Cambridge Pre-U

Cambridge International Examinations
Cambridge Pre-U Certificate

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

6222256936 1

CHEMISTRY (PRINCIPAL) **9791/04**

Paper 4 Practical **May/June 2016**

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	

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

This document consists of **9** printed pages and **3** blank pages.

CAMBRIDGE International Examinations

[Turn over

1 **FA 1** is an ore that contains magnesium carbonate.
You will determine the percentage by mass of magnesium carbonate in **FA 1** by measuring the mass loss when the ore is reacted with an excess of hydrochloric acid.

$$MgCO_3(s) + 2HCl(aq) \rightarrow MgCl_2(aq) + H_2O(l) + CO_2(g)$$

FA 2 is hydrochloric acid, HC*l*.

(a) Method
Before starting any practical work, read through all the instructions and prepare a table for your results in the space provided.

1. Use the measuring cylinder to transfer 50 cm^3 of **FA 2** into a conical flask.
2. Weigh the conical flask containing the acid and record the mass.
3. Weigh the stoppered tube containing **FA 1** and record the mass.
4. Slowly and carefully, to avoid acid spray, add all the sample of **FA 1** a little at a time to the acid in the conical flask. Swirl the flask after each addition until there is no further visible reaction.
5. Reweigh the conical flask and its contents and record the mass.
6. Reweigh the stoppered tube containing any residual **FA 1** and record the mass.
7. Calculate the mass of **FA 1** added to the acid and record this value.
8. Calculate the mass of carbon dioxide given off and record this value.

I	
II	
III	
IV	
V	
VI	

[6]

(b) Calculations

You must show your working and appropriate significant figures in the final answer to each step of your calculations.

(i) Calculate the amount, in mol, of carbon dioxide given off when the magnesium carbonate reacted with **FA 2**.

amount of CO_2 = ... mol

(ii) Calculate the mass of the magnesium carbonate in the original sample of **FA 1**.

mass of $MgCO_3$ = ... g

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

percentage by mass of $MgCO_3$ = ... %

(iv) In carrying out this analysis, what assumption have you had to make about the other components in the ore?

.....

.....

.....

[4]

(c) (i) A student decided to repeat the experiment but using the same volume of more dilute hydrochloric acid. The student reasoned that this would reduce acid spray and so make the percentage by mass more accurate.
When the experiment was carried out, however, the percentage by mass was found to be lower than the true value. Suggest why this was the case.

.....

.....

.....

(ii) Another student claimed that a more accurate percentage by mass could be obtained by using the first method but measuring **FA 2** with a burette rather than a measuring cylinder.
Discuss whether you agree with the student.

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[2]

[Total: 12]

2 The ore **FA 1** also contains magnesium hydroxide, $Mg(OH)_2$. In this experiment you will determine the percentage by mass of magnesium hydroxide in the ore.

Solution **FA 3** was prepared as follows. An 18.0 g sample of the ore was dissolved in 250.0 cm^3 of hydrochloric acid with a concentration of 2.00 mol dm^{-3} and the resulting solution made up to 1.00 dm^3 using distilled water.

$$Mg(OH)_2(s) + 2HCl(aq) \longrightarrow MgCl_2(aq) + 2H_2O(l)$$

In this experiment you will determine the amount of hydrochloric acid that remains in the solution by a titration using aqueous sodium hydroxide.

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

The following reagents are provided.

FA 4 0.100 mol dm^{-3} sodium hydroxide, NaOH
methyl orange indicator

(a) Method
Before starting any practical work, read through all the instructions and prepare a suitable table for your results in the space provided.

1. Fill the burette with **FA 3**.
2. Use a pipette to transfer 25.0 cm^3 of **FA 4** into a clean conical flask.
3. Add 5 drops of methyl orange indicator to the conical flask.
4. Titrate the solution in the flask with **FA 3**.
5. Repeat the titration as many times as you feel are necessary in order to obtain consistent results.
6. Record your results in a suitable form in the space below.

[6]

(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** for neutralisation.
[1]

(c) You must show your working and appropriate significant figures in the final answer to each step of your calculations.

(i) Calculate the amount, in mol, of sodium hydroxide present in 25.0 cm^3 of **FA 4**.

..... mol

(ii) Calculate the amount, in mol, of hydrochloric acid present in the volume of **FA 3** obtained in **(b)**.

..... mol

(iii) Use your answer to **(c)(ii)** to calculate the amount, in mol, of hydrochloric acid that was present in 1.00 dm^3 of **FA 3.**

..... mol

(iv) **FA 3** was prepared using 250.0 cm^3 of hydrochloric acid with a concentration of 2.00 mol dm^{-3}.

Calculate the amount, in mol, of hydrochloric acid used to prepare **FA 3**.

..... mol

(v) Use the percentage by mass of $MgCO_3$ calculated in **1(b)(iii)** to determine the mass of $MgCO_3$ in 18.0 g of **FA 1**.

If your percentage by mass of $MgCO_3$ calculated in **1(b)(iii)** was greater than 90% then use a value of 81%. Do not assume that this is the correct value.

..... g

(vi) Calculate the amount, in mol, of hydrochloric acid that would react with the mass of $MgCO_3$ calculated in **(c)(v)**.

..... mol

(vii) Use your answers to **(c)(iii)**, **(iv)** and **(vi)** to calculate the amount, in mol, of hydrochloric acid that reacted with the magnesium hydroxide present in 18.0 g of **FA 1**.

..... mol

(viii) Calculate the percentage by mass of magnesium hydroxide in **FA 1**.

..... %
[5]

[Total: 12]

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3 **(a)** **FA 5** and **FA 6** each contain an anion from those listed in the Qualitative Analysis Notes. You will identify the anion present in each salt.

Carry out the following tests and record your observations.

test	observations
(i) To approximately 1 cm depth of **FA 5** in a test-tube, add approximately 1 cm depth of dilute sulfuric acid. **As soon as you have made your observations rinse out the test-tube.**	
(ii) To approximately 1 cm depth of **FA 5** in a test-tube, add a few drops of acidified aqueous potassium manganate(VII). **As soon as you have made your observations rinse out the test-tube.**	
(iii) To approximately 1 cm depth of **FA 5** in a test-tube, add approximately 1 cm depth of **FA 6**, then,	
add one drop of dilute sulfuric acid, then,	
add a few drops of starch solution. **As soon as you have made your observations rinse out the test-tube.**	

[4]

(iv) Carry out a further test to support the identification of the anion in **FA 5**. Record the reagents used and your observations.

test	observations

[2]

(v) Carry out a further test to confirm the identity of the anion in **FA 6**. Record the reagents used and your observations.

test	observations

[2]

(vi) Identify the two anions.

The anion in **FA 5** is ..... .

The anion in **FA 6** is ..... .

[2]

Question 3 continues on page 10.

(b) **FA 7** contains a cation from those listed in the Qualitative Analysis Notes. You will identify the cation present.

Carry out the following tests and record your observations.

test	observations
(i) To approximately 1 cm depth of **FA 7** in a test-tube, add aqueous ammonia.	
(ii) To approximately 1 cm depth of **FA 7** in a test-tube, add a few drops of **FA 5**, then,	
add approximately 1 cm depth of dilute sulfuric acid.	

[4]

(iii) Identify the cation.

The cation in **FA 7** is ..... .

[1]

(iv) Suggest an explanation for the observations you made in **(b)(ii)**.

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[1]

[Total: 16]

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