OCR
RECOGNISING ACHIEVEMENT

OXFORD CAMBRIDGE AND RSA EXAMINATIONS
Advanced GCE

CHEMISTRY 2816/03/TEST

Practical Examination 2 (Part B – Practical Test)

Friday **28 JANUARY 2005** 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.

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.

Answer **all** the parts.

Introduction

In this Test, you will investigate an iron(II) compound.
The main experiment you will carry out is a redox titration using potassium manganate(VII).

Three chemicals are provided.

- **D** is a solution of potassium manganate(VII), $KMnO_4$, containing $3.00\,g\,dm^{-3}$ of solid. **No hazard**
- **E** is the iron(II) compound. **Harmful**
- Dilute sulphuric acid. **Irritant**

Part 1 Redox titration
Skill I (Implementing) **[12 marks]**

All readings should be recorded on page 3 of this booklet.

Weigh the bottle provided containing the iron(II) compound, **E**.
Tip the entire contents of the bottle into a beaker, and weigh the empty bottle.

Dissolve your solid **E** in a mixture of about $20\,cm^3$ of dilute sulphuric acid and $80\,cm^3$ of distilled (or deionised) water. Stir the mixture.
When all the solid has dissolved, make up the solution to exactly $250\,cm^3$ in a volumetric flask.
Mix the solution thoroughly before use.

Using a pipette and filler, transfer $25.0\,cm^3$ of this solution of **E** into a conical flask.
Using a measuring cylinder, add about $15\,cm^3$ of dilute sulphuric acid.

Fill the burette with solution **D**, aqueous potassium manganate(VII).
Record burette readings to $0.05\,cm^3$.

Carry out a trial titration.
At the end-point, the colourless solution in the conical flask turns a **pale pink** colour.

Repeat the titration procedure to obtain two accurate titres.
In each case, remember to add about $15\,cm^3$ of dilute sulphuric acid to $25.0\,cm^3$ of the solution of **E**.
You will not have time to carry out more than two accurate titrations.

Keep the remainder of your solution of E for test tube tests in Part 3.

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.

Safety

State and explain one safety precaution you took while doing the experiment.

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For Examiner's Use

Part 2 Calculation of the formula of the iron(II) compound used
Skill A (Analysing) **[11 marks]**

In this section, all your working must be shown clearly.

(a) Calculate the concentration, in $mol\,dm^{-3}$, of $KMnO_4$ in **D**.
Remember that **D** contains $3.00\,g\,dm^{-3}$ of $KMnO_4$.
Then calculate the amount, in moles, of $KMnO_4$ used in your mean titre.

answer = ... mol

(b) During the titration in acid solution, the manganate(VII) ion, MnO_4^- is reduced to Mn^{2+}.
Deduce the ionic half-equation for this reduction in acid conditions.

(c) The iron(II) ion is oxidised to iron(III) ion.
Write the ionic half-equation for this oxidation.

Hence show that 1 mol of MnO_4^- reacts with 5 mol of Fe^{2+}.

For Examiner's Use

(d) Calculate the amount, in moles, of Fe^{2+} which reacted with $KMnO_4$ in the mean titre. Then calculate the amount, in moles, of Fe^{2+} dissolved in 250 cm^3 of solution in the volumetric flask.

answer = ... mol

(e) 1 mol of **E** contains 1 mol of Fe^{2+}.
Calculate the relative formula mass of the iron(II) compound, **E**.

answer = ...

(f) **E** is called a **double salt** because it contains two different cations but the same anion. Its name is ammonium iron(II) sulphate.

The formula of **E** can be written as $(NH_4)_2SO_4.FeSO_4.\boldsymbol{x}H_2O$.
1 mol of **E** contains 1 mol of ammonium sulphate, 1 mol of iron(II) sulphate, and ***x*** mol of water of crystallisation.

Use the relative formula mass of **E** from part **(e)** to calculate ***x***.

Note: if you were unable to calculate the relative formula mass of ***E****, assume it to be 380 so that you can attempt part* ***(f)****.*

answer ***x*** = ...

Part 3 Test tube tests on your solution of E
Skills I and A (Implementing and Analysing) **[7 marks]**

For **each** of these three tests, use about a 2 cm depth of your solution of **E**, the iron(II) compound, in a test tube. **No hazard**

(a) Add an equal volume of aqueous sodium hydroxide to solution **E**. **Irritant**

Record the observation and give the **ionic** equation for the reaction.

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(b) Add an equal volume of aqueous sodium carbonate to solution **E**. **Irritant**

Record the observations and suggest the name of the compound produced in the test tube.

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(c) Add two drops of aqueous potassium thiocyanate, KCNS, to solution **E**. **Harmful**

Record your observation.
State and explain what has happened to solution **E**.

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For Examiner's Use

Part 4 Skill E (Evaluating) [14 marks]

A student determined the relative formula mass of double salt **E**, $(NH_4)_2SO_4.FeSO_4.xH_2O$, by another method described below.

He weighed out 0.17 g of **E** on a balance reading to 0.01 g.
He dissolved it in about 10 cm^3 of water.

He added aqueous barium chloride to his solution of **E**.
This reaction produced a precipitate of barium sulphate, $BaSO_4$.

He filtered the precipitate using a pre-weighed filter paper.
Then he placed the filter paper and precipitate in a hot oven for about 5 minutes.

Finally, he weighed the filter paper with the precipitate.
He obtained 0.22 g of barium sulphate.

(a) Use the student's results to calculate:

- the amount, in moles, of barium sulphate;
- the relative formula mass of **E**.

(b) Calculate the % error in the weighing of barium sulphate.
Suggest and explain how the % accuracy in weighings could be improved.

(c) State and explain **two** further things the student could do to make his determination of the relative formula mass more accurate and reliable.

(d) The titration method for determination of the relative formula mass that you carried out in Part 1 is more accurate and reliable than the student's method. Explain why.

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END OF QUESTION PAPER