

**ADVANCED GCE  
CHEMISTRY**

Practical Examination 2 (Part B – Practical Test)

**THURSDAY 22 MAY 2008**

**2816/03/TEST**

Morning

Time: 1 hour 30 minutes

Candidates answer on the question paper.

**Additional materials:** Candidate's Plan  
(Part A of the Practical Examination)  
Scientific Calculator  
*Data Sheet for Chemistry (Inserted)*

Candidate  
Forename

Candidate  
Surname

Centre  
Number

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Candidate  
Number

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**INSTRUCTIONS TO CANDIDATES**

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or black ink. Pencil may be used for graphs and diagrams only.
- Read each question carefully and make sure that you know what you have to do before starting your answer.
- Answer **all** the questions.
- Do **not** write in the bar codes.
- Write your answer to each question in the space provided.

**INFORMATION FOR CANDIDATES**

- In this Exercise, 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 steps in any calculations.
- You will be awarded marks for the quality of written communication where this is indicated.
- A copy of the *Data Sheet for Chemistry* is provided as an insert with this question paper.

FOR EXAMINER'S USE		
	Max.	Mark
Planning	16	
Implementing & Analysing	30	
Evaluating	14	
<b>TOTAL</b>	<b>60</b>	

This document consists of **12** printed pages and a *Data Sheet for Chemistry*.



Answer **all** the parts.

## Introduction

This Practical Test needs to be carried out in four parts.

Before you start, read this introduction carefully to see the order in which these four parts must be carried out.

You are supplied with three chemicals.

- **G** Aqueous sulphuric acid.
- **H** Solid sodium hydrogencarbonate,  $\text{NaHCO}_3$ .
- **J** Aqueous sodium hydroxide.

Irritant



Corrosive



During this Test you will carry out two experiments. The first experiment takes some time so you will start with this experiment, then carry out a second experiment before returning to complete the first experiment.

- Carry out Part **1(a)** on page 2.
- Leave this and carry out **Parts 2 and 3** on pages 4–6.
- Return to **Part 1(b)** on page 3.
- Carry out **Parts 4 and 5** on pages 7–11.

### Part 1 Skill I (Implementing)

[5 marks]

- (a) You will determine the mass of carbon dioxide produced when a known volume of aqueous sulphuric acid, **G**, reacts with **excess** sodium hydrogencarbonate, **H**.

**Record all your readings in a table in the space on page 3.**

Using a measuring cylinder, pour  $25\text{ cm}^3$  of **G** into a conical flask.  
Weigh the flask containing **G**, and record the mass.

Weigh the container and lid containing sodium hydrogencarbonate, **H**.  
Record the mass.

***The reaction that follows is vigorous.***  
***Avoid inhaling any acid spray that may be produced.***

Place the conical flask containing **G** on the heat-proof mat provided.  
Tip **H**, in small portions, from the container into the acid in the conical flask.  
Swirl the flask between additions and try to minimise loss of acid as 'spray'.  
Weigh the empty container, with the lid.  
Record the mass.

**Leave the conical flask for about 30–40 minutes.**  
**You will complete Part 1(b) later.**

**NOW CARRY OUT PARTS 2 AND 3 ON PAGES 4–6**

- (b) The conical flask will now have been standing for about 30–40 minutes.

Weigh the conical flask and the solution.  
Record the mass.

**Results for Parts 1(a) and 1(b)**

Use the space below to record your readings.

**Safety**

Explain the benefit of wearing safety spectacles while carrying out **this** reaction.

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**NOW ANALYSE THESE RESULTS IN PART 4 ON PAGES 7 AND 8**

**Part 2 Skill I (Implementing)****[7 marks]**

You will carry out a 'thermometric titration' by adding measured volumes of aqueous sulphuric acid, **G**, to aqueous sodium hydroxide, **J**.

After each addition of acid, the temperature of the mixture will change. You will measure and record the temperature of the mixture.

**Read through all the instructions below before starting the experiment.**

**Record all your readings in the table below.**

**Record all temperatures to the nearest 0.5 °C.**

Support the plastic cup provided in a glass beaker.

**CAUTION! Aqueous sodium hydroxide, J, is corrosive.**

**Inform your supervisor immediately if there is a spillage of this solution.**

Using a pipette and filler, transfer 25.0 cm<sup>3</sup> of **J** into the plastic cup.

