YAKEEN NEET 2.0

2026

Ionic Equilibrium

Physical Chemistry | Lecture -08

By- Amit Mahajan Sir

Topics to be covered

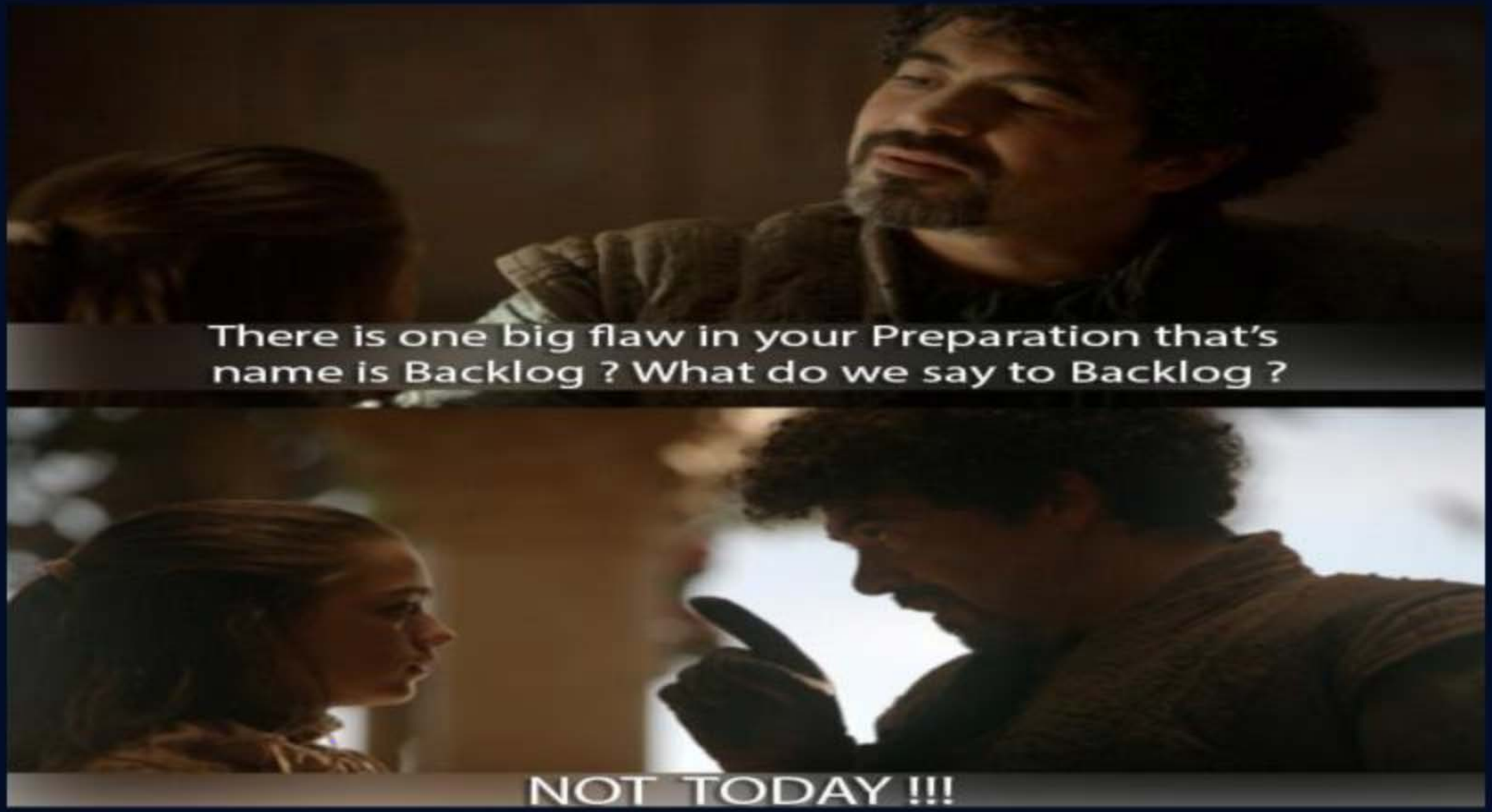
1. Medics Test, Revision of Last Class
2. Solubility Product, Ionic Product,
3. Simultaneous Solubility, Buffer solution.
4. Magarmach Practice questions, Home work from modules

Rule to Attend Class

1. Always sit in a peaceful environment with headphone and be ready with your copy and pen.
2. Never ever attend a class from in between or don't join a live class in the middle of the chapter.
3. Make sure to revise the last class before attending the next class & always complete your home work along with DPP.
4. Never ever engage in chat whether live or recorded on the topic which is not being discussed in current class as by doing so u can be blocked by the admin team or your subscription can be cancelled.

