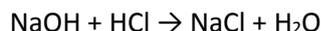


**Question:**

Why does the titration of 50 mL of 0.1 M H<sub>2</sub>SO<sub>4</sub> require a larger titrant than the titration of 50 mL of 0.1 M HCl? Assume that the titrant being used is 0.1 M NaOH.

**Answer:**

The titration of HCl is described with the equation:



The amount of moles of 0.1 M HCl in 50 ml is:

$$v(\text{HCl}) = C(\text{HCl}) \times V(\text{HCl}) = 0.1 \text{ M} \times \frac{50 \text{ ml}}{1000} = 5 \cdot 10^{-3} \text{ moles}$$

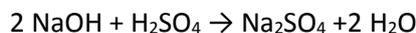
The amount of moles of NaOH required to neutralize 5 · 10<sup>-3</sup> moles of HCl according to the equation above is the same:

$$v_1(\text{NaOH}) = v(\text{HCl}) = 5 \cdot 10^{-3} \text{ moles}$$

The volume of 0.1 M NaOH required for the titration is

$$V_1(\text{NaOH}) = \frac{v_1(\text{NaOH})}{C(\text{NaOH})} = \frac{5 \cdot 10^{-3} \text{ moles}}{0.1 \text{ M}} = 5 \cdot 10^{-2} \text{ L} = 50 \text{ ml}$$

The equation reaction for H<sub>2</sub>SO<sub>4</sub> is:



The amount of moles of 0.1 H<sub>2</sub>SO<sub>4</sub> in 50 ml of its solution is

$$v(\text{H}_2\text{SO}_4) = C(\text{H}_2\text{SO}_4) \times V(\text{H}_2\text{SO}_4) = 0.1 \text{ M} \times \frac{50 \text{ ml}}{1000} = 5 \cdot 10^{-3} \text{ moles}$$

According the above equation, two moles of NaOH are required to neutralize one mole of NaOH. Than the amount of NaOH that is required to neutralize 5 · 10<sup>-3</sup> moles is

$$v_2(\text{NaOH}) = 2 \times v(\text{H}_2\text{SO}_4) = 2 \times 5 \cdot 10^{-3} \text{ moles} = 10 \cdot 10^{-3} \text{ moles}$$

The volume of 0.1 M NaOH that contains 10 · 10<sup>-3</sup> moles is

$$V_2(\text{NaOH}) = \frac{v_2(\text{NaOH})}{C(\text{NaOH})} = \frac{10 \cdot 10^{-3} \text{ moles}}{0.1 \text{ M}} = 10 \cdot 10^{-2} \text{ L} = 100 \text{ ml}$$