YAKEEN NEET 2.0

2026

Ionic Equilibrium

Physical Chemistry | **Lecture -09**

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Topics to be covered

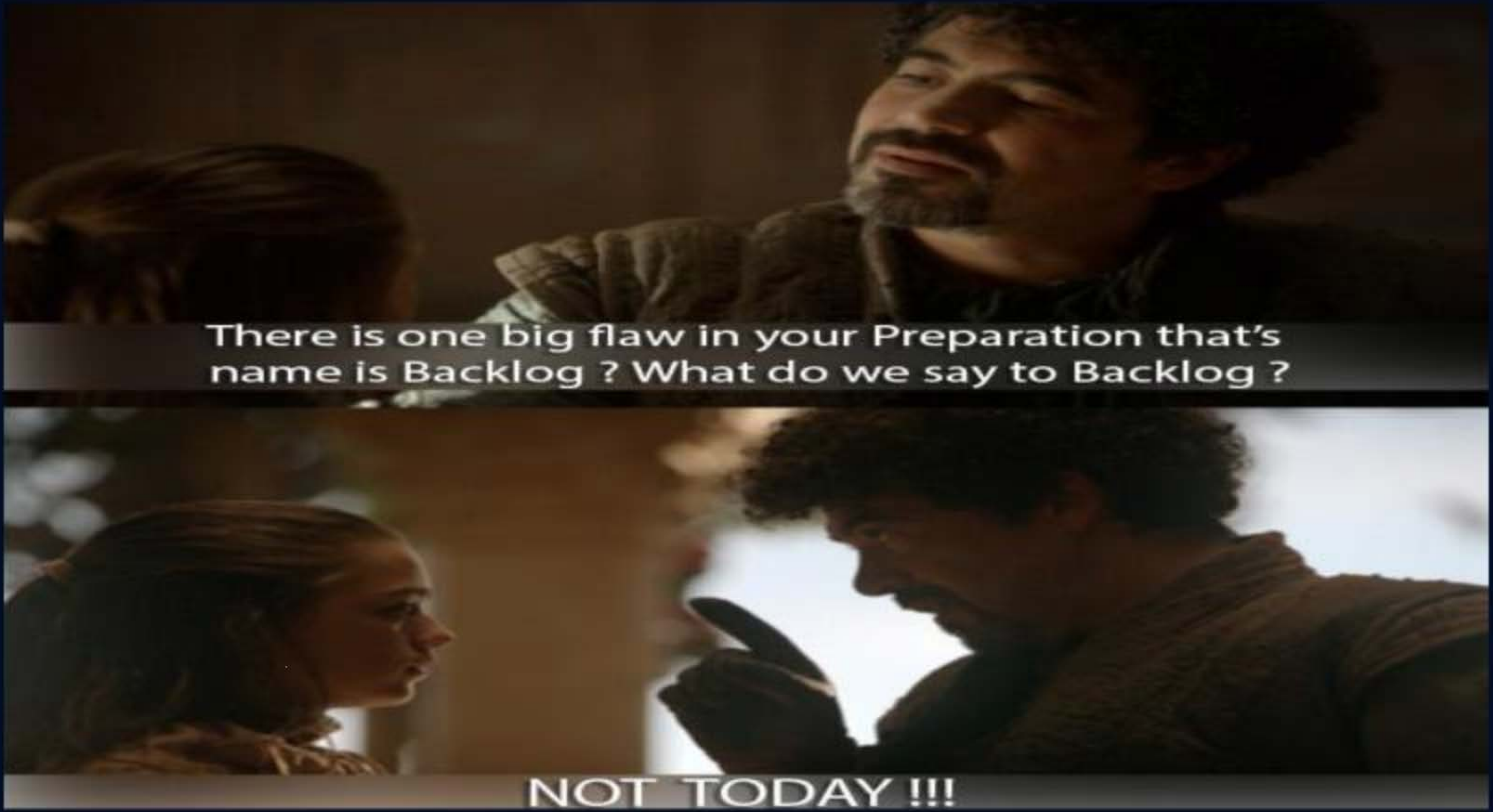
1. Medics Test, Revision of Last Class
2. Buffer solution & its types
3. Buffer capacity and its range
4. Home work from modules

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 !!!

MEDICS

Mastery
Checks your grasp over NEET-level concepts

Evaluation
Judging both knowledge and test-smartness

Decision Making
Testing your speed + accuracy under pressure

Intuition
Some answers need gut + logic – can you spot the trick?

