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.

For Examiner's Use	
1	
2	
TOTAL	

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

1 Solution **P** was prepared by dissolving 3.30 g of a compound MIO_3 in 1.00 dm^3 of water. An acidified solution of MIO_3 oxidises potassium iodide to iodine which can be titrated with sodium thiosulphate.

$$MIO_3 + 5I^- + 6H^+ \longrightarrow M^+ + 3I_2 + 3H_2O$$

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

You are to determine the relative molecular mass of MIO_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]

(b) **Q** is 0.100 mol/dm^3 sodium thiosulphate.
One mole of $M\text{IO}_3$ 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 $M\text{IO}_3$ in solution **P**.

Concentration of $M\text{IO}_3$ in **P** is ..... mol/dm^3. [2]

(c) **P** contains 3.30 g/dm^3 $M\text{IO}_3$.
Using your answer to **(b)**, calculate the relative molecular mass of $M\text{IO}_3$.

Relative molecular mass of $M\text{IO}_3$ 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*.

Metal *M* is ..... [1]

[Turn over

Question 2 starts on page 6.

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	43 Tc Technetium	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 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 Mercury 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 = 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.).

2 You are provided with solutions **R**, **S** and **T** which contain the same anion. Carry out the following experiments on each solution and record your observations in the table. You should 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]

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