Syed Naqib

CHEMISTRY PRACTICAL
PLANNING EXERCISE

TITRATION METHOD

Aim:

To demonstrate that sulphuric acid, H_2SO_4 is a dibasic acid through titration.

Equipment:

50 cm^3 Burette,
25 cm^3 Pipette,
Conical flask,
Funnel,
Distilled water,
0.1 mol dm^{-3} Sulphuric Acid,
0.1 mol dm^{-3} Sodium Hydroxide (NaOH) solution,
Phenolphthalein indicator,
Clamp stand for burette,
White tile,
White lab coat,
Gloves and
Goggles

Background Information:

My experiment involves proving that Sulphuric acid, H_2SO_4 is a dibasic acid. A dibasic acid is defined as one for which one mole of the acid is completely neutralised by two moles of an alkali such as sodium or potassium hydroxide (http://chemistry-react.org/go/default/Faq/Faq_3582.html). Sulphuric acid is a dibasic acid because it has 2 hydrogen atoms which can be ionized in aqueous solution to give hydrogen ions, H^+ (http://www.ucc.ie/academic/chem/dolchem/html/comp/h2so4.html).

$$H_2SO_4 \longrightarrow 2\,H^+ + SO_4^{2-}$$

Equation for reaction with Sodium hydroxide:

$$H_2SO_{4\,(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4\,(aq)} + 2H_2O_{(l)}$$

Molar ratio 1 : 2

i.e. $2H^+ + 2OH^- \longrightarrow 2H_2O$

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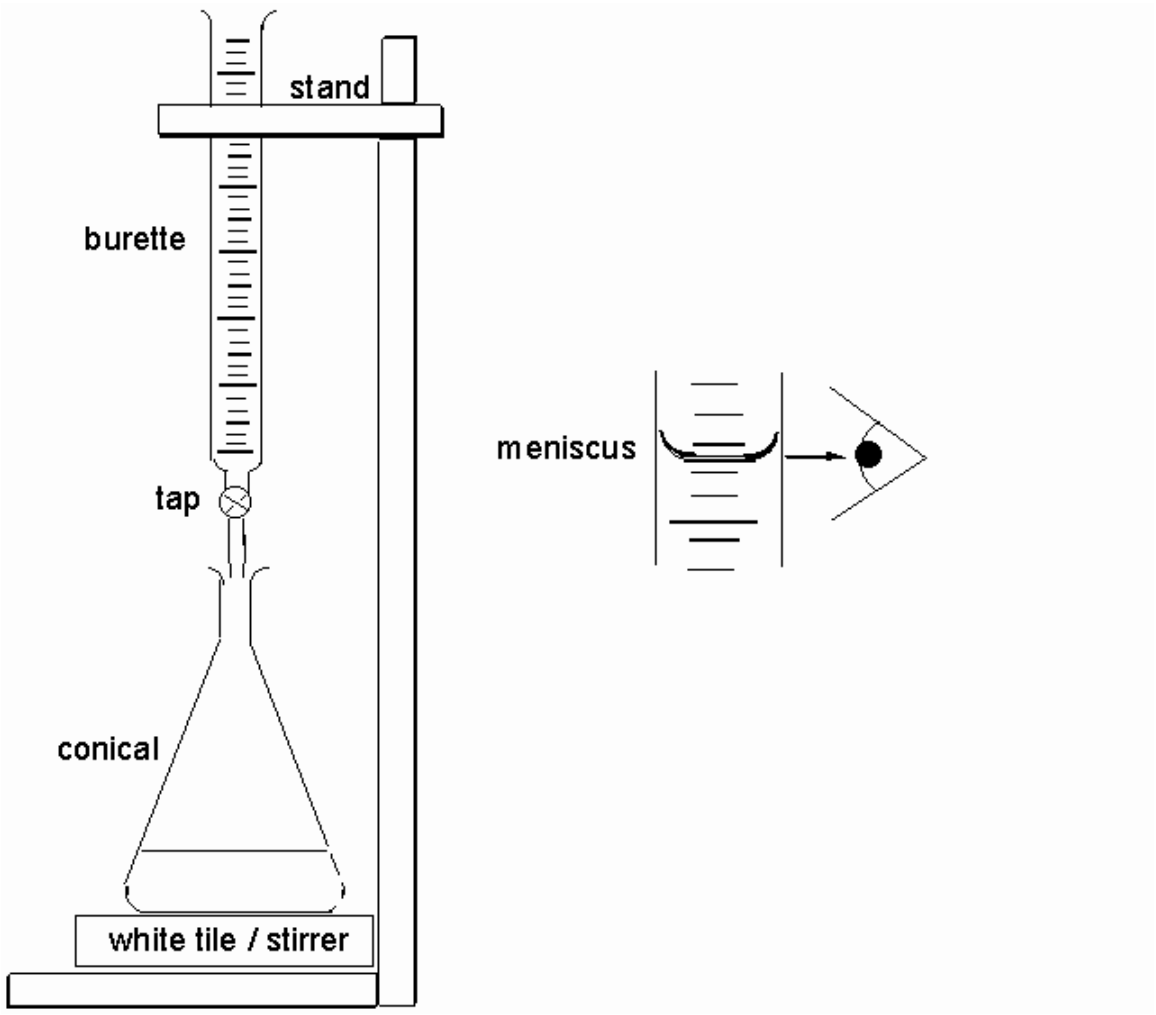
Diagram:



Method:

- Dilute the 1.0 mol dm^{-3} of H_2SO_4 by adding 1 part of the acid to 9 parts of water to make a concentration of 0.1 mol dm^{-3}. The acid needs to be diluted since sulphuric acid is extremely strong and the original concentration can be hazardous
- Obtain Sodium hydroxide, NaOH of the same concentration using the above method
- Wash the burette and the pipette with distilled water
- Once this has been done, wash the burette with the diluted acid and the pipette with the diluted NaOH solution

- Clamp the burette using the stand and slowly add the acid into the burette through the funnel to avoid splashing the acid
- Make sure to avoid air bubbles while filling the burette and run the burette in order to fill its end below the stopper with the acid solution
- Record the initial reading on the burette
- Now, using the pipette deliver 25 cm^3 of NaOH solution into a clean conical flask. Ensure the edge of the pipette is dipped into the flask to remove any remaining solution in the pipette
- Place the flask under the end of the burette above the white ceramic tile
- Add 3-4 drops of the indicator phenolphthalein, which turns the NaOH solution pink
- Release the burette stopper and add the acid into the flask, whilst shaking it constantly until the pink solution turns colourless. Note the final reading on the burette
- Wash the conical flask with distilled water and repeat the titration a further 3 times to get an average reading. The results should be within 0.1 cm^3 of each other.
- Record your results in the table below:

	Rough/cm^3	1st accurate /cm^3	2nd accurate / cm^3	3rd accurate / cm^3
Final burette reading				
Initial burette reading				
Titre				

Calculations:

In order to prove that Sulphuric acid is a dibasic acid, we need to refer back to the equation between H_2SO_4 and NaOH:

$$H_2SO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + 2H_2O_{(l)}$$

Molar ratio 1 : 2

According to this equation one mole of sulphuric acid reacts with 2 moles of sodium hydroxide to give water.

Let the known volume of NaOH be V_1 cm^3 and the volume of H_2SO_4 needed to neutralise it is V_2 cm^3. Let the concentrations of NaOH and H_2SO_4 be C_1 and C_2 mol dm^{-3} respectively.

Therefore,

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Calculating the no. of moles of NaOH using the equation:

$$\begin{aligned} \text{No. of moles} &= (\text{Concentration} \times \text{Volume})/1000 \\ &= (0.1 \times 25)/1000 \\ &= 2.5 \times 10^{-3} \text{ moles} \end{aligned}$$

I am going to work out the no. of moles of H_2SO_4 needed to neutralise the NaOH solution using the same formula and substituting the values for the acid.

Finally I would calculate the ratio of moles:

$$\text{No. of moles of } H_2SO_4 : \text{No. of moles of NaOH}$$

If this answer is then 2:1, as expected through the equation, it proves that sulphuric acid is dibasic i.e. half the moles of sulphuric acid are needed to neutralise sodium hydroxide.

Risk Assessment:

Sulphuric acid and Sodium Hydroxide are both corrosive and should not be allowed to contact the skin or eyes.
Goggles and gloves should be worn at all times during the experiment to prevent skin and eye contact of the chemicals.
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Care should be taken while handling the glass equipment in order to prevent breakage which might lead to cuts.

The finished solutions must be disposed off appropriately and with care to avoid any hazards.

A lab coat should be worn while carrying out the experiment.

Finally, care should be taken while diluting the acid. Ensure the acid is added into the water and not the other way around since the reaction is exothermic and you want the large amount of water to be able to absorb the heat (http://physchem.ox.ac.uk/~hmc/hsci/chemicals/sulfuric_acid.html).