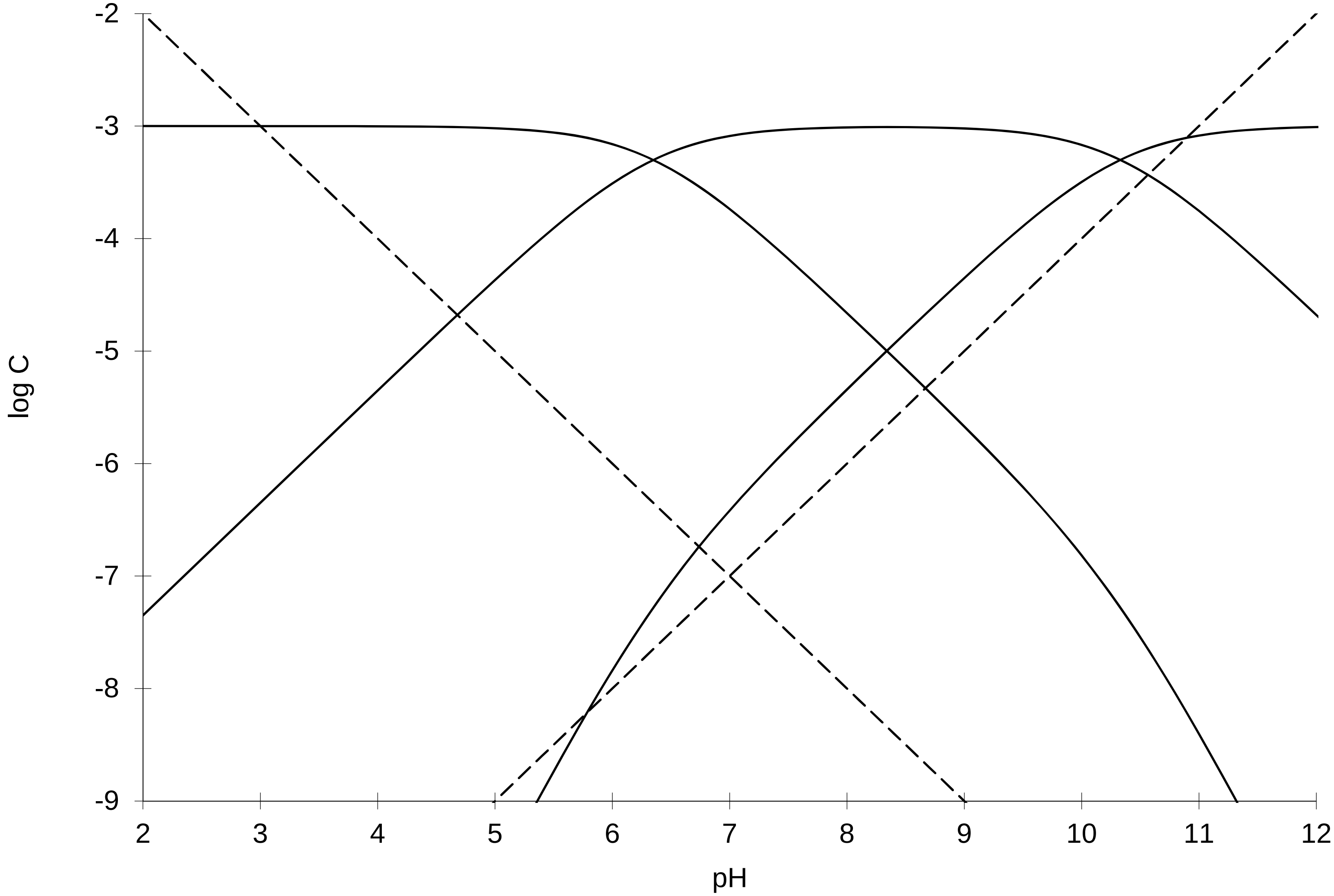
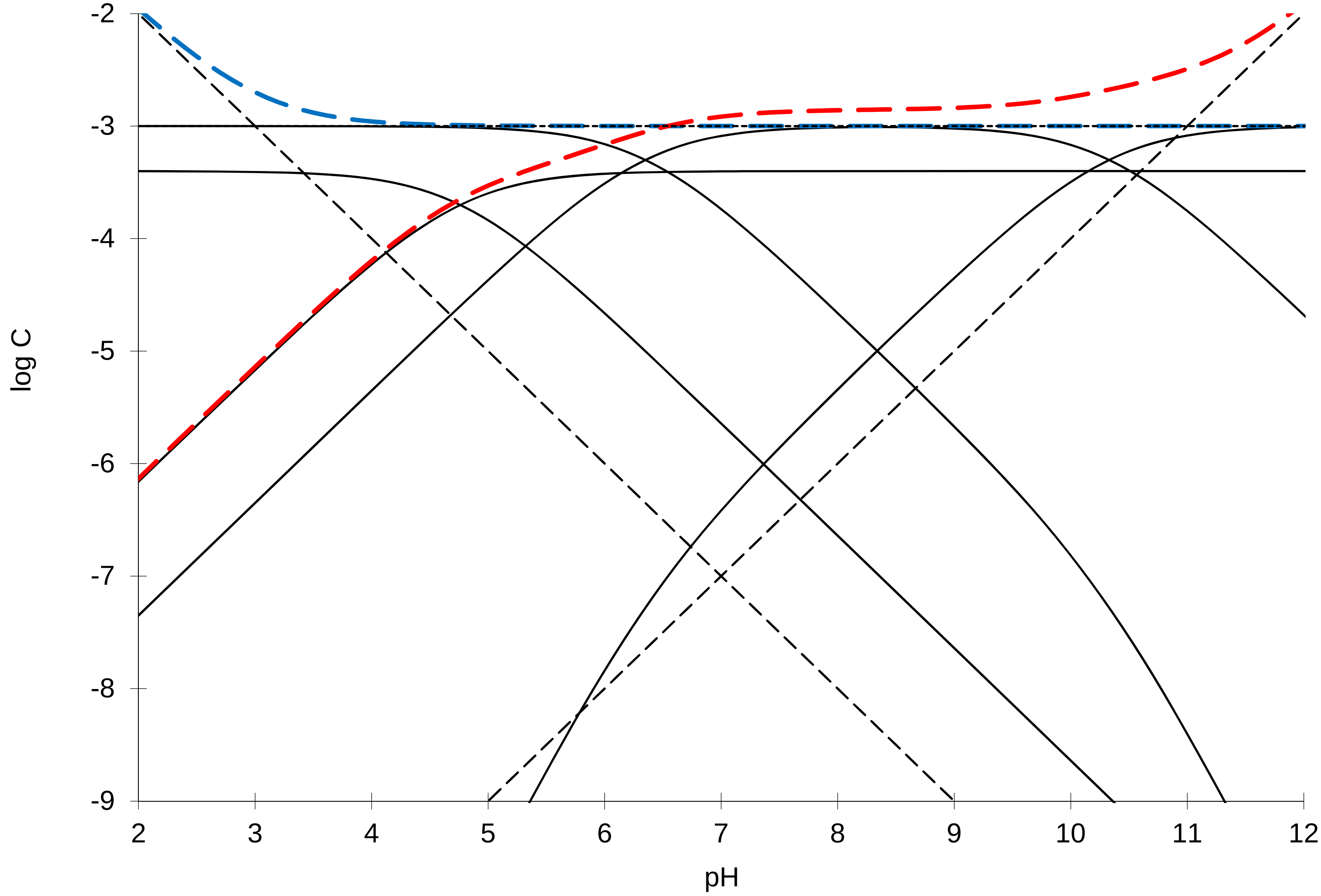
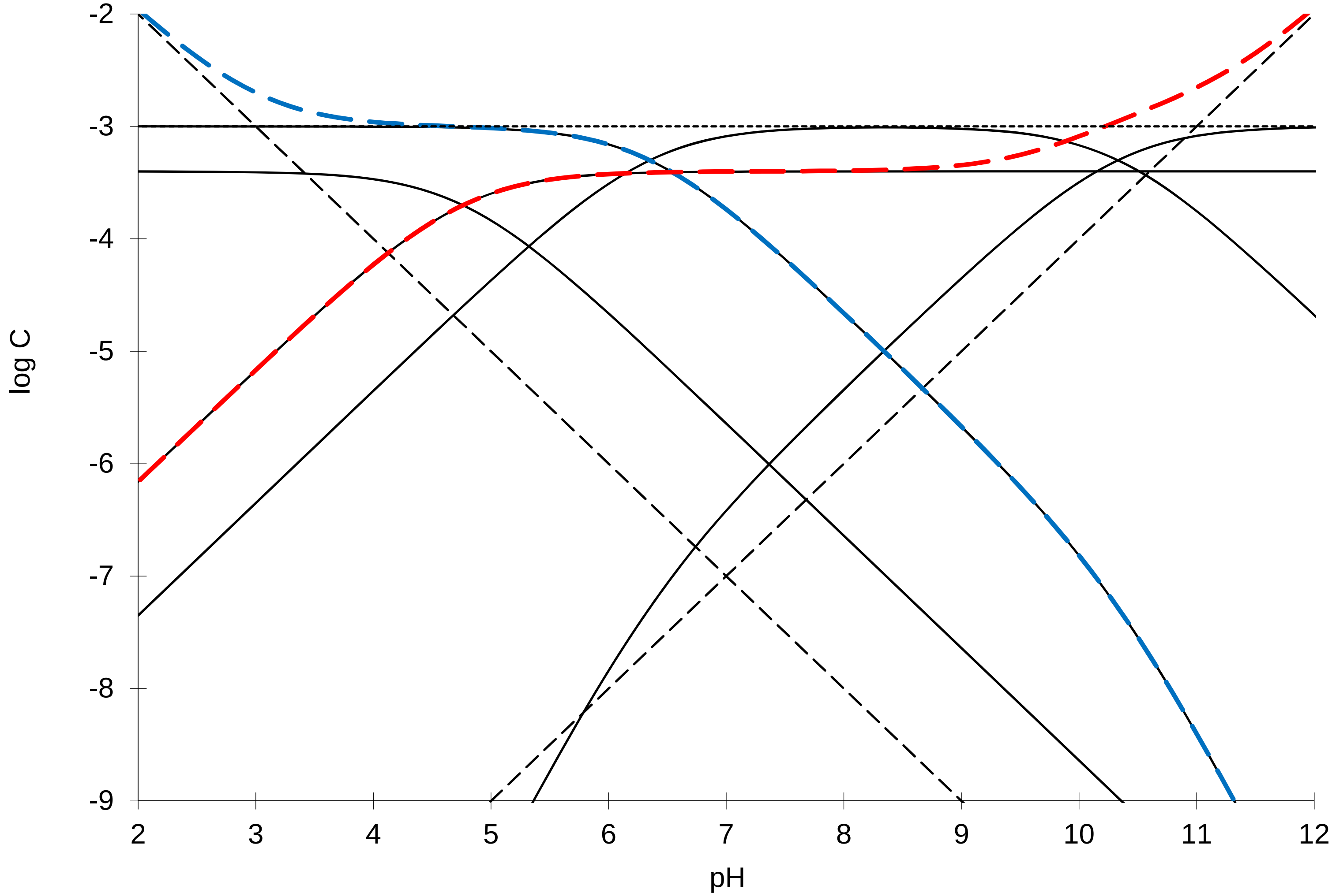
10^{-3} NaHCO$_3$



