**Year 11 Chemistry Practical Investigation**

# Acid-Base Titration of an Eggshell

**Aim:** To determine the percentage (by mass) concentration of calcium carbonate in eggshell.

**Equipment:**

* Dried eggshell
* Electronic balance
* 100 mL beaker
* 250 mL beaker
* 2.0 mol/L HCl
* 0.5 mol/L NaOH
* Wash bottle
* Filter paper
* Funnel
* Phenolpthalein
* Titration apparatus (retort stand, conical flask, tile, volumetric burette, pipette and bulb)

**Procedure:**

*SAFETY NOTE:*HCl and NaOH are corrosive. Avoid contact and wash hands if contact occurs.

1. Placed approximately 1g of dried eggshell into a clean mortar, and grind to a very fine powder.
2. Place a 250 mL beaker on an electronic balance and tare the scale. Transfer the powder from the mortar to the beaker and record the mass.
3. Add 25 mL of 2.0 mol/L HCl to the 250 mL beaker. Swirl gently for about 3-4 minutes. During this process, wash residue from the stirring rod and sides beaker with 75 mL of distilled water (bringing the total volume of solution in the beaker to 100 mL).
4. Use filter paper and a funnel to separate the eggshell solution from any undissolved eggshell.
5. Titrate 20 mL samples of the eggshell solution, with 0.5 mol/L NaOH in the burette and 3 drops of phenolphthalein solution as the indicator (reaction complete at first permanent pink colour).

**Results:**

Mass of eggshell sample: \_\_\_\_\_ g

|  |  |  |
| --- | --- | --- |
|  | **Trial 1** | **Trial 2** |
| Initial (mL) |  |  |
| Final (mL) |  |  |
| Titre (mL) |  |  |

**See other side for instructions for Analysis and Evaluation**

**Analysis:**

1. The calcium carbonate in the eggshell reacts with the HCl. Write a balanced chemical reaction for this reaction.
2. The excess HCl is then reacted in titration with NaOH. Write a balanced chemical equation for the acid-base neutralization of the excess HCl with the NaOH.
3. Calculate the average volume of NaOH required to neutralize the HCl solution during titration.
4. Hence calculate the number of moles of NaOH in the reaction.
5. Write the reacting mole ratio $\frac{n\_{HCl}}{n\_{NaOH}}$
6. Hence calculate the number of moles of excess HCl in each 20 mL sample.
7. Hence calculate the number of moles of excess HCl remaining in the 100 mL after reaction with the eggshell.
8. Calculate the number of moles of HCl before reaction with the eggshell.
9. Hence calculate the number of moles of HCl that reacted with eggshell.
10. Write the reacting mole ratio $\frac{n\_{CaCO\_{3}}}{n\_{HCl}}$
11. Hence calculate the number of moles of CaCO3 that reacted.
12. Hence calculate the mass of CaCO3 in the sample of eggshell.
13. Hence calculate the percentage (by mass) of CaCO3 in the eggshell.

**Evaluation:**

1. Workers in a lab in another city have also tested eggs, and they found that a normal eggshell is about 95% CaCO3. Calculate the percent error for your measurement.
2. Identify and explain two possible sources of error.
3. Evaluate the procedure, suggesting possible improvements.