Ch # 07

Chemical Equilibrium

Reversible Rxn	Irreversible
* Bidirectional	* unidirectional
* Not Completed	* Completed.
* Reactant = Reactive	* Reactant = Reactive
* product = Reactive	* Product = Stable
* A.E of Forward & Backward Rxn almost Same	* A.E of F.R ⇓ but A.E of R.R ⇑
* Less in Nature	* More in Nature

Equilibrium

Chemical

⇓

* Composition = change

$H_2 + I_2 \rightleftharpoons 2HI$

Physical

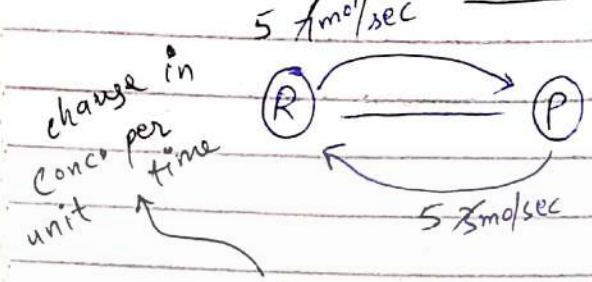
⇓

* Composition = Same

$H_2O_{(l)} \rightleftharpoons H_2O_{(g)}$

* only state change

Chemical Equilibrium



at C. equil ⇓

* Rate of forward Rxn = Rate of Reverse Rxn

* $\frac{\Delta[R]}{\text{time}} = \frac{\Delta[P]}{\text{time}}$

* at which conc of R & P → Constant

* Rate of appearence = Rate of disappearance

Characteristics of C. equilibrium:

* Gas + volatile liquid → closed container

* Solid + Non-volatile liquid → Closed & open

* Net Rate of rxn at C.E = zero

* independant of directional

* established from both sides.

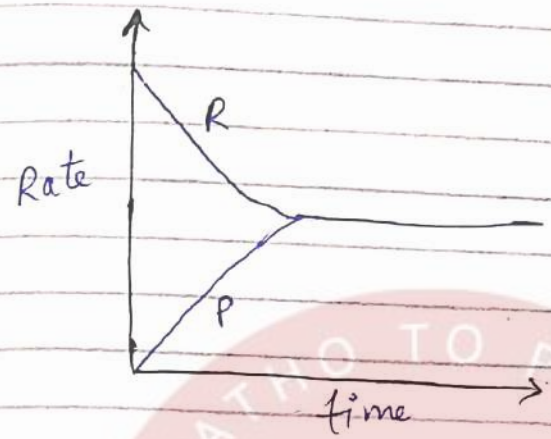
* Self maintaining process.

* Conc of Reactant & prod → Constant at eq

* Relative Concen of R & Prod at eq → Same or different

* [R] = [P] * [R] > [P] * [R] < [P]

Rate - time Graph:



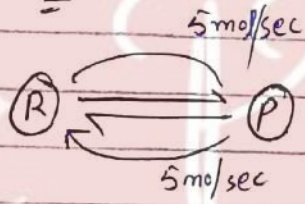
at Equilibrium applied for

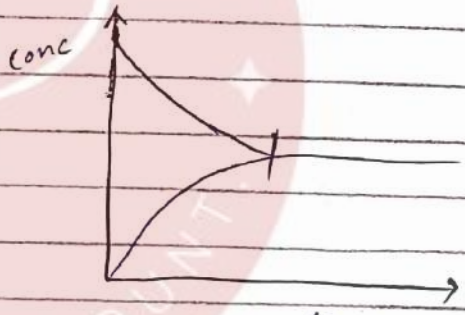
[R] = [P]

[R] > [P]

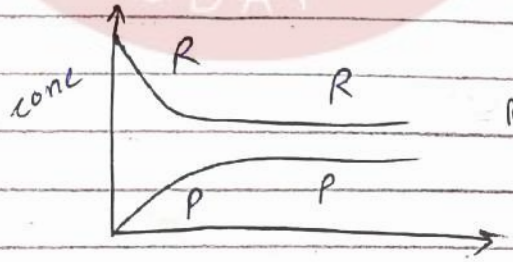
[R] < [P]

