

EQUILIBRIUM & Keq NOTES

REVERSIBLE REACTION: a reaction where the reactants form the products, then the products re-form the reactants

* can proceed in **either direction**

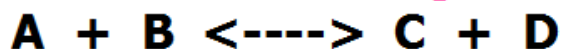
* represented by \rightleftharpoons ("double arrow") 

Reactions that are NOT reversible:

- produce a precipitate (ppt)

Solid/insoluble compound produced
by the reaction of 2 aqueous
solutions

GENERALIZED EQUILIBRIUM RXN:

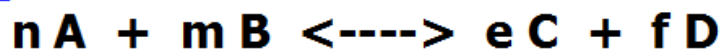


- $A + B \rightarrow C + D$ called "forward" reaction
- $C + D \rightarrow A + B$ called "reverse" reaction

CHEMICAL EQUILIBRIUM:

- occurs when **the rate of the forward reaction is equal to the rate of the reverse reaction;** appears like nothing is happening
- **concentration of the products and reactants remain unchanged**

EQUILIBRIUM CONSTANT EXPRESSION (K_{eq})



lowercase letters (n, m, e, f) represent **coefficients**

CAPITAL LETTERS (A, B, C, D) represent **substances**
(elements, compounds)
ions

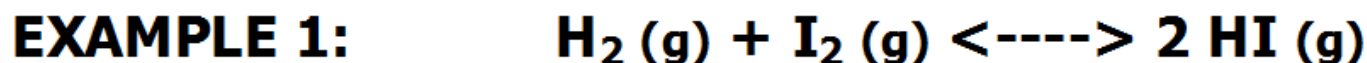
$$K_{eq} = \frac{[C]^e [D]^f}{[A]^n [B]^m}$$

* [] means "concentration of"
(molarity = M)

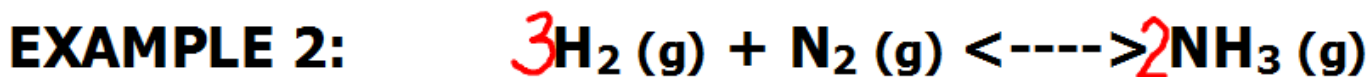
$$K_{eq} = \frac{[\text{right side}]}{[\text{left side}]}$$

EXTRA **K_{eq}** NOTE:

Do **NOT** include (s) or (l) in K_{eq} expressions – (aq) and (g) only!



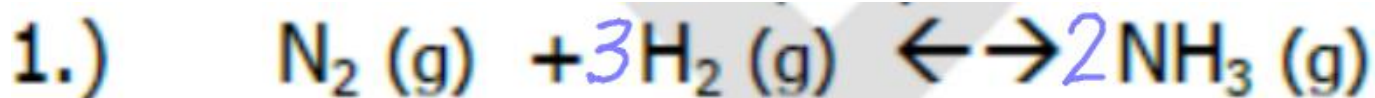
$$K_{eq} = \frac{[HI]^2}{[H_2][I_2]}$$



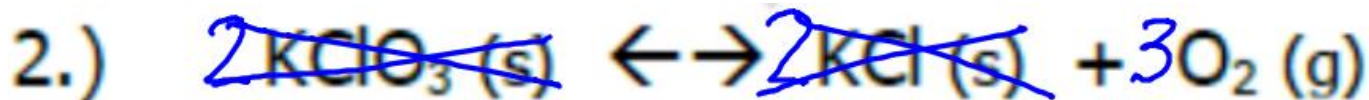
$$K_{eq} = \frac{[NH_3]^2}{[H_2]^3 [N_2]}$$



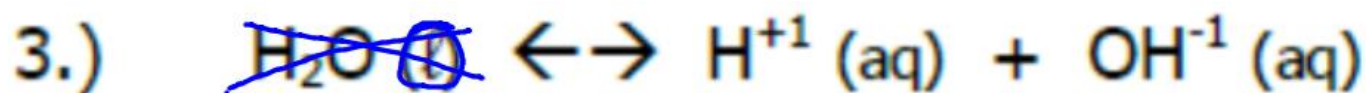
$$K_{eq} = [Na^{+1}] [Cl^{-1}]$$



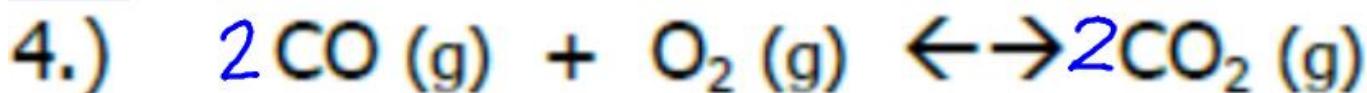
$$K_{\text{eq}} = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$



$$K_{\text{eq}} = [\text{O}_2]^3$$



$$K_{\text{eq}} = [\text{H}^{+1}][\text{OH}^{-1}]$$



$$K_{\text{eq}} = \frac{[\text{CO}_2]^2}{[\text{CO}]^2[\text{O}_2]}$$



$$K_{\text{eq}} = [\text{Li}^{+1}]^2 [\text{CO}_3^{-2}]$$

Use the K_{eq} expressions written above to determine the value of K in each condition.

1.) $[N_2] = 0.0200 \text{ M}, [H_2] = 0.0200 \text{ M}, [NH_3] = 0.0100 \text{ M}$

2.) $[O_2] = 0.0500 \text{ M}$ 1.25×10^{-4}

3.) $[H^{+1}] = 1 \times 10^{-8} \text{ M}, [OH^{-1}] = 1 \times 10^{-6} \text{ M}$ 1×10^{-14}

4.) $[CO] = 2.0 \text{ M}, [O_2] = 1.5 \text{ M}, [CO_2] = 3.0 \text{ M}$ 1.5

5.) $[Li^{+1}] = 0.2 \text{ M}, [CO_3^{-2}] = 0.1 \text{ M}$ 0.004

$$\frac{(0.0100)^2}{(0.0200)^3 \cdot 0.0200} \cdot \frac{1 \times 10^{-4}}{1.6 \times 10^{-7}} = 625$$

(8×10^{-6})