WJEC (Eduqas) Chemistry A-level

SP PI1.2b - Estimation of Copper in Copper(II) Salts

Flashcards

Explain how a titration can be used to determine the percentage by mass of copper in copper(II) sulfate crystals

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Excess potassium iodide solution is added to a standard solution of copper(II) sulfate. This liberates iodine so that the amount of iodine can be found by titration with sodium thiosulphate. Before the titration end-point, several drops of starch solution are added which react with any iodine to produce a blue colour. The titration is continued until the blue colour disappears, leaving an off-white precipitate.

Give the equation for the reaction that takes place between the Cu^{2+} ions and the I^- ions

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$$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$$

Give the equation for the reaction that takes place between iodine and the $S_2O_3^{2-}$ ions

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$$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$$

How does the number of moles of $S_2O_3^{2-}$ found from titration, relate to the number of moles of Cu^{2+} in the copper(II) sulfate?

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Consider the two reactions which take place:

$$2Cu^{2+} + 4I^- \rightarrow 2CuI + I_2$$

$$2S_2O_3^{2-} + I_2 \rightarrow S_4O_6^{2-} + 2I^-$$

There is a 1:1 ratio of the number of moles of Cu^{2+} ions to $S_2O_3^{2-}$ ions. This means the number of moles of Cu^{2+} is equal to the number of moles of $S_2O_3^{2-}$ found from titration.

What apparatus is required to determine the percentage by mass of copper in copper(II) sulfate crystals?

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- Digital mass balance
- Weighing boat
- 50 cm^3 beakers
- 250 cm^3 beaker
- 250 cm^3 conical flasks
- 250 cm^3 volumetric flask
- 25 cm^3 pipette and filler
- Burette
- Funnel
- Stand
- White tile
- Dropping pipettes

What chemicals are required to determine the percentage by mass of copper in copper(II) sulfate crystals?

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- Deionised water
- $CuSO_4.5H_2O$ crystals
- $Na_2S_2O_3$ solution
- Starch solution
- KI powder

Outline an experimental procedure to determine the percentage by mass of copper in copper(II) sulfate crystals

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1. Accurately weigh out 6 g copper(II) sulfate crystals into a weighing boat.
2. Make up a 250 cm^3 standardised solution of copper(II) sulfate.
3. Pipette 25 cm^3 of the standard solution into a conical flask.
4. Add 1.5 g potassium iodide to the flask. Mix the flask thoroughly.
5. Titrate this solution with 0.1 mol dm^{-3} $Na_2S_2O_3$ in a burette. When the iodine colour fades, add 1 cm^3 starch indicator.
6. Use your titration data to calculate the percentage by mass of copper in the copper(II) sulfate crystals.

What is the purpose of the starch indicator?

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The starch reacts with any iodine in the reaction mixture to produce a deep blue colour. This indicates that the titration is not yet complete as there is still iodine left to react with the $Na_2S_2O_3$.

What is the ‘weighing by difference’ technique?

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Weighing by difference ensures that the mass of a solid is measured as accurately as possible.

The copper(II) sulfate is weighed in a weighing boat before it is added to the beaker of deionised water. The empty weighing boat is then reweighed after the iron(II) salt is added to the beaker, to calculate exactly how much solid was used to make up the standard solution.

What is a standard solution?

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A standard solution is a solution of known concentration.

How do you make up a standard solution of copper(II) sulfate from copper(II) sulfate crystals?

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1. Weigh the required mass of copper(II) sulfate crystals and add them to a beaker. Use the weighing by difference technique for accuracy.
2. Add enough deionised water to the beaker to dissolve the copper(II) sulfate crystals. Stir the solution with a glass rod.
3. Pour the solution into the volumetric flask.
4. Wash the funnel, rod and beaker into the volumetric flask.
5. Fill the volumetric flask up to the graduation mark using deionised water.

What is the purpose of ‘washing’ the funnel, rod and beaker into the volumetric flask when making up a standard solution?

What is the purpose of ‘washing’ the funnel, rod and beaker into the volumetric flask when making up a standard solution?

Washings ensures there is no solute left behind in the beaker or on the glass rod. This is important to ensure the concentration of the standard solution is as accurate as possible.

Why must the volumetric flask and graduation mark be at eye level when adding the final drops of deionised water?

Why must the volumetric flask and graduation mark be at eye level when adding the final drops of deionised water?

This ensures the graduation mark is being viewed at the right angle, allowing the solution to be made up to 250 cm^3 more accurately. This avoids parallax errors.

What is the meniscus?

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The meniscus is the curved surface of the liquid within a tube. When making the solution up to the graduation mark, the bottom of the meniscus should be exactly in line with the graduation mark.

Why is the copper(II) sulfate solution placed in a conical flask for titration?

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The conical flask allows the reaction mixture to be easily swirled without losing any of the contents.

Why must the reaction mixture be swirled during the titration?

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Swirling ensures all the reacting particles collide and react. This helps to give a more accurate end point for the reaction.

Why is a white tile regularly used in titration experiments?

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The white tile allows the point of colour change to be easily identified, ensuring the volumes are measured as accurately as possible.

Why might the burette be rinsed with $Na_2S_2O_3$ before titration?

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Rinsing the equipment with the solutions removes any water which may be in the equipment. This is important because the water will affect the concentrations of the solutions. Therefore, rinsing ensures a more accurate titration experiment.