Titration-finding the concentration of a solution of sulphuric acid essay sample

Environment, Water

Aim

The point of this investigation is to find out the concentration of the sulphuric acid in my experiment. I will do this by titrating the sulphuric acid with sodium carbonate.

$H_2SO_4 + Na_2CO_3 \rightarrow Na_2SO_4 + H_2O + CO_2$

Acid + Alkali à Salt + Water + Carbon dioxide

Ratio of sulphuric acid to sodium carbonate:

$H_2SO_4 : Na_2CO_3$

1 : 1

Concentration of sulphuric acid:

H_2SO_4 is approximately 0. 05 – 0. 15 moldm-3

The average concentration of the sulphuric acid is:

0. 05 + 0. 15 = 0. 1 moldm-3

2

Concentration (moldm-3) = concentration (g dm-3)

Molar mass (g mol-1)

Mr of Na_2CO_3 = (23 x 2) + (16 x 3)

= 106 g mol-1

250cm3 x 0. 1moldm-3 x 106 gmol-1 = 2. 650g

1000cm3

I will use 2. 650g of Na2CO3 in 250cm3 of distilled water.

Apparatus

· Weighing bottle

· Clamp stand

· Glass rod

· 250cm3 volumetric flask

· Small conical flask

· 50cm3 burette

· 100cm3 beaker

· 25cm3 pipette

· Pipette filler

· Plastic pipette

· Small filter funnel

· Balance

· Distilled water

· Sulphuric acid

· 2. 650g of sodium carbonate

· Spatula

· White tile

· Methyl orange indicator

Method

· I will make a solution where the solute will be the sodium carbonate and the solvent will be distilled water.

· I will first measure the weighing bottle on its own without the lid on.

· I will then make the weight of the bottle equal to 0. 00g on the balance.

· I will add 2. 650g of sodium carbonate using a spatula.

· I will then pour the sodium carbonate into a beaker, which has been washed out with distilled water to remove unwanted compounds.

· I will weigh the mass of the weighing bottle without the lid on.

· I will add distilled water to the beaker, drop by drop to make a viscous solution in order to reduce the amount of solid formed.

· I will add approximately 100cm3 of distilled water into the beaker.

· I will use the glass rod to stir the solution and get rid of solid forms.

· After the sodium carbonate has dissolved completely in the distilled water, I will wash out the sodium carbonate into the volumetric flask. I will do this twice with 100cm3 of distilled water.

· Then I will add slightly less than 50cm3 of water to the beaker and pour that into the volumetric flask.

· Then I will use a pipette to add distilled water to the volumetric flask up to the 250cm3 line and will make sure that I can see the bottom of the meniscus reach the line at eye level. I will be using 250cm3 of the solution so that I have a known volume of the solution.

· Then I will put the stopper onto the volumetric flask and make sure that it is secure. Then I will shake the volumetric flask 100 times, making sure that my thumb is pressing down on the stopper of the volumetric flask so that the solution does not seep out.

· I will then set up the experiment. I will set up a clamp stand on the workbench. I will attach a 50cm3 burette to the clamp stand.

· I will put a funnel in the top. I will put a beaker under the burette.

· I will then wash out the burette with a sample of the sulphuric acid I will be using in order to get rid of any unwanted compounds. I will remove this beaker of acid from the experiment.

· I will get a pipette and pipette filler and suck up some of the solution from the volumetric flask until the pipette is half full. I will then remove the pipette

filler and press my thumb against each side of the pipette and shake the pipette from side to side to get rid of any other elements in the pipette. I will then take the pipette to the sink and release the solution.

· I will then draw up 25cm3 of solution from the volumetric flask and make sure the bottom of the meniscus has reached the line at eye level. I will use a pipette filler. I will then expel the solution from the pipette into a conical flask.

· I will tap the end of the pipette against the conical flask to release a few more drops, although some of the solution will remain inside.

· I will use a plastic pipette to add five drops of phenyl orange to the conical flask. The solution will turn an orange colour. The phenyl orange is an indicator, which stays orange when it is neutral but turns red when it is acidic.

· I will put the conical flask on top of a white tile so that it is easy to see any colour change that will take place in the solution. I will put the conical flask and the tile directly under the tap of the burette.

· I will make sure that the tap of the burette is closed and then pour about 45cm3 of acid into the burette.

· Then I will use a plastic pipette to make sure that the bottom of the meniscus is at the 0. 00cm3 line. I will check this at eye level. While handling acid, I will wear safety glasses.

· I will remove the funnel from the top of the pipette to prevent any stray drops of acid falling into the burette and changing the amount of acid in there.

· My partner will turn the tap of the burette to release 1cm3 of acid into the beaker each time, while I will be swirling the solution around in the conical flask and noting any colour change.

