Rewarding Learning

Centre Number

Candidate Number

General Certificate of Secondary Education
2019

Chemistry

Unit 3: Practical Skills
Practical Booklet B
Higher Tier

MV18

[GCM34]

WEDNESDAY 19 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(a)**.
A Data Leaflet, which includes a Periodic Table of the Elements, is provided.

1 25.0 cm^3 of a solution of sodium hydroxide were placed in a conical flask using a pipette. Three drops of methyl orange indicator were added. The sodium hydroxide was titrated against 0.045 mol/dm^3 sulfuric acid. The sulfuric acid was added from a burette.

(a) Describe how

- a burette is prepared and filled with sulfuric acid and
- accuracy is ensured when determining the end-point.

[6 marks]

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

(b) A rough titration and two subsequent accurate titrations were carried out.
The table below gives the results of the titrations and the average titre is recorded below the table.

	Initial burette reading (cm^3)	**Final burette reading (cm^3)**	**Titre (cm^3)**
Rough titration	0.0	21.2	21.2
First accurate titration	21.2	41.4	20.2
Second accurate titration	25.2	45.2	20.0

Average titre = 20.1 cm^3

(i) Why is a rough titration carried out? [1 mark]

(ii) State the colour change at the end-point.
[2 marks]

From _____

to _____

(iii) Calculate the number of moles of sulfuric acid added from the burette. [1 mark]

moles of sulfuric acid = _____

The equation for the reaction is:

$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

(iv) Calculate the number of moles of sodium hydroxide present in 25.0 cm^3. [1 mark]

moles of sodium hydroxide = _____

(v) Calculate the concentration of the sodium hydroxide solution in mol/dm^3. [1 mark]

concentration = _____ mol/dm^3

(vi) Calculate the concentration of the sodium hydroxide solution in g/dm^3. [1 mark]

concentration = _____ g/dm^3

2 **(a)** A solution of an ionic compound, labelled A, was tested as shown in the table below.

Test	Observations
1. Place approximately 5 cm^3 of solution A in a test tube and add a few drops of sodium hydroxide solution	white precipitate
2. Add excess sodium hydroxide solution to the test tube from test 1	white precipitate is soluble forming a colourless solution
3. Place approximately 5 cm^3 of solution A in a test tube and add a few drops of silver nitrate solution	cream precipitate
4. Place approximately 5 cm^3 of solution A in a test tube and add a few drops of ammonia solution	white precipitate
5. Add excess ammonia solution to the test tube from test 4	white precipitate is soluble forming a colourless solution

(i) Write the formula of the cation present in solution A. [1 mark]

_____

(ii) Write the formula of the anion present in solution A. [1 mark]

_____

(iii) Write the name and formula of the ionic compound dissolved in solution A. [2 marks]

Name: _____

Formula: _____

(iv) Write an ionic equation for the reaction in test 3 including state symbols. [3 marks]

_____

(v) Name the white precipitate formed in test 4. [1 mark]

_____

(b) An unknown solid is thought to be potassium carbonate.

(i) State how you would prove that the solid contained potassium ions. [2 marks]

_____

_____

(ii) Describe the procedure you would use to prove that the solid contained carbonate ions. [4 marks]

