Chemistry Assessed Practical 2
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Planning:

Introduction and background:

The experiment is the mixing of hydrochloric acid and calcium hydroxide together and using an appropriate method to find the concentration of limewater. This is the equation of the reaction:

$$Ca(OH)_2(aq) + 2HCl(l) \longrightarrow CaCl_2(aq) + 2H_2O(l)$$

Knowing this and using calculations we can work out the concentration of limewater having titrated the two solutions, from the volumes and concentration of HCl. In the presence of Phenolphthalein hydroxides turn pink, when neutralized, go colourless, this will be the indication of the end of the reaction, when all limewater is reacted. However as stated in "Chemistry in context", phenolphthalein has a very high end point to its pH scale, making it suitable for use in titrations with fairly high concentrations. But clearly using a weak base like calcium hydroxide would make methyl orange a better choice. Using phenolphthalein would change in colour before the point of balance between acid and base, thus giving inaccurate results.

Method:

In order to find out concentration of the limewater, we need to dilute the hydrochloric acid to a very low concentration, so that it neutralizes the limewater slowly enough to record the change in volume of acid titrated. I predict that $0.02mol/dm^3$ solution of HCL acid will be sufficient as the limewater is stated to be around $1g/dm^3$ which is about $0.013mol/dm^3$. With the given solution of HCl, it is easily be diluted by adding water. Add exactly $25cm^3$ of HCl (using a glass pipette) to a $250cm^3$ volumetric flask then fill to the mark, then take exactly $25cm^3$ of this solution and dilute again in another identical flask to form the required concentration of $0.02mol/dm^3$. A control should also be made with excess HCl acid used to ensure that the end result colour is correct.

Thus we are set to carry out the experiment, using a regular titration set up, with the following method and apparatus:

Apparatus:

- Volumetric flasks 250 cm^3
- Burette
- Pipette $25cm^3$
- Beakers
- Chonical flasks 250 cm^3
- Retort stand and clamp
- Methyl orange
- Burette funnel
- White tile
- Provided solutions: $250cm^3$ limewater of $1g/dm^3$ and 2Mol solution HCl acid

Method break down:

Having diluted the acid appropriately, prepare the equipment as follows:

1. Clamp a burette to a retort stand securely, ensuring that the tap is closed
2. Pipette 25cm^3 volume of calcium hydroxide solution in a chonical flask, adding 4 drops of methyl orange to the solution, turning it orange. Then place this chonical flask on a white tile directly beneath the burette.
3. Using a burette funnel fill the burette with the diluted HCl acid, then remove burette funnel. Take initial volume reading and record.
4. Open the tap on the burette and swirl the chonical flask until a colour change occurs, then close the tap immediately, then open very slightly to allow only drops to come out, then stop when the whole solution turns pink.
5. Take an accurate reading of the final burette reading, record this.
6. Using a new flask with fresh solution of the same volume repeat the titration. Take 5 repeats including one rough reading.
7. Using calculations find out the concentration of calcium hydroxide. This can be done by using the equation: Concentration=Moles x Volume. See preliminary calculations sheet over page. The results will be recorded in a table like this:

	Rough	1	2	3	4
Initial Burette reading (cm^3)					
Final burette reading (cm^3)					
Volume of 0.02Mol/ dm^3 HCl used					

Safety/Precautions:

Always wear a lab coat and safety spectacles. Great care must me taken when handling the concentrated HCL, it is corrosive and will damage bare skin, and especially eyes, care must be taken to not spill the substances on your hands.

Precision and accuracy:

- I have chosen the apparatus such that it provides the most accurate answers possible. Glass pipettes and volumetric flasks are the most accurate way of measuring out volumes; and burettes. These instruments carry accuracy of +/-0.05 cm^3, clearly the small error should not place the results very close to actual volumes.
- As explained before, I decided to use methyl orange for its low pH end scale of pH5-8, which will give a colour change at the appropriate phase of the reaction.
- Repeats will be done to check precision, the results may not be 100% accurate but if concurrent, I can analyse why this is the case, without having to say it was due to other variables like pressure, etc.

Analysis:

Refer to the results section.

Clearly, from the result of almost exactly 1g/dm^3 very near to the approximated concentration given to us. This proves that my result must be accurate. However the average titre volume was not exactly the same as the predicted volume, this probably means that the actual concentration was either almost exactly 1g/dm^3 as shown by my results or there was some error within my experiment which caused the inaccuracy. However with concurrent results I can conclude that my results are reliable, especially since the exact concentration of the calcium hydroxide cannot be assumed to be any particular value as it is given as an approximate value.

When carrying out the titrations, I found that after the full colour change had taken place, after about 30 seconds the solution returned to its orange colour, although with a predominant pink tinge. This was the reason for my initial rough titre volume only being 25cm^3. This led me to add about 0.5cm^3 of HCl acid until no colour change occurred. This solution was then used as the control, which allowed me to check when each reaction had reached its end, alongside with the use of the control with excess acid, which differed very slightly in intensity in colour. Therefore I can conclude that there is a "lag" period when the acid is diffusing around the solution, as it is neutralized after a short gap period after it is added, indicated by the solution returning to its pink colour.

Another cause for the possible inaccuracy is the calcium hydroxide solution decanted- a white solid deposited on the base of the large flask containing the calcium hydroxide solution. This would have caused the solution to be a different concentration completely. Thus I swirled it in order to get a constant concentration throughout the solution. However, the constant effect of the particles depositing leads me to conclude that each titration was different in its results as the concentration of the calcium hydroxide varied each time.

Overall, the results were prove to be concurrent and accurate, however there was still error accounted for due to the way calcium hydroxide solution acts and due to the colour change observed not being definite.

After the practical we collected results from everyone in the class in order to see what the average concentration of limewater. This is a table of everyone's results:

Name	Concentration
Me	1.006
Adam	0.913
Scott	1.04
Mehul	1.934
Maneesh	0.8151
Raj	0.868
Unni	0.91

Average: 0.941g/dm^3

The average concentration indicates that my result was very close, thus I can conclude that I came very close to the actual concentration of the limewater solution.