Cambridge
O Level

**Cambridge International Examinations**
Cambridge Ordinary Level

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

*1259911352*

**CHEMISTRY** **5070/31**

Paper 3 Practical Test **May/June 2017**

**1 hour 30 minutes**

Candidates answer on the Question Paper.

Additional Materials: As listed in the Confidential Instructions

**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 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.
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.

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CAMBRIDGE
International Examinations

**1** Chlorine water is an aqueous solution of chlorine made by bubbling the gas through water. The amount of chlorine present in the solution can be estimated by reacting the chlorine with aqueous potassium iodide.

$$Cl_2 + 2KI \rightarrow 2KCl + I_2$$

The amount of iodine produced by the above reaction can then be determined by titration with aqueous sodium thiosulfate, $Na_2S_2O_3$, using starch as an indicator.

$$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$$

**P** is an aqueous solution of iodine produced by mixing 50 $cm^3$ of chlorine water with 200 $cm^3$ of aqueous potassium iodide, an excess.

**Q** is 0.0230 mol / $dm^3$ sodium thiosulfate.

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

Pipette a 25.0 $cm^3$ (or 20.0 $cm^3$) portion of **P** into a flask.

Add **Q** from the burette until the red-brown colour fades to pale yellow, **then** add a few drops of the starch indicator. This will give a dark blue solution. Continue adding **Q** slowly from the burette until one drop of **Q** causes the blue colour to disappear, leaving a colourless solution.

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 **Q** used / $cm^3$ | | | |
| best titration results (✓) | | | |

**Summary**

Tick (✓) the best titration results.

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

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

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**(b)** **Q** is 0.0230 mol / $dm^3$ sodium thiosulfate.

Calculate the number of moles of sodium thiosulfate in the average volume of **Q** used in the titration.

moles of sodium thiosulfate .....[1]

**(c)** Using your answer from **(b)**, deduce the number of moles of iodine in the volume of **P** used in the titration.

$$2Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + 2NaI$$

moles of iodine .....[1]

**(d)** Using your answer from **(c)**, calculate the number of moles of iodine in 250 $cm^3$ of **P**.

moles of iodine in 250 $cm^3$ of **P** .....[1]

**(e)** Using your answer from **(d)**, deduce the number of moles of chlorine in 50 $cm^3$ of the chlorine water.

$$Cl_2 + 2KI \rightarrow 2KCl + I_2$$

moles of chlorine in 50 $cm^3$ of the chlorine water .....[1]

**(f)** Using your answer from **(e)**, calculate the mass, in g, of chlorine in 1 $dm^3$ of the chlorine water.
[$A_r$: $Cl$, 35.5]

mass of chlorine in 1 $dm^3$ of the chlorine water ..... g [2]

[Total: 18]

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**[Turn over**

**2** You are provided with two solutions, **R** and **S**.

**(a)** Carry out the following tests and record your observations in the table.

You should test and name any gas evolved.

| test no. | test | observations |
|---|---|---|
| **1** | **(a)** To 1 cm depth of **R** in a test-tube, add an equal volume of aqueous barium nitrate.<br><br>**(b)** To the mixture from **(a)**, add dilute nitric acid. | |
| **2** | To 1 cm depth of **R** in a test-tube, add aqueous ammonia until no further change occurs. | |
| **3** | **(a)** To 1 cm depth of **R** in a boiling tube, add aqueous sodium hydroxide until no further change occurs.<br><br>**(b)** Warm the final mixture from **(a)** in the boiling tube. | |
| **4** | **(a)** To 1 cm depth of **S** in a test-tube, add an equal volume of aqueous silver nitrate.<br><br>**(b)** To the mixture from **(a)**, add dilute nitric acid. | |

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| test no. | test | observations |
|---|---|---|
| **5** | To 1 cm depth of **S** in a test-tube, add aqueous sodium hydroxide until no further change occurs. | |
| **6** | **(a)** To 1 cm depth of **S** in a test-tube, add a small amount of ascorbic acid and mix well.<br><br>**(b)** To the mixture from **(a)**, add aqueous sodium hydroxide until no further change occurs. | |
| **7** | **(a)** To 1 cm depth of **S** in a test-tube, add an equal volume of aqueous potassium iodide.<br><br>**(b)** To the mixture from **(a)**, add 1 or 2 drops of starch indicator. | |

[18]

**(b) Conclusions**

Identify the ions in solution **R**.

Solution **R** contains ..... .

Identify the ion in solution **S** which acts as an oxidising agent in test **7**.

The ion which acts as an oxidising agent is ..... .

[4]

[Total: 22]

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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 silver 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., insoluble in excess dilute nitric acid |

### 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. |
| chromium(III) ($Cr^{3+}$) | green ppt., soluble in excess, giving a green solution | green ppt., insoluble in excess |
| 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 red 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 |

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