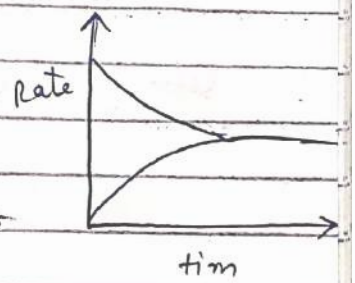
Concentration - time Graph



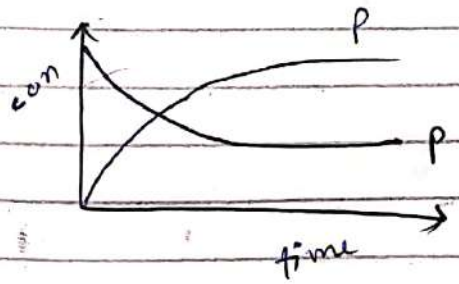


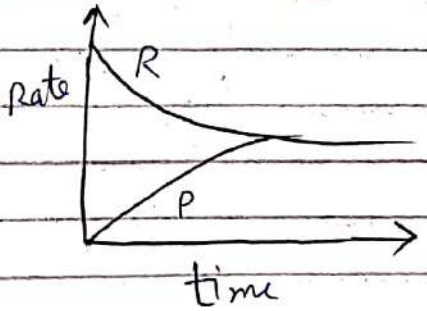
[R] > [P]:





[R] < [P]:





(#) Law of Mass Action

* Valid for both Reversible & Irreversible Rxn
  * Rate $\propto$ Concentration
  * Rate $\propto$ Collision.
  * Rate $\propto$ Active mass
* " " both physical & Chemical System
* Theoritical Law

Active Mass:

or Molar Concentration

⇓

⇒ Amount of Substances/Reactant taking part in a reaction.

⇒ A.m = $\frac{\text{mole}}{\text{Volume}}$ unit = $\frac{\text{mol}}{dm^3}$ ↳ Same As → Mola → Conce

Gas:

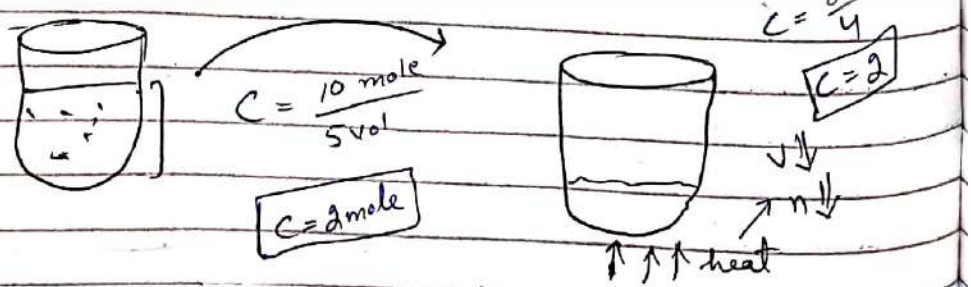
* A.m of Gas = All amount available

Solid & Liquid:

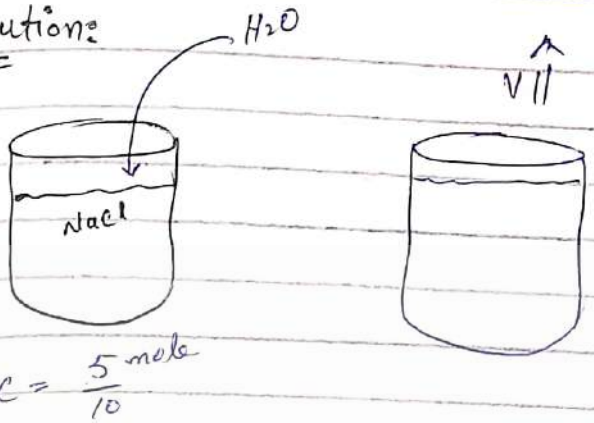
A.m of Solid/Liq = Constant = 1

⇓

Concen Not change



Solution:



$C = \frac{5 \text{ mole}}{10}$

$C = \frac{5 \text{ mole}}{15}$

ℓ = variable

Q# What is the active mass of 8g H_2 in 2 dm^3 of flask.

$$\text{A. mass} = \frac{n}{v} = \frac{4}{2} = \boxed{2M}$$

Law of chemical equilibrium

* at equilibrium Concent of React & product become Constant.

