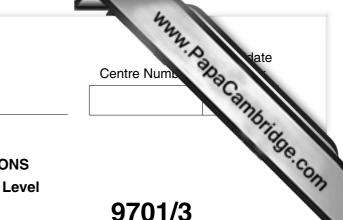
Candidate Name



CAMBRIDGE INTERNATIONAL EXAMINATIONS General Certificate of Education Advanced Level

CHEMISTRY PAPER 3 Practical Test 9701/3

OCTOBER/NOVEMBER SESSION 2002

1 hour 15 minutes

Candidates answer on the question paper. Additional materials: As listed in Instructions to Supervisors Electronic calculator and/or Mathematical tables

TIME 1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

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

Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

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

You may use a calculator.

You are advised to show all working in calculations.

Use of a Data Booklet is unnecessary.

Qualitative analysis notes are printed on pages 6 and 7.

FOR EXAMINER'S USE		
1		
2		
TOTAL		

1 **FA 1** is a hydrated metal sulphate, $XSO_4.7H_2O$.

www.papacambridge.com You are required to determine the mass of water of crystallisation (the 7H₂O in the formula above) in a weighed sample of FA 1 and to calculate the relative atomic mass, A, of the element X.

(a) Accurately weigh the hard glass test-tube provided. Record the mass in Table 1.1 below.

Add to the test-tube between 2.00 g and 2.50 g of **FA 1** and accurately weigh the testtube and contents. Record this mass in Table 1.1 below.

Mass of test-tube + FA 1	/ g
Mass of empty test-tube	/ g
Mass of FA 1	/ g

(b) Heat the test-tube, gently at first then strongly, to drive off the water of crystallisation. The crystals will 'crackle' at first as water is lost and 'steam' (condensed water vapour) will be seen coming out of the mouth of the tube.

If the crystals are overheated the sulphate can decompose and give off sulphur trioxide which will be seen as white fumes. If you see white fumes, do not confuse this with steam, stop heating.

Place the test-tube on a heat proof mat and leave to cool. Do not move about the laboratory with a hot test-tube.

(You are advised to continue with the second question while the tube cools.)

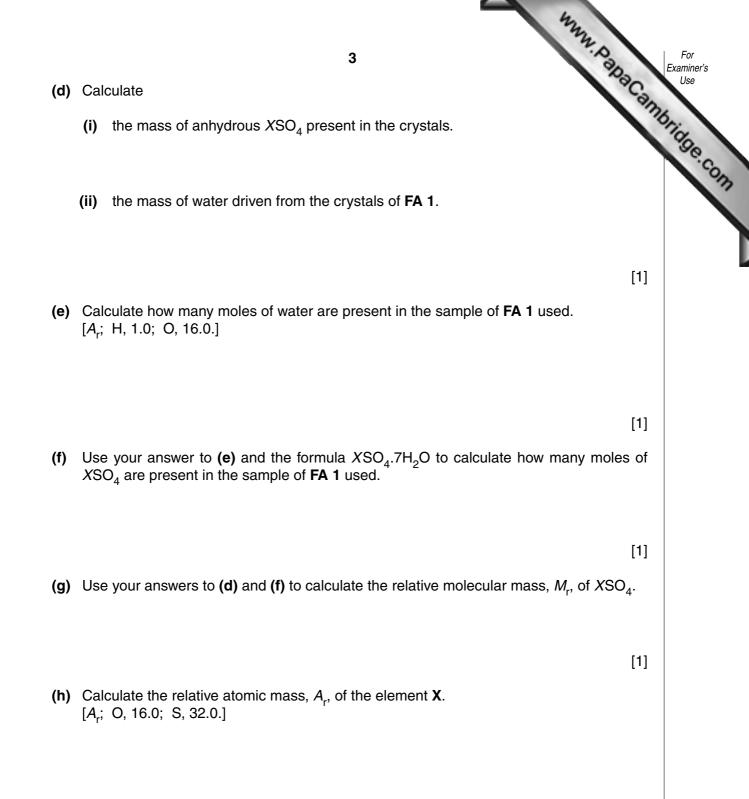
When cool, reweigh the test-tube and its contents. Record the mass in Table 1.2 below.

