



Rewarding Learning

General Certificate of Secondary Education  
2023

Centre Number

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Candidate Number

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## Chemistry

Unit 3: Practical Skills

Practical Booklet B

Higher Tier

**MV18**

**[GCM34]**

**MONDAY 26 JUNE, MORNING**

### Time

1 hour, plus your additional time allowance.

### 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 on blank pages.**

Complete in black ink only.

Answer **all five** questions.

### Information for Candidates

The total mark for this paper is 70.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

Quality of written communication will be assessed in

Question **1(b)**.

A Data Leaflet including a Periodic Table of the Elements is provided.

- 1 (a) The table below shows some tests carried out on sodium chloride.

Test	Procedure	Observations
1	A few drops of <b>Solution A</b> were added to a solution of sodium chloride.	White precipitate
2	A flame test was carried out by dipping a piece of nichrome wire into <b>Liquid B</b> and then into a sample of solid sodium chloride. The wire was placed in a blue Bunsen burner flame.	
3	A few drops of sodium chloride solution were placed on universal indicator paper.	Colour changes to green

- (i) Name **Solution A**. [1 mark]

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- (ii) Write the formula of the white precipitate formed in Test 1. [1 mark]

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- (iii) Name **Liquid B**. [2 marks]

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(iv) What would be observed when Test 2 was carried out? [1 mark]

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(v) State the pH of sodium chloride solution. [1 mark]

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(vi) What colour would be observed when sodium chloride solution is tested using red litmus paper and blue litmus paper? [1 mark]

Red litmus paper: \_\_\_\_\_

Blue litmus paper: \_\_\_\_\_



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**(Questions continue overleaf)**

- 2** Oxygen gas may be prepared from the catalytic decomposition of hydrogen peroxide. The equation for the reaction is:



- (a) (i)** Name the catalyst used for the decomposition of hydrogen peroxide and describe its appearance.  
[2 marks]

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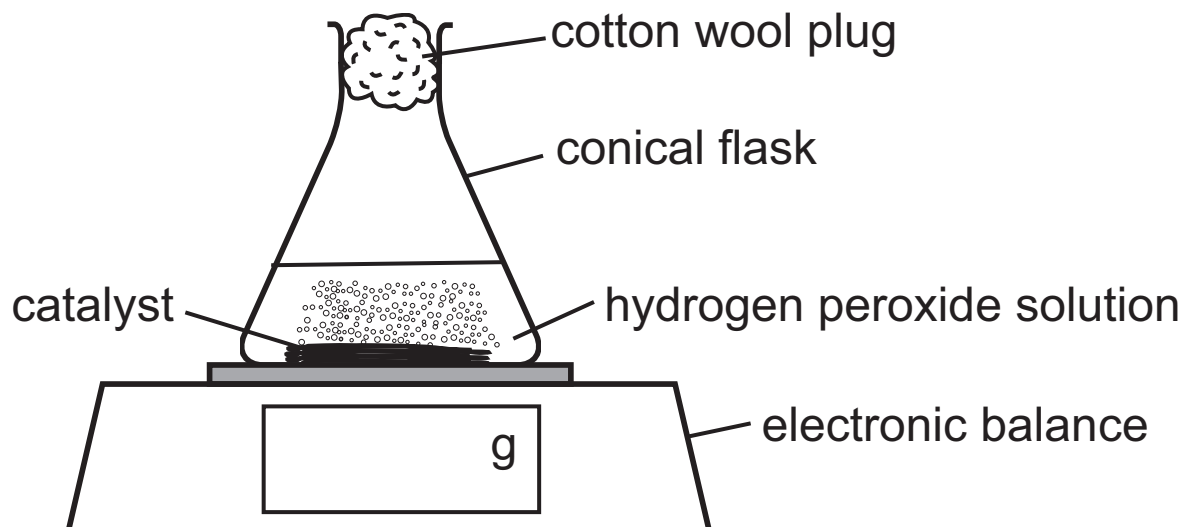
- (ii)** What is meant by the term catalyst?  
[2 marks]

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(b) The apparatus below is used to monitor the mass during the catalytic decomposition of a sample of  $25.0\text{ cm}^3$  of hydrogen peroxide solution over a period of time.



