OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

CHEMISTRY 2816/03/TEST

Practical Test (Part B)

Wednesday **21 MAY 2003** Morning 1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
Data Sheet for Chemistry
Scientific calculator
Candidate's Plan (Part A of Practical Test)

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the spaces above.
- Write your Centre number and Candidate number in the boxes above.
- Answer **all** the questions.
- Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

- In this part of the Practical Test, you will be assessed on the Experimental and Investigative Skills:
  Skill I Implementing
  Skill A Analysing evidence and drawing conclusions
  Skill E Evaluating evidence and procedures
- You may use an electronic calculator.
- You are advised to show all the steps in any calculations.
- Use of the *Data Sheet for Chemistry* is allowed.
- You may refer to your plan produced for Part A.

FOR EXAMINER'S USE		
Qu.	Max.	Mark
Planning	16	
1	30	
2	14	
TOTAL	60	

This question paper consists of 9 printed pages, 2 lined pages and 1 blank page.

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Introduction

This Practical Test involves a rate investigation and some test tube tests.

In Part 1 of this Test, you will investigate the rate of reaction between iron(III) ions and iodide ions.

$$Fe^{3+}(aq) + I^{-}(aq) \rightarrow Fe^{2+}(aq) + \tfrac{1}{2}I_2(aq)$$

Your aim is to determine the order of the reaction with respect to iodide ions, I^{-}, by carrying out four experiments.

(In each experiment, the iron(III) ions will react with iodide ions to produce iodine.
At first, the iodine produced reacts with a fixed amount of a chemical called sodium thiosulphate.
As soon as all of the sodium thiosulphate has been used up, the iodine will react with starch solution, producing a blue colour.)

The rate of the reaction can be calculated from the time taken for the blue colour to appear in your reaction mixture. The order of the reaction will be established by a graphical method.

During your experiments, keep all of your solutions and the distilled (de-ionised) water out of direct sunlight to prevent them from heating up.

You are provided with the following.

- **K** is an aqueous solution containing iron(III) sulphate
- **L** is aqueous potassium iodide
- **M** is aqueous sodium thiosulphate
- starch solution.

1 Skill I (Implementing) and Skill A (Analysing evidence and drawing conclusions) [30 marks]

Part 1 Rate investigation [21 marks]

All readings should be recorded in the table on page 4 of this booklet.

Fill one burette with **L**, aqueous potassium iodide. Label the burette **L**.
Put **M**, aqueous sodium thiosulphate, into the other burette. Label the burette **M**.

Carry out four experiments as described below.

Experiment 1

Put the following four solutions into a conical flask:

- 8.0 cm^3 of solution **L** from one burette;
- 5.0 cm^3 of solution **M** from the other burette;
- 21 cm^3 of distilled (or de-ionised) water from a measuring cylinder;
- about 10 drops of starch solution.

Using a small measuring cylinder, measure 6.0 cm^3 of **K**, aqueous iron(III) ions.
Pour solution **K** into the conical flask.
As K is being added, start your timer or stop clock.
Swirl the mixture thoroughly.
Place the flask on a white tile.
Watch the mixture until it changes colour from yellow to blue.
Note the time taken, to the nearest second, for the blue colour to appear.
Record it in the table of readings on page 4.

Experiments 2, 3 and 4 are done in the same way as Experiment 1, ***except*** *that the volumes of solution* **L** *and distilled water are different.*

Experiment 2

Put the following solutions into a conical flask.

- 5.0 cm^3 of solution **L** from one burette
- 5.0 cm^3 of solution **M** from the other burette
- 24 cm^3 of distilled water from a measuring cylinder
- about 10 drops of starch solution.

Measure out 6.0 cm^3 of solution **K**. Add it to the mixture in the conical flask.
Start the timer and swirl the mixture thoroughly.
Note the time taken for the mixture to go blue.

This Experiment will take longer than Experiment 1. While it is in progress, measure out the solutions into another conical flask ready for Experiment 3.

Experiment 3

Put the following solutions into a conical flask.

- 6.0 cm^3 of solution **L**
- 5.0 cm^3 of solution **M**
- 23 cm^3 of distilled water
- about 10 drops of starch solution.

Add 6.0 cm^3 of solution **K** to the mixture in the conical flask.
Start the timer and swirl thoroughly.
Record the time taken for the mixture to go blue.

Experiment 4

Put the following solutions into a conical flask.

- 10.0 cm^3 of solution **L**
- 5.0 cm^3 of solution **M**
- 19 cm^3 of distilled water
- about 10 drops of starch solution.

Add 6.0 cm^3 of solution **K** to the mixture in the conical flask.
Record the time taken for the mixture to go blue.

Use this table for all your readings.

Enter the volumes of **L** used in Experiments 1–4 and the times, **t**, taken for the blue colour to appear.

experiment number	1	2	3	4
volume of **L** /cm^3				
time, **t**/s				
initial rate of reaction /s^{-1}				
(volume of **L**)^2/cm^6				

For each experiment, assume that the **initial rate of reaction** can be represented by $\frac{1000}{\text{time}}$.
Example: for a reaction time of 30 s, the initial rate of reaction is $\frac{1000}{30} = 33.3\,s^{-1}$.

Work out the initial rate of reaction for each of your experiments.
Enter these values in the table above.

Work out (volume of **L**)^2, the square of the volume of potassium iodide used, for each experiment.
Enter these values in the table above.

The concentration of iodide ions in each experiment is proportional to the volume of aqueous potassium iodide, **L**, used.
The (volume of **L**)^2 is therefore proportional to $[I^-(aq)]^2$.

