CHEMICAL EQUILIBRIUM

EQUILIBRIUM CONSTANT 'K'

For a General Reaction $aA + bB \rightleftharpoons pP + qQ$

The equilibrium constant expression is $K_c = \frac{[P]^p [Q]^q}{[A]^a [B]^b}$

where K_c is the **Equilibrium Constant** (or K_p if they are all gases)

RELATION BETWEEN K_p AND K_c

For the Reaction $aA + bB \rightleftharpoons cC + dD$

$$K_p = \frac{[p_C]^c \times [p_D]^c}{[p_A]^a \times [p_B]^b} = \frac{[C]^c [D]^d}{[A]^a [B]^b} \frac{(RT)^{c+d}}{(RT)^{a+b}}$$

$$K_p = K_C (RT)^{\Delta ng}$$

if $\Delta n_g = 0 \Rightarrow K_p = K_c$

Where, $\Delta n_g = (c+d) - (a+b)$

= no. of moles of gaseous products – no. of moles of gaseous Reactants

WHAT DOES THE VALUE OF 'K' MEAN ?

(a) K >> 1 Reactants $\rightleftharpoons$ Products

If K>> 1, the reaction is product-favoured; product predominates at Equilibrium.

(a) K << 1 Reactants $\rightleftharpoons$ Products

If K<< 1, the reaction is reactant-favoured; reactant predominates at Equilibrium.

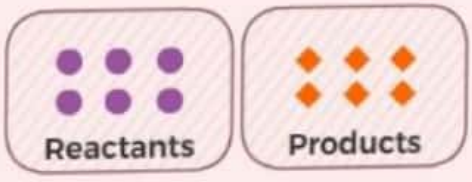
(a) K = 1 The reaction lies in the middle (mix of reactants and products)

MAGNITUDE OF 'K'

Small ($K < 10^{-3}$)

Mostly Reactants

Intermediate ($10^{-3} \leq K \leq 10^{3}$)

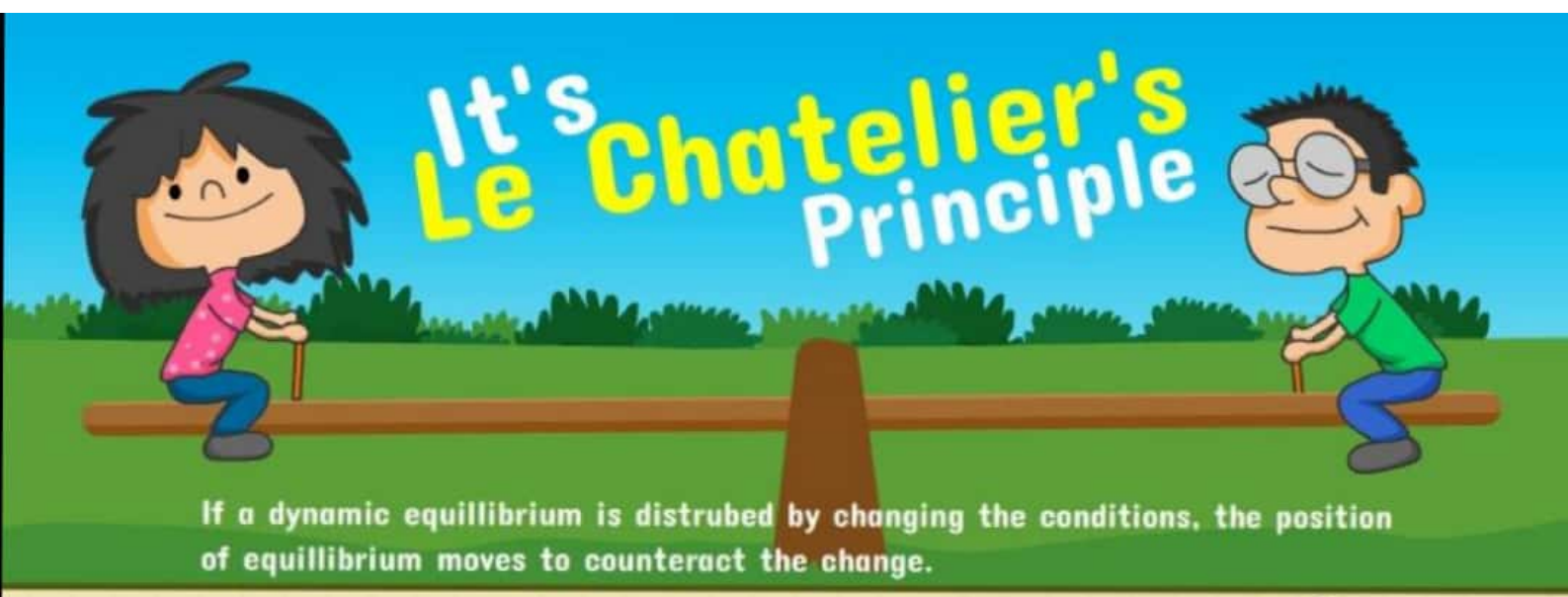


Significant amounts of reactants and products

Large ($K > 10^{3}$)

Mostly Products

It's Le Chatelier's Principle



If a dynamic equillibrium is distrubed by changing the conditions, the position of equillibrium moves to counteract the change.

i will destroy your equilibrium

i will re-establish it

Change	Reactants		Products	Counteract
	a A + b B	⇌	c C + d D	
I will increase reactant concentration		⟷		Then I will shift the reaction forward
I will steal products		⟷		I will shift the reaction forward
I will increase pressure		⟷		I will reduce number of moles
I will decrease pressure		⟷		Then I'll increase number of moles
I will heat up your exothermic reaction		⟷		I'll shift the reaction backward
I will put your endothermic reaction in ice		⟷		I'll warm it up by forward reaction
I will catalyze your reaction		⟷		Hahaha.... It won't disturb my equilibrium
I will add noble gases to your reaction		⟷		Hahaha.... It won't disturb my equilibrium

How did you bypass my tricks ? ⟷ It's Le Chatelier's principle dear !