Rule to Attend Class

5. Try to make maximum notes during the class if something is left then u can use the notes pdf after the class to complete the remaining class.
6. Always ask your doubts in doubt section to get answer from faculty. Before asking any doubt please check whether same doubt has been asked by someone or not.
7. Don’t watch the videos in high speed if you want to understand better.


There is one big flaw in your Preparation that's name is Backlog ? What do we say to Backlog ?
NOT TODAY !!!

Q1 Which salt can furnish H^+ in its aqueous soln?

(a) ✗ NaH_2PO_2 — H_3PO_2

(b) ✗ Na_2HPO_3 — H_3PO_3

(c) ✓ Na_2HPO_4 — H_3PO_4

(d) all of these

Q2 $K_a(HPO_4^{2-}) = 4.8 \times 10^{-13}$

$K_a(HSO_3^-) = 6.3 \times 10^{-8}$

$\therefore HPO_4^{2-}$ is a weaker acid than HSO_3^-

(a) Stronger

(b) ✓ weaker

(c) equal

(d) Can't say

Q3 K_a HSO_4^- = x

K_a $H_2PO_4^-$ = y

K_a HCO_3^- = z

$x > y > z$

find which species is strongest base

(a) CO_3^{2-}

(b) H_2SO_4

(c) SO_4^{2-}

(d) HPO_4^{2-}

Q4 Conjugate base of $H_2PO_4^-$ is

(a) H_3PO_4

(b) HPO_4^{2-}

(c) PO_4^{3-}

(d) $H_2PO_4^-$

Q5 What is hydronium ion conc of 0.25 M HA soln ($K_a = 4 \times 10^{-8}$)

(a) 10^{-4}
(b) 10^{-5}
(c) 10^{-7}
(d) 10^{-10}

$[H_3O^+] = [H^+] = C\alpha$

$C = 0.25\ M$

$= \sqrt{\frac{K_a C^2}{C}}$

$= \sqrt{K_a C}$

$= \sqrt{4 \times 10^{-8} \times 25 \times 10^{-2}}$

$= \sqrt{100 \times 10^{-10}} = \sqrt{10^{-8}} = 10^{-4}\ M$

$\frac{K_a}{C} = \frac{4 \times 10^{-8}}{25 \times 10^{-2}}$

$= \frac{16}{100} \times 10^{-8} < 25 \times 10^{-4}$

$= \frac{}{25}$

Lec-3 + Lec-4 → Ionic eq: revise → Medics test tomorrow.

Revision of Last Class

Solubility product (K_{sp})

S S S

A_xB_y

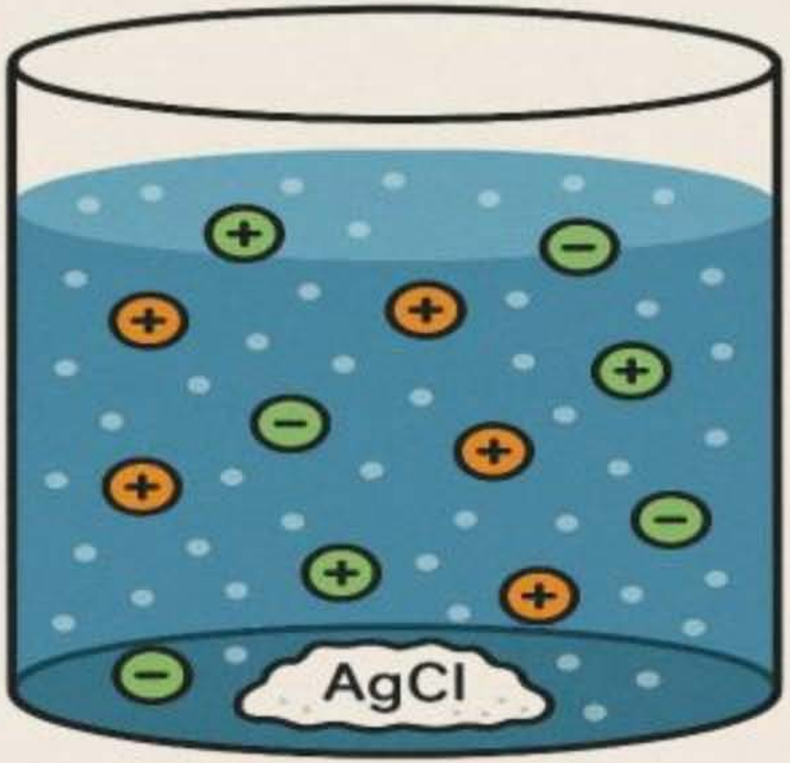
$S \rightarrow M \rightarrow mol/L$

$K_{sp} = x^x y^y (S)^{x+y}$

Hg_2Cl_2

SOLUBILITY PRODUCT

$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$



QUESTION

At 25°C, K_{sp} for $PbBr_2$ is equal to 8×10^{-5}. If the salt is 80% dissociated, what is the solubility of $PbBr_2$ in mol/litre?

