WJEC (Eduqas) Chemistry A-level

SP C1.6a - Gravimetric Analysis

Flashcards

What is gravimetric analysis?

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Gravimetric analysis involves a collection of quantitative experimental techniques which are used to determine the mass or concentration of a substance by measuring a change in mass.

What chemicals can be used to carry out gravimetric analysis on an unknown metal chloride?

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0.5 mol dm^{-3} $AgNO_3$ solution

6.0 mol dm^{-3} HNO_3 solution

2.0 mol dm^{-3} HCl solution

What are the hazards associated with $AgNO_3$, HNO_3 and HCl?

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$AgNO_3$ - corrosive

HNO_3 - corrosive

HCl - irritant

Outline a method to identify an unknown metal chloride using gravimetric analysis

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1. Weigh 0.3 g of the unknown chloride into a 250cm^3 beaker.
2. Dissolve this sample in 100 cm^3 of deionised water and add 3 cm^3 of 6.0 mol dm^{-3} HNO_3.
3. Add 20cm^3 of $AgNO_3$ solution until silver chloride forms a gel and then add a further 5cm^3 of $AgNO_3$.
4. Heat the beaker carefully for 10 minutes - do not allow the solution to boil.
5. Leave the solution to cool for 2 hours.
6. Weigh a filter paper and place in a filter funnel.
7. Pour the mixture into the funnel and wash the precipitate into the beaker with 3cm^3 of wash solution.
8. Transfer all the precipitate to the filter funnel and wash with 20cm^3 of wash solution.
9. Test the used wash solution by adding 3 drops of HCl solution. If a precipitate forms, wash with a further 10 cm^3 and re-test.
10. Dry the precipitate in the filter paper at 105 °C until constant mass is attained

Identify the filtrate and residue in filtration

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Filtrate - the solution which passes through the filter paper

Residue - the solid collected on the filter paper

In the gravimetric analysis of a metal chloride, why is filtration used?

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Filtration separates the silver chloride precipitate from the solution. The silver chloride is left as the residue on the filter paper.

In the gravimetric analysis of a metal chloride, why is the filter paper weighed before use?

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This measurement can be used to calculate the mass of the solid on the filter paper at the end of the reaction. This means the solid does not have to be scraped off the paper to be weighed, so it gives a more accurate measurement.

Why should the solution not be allowed to boil in the gravimetric analysis of a metal chloride?

Why should the solution not be allowed to boil in the gravimetric analysis of a metal chloride?

Some of the solution may evaporate, causing some of the product to be lost. This would decrease the expected yield.

Why are washings used in the gravimetric analysis of a metal chloride?

Why are washings used in the gravimetric analysis of a metal chloride?

Washings are used to remove all of the precipitate from the beaker, allowing it to pour through the filter funnel. It collects any solid which may have stuck to the walls of the beaker, ensuring a maximum yield of product.

Why is deionised water often used as a wash solution?

Why is deionised water often used as a wash solution?

Deionised water does not have any ions in it so it will not interfere with any reactions taking place.

Why is HNO_3 diluted into the wash solution for the gravimetric analysis of an unknown metal chloride?

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The HNO_3 reacts with any ions which may also produce a white precipitate (e.g. carbonate ions). This ensures that if a white precipitate is produced, it can be assumed to be silver chloride.

In the gravimetric analysis of a metal chloride, why is the used wash solution tested with HCl?

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The HCl will react with any silver ions (Ag^+ ions) which have not yet formed silver chloride. The reaction will produce a white precipitate.

In the gravimetric analysis of a metal chloride, why is the solution re-filtered if the filtrate produces a white precipitate when tested with HCl?

In the gravimetric analysis of a metal chloride, why is the solution re-filtered if the filtrate produces a white precipitate when tested with HCl?

The white precipitate shows that there is still some silver chloride to be collected in the filter paper. It must be refiltered to ensure the maximum amount of product is collected. The filtrate must be re-tested with HCl until no precipitate forms.

Why is a final filtrate dried in a drying oven until constant mass?

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The constant mass indicates that all the water has evaporated.

Give the ionic equation for the reaction between silver nitrate and the unknown metal chloride

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$$Ag^{+}_{(aq)} + Cl^{-}_{(aq)} \rightarrow AgCl_{(s)}$$

What causes the white precipitate in the gravimetric analysis of an unknown metal chloride?

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Silver chloride (AgCl)

Why is HNO_3 added to a chloride solution before $AgNO_3$?

Why is HNO_3 added to a chloride solution before $AgNO_3$?

The HNO_3 reacts with other ions that might also give a white precipitate with $AgNO_3$, e.g. carbonate ions. This prevents the ions from being able to react with the $AgNO_3$.

In the gravimetric analysis of a metal chloride, why is the reaction mixture heated before filtering?

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The heating causes the silver chloride precipitate particles to start to coagulate (form a gel) which allows it to be filtered more easily.

In the gravimetric analysis of a metal chloride, why is the reaction mixture left to stand for two hours?

In the gravimetric analysis of a metal chloride, why is the reaction mixture left to stand for two hours?

The mixture is left to stand so that the silver chloride fully coagulates after heating. This will make the sample easier to filter.

How do you calculate the mass of the dried solid collected on the filter paper?

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Mass of solid =

Mass of solid on filter paper - Initial mass of filter paper