

**ADVANCED GCE****CHEMISTRY**

Practical Examination 2 (Part B – Practical Test)

2816/03/TEST

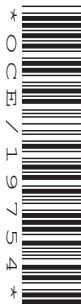
Candidates answer on the question paper

OCR Supplied Materials:

- *Data Sheet for Chemistry* (inserted)

Other Materials Required:

- Candidate's Plan (Part A of the Practical Examination)
- Scientific Calculator

Thursday 21 January 2010**Afternoon****Duration:** 1 hour 30 minutesCandidate
ForenameCandidate
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	

Answer **all** the parts.

Introduction

In this Test, you will investigate a double salt of a compound containing Fe^{2+} ions.

A double salt contains two different cations but the same anion.

The double salt that you will use has an unknown cation, **X**, as well Fe^{2+} .

It has the formula $\text{X}_2\text{SO}_4 \cdot \text{FeSO}_4 \cdot 6\text{H}_2\text{O}$.

The main experiment that you will carry out is a redox titration using potassium manganate(VII).

You are provided with three chemicals.

- **D** Aqueous potassium manganate(VII), KMnO_4 , containing 2.85 g dm^{-3} .
- **E** The solid double salt, $\text{X}_2\text{SO}_4 \cdot \text{FeSO}_4 \cdot 6\text{H}_2\text{O}$.
- Aqueous sulphuric acid, H_2SO_4 .

Harmful



Irritant



Part 1 Titration of aqueous potassium manganate(VII) with the double salt Skill 1 (Implementing)

[12 marks]

Record all your readings on page 3.

Weigh the bottle provided containing the double salt, **E**.

Tip all of **E** into a 250 cm^3 beaker.

Weigh the empty bottle.

Calculate the mass of **E** used.

Dissolve **E** in about 100 cm^3 of aqueous sulphuric acid.

Transfer this solution carefully to a 250 cm^3 volumetric flask.

Add distilled (or deionised) water to make the solution up to exactly 250 cm^3 .

Invert the volumetric flask several times to mix the solution thoroughly.

Using a pipette and filler, transfer 25.0 cm^3 of your solution of **E** into a 250 cm^3 conical flask.

Fill the burette with **D**.

Record all burette readings to 0.05 cm^3 in a table on page 3.

Carry out a trial titration. At the end-point, the solution in the conical flask turns a pale pink colour, which persists for several seconds.

Repeat the titration procedure twice to obtain two **accurate** titres.

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.

Readings and calculations

Use the space below to record all your readings.

Calculate, showing your working:

- the mean mass of **E** used;
- the mean titre for the titration.

Safety

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

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Part 2 Calculating the relative formula mass of the cation X
Skill A (Analysing)

[12 marks]

In all your answers show your working and express your answers to **three** significant figures.

- (a) Solution **D** contains 2.85 g dm^{-3} of KMnO_4 .
Calculate the concentration of KMnO_4 , in mol dm^{-3} , in solution **D**.

concentration = mol dm^{-3}

- (b) Calculate the amount, in moles, of KMnO_4 used in your mean titre.

amount = mol

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

Write the ionic half-equation for this reduction.

- (d) During the titration, Fe^{2+} ions are oxidised to Fe^{3+} ions.

(i) Write the ionic half-equation for this oxidation.

- (ii) Hence write the overall equation for the reaction of iron(II) ions and manganate(VII) ions in acid solution.

- (e) Using your overall equation in (d)(ii), calculate the amount, in moles, of Fe^{2+} dissolved in 250 cm^3 of the solution of **E** in the volumetric flask.

amount = mol

- (f) Calculate the relative formula mass of the double salt, **E**, $\text{X}_2\text{SO}_4 \cdot \text{FeSO}_4 \cdot 6\text{H}_2\text{O}$.

answer =

- (g) Calculate the relative formula mass of the cation, **X**.

answer =

Part 3 Test-tube reactions of the double salt, E, $X_2SO_4 \cdot FeSO_4 \cdot 6H_2O$
Skills I and A (Implementing and Analysing)

[6 marks]

In this part, you will carry out some test-tube reactions on a solution of the double salt, **E**, $X_2SO_4 \cdot FeSO_4 \cdot 6H_2O$.

(a) Add about a 2 cm depth of the solution of **E** into a test-tube.

Harmful



Add an equal volume of aqueous sodium hydroxide to the test-tube.

Irritant



- Record your observations,
- Write an ionic equation for the reaction that takes place.

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(b) Add about a 2 cm depth of the solution of **E** into a test-tube.

Harmful



Add about a 1 cm depth of aqueous hydrogen peroxide, H_2O_2 , into the test-tube.

Irritant



Add about a 2 cm depth of aqueous sodium hydroxide to the test-tube.

Irritant



- Record your observations.
- State and explain what has happened to the solution of **E** to cause the observations.

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Part 4 Skill E (Evaluating)

[14 marks]

A student determined the relative formula mass of **X** in the double salt **E**, $\text{X}_2\text{SO}_4 \cdot \text{FeSO}_4 \cdot 6\text{H}_2\text{O}$, by another method, which is described below.

- Using a two decimal place balance, he weighed out a 0.45 g sample of **E**.
- Using a 100cm^3 measuring cylinder, he measured 30cm^3 of water into a beaker.
- He added the weighed sample of **E** to the water in the beaker and stirred the mixture. The sample completely dissolved to make a solution of **E**.
- Using a 25cm^3 measuring cylinder, he added 10cm^3 , an excess, of aqueous sodium hydroxide to his solution of **E**.

A reaction took place and a precipitate of iron(II) hydroxide, $\text{Fe}(\text{OH})_2$, was formed.

- The student filtered the mixture using pre-weighed filter paper.
- He then placed the filter paper and precipitate in a hot oven for about 10 minutes.

Finally, using the two decimal place balance, he weighed the filter paper with the precipitate.

The student obtained 0.08 g of iron(II) hydroxide.

(a) Using the student's measurements, calculate:

- the amount, in moles, of $\text{Fe}(\text{OH})_2$ formed;
- the relative formula mass of **E**;
- the relative formula mass of **X**.

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- (b) The mass of $\text{Fe}(\text{OH})_2$ precipitated in the experiment was less than the student expected.

Part of the reason for this was the inaccuracy of the equipment used to make the measurements.

Consider the measurements of mass and volume that the student made.

In each case, **explain** whether more precise apparatus would give a more accurate value for the relative formula mass of **X**.

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- (c) The student also considered ways to improve his experimental procedure.

Suggest **two** ways that the procedure could be improved.

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- (d) The titration method that you carried out in **Part 1** is more accurate and reliable than the student's method in **Part 4**.

Explain why.

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END OF QUESTION PAPER

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