Concepts
It's all about strong basics – no shortcuts here

Strategy

The **MEDICS** test – built for those who heal, hustle, and hope.

$5 \xrightarrow{10} 4 \xrightarrow{100} 3 \xrightarrow{1000} 2$

QUESTION

The pH of a solution is 5. To this solution acid was added so that its pH value becomes 2.0. The increase in H^+ concentration is :

(A) 100 times

(B) 5 times

(C) 2.5 times

(D) 1000 times

$pH = 5$

$[H^+] = 10^{-5} M = M_1$

$V_1 = V$

$M_2 = 10^{-2} M$

$V_2 = ?$

$V_2 = \frac{10^{-5} V}{10^{-2}} = \frac{V}{1000}$

$\uparrow C = \frac{n}{V} \downarrow$

QUESTION

10^{-5} moles

Number of equivalents of HCl present in 100 mL of its solution whose pH is 4:

(A) 10^{-4}

(B) 10^{-3}

(C) 10^{-2}

(D) 10^{-5}

$pH = 4$

$[H^+] = 10^{-4} = \frac{n_B \times 1000}{V(ml)}$

$n_B = \frac{10^{-4} \times 100}{1000} = 10^{-5}\ HCl$

$g \cdot eq\ HCl = 10^{-5}$

QUESTION

10^{-5} N H_2SO_4

$\frac{10^{-5}}{2}$ M H_2SO_4

10^{-5} M = $[H^+]$

To a 10 mL of 10^{-3} N H_2SO_4 solution water has been added to make the total volume of one litre. Its pOH would be :

1000 ml

(A) 3

(B) 12

(C) 9

(D) 5

$N_1 = 10^{-3}$ N

$V_1 = 10$ ml

$V_2 = 1000$ ml

$N_2 = ?$

$N_2 = \frac{10^{-3} \times 10}{1000} = 10^{-5}$ N

$N = M \times n_f$

$10^{-5} = M \times 2$

$M = \frac{10^{-5}}{2} = [H_2SO_4]$

$[H^+] = \cancel{2} \times \frac{10^{-5}}{\cancel{2}} = 10^{-5}$ M

pH = 5

pOH = 14 − 5 = 9

QUESTION

pH of a strong diprotic acid (H_2A) at concentrations :

(i) 10^{-4} M,

$[H^+] = 2\times10^{-4}$ M

$pH = 4 - \log 2$

$= 4 - 0.3$

$= 3.7$

(ii) 10^{-4} N

$N = M \times n_f$

$\frac{10^{-4}}{2} = M = [H_2A]$

$[H^+] = 2 \times \frac{10^{-4}}{2} = 10^{-4}$ M

$pH = 4$

are respectively :

(A) 3.7 and 4.0

(B) 4 and 3.7

(C) 4 and 4

(D) 3.7 and 3.7

QUESTION

Which is the strongest acid (pK_a value is given)?

(A) HCOOH [3.77]

(B) C_6H_5COOH [4.22]

(C) CH_3COOH [4.7]

(D) CH_3CH_2COOH [4.88]

QUESTION

$\alpha = \sqrt{\frac{K_a}{C}}$

C_1 C_2

Given the two concentration of HCN ($K_a = 10^{-9}$) are 0.1 M and 0.001 M respectively. What will be the ratio of degree of dissociation?

