OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

CHEMISTRY 2816/03/TEST

Practical Test (Part B)

Tuesday **15 JANUARY 2002** Morning 1 hour 30 minutes

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

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** questions.
- Write your answers in the spaces 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	
Implementing	14	
Analysis	16	
Evaluation	14	
TOTAL	60	

Introduction

In this examination you will determine the enthalpy change of decomposition of aqueous hydrogen peroxide.
First, you will determine the concentration of an aqueous solution of hydrogen peroxide by titration.
Then you will measure the temperature rise when it decomposes.

Four labelled solutions are provided.

B is aqueous hydrogen peroxide, H_2O_2, of *approximate* concentration 1.0 mol dm^{-3}.
C is aqueous potassium iodide, KI, of concentration 0.5 mol dm^{-3}.
D is aqueous sodium thiosulphate, $Na_2S_2O_3$, of concentration 0.0800 mol dm^{-3}.
E is aqueous dilute sulphuric acid, of concentration 1.0 mol dm^{-3}.

You are also provided with aqueous starch to use as the indicator.

Carry out part 1(a) of Skill I, described below, as soon as the examination begins, before reading the remainder of the paper.

Aqueous hydrogen peroxide oxidises iodide ions, I^-, to the element iodine, I_2.
Excess acidified potassium iodide ensures that hydrogen peroxide reacts completely.

$$H_2O_2 + 2H^+ + 2I^- \longrightarrow I_2 + 2H_2O$$

The iodine produced is analysed by titration with aqueous sodium thiosulphate, using starch as indicator. This indicator must be added near the end point of the titration to ensure that it works properly.

$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

Skill I Implementing [14 marks]

Part 1 Titration

(a) Put **all** of the aqueous sulphuric acid, **E**, provided into a 250 cm^3 volumetric flask.
Then add **all** of the aqueous potassium iodide, **C**, provided.
Use a pipette and filler to measure out 10.0 cm^3 of aqueous hydrogen peroxide, **B**.
Empty the pipette into the volumetric flask.
Do **not** allow the tip of the pipette to touch the solution already in the flask.
Immediately, put a stopper in the volumetric flask.
The solution should be dark red, because of aqueous iodine produced.
Shake and swirl the volumetric flask gently to mix the reagents.

Leave the contents of the volumetric flask to finish reacting for at least ten minutes before moving on to **(b)**.
While you are waiting, carry out the temperature measurements in Part 2.

(b) Make the contents of the volumetric flask up to 250 cm^3 using distilled (or deionised) water. Mix the contents of the volumetric flask thoroughly.

(c) Fill a burette with the aqueous sodium thiosulphate, **D**, provided.
Read the burette to the nearest 0.05 cm^3.

(d) Using a pipette and filler, measure out 25.0 cm^3 of the iodine solution from the volumetric flask.
Transfer this solution into a conical flask for a rough/trial titration.
Start adding the aqueous sodium thiosulphate, **D**, from the burette.

When the colour of the solution in the conical flask becomes yellow, add five drops of aqueous starch as indicator.
The reaction between iodine and starch causes a very dark colour to be produced in the flask.
The end point of the titration is when this dark colour disappears.
Titrate until the mixture in the conical flask becomes colourless.
Record your burette readings in the space on page 4.

(e) Now repeat the titration procedure accurately and obtain **two** further values for the titre.
You will not have time to carry out more than two accurate titrations.
In each case use 25.0 cm^3 of the iodine solution you prepared.
Record all of your readings on page 4, and calculate the appropriate mean titre.

Part 2 Temperature Measurement

Using a measuring cylinder, measure 10 cm^3 of aqueous hydrogen peroxide, **B**, into a boiling tube in your test tube rack.
Record the temperature of this solution on page 4.

Add a small spatula measure of manganese(IV) oxide to **B**. This acts as a catalyst, decomposing the hydrogen peroxide to water and oxygen.
Stir gently with the thermometer, and record the maximum temperature reached.

Repeat the procedure, using another 10 cm^3 portion of aqueous hydrogen peroxide **B**.
Record all readings on page 4.

Calculate the mean temperature rise.

Use the space below to write down your readings for Parts 1 and 2.
For each part, show how you have obtained your mean results.

Part 1

Part 2

Explain **one** safety precaution you took either in Part 1 or in Part 2.

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Skill A Analysing evidence and drawing conclusions [16 marks]

In this section all your working must be shown clearly.
Use the equations below to help you with the calculation.

$$H_2O_2 + 2H^+ + 2I^- \longrightarrow I_2 + 2H_2O$$
$$I_2 + 2Na_2S_2O_3 \longrightarrow 2NaI + Na_2S_4O_6$$

(a) From your mean titre of aqueous $Na_2S_2O_3$, **D**, calculate the amount, in moles, of I_2 in the conical flask.

(b) Deduce the amount, in moles, of H_2O_2 which produced this amount of I_2 in the 25.0 cm^3 portion used in the titration.

(c) Deduce the concentration, in mol dm^{-3}, of the H_2O_2 in solution **B**.

(d) **(i)** Calculate the enthalpy change, in kJ, using the mean temperature rise in Part 2 together with the following data.

Density of aqueous hydrogen peroxide = 1.0 g cm^{-3}
Specific heat capacity of hydrogen peroxide = 4.2 J g^{-1} K^{-1}.

(ii) Using your answers in **(c)** and **(d)(i)**, calculate the enthalpy change for the decomposition of 1 mole of hydrogen peroxide, H_2O_2.

$$H_2O_2(aq) \longrightarrow H_2O(l) + \tfrac{1}{2}O_2(g)$$

*(If you were unable to calculate the concentration of H_2O_2 in **(c)**, assume that it was 0.80 mol dm^{-3}.)*

Skill E Evaluating evidence and procedures [14 marks]

(a) Suggest **four** improvements to make the enthalpy experiment in Part 2 more accurate and reliable. Justify each of your improvements.

(b) State and explain whether you consider that your titration data leads to a reliable result for the concentration of solution **B**.

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