OR

* Ratio of Concen of Reac & product becomes product.

$$\boxed{K_c = \frac{[P]}{[R]}}$$

* Valid for reversible Rxn

New Lec

Equilibrium Constant 'Kc':

$$K_c = \frac{[P]}{[R]} \qquad K_c = \frac{[K_f]}{[K_b]}$$

Note:

* Kc no specific unit
* unit depend on Rxn
* Kc expression contain gas & solution
* Kc doesnot contain solid & liquid.
* Kc ⟶ not depend on initial concen
* Each Rxn has specific Kc at a given Tempe
* Kc ⟶ not depend on direction
* Kc ⟶ always be +ve

depend:

Kc depend on

*) Temperature
*) equilibrium Concen
*) stoichemetry of Rxn.

Kc independant of T, P, V, conc, catalyst

⊛ Stoichemetry of Rxn:

Case # 1:

$H_2 + I_2 \rightleftharpoons 2HI \quad K_c = 4$

$2HI \rightleftharpoons H_2 + I_2 \quad K_c = ? \left(\frac{1}{4}\right)$

$$K_{c(New)} = \frac{1}{K_c}$$

Case # 2:

$H_2 + I_2 \rightleftharpoons 2HI \quad K_c = 4$

$2H_2 + 2I_2 \rightleftharpoons 4HI \quad K_c = ?$

$$K_{c(New)} = (K_c)^n \qquad (4)^2 = 16$$

n = number with which a Rxn is multiplied

Case # 3:

$H_2 + I_2 \rightleftharpoons 2HI \quad K_c = 49$

$\frac{1}{2}H_2 + \frac{1}{2}I_2 \rightleftharpoons HI \quad K_c = ?$

$K_c = (49)^{\frac{1}{2}}$

$\sqrt{49} = 7$

$$K_{c(New)} = (K_c)^{\frac{1}{n}}$$

n = number with which Rxn is divided.

Case # 4:

$H_2 + I_2 \rightleftharpoons 2HI \quad K_c = 16$

$HI \rightleftharpoons \frac{1}{2}H_2 + \frac{1}{2}I_2 \quad \frac{1}{(16)^{\frac{1}{2}}} \quad \frac{1}{\sqrt{16}} = \frac{1}{4}$

$$K_{c(New)} = \frac{1}{(K_c)^{\frac{1}{n}}}$$

Case # 5:

multiple Step Rxn.

$(A \longrightarrow E)$

$A \longrightarrow B$

$B \longrightarrow C$

$C \longrightarrow D$

$D \longrightarrow E.$

$K_c = K_1 \times K_2 \times K_3 \times K_n$

practically it is amount in different unit

Equilibrium Expression

$A + B \rightleftharpoons C + D$

K_c K_p K_n K_x

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

$K_p = \frac{P_C^c \cdot P_D^d}{P_A^a \cdot P_B^b}$ → only gases

$K_n = \frac{n_C^c \cdot n_B^d}{n_A^a \cdot n_B^b}$ → solid, liquid, gas, solut

$K_x = \frac{X_C^c \cdot X_D^d}{X_A^a \cdot X_B^b}$ → solid, liquid, gas, solut

unit = $(mol \cdot dm^{-3})^{\Delta n}$

unit = $(atm)^{\Delta ng}$

unit = $(mol)^{\Delta n}$

unit less.

* All depend on Temperature.

Q#

$CaCO_3 \rightleftharpoons$

$C_{(s)} + 2H_{2(g)} \longrightarrow CH_{4(g)}$

$K_c = \frac{[CH_4]}{[H_2]^2}$

unit = $(mol \cdot dm^{-3})^{-1}$

unit = $mol \cdot dm^3$

$\Delta n = 1 - 2$

only gas

$\Delta n = 1 - 3$

$\Delta n = -2$

$K_p = atm^{-1}$ | $K_n = mol^{-2}$ | $K_x =$ No unit

Q#

$$3H_{2(g)} + N_{2(g)} \rightleftharpoons 2NH_{3(g)}$$

$K_c = (mol \cdot dm^{-3})^{-2}$

$K_c = mol^{-2} \cdot dm^{6}$

Q#

$$SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$$

$\Delta n = -\frac{1}{2}$ $\quad K_c = (mol \cdot dm^{-3})^{-\frac{1}{2}}$

$K_c = (mol)^{-\frac{1}{2}} \cdot (dm^{-3})^{-\frac{1}{2}}$

$K_c = mol^{-\frac{1}{2}} \cdot dm^{\frac{3}{2}}$

Q#

$$NaCl_{(s)} + H_2O_{(l)} \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)}$$

represent Solution.

