Cambridge Pre-U

Cambridge Assessment International Education
Cambridge Pre-U Certificate

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

3552464912

CHEMISTRY (PRINCIPAL) **9791/04**

Paper 4 Practical **May/June 2019**

2 hours

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions
Data Booklet

READ THESE INSTRUCTIONS FIRST

Write your centre number, candidate number and name in the spaces at the top of this page.
Give details of the practical session and laboratory where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams or graphs.
Do not use staples, paper clips, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Electronic calculators may be used.
You may lose marks if you do not show your working or if you do not use appropriate units.
A Data Booklet is provided.

At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

Session
Laboratory

For Examiner's Use	
1	
2	
3	
Total	

This syllabus is regulated for use in England, Wales and Northern Ireland as a Cambridge International Level 3 Pre-U Certificate.

This document consists of **8** printed pages.

Cambridge Assessment International Education

1 **FA 1** is a mixture of potassium carbonate, K_2CO_3, and potassium sulfate, K_2SO_4.

In the following experiment you will first react a sample of **FA 1** with an excess of dilute hydrochloric acid, HC*l*(aq). You will then carry out a titration to determine the amount of unreacted acid and hence work out the percentage by mass of potassium carbonate in **FA 1**.

The following reagents are provided:

FA 1 is a mixture of K_2CO_3 and K_2SO_4.
FA 2 is 0.100 mol dm^{-3} hydrochloric acid, HC*l*.
FA 3 is 0.0400 mol dm^{-3} sodium hydroxide, NaOH.
methyl orange indicator

(a) Method

Before starting any practical work, read through all the instructions and prepare suitable tables for your results in the spaces provided.

Preparation of FA 4

1. Weigh the weighing bottle containing **FA 1** and record the mass.
2. Tip the contents of the weighing bottle into the 250 cm^3 beaker.
3. Reweigh the emptied weighing bottle and record the mass.
4. Record the mass of **FA 1** added.

5. Gradually add approximately 150 cm^3 of **FA 2** to the beaker and stir with the glass rod until all the **FA 1** has dissolved.
6. Transfer the contents of the beaker into the 250 cm^3 volumetric flask; using a little more **FA 2**, rinse the beaker and the glass rod and add these washings to the volumetric flask.
7. Fill the volumetric flask to the mark with **FA 2**. Stopper the flask and invert several times to ensure thorough mixing.
8. Label this solution **FA 4**.

Titration of FA 4

9. Fill a burette with **FA 3**.
10. Use a pipette to transfer 25.0 cm^3 of **FA 4** into the conical flask.
11. Add 5 drops of methyl orange indicator.
12. Titrate the solution in the flask with **FA 3**.
13. Repeat the titration as many times as you feel are necessary to obtain consistent results.
14. Record your results in a suitable form.

[8]

(b) From your titration results, obtain a volume of **FA 3** to be used in the following calculations.

Show clearly how you obtained this value.

25.0 cm^3 of **FA 4** required ..... cm^3 of **FA 3**. [1]

(c) The following calculations will determine the percentage by mass of potassium carbonate in **FA 1**.

You must show your working.

(i) Calculate the amount, in mol, of HC*l* present in 250.0 cm^3 of **FA 4**.

..... mol of HC*l* in 250.0 cm^3 of **FA 4** [2]

(ii) Calculate the amount, in mol, of K_2CO_3 that was present in the sample of **FA 1**.

..... mol of K_2CO_3 in **FA 1** [2]

(iii) Calculate the percentage by mass of K_2CO_3 in **FA 1**.

% by mass of K_2CO_3 in **FA 1** = ... [2]

(d) Another way to determine the amount of potassium carbonate in **FA 4**, could be to carry out a precipitation titration. In this titration a solution is added from the burette that causes a precipitate of metal carbonate to form. No indicator is added in this titration. The end-point is when no more precipitate forms.

(i) Suggest a suitable reagent to use in such a titration. Explain your answer.

.....

..... [1]

(ii) Would you expect this type of titration to be more or less accurate than the titration you carried out? Explain your answer.

.....

..... [1]

[Total: 17]

2 In this experiment you will identify M in the hydrated salt, $MSO_4 \cdot xH_2O$, where M is a Group 2 metal.

FA 5 is a sample of the hydrated salt, $MSO_4 \cdot xH_2O$.

(a) Method

Before starting any practical work, read through all the instructions and prepare suitable tables for your results in the spaces provided.

1. Weigh a clean, dry crucible with its lid.
2. Transfer **FA 5** into the crucible.
3. Reweigh the crucible, lid and contents.
4. Support the crucible with its lid in the pipeclay triangle on top of a tripod.
5. Heat the crucible gently for about 1 minute with the lid on.
6. Remove the lid using tongs.
7. Heat the crucible more strongly for a further 4 minutes.
8. Leave the crucible to cool for at least 10 minutes.

You are advised to start Question 3 while the crucible is cooling.

9. When the crucible is cool enough to handle, reweigh the crucible, lid and contents.
10. Repeat steps 7 to 9 until you are satisfied that all of the water of crystallisation has been removed.
11. Record all your readings, the mass of the residue and the mass of water lost.

[5]

[Turn over

(b) The following calculations will identify M in the hydrated salt, $MSO_4 \cdot xH_2O$.

You must show your working.

(i) Calculate the percentage by mass of water in **FA 5**.

..... % by mass of water in **FA 5** [1]

(ii) The percentage by mass of sulfate in **FA 5** is 39.0%.

Calculate the value of x in $MSO_4 \cdot xH_2O$.

x = ... [2]

(iii) Calculate the percentage by mass of M in **FA 5**. Hence identify M.

M is ..... [3]

[Total: 11]

3 **FA 6**, **FA 7**, **FA 8** and **FA 9** are solutions.

Each solution is either:
- a solution where one or both of the ions are listed in the Qualitative Analysis Notes

or
- a solution that is used in the tests listed in the Qualitative Analysis Notes.

One of the solutions is acidified.

All the solutions contain one cation and one anion only, apart from the acidified solution which also contains $H^+(aq)$.

FA 6, **FA 7**, **FA 8** and **FA 9** are all labelled with the same hazard symbols although these do not apply to every solution.

(a) Record your observations on mixing pairs of solutions.

	FA 7	**FA 8**	**FA 9**
To a 1 cm depth of each solution in a test-tube add **FA 6**.			
To a 1 cm depth of each solution in a test-tube add **FA 7**.			
To a 1 cm depth of each solution in a test-tube add **FA 8**.			

[5]

(b) Carry out the following tests on the unknown solutions and record your observations. You should not acidify any of the solutions before carrying out the test.

	To a 1 cm depth of solution in a test-tube, add aqueous silver nitrate.	To a 1 cm depth of solution in a test-tube, add aqueous barium chloride or aqueous barium nitrate.
FA 6		
FA 7		
FA 8		
FA 9		

[2]

(c) Identify as many of the ions as you can.

If you think that more than one cation or anion could account for the observations, then give both alternatives.

Identify the solution that is acidified.

FA 6 .....

FA 7 .....

FA 8 .....

FA 9 .....

The acidified solution is ..... .

[5]

[Total: 12]