

## Chemical Equilibrium

- When some types of chemical reactions occur in the gas or solution phases, these reactions attain "chemical equilibrium", *i.e.*, the reaction does not go to completion, but the reaction vessel will contain both reactant species and product species mixed together.



## Chemical Equilibrium

- This occurs when the concentrations of the reactants stop decreasing, and the concentrations of the products stop increasing.

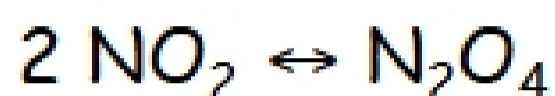


(I will use  $\rightleftharpoons$  to indicate an equilibrium process in my lecture



## Chemical Equilibrium

- $\text{NO}_2$  is a brown gas while  $\text{N}_2\text{O}_4$  is colorless



- At any given time in a container of  $\text{NO}_2$ , some fraction of the gas will be in the form of  $\text{NO}_2$ , and some fraction will be in the form of  $\text{N}_2\text{O}_4$ .



## Chemical Equilibrium


- Chemical equilibrium is a dynamic process—an individual molecule will repeatedly move from the  $\text{NO}_2$  form to the  $\text{N}_2\text{O}_4$  form, the overall concentrations of  $\text{NO}_2$  and  $\text{N}_2\text{O}_4$  do not change at a given temperature



## Equilibrium Constant

- The "equilibrium constant",  $K_{eq}$ , for a chemical reaction indicates whether the reactants or the products will be favored in an equilibrium process
- The equilibrium constant in terms of concentrations is defined as:




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

## Equilibrium Constant

- For the  $2 \text{NO}_2 \leftrightarrow \text{N}_2\text{O}_4$  reaction, the equilibrium constant is given as:

$$K_c = \frac{[\text{N}_2\text{O}_4]}{[\text{NO}_2]^2}$$