$\Delta n = 2 - 0$ $\quad \Delta n = 2$

$K_c = (mol \cdot dm^{-3})^{2}$ $\quad K_c = mol^{2} \cdot dm^{-6}$

$K_p =$ No unit $\quad K_n = \Delta n = 0$ No unit

$K_x =$ No unit

(#) Relation b/w Equilibrium expression

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

$K_p = K_n \left(\frac{P}{N}\right)^{\Delta ng}$

$K_p = K_x (P)^{\Delta ng}$

* $\Delta n = 0$:

$K_p = K_c$ $K_p = K_x$ $K_p = K_n$

$K_p = K_n = K_x = K_c$

* Δn = +ve:

$K_p > K_c$ $K_p > K_x$ $K_p > K_n$

* Δn = -ve:

$K_p < K_c$ $K_p < K_x$ $K_p < K_n$

Q#

$$C_{(s)} + 2H_{2(g)} \rightleftharpoons CH_{4(g)}$$

a) $K_p > K_c$ (b) $K_p < K_c$ c) $K_p = K_c$ d) None

$\Delta n = 1 - 2$

$(\Delta n = -ve)$

Q#

$$PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$$

$\Delta n = 2 - 1$ $\Delta n = 1$

$K_p > K_c$

Q# $3H_2 + N_2 \rightleftharpoons 2NH_3$

The ratio of Kp to Kc for this reaction at 10K is:

$\Delta n = 2 - 4 \quad (\Delta n = -2)$

$Kp = Kc\,(RT)^{-2} \Rightarrow \frac{Kp}{Kc} = (RT)^{-2}$

$\Rightarrow \frac{Kp}{Kc} = \frac{1}{(RT)^2} \Rightarrow \frac{Kp}{Kc} = \frac{1}{(10R)^2} \Rightarrow \boxed{\frac{Kp}{Kc} = \frac{1}{100R^2}}$

Q# $2SO_2 + O_2 \longrightarrow 2SO_3$

What is the Kn for a reaction if Kp is 2 at a pressure of 4 atm for 2 moles.

$\Delta n = 2 - 4 \Rightarrow (\Delta n = -2)$

$Kp = Kn\left(\frac{P}{N}\right)^{\Delta ng}$

$2 = Kn\left(\frac{2}{4}\right)^{-2} \qquad 2 = Kn\left(\frac{1}{2}\right)^{-2}$

$2 = \frac{Kn}{\left(\frac{1}{2}\right)^{-2}} \qquad \boxed{Kn = 4}$

Application of Kc:

① Extent of Reaction:

Relative amount of product Compare to reactant.

* Kc → large $\quad Kc = \frac{[P]}{[R]}$

* extent of Rxn = high
* dominant Rxn = Forward Rxn
* Rxn mixture = product more
* Stability = P > R
* Reactivity = R > P
* Completed more > 50%
* At start A.E of forward < A.E (b)
* $K_c > 10^3$ (large K_c)

* Kc is Small:
* extent of Rxn = low
* [R] > [P]
* dominant rxn = Backward
* Stability = R > P
* Reactivity = P > R
* Rxn mixture = more Reactant
* Completed less than 50%
* At start A.E (7) > (A.E) b
* $K_c < 10^{-3}$ (Small Kc)

* Kc is intermediate:

* extent of Rxn = intermediate
* dominant Rxn = None
* [P] ≈ [R]
* Stability & Reactivity = R ≈ P
* Rxn mixture = both present
* Rxn completed ≈ 50
* A.E(7) ≈ A.E(b)
* $K_c = 10^3 - 10^{-3}$

Q# which Rxn has large Kc

a) $Cl + Cl \rightleftharpoons Cl_2$ (Coval Rxn) ② ↓ reactiv

stable (ionic) x b) $CaCO_3 \rightleftharpoons CaO + CO_2$ ④ R > P

c) ✓ $Na^+ + Cl^- \rightleftharpoons NaCl$ (ionic Rxn) ①

d) $H_2 + O_2 \rightleftharpoons 2H_2O$ ③

Q# which one has large reactive product?

a) $K_c = 1$ b) $K_c = 10^2$ ✓ c) $K_c = 10^{-5}$ d) $K_c = 10^5$

Q# if Kc is equal to 1 then rxn completed:

a) 100% ✓ b) 50% c) 60% d) 70%

Kc is large

Q# Which one ✓ ~~Kas~~ Case A·E (b) is max:

