Centre Number	Index Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
Joint Examination for the School Certificate
and General Certificate of Education Ordinary Level

CHEMISTRY **5070/03**

Paper 3 Practical Test

October/November 2004

1 hour 30 minutes

Candidates answer on the Question Paper.
Additional Materials: as listed in Instructions to Supervisors

READ THESE INSTRUCTIONS FIRST

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

Answer **both** questions.
Write your answers in the spaces provided on the question paper.
You should show the essential steps in any calculation and record all experimental results 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.
The number of marks is given in brackets [ ] at the end of each question or part question.
Qualitative Analysis notes are printed on page 8.

If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

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1	
2	
TOTAL	

This document consists of **8** printed pages.

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1 Solution **P** was prepared by dissolving 3.30 g of a compound $M\mathrm{IO_3}$ in 1.00 dm^3 of wat acidified solution of $M\mathrm{IO_3}$ oxidises potassium iodide to iodine which can be titrated sodium thiosulphate.

$$M\mathrm{IO_3} + 5\mathrm{I^-} + 6\mathrm{H^+} \longrightarrow M^+ + 3\mathrm{I_2} + 3\mathrm{H_2O}$$

$$\mathrm{I_2} + 2\mathrm{S_2O_3}^{2-} \longrightarrow 2\mathrm{I^-} + \mathrm{S_4O_6}^{2-}$$

You are to determine the relative molecular mass of $M\mathrm{IO_3}$ and hence identify M.

Q is 0.100 mol/dm^3 sodium thiosulphate.

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

Pipette a 25.0 cm^3 (or 20.0 cm^3) portion of **P** into a flask and add about a test-tubeful of dilute sulphuric acid followed by about a test-tubeful of aqueous potassium iodide. The solution should turn red-brown. **Do not add the 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 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 solution **P** used was .... cm^3. [12]

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(b) **Q** is 0.100 mol/dm^3 sodium thiosulphate.
One mole of $M\mathrm{IO_3}$ reacts with potassium iodide to produce iodine. The iodine produced reacts with six moles of sodium thiosulphate.
Calculate the concentration, in mol/dm^3, of $M\mathrm{IO_3}$ in solution **P**.

Concentration of $M\mathrm{IO_3}$ in **P** is .... mol/dm^3. [2]

(c) **P** contains 3.30 g/dm^3 $M\mathrm{IO_3}$.
Using your answer to **(b)**, calculate the relative molecular mass of $M\mathrm{IO_3}$.

Relative molecular mass of $M\mathrm{IO_3}$ is .... [1]

(d) Using your answer to **(c)**, and the Periodic Table provided on page 5, calculate the relative atomic mass of *M*.

Relative atomic mass of *M* is .... [1]

(e) Using your answer to **(d)** and the Periodic Table suggest an identity for the metal *M*.

Question 2 starts on page 6.

DATA SHEET
The Periodic Table of the Elements

Group

I	II											III	IV	V	VI	VII	0
							1 **H** Hydrogen 1										4 **He** Helium 2
7 **Li** Lithium	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	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** otassium	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** ubidium	88 **Sr** Strontium 38	89 **Y** Yttrium 39	91 **Zr** Zirconium 40	93 **Nb** Niobium 41	96 **Mo** Molybdenum 42	**Tc** Technetium 43	101 **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	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** Mercury 80	204 **Tl** Thallium 81	207 **Pb** Lead 82	209 **Bi** Bismuth 83	**Po** Polonium 84	**At** Astatine 85	**Rn** Radon 86
Fr rancium	226 **Ra** Radium 88	227 **Ac** Actinium 89 †															

3-71 Lanthanoid series
0-103 Actinoid series

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** Lawr 103

y

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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2 You are provided with solutions **R**, **S** and **T** which contain the same anion. Carry [...] following experiments on each solution and record your observations in the table. You sh[...] test and name any gas evolved.

Test no.	Test	Observations with solution **R**
1	**(a)** To a portion of the solution, add aqueous sodium hydroxide until a change is seen. **(b)** Add excess aqueous sodium hydroxide to the mixture from **(a)**. **(c)** To a portion of the mixture from **(b)** in a **boiling tube,** add an equal volume of aqueous hydrogen peroxide.	
2	**(a)** To a portion of the solution, add aqueous ammonia until a change is seen. **(b)** Add excess aqueous ammonia to the mixture from **(a)**.	
3	**(a)** To a portion of solution **R**, add aqueous barium nitrate and leave the mixture to stand for a few minutes. **(b)** Add nitric acid to the mixture from **(a)**.	
4	**(a)** To a portion of solution **R**, add aqueous silver nitrate and leave the mixture to stand for a few minutes. **(b)** Add nitric acid to the mixture from **(a)**.	

Conclusions

The anion (negative ion) present in **R** is ....

[1]

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Observations with solution **S**	Observations with solution **T**	Test no.
		1
		2
DO NOT CARRY OUT		**3**
THESE TESTS FOR **S** AND **T**.		**4**

[22]

CHEMISTRY PRACTICAL 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 aluminium foil; warm carefully	ammonia produced
sulphate (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 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