OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

CHEMISTRY 2816/03/TEST

Practical Examination 2 (Part B – Practical Test)

Friday **28 MAY 2004** Morning 1 hour 30 minutes

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

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.
- 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 a scientific calculator.
- You are advised to show all the steps in any calculations.
- You may refer to your plan produced for Part A.
- Use of a *Data Sheet for Chemistry* is allowed.

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

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

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Answer **all** the Parts.

Introduction

In this Practical Test you will determine enthalpy changes and carry out test tube tests involving aqueous copper(II) sulphate.

The solution of $CuSO_4$ provided has a concentration of 0.50 mol dm^{-3}.

Copper sulphate is harmful 

Part 1 Determination of the enthalpy change for the reaction
$Fe(s) + CuSO_4(aq) \rightarrow FeSO_4(aq) + Cu(s)$
Skills I and A (Implementing and Analysing) [7 marks]

(a) Use a measuring cylinder to measure 25 cm^3 of aqueous copper(II) sulphate.
Transfer this solution into the 'calorimeter' provided, comprising a foam polystyrene cup supported inside a glass beaker.

Measure the initial temperature of the solution and **record it in the space on page 3.**
Ensure that the thermometer bulb is inserted fully into the solution, by tilting the cup if necessary.
Support the thermometer so that the 'calorimeter' does not tip over.

Add about **half** of the iron powder provided to the aqueous copper(II) sulphate in the cup.

Iron powder is an irritant 

Stir with the thermometer for about 30 seconds, then add the rest of the iron.
Keep stirring constantly.

Record, on page 3, the maximum temperature reached.
Also on page 3, record any other observations made during the experiment.

Using a filter funnel, pour about 10 cm^3 of the solution remaining at the end of the experiment into a test tube for use in Part 4. Put a bung on this tube.
Try not to pour off any solid with the solution.

Use the space below to record your readings and observations.

(b) Analysing

Calculate the enthalpy change for the reaction of iron with one mole of copper(II) sulphate, showing all your working.
Give your answer to an appropriate number of significant figures.

In your reaction, iron was used in excess.
Remember that the concentration of aqueous copper(II) sulphate = 0.50 mol dm^{-3}.
Assume that the density of aqueous copper(II) sulphate = 1.0 g cm^{-3}.
The specific heat capacity of the solution = 4.2 J g^{-1} K^{-1}.

Part 2 Determination of the enthalpy change for the reaction
$Mg(s) + CuSO_4(aq) \rightarrow MgSO_4(aq) + Cu(s)$
Skills I and A (Implementing and Analysing) [8 marks]

(a) Use a measuring cylinder to measure 25 cm^3 of aqueous copper(II) sulphate.
Transfer this solution into a second cup.
Measure the temperature of the solution and record it in the space below.

Tip **about** half of the magnesium powder provided into the aqueous copper(II) sulphate in the cup.

Magnesium powder is highly flammable 

Note: The reaction will be vigorous.
Stir with the thermometer for a few seconds, then add the rest of the magnesium.
Keep stirring constantly.
Record the maximum temperature reached.
Also record any other observations you made during the experiment.

Use the space below to record your readings and observations.

(b) Analysing

Calculate, in the space below, the enthalpy change for the reaction of magnesium with one mole of copper(II) sulphate, showing all your working.
The magnesium was used in excess.
Remember that the concentration of aqueous copper(II) sulphate = 0.50 mol dm^{-3}.
Assume that the density of aqueous copper(II) sulphate = 1.0 g cm^{-3}.
The specific heat capacity of the solution = 4.2 J g^{-1} K^{-1}.

Safety

The reaction you have just carried out was vigorous. Suggest **two** ways in which you could modify the procedure to make the reaction less vigorous.

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Part 3 Calculation of the enthalpy change for the reaction
$Mg(s) + FeSO_4(aq) \rightarrow MgSO_4(aq) + Fe(s)$
Skill A (Analysing) [3 marks]

Use the enthalpy changes you calculated in **Parts 1** and **2** to calculate the enthalpy change for the reaction of magnesium with iron(II) sulphate.
Include an enthalpy diagram (or enthalpy cycle) as part of your working.

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For Examiner's Use

Part 4 Testing the solution obtained after Part 1
Skills I and A (Implementing and Analysing) [4 marks]

Pour about 2 cm^3 (about 2 cm depth) of the solution of iron(II) sulphate left at the end of Part 1 into a test tube.
Add an equal volume of dilute sulphuric acid.

Sulphuric acid is an irritant 

Then add 3 or 4 drops of aqueous potassium manganate(VII).

State and explain your observation(s) in the space below.

Write down the ionic half-equation (ion-electron equation) for **one** of the processes taking place.

For Examiner's Use

Part 5 Test tube tests on aqueous copper(II) sulphate.
Skill I and A (Implementing and Analysis) [8 marks]

For each of the following tests, use about 1 cm^3 (about 1 cm depth) of aqueous copper(II) sulphate.
Record your observation(s) at the end of each part.

(a) With aqueous sodium hydroxide

Add several drops of aqueous sodium hydroxide to about 1 cm^3 of aqueous copper(II) sulphate.

Sodium hydroxide is an irritant 

Write down the observation(s) you made below.
Name the observed product and give the **ionic** equation for the reaction.

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(b) With aqueous ammonia

Add aqueous ammonia dropwise to about 1 cm^3 of aqueous copper(II) sulphate. Keep adding ammonia until the test tube is about two-thirds full.

Ammonia is an irritant 

Put a bung in the test tube and shake it briefly to mix the contents. Then remove the bung.

Record and explain the observations made at both stages in the reaction below.
Suggest the identities of the copper-containing species produced at both stages of the reaction.

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For Examiner's Use

Part 6 Skill E (Evaluating) [14 marks]

About three-quarters of the marks for Part 6 are awarded for **6(b)**.

(a) In **Part 1**
- explain why the iron used was in excess;
- calculate the minimum mass of iron needed for this experiment.

(b) In **Parts 1** and **2**, your experimental procedure lacked accuracy and reliability.

State and explain **four** reasons why the procedures were **either** inaccurate **or** unreliable.
In each case, suggest a modification to improve the accuracy or reliability.
Which of your modifications is the most significant? Explain your answer.