10^{-3} NaHCO$_3$ + 4x10^{-4} HAc



10^{-3} $NaHCO_3$ + $4x10^{-4}$ HAc



10^{-3} $NaHCO_3$ + $4x10^{-4}$ HAc, with CO_3^{2-} as a component

	_____H_2O +	_____H^+ +	_____CO_3^{2-} +	_____Ac^- +	_____Na^+	→ 1 Spec
Species						Conc'n
H_2O	1	0	0	0	0	$(H_2O)_{eq}$
H^+	0	1	0	0	0	$(H^+)_{eq}$
OH^-	1	–1	0	0	0	$(OH^-)_{eq}$
H_2CO_3	0	2	1	0	0	$(H_2CO_3)_{eq}$
HCO_3^-		1				$(HCO_3^-)_{eq}$
CO_3^{2-}		0				$(CO_3^{2-})_{eq}$
HAc		1				$(HAc)_{eq}$
Ac^-		0				$(Ac^-)_{eq}$
Na^+		0				$(Na^+)_{eq}$
Inputs						
$NaHCO_3$	0	1	1	0	1	1e–3
HAc	0	1	0	1	0	4e–4

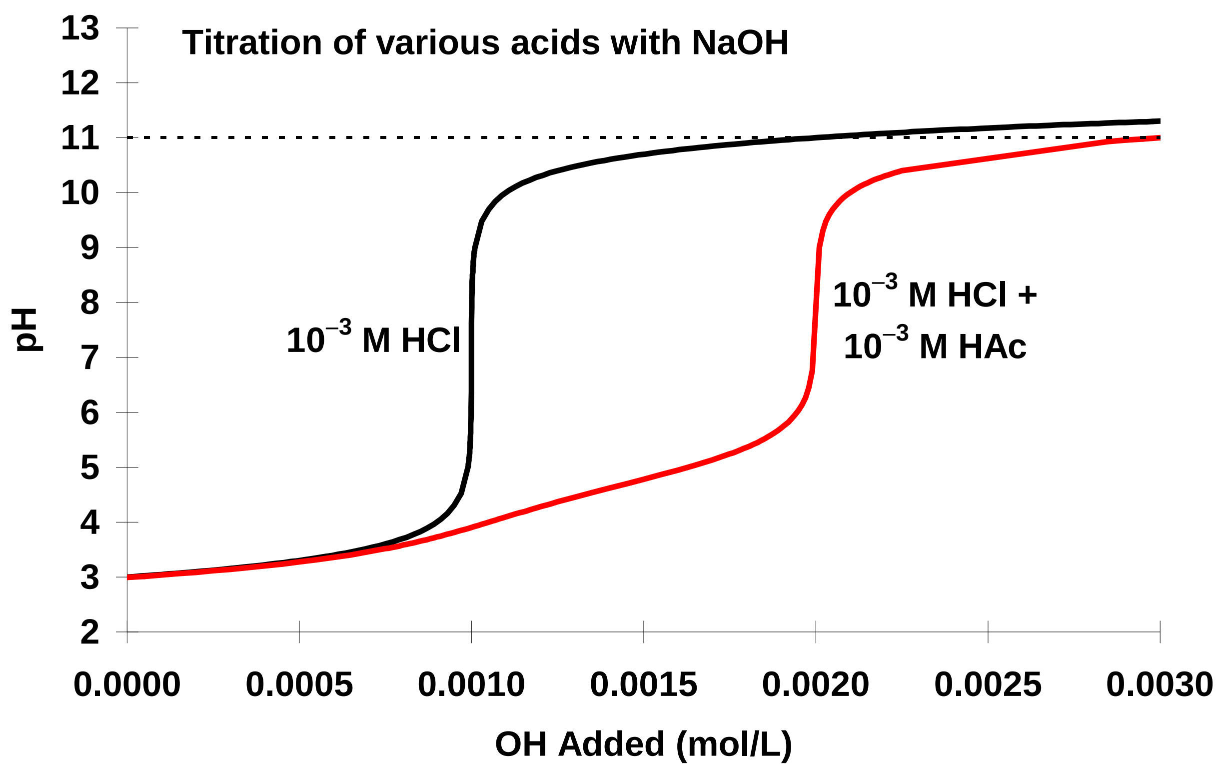
10^{-3} $NaHCO_3$ + $4x10^{-4}$ HAc, with HCO_3^- as a component

	____H_2O +	____H^+ +	____HCO_3^- +	____Ac^- +	____Na^+	→ 1 Spec
Species						Conc'n
H_2O	1	0	0	0	0	$(H_2O)_{eq}$
H^+	0	1	0	0	0	$(H^+)_{eq}$
OH^-	1	–1	0	0	0	$(OH^-)_{eq}$
H_2CO_3	0	1	1	0	0	$(H_2CO_3)_{eq}$
HCO_3^-		0				$(HCO_3^-)_{eq}$
CO_3^{2-}		–1				$(CO_3^{2-})_{eq}$
HAc		1				$(HAc)_{eq}$
Ac^-		0				$(Ac^-)_{eq}$
Na^+		0				$(Na^+)_{eq}$
Inputs						
$NaHCO_3$	0	0	1	0	1	1e–3
HAc	0	1	0	1	0	4e–4