(i) Explain why the results obtained from the experiment are more reliable when a cotton wool plug is placed in the top of the conical flask.  
[2 marks]

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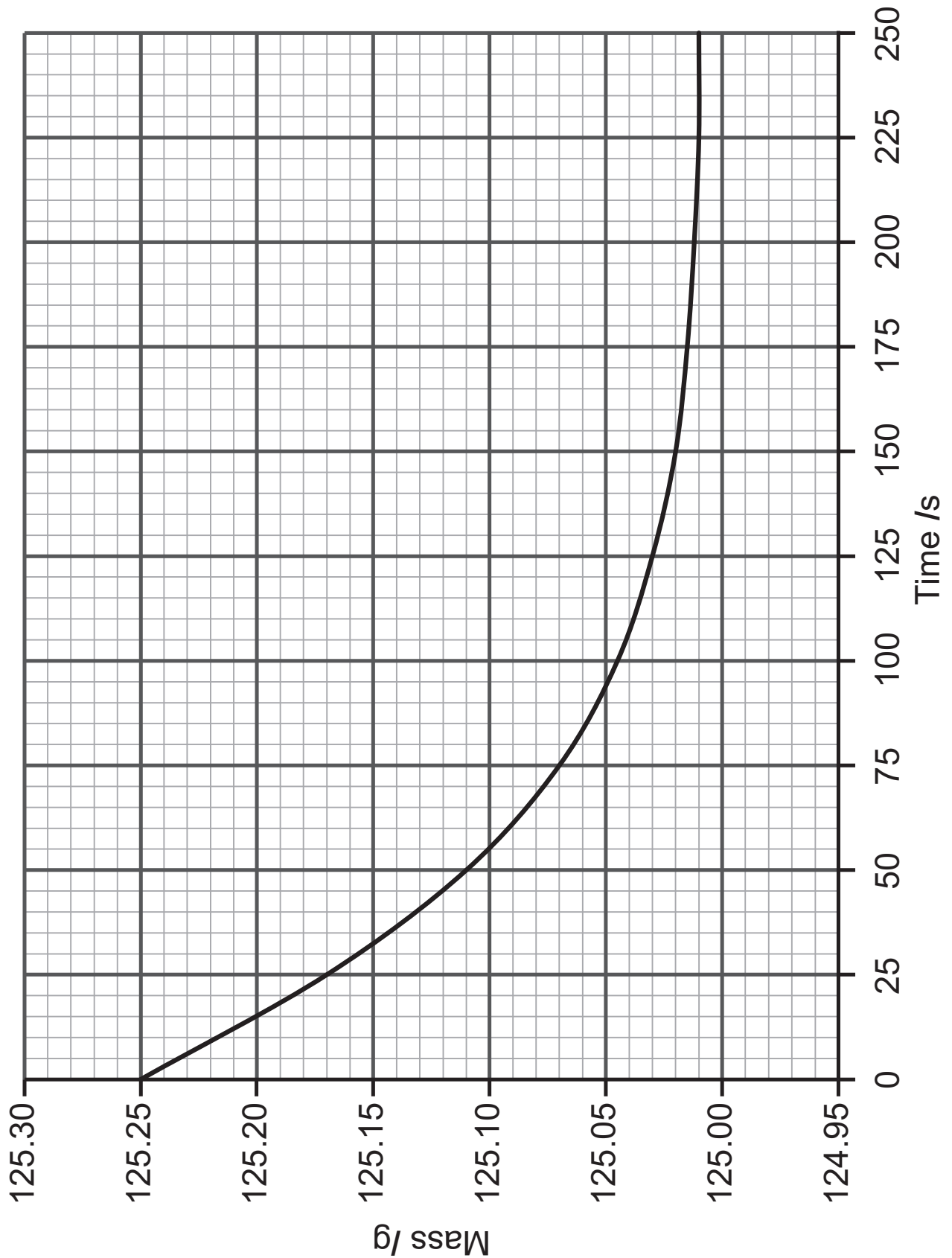
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(ii) What piece of apparatus is missing from the diagram? [1 mark]

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(c) The results of the experiment in (b) are plotted on the graph below. This experiment was carried out at 25°C.



