

## Chemistry - Acid-Base Neutralization

### Given Data:

**Concentration of KOH (Potassium Hydroxide):**  $C_{\text{KOH}} = 0.160 \text{ M}$

**Volume of HClO<sub>4</sub> (Perchloric Acid):**  $V_{\text{HClO}_4} = 55.0 \text{ mL} = 0.055 \text{ L}$

**Concentration of HClO<sub>4</sub>:**  $C_{\text{HClO}_4} = 0.170 \text{ M}$

### Introduction

The problem involves a neutralization reaction between **KOH** and **HClO<sub>4</sub>**. This chemical reaction is given by:



This is a typical acid-base neutralization reaction. To find out how much **KOH** (in liters) is required to completely neutralize the given volume of **HClO<sub>4</sub>**, the number of moles of **HClO<sub>4</sub>** present must be found, and an equivalent amount of **KOH** must be determined, based on the stoichiometry of the balanced chemical equation.

### Step-by-Step Solution:

#### 1. Calculate the moles of HClO<sub>4</sub>

$$\text{Moles of HClO}_4 = C_{\text{HClO}_4} \times V_{\text{HClO}_4}$$

$$\begin{aligned} \text{Moles of HClO}_4 &= 0.170 \text{ M} \times 0.055 \text{ L} \\ &= 0.00935 \text{ moles} \end{aligned}$$

**Explanation:** The molarity (M) is defined as moles of solute per liter of solution. Here, the moles of HClO<sub>4</sub> are calculated by multiplying its concentration by its volume in liters.

**Supporting Statement:** The moles of HClO<sub>4</sub> are essential to determine the amount of KOH needed for complete neutralization.

#### 2. Determine the moles of KOH required

$$\text{Moles of KOH} = 0.00935 \text{ moles}$$

**Explanation:** According to the stoichiometry of the reaction, one mole of KOH neutralizes one mole of HClO<sub>4</sub>. Thus, the moles of KOH required for neutralization are equal to the moles of HClO<sub>4</sub>.

**Supporting Statement:** Identifying the moles of KOH is pivotal to find the volume of the KOH solution needed.

#### 3. Calculate the volume of KOH required

$$V_{\text{KOH}} = \frac{\text{Moles of KOH}}{C_{\text{KOH}}}$$

$$V_{\text{KOH}} = \frac{0.00935 \text{ moles}}{0.160 \text{ M}}$$

$$V_{\text{KOH}} = 0.0584 \text{ L}$$

$$V_{\text{KOH}} = 58.4 \text{ mL}$$

**Explanation:** The volume of KOH required is calculated by dividing the moles of KOH required by its molarity.

**Supporting Statement:** This step ensures the accurate volume of KOH needed to neutralize the given amount of HClO<sub>4</sub>.

### Final Solution

**58.4 mL of 0.160 M KOH is required to completely neutralize 55.0 mL of 0.170 M HClO<sub>4</sub>.**