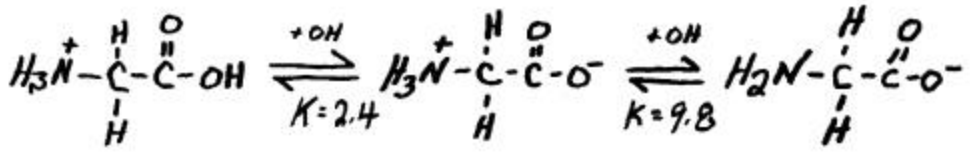
CELL PHYSIOLOGY Special Lecture - Calculations for pH and ΔG (Part III)

I. pH problem for an amino acid:

Using pK values of glycine for the α-COOH as 2.4 and the α-NH_3^+ as 9.8, determine the pH of:



a) A mixture of equal volumes of 0.10 M glycine and 0.05 M NaOH

$HGly \rightleftharpoons H^+ + Gly$

S 0.10 0 0

E (0.10 - 0.05) (0.05)

$pH = 9.8 + \log \frac{0.05}{0.05}$

$pH = \underline{9.8}$

b) A mixture of equal volumes of 0.10 M glycine and 0.05 M HCl

$H_2Gly \rightleftharpoons H^+ + HGly$

S 0.10 0 0

E (0.10 - 0.05) (0.05)

$pH = 2.4 + \log \frac{0.05}{0.05}$

$pH = \underline{2.4}$

II. Use of free energy to calculate ratio of metabolites in a reaction:

The following reaction is catalyzed by the enzyme phosphoglycerate kinase:

1,3-bisphosphoglycerate + ADP ↔ 3-phosphoglycerate + ATP

The ΔG° for this reaction is –4.5 kcal/mol. Assuming that the value of [ATP]/[ADP] is 10 and the temperature is 25 °C, calculate the concentration ratio of 3-phosphoglycerate to that of 1.3-bisphosphoglycerate at equilibrium.

$K_{eq} = \frac{[3\text{-PGA}][ATP]}{[1,3\text{diPGA}][ADP]}$

Use: $\Delta G^\circ = -2.3RT \log K_{eq}$

or $\log K_{eq} = \frac{-\Delta G^\circ}{2.3RT}$

① $\log K_{eq} = \frac{+4500\ cal/mol}{(2.3)(1.987\ cal/degree \cdot mol)(298K)}$

② $\log K_{eq} = 3.30$; $K_{eq} = 2.015 \times 10^3$

③ $2.015 \times 10^3 = \frac{[3\text{-PGA}]}{[1,3\text{diPGA}]}(10)$

④ $\frac{[3\text{-PGA}]}{[1,3\text{diPGA}]} = \underline{201.5}$