Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2023

Chemistry

Unit 3: Practical Skills

Practical Booklet B
Higher Tier

GCM34

[GCM34]
MONDAY 26 JUNE, 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 five** 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 **1(b)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is provided.

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

Test	Procedure	Observations
1	A few drops of **Solution A** 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 **Liquid 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]

(ii) Write the formula of the white precipitate formed in Test 1.

_____ [1]

(iii) Name **Liquid B**.

_____ [2]

(iv) What would be observed when Test 2 was carried out?

_____ [1]

(v) State the pH of sodium chloride solution.

_____ [1]

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

Red litmus paper: _____

Blue litmus paper: _____ [1]

[Turn over

(b) A white solid is thought to be zinc sulfate. Describe the tests you would carry out to fully identify the solid as **zinc sulfate**.

Your answer should include:

- any reagents used
- expected observations.

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

[6]

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(Questions continue overleaf)

[Turn over

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

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

(a) (i) Name the catalyst used for the decomposition of hydrogen peroxide and describe its appearance.

_____

_____ [2]

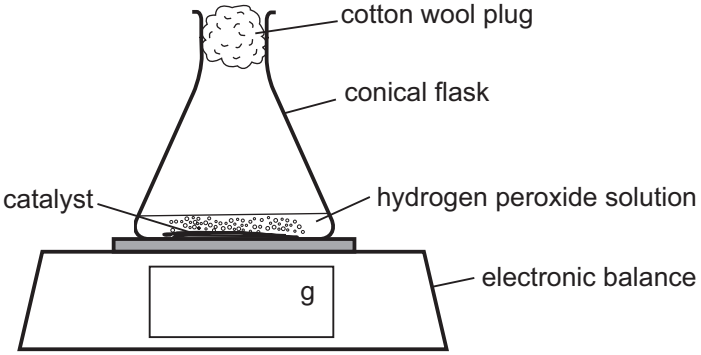
(ii) What is meant by the term catalyst?

_____

_____

_____ [2]

(b) The apparatus below is used to monitor the mass during the catalytic decomposition of a sample of 25.0 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.

_____

_____

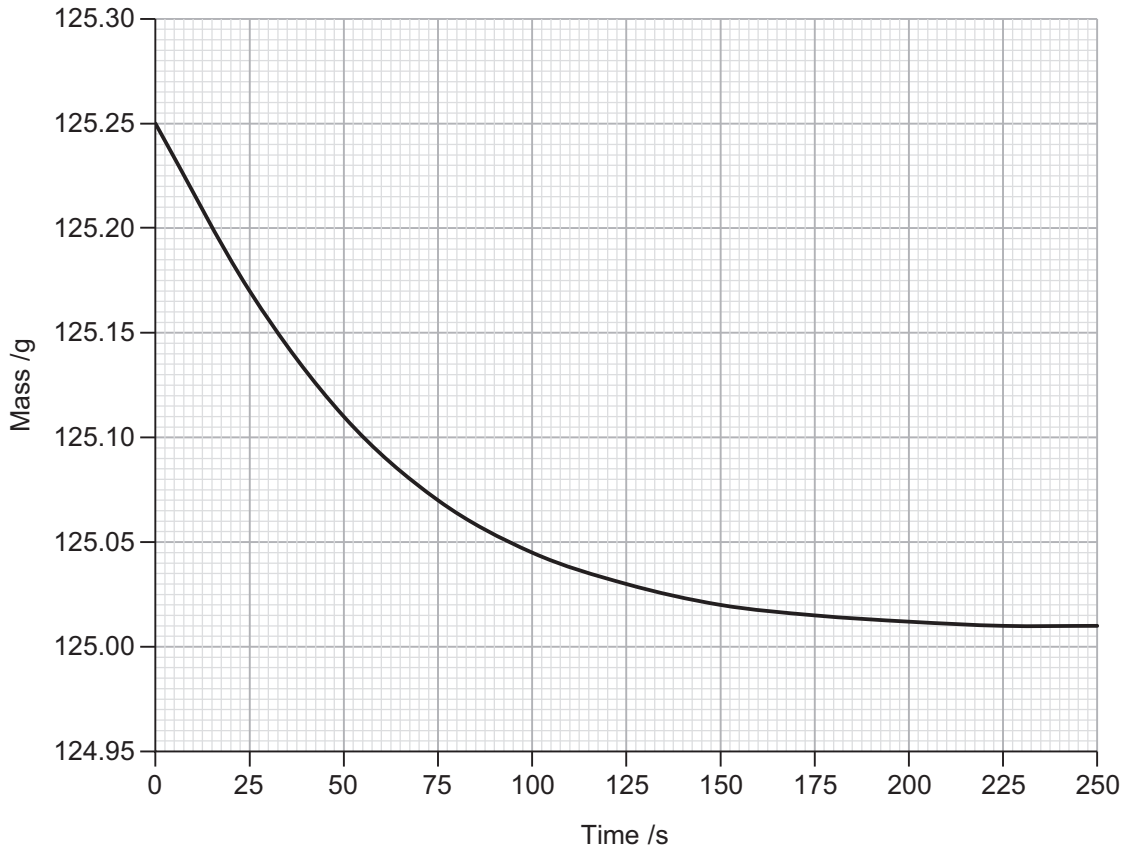
_____ [2]

