THIS IS A LEGACY SPECIFICATION

OCR
RECOGNISING ACHIEVEMENT

ADVANCED GCE

CHEMISTRY

2816/03/TEST

Practical Examination 2 (Part B – Practical 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

Friday 21 May 2010
Afternoon

Duration: 1 hour 30 minutes

OCE/25717

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 **8** 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

Information about organic compounds can sometimes be obtained by the determination of their relative molecular masses. In the case of ethanedioic acid, $(COOH)_2$, this can be done using a titration.

In this experiment, you will determine the value of ***x*** in hydrated ethanedioic acid, $(COOH)_2.xH_2O$.

You will carry out a redox titration using potassium manganate(VII), $KMnO_4$.

Two chemicals are provided.

- **D** is a solution of potassium manganate(VII) containing $3.00\,g\,dm^{-3}$ of $KMnO_4$. **Irritant**
- **E** is a solid sample of hydrated ethanedioic acid, $(COOH)_2.xH_2O$. **Harmful**

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

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

Record all your readings on page 3.

Weigh the bottle provided containing hydrated ethanedioic acid, **E**.
Tip all of **E** into a beaker and weigh the empty bottle.
Calculate the mass of **E** used.

Dissolve **E** in about $100\,cm^3$ of distilled (or deionised) water.
Stir to speed up the process.
When all the solid has dissolved, make the solution up to exactly $250\,cm^3$ in a volumetric flask using distilled (or deionised) water.
Invert the volumetric flask several times before use, to mix the solution thoroughly.

Fill the burette with **D**.

Using a pipette and filler, transfer $25.0\,cm^3$ of your solution of **E** into a conical flask.
Using a measuring cylinder, add about $20\,cm^3$ of dilute sulphuric acid.
Place the thermometer in the solution in the conical flask.
Place the conical flask and its contents on a tripod and gauze and heat them up to between 60–70 °C. Then remove the Bunsen burner.

Remove the thermometer and rinse the end of the thermometer with a little distilled water so that the rinsings go into the conical flask.
Carefully remove the hot conical flask from the tripod and gauze ready for the titration.

Record all accurate 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, which persists for several seconds.
Run in **D** from the burette.
Record all your readings in a suitable table on page 3.

If a brown precipitate forms during your titration, the temperature is too low. If this happens, briefly re-heat the solution and the brown precipitate should disappear.

- *If it does disappear, you can continue the titration.*
- *If it does **not** disappear, stop the titration and start again with a fresh 25.0 cm^3 portion of your solution of **E**.*

Now carry out the titration accurately and repeat it to obtain two values for the titre. In each case use 25.0 cm^3 of your solution of **E**.

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

Results

Use the space below to record all your readings.

Weighings

mass of **E** used = ... g

Titration data (tabulated)

Summary

25.0 cm^3 of the solution of **E** required a mean titre of …… cm^3 of **D**.

Show which readings you used to obtain this value for **D** 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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Part 2 Calculating the value of *x* in hydrated ethanedioic acid, $(COOH)_2.xH_2O$.
Skill A (Analysing) **[16 marks]**

Show your working.

(a) Calculate the concentration, in mol dm^{-3}, of $KMnO_4$ in solution **D**.
Remember that solution **D** contains 3.00 g dm^{-3} of $KMnO_4$.

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

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

amount = ... mol

(c) The ionic half-equation for the oxidation of **E**, $(COOH)_2$, during the reaction is

$$(COOH)_2 \longrightarrow 2H^+ + 2CO_2 + 2e^-$$

During the titration, MnO_4^- is reduced in acid solution to Mn^{2+}.

Write the ionic half-equation for the reduction of the acidified manganate(VII) ion.

(d) Use both half-equations in **(c)** to show that 1 mol of MnO_4^- oxidises 2.5 mol of $(COOH)_2$.

(e) Calculate the amount, in moles, of $(COOH)_2$ which reacted with $KMnO_4$ used in your mean titre.

amount = ... mol

(f) Calculate the amount, in moles, of $(COOH)_2$ in the 250 cm^3 of solution in the volumetric flask.

amount = ... mol

(g) Calculate the relative molecular mass of $(COOH)_2.\boldsymbol{x}H_2O$, quoting your answer to three significant figures.

Hence, deduce the value of ***x***.

x = ...

Part 3 Skill E (Evaluating) **[14 marks]**

Information

A student decided to determine the value of ***x*** in $(COOH)_2.xH_2O$ by a different method. He suggested using the following procedure.

- Weigh an empty crucible.
- Tip the sample of $(COOH)_2.xH_2O$ into the crucible and reweigh.
- Heat the crucible until it appears that all the water has been driven off.
- Reweigh the crucible containing the anhydrous sample obtained.

(a) Explain how the student could use the results of the experiment to determine the value of ***x***.

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(b) State and explain **two** ways in which the experimental procedure described could be improved to increase its accuracy and reliability.

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(c) The titration procedure gives more accurate results than the student's method above.

Give **two** reasons why the titration procedure is more accurate.

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(d) When the student's procedure is carried out, the value of ***x*** obtained is greater than it should be.

Give **two** procedural errors and, for each, explain why the error would lead to a greater value of ***x***.

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..... **[3]**

END OF QUESTION PAPER

PLEASE DO NOT WRITE ON THIS PAGE