(A) $\left[\frac{10^{-4}}{1.6 \times 1.6}\right]^{1/3}$

(B) $\left[\frac{10^{-5}}{1.6 \times 1.6}\right]^{1/3}$

(C) $\left[\frac{10^{-4}}{0.8 \times 0.8}\right]^{1/3}$

(D) $\left[\frac{10^{-5}}{1.6 \times 1.6}\right]^{1/2}$

$\frac{80}{100} \times S = 0.8S$

$K_{sp} = 8 \times 10^{-5}$

$S = ?$

$PbBr_2(s) + H_2O \rightleftharpoons Pb^{2+} + 2Br^-$

$0.8S \qquad 0.8S \qquad 0.8 \times 2S$

$1.6S$

$K_{sp} = [Pb^{2+}][Br^-]^2$

$8 \times 10^{-5} = (0.8S)^1 (1.6S)^2$

$16 \times 16 = 256$

$8 \times 10^{-5} = 8 \times 10^{-2} \times 256\, S^3$

$S = \left(\frac{10^{-2}}{256}\right)^{1/3} = \left(\frac{10^{-4}}{2.56}\right)^{1/3}$

Difference Between K_{ip} & K_{sp}

Roti 2 4 7 | Max. roti 4 4 4

K_{ip} = Ionic Product $= [Ag^+]^1[Cl^-]^1$ $s = 10^{-3}$ M

K_{sp} = Solubility product $= [Ag^+]^1[Cl^-]^1$

$AgCl + H_2O \rightarrow Ag^+ + Cl^-$

$S = 10^{-5}$ M $\quad 10^{-5}$ M

MIT

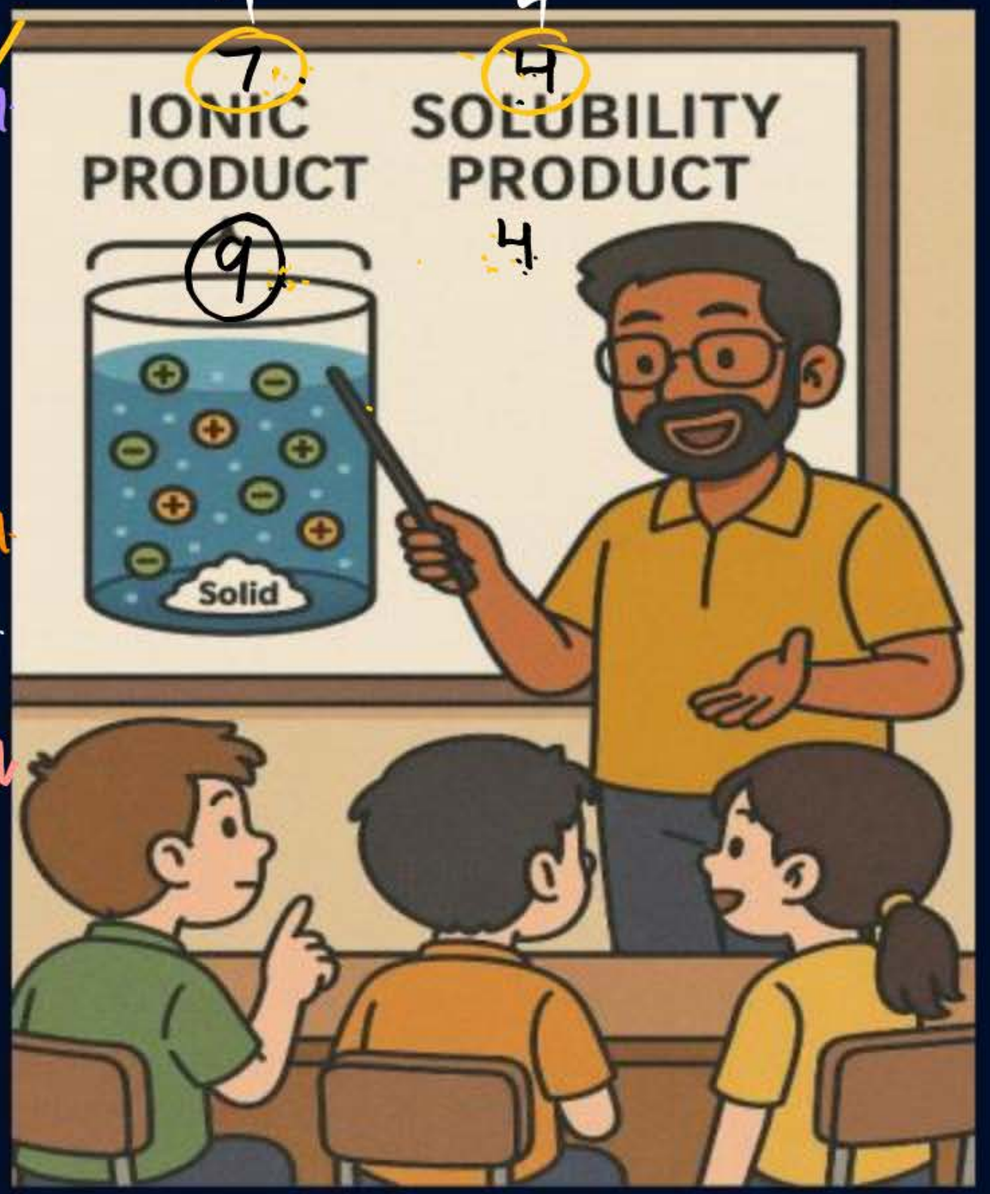
(1) $K_{ip} < K_{sp} \Rightarrow$ sol^n is unsaturated $\Rightarrow$ p.p.t. not formed

