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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.

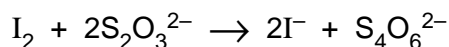
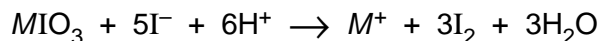
Stick your personal label here, if provided.

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1	
2	
TOTAL	

This document consists of 8 printed pages.



- 1 Solution **P** was prepared by dissolving 3.30 g of a compound MIO_3 in 1.00 dm³ of water. An acidified solution of MIO_3 oxidises potassium iodide to iodine which can be titrated with sodium thiosulphate.



You are to determine the relative molecular mass of MIO_3 and hence identify M .

Q is 0.100 mol/dm³ sodium thiosulphate.

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

Pipette a 25.0 cm³ (or 20.0 cm³) 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 cm³.

Volume of solution **P** used was cm³.

[12]

- (b) **Q** is 0.100 mol/dm^3 sodium thiosulphate.
One mole of MIO_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 MIO_3 in solution **P**.

Concentration of MIO_3 in **P** is mol/dm^3 . [2]

- (c) **P** contains 3.30 g/dm^3 MIO_3 .
Using your answer to (b), calculate the relative molecular mass of MIO_3 .

Relative molecular mass of MIO_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

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									
7 Li Lithium 3	9 Be Beryllium 4										
23 Na Sodium 11	24 Mg Magnesium 12	11 B Boron 5	12 C Carbon 6	13 Al Aluminium 13	14 Si Silicon 14	15 P Phosphorus 15	16 S Sulphur 16	17 Cl Chlorine 17	18 Ar Argon 18	19 F Fluorine 9	20 Ne Neon 10
39 K Potassium 19	40 Ca Calcium 20	27 Co Cobalt 27	28 Ni Nickel 28	29 Cu Copper 29	30 Zn Zinc 30	31 Ga Gallium 31	32 Ge Germanium 32	33 As Arsenic 33	34 Se Selenium 34	35 Br Bromine 35	36 Kr Krypton 36
85 Rb Rubidium 37	88 Sr Strontium 38	55 Mn Manganese 25	56 Fe Iron 26	57 Co Cobalt 27	58 Ni Nickel 28	59 Co Cobalt 27	60 Ni Nickel 28	61 Cd Cadmium 48	62 Ag Silver 47	63 Pd Palladium 46	64 Cu Copper 29
133 Cs Caesium 55	137 Ba Barium 56	52 Cr Chromium 24	53 Mn Manganese 25	54 Fe Iron 26	55 Mn Manganese 25	56 Fe Iron 26	57 Co Cobalt 27	58 Ni Nickel 28	59 Co Cobalt 27	60 Ni Nickel 28	61 Cd Cadmium 48
		51 V Vanadium 23	52 Cr Chromium 24	53 Mn Manganese 25	54 Fe Iron 26	55 Mn Manganese 25	56 Fe Iron 26	57 Co Cobalt 27	58 Ni Nickel 28	59 Co Cobalt 27	60 Ni Nickel 28
		48 Ti Titanium 22	49 V Vanadium 23	50 Cr Chromium 24	51 Mn Manganese 25	52 Fe Iron 26	53 Mn Manganese 25	54 Fe Iron 26	55 Mn Manganese 25	56 Fe Iron 26	57 Co Cobalt 27
		45 Sc Scandium 21	46 Ti Titanium 22	47 V Vanadium 23	48 Cr Chromium 24	49 Mn Manganese 25	50 Fe Iron 26	51 Co Cobalt 27	52 Ni Nickel 28	53 Co Cobalt 27	54 Ni Nickel 28
		89 Y Yttrium 39	90 Zr Zirconium 40	91 Nb Niobium 41	92 Mo Molybdenum 42	93 Tc Technetium 43	94 Ru Ruthenium 44	95 Rh Rhodium 45	96 Pd Palladium 46	97 Ag Silver 47	98 Cd Cadmium 48
		139 La Lanthanum 57	140 Ce Cerium 58	141 Pr Praseodymium 59	142 Nd Neodymium 60	143 Pm Promethium 61	144 Nd Neodymium 60	145 Pm Promethium 61	146 Sm Samarium 62	147 Eu Europium 63	148 Gd Gadolinium 64
		178 Hf Hafnium 72	179 Ta Tantalum 73	180 W Tungsten 74	181 Re Rhenium 75	182 Os Osmium 76	183 Ir Iridium 77	184 Pt Platinum 78	185 Au Gold 79	186 Hg Mercury 80	187 Tl Thallium 81
		226 Ra Radium 88	227 Ac Actinium 89	192 Os Osmium 76	193 Ir Iridium 77	194 Pt Platinum 78	195 Au Gold 79	196 Hg Mercury 80	197 Tl Thallium 81	198 Pb Lead 82	199 Bi Bismuth 83
		208 Pb Lead 82	209 Bi Bismuth 83	210 Po Polonium 84	211 At Astatine 85	212 Rn Radon 86	213 Fr Francium 87	214 Ra Radium 88	215 Ac Actinium 89	216 Th Thorium 90	217 Pa Protactinium 91
		131 Xe Xenon 54	132 Fr Francium 87	133 Cs Caesium 55	134 Ba Barium 56	135 La Lanthanum 57	136 Ce Cerium 58	137 Pr Praseodymium 59	138 Nd Neodymium 60	139 Pm Promethium 61	140 Sm Samarium 62
		127 I Iodine 53	128 Te Tellurium 52	129 Sb Antimony 51	130 Sn Tin 50	131 Pb Lead 82	132 Bi Bismuth 83	133 Po Polonium 84	134 At Astatine 85	135 Rn Radon 86	136 Fr Francium 87
		175 Lu Lutetium 71	176 Yb Ytterbium 70	177 Lu Lutetium 71	178 Yb Ytterbium 70	179 Lu Lutetium 71	180 Yb Ytterbium 70	181 Lu Lutetium 71	182 Yb Ytterbium 70	183 Lu Lutetium 71	184 Yb Ytterbium 70
		103 Lr Lawrencium 103	104 No Nobelium 102	105 Lr Lawrencium 103	106 No Nobelium 102	107 Lr Lawrencium 103	108 No Nobelium 102	109 Lr Lawrencium 103	110 No Nobelium 102	111 Lr Lawrencium 103	112 No Nobelium 102

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

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

Key

The volume of one mole of any gas is 24 dm³ 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	<p>(a) To a portion of the solution, add aqueous sodium hydroxide until a change is seen.</p> <p>(b) Add excess aqueous sodium hydroxide to the mixture from (a).</p> <p>(c) To a portion of the mixture from (b) in a boiling tube, add an equal volume of aqueous hydrogen peroxide.</p>	
2	<p>(a) To a portion of the solution, add aqueous ammonia until a change is seen.</p> <p>(b) Add excess aqueous ammonia to the mixture from (a).</p>	
3	<p>(a) To a portion of solution R, add aqueous barium nitrate and leave the mixture to stand for a few minutes.</p> <p>(b) Add nitric acid to the mixture from (a).</p>	
4	<p>(a) To a portion of solution R, add aqueous silver nitrate and leave the mixture to stand for a few minutes.</p> <p>(b) Add nitric acid to the mixture from (a).</p>	

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

<i>anion</i>	<i>test</i>	<i>test result</i>
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

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
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

<i>gas</i>	<i>test and test result</i>
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

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