A) 1

B) 0.1

C) 0.003

D) 0.01

$\frac{\alpha_1}{\alpha_2} = \sqrt{\frac{C_2}{C_1}}$

$= \sqrt{\frac{0.001}{0.1}} = \sqrt{\frac{1}{100}} = \frac{1}{10} = 0.1$

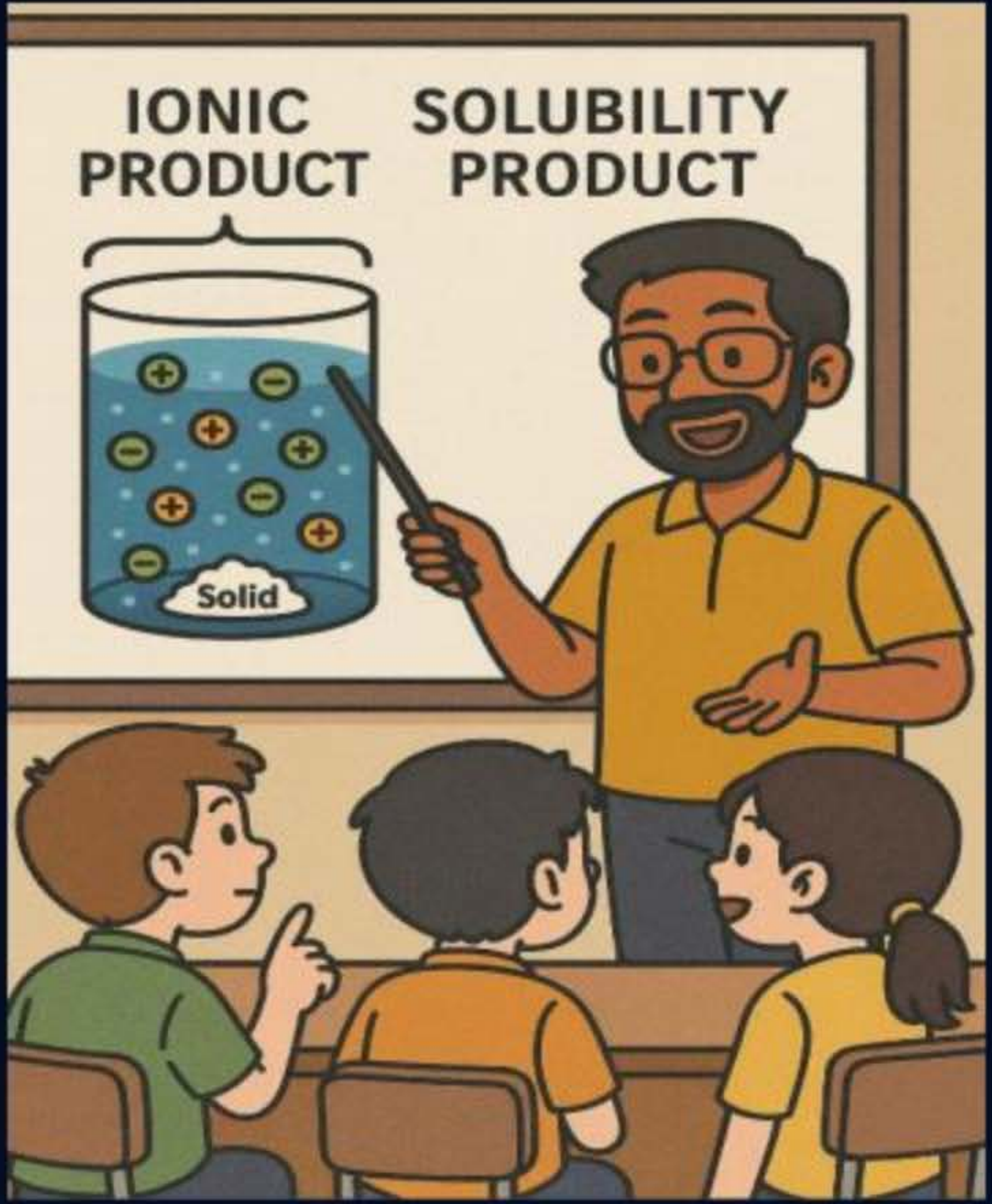
Lec-5 & Lec-6 → Ionic eq. → Revise → MEDJCS test.

Revision of Last Class

$K_{ip} < K_{sp} \rightarrow$ unsat.

$K_{ip} = K_{sp} \Rightarrow$ sat.

$K_{ip} > K_{sp} \Rightarrow$ super. sat $\Rightarrow$ p.p.t. will occur.



Common ion Effect

S.E.

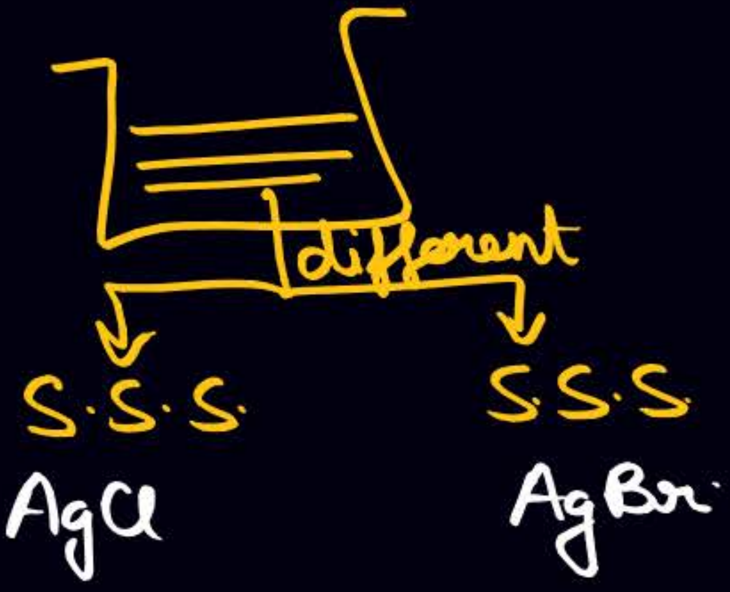
$[\text{Common ion}]_{\text{conc}} = [\text{Common ion}]_{S.E}$

