OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE **2816/03/TEST**

CHEMISTRY

Practical Examination 2 (Part B – Practical Test)

TUESDAY 22 JANUARY 2008 Morning

Time: 1 hour 30 minutes

Candidates answer on the question paper.

Additional materials: Candidate's Plan (Part A of the Practical Examination)
Scientific Calculator
Data Sheet for Chemistry (Inserted)

CUP/T36364

Candidate Forename		Candidate Surname	

Centre Number						Candidate Number				

INSTRUCTIONS TO CANDIDATES

- Write your name in capital letters, your Centre Number and Candidate Number in the boxes above.
- Use blue or 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.
- Do **not** write outside the box bordering each page.
- Write your answer to each question in the space provided.

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.
- 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.

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

This document consists of **10** printed pages, **2** blank pages and a *Data Sheet for Chemistry*.

[Turn over

Answer **all** the parts.

Introduction

In this examination, you will investigate some reactions of ethanedioic acid, $H_2C_2O_4$.
The main experiment is a redox titration using potassium manganate(VII), $KMnO_4$.

Three chemicals are provided.

- Solution **F** is aqueous potassium manganate(VII), $KMnO_4$, containing 3.50 g of solid dissolved in 1.00 dm^3 of solution. **Irritant** 
- Solid **G** is hydrated ethanedioic acid, $H_2C_2O_4.2H_2O$. **Harmful** 
- Solution **H** is aqueous sulphuric acid, H_2SO_4, of concentration 1.00 mol dm^{-3}. **Irritant** 

Part 1 Titration of ethanedioic acid with potassium manganate(VII)

Skill I (Implementing) **[14 marks]**

Record all your readings on page 3.

Pour about 100 cm^3 of distilled (or de-ionised) water into the beaker provided.
Using a Bunsen burner, tripod and gauze, gently heat the water to about 40 °C.

Weigh the stoppered bottle, containing **G**.
Tip all of **G** into the beaker of warm water.
Weigh the empty bottle, with the lid.

Stir the mixture in the beaker until 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 **G** into a conical flask.
Using a measuring cylinder, add about 20 cm^3 of aqueous sulphuric acid, **H**.

Fill the burette with aqueous potassium manganate(VII), **F**.
Record burette readings to 0.05 cm^3 in a table on page 3.

Place the conical flask with its contents on the tripod and gauze.
Heat the mixture up to 60–70 °C.
Holding the hot conical flask in a suitable way, carefully remove it from the tripod and gauze and place it on a white tile.

Carry out a trial titration using the following procedure.

- Run in solution **F** from the burette, slowly at first.
- Swirl the flask to ensure that solution **F** loses its purple colour.
- Continue the titration, adding a few cm^3 of solution **F** at a time, followed by swirling.
- At the end-point, the colourless solution in the conical flask turns **pale pink**.

Note: *if a brown colour or precipitate develops that does* ***not*** *disappear on swirling, stop the titration.*
Gently heat the mixture on the tripod and gauze for several seconds and swirl.
If the brown colour disappears, continue with the titration.

If the brown colour is permanent you probably added solution ***F*** *from the burette too quickly. You must start another titration using a fresh 25.0 cm^3 portion of* ***G*** *and 20 cm^3 of* ***H****.*

Repeat the titration **twice** more to obtain **two** accurate titrations.
You will **not** have time to carry out more than **two** accurate titrations.
In each case use 25.0 cm^3 of your solution of **G** and 20 cm^3 of **H**.

Keep the remainder of your solution of **G** for the test tube test in **Part 3**.

Readings

Use the space below to record all your readings.
Calculate the mass of **G** used and the mean titre.

Handling of chemicals

If spilt, aqueous potassium manganate(VII) causes purple stains that should be removed quickly.
How would you remove such a purple stain using a chemical treatment?

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Part 2 Calculation of the change in oxidation state of carbon in ethanedioic acid
Skill A (Analysing) **[12 marks]**

In all questions show your working. Express your answers to **three** significant figures in questions **(a)–(c)**.

(a) Calculate the concentration, in mol dm^{-3}, of $H_2C_2O_4.2H_2O$ in the solution of **G** that you made up.

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

(b) Calculate the amount, in moles, of $H_2C_2O_4.2H_2O$ pipetted in each titration.

answer = ... mol

(c) Solution **F** contains 3.50 g of $KMnO_4$ dissolved in 1.00 dm^3 of solution.
Calculate the amount, in moles, of $KMnO_4$ used in your mean titre.

answer = ... mol

(d) (i) Use your answers to **(b)** and **(c)** to calculate how many moles of $H_2C_2O_4.2H_2O$ would react with **2 moles** of $KMnO_4$.
Give your answer to the nearest whole number.

answer = ... mol

(ii) During the titration, manganese in MnO_4^- is reduced to Mn^{2+}.
Give the oxidation state of manganese in each ion.

MnO_4^- .....

Mn^{2+} .....

(iii) During the titration, MnO_4^- oxidises both carbon atoms in $H_2C_2O_4$.
The oxidation state of each carbon in $H_2C_2O_4$ is +3.

Use your answers to **(d)(i)** and **(d)(ii)** to show that the **final** oxidation state of carbon after this redox reaction is +4.

(e) Suggest the identity of the compound of carbon to which $H_2C_2O_4$ was oxidised during the redox titration.

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Part 3 Test tube reaction of the solution of ethanedioic acid
Skills I and A (Implementing and Analysing) **[4 marks]**

(a) Pour about 2 cm depth of the solution of **G** into the test tube.
Add a similar volume of aqueous calcium chloride, $CaCl_2$, to the test tube.

Record the observation made.

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(b) In the solution of **G**, ethanedioic acid ionises as shown below.

$$H_2C_2O_4(aq) \rightleftharpoons 2H^+(aq) + C_2O_4^{2-}(aq)$$

(i) Name the observed product of the reaction in **(a)**.

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(ii) Write the ionic equation for the formation of this product. Include state symbols.

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Part 4 Skill E (Evaluating) **[14 marks]**

(a) The redox titration between aqueous ethanedioic acid and aqueous acidified potassium manganate(VII) was carried out at about 60–70 °C.

Use ideas about particles to explain why the reagents were heated.

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(b) Some water evaporates from the conical flask during heating, making the solution of ethanedioic acid more concentrated.
A student suggested that this makes the titration inaccurate.

Explain why the student is incorrect.

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(c) During the titration procedure, you used the following pieces of apparatus:

- 250 cm^3 volumetric flask (accurate to 0.2 cm^3)
- 25 cm^3 pipette (accurate to 0.06 cm^3)

Carry out calculations to decide which piece of apparatus has the lower % error.

[3]

(d) A student suggested that the measurement of the aqueous sulphuric acid, **H**, during the titration should have been more accurate.

State **and** explain whether or not you agree with this suggestion.

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(e) During the titration, manganese in MnO_4^- is reduced to Mn^{2+}.
If the temperature is too low, some brown colouration is formed, due to solid manganese(IV) oxide, MnO_2.

Suggest **and** explain **two** ways in which the formation of MnO_2 would affect the accuracy or reliability of the titration.

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END OF QUESTION PAPER

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