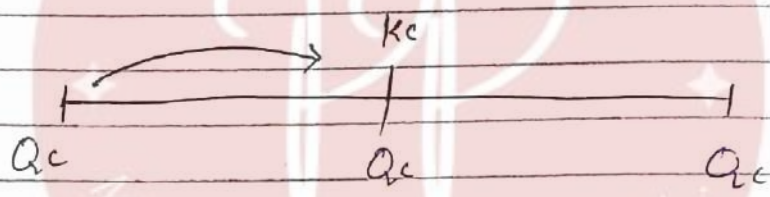
a) $K_c = 10^2$ (b) $K_c = 10^5$ c) $K_c = 10^{-3}$ d) $K_c = 10^{-5}$

Direction of Reaction

$$Q_c = \frac{[P]}{[R]}$$ → Rxn Co-efficient

Non equalibrium conce

$$K_c = \frac{[P]}{[R]}$$ (equilibrium Concent)



* $K_c = Q_c$ ⟶ Rxn at equilibrium
* $K_c > Q_c$ ⟶ Rxn at forward direction
* $K_c < Q_c$ ⟶ Rxn at backward direction.

Q#

$A + B \longrightarrow C$ $K_c = 10$

if 4 moles A, 2 moles of B & 6 moles of C are present in 2 Litre flask. Rxn moves toward.

$Q_c = \frac{6}{4 \times 2} = \frac{6}{8} = \frac{3}{4}$

$A = \frac{4}{2} = 2M$

$B = \frac{2}{2} = 1M$

$C = \frac{6}{2} = 3M$

$Q_c = \frac{3}{3} = 1$ $\quad K_c > Q_c$

Rxn $\longrightarrow$ forward direction

equilibrium disturb for short time → New Lec

Le-Chatlier's Principle

* valid for System at equilibrium

* valid → both physical & chemical System.
* P, V, conce ⟶ change equilibrium
* T ⟶ equilib + Kc
* Catalyst ⟶ Not change equili + Kc
  ↳ Not obey Le-chatlier's principle

① Concentration:

$K_c = \frac{[P]}{[R]}$ => constant for rxn

$Q_c = \frac{[P]}{[R]}$ => variable

$A + B \rightleftharpoons C + D$

Reactant

adding ⇓
* $K_c > Q_c$
* forward direction

Removal ⇓
* $Q_c > K_c$
* backward

Product

adding ⇓
$Q_c > K_c$ ⇓
Backward

Removal ⇓
$K_c > Q_c$ ⇓
Forward

1) Inert gas:

System at equilibrium.

Q#

$3H_2 + N_2 \rightleftharpoons 2NH_3$

add 3M He Rxn move toward.

at equilibrium

Q#

$3H_2 + N_2 \rightleftharpoons 2NH_3$

add 3M Cl_2 Rxn move toward.

Backward direction

$H_2 + Cl_2 \longrightarrow 2HCl$

② Add equal conc. of R & P => Rxn will at equilibrium

Q#

$H_2 + I_2 \rightleftharpoons 2HI$

add 2M H_2 & 2M I_2 & 4M HI Rxn, move toward ⟶ Rxn at equilibrium

③ Nature:

$NaCl_{(s)} \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)}$ already stable

By heating the dilute solution. the rxn moves toward. (backward direction)

(water evaporate)

if conce then Rxn → forward.

Q#

$H_2 + I_2 \rightleftharpoons 2HI$

at equi conc of H_2 is 10M by adding 5M H_2 the conc. of H_2 after sometime.

a) 10M b) 15M c) 8M d) 12M

$H_2 + I_2 \rightleftharpoons 2HI$

10 15M B/w 10 & 15 => 12 M

(b) Pressure:

P change = V chang => by changing mole

$P \propto \frac{1}{\text{mole}}$

(*) R & P → both in gaseous.

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$ (all g)

if P ↑ → Rxn backward

(*) R & P → both Contain Solid or liquid:

⇓

Consider only Gases.

MCQs:

$C_{(s)} + O_{2(g)} \rightleftharpoons CO_{2(g)}$

if P ↑ → at equilibrium.

