#11-1
Ksp Introduction and Constant Manipulation

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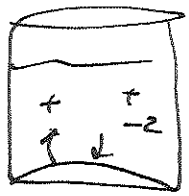
1. Write solubility reaction of silver nitrate and sodium carbonate anions producing a solid silver carbonate.
   a. Molecular version $AgNO_3 + Na_2CO_3 \rightarrow Ag_2CO_3(s) + NaNO_3$
   b. Ionic version $Ag^+ + NO_3^- + Na^+ + CO_3^{-2} \rightarrow Ag_2CO_3 + Na^+ + NO_3^-$
   c. Net ionic $Ag^+ + CO_3^{-2} \rightarrow Ag_2CO_3$
   d. Write an equilibrium expression of letter "c".
   $K_c = \frac{1}{[Ag^+]^2[CO_3^{-2}]}$
   e. How would the value of the equilibrium constant ~~increase~~ for more soluble substances given previous equilibrium expression?
   Solubility ↑ K_c ↓



   f. How is this reaction expressed with typical solubility equilibrium?
   $Ag_2CO_3 \rightarrow 2Ag^+ + CO_3^{-2}$
   g. Write an equilibrium expression of letter "f".
   $K_{sp} = [Ag^+]^2[CO_3^{-2}]$
   h. How would the value of the equilibrium constant increase for more soluble substances given previous equilibrium expression?
   ↑ Sol ↑ K_{sp}
   i. Write a Ksp expression for the dissolving reaction and equilibrium expression for
      i. $BaCO_3 \rightarrow 2Rb^{+1} + CO_3^{-2}$ $K_{sp} = [Rb]^{+2}[CO_3^{-2}]$
      ii. $SrCO_3 \rightarrow Sr^{2+} + CO_3^{-2}$ $K_{sp} = [Sr][CO_3^{-2}]$

- Does K = Solubility? No K_{sp} is generated via an algorithm.
- How does K correlate to solubility? $BaCO_3 > SrCO_3$
  Ag_2CO_3, Hard to compare.

constant manipulation basics

$A + B \rightarrow 2Z$ $K = ☺$

$2Z \rightarrow A + B$ $K = \frac{1}{☺}$

$2A + 2B \rightleftharpoons 4Z$ $☺^{\wedge 2}$

$\frac{1}{2}A + \frac{1}{2}B \rightarrow Z$ $☺^{\wedge \frac{1}{2}}$ or $\sqrt{☺}$

2. (brown568) Write the expression and determine the Kc for the following reaction: $2NO_{(g)} \leftrightarrow N_{2(g)} + O_{2(g)}$ with the information provided: $N_{2(g)} + O_{2(g)} \Leftrightarrow 2NO_{(g)}$ The value for the equilibrium constant for this reaction @ 25°C is Kc = 1 E-30

$\frac{1}{1.E-30} = 1.0E30$

3. (brady634) At 25°C, 7.0E25 for the reaction: $2SO_{2(g)} + O_2 \Leftrightarrow 2SO_{3(g)}$. What is the value of K_c for the reaction:

$\sqrt{\frac{1}{K}}$ $SO_3 \Leftrightarrow SO_2 + \frac{1}{2} O_2$? $\sqrt{\frac{1}{7.E25}} = 1.19E-13$

7. (brady634)At 25°C, the following reactions have the equilibrium constants noted to the right of their equations.
$2CO_{(g)} + O_{2(g)} \Leftrightarrow 2CO_{2(g)}$ $K_{c1} = 3.3E91$
$2H_{2(g)} + O_2 \Leftrightarrow 2H_2O_{(g)}$ $K_{c2} = 9.1E80$
Use this data to calculate Kc for the reaction: $H_2O_{(g)} + CO_{(g)} \Leftrightarrow CO_{2(g)} + H_{2(g)}$

What do we do when we have multiple K values?

$K_1 * K_2 = K_{12}$ ←
- make sure reactions add up. then

$2CO + O_2 \rightleftharpoons 2CO_2$ ← ÷2 $\sqrt{3.3E91} = K_1$

$2H_2 + O_2 \rightleftharpoons 2H_2O$ ← flip ÷2 $\sqrt{\frac{1}{9.1E80}} = K_2$

$H_2O + CO \rightleftharpoons CO_2 + H_2$

$5.7E45 = X$ (1.8E5) K_{12}

$3.3E-41$

9. (Kotz755) A mixture of nitrogen, hydrogen, and ammonia is brought to equilibrium. When the equation is written using whole-number coefficients, $N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$ the value of Kc = 3.5E8 at 25°C., Determine the K value for the following reactions.

a) $1/2N_{2(g)} + 3/2H_{2(g)} \Leftrightarrow NH_{3(g)}$ $\sqrt{3.5E8} = 1.8E4$
b) $2N_{2(g)} + 6H_{2(g)} \Leftrightarrow 4NH_{3(g)}$ $3.5E8 \times 2 = 7.0E8$
c) $2NH_{3(g)} \Leftrightarrow N_{2(g)} + 3H_{2(g)}$ $\left(\frac{1}{3.5E8}\right)^2 = 8.1E-18$