| Centre Number | Candidate Number |
|---|---|
| | |

Candidate Name _____

**EXAMINATIONS COUNCIL OF ZAMBIA**

**Examination for School Certificate Ordinary Level**



**stry** **5070/3**

**PAPER 3 Practical Test**

**Monday** **2 NOVEMBER 2015**

Additional materials:

Mathematical tables/Calculator (non-programmable)

**Time: 1 hour 30 minutes**

## Instructions to candidates

Write your **name, centre number and candidate number** in the spaces at the top of this page.

There are **two (2) questions** in this paper. Answer **both** questions.

You should show the essential steps in any calculation and record all experimental results and observations in the spaces provided on the question paper.

If you are using semi-micro methods in Question **2**, you should modify the instructions to suit the size of apparatus and the techniques you are using.

## Information for candidates

The number of marks is shown in brackets [ ] at the end of each question or part question.

Both questions carry 50% of the total marks.

Mathematical tables are available. Non-programmable calculators can be used.

Qualitative Analysis notes for this paper are printed on page **5**.

The Periodic Table is printed on page **6**.

**Cell phones are not allowed in the examination room.**

| FOR EXAMINER'S USE | |
|---|---|
| 1 | |
| 2 | |
| TOTAL | |

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**QUESTION 1**

**VOLUMETRIC ANALYSIS**

**P** is 0.0200 mol/dm$^3$ sodium bromate (v), $NaBrO_3$.

Sodium bromate (v) oxidises acidified potassium iodide, KI, to iodine. The mole ratio for the reaction can be determined by titrating the iodine produced with a solution of Sodium thiosulphate whose concentration is known.

**Q** is 0.125 mol/dm$^3$ sodium thiosulphate.

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

Pipette a 25.0cm$^3$ (or 20.0cm$^3$) portion of **P** into a flask. Add about a test tube full of dilute sulphuric acid followed by about a test tube full of aqueous potassium iodide. The solution should turn red-brown. **Do not add starch indicator at this stage.**

Add **Q** from the burette until the red-brown colour fades to pale yellow, then add a few drops of starch indicator. This will give a deep 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 whole procedure as many times as you consider necessary to achieve consistent results. Tick (✓) the concording values.

Results

Burette readings

| **Titration No.** | **Rough** | **1** | **2** | |
|---|---|---|---|---|
| Final reading /cm$^3$ | | | | |
| Initial reading/cm$^3$ | | | | |
| Volume of **Q** used/cm$^3$ | | | | |
| Best titration (√) | | | | |

**Summary:**

Tick (✓) best titration results.

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

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

**(b)** **Q** is 0.125 mol/dm$^3$ sodium thiosulphate. Using your answer to **(a)**. Calculate the number of moles of sodium thiosulphate in the average volume of **Q**.

Number of moles of sodium thiosulphate is ..... mole. [2]

**(c)** One mole of sodium thiosulphate reacts with one mole of iodine produced by potassium iodide. Using your answer to **(b),** state the number of moles of potassium iodide used in each titration.

Number of moles of potassium iodide used is ..... [2]

**(d)** **P** is 0.0200 mol/dm$^3$ sodium bromate (v). Calculate the number of moles of sodium bromate (v) pipetted for use in each titration.

Number of moles of sodium bromate (v) is ..... [1]

**(e)** Using your answer to **(c)** and **(d),** calculate

$$\frac{\text{the number of moles of potassium iodide}}{\text{the number of moles of sodium bromate (v)}} = \text{.....}$$ [1]

**(f)** Using your answer to **(e),** complete the partial equation below for the reaction of sodium bromated (v) and potassium iodide.

_ $NaBrO_3$ + _ KI + acid $\longrightarrow$ iodine and other products. [2]

**[Total: 20]**

## QUESTION 2

### QUALITATIVE (SALT) ANALYSIS

You are provided with sample **S**. You are to carry out the tests indicated in the table. Record your observations in the table below. **S** contains one cation and one anion both specified in the 5070/3 syllabus.

| Test No. | Test | Observations |
|---|---|---|
| 1 | **(a)** Describe the appearance of **S**.<br>**(b)** To a small portion of **S** add an equal volume of nitric acid. | |
| 2 | **(a)** To a second small portion of **S**, add a few drops of sodium hydroxide until a change is seen.<br>**(b)** To the mixture in **(a)** add excess of sodium hydroxide solution. | |
| 3 | **(a)** To another small portion of **S**, add a few drops of aqueous ammonia.<br>**(b)** To the mixture in **(a)** add an excess of ammonia. | |
| 4 | **(a)** To another portion of **S** add a small portion of sodium carbonate solution.<br>**(b)** To the mixture in **(a)** add a small amount of nitric acid. | |
| 5 | **(a)** To another small portion of **S**, add a small amount of barium nitrate or barium chloride solution.<br>(**b**) To the mixture in **(a)** add a small amount of nitric acid. | |