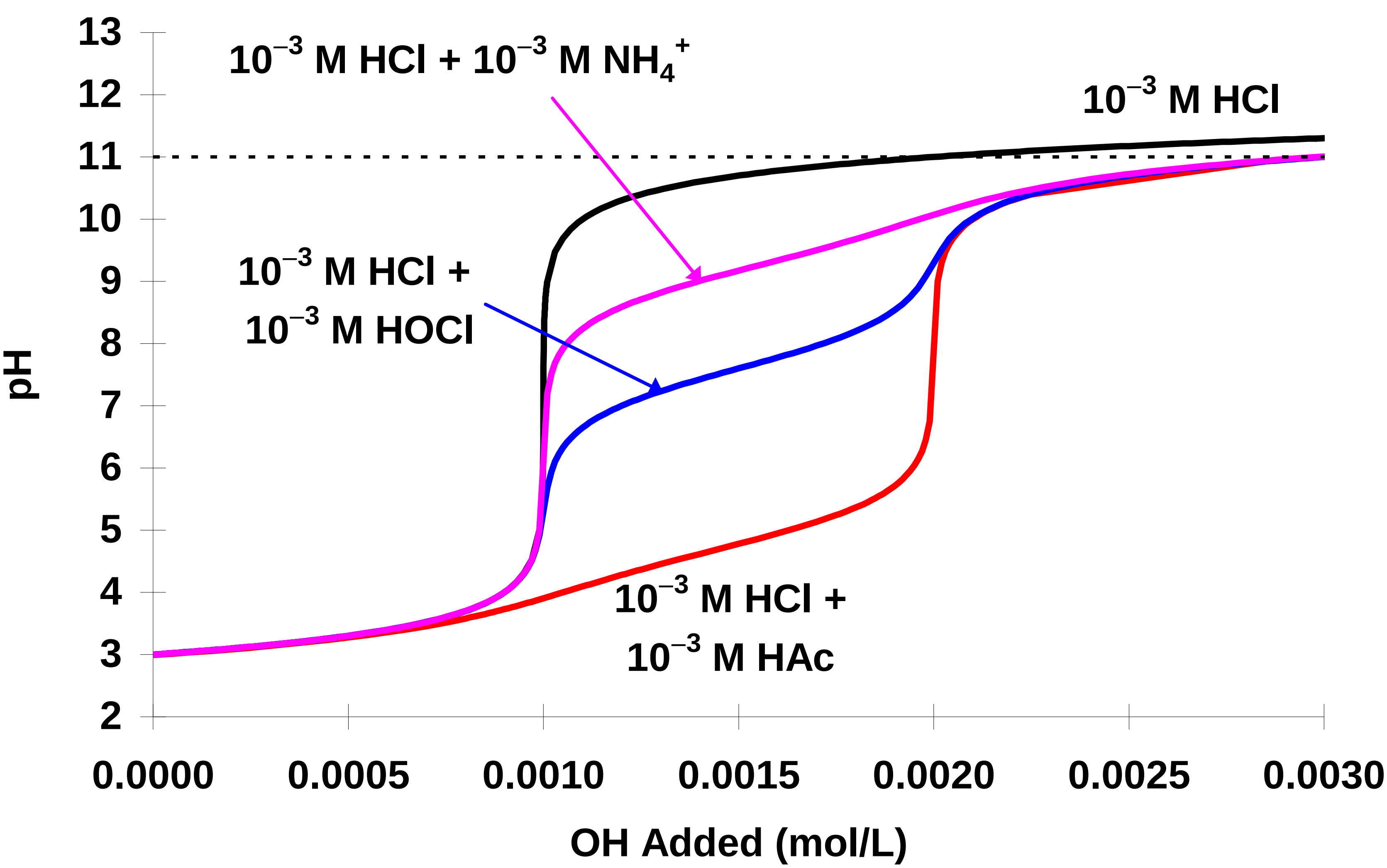
Titration with Strong Acid or Base

- Consider two solutions that are identical, except that one contains *TOT*A of a weak acid/base pair

- If pH is in range where speciation of the *TOT*A is almost constant, the two solutions will have almost identical responses to titrant additions
- If pH is in range where speciation of the *TOT*A is changing rapidly, the base will acquire much of the added H^+, and pH will change more slowly in the system with *TOT*A

