



Rewarding Learning

General Certificate of Secondary Education
2022

Centre Number

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Candidate Number

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Chemistry

Unit 3: Practical Skills

Practical Booklet B

Higher Tier



[GCM34]

GCM34

MONDAY 27 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 **4(b)**.

A Data Leaflet, which includes a Periodic Table of the Elements, is provided.

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1 The solubility of many substances increases as temperature increases.

(a) What is meant by the term solubility?

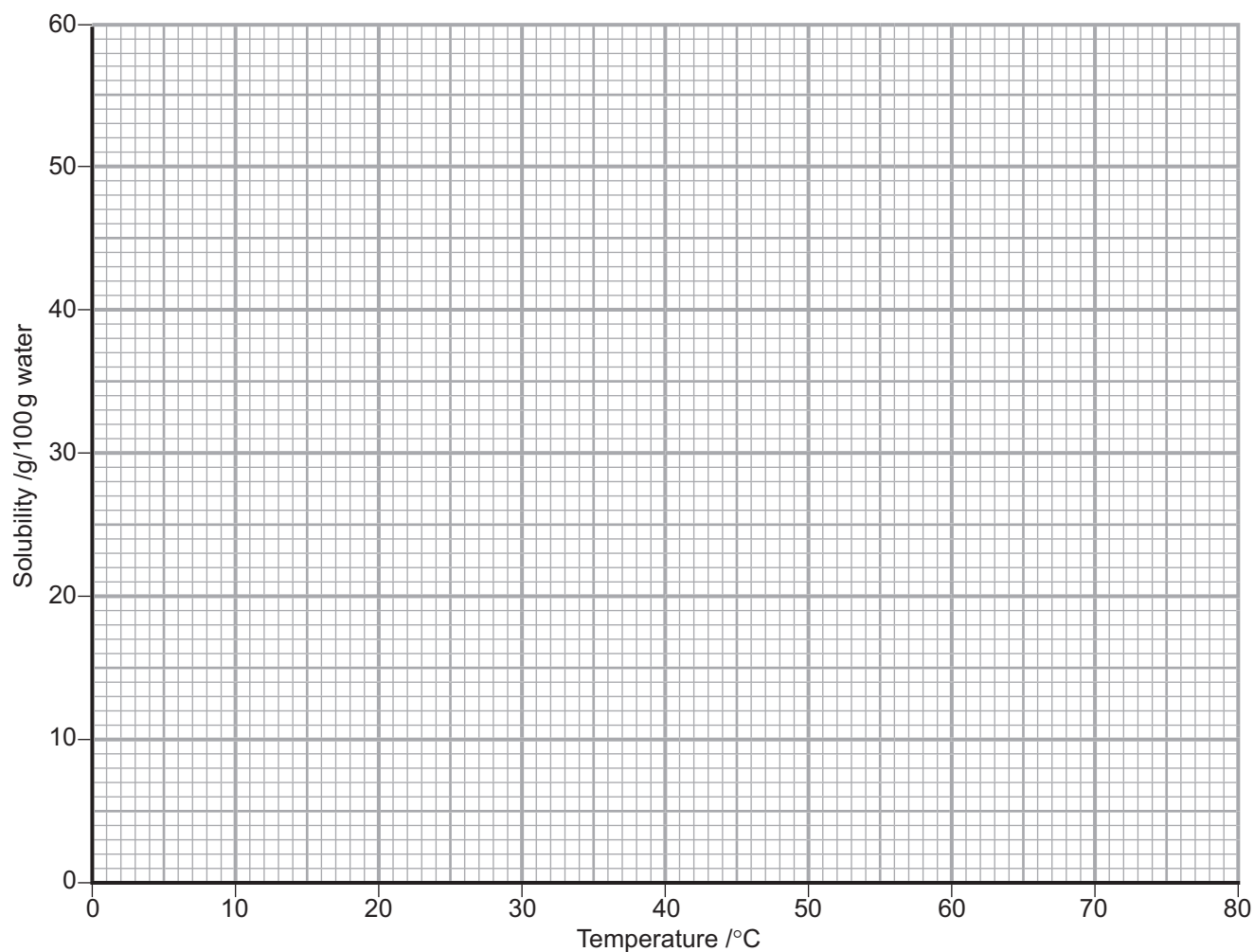
[3]

(b) A student carried out a series of experiments to determine the solubility of potassium chloride over a range of temperatures. The results are shown in the table below.

