UNIVER	General Ce	GE INTERNATIONAL EXAMINATIONS ertificate of Education ry Level and Advanced Level
CHEMISTR	Y	9701/03
Paper 3 Pra	ctical Test	October/November 2004
		1 hour 15 minutes
	swer on the Question Pa rials: As listed in the Ins	per. structions to Supervisors.
Write in dark blue or bla You may use a soft per Do not use staples, pap Answer all questions. At the end of the exami	ack pen in the spaces pr icil for any diagrams, gra per clips, highlighters, glu nation, fasten all your w s given in brackets [] at w all working in calculati	ue or correction fluid. ork securely together. the end of each question or part question.
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In the presence of acid, the oxidant **X** oxidises iodide ions to iodine.

1 mole of \boldsymbol{X} produces 3 moles of iodine, I_2

The iodine liberated can then be titrated with thiosulphate ions, $S_2O_3^{2-}$, to reduce the iodine back to iodide.

$$2Na_2S_2O_3(aq) + I_2(aq) \rightarrow Na_2S_4O_6(aq) + 2NaI(aq)$$

You are to determine the relative molecular mass of the oxidant **X**.

(a) Pipette 25.0 cm³ of FA 2 into a conical flask. Use the measuring cylinder provided to add an excess of iodide ions (approximately 10 cm³ of FA 3), and 10 cm³ of sulphuric acid, FA 4.

Titrate the iodine produced in the conical flask with **FA 1**. As the titration proceeds the colour of the iodine in solution will diminish. The end-point is reached when the colour disappears and the solution becomes colourless.

There is no need to add starch indicator to find the end-point.

Record your results in Table 1.1.

Repeat the titration as many times as you think necessary to obtain accurate results.

Make certain that the recorded results show the precision of your practical work.

final burette reading/cm ³		
initial burette reading/cm ³		
volume of FA 1 used/cm ³		

[2] + [6]

Summary

 25.0 cm^3 of **FA 2** produced sufficient iodine to react with cm³ of **FA 1**.

Show which results you used to obtain this volume of **FA 1** by placing a tick (\checkmark) under the readings in Table 1.1.

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[2]

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(b) Calculate how many moles of sodium thiosulphate, $Na_2S_2O_3$, were run from the

You are advised to show full working in all parts of the calculations.

burette during the titration. [*A*_r: Na, 23.0; S, 32.1; O, 16.0.] **2 FA 5** contains **two cations** and **one anion** from the following list: $(Al^{3+}, NH_4^+, Ba^{2+}, Ca^{2+}, Cr^{3+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Pb^{2+}, Mg^{2+}, Mn^{2+}, Zn^{2+}; CO_3^{2-}, CrO_4^{2-}, Cl^-, Br^-, I^-, NO_3^{--}, NO_2^{--}, SO_4^{-2-}, SO_3^{-2-}).$

In all tests, the reagent should be added gradually, with shaking after each addition. Record your observations in the spaces provided.

Your answers should include

- details of colour changes and precipitates formed,
- the names of gases evolved and details of the test used to identify each one.

You should indicate clearly at what stage in a test a change occurs.

Marks are **not** given for chemical equations.

No additional or confirmatory tests for ions present should be attempted.

Candidates are reminded that definite deductions may be made from tests where there appears to be no reaction.

	Test	Observations [7]
(a)	To 2 cm depth of FA 5 in a test-tube, add 1 cm depth of aqueous silver nitrate. Leave the mixture to stand and continue with tests (b) to (e) .	
(b)	To 2 cm depth of FA 5 in a boiling-tube, add 4 cm depth of aqueous sodium hydroxide. Stir thoroughly with the glass rod provided. Filter the mixture and retain the filtrate for tests (c) , (d) and (e) .	
	Observe the residue in the filter paper after it has been exposed to the air for a few minutes.	
(c)	To 1 cm depth of the filtrate from (b) in a test-tube, add 2 cm depth of dilute nitric acid followed by aqueous silver nitrate.	
(d)	To 1 cm depth of the filtrate from (b) in a test-tube, add 2 cm depth of dilute hydrochloric acid followed by aqueous barium chloride.	

