

Centre Number	Candidate Number	Name
---------------	------------------	------

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

**CHEMISTRY**

**9701/05**

Paper 5 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 details, including practical session and laboratory where appropriate, in the boxes provided. Write in dark blue or black pen in the spaces provided on the Question Paper. 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.

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

You are advised to show all working in calculations.

You may use a calculator.

Use of a Data Booklet is unnecessary.

<b>SESSION</b>	
<b>LABORATORY</b>	

<b>FOR EXAMINER'S USE</b>	
<b>1</b>	
<b>2</b>	
<b>TOTAL</b>	

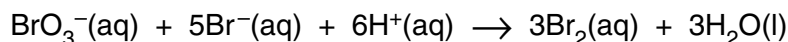
If you have been given a label, look at the details. If any details are incorrect or missing, please fill in your correct details in the space given at the top of this page.

Stick your personal label here, if provided.

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



- 1 In the presence of hydrogen ions,  $\text{H}^+$ , bromate(V) ions,  $\text{BrO}_3^-$ , oxidise bromide ions,  $\text{Br}^-$ , to bromine,  $\text{Br}_2$ .



The reaction is relatively slow and can be followed by adding aqueous phenol and the indicator methyl orange to the reaction mixture.

As bromine is formed it reacts rapidly with the phenol present until the latter is used up. The free bromine now in solution bleaches the methyl orange indicator. The reaction is timed from the mixing of the solutions until the colour of the indicator is lost.

You are to investigate how the rate of reaction depends on the concentrations of bromate(V), bromide and hydrogen ions.

**FB 1** is aqueous phenol containing methyl orange indicator.

**FB 2** is aqueous potassium bromide,  $\text{KBr}$ .

**FB 3** is aqueous potassium bromate(V),  $\text{KBrO}_3$ .

**FB 4** is  $0.50 \text{ mol dm}^{-3}$  sulphuric acid,  $\text{H}_2\text{SO}_4$ .

You will also require a supply of distilled water.

- (a) Fill the burette labelled **FB 1** with the phenol/indicator solution, **FB 1**, and the burette labelled **FB 4** with the sulphuric acid, **FB 4**.

#### *Experiment 1*

Run  $20 \text{ cm}^3$  of **FB 1** from the burette into the conical flask.

Use measuring cylinder **A** to add  $50 \text{ cm}^3$  of **FB 2** to the flask.

From the second burette, run into the flask  $20 \text{ cm}^3$  of **FB 4**.

Use measuring cylinder **B** to measure  $50 \text{ cm}^3$  of **FB 3**.

Pour the **FB 3** from the measuring cylinder into the flask and at the same time start the stop-clock or note the time on a clock.

Swirl the flask to ensure a uniform solution and place the flask on the white tile. Stop the clock or note the time when the colour of the indicator just disappears to leave a colourless solution. Record the time, to the nearest second, in Table 1.1 at the top of page 3.

#### *Experiment 2*

Empty and rinse the flask used in *Experiment 1*. Shake out as much of the rinse water as possible or dry the flask using a paper towel.

Repeat the experiment using the volumes of solution shown in Table 1.1 for *Experiment 2*.

It is important that measuring cylinder **A** is only used for potassium bromide solution, **FB 2**, and water, and measuring cylinder **B** only for potassium bromate solution, **FB 3**.

#### *Experiments 3 and 4*

Repeat the experiment using the volumes of solution shown in Table 1.1 for each of these experiments and complete the table.

Table 1.1

Expt	in flask				in measuring cylinder	time	rate (1000/time)
	volume of <b>FB 1</b> (phenol) /cm <sup>3</sup>	volume of <b>FB 2</b> (KBr) /cm <sup>3</sup>	volume of <b>FB 4</b> (H <sub>2</sub> SO <sub>4</sub> ) /cm <sup>3</sup>	volume of water /cm <sup>3</sup>			
1	20	50	20	0	50		
2	20	50	20	10	40		
3	20	30	20	20	50		
4	20	30	40	0	50		

[1] + [10]

(b) Why is the total volume used in each experiment kept constant?

.....[1]

### Processing of results

(c) How is the rate of reaction affected by changing the concentration of BrO<sub>3</sub><sup>-</sup> ion?

Use, **in calculations**, the experimental data from *Experiment 1* and *Experiment 2* to suggest the order of reaction with respect to the bromate(V) ion, BrO<sub>3</sub><sup>-</sup>.

[3]

- (d) How is the rate of reaction affected by changing the concentration of  $\text{Br}^-$  ions?

Use, **in calculations**, the experimental data from *Experiment 1* and *Experiment 3* to suggest the order of reaction with respect to the bromide ion,  $\text{Br}^-$ .

[3]

- (e) How is the rate of reaction affected by changing the concentration of  $\text{H}^+$  ions?

Use, **in calculations**, selected experimental data from *a pair of experiments* to suggest the order of reaction with respect to the hydrogen ion,  $\text{H}^+$ .

Which *pair of experiments* have you selected?

.....

Calculations

[2]

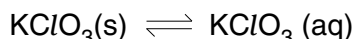
**[Total : 20]**

**Question 2 continues overleaf.**

## 2 ASSESSMENT OF PLANNING SKILLS

The ‘**solubility**’ of a substance in aqueous solution is defined as the mass of anhydrous solid that will dissolve in and just saturate 100 g of water at a fixed temperature.

- ‘Solubility’ changes with temperature. In most cases more solid dissolves at higher temperatures.
- A solution that is saturated at a particular temperature is one in which no more solid may be dissolved.
- A saturated solution of potassium chlorate(V) can be represented by the equilibrium:



- A saturated solution can be recognised by undissolved solid in equilibrium with aqueous solution.

