OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

CHEMISTRY 2816/03/TEST

Practical Examination 2 (Part B – Practical Test)

Monday **30 JANUARY 2006** Afternoon 1 hour 30 minutes

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

Candidate Name	Centre Number	Candidate Number

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

- Write your name in the space 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.
- Read instructions and questions carefully.

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.
- You will be awarded marks for the quality of written communication where this is indicated.

FOR EXAMINER'S USE		
Qu.	**Max.**	**Mark**
Planning	**16**	
Implementing & Analysing	**30**	
Evaluating	**14**	
TOTAL	**60**	

This question paper consists of 10 printed pages and 2 blank pages.

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Answer **all** the parts.

Introduction

In this examination, you will determine the enthalpy change of decomposition of aqueous hydrogen peroxide.

In **Part 1**, you will carry out a titration using aqueous potassium manganate(VII) to determine the concentration of an aqueous solution of hydrogen peroxide.
In **Part 2**, you will calculate the concentration of the aqueous hydrogen peroxide from the readings obtained in the titration.
In **Part 3**, you will measure the temperature rise when aqueous hydrogen peroxide decomposes giving water and oxygen.
In **Part 4**, you will calculate the enthalpy change of decomposition of aqueous hydrogen peroxide.

Four chemicals are provided.

- Solution **H** is aqueous hydrogen peroxide, H_2O_2. **Irritant** 
- Solution **J** is aqueous sulphuric acid. **Irritant** 
- Solution **K** is aqueous potassium manganate(VII), of concentration $0.0250\,mol\,dm^{-3}$.
- Solid **L** is powdered manganese(IV) oxide. **Harmful** 

Part 1 Titration with $KMnO_4$

Skill I (Implementing) **[10 marks]**

Record all of your readings in the space on page 3.

Use a $10.0\,cm^3$ pipette and filler to measure out $10.0\,cm^3$ of aqueous hydrogen peroxide, **H**.
Empty the pipette into the volumetric flask.
Add distilled (or deionised) water to make up the solution to exactly $250\,cm^3$.
Mix the solution thoroughly before use.

Using a $25.0\,cm^3$ pipette and filler, transfer $25.0\,cm^3$ of this **diluted** solution into a conical flask.
Using a measuring cylinder, add $20\,cm^3$ of dilute sulphuric acid, **J**.
Fill the burette with aqueous potassium manganate(VII), **K**.
Record all burette readings to $0.05\,cm^3$ in a table on page 3.

Carry out a trial titration.
The colour change at the end-point is from colourless to light pink.

Repeat the titration procedure to obtain **two** accurate titres.
In each case, remember to add $20\,cm^3$ of **J** to the diluted hydrogen peroxide solution before titrating.
You will not have time to carry out more than two accurate titrations.

Write your readings in the space below.

Calculate the mean titre.
Show which readings you used to calculate the mean titre by placing a tick under the readings used.

Part 2 Calculating the concentration of H_2O_2 in solution H
Skill A (Analysis) **[7 marks]**

In all questions, show your working and express your answer to 3 significant figures.

(a) Calculate the amount, in moles, of $KMnO_4$ used in the mean titre.
The concentration of solution **K**, $KMnO_4$, is 0.0250 mol dm^{-3}.

answer = ... mol

(b) The ionic half-equation for the reaction of H_2O_2 is

$$H_2O_2 \longrightarrow O_2 + 2H^+ + 2e^-$$

During the titration, the manganate(VII) ion, MnO_4^-, is reduced to Mn^{2+} in acidic conditions.

Give the ionic half-equation for this reaction.
Hence show that, in the titration, 1 mol of MnO_4^- ion reacts with 2.5 mol of H_2O_2.

(c) Calculate the amount, in moles, of H_2O_2 in 25.0 cm^3 of the **diluted** solution used in the titration.

answer = ... mol

(d) Calculate the concentration, in mol dm^{-3}, of H_2O_2 in the undiluted solution **H**.

answer = ... mol dm^{-3}

Part 3 Measuring the temperature change during decomposition of aqueous hydrogen peroxide, H.
Skill I (Implementing) [5 marks]

Record all your readings in a table in the space below.

