

V. Scally - Titration assignment

by Vick Scally

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UWTSD
OME DEGREE COURSE

Victoria C. Scally

Titration Lab assignment

professional title page

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good ToC and Tables

1. INTRODUCTION

Titration

Titration is a method that can be used to determine the concentration of an unknown sample. It is reacted with a standard solution (which is a solution with an exactly known concentration) until the equivalence point is reached. This is seen using an indicator, which changes colour once the test reaches its end point. The indicator in this case is phenolphthalein. Once this turns pink the neutralisation reaction is complete.

In this experiment, sodium hydroxide (NaOH) is used along with an indicator to test the hypothesis that using a sample of known concentration along with an indicator can be used to find the concentration of (in this case) hydrochloric acid (HCl). The aim of this experiment is to as accurately as possible determine the concentration of HCl using NaOH at concentration 0.09977mol/L.

variables are not identified

Results

Flask	1 rough titration	2	3
V HCl (mL) from pipette	25.00 <i>precision of pipette is 0.05 mL; sig figs!</i>	25.00	25.00
Initial burette reading (mL)	0.00 <i>the precise reading of burette is either .00 or .05 mL</i>	16.85	22.62
Final burette reading (mL)	16.85	33.55	16.29 <i>wrong calculations</i>
V NaOH (mL)	16.85	16.7	16.29
Moles of NaOH (mol)	0.001681	0.001666	0.001625
Moles of HCl (mol)	0.001681	0.001666	0.001625
Molarity HCl (mol/L)	0.06724	0.06664	0.06500

Table 1: Table of results of titration



The number of moles of HCl equals the number of moles of NaOH at the endpoint. Essentially, the moles of H^+ equals moles OH^- .

The equation for molarity, $M = n / v$ can be solved for n (number of moles).

$$M_A V_A = M_B V_B$$

Discussion

The above results were used to calculate the Moles of HCl as seen in Table 1. As seen in the results table, the results are not consistent. The rough titration was a very pink colour, the second titration appeared less pink though still an obviously pink colour and the third was by far the most accurate with a barely visible pink colour, shown by the indicator. This final titration was by far the most accurate and shows the need for accuracy as well as the need for taking the time to complete the titration in a less rushed manner. Errors can also be made when measuring the meniscus, to ensure the most accurate reading this must be read at eye level. Results can also be affected by the presence of contaminants in the equipment, although the equipment was rinsed before use, it is still possible to have contaminants present. *you could have shown pictures here*

Relevance to OME

Titration is used within OME to find the presence of certain substances after an explosive reaction, or in explosive analysis. This has been used to analyse fluoride in explosives. As fluorine is highly toxic, it is useful to calculate the concentration produced during an explosive reaction to establish the effects this could have on the environment.

"The procedures listed above are recommended for the analysis of the explosive LX-09. They supersede the previously reported sequential extraction procedures. Various procedures for the analysis of fluorine in explosives have been reported by the writer. 3 • 4 • 5 The method of titration with thorium nitrate using methylthymol blue indicator 6 is recommended because of its simplicity." [1]

Conclusion

This experiment proved the hypothesis that conducting a titration of sodium hydroxide and hydrochloric acid can be used to calculate the molar concentration of the hydrochloric acid. The results are highly dependant on human accuracy and error rates are high when not carried out carefully, as seen with the results in table 1. This can be improved by repeating the experiment a number more times to improve accuracy. A pipette that can hold the exact volume of what is required could also help to reduce error factors.

References

[1] Walter Selig, "SOME ANALYTICAL METHODS FOR EXPLOSIVES, PART III," *Osti.gov*, Sep. 1969. <https://www.osti.gov/servlets/purl/4164713> (accessed Mar. 22, 2025).