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	Test	Observations
(e)	Place 1 cm depth of the filtrate from (b) in a boiling-tube and warm the tube gently. Take care as a solution containing sodium hydroxide may 'bump' on heating and eject hot corrosive sodium hydroxide.	
(f)	Observe the mixture left to stand in test (a) .	
	Use a teat pipette to remove the solution from the precipitate formed, then add 2 cm depth of distilled water to wash the precipitate. Allow the precipitate to settle and again use a teat pipette to remove the solution. Dissolve the solid in 2 cm depth of dilute aqueous nitric acid. You may need to	
	cautiously warm the mixture. Use this solution in the test below.	
	Add dilute hydrochloric acid to the solid dissolved in nitric acid.	
	Use the information in the Qualitative Analy present in FA 5 .	rsis Tables on pages 6 and 7 to identify the ions
-	The cations present in FA 5 are	and
-	The anion present in FA 5 is	[1
١	Which observations support your choice of t	these ions?

[Total: 10]

......[1]

.....

......[1]

What is the identity of the solid formed and dissolved in test (f)? Give a reason.

QUALITATIVE ANALYSIS NOTES

[Key: ppt. = precipitate]

1 Reactions of aqueous cations

ion	reaction with			
ION	NaOH(aq)	NH ₃ (aq)		
aluminium,	white ppt.	white ppt.		
Al ³⁺ (aq)	soluble in excess	insoluble in excess		
ammonium, NH ₄ ⁺ (aq)	ammonia produced on heating			
barium, Ba ²⁺ (aq)	no ppt. (if reagents are pure)	no ppt.		
calcium, Ca ²⁺ (aq)	white ppt. with high [Ca ²⁺ (aq)]	no ppt.		
chromium(III),	grey-green ppt. soluble in excess	grey-green ppt.		
Cr ³⁺ (aq)	giving dark green solution	insoluble in excess		
copper(II), Cu ²⁺ (aq)	pale blue ppt. insoluble in excess	blue ppt. soluble in excess giving dark blue solution		
iron(II),	green ppt.	green ppt.		
Fe ²⁺ (aq)	insoluble in excess	insoluble in excess		
iron(III),	red-brown ppt.	red-brown ppt.		
Fe ³⁺ (aq)	insoluble in excess	insoluble in excess		
lead(II),	white ppt.	white ppt.		
Pb ²⁺ (aq)	soluble in excess	insoluble in excess		
magnesium,	white ppt.	white ppt.		
Mg ²⁺ (aq)	insoluble in excess	insoluble in excess		
manganese(II),	off-white ppt.	off-white ppt.		
Mn ²⁺ (aq)	insoluble in excess	insoluble in excess		
zinc,	white ppt.	white ppt.		
Zn ²⁺ (aq)	soluble in excess	soluble in excess		

[Lead(II) ions can be distinguished from aluminium ions by the insolubility of lead(II) chloride.]

2 Reactions of anions

ion	reaction
carbonate, CO ₃ ²⁻	CO ₂ liberated by dilute acids
chromate(VI), CrO ₄ ²⁻ (aq)	yellow solution turns orange with H ⁺ (aq); gives yellow ppt. with Ba ²⁺ (aq); gives bright yellow ppt. with Pb ²⁺ (aq)
chloride, C <i>l</i> [_] (aq)	gives white ppt. with Ag ⁺ (aq) (soluble in NH ₃ (aq)); gives white ppt. with Pb ²⁺ (aq)
bromide, Br⁻(aq)	gives cream ppt. with Ag ⁺ (aq) (partially soluble in NH ₃ (aq)); gives white ppt. with Pb ²⁺ (aq)
iodide, I ⁻ (aq)	gives yellow ppt. with Ag ⁺ (aq) (insoluble in NH ₃ (aq)); gives yellow ppt. with Pb ²⁺ (aq)
nitrate, NO ₃ [–] (aq)	NH_3 liberated on heating with $OH^-(aq)$ and Al foil
nitrite, NO ₂ ⁻ (aq)	NH ₃ liberated on heating with OH ⁻ (aq) and A <i>l</i> foil, NO liberated by dilute acids (colourless NO \rightarrow (pale) brown NO ₂ in air)
sulphate, SO ₄ ^{2–} (aq)	gives white ppt. with Ba ²⁺ (aq) or with Pb ²⁺ (aq) (insoluble in excess dilute strong acid)
sulphite, SO ₃ ^{2–} (aq)	SO ₂ liberated with dilute acids; gives white ppt. with Ba ²⁺ (aq) (soluble in excess dilute strong acid)

3 Tests for gases

gas	test and test result	
ammonia, NH ₃	turns damp red litmus paper blue	
carbon dioxide, CO ₂	gives a white ppt. with limewater (ppt. dissolves with excess CO ₂)	
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 potassium dichromate(VI) (aq) from orange to green	

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