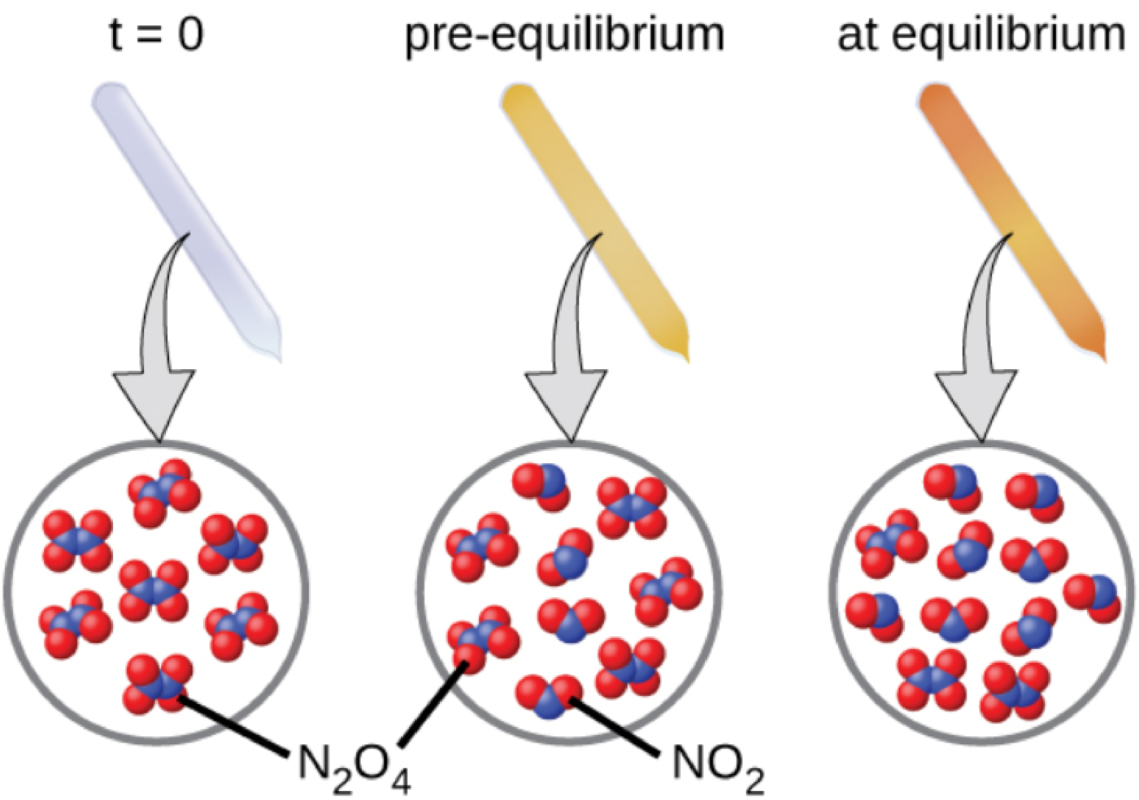
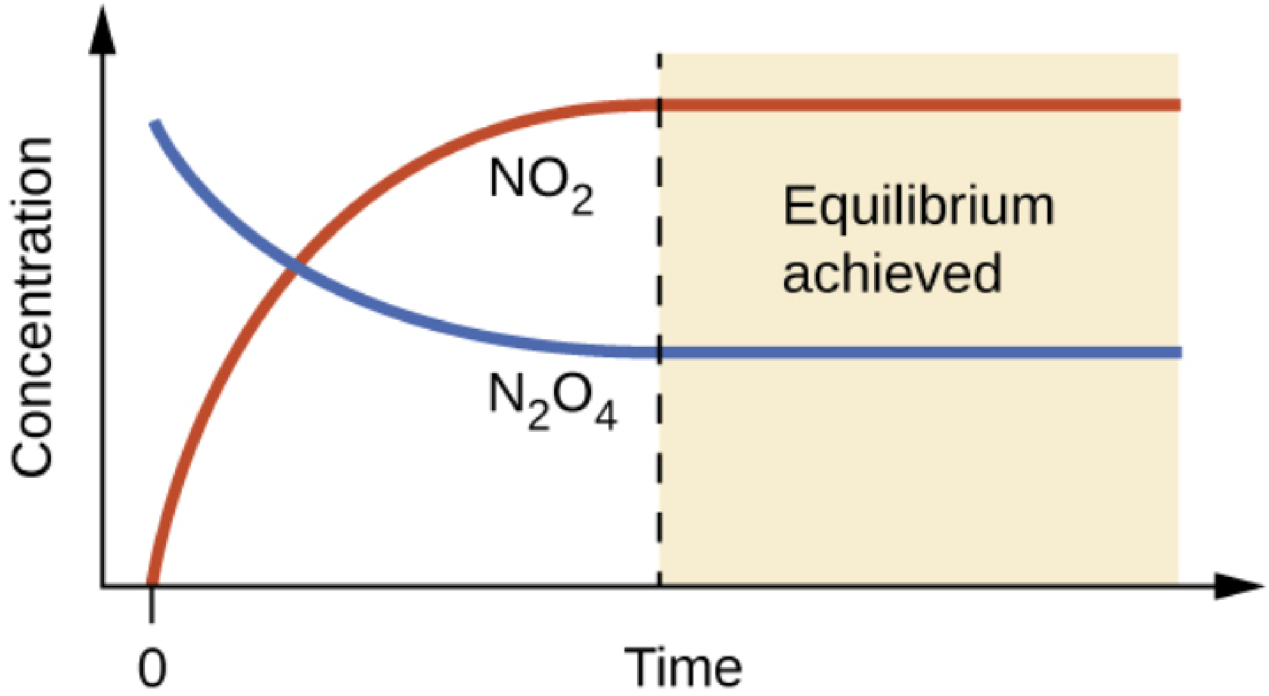
Chemical Equilibrium and Le Chatliers principle

