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OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

CHEMISTRY

2816/03/TEST

Practical Examination 2 (Part B – Practical Test)

OCE/T69314

Candidates answer on the question paper

OCR Supplied Materials:
- *Data Sheet for Chemistry* (inserted)

Other Materials Required:
- Candidate's Plan (Part A of the Practical Examination)
- Scientific Calculator

Thursday 21 May 2009
Morning

Duration: 1 hour 30 minutes

2816032

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name clearly in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use 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, however additional paper may be used if necessary.

INFORMATION FOR CANDIDATES

- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **60**.
- 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 a scientific calculator.
- You are advised to show all the steps in any calculations.
- You may refer to your Plan produced for Part A.
- 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.
- This document consists of **12** pages. Any blank pages are indicated.

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

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Answer **all** the parts.

Introduction

You will determine the enthalpy change of decomposition of aqueous hydrogen peroxide.

In **Part 1** you will carry out a titration of the aqueous hydrogen peroxide supplied.

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 is decomposed by adding manganese(IV) oxide.

In **Part 4** you will calculate the enthalpy change of decomposition of aqueous hydrogen peroxide.

In **Part 5** you will evaluate some of the procedures used.

Six chemicals are supplied.

- **B** aqueous hydrogen peroxide, H_2O_2 **Irritant** 
- **C** aqueous sulphuric acid, H_2SO_4, *shared* **Irritant** 
- **D** aqueous potassium iodide, KI, *shared*
- **E** aqueous sodium thiosulphate, containing 15.5 g dm^{-3} of $Na_2S_2O_3.5H_2O$
- **F** **two** containers of powdered manganese(IV) oxide, MnO_2 **Harmful** 
- **G** aqueous starch (indicator), *shared*

Part 1 Titration of aqueous hydrogen peroxide using aqueous sodium thiosulphate
Skill I (Implementing) **[10 marks]**

You will do this in two stages, (a) and (b).

(a) Using a pipette and filler, transfer 10.0 cm^3 of **B** into the 250 cm^3 volumetric flask.

Using a measuring cylinder, add 50 cm^3 of **C** to the volumetric flask.

Using the same measuring cylinder, add 80 cm^3 of **D** to the volumetric flask.

Put the stopper on the volumetric flask.
Shake the volumetric flask gently for a few seconds to mix the reagents.

The solution will become dark red–brown, due to formation of aqueous iodine.

Leave the contents of the volumetric flask for several minutes for the reaction to finish. You will carry out Part 1(b) later.

NOW CARRY OUT PART 3 ON PAGE 6.

(b) Record all your readings in a table in the space below.

After completing **Part 3**, make the mixture in the volumetric flask up to 250 cm^3 using distilled (or de-ionised) water.
Invert the volumetric flask several times before use, to mix the contents thoroughly.

Using a pipette and filler, transfer 25.0 cm^3 of this solution into a conical flask.

Fill the burette with **E**.
Record all burette readings to 0.05 cm^3.

Carry out a trial titration.
When the colour of the solution in the conical flask changes from red–brown to yellow, add five drops of indicator **G**.
The titration is complete when the solution changes from blue to colourless.

Repeat the titration procedure to obtain **two** accurate titres.
In each case, add indicator **G** when the solution in the flask becomes yellow.

You will not have time to carry out more than two accurate titrations.

Readings

Calculate the mean titre.

Safety

Hydrogen peroxide can be used in hair bleach.
Suggest what precautions you should take when using a solution of hydrogen peroxide in this way.

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Part 2 Calculating the concentration of hydrogen peroxide, H_2O_2, in solution B
Skill A (Analysing) **[9 marks]**

Show your working and give your answers to **three** significant figures.

(a) Solution **E** contains 15.5 g dm^{-3} of hydrated sodium thiosulphate, $Na_2S_2O_3.5H_2O$. Calculate the amount, in moles, of $Na_2S_2O_3.5H_2O$ used in the mean titre.

answer = ... mol

(b) In the titration, iodine, I_2, reacts with sodium thiosulphate.

