



**Cambridge International Examinations**  
Cambridge Ordinary Level

CANDIDATE NAME

CENTRE NUMBER 

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CANDIDATE NUMBER 

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**CHEMISTRY** **5070/31**  
Paper 3 Practical Test **May/June 2015**  
**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, graphs or rough work.  
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                  |  |
| <b>Total</b>       |  |

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

- 1 An oxyacid of phosphorus has the formula  $\text{H}_3\text{PO}_3$ .

You are required to find by experiment the number of moles of sodium hydroxide that react with 1 mole of this acid.

**P** is  $0.0984 \text{ mol/dm}^3$  sodium hydroxide.

**Q** is an aqueous solution of the oxyacid of phosphorus,  $\text{H}_3\text{PO}_3$ , containing  $5.04 \text{ g/dm}^3$ .

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

Pipette a  $25.0 \text{ cm}^3$  (or  $20.0 \text{ cm}^3$ ) portion of **P** into a flask and titrate with **Q**, 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 / $\text{cm}^3$           |   |   |  |
| initial reading / $\text{cm}^3$         |   |   |  |
| volume of <b>Q</b> used / $\text{cm}^3$ |   |   |  |
| best titration results (✓)              |   |   |  |

### Summary

Tick (✓) the best titration results.

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

Volume of **P** used was .....  $\text{cm}^3$ .

[12]

(b) **P** is  $0.0984 \text{ mol/dm}^3$  sodium hydroxide.

Calculate the number of moles of sodium hydroxide in the volume of **P** used.

moles of sodium hydroxide in the volume of **P** used .....[1]

(c) **Q** is an aqueous solution of  $\text{H}_3\text{PO}_3$  containing  $5.04 \text{ g/dm}^3$ .

Calculate the concentration, in  $\text{mol/dm}^3$ , of  $\text{H}_3\text{PO}_3$  in **Q**.  
The relative formula mass of  $\text{H}_3\text{PO}_3$  is 82.

concentration of  $\text{H}_3\text{PO}_3$  in **Q** ..... $\text{mol/dm}^3$  [1]

(d) Calculate the number of moles of  $\text{H}_3\text{PO}_3$  in the average volume of **Q** used in the titration.

moles of  $\text{H}_3\text{PO}_3$  .....[1]

(e) Using your answers from (b) and (d), calculate the number of moles of sodium hydroxide which react with 1 mole of  $\text{H}_3\text{PO}_3$ .

moles of sodium hydroxide .....[1]

(f) Using your answer to (e), write an equation for the reaction of the oxyacid of phosphorus,  $\text{H}_3\text{PO}_3$ , with sodium hydroxide.

.....[2]

[Total: 18]

- 2 You are provided with solutions **R** and **S**.  
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        | Gently warm 2 cm depth of <b>R</b> in a test-tube.  |              |
| 2        | To 1 cm depth of aqueous zinc sulfate in a test-tube, add <b>R</b> until no further change occurs.  |              |
| 3        | <p><b>(a)</b> To 1 cm depth of aqueous sodium chloride in a test-tube, add a few drops of aqueous silver nitrate.</p> <p><b>(b)</b> To the mixture from <b>(a)</b>, add <b>R</b> until no further change occurs.</p>          |              |
| 4        | <p><b>(a)</b> To 1 cm depth of aqueous hydrogen peroxide in a test-tube, add an equal volume of <b>R</b>.</p> <p><b>(b)</b> To the mixture from <b>(a)</b>, add a small amount of copper(I) oxide powder. Leave to stand.</p> |              |

| test no. | test  | observations |
|----------|---|--------------|
| 5        | <p>(a) To 1 cm depth of <b>S</b> in a test-tube, add an equal volume of aqueous barium nitrate.</p> <p>(b) To the mixture from (a), add dilute nitric acid.</p>   |              |
| 6        | To 1 cm depth of <b>S</b> in a test-tube, add <b>R</b> until no further change is seen. Allow the final mixture to stand for a few minutes.   |              |
| 7        | <p>(a) To 1 cm depth of <b>S</b> in a boiling tube, add an equal volume of dilute sulfuric acid. Add a small amount of manganese(IV) oxide to the boiling tube. Warm the mixture gently for about 20 seconds, then filter the warm mixture and collect the filtrate.</p> <p>(b) To 1 cm depth of the filtrate from (a) in a test-tube, add <b>R</b> until no further change occurs.</p> |              |

[20]

### Conclusions

Identify the compounds in solutions **R** and **S**.

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

Solution **S** contains .....

[2]

[Total: 22]

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## QUALITATIVE ANALYSIS NOTES

### Tests for anions

| <i>anion</i>                                    | <i>test</i>   | <i>test result</i>                     |
|---|---|--|
| carbonate ( $\text{CO}_3^{2-}$ )                | add dilute acid   | effervescence, carbon dioxide produced |
| chloride ( $\text{Cl}^-$ )<br>[in solution]     | acidify with dilute nitric acid, then add aqueous silver nitrate      | white ppt.                             |
| iodide ( $\text{I}^-$ )<br>[in solution]        | acidify with dilute nitric acid, then add aqueous silver nitrate      | yellow ppt.                            |
| nitrate ( $\text{NO}_3^-$ )<br>[in solution]    | add aqueous sodium hydroxide, then add aluminium foil; warm carefully | ammonia produced                       |
| sulfate ( $\text{SO}_4^{2-}$ )<br>[in solution] | acidify with dilute nitric acid, then add aqueous barium nitrate      | white ppt.                             |

### Tests for aqueous cations

| <i>cation</i>                   | <i>effect of aqueous sodium hydroxide</i>                   | <i>effect of aqueous ammonia</i>                               |
|---------------------------------|---|--|
| aluminium ( $\text{Al}^{3+}$ )  | white ppt., soluble in excess giving a colourless solution  | white ppt., insoluble in excess                                |
| ammonium ( $\text{NH}_4^+$ )    | ammonia produced on warming                                 | –  |
| calcium ( $\text{Ca}^{2+}$ )    | white ppt., insoluble in excess                             | no ppt., or very slight white ppt.                             |
| copper(II) ( $\text{Cu}^{2+}$ ) | light blue ppt., insoluble in excess                        | light blue ppt., soluble in excess giving a dark blue solution |
| iron(II) ( $\text{Fe}^{2+}$ )   | green ppt., insoluble in excess                             | green ppt., insoluble in excess                                |
| iron(III) ( $\text{Fe}^{3+}$ )  | red-brown ppt., insoluble in excess                         | red-brown ppt., insoluble in excess                            |
| zinc ( $\text{Zn}^{2+}$ )       | white ppt., soluble in excess, giving a colourless solution | white ppt., soluble in excess, giving a colourless solution    |

### Tests for gases

| <i>gas</i>                       | <i>test and test result</i>  |
|----------------------------------|--|
| ammonia ( $\text{NH}_3$ )        | turns damp red litmus paper blue   |
| carbon dioxide ( $\text{CO}_2$ ) | turns limewater milky  |
| chlorine ( $\text{Cl}_2$ )       | bleaches damp litmus paper   |
| hydrogen ( $\text{H}_2$ )        | 'pops' with a lighted splint   |
| oxygen ( $\text{O}_2$ )          | relights a glowing splint  |
| sulfur dioxide ( $\text{SO}_2$ ) | turns aqueous acidified potassium manganate(VII) from purple to colourless |

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