EXPERIMENT NO. 19

Quantitative analysis

Read through the whole method before starting any practical work. Where appropriate, prepare a table for your results in the space provided.

Show your working and appropriate significant figures in the final answer to **each** step of your calculations.

1 You will carry out a titration to determine the concentration of a solution of potassium manganate(VII). You will react potassium manganate(VII) with excess acidified potassium iodide to produce iodine. You will then titrate the iodine with sodium thiosulfate.

FB 1 is hydrated sodium thiosulfate, $Na_2S_2O_3{\bullet}5H_2O$.
FB 3 is aqueous potassium manganate(VII), $KMnO_4$.
FB 4 is 0.50 mol dm^{-3} potassium iodide, KI.
FB 5 is dilute sulfuric acid, H_2SO_4.
starch indicator

(a) Method

Preparing a solution of FB 1

- Weigh the stoppered container of **FB 1**. Record the mass in the space below.
- Tip all the **FB 1** into the beaker.
- Reweigh the container with its stopper. Record the mass.
- Calculate and record the mass of **FB 1** used.
- Add approximately 100 cm^3 of distilled water to the **FB 1** in the beaker.
- Stir the mixture with a glass rod until all the **FB 1** has dissolved.
- Transfer this solution into the 250 cm^3 volumetric flask.
- Wash the beaker with distilled water and transfer the washings to the volumetric flask.
- Rinse the glass rod with distilled water and transfer the washings to the volumetric flask.
- Make the solution in the volumetric flask up to the mark using distilled water.
- Shake the flask thoroughly.
- This solution of sodium thiosulfate is **FB 2**. Label the flask **FB 2**.

Titration

- Fill the burette with **FB 2**.
- Pipette 25.0 cm^3 of **FB 3** into a conical flask.
- Use the 25 cm^3 measuring cylinder to add 15 cm^3 of **FB 5** to the conical flask.
- Use the same measuring cylinder to add 10 cm^3 of **FB 4** to the conical flask.
- Perform a rough titration by adding **FB 2** from the burette to the conical flask until the solution is yellow. Then add several drops of starch indicator and continue the titration until the mixture in the flask becomes colourless. This is the end-point.

The rough titre is .... cm^3.

- Carry out as many accurate titrations as you think necessary to obtain consistent results.
- Make sure any recorded results show the precision of your practical work.
- Record in a suitable form below all of your burette readings and the volume of **FB 2** added in each accurate titration.

I	
II	
III	
IV	
V	
VI	
VII	
VIII	

[8]

(b) From your accurate titration results, obtain a suitable value for the volume of **FB 2** to be used in your calculations.
Show clearly how you obtained this value.

The iodine produced by **FB 3** required .... cm^3 of **FB 2**. [1]

(c) Calculations

(i) Give your answers to **(c)(ii)**, **(c)(iii)**, **(c)(iv)** and **(c)(v)** to the appropriate number of significant figures. [1]

(ii) Calculate the number of moles of hydrated sodium thiosulfate, **FB 1**, that you weighed.

moles of $Na_2S_2O_3{\bullet}5H_2O$ = ... mol [1]

(iii) Calculate the number of moles of sodium thiosulfate in the volume of **FB 2** calculated in **(b)**.

moles of $Na_2S_2O_3$ = ... mol [1]

(iv) The reaction by which iodine is produced is shown.

$$2KMnO_4(aq) + 10KI(aq) + 8H_2SO_4(aq) \rightarrow 6K_2SO_4(aq) + 2MnSO_4(aq) + 5I_2(aq) + 8H_2O(l)$$

During the titration, sodium thiosulfate reacts with the iodine produced.

$$2Na_2S_2O_3(aq) + I_2(aq) \rightarrow 2NaI(aq) + Na_2S_4O_6(aq)$$

Use your answer to **(c)(iii)** to calculate the concentration of $KMnO_4$, in mol dm^{-3}, in **FB 3**.

concentration of $KMnO_4$ = ... mol dm^{-3} [1]

(v) Calculate the mass of $KMnO_4$ needed to prepare 1.00 dm^3 of **FB 3**. Show your working.

mass of $KMnO_4$ = ... g [1]

(d) (i) Solution **FB 3** was actually prepared by dissolving 3.16 g of $KMnO_4$ in 1.00 dm^3 of solution.

Show how you would use your answer to **(c)(v)** to calculate the overall percentage error in your experiment.

[1]

(ii) A student suggested that the percentage error in the experiment would be reduced by using a 10 cm^3 pipette to measure **FB 4**.

State whether the student is correct. Explain your answer.

....

.... [1]

[Total: 16]