(i) Balance the equation for this reaction.

$$\ldots I_2 + \ldots Na_2S_2O_3 \rightarrow \ldots Na_2S_4O_6 + \ldots NaI$$

(ii) Deduce the amount, in moles, of I_2 used in each titration.

answer = ... mol

(c) The ionic half-equation for the reduction of H_2O_2 is shown below.

$$2H^+ + H_2O_2 + 2e^- \rightarrow 2H_2O$$

During the reaction of H_2O_2 with potassium iodide, KI, iodide ions, I^-, are oxidised to I_2.

(i) Write the ionic half-equation for the oxidation of I^-.

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(ii) Hence show that 1 mol of H_2O_2 reacts with KI to produce 1 mol of I_2.

(d) Deduce the amount, in moles, of H_2O_2 that produced the amount of I_2 in **(b)(ii)** used in the titration.

answer = ... mol

(e) Calculate the concentration, in mol dm^{-3}, of H_2O_2, in solution **B**.
Show your working clearly.

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

NOW CARRY OUT PART 4 ON PAGE 7

Part 3 Measuring the temperature change during decomposition of hydrogen peroxide
Skill I (Implementing) [6 marks]

Record all your readings in a table in the space below.
You will carry out the experiment **twice**.

Support a plastic cup inside the glass beaker.
Using a measuring cylinder, transfer 25.0 cm^3 of **B** into the plastic cup.
Measure and record the temperature of **B**, to the nearest 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.

Tip one of the containers of manganese(IV) oxide, **F**, into the plastic cup containing **B**.
Stir the mixture with the thermometer until the maximum temperature is reached.
Record the maximum temperature.
Calculate the temperature rise.

Repeat the experiment using another plastic cup and the other container of **F**.

Readings

Calculate the mean temperature rise.

answer = ...°C

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

Part 4 Calculating the enthalpy change of decomposition of hydrogen peroxide
Skill A (Analysing) **[5 marks]**

Show your working clearly.
Give your answers to a suitable number of significant figures.

(a) Calculate the heat evolved, in Joules, when 25.0 cm^3 of H_2O_2 decomposes, given that:

- mass of 25.0 cm^3 of H_2O_2 solution = 25.0 g;
- specific heat capacity of the solution = 4.2 $J\,g^{-1}\,K^{-1}$.

answer = ... J

(b) In the presence of MnO_2, hydrogen peroxide decomposes to give water and oxygen.
Complete the balanced equation for this reaction.
Include state symbols.

$$H_2O_2(aq) \rightarrow \text{.....} + \text{.....}$$

(c) **(i)** Refer to the concentration of H_2O_2 in solution **B** that you calculated in **Part 2(e)**.
Calculate the amount, in moles, of H_2O_2 decomposed in the plastic cup in **Part 3**.

*If you were unable to calculate the concentration of H_2O_2 in solution **B** in **Part 2(e)**, assume that it was 0.880 $mol\,dm^{-3}$ so that you can attempt this part of the calculation.*

answer = ... mol

(ii) Hence calculate the enthalpy change for the decomposition of 1 mol H_2O_2, in kJ.

answer = ... kJ

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

(a) In your titration procedure in **Part 1**, **excess** aqueous potassium iodide was added to aqueous hydrogen peroxide.

(i) Suggest **two** reasons why **excess** KI must be used.

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(ii) The equation for the reaction taking place is:

$$H_2O_2 + 2KI + H_2SO_4 \rightarrow K_2SO_4 + I_2 + 2H_2O$$

Carry out a calculation to show that **excess** KI was actually used in **Part 1**.
Assume that the concentration of H_2O_2 in solution **B** was 0.88 mol dm^{-3}.
The concentration of KI in solution **D** was 0.50 mol dm^{-3}.

[2]

(iii) State and explain whether the titration you carried out was **reliable**.

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(b) During the experiment in **Part 3**, the temperature rise you measured was lower than expected.

This is partly because there are heat losses from the apparatus.

State **two** methods by which heat losses from the apparatus could be reduced.

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(c) For the determination of the enthalpy change of decomposition of hydrogen peroxide, you used aqueous hydrogen peroxide of '10 volume' concentration.
The aqueous hydrogen peroxide supplied to schools and colleges often has a concentration of '100 volume'.

Suggest **three** reasons why the accuracy of the experiment in **Part 3** would be affected if 25.0 cm^3 of a '100 volume' solution of hydrogen peroxide had been used instead of 25.0 cm^3 of the '10 volume' solution.

Explain each reason.

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END OF QUESTION PAPER

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