Mass of test-tube + FA 1 after heating	/ g	
Mass of empty test-tube (from Table 1.1)	/ g	
Mass of FA 1 after heating	/ g	

Table 1.2	Mass of FA 1 after heating
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(c) By repeating the heating, cooling and reweighing, show clearly by your results in Table 1.2 that all the water of crystallisation has been driven from the crystals, FA 1.

[4]



[1]

[Total : 15]

2 The solution FA 2 contains two cations and two anions from the following list: (Al^3) Ba²⁺, Ca²⁺, Cr³⁺, Cu²⁺, Fe²⁺, Fe³⁺, Pb²⁺, Mg²⁺, Mn²⁺, Zn²⁺; CO₃²⁻, CrO₄²⁻, Cl⁻, Br NO₃⁻, NO₂⁻, SO₄²⁻, SO₃²⁻).

www.papaCambridge.com In all tests, the reagent should be added gradually until no further change is observed, with shaking after each addition.

Record your observations and the deductions you make from them 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, writing any deductions you make alongside the observations on which they are based.

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 [5]	Deductions [4]
(a)	Place 3 cm depth of FA 2 in a boiling-tube, add an equal depth of dilute aqueous sodium hydroxide. Cautiously warm the tube.		
(b)	Filter the mixture from (a) and collect the filtrate. Leave the residue in the filter paper and observe it again after several minutes.		
(c)	Place 2 cm depth of the filtrate from (b) in a test- tube and add dilute nitric acid, drop by drop, until no further change is seen.		

	5	A.D.
Test	Observations	Deductions
Place 2 cm depth of the filtrate from (b) in a boiling-tube. Add a piece of aluminium foil.		Deductions
Cautiously warm the tube.		
Place 3 cm depth of FA 2 in a test-tube, add an equal depth of dilute aqueous ammonia.		
Cautiously warm the tube.		
Filter the mixture. Add dilute nitric acid, drop by drop, to the filtrate until no further change is seen.		
Place 2 cm depth of FA 2 in a test-tube, add dilute hydrochloric acid,		
followed by aqueous barium chloride.		
Place 2 cm depth of FA 2 in a test-tube, add dilute nitric acid,		
followed by aqueous silver nitrate.		

Summary

The cations present in FA 2 are and

The anions in FA 2 are and

[1]

[Total : 10]

QUALITATIVE ANALYSIS NOTES

Reactions of aqueous cations 1

		Mar .	
6 EVALITATIVE ANALYSIS NOTES Key: ppt. = precipitate.] Reactions of aqueous cations reaction with			
Key: ppt. = precipitat	e.]	1011	
Reactions of ac	ueous cations		
	reaction w	vith	
	NaOH(aq)	NH ₃ (aq)	
aluminium, Al ³⁺ (aq)	white ppt. soluble in excess	white ppt. 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), Cr ³⁺ (aq)	grey-green ppt. soluble in excess giving dark green solution	grey-green ppt. 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), Fe ²⁺ (aq)	green ppt. insoluble in excess	green ppt. insoluble in excess	
iron(III), Fe ³⁺ (aq)	red-brown ppt. insoluble in excess	red-brown ppt. insoluble in excess	
lead(II), Pb ²⁺ (aq)	white ppt. soluble in excess	white ppt. insoluble in excess	
magnesium, Mg ²⁺ (aq)	white ppt. insoluble in excess	white ppt. insoluble in excess	
manganese(II), Mn ²⁺ (aq)	off-white ppt. insoluble in excess	off-white ppt. insoluble in excess	
zinc, Zn ²⁺ (aq)	white ppt. soluble in excess	white ppt. soluble in excess	
		1	

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

2 **Reactions of anions**

	reaction CO2 liberated by dilute acids yellow solution turns orange with H ⁺ (aq);
2 Reactions of ar	nions
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, Cl ⁻ (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)	$\begin{array}{l} NH_3 \text{ liberated on heating with OH}^-(aq) \text{ and } Al \text{ foil,} \\ NO \text{ liberated by dilute acids} \\ (colourless \ NO \to (pale) \text{ brown } NO_2 \text{ in air}) \end{array}$
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)

Tests for gases 3

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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