MCQs:

$C_{(s)} + 2H_{2(g)} \rightleftharpoons CH_4$

if P ↓ → (backward)

(*) R & P → contain Solid or liquid:

⇓

only P increase but not decrease

System moves toward opposite to gas.

MCQs

$CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

if P ⇑ ⟶ opposite to gases (Backward)

* P ⇓ ⟶ equilibrium.

(*) Both R & P ⟶ Contain Solid or liquid

⇓

No gas present so no effect of pressure.

c) Volume:

Van / Same as Gases of pressure

* $PCl_5 \rightleftharpoons PCl_3(g) + Cl_2(g)$

if V ⇑ ⟶ forward direction.

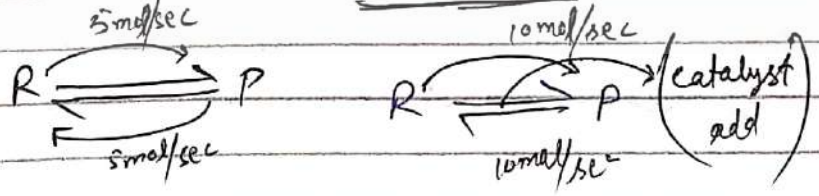
* $N_2 + 3H_2 \rightleftharpoons 2NH_3$

if V ⇑ ⟶ Backward

d) Catalyst:

* Not change equilibrium.

* b/c increase Rate of backward & forward with same extent.



* Temperature:

$K_c = \frac{K_f}{K_b}$

a): endothermic Rxn:

~~endother~~ $R + heat \rightleftharpoons P$

if T ⇑
- * forward
- * $K_f > K_b$
- * K_e ⇑

if T ⇓
- * backward
- * $K_b > K_f$
- * K_c ⇓

b): Exothermic Rxn:

$R \rightleftharpoons P + heat$

if T ⇑
- * backward
- * $K_b > K_f$
- * K_c ⇓

if T ⇓
- * forward
- * $K_f > K_b$
- * K_c ⇑

Q# $3H_2 + N_2 \rightleftharpoons 2NH_3$ $\Delta H = -340^\circ C$

K_c of Rxn is 10 at 20°c its K_c ✓ at 40°c will be:

(a) 8 b) 12 c) 40

exothermic

Q# $3H_2 + N_2 \rightleftharpoons 2NH_3$ $\Delta H = -ve$.

The maximum yield is obtained as:

(a) T↑ P↑ (b) T↑P↓ (c) T↓ P↑ (d) T↓ P↓

Physical Equilibrium

① Solid–liquid Equilibrium:

$H_2O_{(l)} \rightleftharpoons H_2O_{(s)}$

V⇓ V⇑ $P \propto \frac{1}{V}$

if P⇑ ⟶ more liquid will formed

$(V \propto \frac{1}{T})$ if T⇑ ⟶ more liquid will be formed

(up to 4°C)

other:

liquid ⇌ solid

V⇑ V⇓

$P \propto \frac{1}{V}$ ⇒ P⇑ ⟶ more solid

$V \propto T$ ⇒ T⇑ ⟶ more liquid

② liquid & gas:

liquid ⇌ gas

V↓ V↑ liquid

if P↑ ⟶ ~~volume~~ form

if T↑ ⟶ gas form.

Solubility product

valid for

* electrolyte (Weak)
  ↳ or Sparingly Soluble

$AgCl_2$, $PbCl_2$

* based on
* M. form: s mol

$$AB \rightleftharpoons A^+ + B^-$$

at saturated condition:

$$K_c = \frac{[A^+][B^-]}{[AB]}$$

$$K_c [AB] = [A^+][B^-]$$

$$\boxed{K_{sp} = [A^+][B^-]}$$

$$\boxed{K_{sp} = K_c \times [\text{weak electrolyte}]}$$

Representation:

in term of solubility

AB

$$AB \xrightarrow{H^+} A^+_{(aq)} + B^-_{(aq)}$$

s s

$$K_{sp} = [A^+][B^-]$$

$$K_{sp} = (s)(s) \qquad \boxed{K_{sp} = s^2}$$

$$AB_2 \rightleftharpoons A^{+2} + 2B^-$$

s 2s

Both in co-efficient
↳ power

$Ksp = (s)^1(2s)^2$

$\boxed{Ksp = 4s^3}$

AB_3: $\longrightarrow$ $\overset{s}{A^{+3}} + \overset{3s}{3B^-}$

$Ksp = (s)^1 (3s)^3$

$\boxed{Ksp = 27s^4}$

* In term of Concentration:

