An acid-base volumetric titration

Transcript

Volumetric titration is one of the major techniques used in quantitative analysis and utilises volume and stoichiometric equations to measure the concentration of a chemical in an unknown solution. The simplest type of volumetric titration is between an acid and a base.

In this experiment, the concentration of ethanoic acid in vinegar will be determined by a simple acid-base titration.

First, a dilute vinegar sample needs to be prepared. A twenty-five centimetres cubed pipette is cleaned by rinsing with deionised water from the wash bottle.

The vinegar is diluted by pipetting the stock vinegar solution into a standard flask.

Deionised water is then added and a plastic dropper is used to add the water as the solution gets near to the mark.

The flask is inverted three times to ensure that the contents are thoroughly mixed.

A fresh pipette, rinsed with deionised water, is used to pipette out the diluted vinegar into a conical flask.

Thymolphthalein indicator is added to the diluted vinegar and the conical flask is swirled gently to aid mixing.

A burette is attached to the burette holder making sure the tap at the bottom is closed.

A filter funnel is added to the top of the burette.

The whole set-up is moved to the floor so that the sodium hydroxide can be added easily.

The sodium hydroxide is added almost to the top.

The filter funnel is removed and a waste beaker is placed under the burette, and the tap is opened to allow twenty centimetres cubed to flow through.

The tap is then closed and the burette is refilled to above the zero mark as before.

The burette is then moved back up onto the lab bench and the tap is opened slowly to allow the level of sodium hydroxide to fall, until the meniscus is on the zero line.

A white tile is added under the burette and the conical flask, with the diluted vinegar sample, is placed on it. The white tile makes the colour change easier to see.

The first measurement is called the rough titre. This acts as an estimate for how much sodium hydroxide needs to be added to reach the end-point. It is not used in the final calculations.

The sodium hydroxide is added to the conical flask one centimetre cubed at a time.

The conical flask is gently swirled between additions until a permanent blue colour appears (at the end-point). No more sodium hydroxide is added.

The contents of the conical flask are poured down the sink and the flask is washed out with deionised water.

Next an accurate titre will be performed. The diluted vinegar sample is added to the clean conical flask using the pipette.

Thymolphthalein indicator is added and the conical flask is placed underneath the burette.

Seventeen centimetres cubed of sodium hydroxide is added to the flask and is gently swirled. The blue colour that is observed will disappear.

The sodium hydroxide is now added slowly and the flask is gently swirled.

The slow addition of drops is repeated until a permanent colour change is observed. The permanent blue colour is very pale.

A second accurate titration should be measured and at this point the burette may need to be re-filled to the top with sodium hydroxide.

The concentration of the ethanoic acid in the diluted vinegar sample, C_2 is calculated from the titration formula. The balanced chemical equation provides the values for n_1 and n_2. V_2 is the volume of the diluted vinegar solution used and V_1 is the average titre volume.

The titration formula is rearranged to find C_2. The original vinegar solution was diluted by one in ten. So, the value calculated is multiplied by 10 to give the concentration in the original undiluted vinegar.

Volumetric titration techniques are very useful in quantitative chemical analysis, such as analysing the acidity of drinks like orange juices and in measuring the effect of acid rain by analysing the acidity of water samples.