(ii) What piece of apparatus is missing from the diagram?

_____ [1]

[Turn over

(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]

(ii) Calculate the mass of oxygen gas lost during this experiment.
Show your working out.

loss in mass = _____ g [2]

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

$$2H_2O_2(aq) \rightarrow 2H_2O(l) + O_2(g)$$

The volume of hydrogen peroxide solution used was 25.0 cm^3.

Calculate the concentration, in mol/dm^3, of the hydrogen peroxide solution using the mass of oxygen gas (O_2) calculated in **(c)(ii)**.

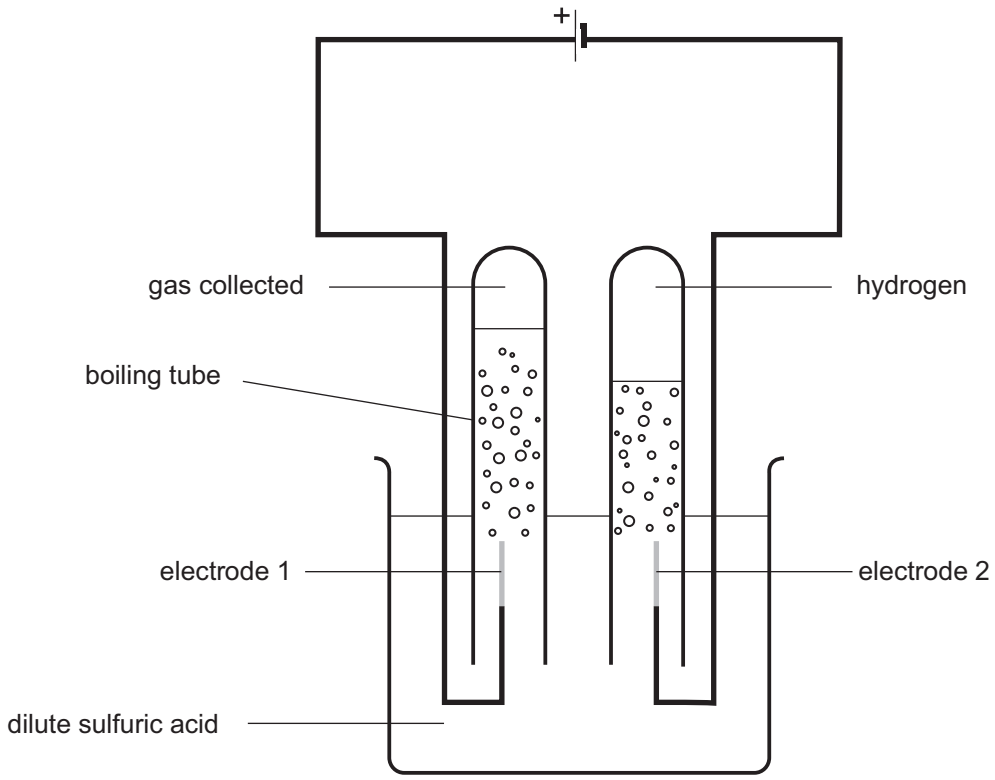
concentration = _____ mol/dm^3 [3]

(iv) On the graph, sketch the line you would expect to obtain if the experiment was repeated at 40 °C. All other conditions remain unchanged. [1]

[Turn over

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]

(ii) State one reason why platinum is used for the electrodes.