$K_{ip} = K_{sp} \Rightarrow$ sol^n is saturated $\Rightarrow$ p.p.t. not formed

$K_{ip} > K_{sp} \Rightarrow$ sol^n is super saturated $\Rightarrow$ p.p.t. formed

↓ Practically not possible.

(2) Higher difference b/w K_{ip} & K_{sp} $\Rightarrow$ faster is p.p.t.^{n}



QUESTION

A solution which is 10^{-3} M each in Mn^{2+}, Fe^{2+}, Zn^{2+} and Hg^{2+} is treated with 10^{-16} M sulphide ion. If K_{SP} of MnS, ZnS, FeS and HgS are 10^{-15}, 10^{-23}, 10^{-20} and 10^{-54} respectively, which one will precipitate first.

$[S^{2-}] = 10^{-16}$ M $\quad K_{(Q)} = 10^{-19}$

(A) FeS

(B) MgS

(C) HgS

(D) ZnS

QUESTION – (AIIMS 2008)

0.1M 0.1M 0.1M

On adding 0.1 M solution each of $[Ag^+]$, $[Ba^{2+}]$, $[Ca^{2+}]$ in a Na_2SO_4 solution, species first precipitated is:
$[K_{sp}\ BaSO_4 = 10^{-11}, K_{sp}\ CaSO_4 = 10^{-6}, K_{sp}\ Ag_2SO_4 = 10^{-5}]$

(A) Ag_2SO_4

(B) $BaSO_4$

(C) $CaSO_4$

(D) All of these

$K_{ip}(Ag_2SO_4) = [Ag^+]^2[SO_4^{2-}]$
$= (0.1)^2 x$
$= 10^{-2} x$

$K_{ip}\ BaSO_4 = K_{ip}\ CaSO_4 = 10^{-1} x$

QUESTION

When equal volume of $AgNO_3$ and NaCl solution are mixed, the precipitation of AgCl ($K_{sp} = 1.81 \times 10^{-10}$) will occur with:

A. 10^{-3} M (Ag^+) and 10^{-10} M (Cl^-)

B. 10^{-5} M (Ag^+) and 10^{-5} M (Cl^-)

C. 10^{-6} M (Ag^+) and 10^{-5} M (Cl^-)

D. 10^{-4} M (Ag^+) and 10^{-4} M (Cl^-)

$K_{ip} = [Ag^+][Cl^-]$

$K_{ip} = \frac{1}{2} \times 10^{-4} \times \frac{1}{2} \times 10^{-4}$

$= \frac{1}{4} \times 10^{-8}$

$= 0.25 \times 10^{-8}$

$= 25 \times 10^{-10}$

$K_{ip} > K_{sp}$

$[Ag^+]$

$M_1 = 10^{-4}\ M$ $\quad V_1 = V\ L$

$V_2 = 2V\ L$

$M_2 = \frac{10^{-4} \times V}{2V}$

$[Ag^+] = \frac{1}{2} \times 10^{-4}$

$[Cl^-]$

$M_1' = 10^{-4}$ $\quad V_1' = V L$

$V_2' = 2V L$

$M_2' = \frac{10^{-4} \times V}{2V}$

$= \frac{1}{2} \times 10^{-4}\ M$

QUESTION

Q At 25° C, the solubility product of Hg_2Cl_2 in water is 3.2×10^{-17} mol^3 dm^{-9}. What is the solubility of Hg_2Cl_2 in water at 25° C?

