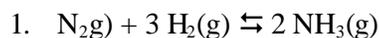


16 • Chemical Equilibria

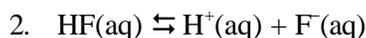
PROBLEM SET # 1

For the following three reactions,

- write the K_{eq} expression in terms of concentration, K_c .
- given the equilibrium concentrations, state whether each equilibrium is product-favored, reactant-favored, or fairly even ($[products] \approx [reactants]$).
- calculate the value of K_c .



At equilibrium: $[N_2] = 1.50 \underline{M}$
 $[H_2] = 2.00 \underline{M}$
 $[NH_3] = 0.01 \underline{M}$



At equilibrium: $[HF] = 0.55 \underline{M}$
 $[H^+] = 0.001 \underline{M}$
 $[F^-] = 0.001 \underline{M}$



At equilibrium: $[Fe^{3+}] = 0.55 \underline{M}$
 $[SCN^-] = 0.001 \underline{M}$
 $[FeSCN^{2+}] = 0.001 \underline{M}$

Summarize:

Fill in the blanks with product-favored, reactant-favored, and approximately equal

| K_c | state of equilibrium |
|-----------------|----------------------|
| $K_c \gg 1$ | |
| $K_c \ll 1$ | |
| $K_c \approx 1$ | |

4. Knowing that pure water has a density of 1g/1mL calculate the mass of 1.00 Liter of water.

Calculate the number of moles in 1.00 L of H_2O .

What is the concentration (M) of water in water?

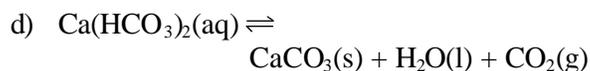
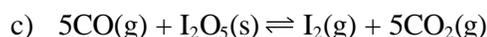
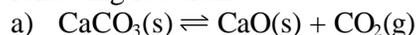
At this temperature, can you get more moles of water into this Liter of water?

The $[H_2O]$ _____ (is / is not) constant.

Important Note:

Since the concentrations of solids and liquids are constant, they are incorporated into the equilibrium constant, K_{eq} . That means, just leave them out of the K_c or K_p expression. Only include (g) and (aq)!

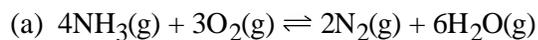
5. Write equilibrium expressions for each of the following reactions:



6. Write the equilibrium expression in terms of partial pressures (K_p) for each of the following reactions.

Rate the reactions in order of their increasing tendency to proceed toward completion:

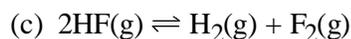
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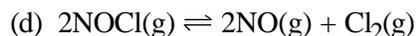
$$K_p = 1 \times 10^{228} \text{ atm}$$



$$K_p = 5 \times 10^{-31}$$



$$K_p = 1 \times 10^{-13}$$



$$K_p = 4.7 \times 10^{-4} \text{ atm}$$

A Question That You Should Be Able To Answer:

Why don't the K_p 's in (b) and (c) have units?

7. (a) Write the K_c expression for
 $2 \text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2 \text{SO}_3(\text{g})$

Calculate the value of K_c :

At equilibrium: $[\text{SO}_2] = 1.50 \text{ M}$
 $[\text{O}_2] = 1.25 \text{ M}$
 $[\text{SO}_3] = 3.50 \text{ M}$

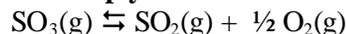
- (b) If we **reverse** the equation, it is:



Write the K_c expression for this equation and calculate the new value of K_c :

How does the expression and the value of K_c in 7(b) compare with those in 7(a)?

- (c) If we now **multiply all of the coefficients by 1/2**:



Write the K_c expression for this equation and calculate the new value of K_c :

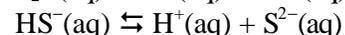
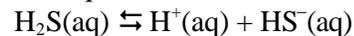
How do they compare with 7(b)?

- (d) What would happen to the K_c expression and its value if we **doubled** the coefficients?

Summarize:

| Equation | K_c expression & Value |
|----------|--------------------------|
| doubled | |
| reversed | |
| halved | |

8. Consider an equilibrium that occurs in two steps:



- (a) Write the overall reaction.
 (b) How do the K_c 's for the two steps (K_{c1} & K_{c2}) relate to the K_c of the overall reaction (K_c)?