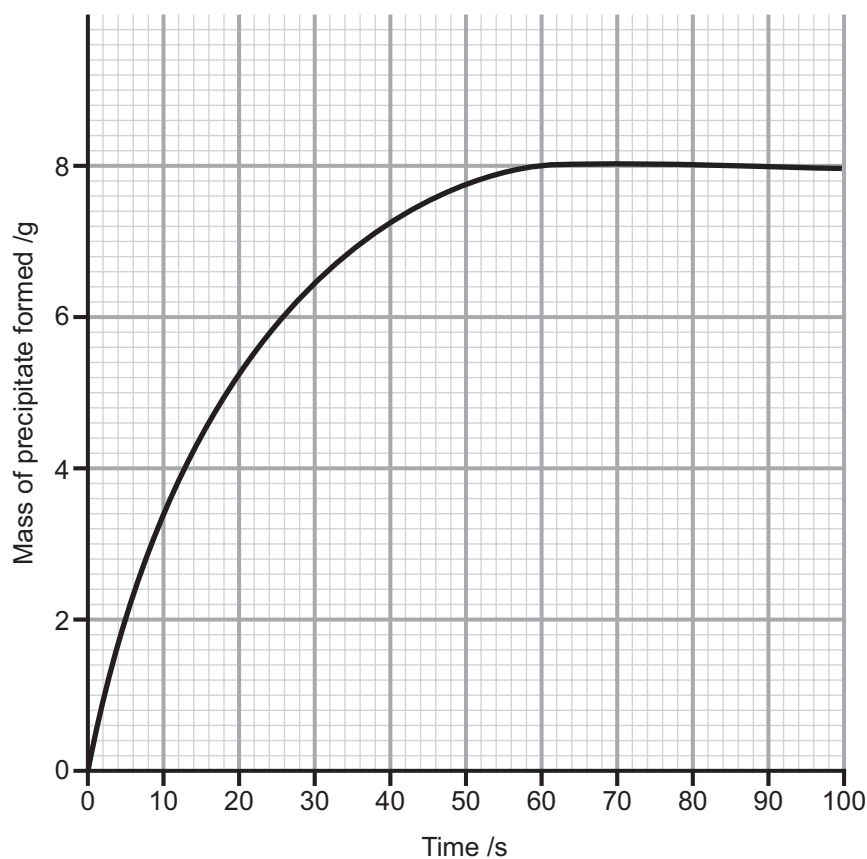
PSRQ

QSRP

[1]



(iii) The graph below shows the mass of precipitate formed against time for **Reaction 4**.



When this reaction was repeated at a **lower temperature** it took 76 seconds for the precipitate to form completely.

Sketch, **on the same axis**, the graph you would expect to obtain when the reaction was repeated at this lower temperature. [3]

(b) Catalysts can speed up the rate of a chemical reaction.

Which metals are widely used as catalysts?

Circle the correct answer.

**alkali
metals**

**alkaline
earth metals**

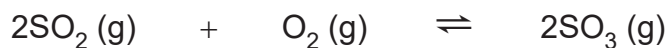
**transition
metals**

[1]

[Turn over]



- 8 The equation below shows the reaction between sulfur dioxide and oxygen to form sulfur trioxide.



- (a) Complete the sentences below about the reaction between sulfur dioxide and oxygen.

The arrows in this equation show that the reaction is _____.

This means that the reactants can change into _____

and the product can change back into _____. [3]

- (b) Suggest two reaction conditions that, when altered, will affect the amount of product formed in this reaction.

1. _____

2. _____ [2]

- (c) Complete the following sentence by circling the correct word.

Sulfur dioxide is classified as

acidic

basic

neutral

[1]

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For Examiner's use only	
Question Number	Marks
1	
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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																							
7		9																		20																							
Li		Be																		He																							
Lithium		Beryllium																		Helium																							
3		4																		10																							
23		24																		40																							
Na		Mg																		Ar																							
Sodium		Magnesium																		Argon																							
11		12																		18																							
																11	12	14	16	19	20																						
																B	C	N	O	F	Ne																						
																Boron	Carbon	Nitrogen	Oxygen	Fluorine	Neon																						
																5	6	7	8	9	10																						
																27	28	31	32	35.5	40																						
																Al	Si	P	S	Cl	Ar																						
																Aluminium	Silicon	Phosphorus	Sulfur	Chlorine	Argon																						
																13	14	15	16	17	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																

* 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