WJEC (Wales) Chemistry A-level

SP 3.2a - Simple Redox Titration

Flashcards

What is a redox reaction?

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Redox reactions are reactions in which both oxidation and reduction takes place. This means there is a transfer of electrons between chemical species, causing a change in oxidation states.

Describe how you can use a simple redox titration to determine the relative molecular mass of an iron(II) salt

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The iron(II) salt is made up into a standard solution and then titrated with a known concentration of potassium manganate(VII). The potassium manganate(VII) oxidises the Fe^{2+} ions to Fe^{3+} ions. The volume of potassium manganate(VII) required for titration can be used with the overall reaction equation to determine how many moles of the iron(II) salt took place in the reaction. This can then be used to determine the relative molecular mass.

Which species are oxidised and which are reduced in the reaction between potassium manganate(VII) and an iron(II) salt?

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Potassium manganate is reduced since it acts as the oxidising agent.

The iron(II) salt is oxidised.

What are the half equations for the reactions which take place when potassium manganate(VII) reacts with an iron(II) salt?

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$$MnO_4^-{}_{(aq)} + 8H^+{}_{(aq)} + 5e^- \rightarrow Mn^{2+}{}_{(aq)} + 4H_2O_{(l)}$$

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

What is the redox equation for the overall reaction which takes place between potassium manganate(VII) and an iron(II) salt?

What is the redox equation for the overall reaction which takes place between potassium manganate(VII) and an iron(II) salt?

Balance the electrons in the half equations and then combine the half equations so that the number of electrons cancel:

$$MnO_4^- + 8H^+ + 5Fe^{2+} \rightarrow Mn^{2+} + 5Fe^{3+} + 4H_2O$$

What apparatus is required to carry out a redox titration to determine the relative molecular mass of an iron(II) salt?

What apparatus is required to carry out a redox titration to determine the relative molecular mass of an iron(II) salt?

- Digital mass balance
- 50 cm^3 burette and funnel
- 25 cm^3 pipette and filler
- 250 cm^3 conical flasks
- 250 cm^3 volumetric flask

Outline the experimental procedure of a redox titration to determine the relative molecular mass of an iron(II) salt

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1. Accurately weigh out 9.8 g of iron(II) salt.
2. Make the salt up to 250 cm^3 of a standard solution with H_2SO_4 solution.
3. Titrate 25 cm^3 portions of the standard solution against the known concentration of $KMnO_4$ solution.
4. Use the results along with the overall reaction equation to calculate the relative molecular mass of the iron(II) salt.

What is a standard solution?

What is a standard solution?

A solution with a known concentration.

What apparatus is required to make up a standard solution?

What apparatus is required to make up a standard solution?

- Weighing bottle or boat
- 250 cm^3 volumetric flask
- Digital mass balance
- Funnel
- 250 cm^3 beaker
- Pipette

Why must the volumetric flask and graduation mark be at eye level when adding the final drops of H_2SO_4?

Why must the volumetric flask and graduation mark be at eye level when adding the final drops of H_2SO_4?

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.

When carrying out a redox titration of an iron(II) salt with potassium manganate(VII), why is there no need for an indicator?

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A colour change will take place due to the changes in oxidation states of the ions.

During the titration, the green solution of the iron(II) salt will turn orange/yellow. What does this colour change indicate?

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The green Fe^{2+} standard solution will be oxidised to a yellow/orange solution of Fe^{3+} ions. Therefore the change in colour is indicative of the redox reaction taking place.

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 iron(II) salt is weighed in a weighing boat before it is added to the volumetric flask. The empty weighing boat is then reweighed after the iron(II) salt is added to the flask, to calculate exactly how much solid was added to the reaction mixture.

What is the colour of potassium manganate(VII)?

What is the colour of potassium manganate(VII)?

Deep purple. It decolourises as it is reduced.

Why is a white tile regularly used in titration experiments?

Why is a white tile regularly used in titration experiments?

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

Why should the burette be filled below eye level?

The burette should be filled below eye level so that if any of the acid spills whilst being poured in, it will not splash into your face.

Why should the burette readings be taken from eye level?

Why should the burette readings be taken from eye level?

The readings should be taken from eye level so that the meniscus can be easily lined up with the burette scale and to avoid parallax errors.

Why is the iron(II) salt standard solution placed in a conical flask?

Why is the iron(II) salt standard solution placed in a conical flask?

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

Why must the reaction mixture be swirled during the titration?

Why must the reaction mixture be swirled during the titration?

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

Why are burettes and pipettes always used in titrations?

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Burettes and pipettes measure volumes very precisely.

Why might the burette be rinsed with potassium manganate(VII) before use?

Why might the burette be rinsed with potassium manganate(VII) before use?

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.