

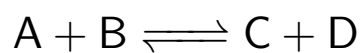
Structure & Function of Biomolecules
Acid Base Concepts
Chemistry 240 – Spring 2018

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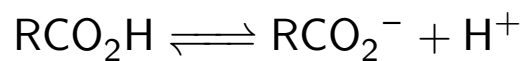
The Idea of Equilibrium



$$K = \frac{[C][D]}{[A][B]}$$

- If K is large ...
- If K is 1 ...
- If K is small ...

Carboxylic Acids are "Typical Weak Acids"



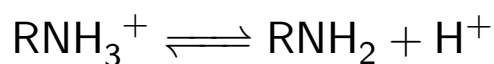
$$K_a = \frac{[\text{RCO}_2^-][\text{H}^+]}{[\text{RCO}_2\text{H}]}$$

$$pK_a = -\log K_a$$

- If K is large ...
- If K is 1 ...
- If K is small ...

Amines are "Typical Weak Bases"

...but look what I did here



$$pK_b \quad \dots \text{ NEVER!}$$

Acids vs Their Conjugate Bases

Category	Example	pK_a	Conj. Base
mineral acids	HCl, HNO ₃	< 0.0	
carboxylic acids	RCO ₂ H	~4-5	
ammonium ions	RNH ₃ ⁺	~9-12	
water	H ₂ O	~16	

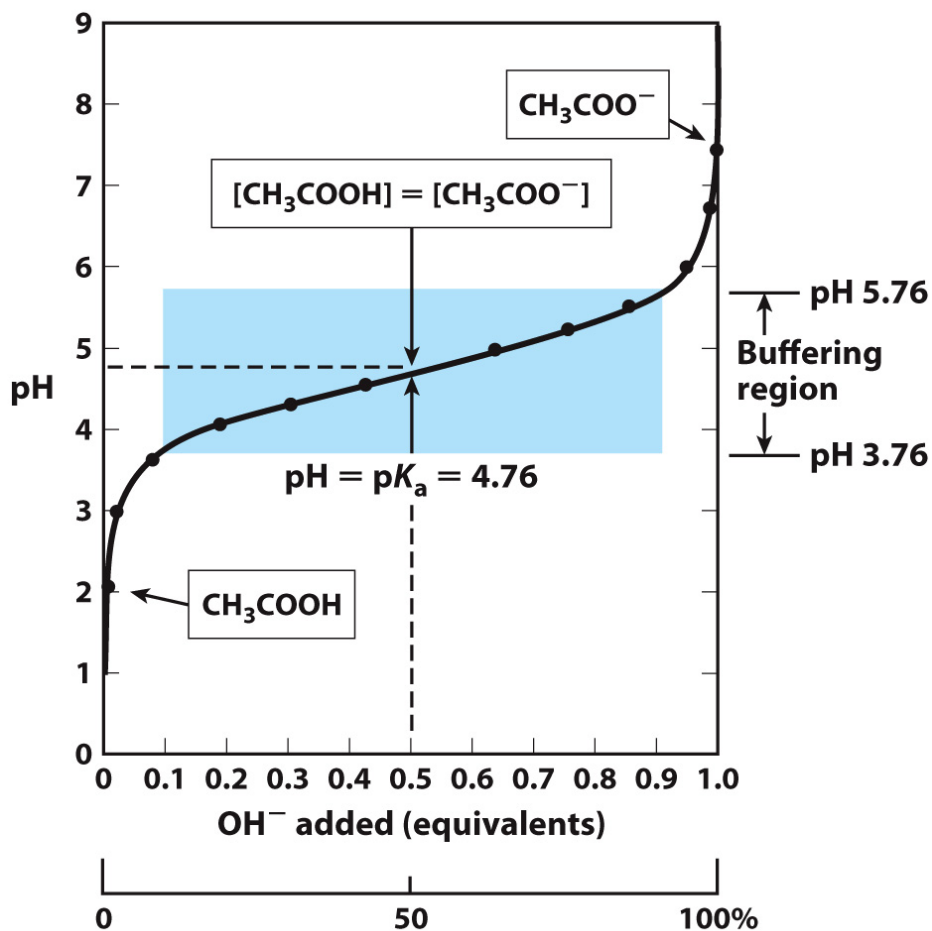
Let's Relate Energy Changes to Equilibrium

$$\Delta G^\circ = -2.303RT \log K$$

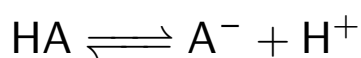
K	pK_a	ΔG
large	small	negative or exergonic
1	0	0
small	positive	positive or endergonic

- Energy diagrams ...