_____ [1]

(iii) Explain why dilute sulfuric acid conducts electricity.

_____ [1]

(iv) Complete the table below for the electrolysis of dilute sulfuric acid.

	Electrode 1	**Electrode 2**
Name of electrode		
Gaseous product		hydrogen
Half equation	$4OH^- \rightarrow O_2 + 2H_2O + 4e^-$	

[5]

(v) 20 cm^3 of hydrogen gas were collected at electrode 2. Predict the volume of gas collected at electrode 1.

_____ cm^3 [1]

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

Describe how you would carry out the test to identify ammonia gas.

_____

_____

_____

_____ [4]

[Turn over

4 Hydrated chromium(III) nitrate, $Cr(NO_3)_3.9H_2O$, 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]

(b) What is meant by water of crystallisation?

_____

_____ [1]

(c) Explain how the solid may be heated to constant mass.

_____

_____ [2]

(d) Calculate the mass of the crucible and solid obtained if all the water of crystallisation is removed.

mass = _____ g [5]

(e) Suggest one reason why the mass calculated in **(d)** may be greater than the mass obtained when the experiment is carried out.

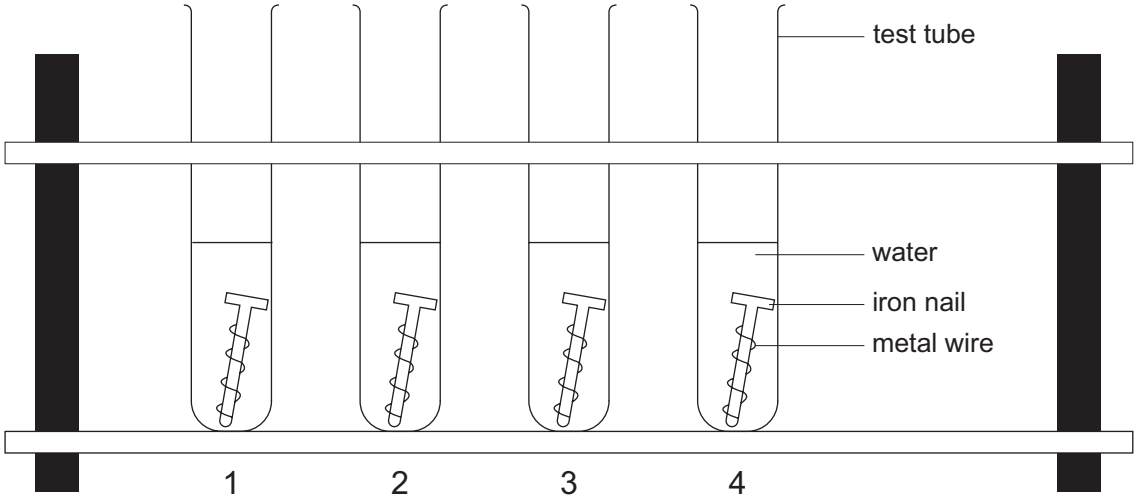
_____

_____ [1]

[Turn over

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]

(ii) Explain why rust does not form in test tube 1.

_____

_____ [2]

(iii) Explain why all the nails in the test tubes would eventually form rust.

_____

_____ [1]

(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 cm^3 is placed in separate test tubes.

Sodium hydroxide solution is added to the solution in 1 cm^3 portions to the first test tube. A green precipitate forms when 6 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]

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

_____ [3]

(iii) Identify the green precipitate.

_____ [1]

[Turn over

(iv) Suggest why the green precipitate does not form until 6 cm^3 of sodium hydroxide solution were added.

_____

_____ [1]

(v) Name the gas causing effervescence in the second test tube.

_____ [1]

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

_____

_____

_____ [2]

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

_____ [1]

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

Examiner Number

GCM34/5
275756

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

11984.02

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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