Free Energy Change Under Nonstandard conditions

$\Delta G = \Delta G^\circ + RT \ln(Q)$

Ex. phosphocreatine + ADP $\rightleftharpoons$ creatine + ATP

	phosphocreatine	ADP	creatine	ATP
concent. (mM)	25	4.0	13	0.013

$\Delta G = \Delta G^\circ RT \ln(Q) = -12.6\ kJ/mol + (8.315 \times 10^{-3}\ kJ/mol\,K)\,310K \cdot \ln Q$

$Q = \frac{(0.013 \times 10^{-3})(13 \times 10^{-3})}{(25 \times 10^{-3})(4.0 \times 10^{-3})}$ $\quad \Delta G = -29\ kJ/mol$

after recovery: $\Delta G = 12.6\ kJ/mol$: creatine + ATP $\rightleftharpoons$ phosphocreatine + ADP

	creatine	ATP	phosphocreatine	ADP
(mM)	35	4.1	2.9	.16

$Q = \frac{[PC][ADP]}{[creatine][ATP]}$

ΔG° and K: at equilibrium, $Q = K$ and $\Delta G = 0$

Equation becomes $0 = \Delta G^\circ + RT \ln(K) \rightarrow \Delta G^\circ = -RT \ln K$

April 12, 2019 Electrochemistry I

Electrochemistry: study of the interchange between chemical + electrical energy

- Determining whether a particular oxidation-reduction reaction is spontaneous: generating electric current from spont. redox rxn
- using an electric current to drive a nonspontaneous redox rxn

Redox Reactions

$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O$ + energy $\quad 4Fe_{(s)} + 3O_{2(g)} \rightarrow 2Fe_2O_{3(s)}$

reducing agent/is oxidized — oxidizing agent/is reduced — oxidation and reduction always occur together

reducing agent: is oxidized — oxidizing agent: is reduced

- Oxidation numbers: to keep track of what loses electrons and what gains them
  - ↳ if oxidation # increases → element oxidized
  - " decreases → element is reduced

Rules to assign oxidation states

- ✓ Elements = 0
- ✓ monatomic ion = charge
- ✓ O: -2 (unless peroxide = -1)
- ✓ H: +1 (unless a metal hydride = -1)
- ✓ the sum of the oxidation numbers equals the overall charge (0 in a compound)

Tracking Oxidation States

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

Nitrogen: oxidation # decreased, so nitrogen reduced

: $CH_{4(g)} + O_{2(g)} \rightarrow CO_{2(g)} + H_2O$

following (carbon: oxidation # is increased, so carbon is oxidized

Corrosion: process by which something deteriorates because of oxidation

"Acids are corrosive"