Appendix

Materials

- 1x 50mL burette attached
- burette stand and clamp
- 1x10/5mL Pipette
- 3x 100 mL conical flasks
- 1x funnel, small
- 1x Plastic pipette
- 1x deionised water bottle
- 1x 100mL Graduated cylinder
- 1x White paper
- 1 waste disposal beaker

Method

Step 1:

Wash the pipette with deionised water from the wash bottle. Use HCl to wash this again and then discard the washings

Wash the burette with deionised water and then a small volume of NaOH, discard and then use the funnel to pour a few mL of NaOH

Wash the conical flask with a small amount of deionised water

Step 2:

Fill the burette with NaOH solution, run this through the tap until the bottom of meniscus is on the zero level. This will ensure there are no air bubbles, if in doubt, repeat. Record the reading.

Step 3:

Fill the three conical flasks with 25mL of HCl solution using the pipette.

Step 4:

Add 3-4 drops of phenolphthalein indicator (in this case this step was completed by a lecturer) to each conical flask which contains acid, add 10 mL of deionised water using a graduated cylinder.

Step 5:

Run the NaOH solution into a conical flask using the tap, mixing thoroughly by swirling, stop when the solution turns pink. This is the rough titration and will estimate the volume of NaOH

required

recured to reach neutralisation.

Record the reading on the burette.

STEP 6:

Run the NaOH into the acid /indicator/water mix until the volume of NaOH is within 2 mL of the rough titration. Decrease the tap of the burette to a drip, this means it is possible to get more accurate results within 0.05mL (one drop) of HCl required to reach neutralisation. Take a reading as soon as the whole solution changes colour, swirl the flask as the colour can appear to change and then dissipate.

STEP 7:

Repeat steps 5 and 6.

Ensure results are clearly recorded and note any errors.

scan of raw data not included; verification of burette readings - not possible

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GRADEMARK REPORT

FINAL GRADE

50/100

GENERAL COMMENTS

Engagement with Literature Skills 5.5/15

Only one source is cited, an older but relevant document on fluorine titration in explosives. While the content is appropriate for OME context and the IEEE referencing format is followed, there's no attempt to integrate multiple sources or offer comparison with other studies or titration methods.

Feedback: Incorporate more recent, peer-reviewed, and diverse literature, and link the performed experiment more closely with the cited material.

Knowledge and Understanding Skills 11.5/20

The report explains the titration concept well, including the aim, the use of a standard solution, and the endpoint based on indicator colour change. The balanced chemical equation is correctly written, and MAVA and molarity equations are mentioned. However, key terms like dependent/independent variables are not defined, and net ionic equation is missing.

Feedback: Clarify experimental variables and enhance theoretical explanation with ionic equation and definitions for completeness.

Cognitive and Intellectual Skills 12.5/25

The calculated moles and molarities are shown in the table but actual calculations are missing. You reflect on issues of accuracy, such as meniscus reading and over-pink endpoint. However, analysis is fairly general and lacks deeper interpretation of patterns. The mention of inconsistencies is helpful, but no average is calculated, and OME discussion is brief and limited to a single fluorine-related example.

Feedback: Add a calculated average HCl concentration and develop more critical insight into data trends and relevance to OME applications.

Practical Application Skills 12.5/25

Most of the calculations are correct except Trial 3. There are errors in sig. figs.

Feedback: include volume conversions and mole/molarity calculations.

Transferable/Professional Skills 8/15

The structure is logical with a contents page and headings. Language is clear, and passive voice is mostly used. However, grammar could be improved in places ("recured" instead of "required", missing capitalisation).

Feedback: Proofread for grammar and spelling.

PAGE 1

Text Comment. professional title page

PAGE 2

Text Comment. good ToC and Tables

PAGE 3

Text Comment. good definition of titration

Text Comment. relevant hypothesis and aim

Text Comment. variables are not identified

Text Comment. .00

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Text Comment. .00

Text Comment. precision of pipette is 0.05 mL; sig figs!

Text Comment. the precise reading of burette is either .00 or .05 mL

Text Comment. wrong calculations

Text Comment. no comment

Text Comment. $\text{H}^+ + \text{OH}^- \rightarrow \text{H}_2\text{O}$

Text Comment. no calculations are shown

Text Comment. you could have shown pictures here

Text Comment. required

Strikethrough.

Text Comment. scan of raw data not included; verification of burette readings - not possible