

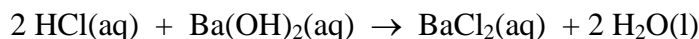
Stoichiometry in Indirect Titration

Problem 4-54

A 25.00-mL sample of HCl(aq) was added to a 0.1000-g sample of CaCO₃. All the CaCO₃ reacted, leaving some excess HCl(aq).



The excess HCl(aq) required 43.82 mL of 0.01185 M Ba(OH)₂(aq) to complete the following reaction. What is the molarity of the original HCl(aq)?



Solution:

This is two individual problems. The first part is to calculate how much HCl(aq) reacted with the CaCO₃ and the second part is to calculate how much HCl(aq) was left over. The sum of the two molar quantities of HCl(aq) is the total amount in the original 25 mL sample.

First, the amount of HCl that reacted with CaCO₃ :

$$n_{\text{HCl}} = \left(\frac{0.1000 \text{ g CaCO}_3}{100.09 \frac{\text{g}}{\text{mol}}} \right) \times \frac{2 \text{ mol HCl}}{1 \text{ mol CaCO}_3} = 0.0019982 \text{ mol HCl}$$

Now, the remaining amount of HCl from the titration:

$$n_{\text{HCl}} = \left(0.01185 \frac{\text{mol Ba}(\text{OH})_2}{\text{L soln}} \times 0.04382 \text{ L soln} \right) \times \frac{2 \text{ mol HCl}}{1 \text{ mol Ba}(\text{OH})_2} = 0.0010385 \text{ mol HCl}$$

The total amount of HCl in the original 25.00 mL is

$$n_{\text{total}} = 0.0019982 \text{ mol} + 0.0010385 \text{ mol} = 0.003037 \text{ mol HCl}$$

And the concentration is:

$$C_{\text{HCl}} = \frac{0.003037 \text{ mol HCl}}{0.02500 \text{ L}} = 0.1215 \text{ M HCl}$$