Centre Number	Candidate Number

Candidate Name _____

CAMBRIDGE INTERNATIONAL EXAMINATIONS

General Certificate of Education Advanced Level

CHEMISTRY **9701/5**

PAPER 5 Practical Test

MAY/JUNE SESSION 2002

1 hour 30 minutes

Candidates answer on the question paper.
Additional materials:
As listed in Instructions to Supervisors

TIME 1 hour 30 minutes

INSTRUCTIONS TO CANDIDATES

Write your name, Centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided on the question paper.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets [ ] at the end of each question or part question.
You are advised to show all working in calculations.
Use of a Data Booklet is unnecessary.

FOR EXAMINER'S USE	
1	
2	
TOTAL	

This question paper consists of 7 printed pages and 1 blank page.

[Turn over

1 **FB 1** is 0.02 mol dm^{-3} potassium manganate(VII), $KMnO_4$.
FB 2 is a solution containing iron(II) ions, Fe^{2+}.
FB 3 is an aqueous solution of a substance, **X**.

Under acid conditions **X** oxidises iron(II) to iron(III).

You are required to determine
- the concentration of iron(II) ions in **FB 2** and, by a graphical method,
- the volume of **FB 3** that will oxidise the iron(II) ions in 25.0 cm^3 of **FB 2**.

(a) *Experiment 1*

Fill a burette with potassium manganate(VII), **FB 1**.

Pipette 25.0 cm^3 of **FB 2** into a conical flask and add, using the measuring cylinder provided, 10 cm^3 of 1 mol dm^{-3} sulphuric acid.

Run **FB 1** from the burette into the conical flask until the first permanent pale pink colour remains. This is the end point of the titration.

Record your burette readings in Table 1.1.

Repeat the titration as many times as you think necessary to obtain accurate results.
Make certain that the recorded results show the precision of your practical work.

Table 1.1 Titration of FB 2 with FB 1

Final burette reading / cm^3 Initial burette reading / cm^3				
Volume of **FB 1** used / cm^3				

[8]

Summary

25.0 cm^3 of **FB 2** reacted with …… cm^3 of **FB 1**.

Show which results you used to obtain this volume of **FB 1** by placing a tick (✓) under the readings in Table 1.1.

You are advised to show full working in all parts of the calculations.

(b) Calculate how many moles of potassium manganate(VII) were run from the burette into the conical flask during the titration of **FB 2** with **FB 1**.

[1]

(c) Use the half equations for the reaction

$$MnO_4^-(aq) + 8H^+(aq) + 5e^- \rightarrow Mn^{2+}(aq) + 4H_2O(l)$$

$$Fe^{2+}(aq) \rightarrow Fe^{3+}(aq) + e^-$$

and your answer to **(b)** to calculate the concentration of Fe^{2+}, in mol dm^{-3}, in **FB 2**.

[2]

(d) *Experiment 2*

Fill the second burette with **FB 3**, the aqueous solution of **X**.

Pipette 25.0 cm^3 of **FB 2** into a conical flask and add, using the measuring cylinder provided, 10 cm^3 of 1 mol dm^{-3} sulphuric acid.

Add, from the second burette, 4.00 cm^3 of FB 3. This oxidises some of the Fe^{2+} that has been pipetted into the flask.

Titrate the remaining Fe^{2+} in the conical flask with **FB 1**, potassium manganate(VII) until the first permanent pink colour remains.

Record the volume of **FB 3** added and your burette readings in Table 1.2.

One accurate titration will be sufficient. Remember that the volume added will be less than in *Experiment 1* as some of the Fe^{2+} has been oxidised by X.

Table 1.2 Titration of FB 2/FB 3 mixture with FB 1

Volume of **FB 3** added	/ cm^3	0.00	4.00	8.00	12.00
Final burette reading	/ cm^3				
Initial burette reading	/ cm^3				
Volume of **FB 1** added	/ cm^3				

Enter the titration value from *Experiment 1*.

[3]

Empty and rinse the conical flask.