Record the temperature of solution **J** in the table below, next to 0.00 cm<sup>3</sup> of **G**.

Fill the burette with aqueous sulphuric acid, **G**.

Using the burette, add 2.00 cm<sup>3</sup> of solution **G** to solution **J** in the plastic cup.

Stir the mixture with the thermometer and record the temperature reached.

**Without delay**, add a further 2.00 cm<sup>3</sup> of solution **G** to the mixture.

The total volume of **G** added to the plastic cup is now 4.00 cm<sup>3</sup>.

Stir the mixture with the thermometer and record the temperature reached.

Add solution **G**, 2.00 cm<sup>3</sup> at a time, until a **total** of 24.00 cm<sup>3</sup> have been added.

After each addition, stir and record the temperature reached.

You will plot a graph of your results on page 5.

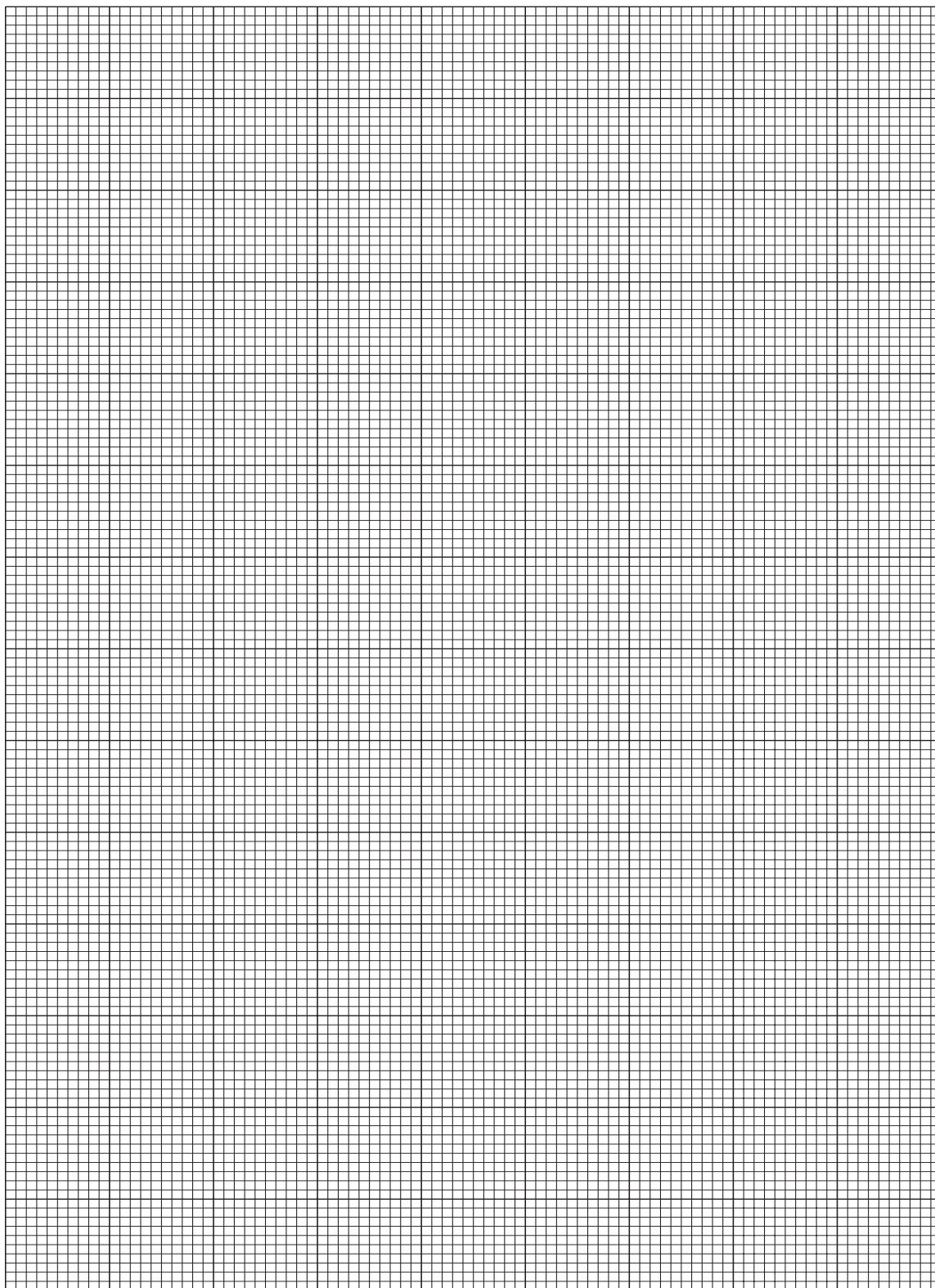
**Results of thermometric titration**

total volume of sulphuric acid, <b>G</b> , added / cm <sup>3</sup>	temperature / °C
0.00	
2.00	
4.00	
6.00	
8.00	
10.00	
12.00	
14.00	
16.00	
18.00	
20.00	
22.00	
24.00	

**Part 3 Skill A (Analysis)****[10 marks]**

- (a) Using the grid below, plot a graph of the **temperature** reached (y-axis) against the **volume of solution G** added (x-axis).

Draw two smooth lines/curves using the plotted points.



- (b) Use your graph to determine the maximum temperature reached in this reaction.

maximum temperature = ..... °C

- (c) Deduce from the graph the volume of aqueous sulphuric acid, **G**, that neutralised 25.0 cm<sup>3</sup> of aqueous sodium hydroxide, **J**.

volume = ..... cm<sup>3</sup>

- (d) Explain why the temperature on the graph you plotted increases to a maximum but then falls.

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**NOW RETURN TO YOUR EXPERIMENT IN PART 1(b) ON PAGE 3**

**Part 4 Calculating the concentrations of aqueous sulphuric acid, G, and of aqueous sodium hydroxide, J.**

**Skill A (Analysis)**

**[8 marks]**

In all questions, show your working and express your answers to an appropriate number of significant figures.

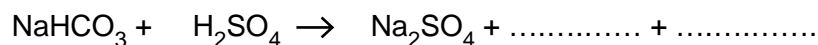
