# Chapter Summary: Chemical Equilibrium

**Dynamic Equilibrium**: When forward and reverse reaction rates are same. Note the reaction arrow is going both forward and reverse.

$$A + B \rightleftharpoons C + D$$

**Equilibrium constant ($K_c$)**: Mathematical constant particular to a particular reaction.

$K_c = \frac{[products]^x}{[reactants]^y}$ (x and y are stoichiometric quotients)

**Manipulation of $K_c$**: Equilibrium constant can be reversed if the reaction is reversed. If the stoichiometric quotients are changed (i.e. if the equation is multiplied by 2) then $K_c$ can be squared so the new $K_c = K_c^2$.

For gases = $K_p = K_c (RT)^{\Delta n}$ where n = coefficient products – coefficient reactants

**Reaction Quotient ($Q_c$)**: Equilibrium is not constant but dynamic and the relationship between $Q_c$ and $K_c$ gives the direction of the equilibrium. $Q_c$ is calculated the same way as $K_c$.
If $Q_c < K_c$ then equilibrium is in the forward direction
If $Q_c = K_c$ then reaction is in equilibrium.
If $Q_c > K_c$ then equilibrium is in the reverse direction

**Le Chatlier's Principle**: when change in concentration, temperature, pressure or volume occurs on a reaction, the equilibrium shifts to minimize that change.

1) Changing reactants: Addition of these should shift equilibrium forward.
2) Removing products: Should shift equilibrium forward.
3) Changing pressure or volume: When P is increased (or V is decreased) shift is towards smaller number of moles of gas produced; when P is decreased (or V is increased) equilibrium shifts to the larger number of moles of gas produced; if the number of moles of gas produced is the same then P does not have an effect.
4) Changing the temperature: Raising T shifts equilibrium towards endothermic whereas decreasing T shifts equilibrium towards exothermic reaction.
5) Catalyst: No change since both forward and backward reaction rates are increased.

**Key Words**

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|---|---|---|
| Equilibrium constant for gases and aqueous reactions | Reaction quotient ($Q_c$) | Le Chatlier's Principle |
| Manipulation of $K_c$ | | |