Centre Number	Candidate Number	Name

UNIVERSITY OF CAMBRIDGE INTERNATIONAL EXAMINATIONS
General Certificate of Education
Advanced Subsidiary Level and Advanced Level

CHEMISTRY **9701/03**

Paper 3 Practical Test

May/June 2006

1 hour 15 minutes

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

READ THESE INSTRUCTIONS FIRST

Write your details, including practical session and laboratory where appropriate, in the boxes provided.
Write in dark blue or black pen.
You may use a soft pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, highlighters, glue or correction fluid.

Answer **all** questions.
You are advised to show all working in calculations.
Use of a Data Booklet is unnecessary.
Tests for gases are provided on page 8.
You may use a calculator.
At the end of the examination, fasten all your work securely together.
The number of marks is given in brackets [ ] at the end of each question or part question.

SESSION
LABORATORY

For Examiner's Use	
1	
2	
TOTAL	

This document consists of **7** printed pages and **1** blank page.

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1 **FA 1** is an aqueous bleach named 'Superclean'.
FA 2 is a solution containing 19.78 g dm^{-3} of sodium thiosulphate, $Na_2S_2O_3$.

You are also provided with:
aqueous potassium iodide, KI,
1.0 mol dm^{-3} sulphuric acid, H_2SO_4,
starch indicator solution,
distilled water.

Many commercial bleaches contain compounds of chlorine as the 'active ingredient'. They are able to displace iodine from aqueous potassium iodide. This iodine can be titrated against sodium thiosulphate to determine the *'free chlorine'* concentration for the bleach. You are to determine the *'free chlorine'* concentration in 'Superclean'.

(a) Dilution of 'Superclean'

Pipette 25.0 cm^3 of **FA 1** into the 250 cm^3 graduated flask, labelled **FA 3**. Make the solution up to 250 cm^3 with distilled water and mix the solution thoroughly.
This solution is **FA 3**.

(b) Titration of iodine produced on reacting FA 3 with an excess of iodide ions

Rinse the 25 cm^3 pipette used in **(a)**, firstly with water and then with **FA 3**. Pipette 25.0 cm^3 of **FA 3** into a conical flask and, using a measuring cylinder, add to the flask 10 cm^3 of aqueous potassium iodide and 10 cm^3 of 1.0 mol dm^{-3} sulphuric acid.

Fill the burette with **FA 2** and titrate the displaced iodine until the colour of the solution becomes pale yellow. Then add 1 cm^3 of starch indicator solution. Swirl the flask to mix the indicator and solution, then continue the titration until the blue colour of the starch/iodine complex disappears, leaving a colourless solution. This is the end-point.

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.

Table 1.1 Titration of liberated iodine with FA 2

final burette reading / cm^3				
initial burette reading / cm^3				
volume of **FA 2** used / cm^3				

[7]

Summary

25.0 cm^3 of **FA 3** displaced iodine that reacted with ..... cm^3 of **FA 2**.

Show which results you used to obtain this volume of **FA 2** by placing a tick (✓) under the readings in Table 1.1.

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

(c) Calculate how many moles of sodium thiosulphate, $Na_2S_2O_3$, were run from the burette during the titration.
[A_r: Na, 23.0; S, 32.1; O, 16.0]

[2]

(d) Calculate how many moles of iodine, I_2, were present in the conical flask after **FA 3** reacted with an excess of iodide ions.

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

[1]

(e) 1 mol of iodine is displaced by 1 mol of *'free chlorine'*.

$$Cl_2(aq) + 2I^-(aq) \longrightarrow 2Cl^-(aq) + I_2(aq)$$

Calculate the *'free chlorine'* concentration, in mol dm^{-3}, of **FA1**, the bleach 'Superclean'.

[3]

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[Turn over

(f) The *'free chlorine'* concentration of a second bleach, 'Germfree', is found by the same method.

50.0 cm^3 of 'Germfree' is pipetted into a 250 cm^3 graduated flask and the solution made up to 250 cm^3 with distilled water. The *'free chlorine'* concentration in the diluted solution is found to be 0.082 mol dm^{-3}.

Calculate the *'free chlorine'* concentration, in mol dm^{-3}, in 'Germfree'.

[1]

(g) The cost of each bleach is as follows.

'Superclean' \$2.80 dm^{-3} 'Germfree' \$1.80 dm^{-3}

Use the data above and your answers to **(e)** and **(f)** to show which of the bleaches is better value for money.

[1]

[Total: 15]

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2 You are provided with four aqueous solutions, **FA 4**, **FA 5**, **FA 6** and **FA 7**.

Each solution contains one of the following.

an alcohol
an aldehyde
a carboxylic acid
a ketone

You are to perform the tests below and from the results establish which type of organic compound is contained in each of **FA 4**, **FA 5**, **FA 6** and **FA 7**.

After each test discard the contents of the tubes into the 250 cm^3 beaker, labelled organic waste. Rinse and re-use the tubes for the remaining tests.

Tests for gases are printed on page 8.

Record your results in the table on page 7. Where no reaction has taken place, write 'no change' in the appropriate box in the table.

test (a)	Place 1 cm depth of each of the solutions **FA 4**, **FA 5**, **FA 6** and **FA 7** into separate test-tubes. To each tube add a small quantity of magnesium powder or turnings. Identify any gas given off and record the test you used to make the identification.
test (b)	Place 1 cm depth of each of the solutions **FA 4**, **FA 5**, **FA 6** and **FA 7** into separate test-tubes. To each tube add a small quantity of powdered sodium carbonate. Identify any gas given off and record the test you used to make the identification.
test (c)	Place 1 cm depth of each of the solutions **FA 4**, **FA 5**, **FA 6** and **FA 7** into separate test-tubes. To each tube add 1 cm depth of 2,4-dinitrophenylhydrazine reagent.
test (d)	Place 1 cm depth of each of the solutions **FA 4**, **FA 5**, **FA 6** and **FA 7** into separate test-tubes. Place 2 cm depth of aqueous silver nitrate in a boiling-tube and add to it 1 cm depth of aqueous sodium hydroxide. This will produce a precipitate of silver oxide. Use a dropping pipette to add dilute aqueous ammonia to this mixture until the precipitate of silver oxide **just** dissolves. Do **not** add an excess of aqueous ammonia. To each of the tubes containing **FA 4**, **FA 5**, **FA 6** and **FA 7** add 1 cm depth of the silver-containing solution you have just prepared.
test (e)	Place 1 cm depth of each of the solutions **FA 4**, **FA 5**, **FA 6** and **FA 7** into separate boiling-tubes. To each tube add a few drops of acidified potassium dichromate(VI) to give a yellow-orange solution. Warm the tube gently.

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test	FA 4	FA 5	FA 6	FA 7
(a)				
(b)				
(c)				
(d)				
(e)				

[8]

Identify the type of organic compound present in each of the solutions **FA 4**, **FA 5**, **FA 6** and **FA 7** and complete the table below.

	type of organic compound contained in the solution	confirmed by the observations in test(s)
FA 4		
FA 5		
FA 6		
FA 7		

[2]

[Total: 10]

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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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