Temperature /°C	0	20	40	60	80
Solubility /g/100 g water	28	34	40	46	52



(i) Plot these results on the axes below and draw a suitable line or curve.



[3]

(ii) Use the graph to determine the temperature at which the solubility of potassium chloride is 48 g/100 g water.

[1]

[Turn over

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(iii) Calculate the mass of solid which crystallises out of solution when a saturated solution of potassium chloride containing 80 g of water is cooled from 70°C to 10°C.

mass of crystals = _____ g [4]

(iv) 10 g of potassium chloride were placed in 20 g of water at 50°C. A saturated solution was formed. Calculate the mass of potassium chloride which did not dissolve.

mass of potassium chloride = _____ g [3]





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2 The reactivity of metals may be determined using different chemical reactions.

(a) Calcium reacts with water. During the reaction, heat is released and the calcium sinks and then rises in the water.

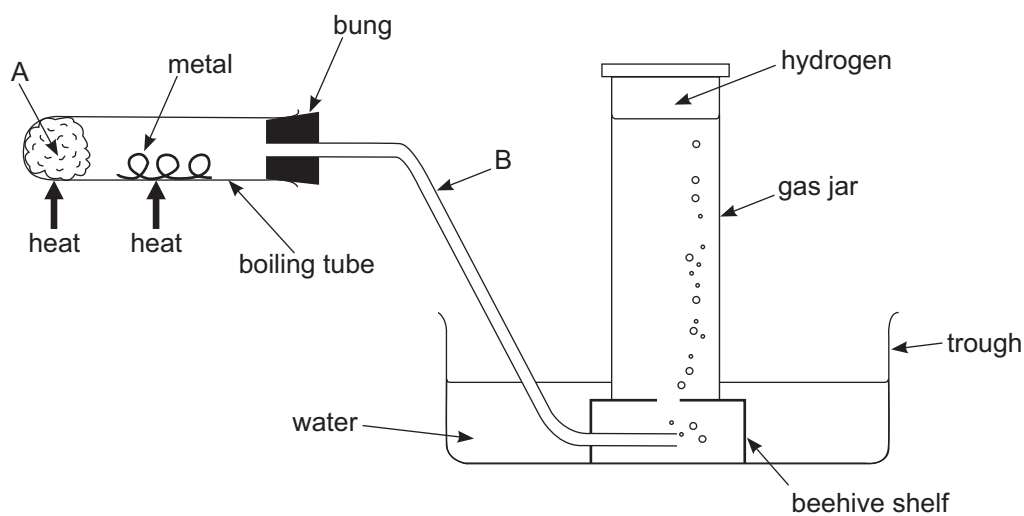
(i) Write a balanced symbol equation for the reaction of calcium with water.

_____ [3]

(ii) State two other observations which would be made when calcium reacts with water.

_____ [2]

(b) The apparatus below is used to react metals, such as magnesium or aluminium, with steam.



(i) What labels should be placed at A and B on the diagram?

A _____

B _____ [2]

(ii) Write a balanced symbol equation for the reaction of aluminium with steam. Include state symbols.

_____ [4]

(iii) Suggest why the bung is removed from the boiling tube as soon as heating is stopped.

_____ [1]

[Turn over

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- (c) The reactivity of four metals was investigated using displacement reactions. Each metal was placed in different metal nitrate solutions. The results are shown in the table below. A tick (✓) indicates that a reaction occurred.

metal \ metal salt solution	magnesium nitrate	copper(II) nitrate	cobalt(II) nitrate	iron(II) nitrate
magnesium		✓	✓	✓
copper	×		×	×
cobalt	×	✓		×
iron	×	✓	✓	

- (i) Iron(II) nitrate solution is green. Predict what you would observe when magnesium reacts with iron(II) nitrate solution.

