AP Chemistry

Thou Shalt Not Forget

Credit: Dan Reid

General Equilibrium

1. K_{eq} = [products]^x/[reactants]^y … x and y represent the coefficients in the balanced chemical equation.
2. Only (aq) and (g) appear in an equilibrium expression. Use [ ] for Molarity and (P_{gas}) for atm.
3. A large K_{eq} means that there are more products at equilibrium. A small K_{eq} means there are more reactants at equilibrium.
4. Reversing a reaction? $1/K_{eq}$ Doubling a reaction? $(K_{eq})^2$ Adding reactions? Multiply the K's together
5. Le Chatelier's Principle: It's all about determining Q!! If Q >K_{eq} , then the reaction shifts to the left, towards the reactants.
6. Catalysts and inert gases DO NOT shift an equilibrium.
7. Changes in pressure (caused by changing the volume of a container) can shift an equilibrium ONLY IF the # of gas particles are different on each side...An increase in the pressure favors a shift in the equilibrium towards the side with LESS moles of gas. (Reminder: As V↓ , P↑)

Acid-Base Equilibrium

1. The pH of acids are less than 7, and bases are greater than 7. The pH of pure water is only 7 when the temp. is 25°C.
2. Acids donate [H^+]; bases accept [H^+].
3. The hydronium ion is H_3O^+. [H^+] is a proton.
4. Strong acids: HNO_3 H_2SO_4 $HClO_4$ $HClO_3$ and HBr, HI, HCl…"NO SO ClO 3, 4, 4, 3 and BrICl"
5. Strong bases: Group 1 hydroxides Group 2 hydroxides *Some Group II hydroxides are only slightly soluble, but whatever dissolves can completely ionize.
6. pH = −log [H^+] [H^+] = 10^{-pH}
7. The stronger the acid, the weaker its conjugate base.
8. Acid-Base reactions favor the direction of the "strong side" to the "weak side"...If K>1, then the reactants are stronger.
9. [H^+] =Square Root of M_aK_a…(This shortcut only works if "x" is really small compared to M_a . Also, don't use this shortcut if you are given the pH of the solution and you are asked to solve for K_a because the pH can be used to find "x" in the ICE box.)
10. "x" in the ice box calculation is [H^+] for a weak acid, and [OH^-] for a weak base.
11. % Ionization of a weak acid = [H^+] /M_a
12. % ionization increases as the acid concentration decreases...adding more water will increase the amount of ionization.
13. If a salt contains a conjugate base of a weak acid, the salt is going to be slightly basic...CBOWA's are (-) ions.
14. If a salt contains a conjugate acid of a weak base, the salt is going to be slightly acidic...CAOWB's are (+) ions.
15. If a salt contains conjugates of strong acid/bases, the ion is neutral. Example -- KBr is a neutral salt (KOH + HBr)
16. A larger K_a value means a stronger acid. A larger K_b means a stronger base.

17. Relative strengths of acids: (a) Smaller cations are more acidic. (b) More (+) charge on the cation makes it more acidic. (c) More oxygens (or more electronegative atoms) on an anion makes it more acidic since the proton is "more ionizable".

<u>Additional Aspects of Aqueous Equilibrium: Titrations and Buffers</u>

1. Buffers are created by a weak acid + CB (salt) or by a weak base + CA (salt).
2. $[H^+] = M_aK_a/[salt]$...You can use # of moles instead of molarity in this formula.
3. Adding a common ion to a weak acid (or base) decreases the % ionization, and therefore the pH gets closer to 7.
4. $M_aV_a=M_bV_b$ ...This is only true at the equivalence point.
5. $M_1V_1 = M_2V_2$ This is not on the formula sheet, but it is extremely useful for dilution calculations.
6. Titrations: Weak acid + Strong Base has a pH at the equivalence point that's above 7. Weak Base + Strong Acid has a pH at the equivalence point that's below 7. Strong Acid + Strong Base has a pH =7 at the equivalence point.
7. $pH = pK_a$ at the ½ equivalence point for a "weak + strong" titration. Also, when pH = pKa, then $[HA] = [A^-]$
8. More buffer capacity = more moles of weak acid & CB (or weak base and CA).
9. Solubility Equilibrium: 2 ions....$K_{sp} = x^2$; 3 ions...$K_{sp} = 4x^3$ "x" = Molar Solubility in units of moles/Liter
10. The larger the "x" value, the more soluble the salt is.
11. If $Q > K_{sp}$, a precipitate forms.
12. Group I cations, NH_4^+, and NO_3^- salts are always soluble in water. These are usually the spectator ions in a chemical reaction.