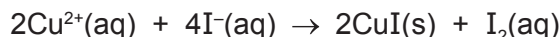
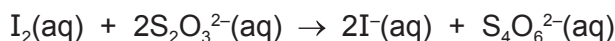


EXPERIMENT NO. 6

- 1 In this experiment you will determine the value of x in the formula for hydrated copper(II) sulfate, $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$. You will first react a solution of Cu^{2+} ions with excess iodide ions, I^- . This reaction produces iodine.



The amount of iodine produced can be determined by titrating with thiosulfate ions, $\text{S}_2\text{O}_3^{2-}$.



FA 1 is $0.150 \text{ mol dm}^{-3}$ sodium thiosulfate, $\text{Na}_2\text{S}_2\text{O}_3$.

FA 2 is dilute sulfuric acid.

FA 3 is 1.00 mol dm^{-3} potassium iodide, KI .

FA 4 is a solution made by dissolving 32.5 g of $\text{CuSO}_4 \cdot x\text{H}_2\text{O}$ in 1.00 dm^3 of solution.
starch indicator

(a) Method

- Fill the burette with **FA 1**.
- Pipette 25.0 cm^3 of **FA 4** into a conical flask.
- Use the measuring cylinder to add 10 cm^3 of **FA 2** to the same conical flask.
- Use the measuring cylinder to add 10 cm^3 of **FA 3** to the same conical flask. The mixture will become brown because of the formation of I_2 , and will become cloudy because of the formation of the white precipitate of CuI .
- Add **FA 1** from the burette until the mixture becomes a light brown colour.
- Add 10 to 20 drops of starch indicator until the mixture becomes blue-black.
- Continue to titrate with **FA 1** until the blue-black colour disappears leaving a mixture with an off-white solid. This is the end-point.
- You should test that the end-point has been reached by adding 2 more drops of starch indicator. If the titration has reached the end-point the added starch indicator will cause no change in colour.
- Perform a rough titration and record your burette readings in the space below.

final burette reading/ cm^3	28.00
initial burette reading/ cm^3	1.40
titre/ cm^3	26.60

The rough titre is 26.60 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 **FA 1** added in each accurate titration.

final burette reading/ cm^3	33.20	38.60	28.30	
initial burette reading/ cm^3	6.90	12.50	2.20	
titre/ cm^3	26.30	26.10	26.10	
best titre		✓	✓	

I	
II	
III	
IV	
V	
VI	
VII	

[7]

- (b) From your accurate titration results, obtain a suitable value for the volume of **FA 1** to be used in your calculations.
Show clearly how you obtained this value.

$$\frac{26.10 + 26.10}{2}$$

25.0 cm³ of **FA 4** required 26.10 cm³ of **FA 1**. [1]

(c) **Calculations**

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

- (i) Calculate the number of moles of thiosulfate ions in the volume of **FA 1** calculated in (b).

$$n = cV$$

$$= 0.150 \times \frac{26.10}{1000}$$

moles of S₂O₃²⁻ = 3.92 × 10⁻³ mol

- (ii) Using the equations on page 1, calculate the number of moles of copper(II) ions in 25.0 cm³ of **FA 4**.



moles of Cu²⁺ = 3.92 × 10⁻³ mol

- (iii) Calculate the concentration, in mol dm⁻³, of copper(II) ions in **FA 4**.

$$c = \frac{n}{V} = \frac{3.92 \times 10^{-3}}{25/1000}$$

concentration of Cu²⁺ in **FA 4** = 0.157 mol dm⁻³

- (iv) Calculate the value of **x** in CuSO₄·**x**H₂O.

$$M_r = \frac{m}{n} = \frac{32.5}{0.157}$$

$$M_r = 207$$

$$xH_2O = \text{CuSO}_4 \cdot xH_2O - \text{CuSO}_4$$

$$= 207 - 159.6$$

$$= 47.4$$

$$x = \frac{47.4}{18} = 2.63 \approx 3$$

x = 3

[5]

(d) (i) Calculate the maximum percentage error in one of your accurate titres.

$$\text{error} = \frac{\text{Least Count}}{d}$$
$$\% \text{ error} = \frac{\text{error}}{\text{value}} \times 100$$

$$\text{error} = \frac{0.10}{d} = \pm 0.05 \text{ cm}^3$$
$$\% \text{ error} = \frac{2(0.05)}{26.10} \times 100$$

maximum percentage error = 0.383 %

(ii) A student suggests that the experiment could be made more accurate if the volume of FA 3 was measured using a burette.

Give a reason why the student might make this suggestion.

The volume from the burette has a smaller error.

OR

Burette is more precise.

Explain why this change would **not** improve the accuracy of the experiment.

As FA3 is in excess.

[3]

[Total: 16]