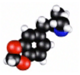
化学

Chemistry 223



Key Equations for CH 223

This may not include all the important equations from CH 223, but most of them are included here, separated by chapter.

Good luck!

Important Equations, Constants, and Handouts from Chapter 13:

for: a A + b B $\rightleftharpoons$ c C + d D

$$K = \frac{[C]^c\,[D]^d}{[A]^a\,[B]^b}$$

conc. of products

conc. of reactants

equilibrium constant

$K_p = K_c(RT)^{\Delta n}$

R = 0.082057 L atm mol^{-1} K^{-1}

Under Any Reaction Conditions

Product concentrations

$$\text{Reaction quotient} = Q = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Reactant concentrations

Handouts:

- *Manipulating Equilibrium Constant Expressions*
- *Types of Equilibrium Constants*

Le Chatelier's Principle

Important Equations, Constants, and Handouts from Chapter 14 Part I:

$pH_{(strong\ acid)} = -\log C_a$

$pH_{(strong\ base)} = 14 + \log C_b$

$pH_{(weak\ acid)} = -\log [K_a{*}C_a]^{1/2}$

$pH_{(weak\ base)} = 14 + \log [K_b{*}C_b]^{1/2}$

$14 = pH + pOH = pK_a + pK_b$

$K_w = 1.00 * 10^{-14} = [H_3O^+][OH^-] = K_a{*}K_b$ (25 °C)

$HOAc + H_2O \rightleftharpoons H_3O^+ + OAc^-$

$$K_a = \frac{[H_3O^+][OAc^-]}{[HOAc]}$$

$$B(aq) + H_2O(\ell) \rightleftharpoons BH^+(aq) + OH^-(aq)$$

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

Acid-Base Theory: **Brønsted theory, conjugate acid** *and* **base, strong** *and* **weak acids** *and* **bases,** *know the* **8 strong acids** *and* **bases!, autoionization, Lewis theory, electron pair acceptor** *and* **donator, salt acidity/basicity, formation constants (K_f)**

Handouts:

- *Manipulating Equilibrium Constant Expressions*
- *Types of Equilibrium Constants*
- *Table of K_a and K_b values in Problem Set #2*

Important Equations, Constants, and Handouts from Chapter 14 Part II:

Titrations (SA+SB, SB+SA, WA+SB, WB+SA) *and* **Buffers** *chapter*

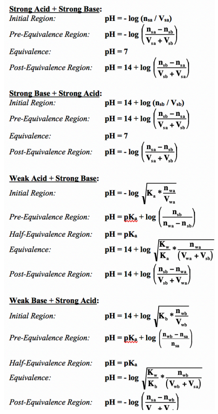
$$pH = pK_a + \log\frac{[\text{Conj. base}]}{[\text{Acid}]}$$

$$pH = pK_a + \log\frac{(mol_{\text{Conj base}} - mol_{\text{strong acid}})}{(mol_{\text{weak acid}} + mol_{\text{strong acid}})}$$

$$pH = pK_a + \log\frac{(mol_{\text{Conj base}} + mol_{\text{strong base}})}{(mol_{\text{weak acid}} - mol_{\text{strong base}})}$$

Handouts:

- *Manipulating Equilibrium Constant Expressions*
- *Types of Equilibrium Constants*
- *Table of K_a and K_b values in Problem Set #2*
- *Titration Guide*
- *Buffers and Henderson-Hasselbalch Guide*



Strong Acid + Strong Base:

Initial Region: $pH = -\log (n_{sa} / V_{sa})$

Pre-Equivalence Region: $pH = -\log\left(\frac{n_{sa} - n_{sb}}{V_{sa} + V_{sb}}\right)$

Equivalence: $pH = 7$

Post-Equivalence Region: $pH = 14 + \log\left(\frac{n_{sb} - n_{sa}}{V_{sb} + V_{sa}}\right)$

Strong Base + Strong Acid:

Initial Region: $pH = 14 + \log (n_{sb} / V_{sb})$

Pre-Equivalence Region: $pH = 14 + \log\left(\frac{n_{sb} - n_{sa}}{V_{sa} + V_{sb}}\right)$

Equivalence: $pH = 7$

Post-Equivalence Region: $pH = -\log\left(\frac{n_{sa} - n_{sb}}{V_{sa} + V_{sb}}\right)$