Using a measuring cylinder, transfer 25.0 cm^3 of aqueous hydrogen peroxide, **H**, into the plastic cup in the beaker.
Measure and record its temperature to 0.5 °C.
You may need to tilt the cup so that the thermometer bulb is completely immersed.

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

Place the plastic cup and the beaker on the heat-proof mat provided.
Add the manganese(IV) oxide, **L**, to the hydrogen peroxide, **H**.
Stir the mixture with the thermometer until the maximum temperature is reached.
Record the maximum temperature to 0.5 °C.
Calculate the temperature rise.

Readings

[Turn over

Part 4 Calculating the enthalpy change of decomposition of hydrogen peroxide
Skill A (Analysing) [8 marks]

(a) State and explain briefly the role manganese(IV) oxide plays during the decomposition of hydrogen peroxide.

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(b) Calculate the heat evolved, in Joules, when 25.0 cm^3 of aqueous hydrogen peroxide, **H**, decomposes, given

- mass of water present in 25.0 cm^3 of aqueous hydrogen peroxide = 25.0 g;
- specific heat capacity of an aqueous solution = 4.2 $J\,g^{-1}\,K^{-1}$.

answer = ... J

(c) Use your answer from **Part 2(d)** to calculate the amount, in moles, of H_2O_2 decomposed in the plastic cup in **Part 3**.
Hence calculate the enthalpy change for the decomposition of 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 solution **H** in **Part 2**, assume that it was 1.73 $mol\,dm^{-3}$ so that you can attempt this part of the calculation.*

answer = ... $kJ\,mol^{-1}$

(d) Safety
Do you think that wearing protective gloves during this experiment would be desirable?
Justify your answer.

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Part 5 Skill E Evaluating **[14 marks]**

Part (d) *carries about one third of the marks for* ***Part 5****.*

(a) State and explain **two** ways in which heat is lost during the experiment in **Part 3**. In each case, suggest how the apparatus could be improved to minimise the heat loss.

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(b) During **Part 3**, a student accidentally measured out and used 50 cm^3, instead of 25 cm^3, of aqueous hydrogen peroxide, **H**.
State and explain why this error would **not** alter the **temperature rise** she measured.

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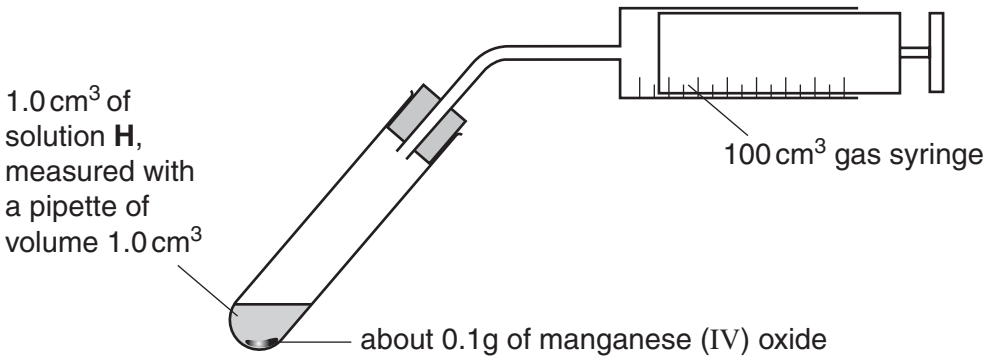
(c) The concentration of H_2O_2 in solution **H** can also be determined by adding manganese(IV) oxide and measuring the volume of gas produced.
In a preliminary experiment, a student found that 1.0 cm^3 of solution **H** produced about 18 cm^3 of oxygen when decomposed.
He then attempted to carry out one accurate experiment. A diagram of the apparatus showing his experiment in progress is shown below. He measured the final volume of gas when the reaction eventually stopped.



Suggest **two** improvements to this procedure that would significantly improve its accuracy. Justify both improvements that you suggest.

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(d) Which experiment for determination of the concentration of H_2O_2 in solution **H** would be more accurate and more reliable, the method in **(c)** above or the titration you carried out in **Part 1**?
Justify your answers.

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