

Show $[OH^-] = [base]$ at $V_{base} = \infty$ in acid – base titration.

Situation:

- add strong base to strong acid (or weak acid)
- acid & base are monoprotic

At $V_{base} > V_{base}$ at end point,

$$[OH^-] = \frac{n_{OH^-}}{V_{total}} = \frac{n_{base} - n_{acid}}{V_{total}} = \frac{[B]V_b - [A]V_a}{V_a + V_b}.$$

At $V_b = \infty$,

$$\begin{aligned} \lim_{V_b \rightarrow \infty} [OH^-] &= \lim_{V_b \rightarrow \infty} \frac{[B]V_b - [A]V_a}{V_a + V_b} && [eqn. 1] \\ &= \lim_{V_b \rightarrow \infty} \frac{[B] - [A]\frac{V_a}{V_b}}{\frac{V_a}{V_b} + 1} = [B] \end{aligned}$$

alternatively, apply L'Hopital's rule to [eqn. 1]. That is, at $V_b = \infty$, $[OH^-] = [base]$; thus at $V_b = \infty$, $pH = pH_{base}$

As such, when sketching an acid-base titration curve, the pH at $V_b = \infty$ is the pH of the base. A similar argument would apply to the addition of a strong acid to strong / weak base: $[H^+] = [acid]$ at $V_a = \infty$.