Co-efficient only in power

$AB_2 \rightleftharpoons A^{+2} + 2B^-$

$Ksp = [A^{+2}][B^{-1}]^{+2}$

MCQs

$A_xB_y \longrightarrow A^{+y} + B^{-x}$

co-effici comes to power

$Ksp = [A^{+y}]^x [B^{-x}]^y$

Factors:

$\boxed{Ksp \propto solubility}$

$\boxed{Ksp \propto Conductivity}$

$\boxed{Ksp \propto electrolytic\ strength}$

$\boxed{Ksp \propto \frac{1}{precipitation}}$

heat of solution

$\boxed{Ksp \propto T} \rightarrow \Delta H = +ve$

$\boxed{Ksp \propto \frac{1}{T}} \rightarrow \Delta H = -ve$

Ksp does not depend on Temperature if $\boxed{\Delta H_s \approx 0}$

MCQs: NaCl by ⇑ T Ksp => Same

Ksp & ionic product

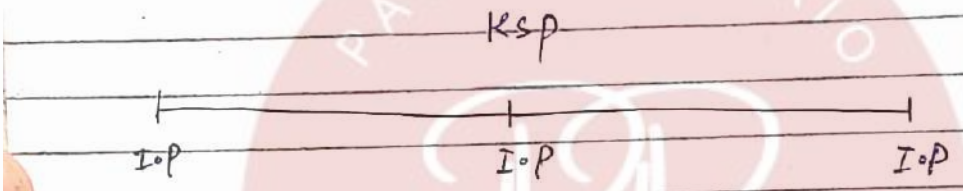
Ksp = $[A^+][B^-]$ → i.p at saturated condition

I.P = $[A^+][B^-]$ → I.P at unsaturated condition or

Super saturated or saturation

⇓

called Iesp



* I.P = KSP:
  * Saturated Condition
  * No precipitation
  * Rxn at equilibrium
  * R(f) = R(r)

* I.P > KSP:
  * Super saturated
  * Backward Rxn occur to min ions.
  * precipitation ⇑.

* I.P < Ksp:
  * unsaturated
  * Forward Rxn
  * precipitation ⇓

MCQs

$A_2B \rightleftharpoons 2A^+ + B^-$ $\quad K_{sp} = 2.1 \times 10^{-3}$

At a given Condition the conc of A^+ is 0.2M & B^- is 10^{-2} M then solution is:

$$I.P = [A^+]^2[B^-]^1$$

$$= (0.2)^2(10^{-2})$$

$$= 0.4 \times 10^{-2} \quad \boxed{4 \times 10^{-3}}$$

$I.P > K_{sp}$ → Super Saturated

New Lec

Atomic ratio	Ksp	solubility	Concentration
* 1:1	$Ksp = s^2$	$s = \sqrt{Ksp}$	$S : S$
* 1:2	$Ksp = 4s^3$	$s = \left(\frac{Ksp}{4}\right)^{1/3}$	$S : 2S$
* 1:3	$Ksp = 27s^4$	$s = \left(\frac{1}{27}\right)^{1/4}$	$S : 3S$

Q#: The solubility of $PbCl_2$ is 2×10^{-3} then its Ksp is:

Sol:

$$Ksp = 4s^3$$

$$Ksp = 4(2 \times 10^{-3})^3$$

$$= 4 \times 8 \times 10^{-9}$$

$$\boxed{Ksp = 32 \times 10^{-9}}$$

Q# if Ksp of $PbCl_2$ is 32×10^{-12} then solubility of Cl^- ion is:

Sol:

$PbCl_2$ → $Pb = s$

$PbCl_2$ → $Cl = 2s$

$$s = \left(\frac{32 \times 10^{-12}}{4}\right)^{1/3} \quad s = (8 \times 10^{-12})^{1/3}$$

$$s = (2^3)^{1/3} (10^{-12})^{1/3}$$

$$s = 2 \times 10^{-4}$$

also Conc of Pb^{+2} & Cl^-

$$\boxed{Pb^{+2} = 2 \times 10^{-4}}$$

$$\boxed{Cl^- = 4 \times 10^{-4}}$$

Common Ion effect

* Valid for electrolytes
* Based on Le-chatlier's principle.