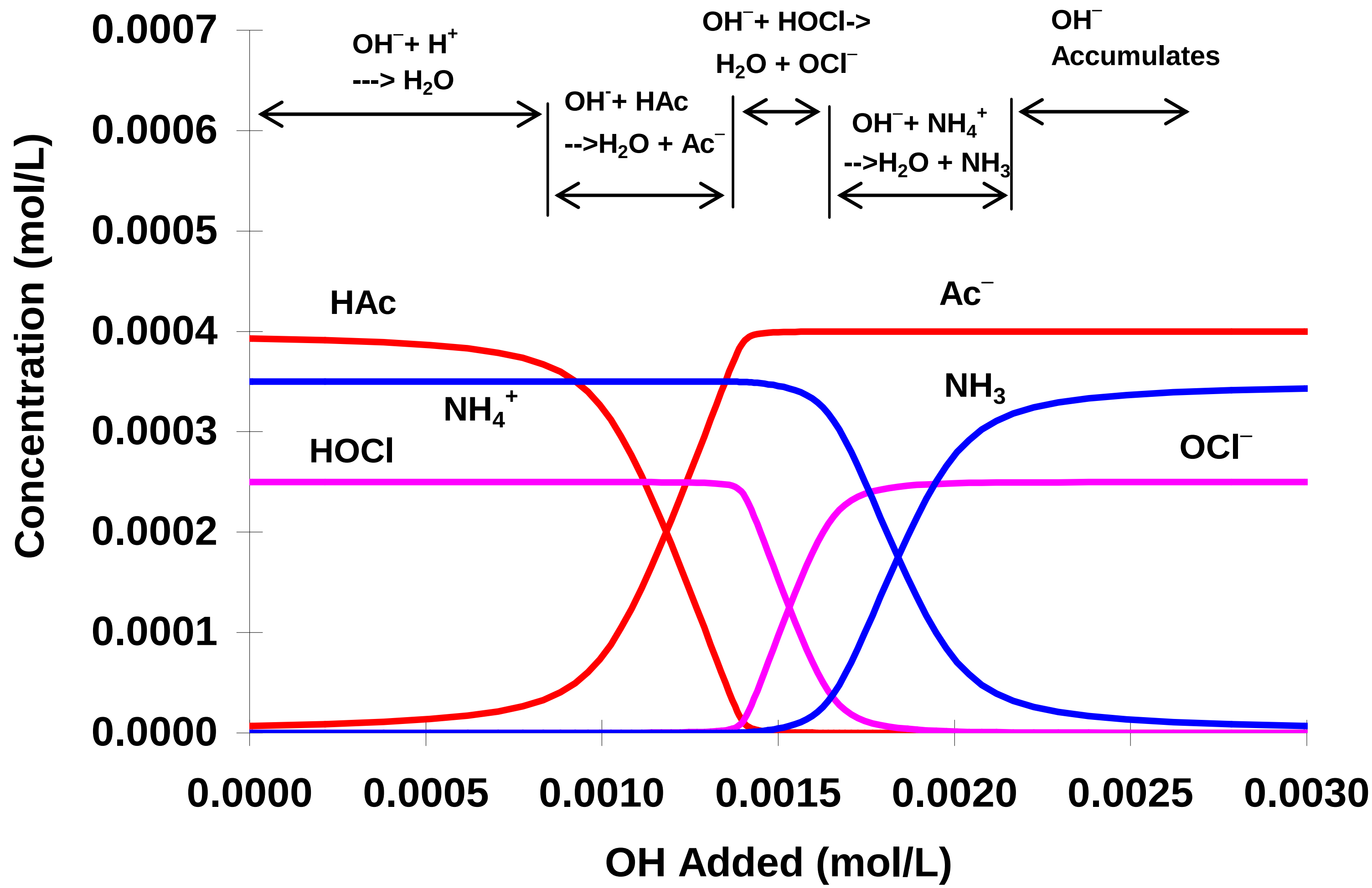


Titration with Strong Acid or Base



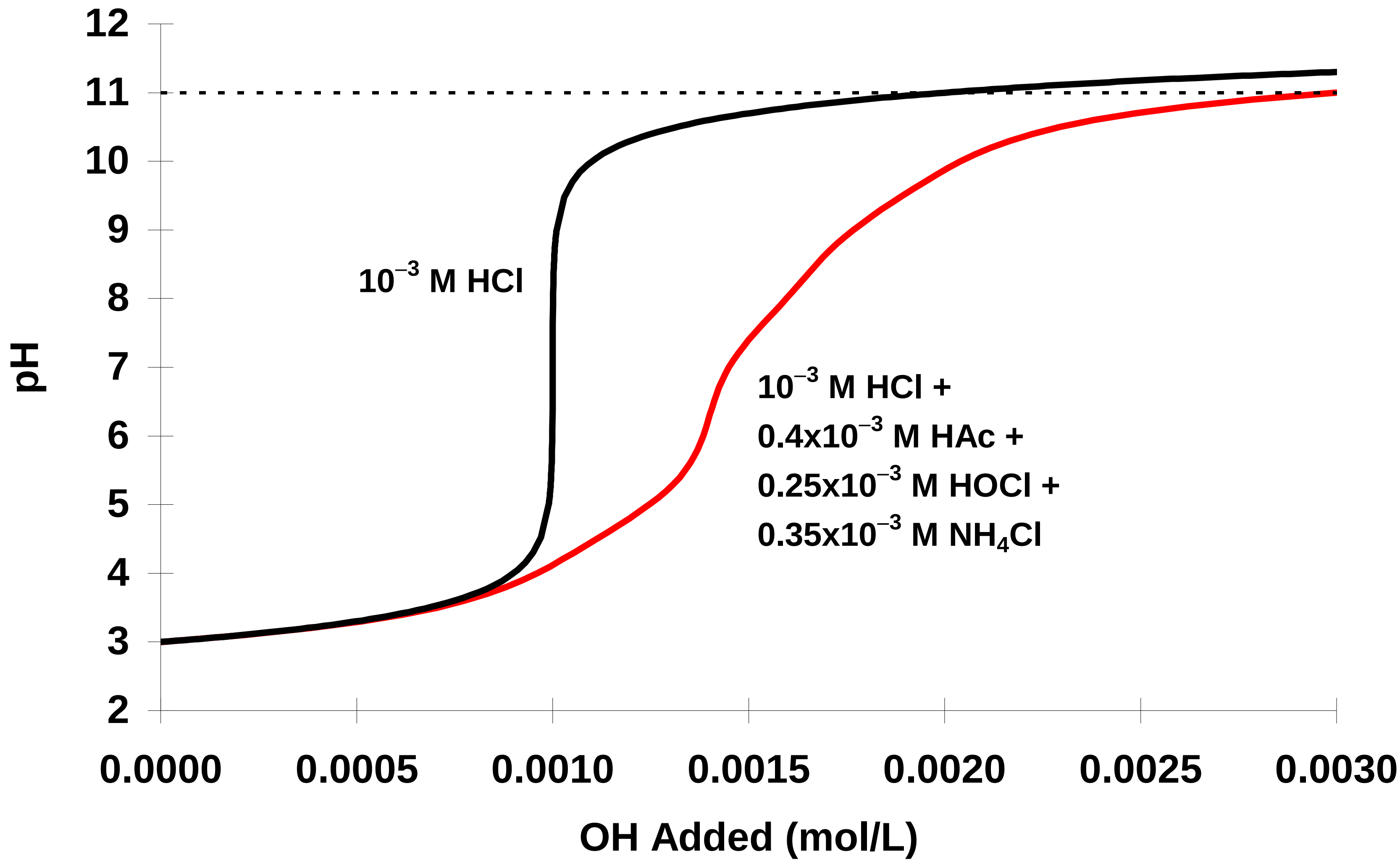
Titration with Strong Acid or Base

10^{-3} HCl + $0.4\text{x}10^{-3}$ HAc + $0.25\text{x}10^{-3}$ HOCl + $0.35\text{x}10^{-3}$ NH_4Cl

