Chem 163 – K. Marr

[Keep for Reference]

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**BLUFFER’S GUIDE**

1. aA + bB + . . . ⇋ rR + sS + . . .
   \[ K_c = \frac{[R]^r [S]^s \cdots}{[A]^a [B]^b \cdots} \]
   and for gases:
   \[ K_p = \frac{(P_R)^r (P_S)^s \cdots}{(P_A)^a (P_B)^b} \]

2. K > 1 **products** favored
   K < 1 **reactants** favored

3. Excluded: solids; pure liquids; water (in aqueous solutions) because their [ ]’s do not change.

4. Convert from \( K_c \) to \( K_p \)
   \[ K_p = K_c (RT)^{\Delta n} \]
   where \( \Delta n \) = moles of gaseous product – moles of gaseous reactant.

5. Typical question: Given \( K_c \) and the starting concentrations of reactants, find concentrations of products at equilibrium.
   Example: \( K_c \) for acetic acid = 1.8 x 10^{-5}
   What is the equilibrium concentration of \([H^+]\) in a 0.100 M solution of the acid?

6. Equilibrium constant for a **reverse** reaction = \( \frac{1}{K} \), the value of the forward reaction.

7. Equilibrium constant for a doubled reaction = \( K^2 \).

8. When using Hess’s Law:
   \[ K_{overall} = K_1 \times K_2 \]


10. If **out** of equilibrium: Calculate the reaction quotient (Q) similar to the way an equilibrium constant would be found. If:
    - Q < K \text{ forward} reaction occurs to reach equilibrium
    - Q > K \text{ reverse} reaction occurs to reach equilibrium

11. Problem solving:
    - Set up problems using the “magic box” (or ICE box) C = “change” or \( \Delta \).
    - Example: A ⇋ B + C
      \[
      \begin{array}{ccc}
      \text{initial} & 5.0 \text{ M} & 0 \text{ M} & 0 \text{ M} \\
      \text{equilibrium} & & & \\
      \Delta & & & \\
      \end{array}
      \]
      “\( \Delta \)” row only follows the stoichiometry of the equation.
    - Learn when to make an approximation (needed for multiple choice questions!)
      5% rule usually works when value of K is 10^3 smaller than value of known concentrations.
      Example: A ⇋ B + C
      \[ K = 3.0 \times 10^{-6} \]
      if \([A] = 5.0\text{M} \) initially; find \([C] \) at equilibrium.
    - If greater than 5% use the quadratic equation: \( ax^2 + bx + c = 0 \)
      \[ x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a} \]
    - Another easy to solve situation is the perfect squares situation.
      Example: \( H_2 + I_2 ⇋ 2HI \) \( K = 3.5 \times 10^2 \)
      Calculate \([HI]\) when \([H_2] = [I_2] = 0.10 \text{ M} \)

*Based on a handout by William Bond, Snohomish HS*