WJEC (Eduqas) Chemistry A-level

SP C2.1d - Double Titration

Flashcards

What apparatus is required to carry out a double titration?

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- 50 cm^3 burette
- Funnel
- Burette clamp and stand
- 25 cm^3 volumetric pipette with safety filler
- 2 x 250 cm^3 conical flask
- White tile

Why are burettes and pipettes always used in titrations?

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Burettes and pipettes measure the volumes of solutions very precisely.

Before use, why might the pipette be rinsed with the $NaOH/Na_2CO_3$ mixture and the burette be rinsed with HCl?

Before use, why might the pipette be rinsed with the $NaOH/Na_2CO_3$ mixture and the burette be rinsed with HCl?

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.

Outline the experimental procedure to determine the concentration and the mass of NaOH and Na_2CO_3 in a mixed solution

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1. Titrate 25.00 cm^3 of the mixed solution against HCl, using phenolphthalein as the indicator. Do not agitate the flask any more than necessary when mixing the acid.
2. Record the volume of HCl used at the phenolphthalein end-point.
3. Add methyl orange and continue titrating until its end-point.
4. Record the total volume of hydrochloric acid added to this end-point.
5. Repeat as necessary until the titration values obtained agree within 0.20 cm^3 and separately average results for the two values.
6. Calculate the concentration and the mass of NaOH and Na_2CO_3 in the mixed solution.

What type of reaction takes place between HCl and NaOH?

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Neutralisation

Give the chemical equation for the reaction that takes place between HCl and NaOH

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$$NaOH + HCl \rightarrow NaCl + H_2O$$

How does HCl react with Na_2CO_3?

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Na_2CO_3 reacts with HCl in two steps:

1. $Na_2CO_3 + HCl \rightarrow NaHCO_3 + NaCl$
2. $NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$

How does a double titration work to determine the concentration of NaOH and Na_2CO_3 in a mixed solution?

How does a double titration work to determine the concentration of NaOH and Na_2CO_3 in a mixed solution?

In the first titration the following two reactions occur:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

$$Na_2CO_3 + HCl \rightarrow NaHCO_3 + NaCl$$

In the second titration the following reaction takes place:

$$NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$$

The second titre gives moles of $NaHCO_3$ which is equal to the moles of Na_2CO_3. Then, moles of NaOH = moles of HCl in first titre - moles of Na_2CO_3. Then divide the moles of NaOH and Na_2CO_3 by volume used to determine the concentration.

Why are two different indicators used in the double titration?

Why are two different indicators used in the double titration?

There are two different end points in the titration. Different end points occur at different pH and so an indicator must be chosen so that the pH range of colour change coincides with the end point. In the double titration of the NaOH and Na_2CO_3 mixture, the first end point has a higher pH so phenolphthalein is used, and the second end point has a lower more acidic pH so methyl orange is used.

What is the colour change of phenolphthalein and at what pH does the colour change occur?

What is the colour change of phenolphthalein and at what pH does the colour change occur?

- Colourless in acid
- Pink in alkali

Phenolphthalein will change colour in the pH range 8.3-10.

What is the colour change of methyl orange and at what pH does the colour change occur?

What is the colour change of methyl orange and at what pH does the colour change occur?

- Red in acid
- Yellow in alkali

Methyl orange will change colour in the pH range 3.1-4.4.

What is the meniscus?

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The meniscus is the curved surface of the liquid within a tube. When taking a reading from a burette, the reading should be taken from the value exactly in line with the bottom of the meniscus.

What are the hazards associated with HCl, NaOH, phenolphthalein and methyl orange?

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HCl - irritant

NaOH - irritant

Phenolphthalein - flammable

Methyl orange - flammable

Why should the burette be filled below eye level?

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 are titrations usually carried out on a white tile?

Why are titrations usually carried out on a white tile?

The white tile allows the point of colour change to be easily identified.

Why is the $NaOH/Na_2CO_3$ placed in a conical flask?

Why is the NaOH placed in a conical flask?

The conical flask allows the mixture to be gently 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 is it important in a double titration that the conical flask is not swirled too vigorously during the first titration?

Why is it important in a double titration that the conical flask is not swirled too vigorously during the first titration?

In the first titration, HCl reacts with Na_2CO_3 and NaOH. Swirling may encourage the HCl to react with the $NaHCO_3$ formed from the reaction with Na_2CO_3. This reaction should not take place until the second titration, so it is important that the HCl avoids reacting with it.