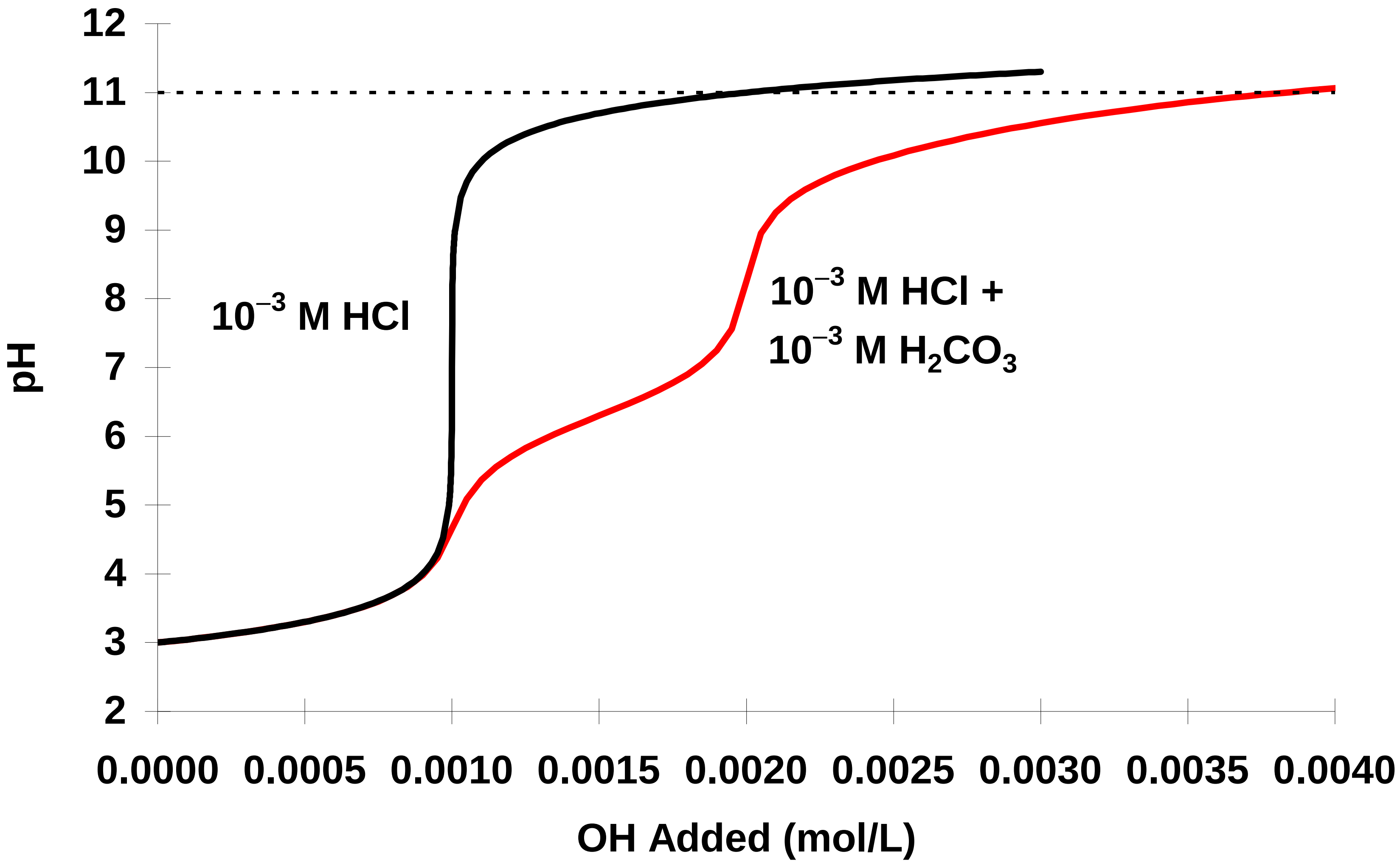


Titration with Strong Acid or Base

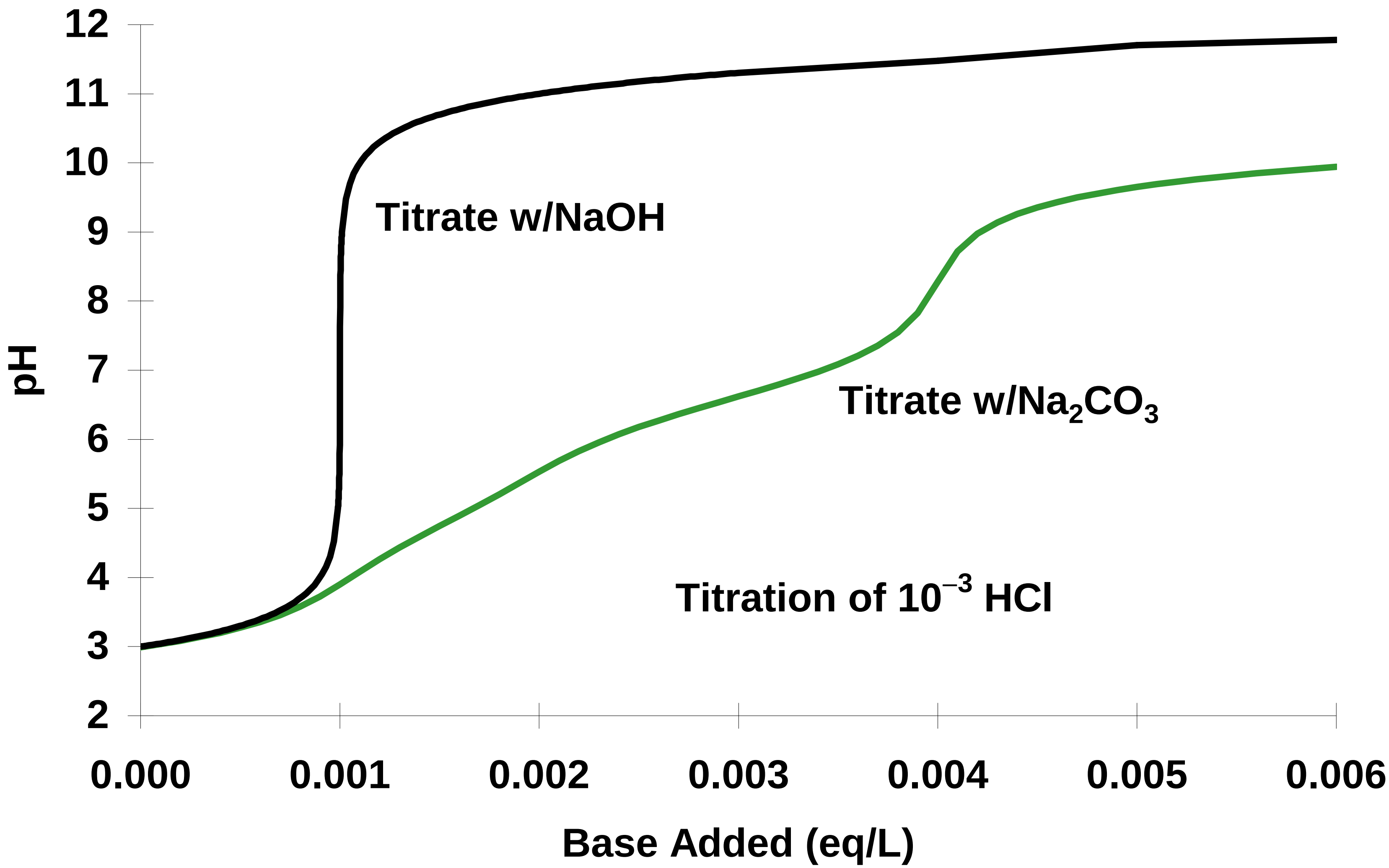
10^{-3} HCl + 0.4×10^{-3} HAc + 0.25×10^{-3} HOCl + 0.35×10^{-3} NH_4Cl