[17]

**Conclusion**

**1** The formula of cation in solution **S** is .....

**2** The formula of anion in solution **S** is .....

**3** The formular of the salt in solution **S** is ..... [3]

**[Total: 20]**

## NOTES FOR USE IN QUALITATIVE ANALYSIS

### Test 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 aluminium foil; warm carefully | ammonia produced |
| sulphate ($SO_4^{2-}$) [in solution] | acidify with dilute nitric acid, then add aqueous barium nitrate | white ppt. |

### Test 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 |

### Test 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 |
| sulphur dioxide ($SO_2$) | turns aqueous potassium dichromate(VI) green |

# DATA SHEET

## The Periodic Table of the Elements

| Group I | Group II | | | | | | | | | | | Group III | Group IV | Group V | Group VI | Group VII | Group 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | 1 H Hydrogen 1 | | | | | | | | | | 4 He Helium 2 |
| 7 Li Lithium 3 | 9 Be Beryllium 4 | | | | | | | | | | | 11 B Boron 5 | 12 C Carbon 6 | 14 N Nitrogen 7 | 16 O Oxygen 8 | 19 F Fluorine 9 | 20 Ne Neon 10 |
| 23 Na Sodium 11 | 24 Mg Magnesium 12 | | | | | | | | | | | 27 Al Aluminium 13 | 28 Si Silicon 14 | 31 P Phosphorus 15 | 32 S Sulphur 16 | 35.5 Cl Chlorine 17 | 40 Ar Argon 18 |
| 39 K Potassium 19 | 40 Ca Calcium 20 | 45 Sc Scandium 21 | 48 Ti Titanium 22 | 51 V Vanadium 23 | 52 Cr Chromium 24 | 55 Mn Manganese 25 | 56 Fe Iron 26 | 59 Co Cobalt 27 | 59 Ni Nickel 28 | 64 Cu Copper 29 | 65 Zn Zinc 30 | 70 Ga Gallium 31 | 73 Ge Germanium 32 | 75 As Arsenic 33 | 79 Se Selenium 34 | 80 Br Bromine 35 | 84 Kr Krypton 36 |
| 85 Rb Rubidium 37 | 88 Sr Strontium 38 | 89 Y Yttrium 39 | 91 Zr Zirconium 40 | 93 Nb Niobium 41 | 96 Mo Molybdenum 42 | Tc Technetium 43 | 104 Ru Ruthenium 44 | 103 Rh Rhodium 45 | 106 Pd Palladium 46 | 108 Ag Silver 47 | 112 Cd Cadmium 48 | 115 In Indium 49 | 119 Sn Tin 50 | 122 Sb Antimony 51 | 128 Te Tellurium 52 | 127 I Iodine 53 | 131 Xe Xenon 54 |
| 133 Cs Caesium 55 | 137 Ba Barium 56 | 139 La Lanthanum 57 * | 178 Hf Hafnium 72 | 181 Ta Tantalum 73 | 184 W Tungsten 74 | 186 Re Rhenium 75 | 190 Os Osmium 76 | 192 Ir Iridium 77 | 195 Pt Platinum 78 | 197 Au Gold 79 | 201 Hg Mecury 80 | 204 Tl Thallium 81 | 207 Pb lead 82 | 209 Bi Bismuth 83 | Po Polonium 84 | At Astatine 85 | Rn Radon 86 |
| Fr Francium 87 | 226 Ra Radium 88 | 227 Ac Actinium 89 + | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 140 Ce Cerium 58 | 141 Pr Praseodymium 59 | 144 Nd Neodymium 60 | Pm Promethium 61 | 150 Sm Samarium 62 | 152 Eu Europium 63 | 157 Gd Gadolinium 64 | 159 Tb Terbium 65 | 162 Dy Dysprosium 66 | 165 Ho Holmium 67 | 167 Er Erbium 68 | 169 Tm Thulium 69 | 173 Yb Ytterbium 70 | 175 Lu Lutetium 71 |
| 232 Th Thorium 90 | Pa Protactinium 91 | 238 U Uranium 92 | Np Neptunium 93 | Pu Plutonium 94 | Am Americium 95 | Cm Curium 96 | Bk Berkelium 97 | Cf Californium 98 | Es Einsteinium 99 | Fm Fermium 100 | Md Mendelevium 101 | No Nobelium 102 | Lr Lawrencium 103 |

*58-71 Lanthanoid series
+90-103 Actinoid series

Key

| a |
|---|
| X |
| b |

a = relative atomic mass
X = atomic symbol
b = proton (atomic) number

The volume of one mole of any gas is 24 $dm^3$ at room temperature and pressure (r.t.p.).

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