

Weak Acid/Weak Base Equilibrium Calculations

Starting with an acid (proton donor)



$$K_a = \frac{[N][H_3O^+]}{[A]}$$



$$\frac{[N]}{[A]} = 10^{(pH - pK_a)}$$

$$\text{Fraction of charged conjugate} = \frac{\frac{[N]}{[A]}}{\frac{[N]}{[A]} + 1}$$



$$K_a = \frac{[B][H_3O^+]}{[P]}$$



$$\frac{[P]}{[B]} = 10^{(pK_a - pH)}$$

$$\text{Fraction of charged conjugate} = \frac{\frac{[P]}{[B]}}{\frac{[P]}{[B]} + 1}$$

		Lower pH				pH = pKa	Higher pH			
	2	1.5	1	0.5		0.5	1	1.5	2	
$A + H_2O \rightleftharpoons N + H_3O^+$										
Percent Negative	1%	3%	9%	24%	50%	76%	91%	97%	99%	
					pH = pKa					
$P + H_2O \rightleftharpoons B + H_3O^+$										
Percent Positive	99%	97%	91%	76%	50%	24%	9%	3%	1%	

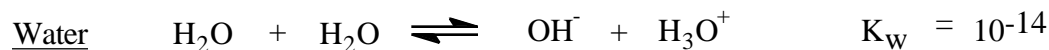
Starting with a base (proton acceptor)



$$K_b = \frac{[P][OH^-]}{[B]}$$



$$K_b = \frac{[A][OH^-]}{[N]}$$



Conjugate acid/base pair $K_a K_b = 10^{-14}$