Titration of strong acid with strong base

degree of titration (%)	What species are present	calculation of pH / pOH	conditions
0	**strong acid**	$[H^+] = c_{\text{strong acid}}$	$c_{\text{strong acid}} > 10^{-6}$ M
		$[H^+] = c_{\text{strong acid}} + \frac{K_W}{[H^+]}$	under any conditions
0-100	neutral salt + **strong acid**	$[H^+] = c_{\text{strong acid}}$	$c_{\text{strong acid}} > 10^{-6}$ M
		$[H^+] = c_{\text{strong acid}} + \frac{K_W}{[H^+]}$	under any conditions
100	**neutral salt**	$[H^+] = [OH^-] = \sqrt{K_W}$	under any conditions
>100	neutral salt + **strong base**	$[OH^-] = c_{\text{strong base}}$	$c_{\text{strong base}} > 10^{-6}$ M
		$[OH^-] = c_{\text{strong base}} + \frac{K_W}{[OH^-]}$	under any conditions

Titration of monoprotic weak acid with srtong base

degree of titration (%)	What species are present	calculation of pH / pOH	conditions
0	**weak acid**	$[H^+] = K_a \cdot \frac{c_{\text{weak acid}} - [H^+]}{[H^+]}$	under any conditions
		$[H^+] = \sqrt{K_a \cdot c_{\text{weak acid}}}$	$c_{\text{weak acid}} >>> K_a$
0-100	weak acid + conjugate base= **acidic BUFFER**	$[H^+] = K_a \cdot \frac{c_{\text{weak acid}}}{c_{\text{conj. base}}} = K_a \cdot \frac{n_{\text{weak acid}}}{n_{\text{conj. base}}}$	under any conditions
100	conjugate base (**basic salt**)	$[OH^-] = K_b \cdot \frac{c_{\text{conj. base}} - [OH^-]}{[OH^-]}$	under any conditions
		$[OH^-] = \sqrt{K_b \cdot c_{\text{conj. base}}}$	$c_{\text{conj. base}} >>> K_b$
>100	basic salt + **strong base**	$[OH^-] = c_{\text{strong base}}$	$c_{\text{strong base}} >> > c_{\text{conj. b.}}$
		$[OH^-] = c_{\text{strong base}} + K_b \cdot \frac{c_{\text{conj. base}} - [OH^-]}{[OH^-]}$	under any conditions

Titration of triprotic acid with strong base, where K_{a1}>>>>K_{a2}>>>>K_{a3}

degree of titration (%)	What species are present	calculation of pH / pOH	conditions
0	**weak acid**	$[H^+] = K_{a1} \cdot \frac{c_{weak\ acid} - [H^+]}{[H^+]}$	under any conditions
		$[H^+] = \sqrt{K_{a1} \cdot c_{weak\ acid}}$	$c_{weak\ acid}$ >>> K_{a1}
0-100	weak acid + conjugate base= **acidic BUFFER**	$[H^+] = K_{a1} \cdot \frac{c_{weak\ acid}}{c_{conj.\ base}} = K_{a1} \cdot \frac{n_{weak\ acid}}{n_{conj.\ base}}$	under any conditions
100	acid salt (ampholyte)	$[H^+] = \sqrt{K_{a1} \cdot K_{a2}}$, pH = -lg[H^+], **or** $pH = \frac{pK_{a1} + pK_{a2}}{2}$	under any conditions
100-200	weak acid + conjugate base= **acidic BUFFER**	$[H^+] = K_{a2} \cdot \frac{c_{weak\ acid}}{c_{conj.\ base}} = K_{a2} \cdot \frac{n_{weak\ acid}}{n_{conj.\ base}}$	under any conditions
200	acid salt (ampholyte)	$[H^+] = \sqrt{K_{a2} \cdot K_{a3}}$, pH = -lg[H^+], **or** $pH = \frac{pK_{a2} + pK_{a3}}{2}$	under any conditions
200-300	weak acid + conjugate base= **acidic BUFFER**	$[H^+] = K_{a3} \cdot \frac{c_{weak\ acid}}{c_{conj.\ base}} = K_{a3} \cdot \frac{n_{weak\ acid}}{n_{conj.\ base}}$	under any conditions
300	**conjugate base (basic salt)**	$[OH^-] = K_{b1} \cdot \frac{c_{conj.\ base} - [OH^-]}{[OH^-]}$	under any conditions $K_{b1} = \cdot \frac{K_W}{K_{a3}}$
		$[OH^-] = \sqrt{K_{b1} \cdot c_{conj.\ base}}$	$c_{weak\ base}$ >>> K_{b1}
>**300**	basic salt + **strong base**	$[OH^-] = c_{strong\ base}$	$c_{strong\ base}$ >>> $c_{conj.\ b.}$
		$[OH^-] = c_{strong\ base} + K_{b1} \cdot \frac{c_{conj.\ base} - [OH^-]}{[OH^-]}$	under any conditions