Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2024

Chemistry

Unit 3: Practical Skills

Practical Booklet B
Higher Tier

GCM34

[GCM34]
FRIDAY 21 JUNE, AFTERNOON

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 **3(a)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is provided.

1 Some metals react readily with oxygen when heated in air. The balanced symbol equation for magnesium reacting with oxygen is:

$$2Mg + O_2 \rightarrow 2MgO$$

(a) A piece of magnesium ribbon was heated directly in a Bunsen burner flame.

(i) Name the piece of apparatus used to hold the magnesium ribbon in a Bunsen burner flame.

_____ [1]

(ii) State two observations which occur during this reaction.

1. _____

2. _____ [2]

(b) The following method was carried out using magnesium.

1. Weigh an empty crucible with a lid and record the mass.
2. Place a sample of magnesium in the crucible, weigh and record the total mass of the crucible, lid and contents.
3. Heat the crucible strongly for two minutes using a Bunsen burner. Lift the crucible lid slightly from time to time.
4. Turn off the Bunsen burner and allow the crucible and contents to cool.
5. Weigh the crucible, lid and contents.
6. Repeat steps 3 to 5 until there is no further change in mass.

(i) Draw a labelled diagram of the assembled apparatus used to heat the magnesium in this experiment.

[3]

(ii) Explain why the crucible lid was lifted slightly from time to time.

_____

_____ [1]

[Turn over

(iii) Calculate the maximum mass of magnesium oxide which could be formed from 0.36 g of magnesium.

$$2Mg + O_2 \rightarrow 2MgO$$

mass of magnesium oxide = _____ g [3]

(c) The experiment in **(b)** was repeated using the metal scandium (relative atomic mass (A_r) = 45). The results obtained, after heating the scandium to constant mass, are given in the table below.

Mass of crucible + lid	42.10 g
Mass of crucible + lid + scandium	45.25 g
Mass of crucible + lid + oxide of scandium	46.93 g

Use the results in the table to calculate the empirical formula of the oxide of scandium formed. Show your working out.

empirical formula _____ [5]

[Turn over

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2 Nitrogen dioxide (NO_2) is a brown gas which may be produced by heating solid lead(II) nitrate in a fume cupboard. Before heating, the lead(II) nitrate must be thoroughly dried.

(a) (i) Write a balanced symbol equation for the decomposition of lead(II) nitrate to form lead(II) oxide, nitrogen dioxide and oxygen.

_____ [3]

(ii) State one way in which the solid lead(II) nitrate could be dried.

_____ [1]

(iii) Describe the test for oxygen gas.

_____

_____ [1]

(iv) Calculate the percentage, by mass, of oxygen in nitrogen dioxide. Give your answer to 1 decimal place.

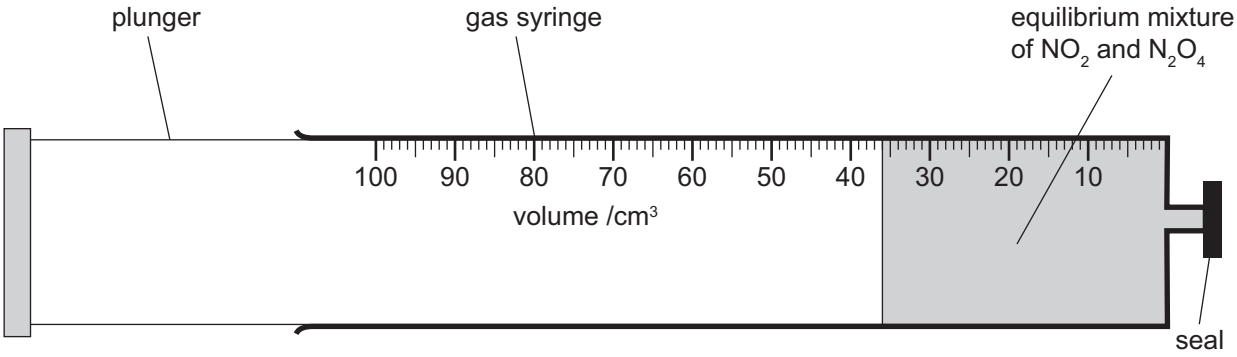
percentage of oxygen = _____ % [2]

[Turn over

(b) Nitrogen dioxide exists in equilibrium with dinitrogen tetraoxide (N_2O_4) which is a colourless gas.

$$\underset{\text{brown}}{2NO_2(g)} \rightleftharpoons \underset{\text{colourless}}{N_2O_4(g)} \qquad \text{energy change} = -58\,\text{kJ}$$

An equilibrium mixture of the two gases at room temperature (20 °C) was placed in a sealed gas syringe. The mixture was light brown in colour.