(i) Explain why the graph levelled off. [1 mark]

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- (ii) Calculate the mass of oxygen gas lost during this experiment. [2 marks]  
**Show your working out.**

loss in mass = \_\_\_\_\_ g

- (iii) The equation for the decomposition of hydrogen peroxide is:



The volume of hydrogen peroxide solution used was  $25.0\text{ cm}^3$ .

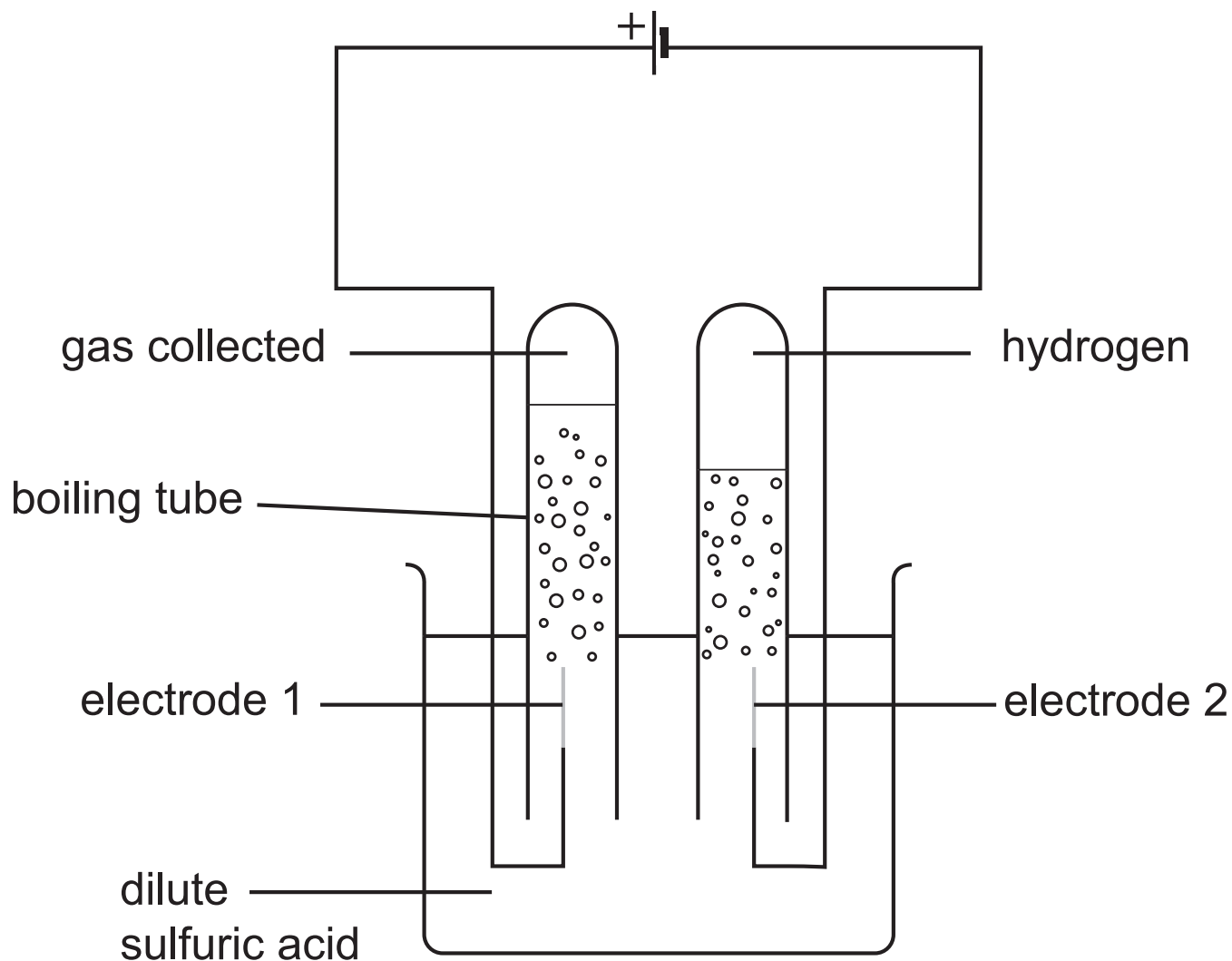
Calculate the concentration, in  $\text{mol/dm}^3$ , of the hydrogen peroxide solution using the mass of oxygen gas ( $\text{O}_2$ ) calculated in (c)(ii). [3 marks]