Titration with Strong Acid or Base



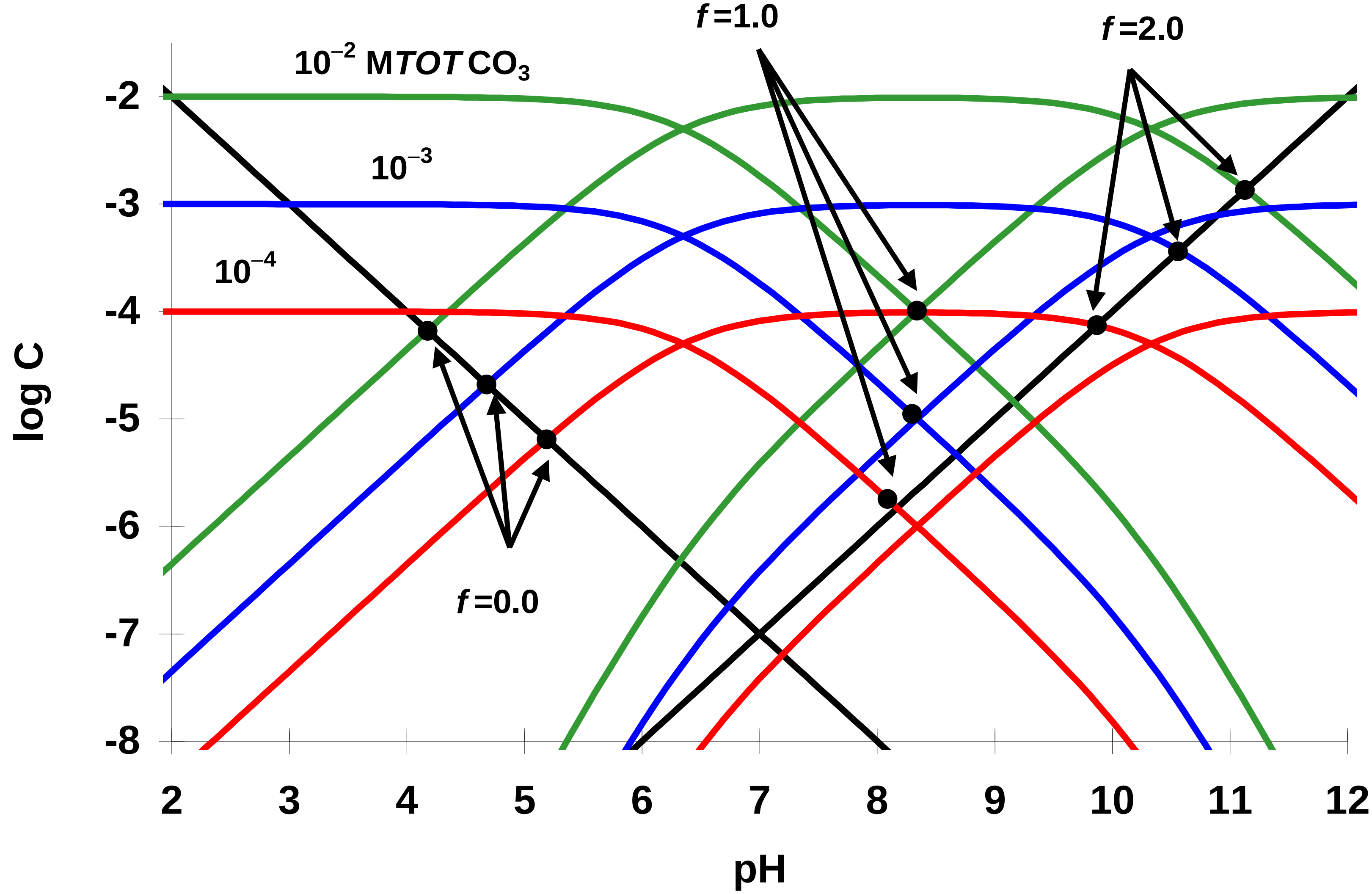
Titration with Weak Acid or Base



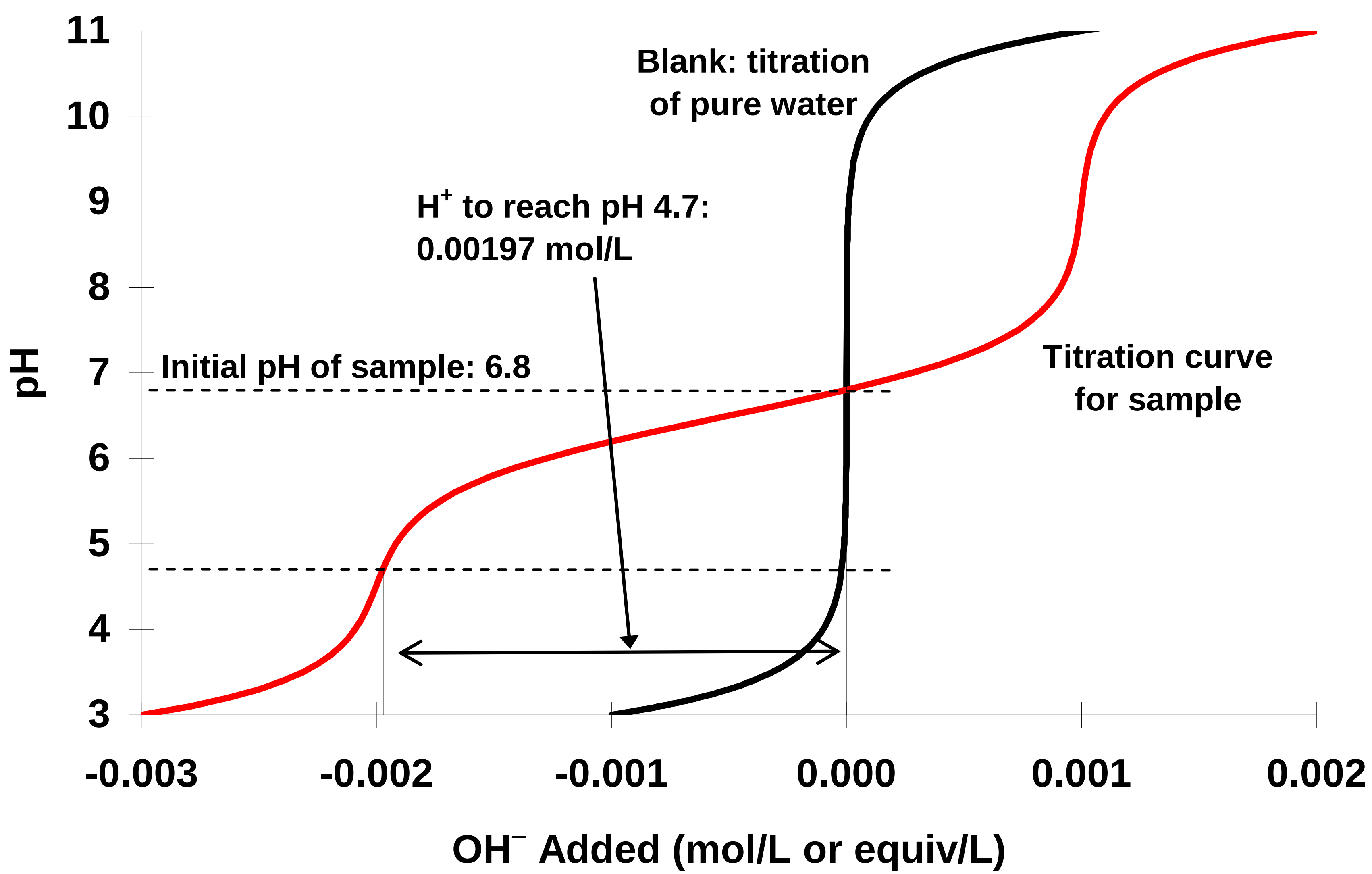
Alkalinity and Acidity

- Generic descriptors of the capacity of the solution to acquire H^+ or OH^- without reaching some limiting or undesirable condition, specified as a particular pH.
- For experimental measurements, pH endpoint for Alk titration is chosen to be 4.5±0.2. Conceptually justified as the pH that would be characterize a solution made by adding $TOTCO_3$ to pure water, entirely as H_2CO_3.
- Alk frequently approximated as deriving entirely from $H_2CO_3/HCO_3^-/CO_3^{2-}$ and $H^+/H_2O/OH^-$ groups. In reality, ***all weak bases contribute to Alk***, because all consume some H^+ between initial condition and titration endpoint.
- Can be quantified as net proton excess at endpoint minus net proton excess prior to titration (i.e., $TOTH_{endpt} - TOTH_{init}$). Therefore, a ***conservative*** property.