A 1.2×10^{-12} M

B 3.0×10^{-6} M

C 2×10^{-6} M ✓

D 1.2×10^{-16} M

$Hg_2Cl_2 + H_2O \rightarrow Hg_2^{2+} + 2Cl^-$

S S 2S

$K_{sp} = (S)^1(2S)^2$

$[Cl^-]^2$

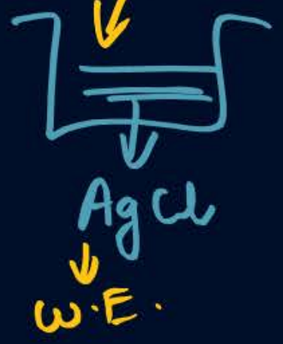
$[2S]^2$

$8 \times 10^{-18} = 4S^3$

$S = (8 \times 10^{-18})^{1/3} = 2 \times 10^{-6}$ M

Common ion Effect

$Na^+Cl^-(aq.) \rightarrow$ S.E.
C



$AgCl + H_2O \rightleftharpoons Ag^+ + Cl^-$
S S S + Conc

$NaCl + H_2O \rightarrow Na^+ + Cl^-$
C C C + S

$K_{sp} = [Ag^+][Cl^-]$

$K_{sp} = (S)(C)$

*When a strong electrolyte is added to a solution of weak electrolyte having a common ion

Weak electrolyte :

QUESTION – (NEET 2020)

Find out the solubility of $Ni(OH)_2$ in 0.1 M NaOH. Given that the ionic product of $Ni(OH)_2$ is 2×10^{-15}.

(A) 2×10^{-8} M

(B) 1×10^{-13} M

(C) 1×10^{8} M

(D) 2×10^{-13} M

$K_{SP} = [Ni^{2+}][OH^-]^2$

$2 \times 10^{-15} = S\,(10^{-1})^2$

$S = 2 \times 10^{-13}$ M

$Ni(OH)_2 + H_2O \rightleftharpoons Ni^{2+} + 2OH^-$

$S \qquad\qquad S \qquad\quad 2S + 0.1 \approx 0.1$

$NaOH + H_2O \rightarrow Na^+ + OH^-$

$0.1 \qquad\qquad\quad 0.1$

QUESTION – (AIIMS 2009)

$4 \times 10^{-9} = (S')(5 \times 10^{-2})^2$

The solubility of PbF_2 in water at 25 °C is $\approx 10^{-3}$ M. What is its solubility in 0.05 M NaF solution? Assume the later to be fully ionized.

(A) 1.6×10^{-6} M

(B) 1.2×10^{-6} M

(C) 1.2×10^{-5} M

(D) 1.6×10^{-4} M

$PbF_2 + H_2O \rightleftharpoons Pb^{2+} + 2F^-$

$S \quad\quad S \quad\quad 2S + 5\times10^{-2} \approx 5\times10^{-2}$

$NaF + H_2O \rightarrow Na^+ + F$

$5\times10^{-2} \quad\quad 5\times10^{-2}$

$S = 10^{-3}\,M \Rightarrow K_{sp} = (10^{-3})(2\times10^{-3})^2 = 4\times10^{-9}$

$K_{sp} = 4\times10^{-9} = (S')(5\times10^{-2})^2$

$\frac{4\times10^{-9}}{25\times10^{-4}} = S'$

$\frac{16}{100}\times10^{-5} = S'$

$16\times10^{-7} = S'$

QUESTION – (AIIMS 2017)

At 25°C, the solubility product of $Mg(OH)_2$ is 1.0×10^{-11}. At which pH will Mg^{2+} ions start precipitating in the form of $Mg(OH)_2$ from a solution of 0.001 M Mg^{2+} ions?

pH = ?

pOH = ?

$[OH^-]$ = ?

- A) 9
- B) 10
- C) 11
- D) 8

$K_{sp} = [Mg^{2+}][OH^-]^2$

$10^{-8} = (10^{-3})[OH^-]^2$

$[OH^-] = \sqrt{10^{-8}} = 10^{-4}\ M$

$pOH = 4$

$pH = 14 - 4 = 10$

Application of Solubility Product

In salting Out Soap

$RCOO^-Na^+ + H_2O \rightleftharpoons RCOO^- + Na^+$

Soap · p · p · t

add aq. Na^+Cl^-

$Na^+Cl^- + H_2O \rightarrow Cl^- + Na^+$

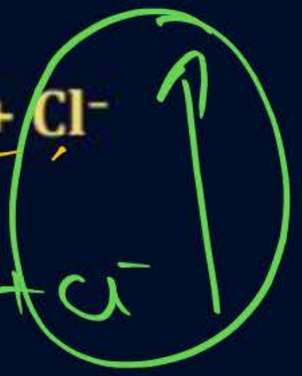
∴ Due to common ion effect by addition of aq. NaCl, eq. shift backward ∴ Soap p · p · t ↑

In Purification of Common Salt

$$Na^+Cl^- + H_2O \rightleftharpoons Na^+ + Cl^-$$

Na^+Cl^- b.p.t.

