

Chemical Equilibria

⇒ Reversible Reactions

→ It is a process where reactants form products and simultaneously the products form back the reactants.

⇒ Dynamic Equilibrium

→ In a closed system, a reversible reaction reaches dynamic equilibrium when the forward and backward reactions occur at the same rate and the concentrations of both reactants and products remain unchanged.

⇒ Factors affecting equilibrium

→ Concentration

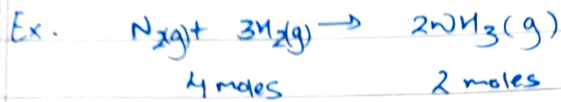
→ if concentration of L.H.S is increased, the equilibrium shifts to right and vice versa.



→ Pressure (only when compounds are in gaseous state)

→ Increase in pressure favors side with less no. of moles.

→ decrease in pressure favors side with more no. of moles.



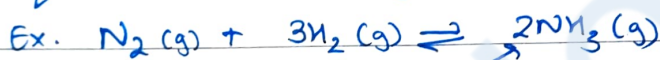
So if pressure ↑ equilibrium shifts to right
 and if pressure ↓ equilibrium shifts to left

→ Temperature

→ as temperature increases it favors the endothermic side

→ as temperature decreases it favors the exothermic side

⇒ Equilibrium Constant K_c



$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

[] means concentration of compound.

to find concentration use $C = \frac{n}{V}$

If $K_c > 1$ then products are more likely to be formed

If $K_c < 1$ then reactants are more likely to be formed

→ Temp affects the value of K_c

→ Pure solids and liquids don't have concentration so it is not included in the expression. only (g) and (aq) are included.



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

we will not write A because it is in solid state.

→ Equilibrium constant K_p

ex. $N_2(g)$	+	$3H_2(g)$	$\rightleftharpoons$	$2NH_3(g)$
molar ratio	1	3		2
mole fraction	$\frac{1}{6}$	$\frac{3}{6}$		$\frac{2}{6}$
partial pressure	$\frac{1}{6} \times P$	$\frac{3}{6} \times P$		$\frac{2}{6} \times P$

Note: P = total pressure

Note: p = partial pressure

$$K_p = \frac{(p_{NH_3})^2}{(p_{H_2})^3 \times p_{N_2}}$$

→ only can be found in gas state reactions.

→ only temperature affects the value of K_p

⇒ Questions



State 2 features of a reaction that is in dynamic equilibrium

→ Rate of forward reaction is equal to rate of backward reaction

→ concentration of reactants and products are constant

the equilibrium constant $K_p = \frac{p_{O_2}}{p^2_{Cl_2}}$

At 1.0×10^5 Pa and 500K, 70% of $Cl_2(g)$ has reacted

calculate K_p and state its units

$2Cl_2 \rightleftharpoons O_2$	$0.3 + 0.35$	$p_{Cl_2} = \frac{0.3}{0.65} \times 1.0 \times 10^5$
I x 0	$= 0.65$	
F $0.37x$ $0.35x$	mole fraction of $Cl_2 = \frac{0.3}{0.65}$	$p_{O_2} = \frac{0.35}{0.65} \times 1.0 \times 10^5$
2:1 1 Cl_2 gives $\frac{1}{2} O_2$	mole fraction of $O_2 = \frac{0.35}{0.65}$	$K_p = \frac{(0.35/0.65) \times 1 \times 10^5}{(\frac{0.3}{0.65})^2 \times 1 \times 10^5}$
so 70% Cl_2 gives $\frac{1}{2} O_2 = 35\%$		$2.53 \times 10^{-5} Pa^{-1}$



when 1.6 mol of HCl are mixed with 0.5 mol of O_2 at 400°C .

0.600 mol of Cl_2 and 0.600 mol of H_2O are formed

The total pressure inside the container is $1.5 \times 10^5 \text{ Pa}$

→ Calculate the amounts in mol of HCl and O_2 in the equilibrium mixture



I 1.6 0.5 0 0

F 0.4 0.2 0.6 0.6

$\text{HCl} = 0.400 \text{ mol}$

$\text{O}_2 = 0.2 \text{ mol}$

→ Calculate the mole fraction and hence the partial pressure of Cl_2

total = 1.8

partial pressure of $\text{Cl}_2 = \frac{1}{3} \times 1.5 \times 10^5$

$M_f \text{ of } \text{Cl}_2 = \frac{0.6}{1.8} = \frac{1}{3}$

= 50000 Pa

⇒ Acid-base equilibria

→ acid is a proton donor (H^+)

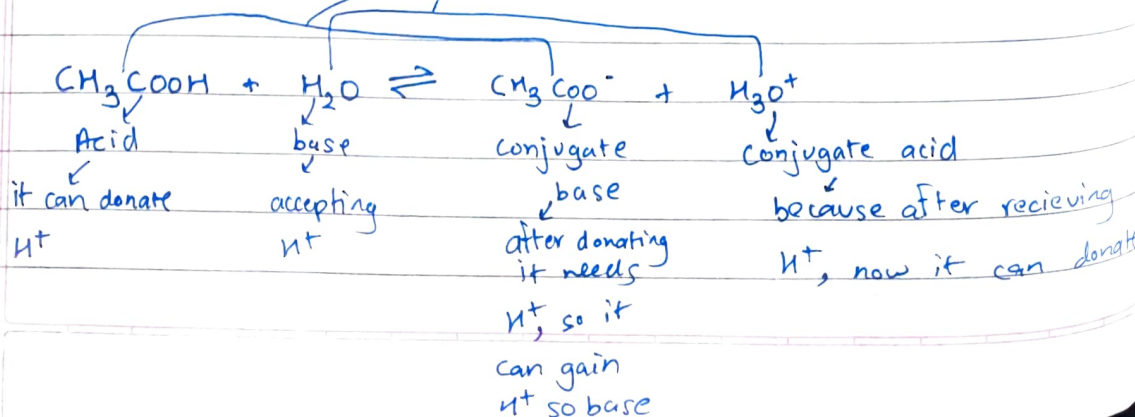
→ base is a proton acceptor (H^+)

→ strong acid and base dissociate fully

→ weak acid and base dissociate partially

→ an amphoteric substance can be both acidic and alkaline ex. H_2O

→ Conjugate base and acid



PAGE No

DATE