concentration = \_\_\_\_\_  $\text{mol/dm}^3$

- (iv) On the graph, sketch the line you would expect to obtain if the experiment was repeated at  $40^\circ\text{C}$ . All other conditions remain unchanged. [1 mark]

3 Hydrogen gas may be generated from the electrolysis of dilute sulfuric acid.

(a) The apparatus shown in the diagram below may be used for the electrolysis of dilute sulfuric acid. The electrodes are made from platinum.



(i) What is meant by the term electrolysis?  
[1 mark]

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(ii) State one reason why platinum is used for the electrodes. [1 mark]

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(iii) Explain why dilute sulfuric acid conducts electricity. [1 mark]

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(iv) Complete the table below for the electrolysis of dilute sulfuric acid. [5 marks]

	Electrode 1	Electrode 2
Name of electrode		
Gaseous product		hydrogen
Half equation	$4\text{OH}^- \rightarrow \text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^-$	

(v) 20 cm<sup>3</sup> of hydrogen gas were collected at electrode 2. Predict the volume of gas collected at electrode 1. [1 mark]

\_\_\_\_\_ cm<sup>3</sup>

**(b)** Hydrogen reacts with nitrogen gas to form ammonia.

Describe how you would carry out the test to identify ammonia gas. [4 marks]

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**(Questions continue overleaf)**

- 4 Hydrated chromium(III) nitrate,  $\text{Cr}(\text{NO}_3)_3 \cdot 9\text{H}_2\text{O}$ , is a violet solid. All of the water of crystallisation may be removed by heating a sample of the solid to constant mass.

The following mass measurements were taken.

Mass of crucible /g	25.24
Mass of crucible and hydrated solid /g	29.24

- (a) Draw a labelled diagram of the assembled apparatus used to heat the solid. [4 marks]

- (b) What is meant by water of crystallisation? [1 mark]

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- (c) Explain how the solid may be heated to constant mass.  
[2 marks]

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- (d) Calculate the mass of the crucible and solid obtained if all the water of crystallisation is removed. [5 marks]