Using the grid on page 5, plot and draw a best-fit **straight line** graph of the initial rate of reaction against (volume of **L**)^2.
Your line should pass through the 0,0 co-ordinate.

From your graph, suggest the order of the reaction with respect to iodide ions.
Justify your answer.

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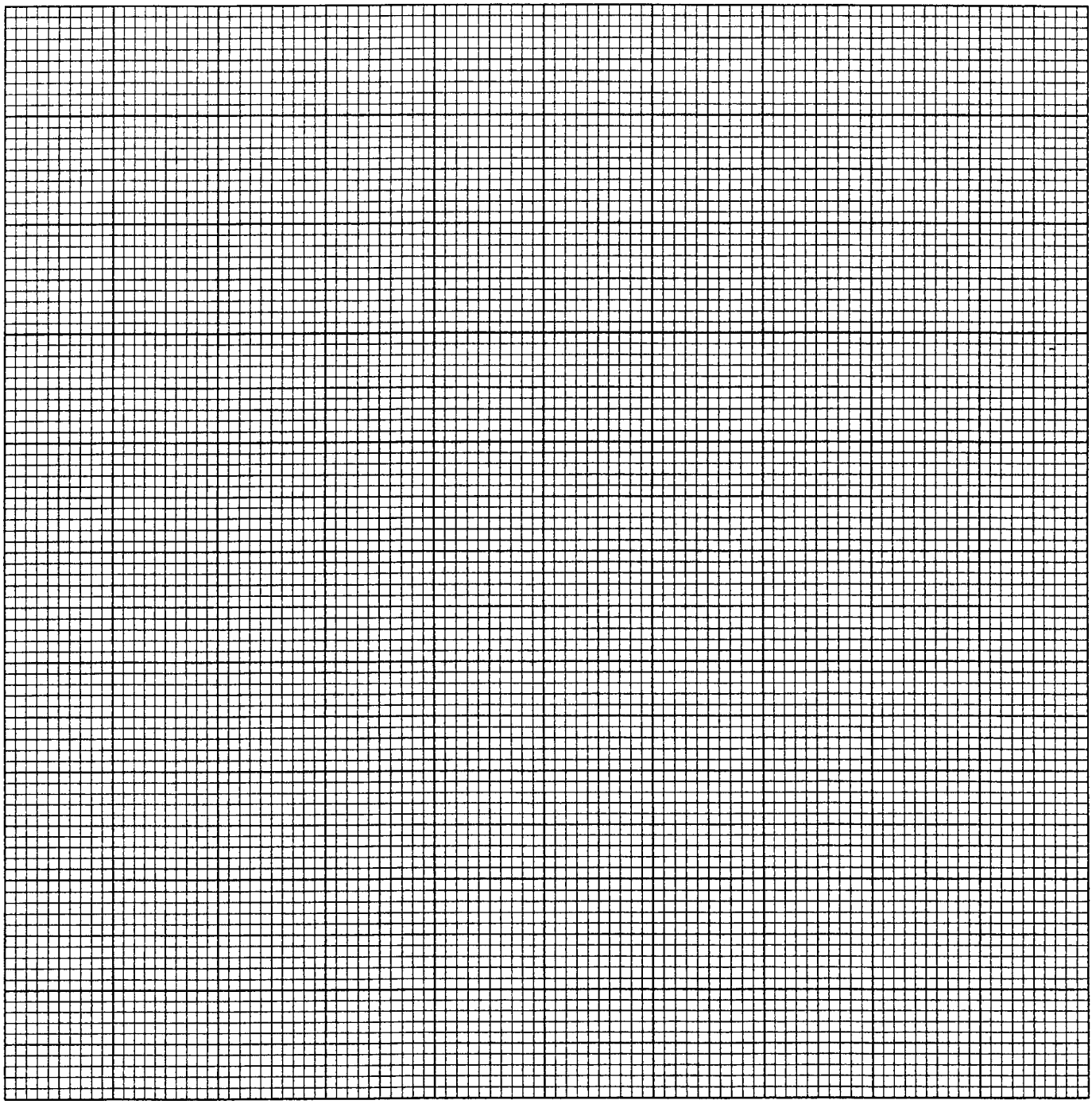
You will find two more short experiments on page 7.



Safety

State and explain **one** safety precaution you took while doing the experiments.

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Part 2 Test tube tests using K, iron(III) sulphate [9 marks]

(a) Put about 1 cm^3 of **K** into a test tube.
Add excess aqueous sodium hydroxide.
State and explain your observation(s) in the space below.
Give the ionic equation for the reaction.

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(b) Add about 1 cm^3 of **L** (potassium iodide) to about 1 cm^3 of **K** in a test tube.
Compare the result with the colour of solution **K** alone.
Then add a few drops of starch solution to the mixture.
State and explain your observation(s) in the space below.
Which **ion** is the oxidising agent in the reaction of **L** with **K**? Explain your answer.

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2 Skill E Evaluating evidence and procedures – rate investigation [14 marks]

1 Explain why the same **total** volume of solution was used in the reaction mixture in all four experiments of the rate investigation.

2 Identify **three** sources of inaccuracy in your experimental procedure for the rate investigation and suggest ways of reducing them.

3 Assess both the **accuracy** and the **reliability** of your results from the rate investigation, giving your reasons.

4 Outline how you could adapt the experimental procedure to find out whether the order of the reaction with respect to iron(III) ions is first order.

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For Examiner's Use

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