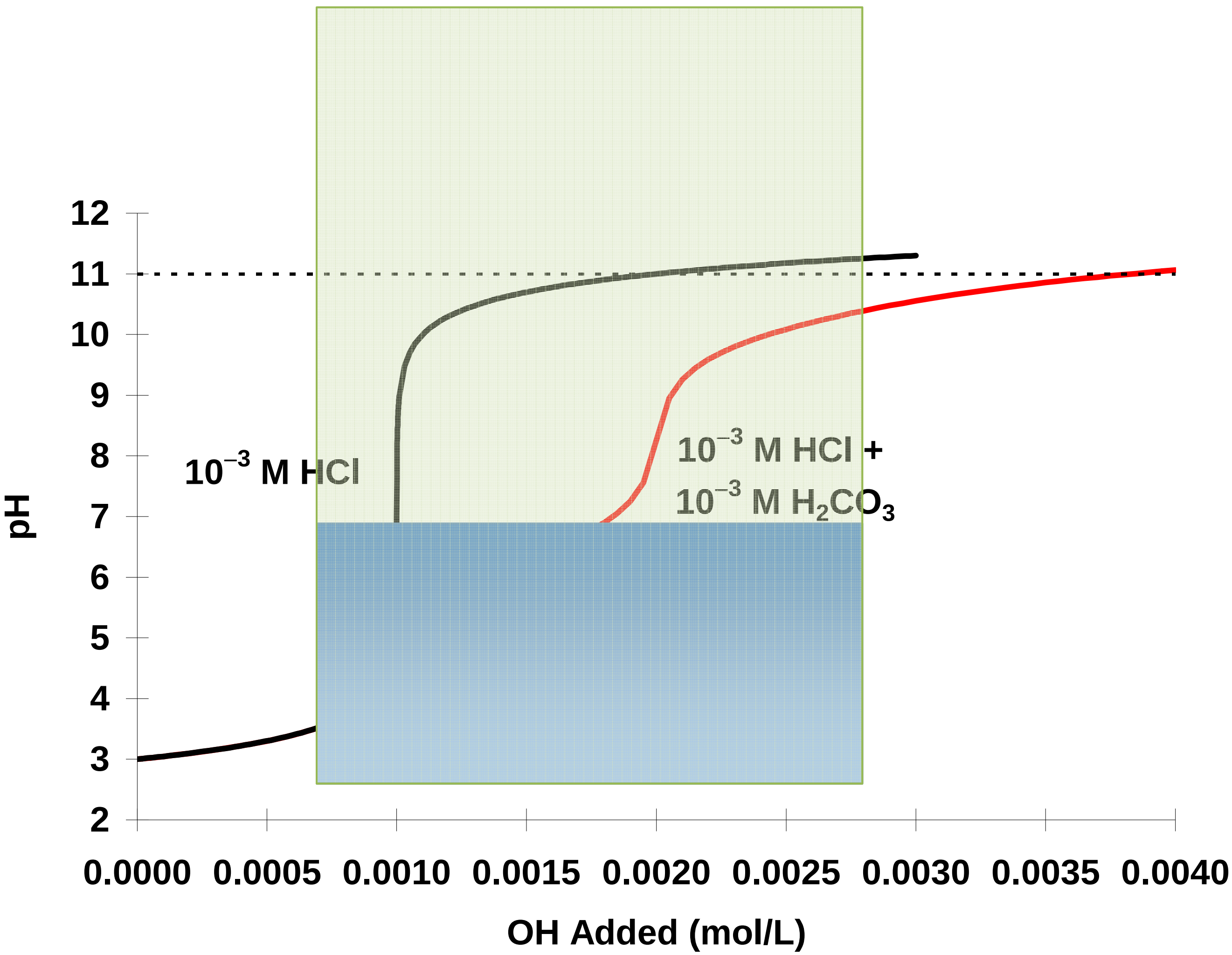
Alkalinity and Acidity



Alkalinity and Acidity



Titration with Strong Acid or Base

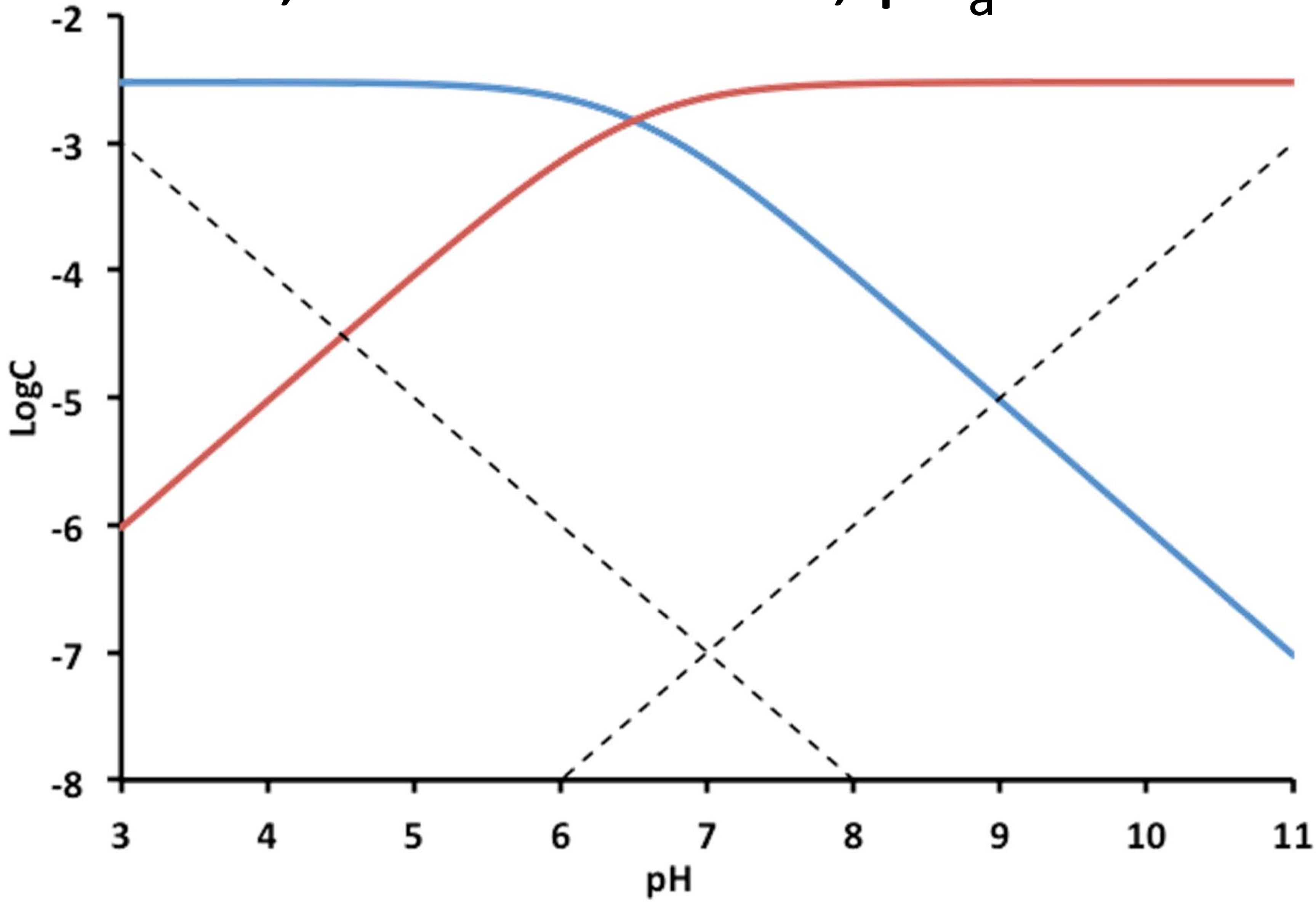


Buffer Intensity

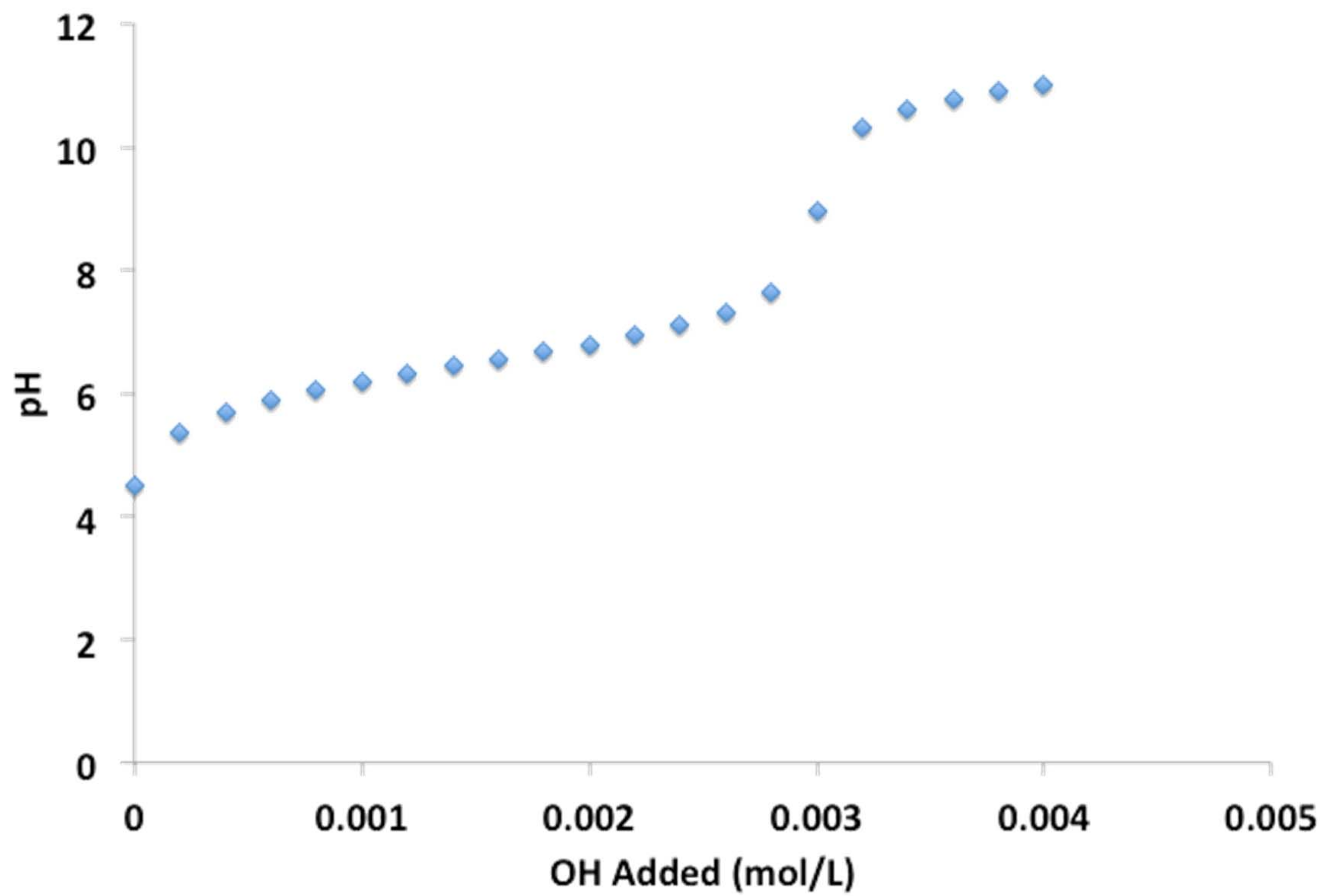
- Generic descriptor of the tendency of the solution to resist a pH change in response to addition of strong acid or base. Defined mathematically as:

$$\beta = -\frac{dTOTH_{added}}{d\mathrm{pH}}$$

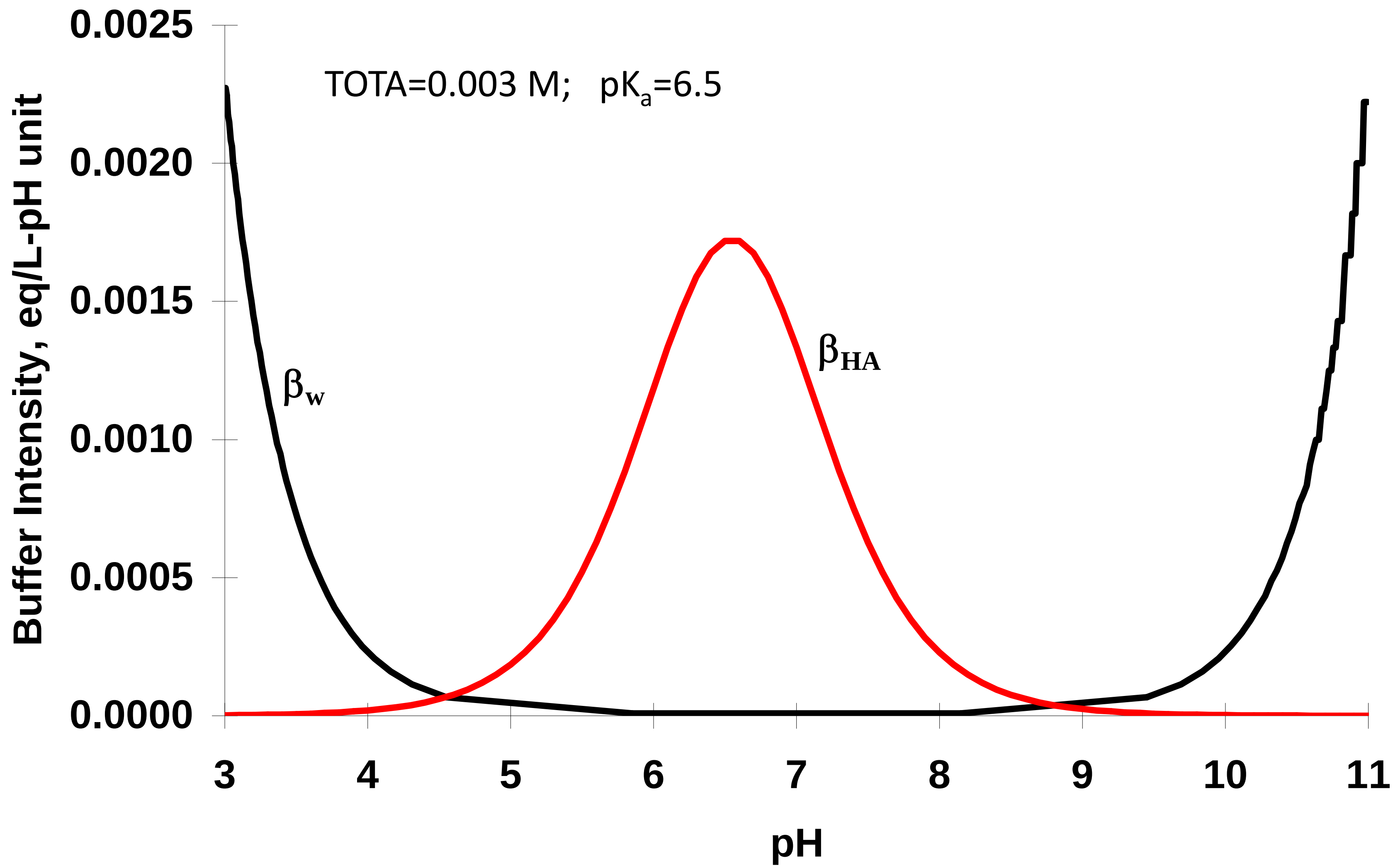
HA, TOTA=0.003M, pK_a=6.5

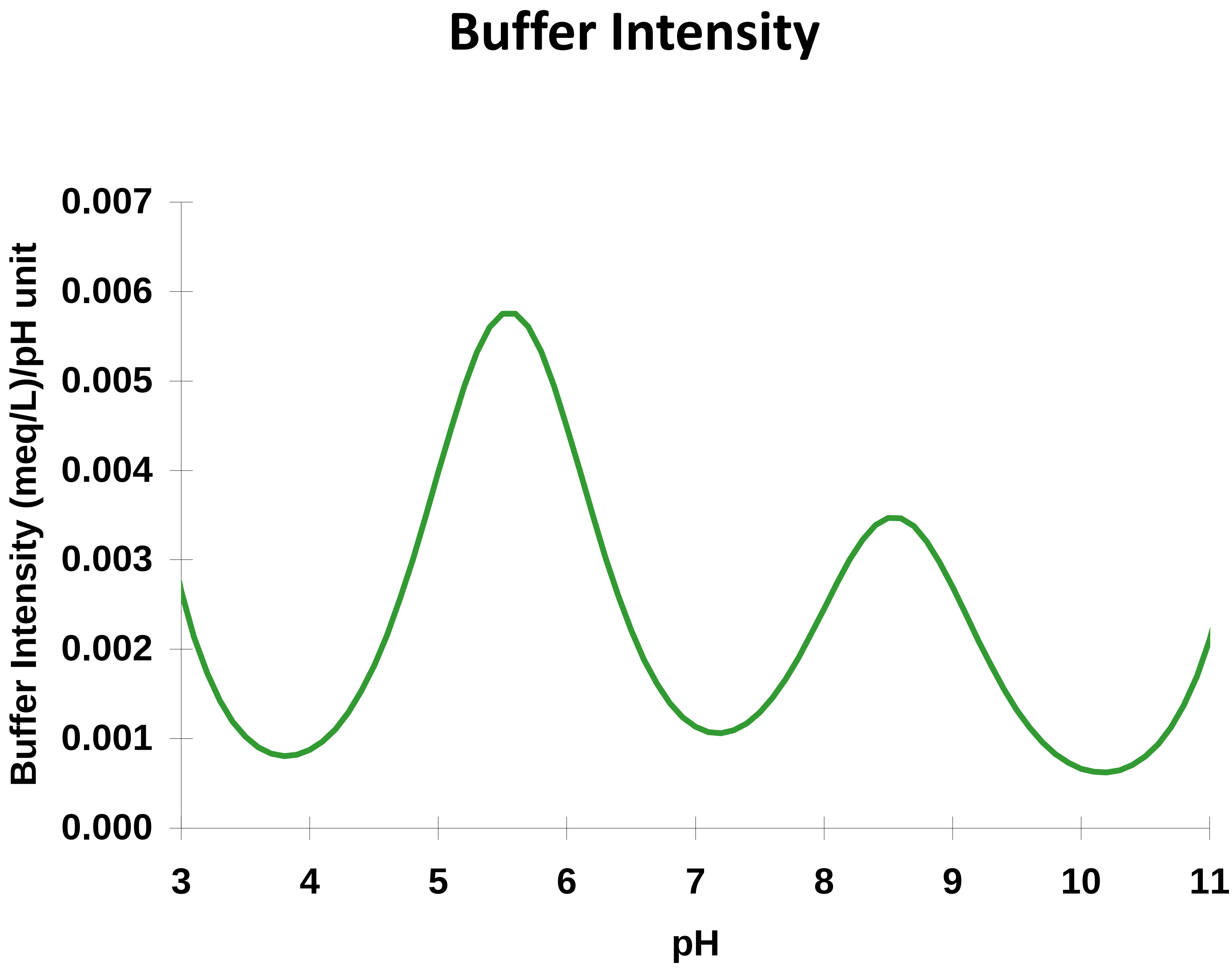


Titration of 0.003M HA w/ NaOH



Buffer Intensity




Buffer Intensity
Buffer Intensity (meq/L)/pH unit
0.007
0.006
0.005
0.004
0.003
0.002
0.001
0.000
3
4
5
6
7
8
9
10
11
pH

Buffer Intensity