

# Titrations

**Aim:** To prepare a primary standard solution of sodium carbonate and use it to determine the concentration of a hydrochloric acid solution.

**Equipment:**

- Electronic Balance
- 2 small beakers
- Small funnel
- 25ml pipette
- 250ml volumetric flask
- Wash bottle with distilled water
- Approx 0.1 mol L<sup>-1</sup> HCl
- Burette
- 250ml conical flask
- Burette clamp
- Retort stand
- Approx 2g of dried sodium carbonate.
- Methyl orange indicator

**Method:**

1. Put approximately 2g of sodium carbonate into a clean and tared beaker. Record the exact mass of the sodium carbonate.
2. Add about 30ml of distilled water to the beaker and stir. Place the funnel into a clean volumetric flask and transfer the sodium carbonate solution into the flask. Use a wash bottle filled with distilled water to carefully wash all the sodium carbonate down the funnel and into the flask. Swirl the beaker so as to dissolve the sodium carbonate.
3. Rinse the beaker with distilled water and transfer wash water into the flask.
4. Add distilled water to the flask until it is about two-thirds full.
5. Fit the stopper and shake until all the sodium carbonate has dissolved.
6. Remove the stopper and fill the flask with distilled water until it is perfectly on the 250ml mark.
7. Rinse the burette with distilled water and then with the HCl solution to be used and discard the rinsings.
8. Set up the burette using a retort stand and burette clamp.
9. Ensure the stopcock is closed and fill the burette with the HCl solution. Record the starting volume.
10. Rinse the pipette with the sodium carbonate solution and discard the rinsings.
11. Fill the pipette with Na<sub>2</sub>CO<sub>3</sub> solution exactly to the 25ml mark and place in a clean 250ml conical flask. Add 2-3 drops of indicator.
12. Fill a small beaker with approximately 25ml of the Na<sub>2</sub>CO<sub>3</sub> solution and add a few drops of indicator.
13. Place the conical flask under the burette and the small beaker next to it to act as a guide.
14. Run the HCl into the flask swirling continuously until the colour changes from that of the guide. This is the end point.
15. Record the end volume.
16. Calculate the volume of HCl used and record.
17. Refill the burette and repeat steps 9 to 16 four more times.

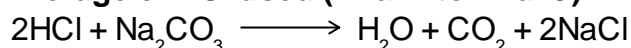
**Results:****Mass of Na<sub>2</sub>CO<sub>3</sub> used:** 2.01 g

	<b>Trial 1</b>	<b>Trial 2</b>	<b>Trial 3</b>	<b>Trial 4</b>	<b>Trial 5</b>
Volume Na <sub>2</sub> CO <sub>3</sub> used	25 ml	25 ml	25 ml	25 ml	25 ml
Initial burette reading	2.7 ml	3.6 ml	0.4 ml	2.9 ml	2.2 ml
Final burette reading	46.7 ml	20.4 ml	35.0 ml	36.4 ml	25.6 ml
Volume of HCl used	44.0 ml	36.8 ml	34.6 ml	33.5 ml	33.4 ml

**Calculations:**

The results from Trial 1 were discarded as they were extremely inconsistent with the rest of the tests and it was the first attempt.

**Average of HCl used (Trial 2 to Trial 5):** 34.575 ml



$$\begin{aligned} \text{Number of Moles} &= \frac{2.01}{105.99} \\ &= 0.018964053 \text{ moles} \end{aligned}$$

$$\begin{aligned} \text{Molarity of Solution} &= \frac{\text{Moles}}{\text{Volume}} \\ &= \frac{0.018964053}{0.250} \\ &= 0.075856212 \text{ mol L}^{-1} \end{aligned}$$

$$\begin{aligned} \text{Number of moles used} &= \text{Molarity} \times \text{Volume} \\ &= 0.075856212 \times 0.025 \\ &= 1.896405321 \times 10^{-3} \text{ Moles} \end{aligned}$$

$$\begin{aligned} \text{Molarity of HCl} &= \frac{2 \times (1.896405321 \times 10^{-3})}{0.034575} \\ &= 0.1097 \text{ Mol L}^{-1} \end{aligned}$$

**Conclusion:** The concentration of the HCl solution was 0.1097 mol L<sup>-1</sup>.