_____ [2]

- (ii) Arrange the metals in order of reactivity from the most reactive to least reactive.

most reactive: _____

least reactive: _____

[1]





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3 A mixture contains two ionic compounds, each with the same anion. The mixture was analysed to determine the identity of the ions present.

(a) Three tests were carried out on the mixture and the observations recorded in the table below.

Test	Observations
1. A flame test was carried out on a solid sample of the mixture.	lilac flame
2. A sample of the mixture was dissolved in deionised water and 5 drops of sodium hydroxide solution were added. An excess of sodium hydroxide solution was added.	white precipitate formed white precipitate disappeared to form a colourless solution
3. A sample of the mixture was dissolved in deionised water and 5 drops of silver nitrate solution were added.	white precipitate formed

Use the information in the table to answer the following questions.

(i) Using the evidence from Test 1, identify a cation present in the mixture.

_____ [1]

(ii) Using the evidence from Test 2, identify two other cations which may be present in the mixture.

_____ [2]

(iii) Using the evidence from Test 3, write the formula of the anion present in the mixture.

_____ [1]



(iv) Write an ionic equation for the formation of the white precipitate in Test 3. Include state symbols.

_____ [3]

(v) Suggest the name of a compound which may be present in the mixture.

_____ [1]

(b) Describe how you would carry out a flame test on the solid sample of the mixture.

_____ [4]

[Turn over

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[6]

(c) The water of crystallisation removed from a sample of hydrated crystals was collected. Describe a chemical test to confirm that the liquid is water and state the observations made for a positive test.

[3]

(d) Calculate the loss in mass when a sample of 1.23 g of $\text{MgSO}_4 \cdot 7\text{H}_2\text{O}$ was heated to remove all of the water of crystallisation.

loss in mass = _____ g [3]

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5 A titration was carried out to find the identity of an unknown metal hydroxide $M(OH)_2$. 6.84 g of the unknown metal hydroxide were dissolved in 1 dm^3 of deionised water. 25.0 cm^3 of this solution were transferred to a conical flask using a pipette and titrated against 0.16 mol/dm^3 hydrochloric acid using methyl orange indicator.

(a) Describe how you would prepare and use a pipette to transfer 25.0 cm^3 of the unknown metal hydroxide solution to the conical flask.

[4]

(b) State the colour change observed at the end point.

[2]

(c) State two ways you would ensure that the end point of the titration is determined accurately.

1.

2.

[2]



(d) The results obtained in the titration are recorded in the table below.

	Initial burette reading /cm ³	Final burette reading /cm ³	Titre /cm ³
Rough titration	0.0	13.2	13.2
First accurate titration	13.2	25.6	12.4
Second accurate titration	25.6	38.2	12.6

(i) Calculate the average titre.

_____ [2]

(ii) Calculate the number of moles of hydrochloric acid used.

moles of hydrochloric acid = _____ [1]

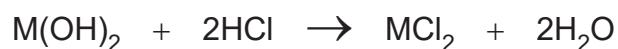
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The balanced symbol equation for the reaction may be represented as:



(iii) Calculate the number of moles of M(OH)_2 present in 25.0 cm^3 of the solution.

moles of $\text{M(OH)}_2 = \underline{\hspace{2cm}}$ [1]

(iv) Calculate the number of moles of M(OH)_2 present in 1 dm^3 of the solution.

moles of $\text{M(OH)}_2 = \underline{\hspace{2cm}}$ [1]



(v) Using the initial mass used to prepare the solution and the answer to (iv) calculate the relative formula mass (M_r) of $M(OH)_2$.

relative formula mass (M_r) = _____ [1]

(vi) Calculate the relative atomic mass (A_r) of M and identify M.

relative atomic mass (A_r) = _____

identity of M: _____ [2]

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Question Number	Marks
1	
2	
3	
4	
5	

Total Marks	
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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

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