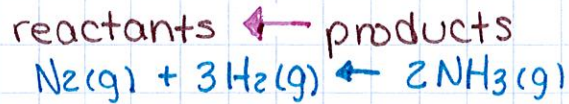


Chemical Equilibrium

- Some chemical reactions are Reversible

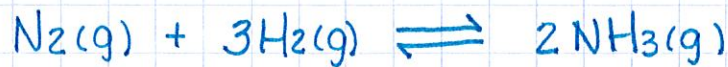


forward reaction



reverse reaction

You can show a reversible reaction by using a DOUBLE ARROW



- Equilibrium occurs when...

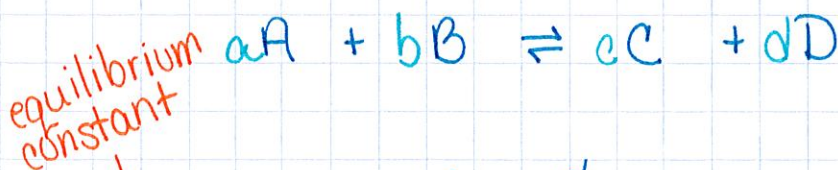
the rate of the forward reaction equals the rate of the reverse reaction.

@ equilibrium

- The concentration of reactants & products does NOT change.
- The concentration of reactants & products do NOT have to be equal.

- concentration of reactant can be written as [reactant]
- same w/ products

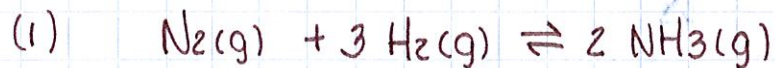
- Writing an equilibrium expression



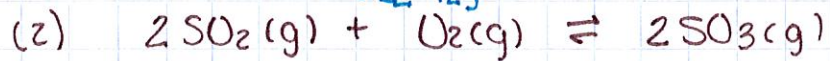
$$K_{eq} = \frac{[C]^c \cdot [D]^d}{[A]^a \cdot [B]^b}$$

Only substances in aqueous or gas states are written in the expression

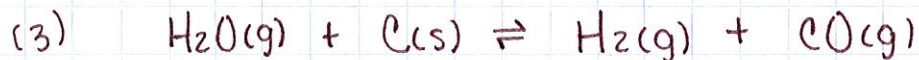
Examples



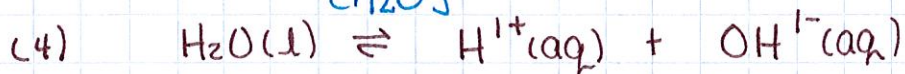
$$K_{\text{eq}} = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$



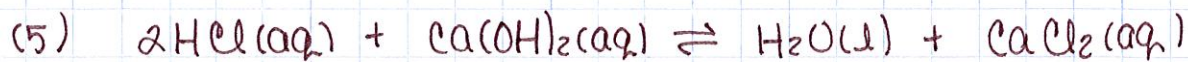
$$K_{\text{eq}} = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$$



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



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



$$K_{\text{eq}} = \frac{[\text{CaCl}_2]}{[\text{HCl}]^2[\text{Ca}(\text{OH})_2]}$$

If K_{eq} is...

_____ reaction is favored.

= 1

neither

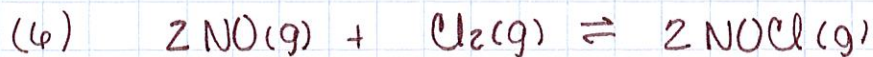
< 1

reverse

> 1

forward

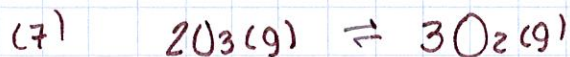
Ex



calculate K_{eq} if $[\text{NO}] = .0200\text{M}$, $[\text{Cl}_2] = .0250\text{M}$, and $[\text{NOCl}] = .500\text{M}$. Is the forward or reverse reaction favored?

$$K_{eq} = \frac{[\text{NOCl}]^2}{[\text{NO}]^2[\text{Cl}_2]} = \frac{[.500\text{M}]^2}{[.0200\text{M}]^2[.0250\text{M}]} = 25000$$

$$= 2.50 \times 10^4 \frac{1}{\text{M}}$$



$K_{eq} = .031$ and $[\text{O}_3] = 1.6 \times 10^{-2}\text{M}$. Calculate $[\text{O}_2]$.
Which reaction is favored? reverse

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

$$.031 = \frac{[x]^3}{[1.6 \times 10^{-2}]^2}$$

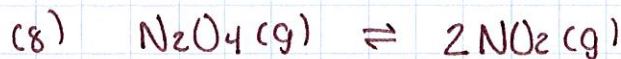
$$.000256 \cdot .031 = \frac{x^3}{.000256}$$

$$7.936 \times 10^{-6} = \frac{x^3}{.000256}$$

$$x^3 = 7.936 \times 10^{-6} \cdot .000256$$

$$x^3 = 2.011264 \times 10^{-6}$$

$$x = \sqrt[3]{2.011264 \times 10^{-6}} = .0199 = x$$



$K_{eq} = .212$ and there is $.04375$ mol NO_2 dissolved in $.50\text{L}$. Calculate $[\text{N}_2\text{O}_4]$. which reaction is favored?