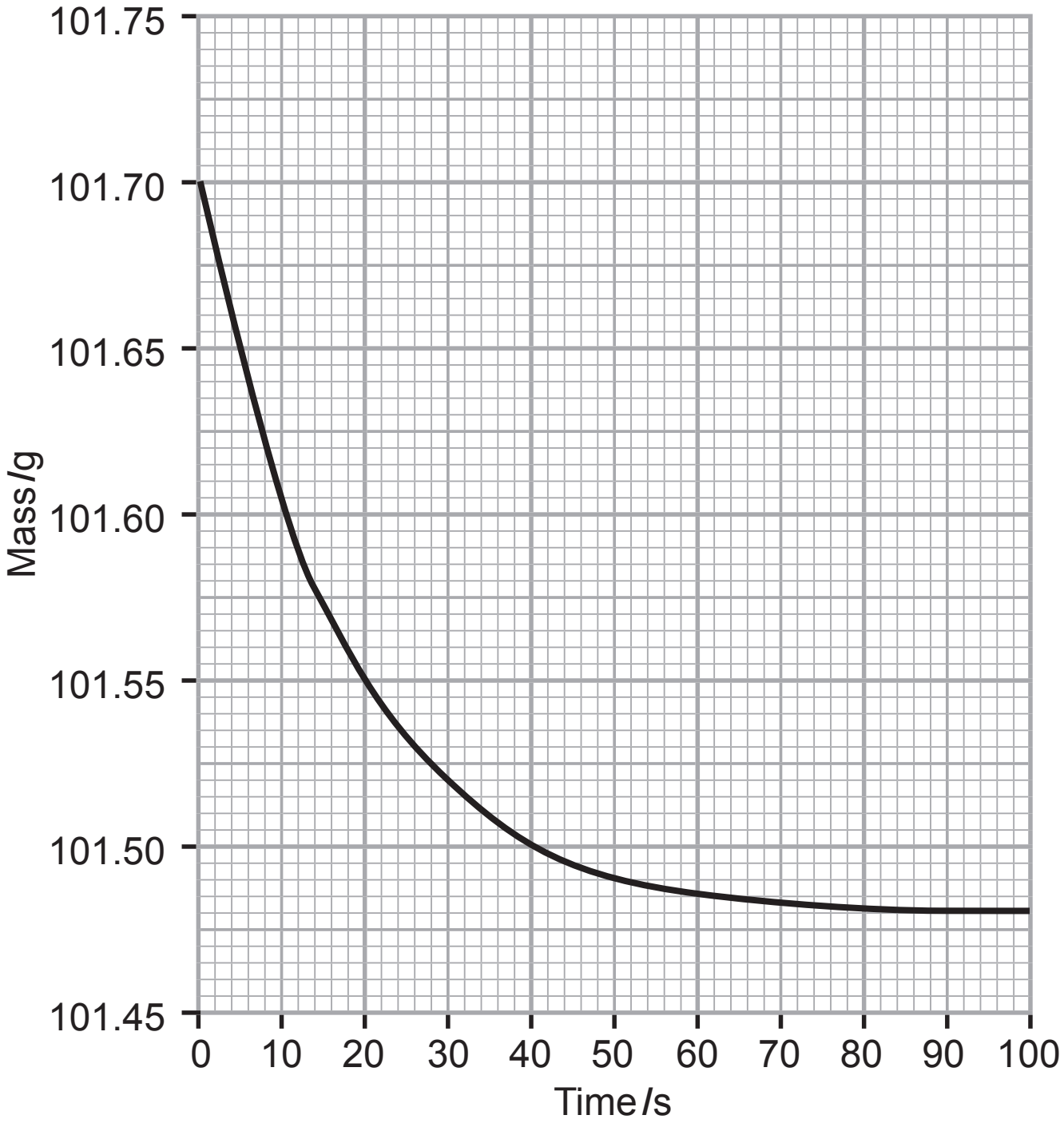
_____

_____

_____

_____

3 A marble chip of mass 0.56 g was added to 25.0 cm^3 of hydrochloric acid in a conical flask at 25 °C. The mass of the flask and its contents was recorded every 10 seconds for 100 seconds. The results are plotted on the axes below.



(a) Draw a labelled diagram of the assembled apparatus used to carry out this experiment. [4 marks]

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

_____

_____

(ii) The experiment was repeated at 40 °C. Sketch the graph on the axes opposite which would be obtained at 40 °C with all other factors being the same. [1 mark]

(c) The balanced symbol equation for the reaction between the calcium carbonate in the marble chip and hydrochloric acid is:

$$CaCO_3(s) + 2HCl(aq) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$$

(i) Use the graph to calculate the mass of carbon dioxide produced during the reaction. [1 mark]

_____

(ii) Calculate the number of moles of carbon dioxide which were produced during the reaction. [1 mark]

moles of carbon dioxide = _____

(iii) Using your answer to **(c)(ii)** and the balanced symbol equation, calculate the number of moles of calcium carbonate which were present in the marble chip. [1 mark]

moles of calcium carbonate = _____

(iv) Calculate the mass of calcium carbonate which was present in the marble chip. [1 mark]

mass of calcium carbonate = _____ g

(v) The mass of the marble chip was 0.56 g. Calculate the percentage of calcium carbonate in the marble chip. Give your answer to 1 decimal place.
[2 marks]

percentage = _____ %

4 The reactivity of metals varies greatly. Many different reactions of metals may be used to determine a reactivity series.

