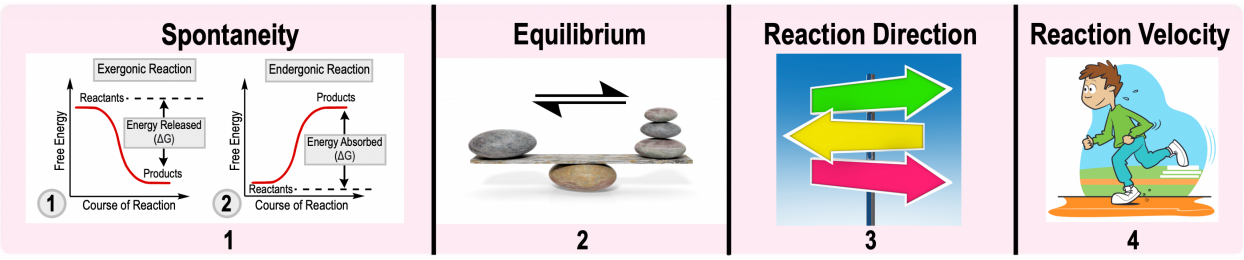
CONCEPT: EQUILIBRIUM CONSTANT

●4 features characterize biochemical reactions: 1) *Spontaneity*, 2)_____ _____, 3) *Directionality*, 4) *Velocity*.

EXAMPLE:



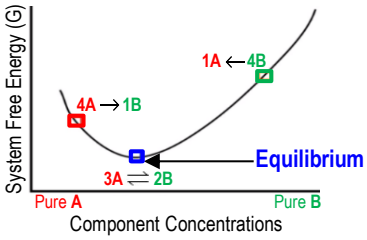
Equilibrium

●A reaction at _____ has the following characteristics:

- □ No _____ change in *concentrations* of *reactants* or *products* (forward reaction rate = reverse reaction rate).
- □ No change in free energy (____ = 0).
- □ At equilibrium, a reaction system's energy is at its _____ (most stable).
- □ The _____ of product concentration to reactant concentration is *constant*.

●All reactions proceed toward _____ equilibrium.

EXAMPLE:



Equilibrium Constant (K_{eq})

●Ratio of product concentrations over reactant concentrations at *equilibrium* is called the equilibrium _____ (**K_{eq}**).

- □ K_{eq} changes with _____(T), but in biological systems, if not given, we assume T is ~298K.

EXAMPLE: Equilibrium Constant Equation

$$\text{Equilibrium constant} = \mathbf{K_{eq}} = \frac{[\text{Products}]_{eq}}{[\text{Reactants}]_{eq}}$$

K_{eq}	Products vs. Reactants
$K_{eq} = 1$	$[\text{Products}]_{eq}$ ___ $[\text{Reactants}]_{eq}$
$K_{eq} < 1$	$[\text{Products}]_{eq}$ ___ $[\text{Reactants}]_{eq}$
$K_{eq} > 1$	$[\text{Products}]_{eq}$ ___ $[\text{Reactants}]_{eq}$

●When there are multiple products/reactants, their concentrations are _____ to get the K_{eq}.

- □ Coefficients (#'s in front of molecules) are included into K_{eq} as _____.

EXAMPLE: K_{eq} with multiple products/reactants & coefficients.

$$\underset{\text{Reactants}}{aA + bB} \longrightarrow \underset{\text{Products}}{cC + dD}$$

$$K_{eq} = \frac{[\ ]\,[D]^d}{[A]^a\,[\ ]}$$

CONCEPT: EQUILIBRIUM CONSTANT

PRACTICE: Calculate the equilibrium constant for the reaction below:

$$N_{2(g)} + 3\,Cl_{2(g)} \rightleftharpoons 2\,NCl_{3(g)}$$

Equilibrium Concentrations: 0.15M 0.25M 0.50M

a) 106.67

b) 43.12

c) 0.0094

d) 133.89

PRACTICE: What is the equilibrium constant expression for the following reaction?

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

a) $\frac{2[NH_3]}{3[N_2][H_2]}$

b) $\frac{[N_2][H_2]^3}{[NH_3]^2}$

c) $\frac{3[N_2][H_2]}{2[NH_3]}$

d) $\frac{[NH_3]^2}{[N_2][H_2]^3}$

PRACTICE: Calculate the K_{eq} for the following reaction to determine which of the following statements is true.

$$O_{2(g)} + 2F_{2(g)} \rightleftharpoons 2OF_{2(g)}$$

Equilibrium Concentrations: O_2 = 0.2 M F_2 = 0.3 M OF_2 = 0.5 M

a) Reactants are favored.

b) Products are favored.

c) Reactants & products are equally favored.

d) Not enough information provided to make conclusions.