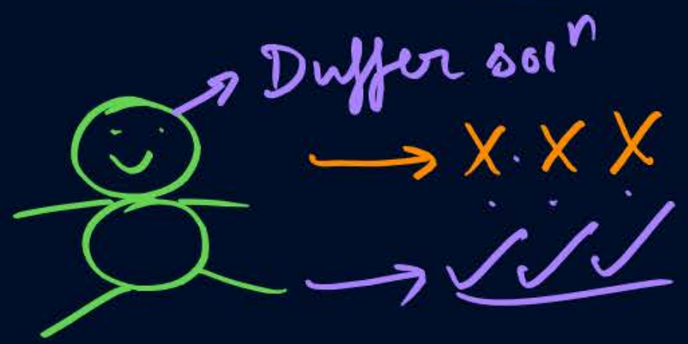
$$HCl + H_2O \longrightarrow H^+ + Cl^-$$



Due to common ion effect of Cl^- ion.
eq. shift backwards ∴ NaCl b.p.t.

Buffer Solution

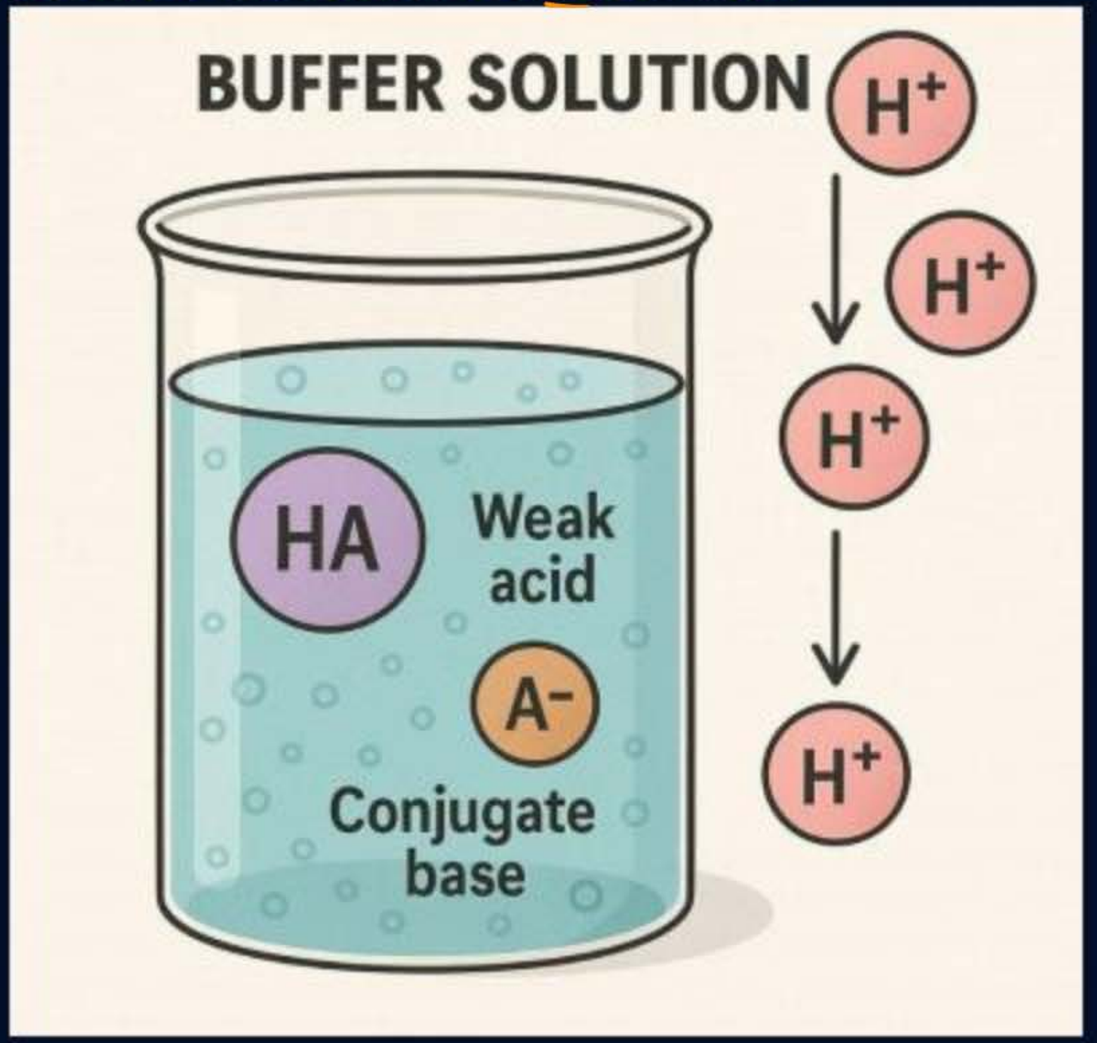
Solution which resist the change in pH on addition of small amount of acid or base or dilution.