(i) Calculate the number of moles of gas in the equilibrium mixture in the syringe.

moles of gas = _____ [2]

(ii) Explain why the equilibrium mixture becomes darker in colour when the gas syringe is placed in a water bath at 50 °C.

_____

_____

_____

_____ [3]

(iii) Explain why the equilibrium mixture becomes lighter in colour when the plunger of the syringe is pushed in to increase the pressure.

_____

_____

_____

_____ [3]

[Turn over

3 Carbon dioxide gas can be prepared in the laboratory and collected over water.

(a) Describe how you would set up the apparatus to prepare carbon dioxide gas and collect the gas over water. State how you would test the gas prepared.

In your answer you should include:

- the names of the reagents used
- the names of the pieces of apparatus and how they are assembled
- how to test for carbon dioxide gas.

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

[6]

(b) Carbon dioxide reacts with water. Write a balanced symbol equation for this reaction.

_____ [2]

(c) The table below gives some information about three gases.

Gas	Colour	Density compared to air	Acidic, basic or neutral
carbon dioxide	colourless	denser than air	
hydrogen	colourless		neutral
ammonia		less dense than air	basic

(i) Complete the table above. [3]

(ii) Describe the test for ammonia gas.

_____

_____

_____

_____ [3]

[Turn over

4 An experiment was carried out to investigate the temperature change during the reaction of acid **A** with potassium hydroxide solution and also during the reaction of acid **B** with potassium hydroxide solution using the method below.

Step 1: Place 25.0 cm^3 of acid **A** in a beaker.

Step 2: Use a thermometer to measure the temperature of acid **A**.

Step 3: Add 5.0 cm^3 of potassium hydroxide solution to acid **A** and swirl the mixture.

Step 4: Use a thermometer to measure the highest temperature of the reaction mixture.

Step 5: Repeat steps 3 and 4 until a total of 40.0 cm^3 of potassium hydroxide solution have been added.

Step 6: Repeat the experiment using 25.0 cm^3 of acid **B**.

(a) Name the piece of apparatus used to add the potassium hydroxide solution to acid **A**.

_____ [1]

(b) Write an ionic equation, with state symbols, for the neutralisation reaction which occurs in this experiment.

