

Chemistry-AS-Assessed Practical (Skills P and A)

The aim of this experiment is to determine the concentration of limewater, in g dm^{-3} , as accurately as possible using hydrochloric acid, HCl.

In the experiment the hydrochloric acid must be diluted and then a titration can be done to find the concentration of limewater. The hydrochloric acid must be diluted as its concentration is too high. The concentration of the hydrochloric acid is exactly 2.00 mol dm^{-3} but it has to be to a similar concentration a calcium hydroxide so the titration can be done.

The first step is to dilute the HCl and then the second step is to perform titration of the calcium hydroxide.

The equation: $2\text{HCl} + \text{Ca}(\text{OH})_2 \rightarrow \text{CaCl}_2 + 2\text{H}_2\text{O}$

This equation is a neutralisation reaction and will be used for the titration so the HCl that will be added to the limewater, that contains calcium hydroxide, will be neutralised.

Equipments

Burette- For measuring HCl as it is accurate. It can measure to 0.05cm^3 .

Conical flask- For solutions to react in.

Pipette- For measuring limewater solution. This is also very accurate.

Pipette controller- To control amount of solution going in and out of pipette.

Clamp stand- To hold burette.

Clamps- To make sure equipments are secure.

Funnel- So chemicals can be poured safely without spilling.

White tile- To see clearly when reaction takes place.

Distilled water- To clean equipments with and to use in the experiment.

Beaker- To contain chemicals, solutions and distilled water

Chemicals

Limewater containing calcium hydroxide

Hydrochloric acid will be used in titration and dilution.

Bromothymol Blue to be used as an indicator. Bromothymol blue will be used as it shows the change clearly in the neutralisation. The colour changes from blue to yellow. Blue will be the colour of the alkaline which is the limewater and yellow will be the colour of the acid which will be the calcium chloride solution.

Safety Equipments

Lab coat will protect your clothing and you body if there is spillage of chemicals.

Goggles will protect your eyes from chemicals.

Gloves will keep you hands safe if the acid or alkali spill.

The safety equipment should be worn at all times during the experiment as this will keep you safe.

The concentration for the HCl is 2molar, this makes it an irritant so you have to be careful when using it and make sure you are wearing eye protection, gloves and a lab coat.

Ca(OH)_2 is also an irritant so precautions should be taken when dealing with it such as wearing eye protection, gloves and a lab coat.

Quantities and concentration of reagents used

In the experiment 250cm^3 of limewater is provided which contains approximately 1dm^{-3} . With the information you can work out the concentration of limewater(Ca(OH)_2).

The relative molecular mass, Mr, of $(\text{Ca(OH)}_2) = 40 + 2(16 + 1) = 74$

Then you use moles = mass / Mr which gives you $1 / 74 = 0.0135 \text{ mol dm}^{-3}$

The HCL has a concentration of 2 mol dm^{-3} which is too high and has to be diluted to around 0.02 mol dm^{-3} so it is similar to the concentration of limewater so it can be neutralised in the titration.

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Method

Diluting the acid

1. Measure 99cm^3 of distilled water using a pipette and place it in a beaker. This will have to be done by first measuring 50 cm^3 of distilled water and then 49 cm^3 of distilled water to get 99 cm^3 as the pipette can reach a maximum of only 50 cm^3 at a time.
2. Set up a burette over the beaker of distilled water using a clamp stand.
3. Put 50cm^3 of HCl in the burette using a funnel.
4. Let out 1cm^3 of HCl in the beaker of distilled water.
5. Stir the mixture to allow the HCl to dissolve.
6. The 0.02mol dm^{-3} of HCl solution is now ready.

Titration

1. Before starting the titration set up your equipment as shown in the diagram.
2. Use a pipette to measure 25cm^3 of calcium hydroxide into a conical flask.
3. Add two drops of Bromothymol blue to the calcium hydroxide, which will turn the mixture blue.
4. Add 50cm^3 of the HCl solution of 0.020mol dm^{-3} using a funnel in the burette. Remove the funnel once done.
5. Open the tap on the burette so the HCl solution can flow in the beaker.
6. Shake the beaker constantly so the reaction can take place.
7. Stop when the solution turns yellow as this is the point of where the calcium hydroxide is neutralised.
8. The value of HCl should be noted down as this can be used to work out the concentration of calcium hydroxide.
9. Repeat the experiment until three concordant values is produced.

The average of the results produced can then be used to work out the concentration of the limewater.

This is done by firstly working out the moles of HCl by,

Moles = concentration / volume

This gives,

Moles = 2/volume of HCl acid used

This gives you the moles of HCL used so this will allow you to do the calculations to work out the number of moles of calcium hydroxide which is,

Moles of HCl / 2 = Moles of calcium hydroxide

The mole of calcium hydroxide can be used with the volume of calcium hydroxide used to find the concentration using,

Concentration = moles / volume

To convert the mol dm^{-3} to gdm^{-3} , you have to multiply by the molar mass.

Sources

1. CGP AS-Level Chemistry The Revision Guide pg18
2. Cambridge Advanced Sciences Chemistry 1 book pg25-28