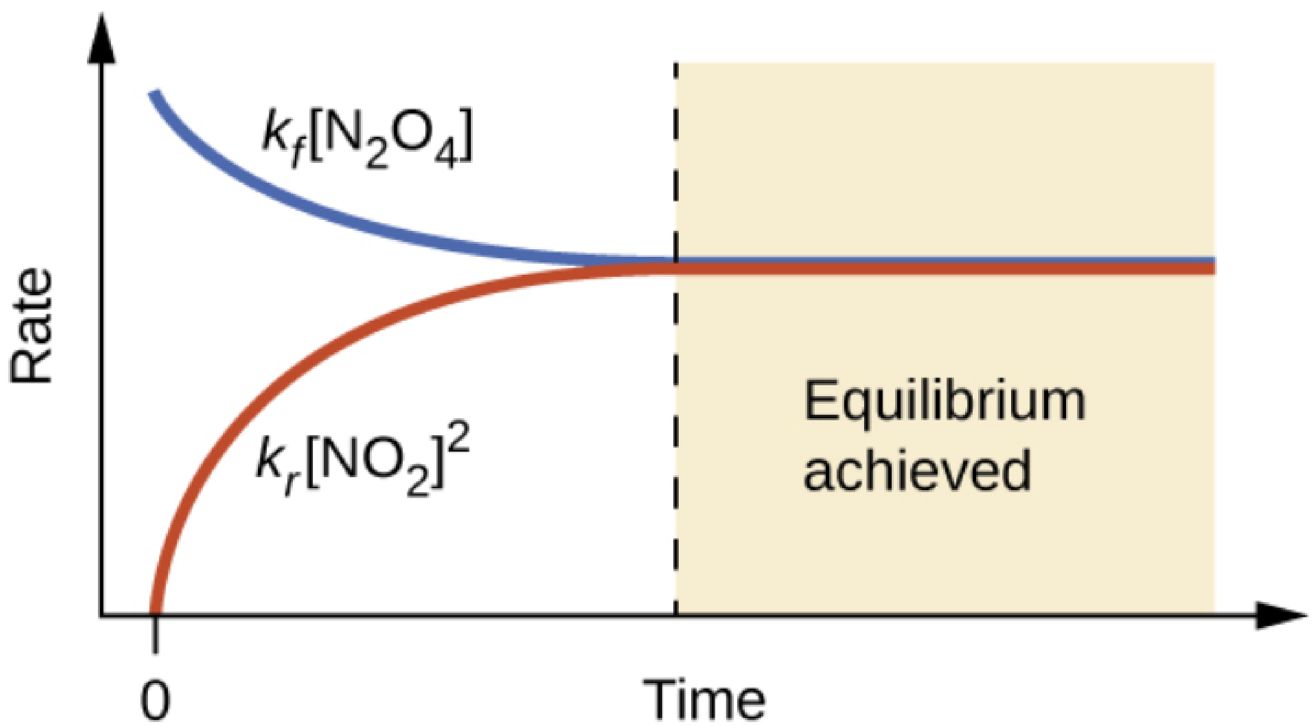
Reversible reactions (denoted by left & right arrows) are reactions in which the products and reactants can interconvert (reactants -> products and products -> reactants). When the forward and reverse reaction rates are equal, the concentrations of either species does not change and the reaction is said to be at **equilibrium**.

An example of a reaction @ equilibrium would be;

$$N_2O_4 \rightleftharpoons 2NO_2$$







Equilibrium Constants

For the reversible reaction;

$$aA + bB \rightleftharpoons cC + dD$$

the **reaction quotient (Q)** is equal to;

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

once the reaction has reached equilibrium, Q = K, the **equilibrium constant**

Le Chatliers Principle

Le Chatliers principle states that if a system at equilibrium is perturbed, the system will shift to counter the perturbtion and return to equilibrium.

Calculating Change in Equilibria - ICE Tabes

$$I_{2(aq)} + I^-_{(aq)} \rightleftharpoons I^-_{3(aq)}$$

If a solution with the concentrations of I2 and I− both equal to 1.000 × 10−3 M before reaction gives an equilibrium concentration of I2 of 6.61 × 10−4 M, what is the equilibrium constant for the reaction?

$$K_c = \frac{[I_3^-]}{[I_2][I^-]}$$

Values	[I2]	[I-]	[I3-]
Initial	10^-3	10^-3	0
Change	-x	-x	+x
Equil.	10^-3 - x	10^-3 - x	x

for I2, if @ equilibrum the concentration is 6.61 × 10−4 M;

$$x = 10^{-3}M - 6.61 \times 10 - 4M = 3.39 \times 10^{-4}M$$

The reset can be solved for as well.

If the equilibrium concentration is not known, often we are faced with an equilibrium constant equation like below;

$$K_c = \frac{[x]}{[n-x]^2}\ or\ K_c = \frac{[x]^2}{[n-x]^2}$$

in which case we need to expand the bottom and use the quadratic equation to solve for x.