Titration of a Weak Acid



The Henderson-Hasselbalch Equation



$$K_a = \frac{[\text{A}^-][\text{H}^+]}{[\text{HA}]}$$

given that $\text{p}K_a = -\log K_a$ and $\text{pH} = -\log[\text{H}^+]$

$$\text{pH} = \text{p}K_a + \log \frac{[\text{A}^-]}{[\text{HA}]}$$

Titration of a Weak Base

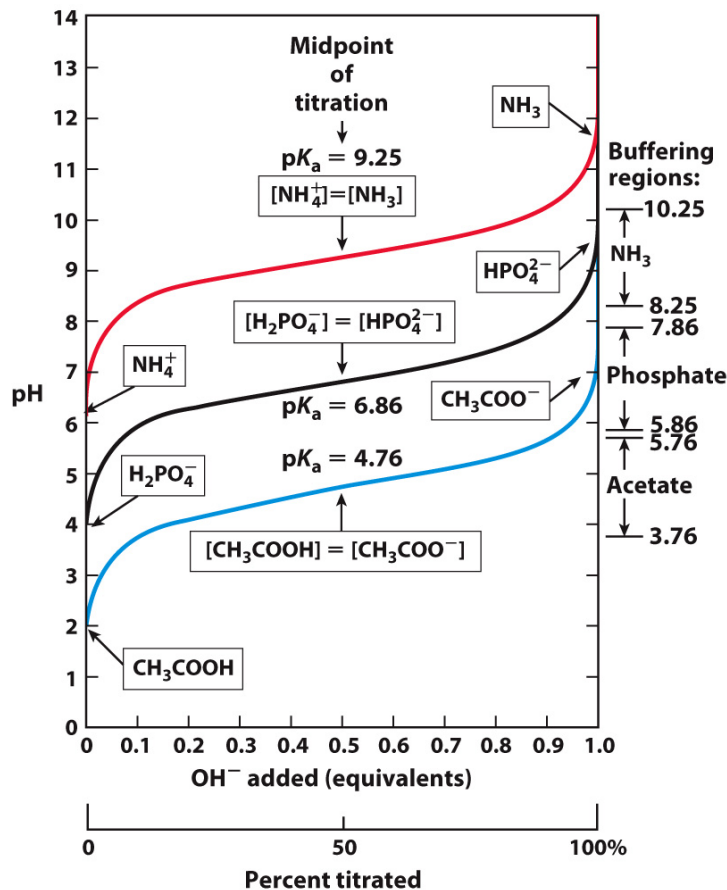


Figure 2-18
Lehninger Principles of Biochemistry, Seventh Edition

What About Phosphoric Acid/Phosphate?

Category	Example	pK_a	Conj. Base
mineral acids	HCl, HNO_3	< 0.0	
phosphoric acid (pK_{a1})	H_3PO_4	~ 2	
carboxylic acids	RCO_2H	$\sim 4-5$	
phosphoric acid (pK_{a2})	H_2PO_4^-	7.2	
ammonium ions	RNH_3^+	$\sim 9-12$	
phosphoric acid (pK_{a3})	HPO_4^{2-}	~ 12	
water	H_2O	~ 16	

What Chemical Species are Present at a Given pH?

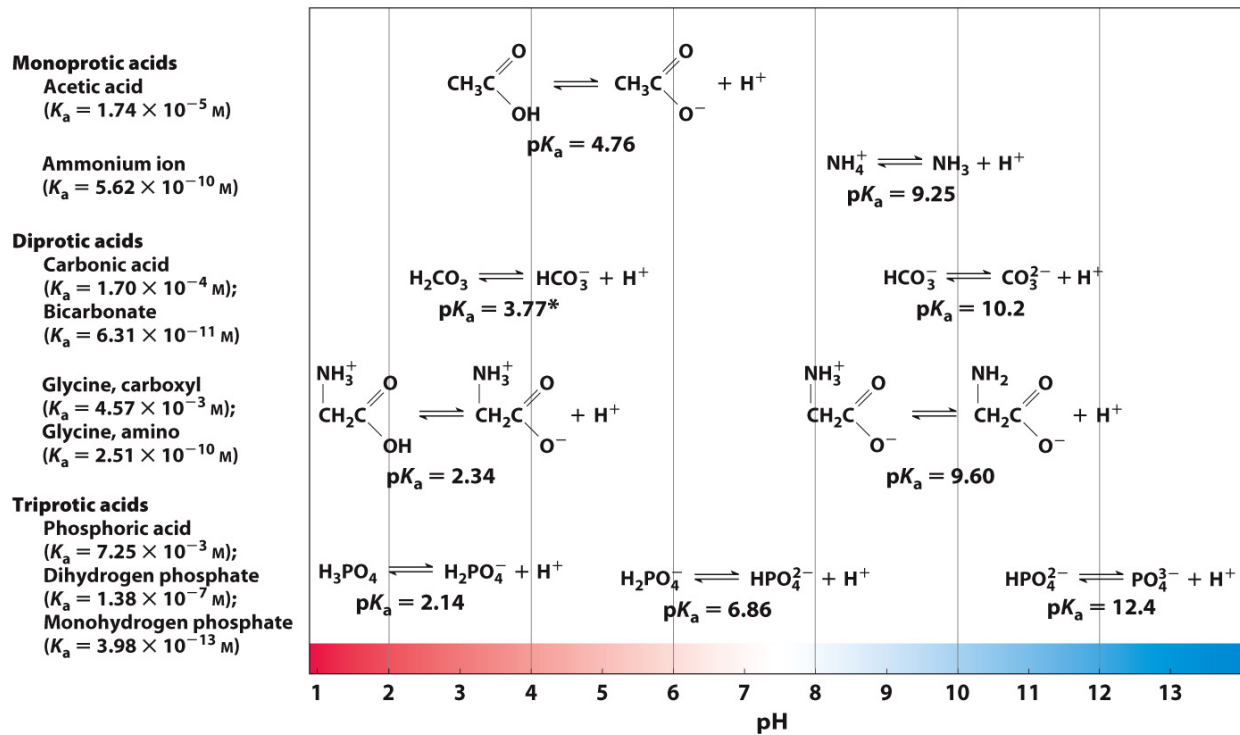


Figure 2-16

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Blood is Buffered

