Dougherty Valley • AP Chemistry

Equilibrium: A Dynamic Process

S-33

STUDY LIST From Paul Groves

I can…

Law of Mass Action:

☐ write the Law of Mass Action for concentration terms.

$$K_c = \frac{[R]^r[S]^s \cdots}{[A]^a[B]^b \cdots}$$

☐ write the Law of Mass Action for pressure terms.

$$K_p = \frac{(P_R)^r(P_S)^s}{(P_A)^a(P_B)^b}$$

☐ remember to exclude solids and liquids in the law of mass action.

☐ use the Law of Mass Action to solve for the equilibrium constant, or to solve for concentrations at equilibrium.

Equilibrium Constant:

☐ use the size of the equilibrium constant to determine if it is a product favored or reactant favored reaction.
$K > 1$ product favored
$K < 1$ reactant favored

☐ convert between Kc and Kp
$K_p = K_c(RT)^{\Delta n}$ Where Δn =
mol of (g) products – mol of (g) reactants

☐ modify the value of K when a chemical reaction has been modified:
Reverse rxn = $1/K_{forward}$
Multiply rxn by a number n = K^n
Adding rxns = $K_1 \times K_2 \times \ldots$

Reaction Quotient, Q:

☐ calculate Q for a reaction not at equilibrium (or if you don't know whether it is at equilibrium or not)

☐ use the size of K versus Q to determine which way a reaction will proceed to reach equilibrium, or to determine if it is already at equilibrium
$K < Q$, too many products,
reverse rxn favored, "shift left"
$K > Q$, too many reactants,
forward rxn favored, "shift right"
$K = Q$, already at equilibrium

Le Chatelier's Principle:

☐ define Le Chatelier's Principle.

☐ describe how changes in concentration, pressure, and temperature shift the equilibrium point of a reaction.

ICE Tables:

☐ set up an ICE table to solve equilibrium problems.

☐ remember to take the stoichiometric coefficients of the reaction into account when using an ICE table.

☐ use the 5% rule to approximate changes to equilibrium to avoid using quadratic equations and other more complex algebra methods – only when 5% rule applies.

☐ use "perfect squares" to help algebraically solve for ICE table values

Connection to Previous Chapters:

☐ make connections between Equilibrium and the Thermochemistry, Thermodynamics, and Kinetics chapters.

Equations from AP Equation Sheet on the back. Not enough space here!

From the AP Exam:

EQUILIBRIUM

$K_c = \frac{[C]^c[D]^d}{[A]^a[B]^b}$, where $a\,A + b\,B \rightleftarrows c\,C + d\,D$

$K_p = \frac{(P_C)^c(P_D)^d}{(P_A)^a(P_B)^b}$

$K_a = \frac{[H^+][A^-]}{[HA]}$

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

$K_w = [H^+][OH^-] = 1.0 \times 10^{-14}$ at 25°C

$= K_a \times K_b$

$pH = -\log[H^+]$, $pOH = -\log[OH^-]$

$14 = pH + pOH$

$pH = pK_a + \log\frac{[A^-]}{[HA]}$

$pK_a = -\log K_a$, $pK_b = -\log K_b$

Equilibrium Constants

K_c (molar concentrations)

K_p (gas pressures)

K_a (weak acid)

K_b (weak base)

K_w (water)