Condition:

Saturated solution

* one weak electrolyte / i.e. strong electrolyte
* Strong electrolyte
* Common ion.

Q#

Valid for

a): NaCl (S) ↔ HCl (S) b): $BaCl_2$ (S) ↔ $Ba(OH)_2$ (S)

c): NH_4OH (BW) ↔ CH_3COOH (W) d): NH_4OH ↔ NH_4Cl.

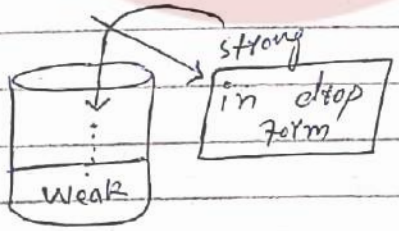
Mathematically:

(Weak) AB ⇌ A^+ + B^- → uncommon ion. (backward rxn occur.)

(Strong) AC → A^+ + Cl^- → common ion

* precipitation ⇑

Rule:



Note:

* Backward rxn of weak electrolyte occur.
* Conc. of uncommon ion of weak electrolyte decrease.

* Conc- of Common ion of weak electrolyte remain Constant.

MCQs: when KCl is added to a solution of KBr then conc. of which ion decreate.

Br^-

MCQs: The solubility of which one decreases when NH_4Br is added to NH_4OH.

OH^-

MCQs:

when $PbCl_2$ is added to $PbBr_2$ to maintain the equilibrium which Rxn occur.

(a) $Pb^{+2} + 2Cl^- \longrightarrow PbCl_2$

(b) $Pb^{+2} + 2Br^- \longrightarrow PbBr_2$

(c) both a & b.

"Kc" based Question

$$nA + nB \longrightarrow nC$$

	A	B	C
Initial con	1	1	0
change in con (co-efficient)	$1-nX$	$1-nX$	nX
Equili con	?	?	?

when initial con = not given the consider 1M

$$con = \frac{n}{V}$$

MCQs

$$A + B \rightleftharpoons 2C$$

if initial conc. of A is 2M & B is 3M. At equilibrium, A is 0.5M then equilib con of C is:

Sol:

	A	B	C
in	2	3	0
chan	2−1.5	3−1.5	2×1.5
Equi	0.5	1.5	(3)

MCQs:

$$N_2 + O_2 \rightleftharpoons 2NO_2$$

at equilibrium conc. of N_2 is 0.25M then equilibrium conc of NO is:

	N_2	O_2	$2NO$
in	1	1	0
ch	1−0.75		2×0.75
E	0.25		1.5

MCQs:

$$A + 2B \longrightarrow C$$

initially 2M of B is present at equilibrium B is 1M then equil conc. of A is:

	A	B	C
in	1	2	
C	1−0.5 1−x	2−2×0.5	x = 0.5
E	0	1	

0.5 (zero)

MCQs

Acid + alcohol $\rightleftharpoons$ ester + H_2O.

if $^{2}/_{3}$ reactant is converted into product then Kc of rxn will be?

	Acid	+ alcohol	$\rightleftharpoons$ ester	+ H_2O
in	1	1	0	0
ch	$1-\frac{2}{3}$	$1-\frac{2}{3}$	$\frac{2}{3}$	$\frac{2}{3}$
eq	$\frac{1}{3}$	$\frac{1}{3}$	$\frac{2}{3}$	$\frac{2}{3}$

$$Kc = \frac{\frac{2}{3}\times\frac{2}{3}}{\frac{1}{3}\times\frac{1}{3}} = \frac{\frac{4}{9}}{\frac{1}{9}} \quad \frac{4}{9}\times\frac{9}{1} = (4)$$

MCQs:

$A + B \rightleftharpoons C + D \qquad Kc = 9$

if two moles of A & B 2 moles of B is mixed in $2dm^3$ flask then $c = \frac{2}{2} = 1$ conc. of C is:

	A	B	$\rightleftharpoons$ C	D
I	1M	1M	0	0
ch	1-x	1-x	x	x
eq	1-x	1-x	x	x

0.75

$$Kc = \frac{[P]}{[R]}$$

$$\sqrt{9} = \sqrt{\frac{x^2}{(1-x)^2}}$$

$$3 = \frac{x}{1-x} \qquad x = 3(1-x)$$

$$x = 3 - 3x \qquad x = \frac{3}{4}$$

$$4x = 3 \qquad x = 0.75$$