(a) Five metals were reacted with dilute nitric acid. The initial temperature of the nitric acid was recorded before the metal was added. The highest temperature during the reaction was also recorded. The results are shown in the table below.

Metal	**Initial temperature (°C)**	**Highest temperature (°C)**	**Temperature change (°C)**
zinc	20	25	5
copper	20	20	0
magnesium	20	39	
iron	20	23	
tin	20	21	

(i) Complete the table. [1 mark]

(ii) The reactivity series for four of the metals is given below. Place tin in this reactivity series. [1 mark]

Most reactive: magnesium

zinc

iron

Least reactive: copper

(iii) Explain how the data in the table shows that the reaction of magnesium and nitric acid is exothermic. [1 mark]

_____

_____

(iv) State two factors which should be kept the same during this experiment. [2 marks]

1. _____

2. _____

(v) Write a balanced symbol equation for the reaction of magnesium with nitric acid. [3 marks]

_____

(b)

Metal	magnesium nitrate	zinc nitrate	iron(II) nitrate	copper(II) nitrate	tin(II) nitrate	chromium(III) nitrate	cobalt(II) nitrate
chromium	✗	✗	✓	✓	✓		✓
cobalt	✗	✗	✗	✓	✓	✗	

A series of displacement reactions was carried out with two other metals, chromium and cobalt. The results are shown in the table on page 14.
A tick (✓) indicates that a reaction occurs.

(i) Look at the statements below. Place a tick (✓) in the box beside the statements which are correct. [1 mark]

Cobalt is more reactive than chromium ☐

Cobalt is more reactive than copper and tin ☐

Chromium is more reactive than iron and less reactive than zinc ☐

(ii) Name the two products of the reaction of cobalt and copper(II) nitrate. [2 marks]

_____

(iii) Write a balanced symbol equation for the reaction of chromium with iron(II) nitrate forming chromium(III) nitrate and iron. [3 marks]

_____

5 **(a)** An organic compound, labelled B, is a liquid at room temperature and is tested as shown in the table below.

Test	Details	Observations
1	Mix the liquid with bromine water and shake	bromine water remains orange
2	Mix the liquid with acidified potassium dichromate solution and warm gently in a water bath	changes from orange to green
3	Add solid sodium carbonate to the liquid	no reaction

(i) State the functional group present in compound B. [1 mark]

_____

(ii) To what homologous series does compound B belong? [1 mark]

_____

(iii) State the functional group which is **not** present in compound B based on test 1. [1 mark]

_____

(iv) State the functional group which is **not** present in compound B based on test 3. [1 mark]

_____

(v) Compound B contains 3 carbon atoms. Draw the structural formula and name two organic compounds which could be compound B. [4 marks]

Name: _____ Name: _____

(b) Carboxylic acids such as ethanoic acid are weak acids. Hydrochloric acid is a strong acid.

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

_____

(ii) Describe how you would test samples of hydrochloric acid and ethanoic acid to prove that one is a weak acid and one is a strong acid. [3 marks]

_____

_____

_____

_____

_____

_____

(c) Propanoic acid reacts with sodium hydroxide solution and with solid copper(II) carbonate.

(i) Name the salt produced in the reaction of propanoic acid with sodium hydroxide. [1 mark]

_____

(ii) Suggest the colour change observed in the solution when copper(II) carbonate is added to propanoic acid. [1 mark]

From _____

to _____

(iii) Write a balanced symbol equation for the reaction of copper(II) carbonate with propanoic acid. [3 marks]

_____

This is the end of the question paper

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

For first teaching from September 2017

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