S.S.S.

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

Weak electrolyte :

Simultaneous solubility :



$$\underset{S}{AgCl} + H_2O \rightleftharpoons \underset{S+S'}{Ag^+} + \underset{S}{Cl^-}$$

$$\underset{S'}{AgBr} + H_2O \rightleftharpoons \underset{S'+S}{Ag^+} + \underset{S'}{Br^-}$$

$$\frac{K_{sp}(AgCl)}{K_{sp}(AgBr)} = \frac{[Ag^+][Cl^-]}{[Ag^+][Br^-]} = \frac{\cancel{(S+S')}\,S}{\cancel{(S+S')}\,S'}$$

$$\frac{S}{S'} = \frac{K_{sp}(AgCl)}{K_{sp}(AgBr)}$$

Q. Find solubility of $\overset{S}{Ag}Cl$ & $\overset{S'}{Ag}Br$ if they are present in same beaker & $K_{sp}(AgCl) = 16 \times 10^{-10}$ & $K_{sp}(AgBr) = 4 \times 10^{-10}$

$$\frac{\cancel{16}^{4} \times \cancel{10^{-10}}}{\cancel{4} \times \cancel{10^{-10}}} = \frac{S}{S'}$$

$$S = 4S'$$

$$16 \times 10^{-10} = (S + S')S$$

$$= (4S' + S')4S'$$

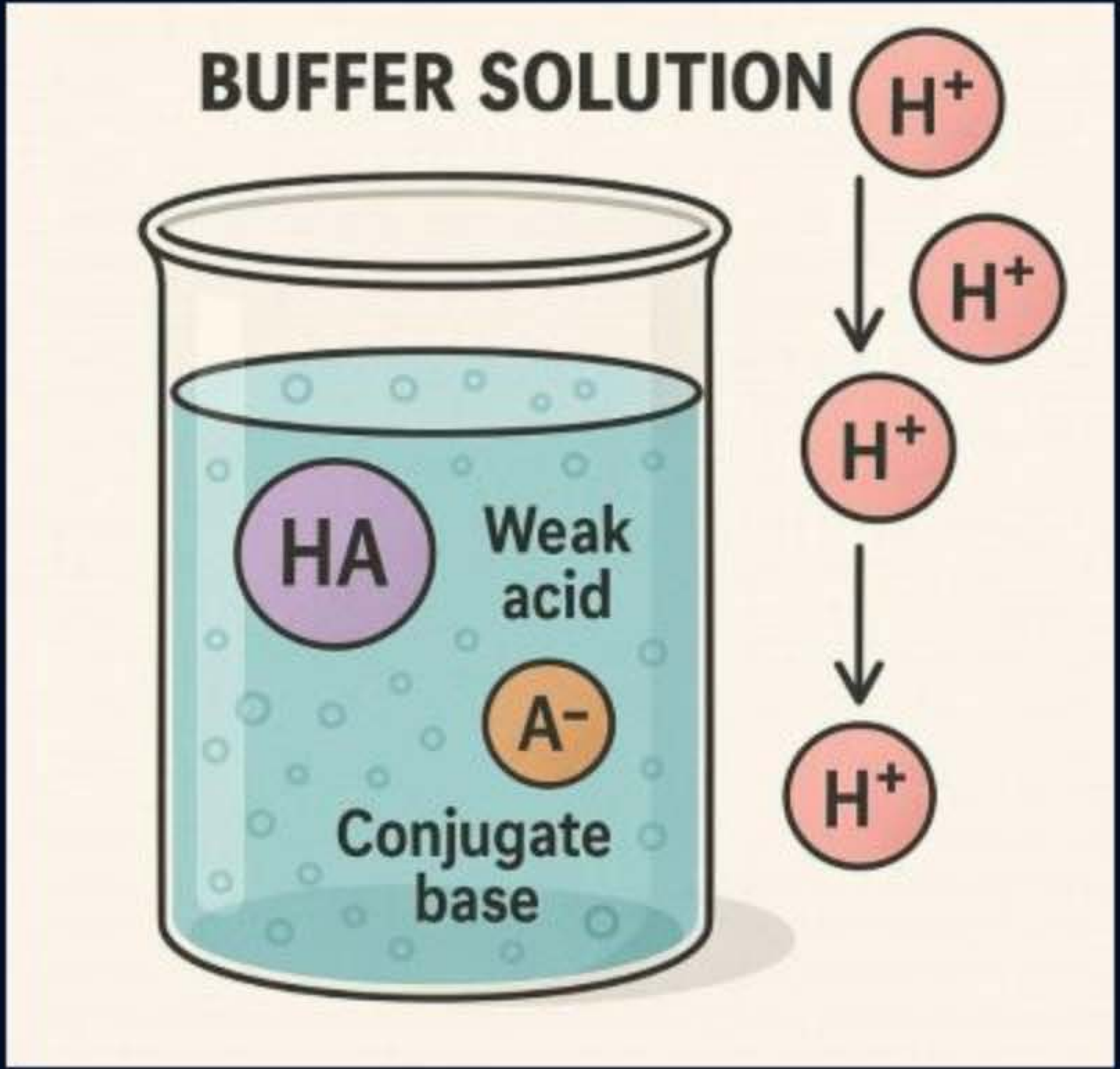
$$\cancel{16}^{4} \times 10^{-10} = \cancel{20}^{5}(S')^2$$