_____ [3]

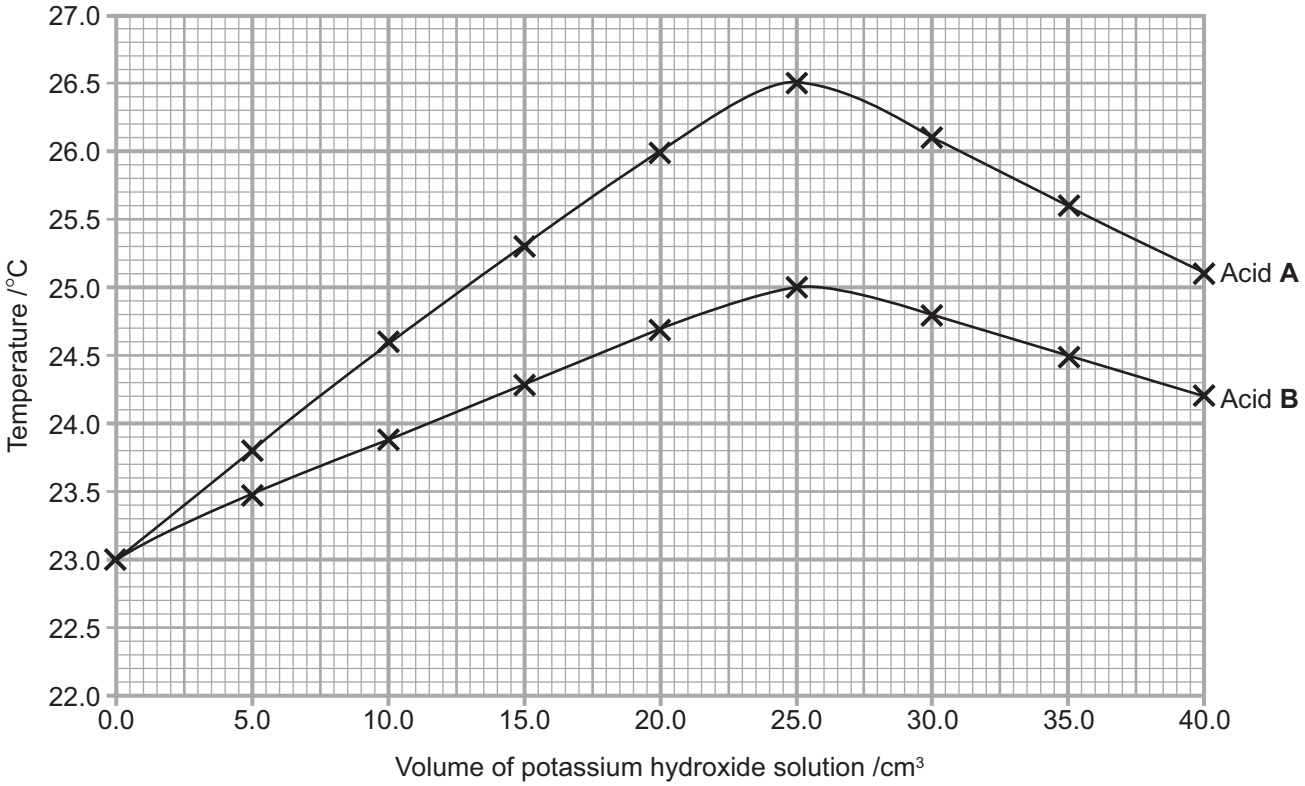
(c) State one source of heat loss in this experiment and explain how the heat loss can be reduced.

_____

_____

_____ [2]

(d) A graph of temperature against volume of potassium hydroxide solution added is shown below for both acids.



(i) How does the graph show that the reaction between acid **A** and potassium hydroxide solution is exothermic?

_____ [1]

(ii) Use the graph to calculate the maximum temperature change for the reactions of potassium hydroxide solution with acid **A** and with acid **B**.

Acid **A**: _____

Acid **B**: _____ [2]

[Turn over

(iii) Explain why the temperature decreased after 25.0 cm^3 of potassium hydroxide solution have been added.

_____

_____ [1]

(iv) State and explain which acid, **A** or **B**, is the stronger acid.

_____

_____ [1]

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(Questions continue overleaf)

[Turn over

5 The reactivity series below includes the metals chromium, lithium and tin.

Most reactive	potassium
	sodium
	lithium
	calcium
	aluminium
	zinc
	chromium
	iron
	tin
Least reactive	copper

(a) Lithium and calcium react with water.

(i) State two differences in the observations for these two reactions.

1. _____

_____

2. _____

_____ [2]

(ii) State two similarities in the observations for these two reactions.

1. _____

_____

2. _____

_____ [2]

(b) The reactivity series may be used to predict if a reaction would occur.

For each of the following, predict whether a reaction would occur. If there is a reaction, complete the ionic equation with state symbols. If there is no reaction, write **no reaction**.

$Cu(s) + Sn^{2+}(aq) \rightarrow$ _____

$Zn(s) + Fe^{2+}(aq) \rightarrow$ _____

$Sn(s) + Zn^{2+}(aq) \rightarrow$ _____ [3]

(c) A piece of aluminium foil was added to a boiling tube containing copper(II) sulfate solution. A reaction occurs but it is very slow.

(i) Write a balanced symbol equation for the reaction of aluminium with copper(II) sulfate.

_____ [3]

(ii) What would be observed during this reaction?

_____

_____ [2]

(iii) Which of the metals, aluminium or copper, has the greater tendency to form ions?

_____ [1]

(iv) Suggest why the aluminium foil reacts slowly.

_____

_____ [2]

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

Examiner Number

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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