UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

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|---|---|
| CANDIDATE NAME | |
| CENTRE NUMBER | |
| CANDIDATE NUMBER | |

*4510058189*

**CHEMISTRY** **5070/33**

Paper 3 Practical Test **October/November 2010**

**1 hour 30 minutes**

Candidates answer on the Question Paper

Additional Materials: Instructions to Supervisors

**READ THESE INSTRUCTIONS FIRST**

Write your Centre number, candidate number and name on all the work you hand in.
Write in dark blue or black ink.
You may use a soft pencil for any diagrams, graphs or rough work.
Do not use staples, paper clips, highlighters, glue or correction fluid.
DO **NOT** WRITE IN ANY BARCODES.

Answer **all** questions.
Qualitative Analysis Notes are printed on page 8.
You should show the essential steps in any calculations and record experimental results in the spaces provided on the question paper.

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.

| For Examiner's Use | |
|---|---|
| 1 | |
| 2 | |
| Total | |

This document consists of **6** printed pages and **2** blank pages.

*For Examiner's Use*

**1** A large volume of water has been contaminated with acid. Before the contaminated water can be disposed of, the acid must be neutralised by adding calcium carbonate.

$$CaCO_3 + 2H^+ \rightarrow Ca^{2+} + H_2O + CO_2$$

You are to determine by titration the concentration of hydrogen ions present in the contaminated water and then calculate the mass of calcium carbonate needed to neutralise all the acid.

Solution **P** is a sample of the contaminated water.
Solution **Q** is 0.100 mol/$dm^3$ sodium hydroxide.

**(a)** Put **P** into the burette.

Pipette a 25.0 $cm^3$ (or 20.0 $cm^3$) portion of **Q** into a flask and titrate with **P**, using the indicator provided.

Record your results in the table, repeating the titration as many times as you consider necessary to achieve consistent results.

**Results**

*Burette readings*

| titration number | 1 | 2 | |
|---|---|---|---|
| final reading / $cm^3$ | | | |
| initial reading / $cm^3$ | | | |
| volume of **P** used / $cm^3$ | | | |
| best titration results (✓) | | | |

**Summary**

Tick (✓) the best titration results.

Using these results, the average volume of **P** required was …………… $cm^3$.

Volume of **Q** used was …………… $cm^3$. [12]

 

For Examiner's Use

**(b)** **Q** is 0.100 mol/dm$^3$ sodium hydroxide.

Using your results from **(a)**, calculate the concentration, in mol/dm$^3$, of hydrogen ions in **P**.

concentration of hydrogen ions in **P**………………… mol/dm$^3$ [2]

**(c)** The volume of the contaminated water is 10 000 dm$^3$.
Calculate the number of moles of hydrogen ions in this volume of contaminated water.

moles of hydrogen ions in 10 000 dm$^3$ of **P** ………………… [1]

**(d)** Using your answer from **(c)**, calculate the minimum mass of calcium carbonate needed to neutralise all the acid in 10 000 dm$^3$ of the contaminated water.
[The relative formula mass of calcium carbonate is 100.]

mass of calcium carbonate needed ………………… g [2]

[Total: 17]

**2** Carry out the following experiments on element **R** and solution **S** and record your observations in the table. You should test and name any gas evolved.

*For Examiner's Use*

| test no. | test | observations |
| --- | --- | --- |
| **1** | To 2 cm depth of dilute hydrochloric acid in a test-tube, add a piece of **R** and warm the mixture gently until the reaction begins.<br><br>Once the reaction is complete divide the colourless solution into two equal portions and use them for tests **2** and **3**. | |
| **2** | To one of the portions of the solution from test **1**, add aqueous sodium hydroxide until no further change occurs. | |
| **3** | To the other portion of the solution from test **1**, add aqueous ammonia until no further change occurs. | |
| **4** | **(a)** To 2 cm depth of aqueous sodium hydroxide in a test-tube, add a piece of **R** and warm the mixture gently until reaction begins. Leave until reaction is complete.<br><br>**(b)** To the colourless solution from **(a)** add dilute hydrochloric acid until no further change occurs. | |

*For Examiner's Use*

| test no. | test | observations |
|---|---|---|
| **5** | **(a)** To 2 cm depth of aqueous copper(II) sulfate in a test-tube, add a piece of **R**.<br><br>**(b)** Add a small amount of solid sodium chloride to the mixture from **(a)** and mix well.<br>Leave to stand for a few minutes. | |
| **6** | **(a)** To 1 cm depth of aqueous iron(III) chloride in a test-tube, add a piece of **R**. To the mixture add the same volume of dilute hydrochloric acid. Warm the contents of the tube gently until reaction begins and then leave until reaction is complete.<br><br>**(b)** To a portion of the solution from **(a)** add aqueous sodium hydroxide until no further change occurs. | |
| **7** | To 1 cm depth of **S** in a test-tube add the same volume of aqueous sodium hydroxide. Warm the mixture gently. To the warm mixture add a piece of **R**. | |

[20]

**Conclusions**

Identify the element **R**.

**R** is …………………………

In test **6**, **R** is acting as …………………………

Solution **S** contains a potassium compound.

Identify the anion in **S**.

**S** contains ………………………… [3]

[Total: 23]

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# QUALITATIVE ANALYSIS NOTES

## Tests for anions

| *anion* | *test* | *test result* |
|---|---|---|
| carbonate ($CO_3^{2-}$) | add dilute acid | effervescence, carbon dioxide produced |
| chloride ($Cl^-$) [in solution] | acidify with dilute nitric acid, then add aqueous silver nitrate | white ppt. |
| iodide ($I^-$) [in solution] | acidify with dilute nitric acid, then add aqueous lead(II) nitrate | yellow ppt. |
| nitrate ($NO_3^-$) [in solution] | add aqueous sodium hydroxide then add aluminium foil; warm carefully | ammonia produced |
| sulfate ($SO_4^{2-}$) [in solution] | acidify with dilute nitric acid, then add aqueous barium nitrate | white ppt. |

## Tests for aqueous cations

| *cation* | *effect of aqueous sodium hydroxide* | *effect of aqueous ammonia* |
|---|---|---|
| aluminium ($Al^{3+}$) | white ppt., soluble in excess giving a colourless solution | white ppt., insoluble in excess |
| ammonium ($NH_4^+$) | ammonia produced on warming | – |
| calcium ($Ca^{2+}$) | white ppt., insoluble in excess | no ppt., or very slight white ppt. |
| copper(II) ($Cu^{2+}$) | light blue ppt., insoluble in excess | light blue ppt., soluble in excess giving a dark blue solution |
| iron(II) ($Fe^{2+}$) | green ppt., insoluble in excess | green ppt., insoluble in excess |
| iron(III) ($Fe^{3+}$) | red-brown ppt., insoluble in excess | red-brown ppt., insoluble in excess |
| zinc ($Zn^{2+}$) | white ppt., soluble in excess giving a colourless solution | white ppt., soluble in excess giving a colourless solution |

## Tests for gases

| *gas* | *test and test result* |
|---|---|
| ammonia ($NH_3$) | turns damp litmus paper blue |
| carbon dioxide ($CO_2$) | turns limewater milky |
| chlorine ($Cl_2$) | bleaches damp litmus paper |
| hydrogen ($H_2$) | 'pops' with a lighted splint |
| oxygen ($O_2$) | relights a glowing splint |
| sulfur dioxide ($SO_2$) | turns acidified aqueous potassium dichromate(VI) from orange to green |