Community

Types of Buffer solution.

1. Simple Buffer → salt of W.A & W.B.
2. Acidic Buffer:
3. Basic Buffer:



Simple Buffer

Salt of w.A + w.B

$CH_3COOH + NH_4OH$

↓

$CH_3COO^- \; NH_4^+$

$pH = 7 + \frac{1}{2}(pK_a - pK_b)$

as no Conc. involved ∴ pH won't Change

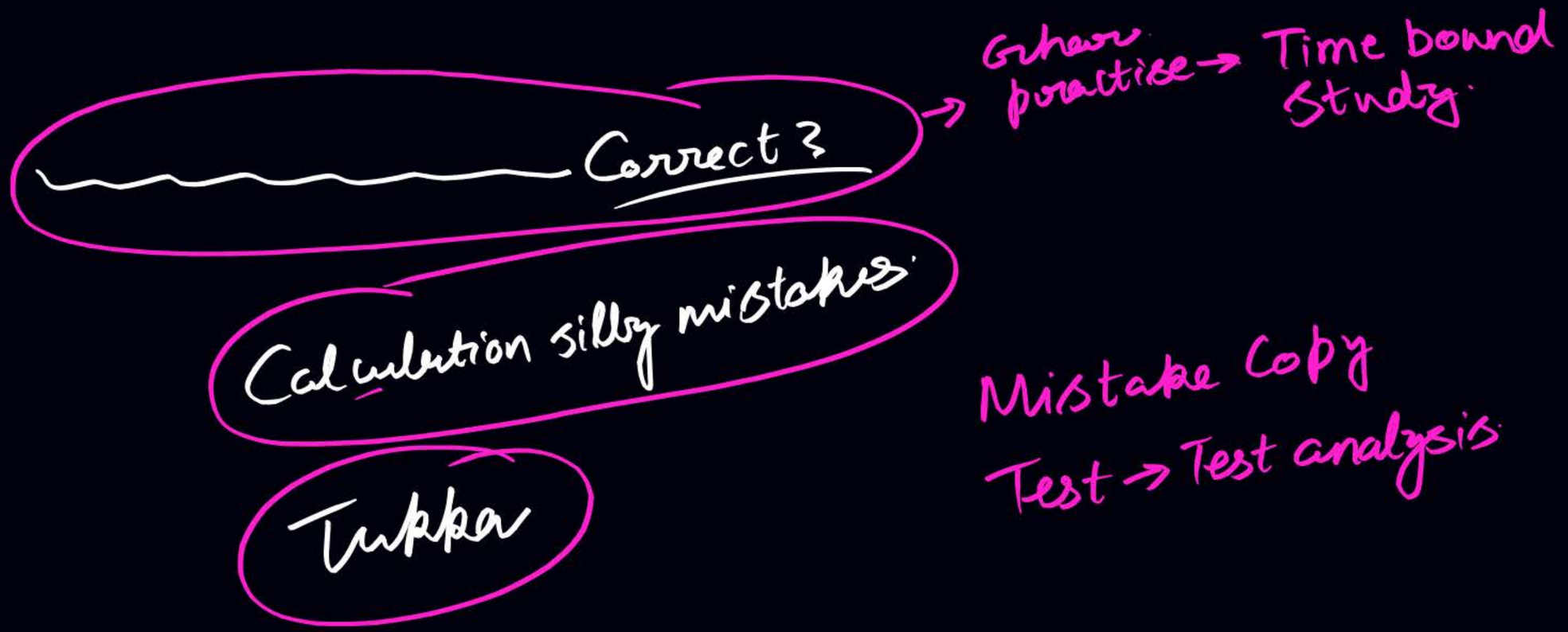
$[H^+]\uparrow$ or $[OH^-]\uparrow$ $\downarrow C = \frac{n}{V\uparrow}$

$NH_4^+ + H_2O \rightleftharpoons NH_4OH + H^+$

$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$

as acid add $[H^+]\uparrow$ this is neutralised by OH^- from hydrolysis of NH_4^+ ∴ pH won't Change.

