Thermometric Titration

Aim

To follow the titration and to find the endpoint by measuring the temperature changes take place during the titration. The importance of temperature in the experiment implies there is a connection with heat therefore the experiment is exothermic. Thus the products are at a lower energy level than the reactants so the energy has been given
The acid and alkali we will use is sodium hydroxide and Hydrochloric acid.

Background

If an acid solution is added to an alkaline solution they will react and neutralize each other, forming a salt. The general Formula for this reaction is

Acid + Base $\longrightarrow$ Salt + Water

However, the resulting solution will be neutral only if acid and alkali are present in exactly the right quantities. If there is more acid than alkali, the all though all the alkali will be neutralized the solution will remain acid. On the other hand if there is more alkali than acid the solution will remain alkali. The precise volumes of acid and alkali solutions will neutralize each other out exactly.

In a titration there is always one solution of accurately known solution, containing a known substance with an unknown concentration, is placed in a conical flask. The result from the titration is used to calculate the amount of substance present in the solution in the conical flask.

Prediction

I predict that as more of the acid is added to the alkali the temperature of the solution will rise because an exothermic reaction is taking place. I also think that at a point the temperature will cease to rise and that will be after neutralization has taken place.

Factors

I think that a factor that could effect the investigation would be the concentration of the solutions say if the acid was extremely concentrate and the alkali was very weak the experiment would prove to be slightly difficult because it would be over in a few cm cubed or it would take a long time and thus have increase the amount of acid we injected into the cup so decreasing accuracy.

Also Human error could be a factor if accidentally a couple of extra drops slipped into the solution and could amount to 0.5cm cubed and therefore my results would be wrong.

Also if the thermometer happens to be little bit out I wouldn't notice and thus my experiment could become inaccurate

Apparatus

Burette
Conical Flask
Beaker
Thermometer
Test tube
Hydrochloric acid
Sodium hydroxide

Method

In my experiment I will fill the burette with hydrochloric acid and I will put 20cm cubed of sodium hydroxide in a conical flask. Into the conical flask I will place a thermometer to record temperature changes and try to find the end point.
I will add 5 drops of hydrochloric acid to the sodium hydroxide swirl quickly and then take a thermometer reading. I will do this until the temperature starts to decrease therefore meaning that all the neutralization has taken place. I will repeat the experiment until before it started to decrease in temperature and that should be my end point.

In the actual experiment we had 50 cm2 of hydrochloric acid in the burette and we then used a pipette to accurately measure 25cm2 of sodium hydroxide and we placed that in a cup under the burette so we could accurately measure with a thermometer and we could stir the solution. We then tried two different ways to get an accurate reading. We tried drooping in 2cm2 of acid into the alkali until the temperature started decrease and then we tried it drooping 1cm2 at a time to get a more accurate set of results.

Results

Cm^3 of Acid Added	Temp (ºC) 1st Experiment	Temp (ºC) 2nd Experiment
0	19.0	19.8
1	-	20.0
2	20.0	20.4
3	-	20.6
4	20.6	20.8
5	-	21.1
6	21	21.3
7	-	21.6
8	21.4	21.8
9	-	22.0
10	21.7	22.3
11	-	22.4
12	22	22.7
13	-	23.0
14	22.2	23.0
15	-	23.1
16	22.5	23.3
17	-	23.3
18	22.6	23.4
19	-	23.5
20	22.8	23.5
21	-	23.4
22	22.6	23.3
23	-	23.2
24	-	-

Conclusion

I conclude from my results that I collected, and the graph that I constructed with the my results, that as more acid is added to the alkali solution, that the temperature rises, which is what I predicted in my prediction. This is because an exothermic reaction is taking place between the acids and alkali every time I add $1cm^3$ of acid.

Also at the end point (neutralization) the temperature ceased to rise and actually dropped again correct with my prediction. This is because the solution has been fully neutralized and is only getting more acidic so there is no exothermic reaction-taking place.

My graph shows that after $20cm^3$of acid had been added to the alkali the solutions temperature stopped rising. This is because all of the alkali has been neutralized and the solution is now becoming acidic.

Evaluation

I think my experiment went as planned I got my results ad plotted them accurately onto a graph. I feel the accuracy of my experiment was down to the accuracy of the equipment being used i.e. burette and the pipette.

I think my experiment could still be more accurate at measuring the temperature rising. If I could do the experiment again I would put a certain volume of acid into the alkali and I would watch the temperature rise and time it so I would be very accurate rather than only accurate to 1cm cubed.