mass = \_\_\_\_\_ g

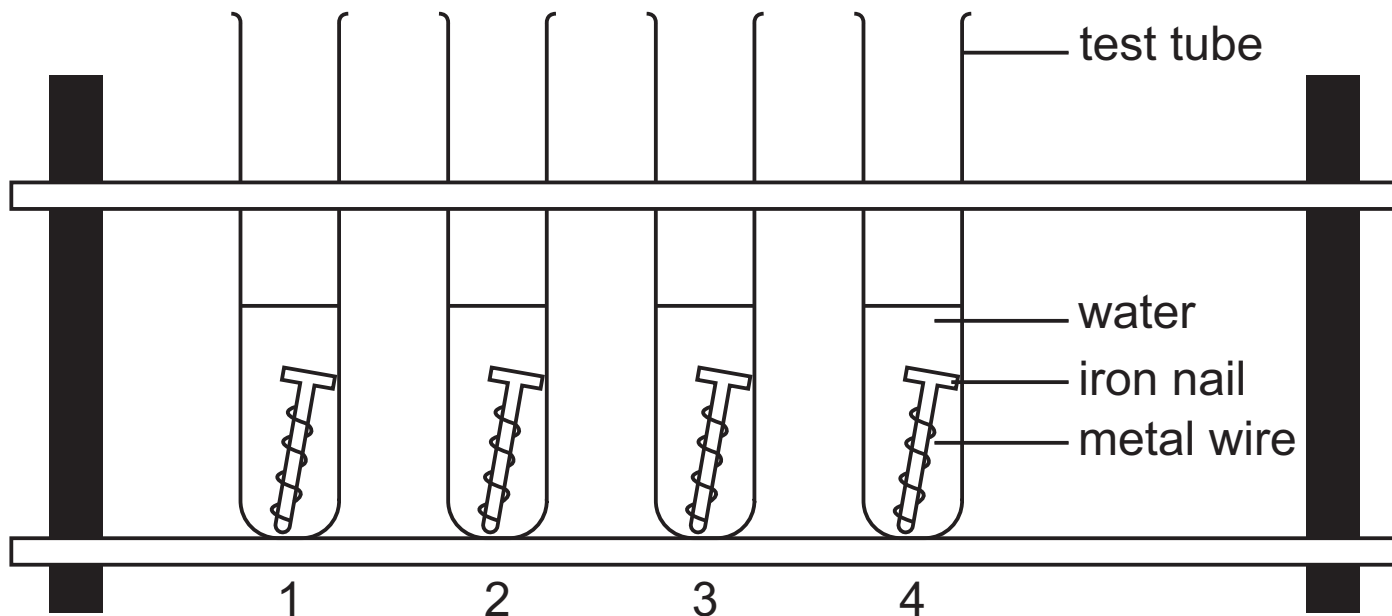
- (e) Suggest one reason why the mass calculated in (d) may be greater than the mass obtained when the experiment is carried out. [1 mark]

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5 Rust is hydrated iron(III) oxide.

(a) The following experiment was set up to determine which metals offer sacrificial protection to iron.



Pieces of metal ribbon or wires were wrapped around the iron nails. The nails were placed in water in four test tubes as shown above. The table below shows which metals were wrapped around the nails.

Test tube	Metal wire/ribbon	Does rust form?
1	magnesium	No
2	silver	
3	copper	
4	zinc	

(i) Complete the table. [2 marks]

**(ii)** Explain why rust does not form in test tube 1.  
[2 marks]

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**(iii)** Explain why all the nails in the test tubes would eventually form rust. [1 mark]

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**(b)** A rusty iron nail is placed in excess sulfuric acid and the solution changes from colourless to yellow due to the formation of iron(III) sulfate and eventually changes to green as iron(II) sulfate forms when metallic iron reacts with iron(III) sulfate.

The resulting solution is filtered and  $5\text{cm}^3$  is placed in separate test tubes.

Sodium hydroxide solution is added to the solution in  $1\text{cm}^3$  portions to the first test tube. A green precipitate forms when  $6\text{cm}^3$  of sodium hydroxide solution have been added.

Solid sodium hydrogencarbonate is added in portions to the second test tube until effervescence stops. A piece of magnesium ribbon is placed in the test tube.

**(i)** Write a balanced symbol equation for the reaction of iron(III) oxide with sulfuric acid forming iron(III) sulfate and water. [3 marks]

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**(ii)** Write a balanced symbol equation for the reaction of iron(III) sulfate with iron to form iron(II) sulfate. [3 marks]

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**(iii)** Identify the green precipitate. [1 mark]

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(iv) Suggest why the green precipitate does not form until  $6\text{cm}^3$  of sodium hydroxide solution were added. [1 mark]

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(v) Name the gas causing effervescence in the second test tube. [1 mark]

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(vi) What would be observed when magnesium is added to the green solution of iron(II) sulfate? [2 marks]

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(vii) State the type of reaction occurring when magnesium reacts with iron(II) sulfate solution. [1 mark]

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**This is the end of the question paper**

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
QWC	

<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