

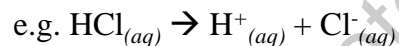
Equilibrium 9.1

Dynamic Equilibrium
Equilibrium Constants (K_{eq} and K_c)
The Equilibrium Expression, K_c

Completion Reactions

Some reactions go to completion.

- Here, all of the reactants are used up, as they all turn into products.

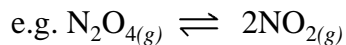


For these reactions, a **one way arrow** is used.

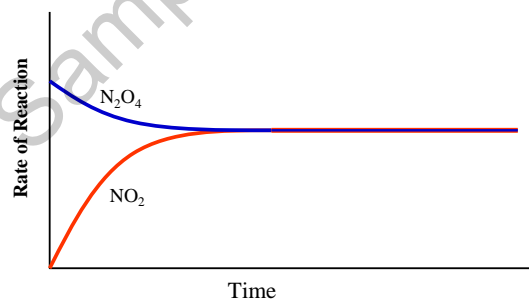
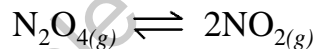
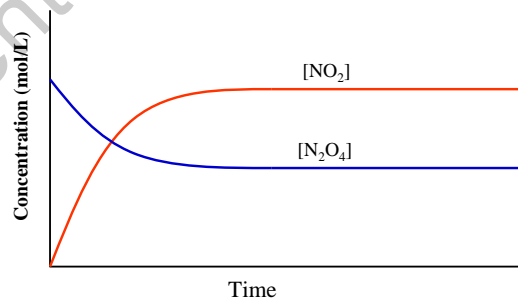
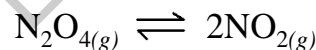
Dynamic Equilibrium

Most reactions do not go to completion.

- Here, all of the reactants **do not** get used up.
- The system reaches a dynamic state where reactants are continually turning into products, and products are continually turning back into reactants.



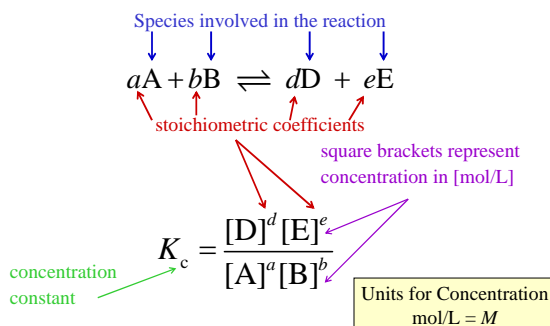
For these reactions, a **two way arrow** is used.



Chemical Equilibrium

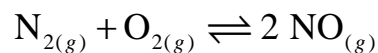
- Forward and reverse reactions continue to take place.
- The rate of the forward reaction equals the rate of the reverse reaction.
- Concentrations of all species remain constant, yet they will rarely be equal to one another.
- Takes place in a closed system

The Equilibrium Constant (K_{eq})



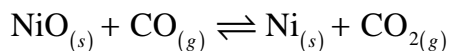
Ex1) Equilibrium Expressions

Ex1) Write the equilibrium expression for:



Ex2) Equilibrium Expressions

Ex2) Write the equilibrium expression for:



$$K_c = \frac{[CO_2]}{[CO]}$$

Solids are left out of the equilibrium expression.

Solids are left out of the equilibrium expression



Initial Volume of NiO_(s)

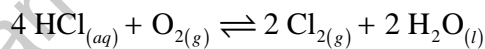


Volume of NiO_(s) at Equilibrium

- The concentration of Nickel (II) Oxide has not changed.
- Concentration is measured in mol/L.
- Both pieces have the same density, so both contain the same number of particles per unit volume.

Ex3) Equilibrium Expressions

Ex3) Write the equilibrium expression for:

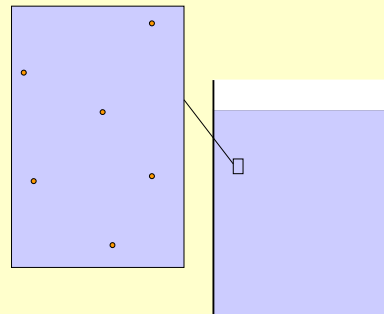


$$K_c = \frac{[Cl_2]^2}{[HCl]^4 [O_2]}$$

Liquids are left out of the equilibrium expression.

Liquids are left out of the equilibrium expression

Adding or taking away small amounts of water in a reaction that takes place in an aqueous solution does not affect the overall concentration of H₂O.



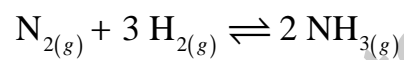
Equilibrium Expressions

When writing an equilibrium expression:

- Include gases (*g*) and aqueous species (*aq*).
- **Do not** include liquids (*l*) or solids (*s*).

Ex) Equilibrium Constant

Ex) Find K_c for the following system at 400 K, if the equilibrium concentrations are: $[\text{NH}_3] = 0.031 \text{ M}$, $[\text{N}_2] = 0.85 \text{ M}$, and $[\text{H}_2] = 0.0031 \text{ M}$.



Sample Copy of Students' Lecture Notes