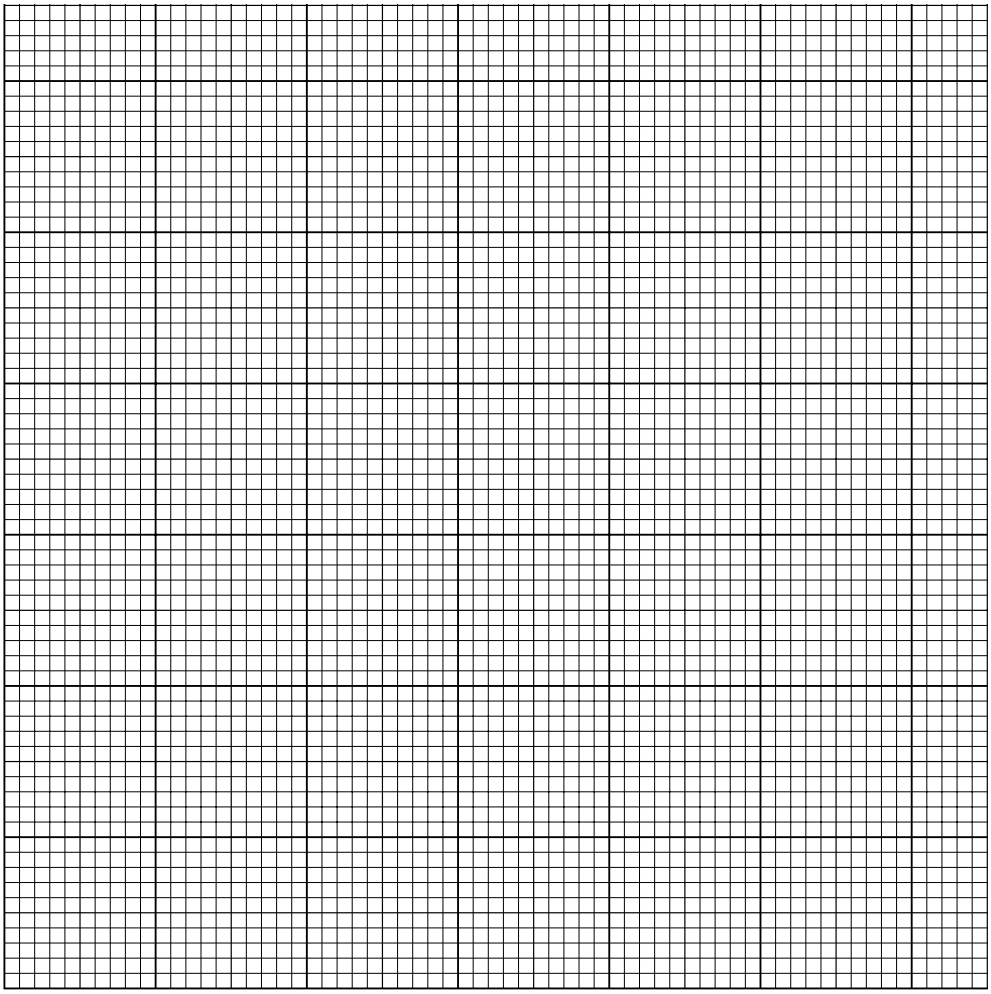
Repeat *Experiment 2*, using the volumes of **FB 3** shown in Table 1.2.

Record your results in Table 1.2.

For Examiner's Use

(e) Plot the volume of **FB 1** against the volume of **FB 3**.

Your scale on the **FB 3** axis should extend to 30.00 cm^3.



[5]

i	
ii	
iii	
iv	

(f) Draw the best-fit straight line through the plotted points. [1]

(g) From your graph find the volume of **FB 3** that reacts with the Fe^{2+} present in 25.0 cm^3 of **FB 2**.

[1]

[Total 21]

2 ASSESSMENT OF PLANNING SKILLS

DO NOT CARRY OUT YOUR PLAN

Caesium nitrate, $CsNO_3$, decomposes on heating.

The decomposition is represented by one of the following equations.

$$4CsNO_3(s) \rightarrow 2Cs_2O(s) + 4NO_2(g) + O_2(g)$$

$$2CsNO_3(s) \rightarrow 2CsNO_2(s) + O_2(g)$$

You are to devise a method of heating the solid nitrate, collecting the gas given off and measuring its volume.
From the experimental results you are to determine which is the correct equation for the decomposition.

Information that may be used in the question.

The molar volume of gas, V_m, is 24.0 dm^3 mol^{-1} under room conditions.

Nitrogen dioxide, NO_2, a toxic gas, is soluble in water.
Oxygen, O_2, is not soluble in water.

[A_r; Cs, 133.0; N, 14.0; O, 16.0.]

(a) Draw and label the apparatus you would use to heat the caesium nitrate, to collect the gas and to measure its volume.

When labelling your diagram include the volume of apparatus used (e.g. 250 cm^3 beaker) where appropriate. [2]

(b) Which gas/gases are you collecting in your apparatus?

.....[1]

(c) Taking into consideration the gas/gases you will collect and the capacity of the collecting apparatus, use the equations to calculate an appropriate mass of caesium nitrate to be heated.
[Show your working]

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.....[3]

(d) Indicate how you would use your results to find the correct equation for the thermal decomposition of caesium nitrate.

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.....[2]

(e) Suggest one safety precaution that should be undertaken during this experiment and the reason for it.

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.....[1]

[Total 9]

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