

## Using indigestion tablets to neutralise an acid

### Learning objectives

- 1 Follow a method and carry out a titration to determine which brand of indigestion tablet contains the most active ingredient.
- 2 Explain the reasons behind particular steps in the titration procedure.
- 3 Explain how procedural errors can contribute towards inaccurate titres.

### Introduction

We use titration, an important analytical technique, in a wide range of real-life contexts, for example to test the purity of drugs or to measure amounts of certain compounds in food. In simple terms, titration uses a reaction of a volume of a solution of known concentration to find out the concentration of an unknown solution. There are many different types of titration; this practical focuses on an acid-base reaction.

Indigestion tablets contain a mixture of substances which can neutralise stomach acid. These include carbonates of group 2 metals (e.g. calcium carbonate) and group 2 hydroxides (e.g. magnesium hydroxide). In this experiment, you will analyse different brands of indigestion tablet and use the average titres of the titration to determine which tablet contains the most active ingredient.

### Titration procedure

Wear safety glasses.

1. Check which indigestion tablets you have been assigned to analyse by your teacher. Read the packet and note down which active ingredients are present.
2. Crush the tablet using a pestle and mortar and carefully transfer it to a conical flask, using a spatula to ensure complete transfer as far as possible. Rinse any remaining fragments into the flask with a few  $\text{cm}^3$  of deionised water.
3. Add about  $25 \text{ cm}^3$  of deionised water to the flask, followed by three drops of methyl orange indicator. **DANGER:** Harmful if swallowed. May cause damage to organs. Highly flammable liquid and vapour.
4. Using a small funnel, pour a few  $\text{cm}^3$  of the dilute hydrochloric acid provided into the burette, with the tap open and a beaker under the open tap. Once the tip of the burette is full of solution, close the tap and add more of the solution up to the zero mark. (Do not reuse the acid in the beaker – this should be rinsed down the sink.) Remove the funnel.
5. Add acid from the burette into the flask,  $1\text{--}2 \text{ cm}^3$  at a time, while slowly swirling the flask. Continue to add the acid until you begin to see a red colour in the flask that quickly returns to yellow-orange.

- When this begins to take longer to happen, add a smaller quantity of acid at a time – e.g.  $0.5 \text{ cm}^3$  – until you reach a point where the red colour remains after one minute.
- Record the volume of acid used.
- Rinse the flask with water and repeat the experiment with the same indigestion tablet until you have concordant results (within  $0.10 \text{ cm}^3$  of each other) or have done the titration 3 times. Refill the burette, if necessary.

## Results

Fill in the results table for the tablet you analysed.

Brand of tablet	Titre 1	Titre 2	Titre 3

Average titre \_\_\_\_\_  $\text{cm}^3$

Summarise the results for each indigestion tablet. State the average titre for each tablet brand.

## Procedure questions

- Step 3 of the method says “Add **about**  $25 \text{ cm}^3$  of deionised water to the flask, followed by **three** drops of methyl orange indicator.
  - Explain why an accurate volume of water is not needed.
  - Explain why only three drops of indicator are added.
- Explain why the funnel is removed from the burette when titrating.
- Near the end of the titration, the sides of the conical flask may be rinsed with distilled water. Explain why this does not affect the results of the titration.
- The burette does not need to be filled to exactly  $0.00 \text{ cm}^3$ . Explain why.

## Analysis questions

- Explain why each group is asked to test one tablet of the same brand, and one of another brand.
- From the list of active ingredients on the packets, write word equation(s) for the reaction(s) that takes place in your flask during the titration.
- Give the balanced symbol equation for the reaction of hydrochloric acid with:
  - Magnesium carbonate
  - Magnesium hydroxide
- Compare the average titre obtained for each of the different brands of tablets and suggest which has the highest amount of active ingredients.
- Use your results, along with the price and recommended dose, to suggest which brand of indigestion tablet represents the best value.
- Is this a fair way of comparing brands of indigestion tablet? Explain your answer.