& base ⟩⟩ $[OH^-]\uparrow$ ~~~~ H^+ ~~~~ CH_3COO^- ∴ ~~~~


Correct ?
Gshare practise → Time bound Study
Calculation silly mistakes
Mistake Copy
Tukka
Test → Test analysis

Home work from modules

Prarambh → Q 104 to Q 115

Prabal → Q 25, 26

Magarmach Practice Questions (MPQ)

QUESTION

If the solubility product of AB_2 is $3.20 \times 10^{-11}\ M^3$, then the solubility of AB_2 in pure water is ..... $\times 10^4\ moL^{-1}$. [Assuming that neither kind of ion reacts with water]

QUESTION

K_{sp} of AgCl is 1×10^{-10}. its solubility in 0.1 M $Ag^+NO_3^-$ will be:

A 10^{-5} moles/litre

B $> 10^{-5}$ moles/litre

C $< 10^{-5}$ moles/litre

D None of these

QUESTION

What is the minimum pH necessary to cause a precipitate of $Pb(OH)_2$ ($K_{sp} = 1.2 \times 10^{-5}$) to form in a 0.12 M $PbCl_2$ solution?

A 12.4

B 10.8

C 12.0

D 11.1

QUESTION – (AIIMS 2018, 27 May)

Solubility of a sparingly soluble salt XB_2 in water is X. What will be its solubility if the concentration of YB is 0.001 M?

A $x^2 \times 10^{-6}$

B $4x^3 \times 10^6$

C $4x^3 \times 10^{-6}$

D $4x^3 \times 10^3$

QUESTION – (AIIMS 2010)

Solubility product of a salt AB is 1×10^{-8} in a solution in which the concentration of A^+ ions is 10^{-3} M. The salt will precipitate when the concentration of B^- ions is kept

A. Between 10^{-8} M to 10^{-7} M

B. Between 10^{-7} M to 10^{-8} M

C. $> 10^{-5}$ M

D. $< 10^{-8}$ M

QUESTION – (NEET 2016-II)

The solubility of AgCl(s) with solubility product 1.6×10^{-10} in 0.1 M NaCl solution would be:

(A) 1.6×10^{-11} M

(B) Zero

(C) 1.26×10^{-5} M

(D) 1.6×10^{-9} M

QUESTION – (AIIMS 2008)

On adding 0.1 M solution each of $[Ag^+]$, $[Ba^{2+}]$, $[Ca^{2+}]$ in a Na_2SO_4 solution, species first precipitated is:
$[K_{sp}\ BaSO_4 = 10^{-11}, K_{sp}\ CaSO_4 = 10^{-6}, K_{sp}\ Ag_2SO_4 = 10^{-5}]$

A Ag_2SO_4

B $BaSO_4$

C $CaSO_4$

D All of these

QUESTION – (NEET 2019)

pH of a saturated solution of $Ca(OH)_2$ is 9. The solubility product (K_{sp}) of $Ca(OH)_2$ is:

A 0.5×10^{-15}

B 0.25×10^{-10}

C 0.125×10^{-15}

D 0.5×10^{-10}

QUESTION – (NEET 2018)

The solubility of $BaSO_4$ in water is 2.42×10^{-3} gL^{-1} at 298 K. The value of its solubility product (K_{sp}) will be
(Given molar mass of $BaSO_4$ = 233 g mol^{-1})

A 1.08×10^{-10} mol^2 L^{-2}

B 1.08×10^{-12} mol^2 L^{-2}

C 1.08×10^{-8} mol^2 L^{-2}

D 1.08×10^{-14} mol^2 L^{-2}

QUESTION – (NEET 2015)

The K_{sp} of Ag_2CrO_4, AgCl, AgBr and AgI are respectively, 1.1×10^{-12}, 1.8×10^{-10}, 5.0×10^{-13}, 8.3×10^{-17}. Which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of NaCl, NaBr, NaI and Na_2CrO_4?

(A) AgCl

(B) AgBr

(C) Ag_2CrO_4

(D) AgI

QUESTION – (AIPMT 2010)

If pH of a saturated solution of $Ba(OH)_2$ is 12, the value of its $K_{(sp)}$ is:

A $4.00 \times 10^{-6}\ M^3$

B $4.00 \times 10^{-7}\ M^3$

C $5.00 \times 10^{-6}\ M^3$

D $5.00 \times 10^{-7}\ M^3$

THANK YOU