· As soon as the solution in the conical flask changes colour to a hint of red, I will note down the amount of acid that has been released from the burette to 2 decimal places. I will read it off at eye level.

· After each individual titration I will wash out the conical flask with a sample of the sodium carbonate solution.

· I will titrate until I have three concordant titres that are 0. 01cm3 or less apart.

Safety

While handling the sulphuric acid I will wear safety glasses, because the acid is corrosive. It gives out heat when added to water, which can cause severe burns. I will make sure that the experiment is set up away from the edge of the workbench and that the burette is secure in the clamp. In the event of a spillage, gloves must be worn when cleaning up the sulphuric acid.

Fair test

I will use the same amount of sodium carbonate solution, 25cm3 in every titration that I will carry out.

I will use five drops of methyl orange indicator each time.

I will always fill the burette up to the 0. 00cm3 line.

I will always wash out the conical flask after each titration.

Analysis

Rough titration Titration 1 Titration 2 Titration 3

Initial burette reading (cm3) 0. 00 0. 00 0. 00 0. 00

Final burette reading (cm3) 49. 50 48. 50 48. 45 48. 55

Value of titre (cm3) 49. 50 48. 50 48. 45 48. 55

Average titre (cm3) (48. 50 + 48. 45 + 48. 55) / 3 = 48. 50

Number of moles (mol) = concentration (moldm-3) x volume (dm3)

Cb = Mass / (Volume x molar mass)

2. 639g / (0. 25 x 106) = 9. 96×10-2 moldm-3

Vb = 25cm3/1000 = 0. 025dm3

Nb = 0. 025dm3 x 9. 96×10-2moldm-3 = 2. 49×10-3 moles

Na = 2. 49×10-3 moles

Va = 48. 50cm3 / 1000 = 0. 0485dm3

Ca = Na / Va

Ca = 2. 49×10-3 mol / 0. 0485dm3 = 0. 051moldm-3

Evaluation

The experiment was carried out with very accurate apparatus. The burette was accurate to 2 decimal places, so this should have led to a precise titration. It was easier to see how much solution was in the pipette then in the burette. This is because the pipette is quite short and could easily have been viewed at eye level. The burette was fixed to a clamp stand which stood on top of the work bench, making it difficult to view the 0. 00cm3 marking on the top of the burette, which was the mark at which we filled the burette up to. I tried to lower the burette as much as I could but still found it difficult to read the marking from the bottom of the meniscus. This might have led to a large error because the titration's that I did were supposed to be concordant results and accurate to 0. 1cm3.

If I obtained any incorrect readings due to being unable to view the burette at eye level, the individual readings might have had a difference of over 0. 1cm3 and this might lead to the imprecise average titration at the end. I would have got better results if I had made the burette easier to read by placing the clamp stand and the burette on top of a stool where I would have got a more accurate reading at eye level. However it was not possible to do this because the surface of the stool was not level so the burette would have

been at an angle, giving an inaccurate titration. I used distilled water to make the sodium carbonate solution because the tap water will have impurities in it and that may affect the titration. I always took the lid off the weighing bottle when I measured the mass because if I left the lid on when I weighed the bottle at the end of the experiment, it would have given an additional mass to the sodium carbonate that was left over.

I washed the beaker that I used with distilled water to get rid of any compounds left over from the other experiments. I used the technique of putting the sodium carbonate in the beaker first, and then adding water drop by drop, in order to reduce the amount of solid clumps formed. I washed the beaker out three times with distilled water into the volumetric flask. I made a solution of 250cm3 so that it was a known amount and I could use it in my calculations. I did not fill the volumetric flask up to the 250cm3 line in one go, because if it went over that line, then I would have to start again. This is because if I did not have a known solution of sodium carbonate I would not have known how much of it was needed to react with the acid. I used a pipette to add distilled water to the volumetric flask up to the 250cm3 line and made sure that I could see the bottom of the meniscus reach the line at eye level. I did this by putting the flask on top of the workbench so that the solution was steady and I bent down to eye level.

I shook the volumetric flask 100 times to make sure that the sodium carbonate was distributed evenly throughout the solution. I washed out the pipette with a sample of sodium carbonate solution to get rid of any other elements in the pipette/ I always pipetted out 25cm3 of solution so that I had

a known volume of sodium carbonate reacting with the sulphuric acid. However, there ware always a few drops left in the pipette. But these few drops would have made a minute difference to the amount of sodium carbonate in the beaker. I always removed the funnel from the top of the burette because even a few drops could have changed the level of acid inside. On the rough titration, my partner released the acid 1cm3 at a time, while I was swirling the solution in the flask and checking the colour. As soon as we got a rough titre, on the real titration we made sure that as soon as we got close to that titre we released the acid in minute amounts. This ensured that the titres were accurate. Each time we did a titration, I washed out the conical flask with a sample of the sodium carbonate to get rid of any of the sodium sulphate formed.