$$0.8 \times 10^{-10} = (S')^2$$

$$S = 4S'$$

Buffer Solution

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



Salt of w.A. + w.B.

$NH_4^+ CH_3COO^-$

base add. $[OH^-]$

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

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

$[H^+]$

acid add.

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

(2) Acidic Buffer

Mixture of W.A + it's salt

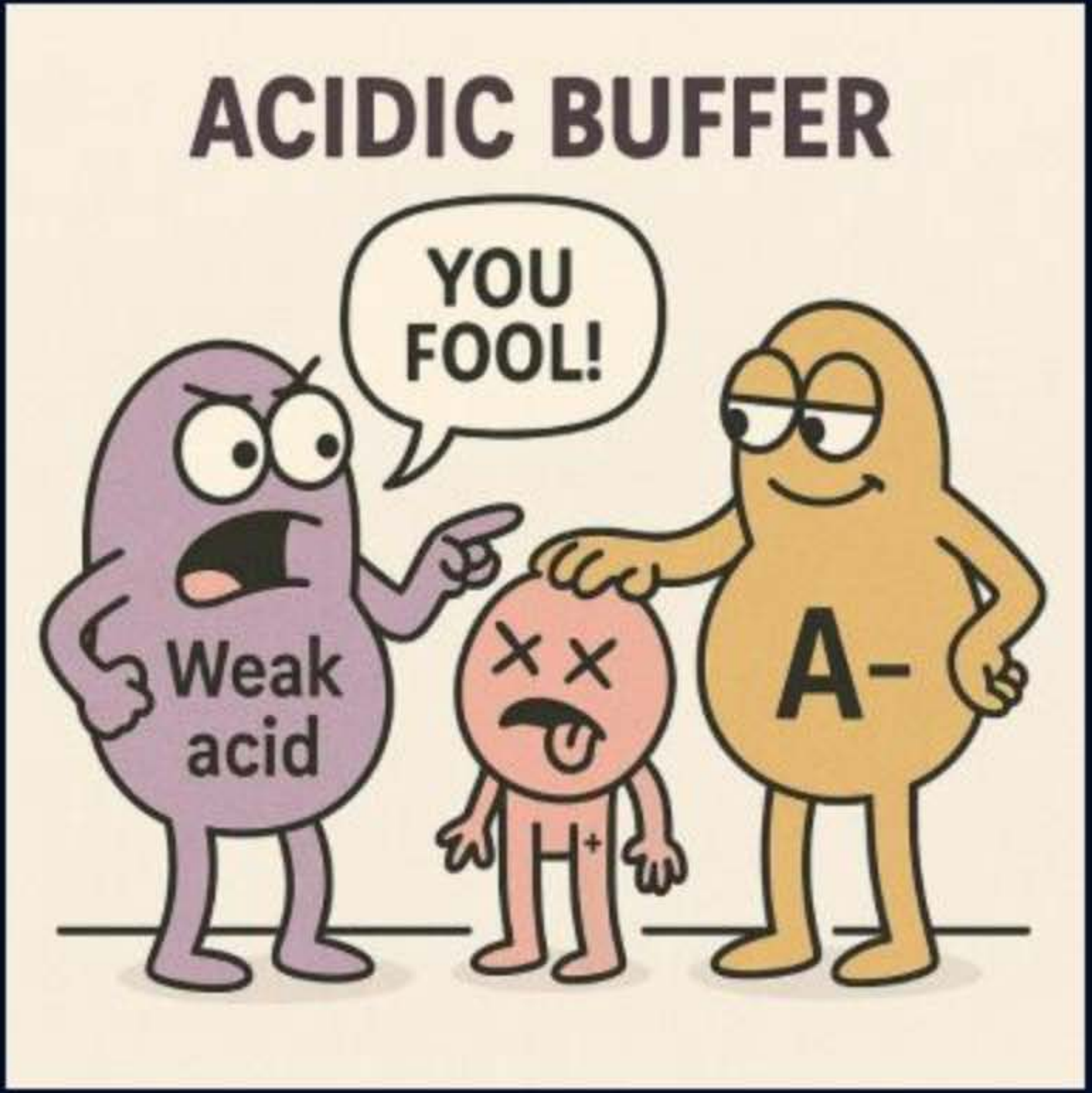
$\downarrow$

$CH_3COOH + CH_3COO^-Na^+$

$CH_3COOH + NaOH$

$\downarrow$

$CH_3COO^-Na^+$



Acidic Buffer

Mixture of weak acid + Salt of W.A. with S.B.

C.A. $\xrightarrow{-H^+}$ C.B.

(1)	CH_3COOH	+	$CH_3COO^-Na^+$
(2)	$HCOOH$	+	$HCOO^-K^+$
(3)	H_2S	+	Na^+HS^-
(4)	$NaHS$	+	Na_2S

$\cancel{H_2}S + \cancel{Na_2}S$

(5) H_3PO_4 has basicity = 3

$\therefore$ H_3PO_4 can form 3 buffers

(a) $H_3PO_4 + NaH_2PO_4$

(b) $NaH_2PO_4 + Na_2HPO_4$

(c) $Na_2HPO_4 + Na_3PO_4$

$$1CH_3COOH(aq.) + 1NaOH(aq.) \longrightarrow CH_3COO^-Na^+ + H_2O$$

$C_1 = C_2$ C_1 C_2

x X

$C = C_1 = C_2 \rightarrow$ sol^n has salt of W.A. + S.B.

