

# Acid and Base Titrations - Equation Guide

## Strong Acid + Strong Base:

*Initial Region:*  $\text{pH} = -\log(n_{\text{sa}} / V_{\text{sa}})$

*Pre-Equivalence Region:*  $\text{pH} = -\log\left(\frac{n_{\text{sa}} - n_{\text{sb}}}{V_{\text{sa}} + V_{\text{sb}}}\right)$

*Equivalence:*  $\text{pH} = 7$

*Post-Equivalence Region:*  $\text{pH} = 14 + \log\left(\frac{n_{\text{sb}} - n_{\text{sa}}}{V_{\text{sb}} + V_{\text{sa}}}\right)$

## Strong Base + Strong Acid:

*Initial Region:*  $\text{pH} = 14 + \log(n_{\text{sb}} / V_{\text{sb}})$

*Pre-Equivalence Region:*  $\text{pH} = 14 + \log\left(\frac{n_{\text{sb}} - n_{\text{sa}}}{V_{\text{sa}} + V_{\text{sb}}}\right)$

*Equivalence:*  $\text{pH} = 7$

*Post-Equivalence Region:*  $\text{pH} = -\log\left(\frac{n_{\text{sa}} - n_{\text{sb}}}{V_{\text{sa}} + V_{\text{sb}}}\right)$

## Weak Acid + Strong Base:

*Initial Region:*  $\text{pH} = -\log\sqrt{K_{\text{a}} * \frac{n_{\text{wa}}}{V_{\text{wa}}}}$

*Pre-Equivalence Region:*  $\text{pH} = \text{p}K_{\text{a}} + \log\left(\frac{n_{\text{sb}}}{n_{\text{wa}} - n_{\text{sb}}}\right)$

*Half-Equivalence Region:*  $\text{pH} = \text{p}K_{\text{a}}$

*Equivalence:*  $\text{pH} = 14 + \log\sqrt{\frac{K_{\text{w}}}{K_{\text{a}}} * \frac{n_{\text{wa}}}{(V_{\text{wa}} + V_{\text{sb}})}}$

*Post-Equivalence Region:*  $\text{pH} = 14 + \log\left(\frac{n_{\text{sb}} - n_{\text{wa}}}{V_{\text{sb}} + V_{\text{wa}}}\right)$

## Weak Base + Strong Acid:

*Initial Region:*  $\text{pH} = 14 + \log\sqrt{K_{\text{b}} * \frac{n_{\text{wb}}}{V_{\text{wb}}}}$

*Pre-Equivalence Region:*  $\text{pH} = 14 - \text{p}K_{\text{b}} + \log\left(\frac{n_{\text{wb}} - n_{\text{sa}}}{n_{\text{sa}}}\right)$

*Half-Equivalence Region:*  $\text{pH} = 14 - \text{p}K_{\text{b}}$

*Equivalence:*  $\text{pH} = -\log\sqrt{\frac{K_{\text{w}}}{K_{\text{b}}} * \frac{n_{\text{wb}}}{(V_{\text{wb}} + V_{\text{sa}})}}$

*Post-Equivalence Region:*  $\text{pH} = -\log\left(\frac{n_{\text{sa}} - n_{\text{wb}}}{V_{\text{sa}} + V_{\text{wb}}}\right)$