- (a)** Calculate the mass of carbon dioxide lost in your experiment in **Part 1**.

mass = ..... g

- (b)** Calculate the amount, in mol, of carbon dioxide lost in your experiment in **Part 1**.

amount = ..... mol

- (c)** Complete and balance the equation, below, for the reaction of sulphuric acid with sodium hydrogencarbonate. State symbols are **not** required.



- (d)** Calculate the concentration, in  $\text{mol dm}^{-3}$ , of  $\text{H}_2\text{SO}_4$  in solution **G**.

concentration = .....  $\text{mol dm}^{-3}$

(e) In **Parts 2** and **3** you reacted  $\text{H}_2\text{SO}_4$  with NaOH. You are now going to use this information to calculate the concentration of the aqueous sodium hydroxide, **J**, in  $\text{mol dm}^{-3}$ .

(i) Write the chemical equation for the reaction of  $\text{H}_2\text{SO}_4$  with NaOH.

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(ii) Using your answer to **Part 3(c)** and **Part 4(d)**, calculate the concentration, in  $\text{mol dm}^{-3}$ , of NaOH in solution **J**.

concentration = .....  $\text{mol dm}^{-3}$



**Part 5 Skill E (Evaluating evidence and procedures)****[14 marks]**

- (a) In **Part 1**, you used about 6 g of sodium hydrogencarbonate,  $\text{NaHCO}_3$ , for each experiment.

Justify the assumption that **excess**  $\text{NaHCO}_3$  was used.

For this calculation, assume that you used  $25.0 \text{ cm}^3$  of sulphuric acid, of concentration  $1.25 \text{ mol dm}^{-3}$ , in the reaction with  $\text{NaHCO}_3$ .

**Note:** see **Part 4(c)** for the chemical equation for this reaction.

The relative formula mass of  $\text{NaHCO}_3 = 84$ .

**[2]**

- (b) In **Part 1** the conical flask was left for 30–40 minutes before being reweighed.

Suggest **two** reasons for this.

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..... **[2]**

..... [8

- (d) Assess the **reliability** of your thermometric titration in **Part 3**.  
Justify your answer.

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..... [2]

END OF QUESTION PAPER

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