

## Summary of formulas and constants used in biochemistry

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### Constants

$$R = 0.008314 \text{ kJ} \cdot \text{mol}^{-1} \cdot \text{K}^{-1}$$
$$T \text{ in K} = T \text{ in } ^\circ\text{C} + 273.15$$

### Free energy

$$\Delta G = \Delta H - T\Delta S$$

### Free energy and concentration:

$$aA + bB \rightleftharpoons cC + dD$$
$$\Delta G^{\circ'} = -RT \ln(K_{eq}) = -RT \ln \left( \frac{[A]_{eq}^a [B]_{eq}^b}{[C]_{eq}^c [D]_{eq}^d} \right)$$
$$\Delta G = \Delta G^{\circ'} + RT \ln \left( \frac{[A]^a [B]^b}{[C]^c [D]^d} \right)$$

The standard state condition is defined as all products and reactants at 1 M, 25°C, 1 atm pressure, pH 7.0.

### Binding

For the reaction:

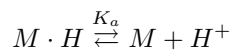
$$A + B \rightleftharpoons A \cdot B$$
$$K_{eq} = K_{association} = K_a = \frac{[A \cdot B]}{[A][B]}$$

You can write this reaction as a dissociation reaction as well (generally preferred by biochemists)

$$A \cdot B \rightleftharpoons A + B$$
$$K_{eq} = K_{dissociation} = K_D = \frac{[A][B]}{[A \cdot B]}$$

Written this way,  $K_D$  has units of concentration and thus measures the concentration at which the reaction will be 50% bound and 50% unbound.

**pH:**



$$K_a = \frac{[M][H^+]}{[M \cdot H]}$$

$$pH = -\log_{10}([H^+]); \quad pK_a = -\log_{10}(K_a)$$

$$\theta = \frac{[M \cdot H]}{[M] + [M \cdot H]} = \frac{1}{1 + K_a/[H^+]} = \frac{1}{1 + 10^{(pH - pK_a)}}$$