### DO NOT CARRY OUT YOUR PLAN

- (a) You are provided with solid potassium chlorate(V),  $KClO_3$ , and distilled water.

You have available all the apparatus normally used in a school laboratory.  
Use the information given above to plan an experiment to

- (i) prepare a solution saturated with potassium chlorate at room temperature, and then
- (ii) determine the ‘solubility’ of the potassium chlorate in that solution.

**(i) Preparation of the saturated solution**

.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....  
.....[3]

a	
b	
c	

**(ii) Determination of the ‘solubility’**

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

Create specimen results for your experiment and show how you would use these results to calculate the ‘Solubility’ of potassium chlorate(V) at room temperature.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

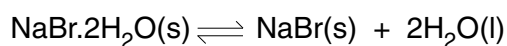
.....

.....

[4]

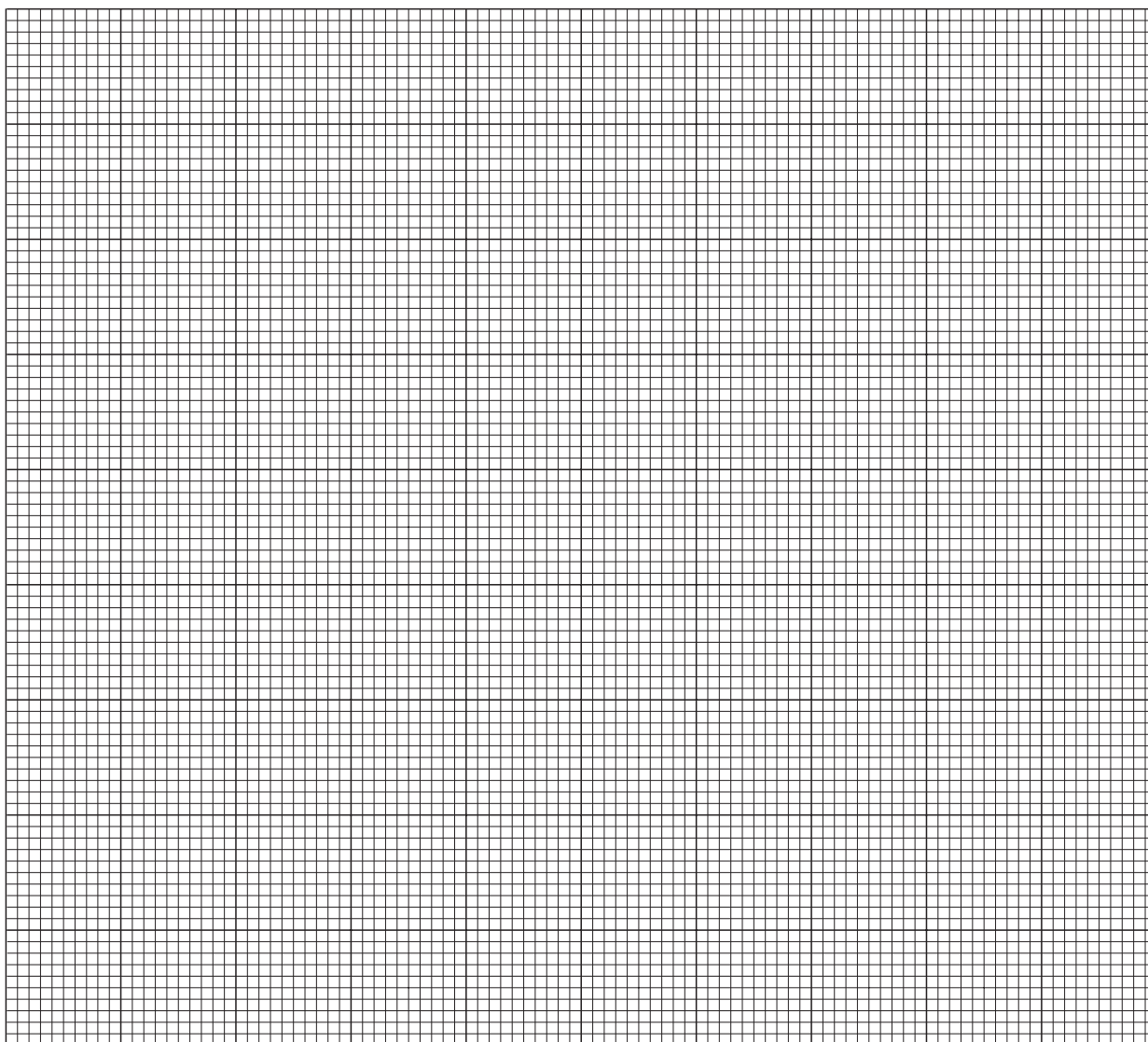
d	
e	
f	
g	

- (b) Sodium bromide crystallises as  $\text{NaBr} \cdot 2\text{H}_2\text{O}$  at low temperatures and as  $\text{NaBr}$  at higher temperatures.



Temperature / °C	10	20	30	40	50	60	70	80	90	100
'Solubility' of sodium bromide /g per 100g $\text{H}_2\text{O}$	84.2	90.5	97.2	105.8	116.0	116.9	117.4	118.3	119.8	121.2

Plot the 'solubility' temperature data for sodium bromide and draw one curve for the 'solubility' of  $\text{NaBr} \cdot 2\text{H}_2\text{O}$  and another curve for the 'solubility' of  $\text{NaBr}$ . Estimate the transition temperature from your graph.



The estimated transition temperature is ..... °C [3]

[Total : 10]

Every reasonable effort has been made to trace all copyright holders. The publishers would be pleased to hear from anyone whose rights we have unwittingly infringed.

University of Cambridge International Examinations is part of the University of Cambridge Local Examinations Syndicate (UCLES), which is itself a department of the University of Cambridge.