Weak Acid + Strong Base:

Initial Region: $pH = -\log\sqrt{K_a * \frac{n_{wa}}{V_{wa}}}$

Pre-Equivalence Region: $pH = pK_a + \log\left(\frac{n_{sb}}{n_{wa} - n_{sb}}\right)$

Half-Equivalence Region: $pH = pK_a$

Equivalence: $pH = 14 + \log\sqrt{\frac{K_w}{K_a} * \frac{n_{wa}}{(V_{wa} + V_{sb})}}$

Post-Equivalence Region: $pH = 14 + \log\left(\frac{n_{sb} - n_{wa}}{V_{sb} + V_{wa}}\right)$

Weak Base + Strong Acid:

Initial Region: $pH = 14 + \log\sqrt{K_b * \frac{n_{wb}}{V_{wb}}}$

Pre-Equivalence Region: $pH = pK_a + \log\left(\frac{n_{wb} - n_{sa}}{n_{sa}}\right)$

Half-Equivalence Region: $pH = pK_a$

Equivalence: $pH = -\log\sqrt{\frac{K_w}{K_b} * \frac{n_{wb}}{(V_{wb} + V_{sa})}}$

Post-Equivalence Region: $pH = -\log\left(\frac{n_{sa} - n_{wb}}{V + V}\right)$

Important Equations, Constants, and Handouts from Chapter 15:

$$M_yX_z\,(s) \rightleftharpoons yM^{Z+}\,(aq) + zX^{Y-}(aq)$$

$$K_{sp} = [M^{z+}]^y[X^{y-}]^z$$

Solubility product constant

Molar solubility of the ions

$Ag^+(aq) + 2\ CN^{-1}(aq) \rightleftharpoons Ag(CN)_2^{-1}(aq)$

$$K_f = \frac{[Ag(CN)_2^{-1}]}{[Ag^+][CN^{-1}]^2} = 5.6 * 10^{18}$$

- *know how to* **predict solubility** *using* **CH 221 solubility guide**

Solubility: **Common ion effect, separating salts by differences in solubility**

Handouts:

- *Types of Equilibrium Constants*
- *Solubility Guide*

Important Equations, Constants, and Handouts from Chapter 16:

$\Delta H_{sys}^o = \Sigma\Delta H^o$ (products) - $\Sigma\Delta H^o$ (reactants)

$\Delta S_{sys}^o = \Sigma S^o$ (products) - ΣS^o (reactants)

$\Delta G_{sys}^o = \Sigma\Delta G^o$ (products) - $\Sigma\Delta G^o$ (reactants)

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

$\Delta G^o_{rxn} = -RT \ln K$

R = 8.3145 J mol^{-1} K^{-1}

$\Delta G_{rxn} = \Delta G^o_{rxn} + RT \ln Q$

Handouts:

- *Types of Equilibrium Constants*
- *Thermodynamic Values (Problem Set #5)*

- *know the* **three laws of thermodynamics!**
- *know the* **difference between enthalpy and entropy** *and* **how they relate to Gibbs free energy**
- *know how to* **calculate enthalpy (CH 221) entropy and Gibbs energy (this chapter)**
- *know how the* **sign of ΔG relates to spontaneity (and also $\Delta S_{universe}$)**

Important Equations, Constants, and Handouts from Chapter 17:

Redox Reactions: oxidation, reduction, LEO, GER, oxidizing agent, reducing agent, anode, cathode, galvanic/voltaic cells, electrolysis (electrolytic cells), shorthand notation for galvanic cells, SHE electrode

- **know how to balance redox reactions in acid or base conditions**
- **be able to calculate E° and E for cells**

$$\Delta G^\circ = -n F E^\circ$$

$$\text{Amps} = \frac{\text{coulombs}}{\text{seconds}}$$

$$E = E^\circ - (RT/nF) \ln Q$$

$R = 8.3145\ J\ mol^{-1}\ K^{-1}$

$F = 9.6485 \times 10^4$ C/mol e^-

$$E^\circ = \frac{RT}{nF} \ln K$$

Handouts:

- *Thermodynamic Values and Electrochemical Cell Values (Problem Set #5)*

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