NEATH PORT TALBOT COLLEGE
COLEG CASTELL NEDD PORT TALBOT

School of Maths & Science
Science Practical

Titration of a Solution of Sodium Hydroxide using Hydrochloric acid

◆ Aim

At the end of the experiment you should be able to:

1. Accurately use a pipette and a burette
2. Perform a titration to an acceptable degree of accuracy.
3. Calculate the concentration of the sodium hydroxide solution.
4. List any errors and evaluate your answer

◆ Introduction

Hydrochloric acid reacts with sodium hydroxide as follows:

$$HCI(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_20(l)$$

You are required to carry out a titration and then calculate the concentration of the given sodium hydroxide solution.

◆ Safety

Control Measures

The wearing of **safety glasses** and a **laboratory coat at all times** will be sufficient to take account of most hazards and **significant tasks.**

- Keep stoppers on bottles as much as is possible.
- Keep flammable liquids away from flames.
- All waste is to be placed in the labeled container immediately after use.
- You are reminded of the need of good laboratory practice in order to maintain a safe working environment.

Hazards

(Highly) Flammable Phenolphthalein

Corrosive Hydrochloric acid, Sodium Hydroxide

◆ Procedure

1. Clean and fill the burette with sodium hydroxide solution
   Pipette 25.00cm^3 of the hydrochloric acid solution into a conical flask and add 2-5 drops of phenolphthalein.
2. Add the sodium hydroxide solution from the burette, proceeding more cautiously as you are approaching the equivalence point. Shake well after each addition and note the reading at the first permanent pink tinge. (NOTE: RECORD ALL READINGS TO TWO DECIMAL POINTS WHERE THE LAST POINT IS A -0 or a -5 e.g. 22.5<u>5</u>, 22.6<u>0</u>
3. Perform a second ACCURATE titration (i.e. go quickly to within 2cm^3 of your initial rough titre and then add drop by drop, stirring between each drop, until a permanent colour is observed
4. Perform another accurate titration – your titrations should be within 0.1cm^3
5. If your titre is not acceptable, repeat the titration procedure until the titre is within an acceptable value. (You should have three values within 0.1cm^3. Record your titre values in the results section.
6. Determine your average titre (clearly show which values you are choosing)
7. Calculate the concentration of the sodium hydroxide solution.

◆ Results

Concentration of HCl (on bottle) …….

Volume of HCl used …….

Colour change observed at endpoint with Phenolphthalein indicator …….

<u>Table of Titres</u>

	Rough	**1**	**2**	**3**	**4**	**5**
Final volume (cm^3)						
Initial volume (cm^3)						
Titre (cm^3)						

Tick the titres you have used to obtain the mean titre

Average Titre (Volume of NaOH) _____cm^3

◆ Calculation

Calculate the concentration of NaOH solution;

1. Calculate the no. of moles of HCI used in the reaction (you know the volume and concentration)

2. Determine the mole ratio of HCl to NaOH (sec equation and hence write down the no. of moles of NaOH in the reaction

3. Use the volume of NaOH used and the no. of moles of NaOH calculated to determine the concentration

♦ Errors and Evaluation

1. Comment on the possible sources of error in the experiment- other than operational error (Use the attached sheet to answer this, this is important for your coursework)

2. *Estimate* the error in your result assuming that the tolerance of the burette is the chief source of error in the titration. When we read the scale on a burette we introduce an uncertainty of 0.14 cm^3 due to the tolerance of the burette.

The percentage error in your work is given by: % error = (0.14/Titre value) x 100

Error in final concentration is given by: Concentration acid x $\frac{\%\ \text{error}}{100}$ $moldm^{-3}$

Concentration of acid should be therefore quoted as: calculated value +/- error $moldm^{-3}$
e.g 0.0502 +/- 0.0003 $moldm^{-3}$

3. What precaution should be taken when filling the burette with the sodium hydroxide solution?

Sources of Error

- **Tolerance of apparatus**

  Some uncertainty is introduced into the titration by the apparatus itself. The glassware that we use is grade B. Therefore when we use a burette the uncertainty introduced into our titre is +/-0.14 cm3. Likewise use of the balance, volumetric flask and pipette introduces some uncertainty due to the tolerance to which they are made.

We could use glassware which is stamped grade A. This glassware is more accurate and introduces less uncertainly into the results. However it is also more expensive.

- **Temperature**

  The glassware is stamped 20 °C and therefore is calibrated to be used at this temperature. If the temperature is different small errors may be introduced due to expansion/ contraction of the apparatus.

Use apparatus at correct temperature

- **Indicator errors**

  The use of an indicator will introduce a small error into our endpoint.

- **Apparatus is damaged/unclean**

  A chipped pipette will not deliver the specified volume.
  The presence of grease in the apparatus can affect the volume readings.
  Glassware that is washed at high temperatures may be permanently damaged in the process.

Always check apparatus for cleanliness/damage before use. If a pipette does not drain properly it is probably greasy.

- **Operator errors.**

  There should be no operator errors for an experienced user but there are probably a large number of these for the first few titrations that you perform.

  One of the less obvious involves (mis)reading of the meniscus (parallax errors). To prevent this always read a meniscus at eye level.

Work carefully and systematically. Learn good practice.