UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education Ordinary Level

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

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

Paper 3 Practical Test **October/November 2011**

**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 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.

DC (LEO) 30738/4


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**[Turn over**

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1 The volume of battery acid contained in a car battery is 4.50 $dm^3$. Battery acid is an aqueous solution of sulfuric acid. You are to determine by titration the concentration of the battery acid by titrating a diluted solution of the acid with aqueous sodium hydroxide. You will then calculate the mass of sulfuric acid in the battery.

**P** is dilute sulfuric acid. It has been made by adding water to 10.0 $cm^3$ of battery acid until the volume was 1000 $cm^3$.
**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]

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

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

$$2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$$

concentration of sulfuric acid in **P** .................................. mol/dm$^3$ [2]

**(c)** Using your answer from **(b)** and information given in the question, calculate the concentration of sulfuric acid in battery acid.

concentration of sulfuric acid in battery acid .......................... mol/dm$^3$ [1]

**(d)** Using your answer from **(c)**, calculate the mass of sulfuric acid present in 4.50 dm$^3$ of battery acid.
The relative formula mass of sulfuric acid is 98.

mass of sulfuric acid present in 4.50 dm$^3$ of battery acid .......................... g [1]

[Total: 16]

2 You are provided with solution **R** and solid **S**, both of which contain different compounds of the same metal.

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 2 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 2 cm depth of **R** in a test-tube, add aqueous ammonia solution until no further change occurs. | |
| **3** | **(a)** To 2 cm depth of **R** in a test-tube, add sodium chloride powder with mixing until no more sodium chloride will dissolve.<br><br>**(b)** To the mixture from **(a)**, add aqueous sodium hydroxide until no further change occurs. | |
| **4** | To 2 cm depth of **R** in a test-tube, add a small amount of iron powder and mix well. | |

| test no. | test | observations |
|---|---|---|
| **5** | To 2 cm depth of dilute sulfuric acid in a test-tube, add a small amount of **S**. Gently warm the mixture. | |
| **6** | To 2 cm depth of dilute nitric acid in a test-tube, add a small amount of **S**. Gently warm the mixture. | |
| **7** | **(a)** To 2 cm depth of dilute hydrochloric acid in a test-tube, add a small amount of **S** and mix well for about 30 seconds.<br>**(b)** To the mixture from **(a)**, add aqueous ammonia until no further change occurs. | |
| **8** | **(a)** To 2 cm depth of aqueous hydrogen peroxide in a test-tube, add a small amount of **S**.<br>**(b)** To the mixture from **(a)**, add aqueous ammonia. | |

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[22]

**Conclusions**

Identify the anion in **R**

The anion in **R** is ..........................................................

Identify the metal in **R** and **S**.

The metal in **R** and **S** is .......................................................... [2]

[Total: 24]

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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. |

### 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 |