$$pH = 7 + \frac{1}{2}(pKa + \log C)$$

NaOH is L.R

$C_1 > C_2$ $C_1 - C_2$ X C_2

acidic buffer

$$pH = pKa + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$C_1 < C_2$ X $C_2 - C_1$ C_1

base   base

Mix. of W.B + S.B. $\Rightarrow [OH^-]_{total} = [OH^-]_{S.B}$

$\downarrow$

pOH

pH

pH of Acidic Buffer

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

W.E.

$$CH_3COO^-Na^+ + H_2O \longrightarrow CH_3COO^- + Na^+$$

S.E.

$$-\log[H^+] = -\log K_a - \log \frac{[CH_3COOH]_{in}}{[CH_3COO^-]_{salt}}$$

$$pH = pK_a + \log \frac{[CH_3COO^-]_{salt}}{[CH_3COOH]_{initial}}$$

$$K_a = \frac{[CH_3COO^-]_{salt}[H^+]}{[CH_3COOH]_{initial}}$$

$$[H^+] = K_a \frac{[CH_3COOH]_{initial}}{[CH_3COO^-]_{salt}}$$

MIT

① acidic buffer → mix. of w.A + Conjugate base (Salt of w.A + S.B.)

② no. of buffer made by w.A. = Basicity.

③ $CH_3COOH(aq.) + NaOH(aq.)$

$C_1 > C_2 \Rightarrow$ Acidic buffer.

④ $pH = pK_a + \log \frac{[\text{Anion of w.A.}]^{x}_{salt}}{[\text{w.A.}]^{y}}$ } → Henderson - Hassal bach eq^n.

⑤ On addition of water ⇒ V ↑ C ↓ ⇒ ∴ pH won't Change.

acid ∴ $[H^+]$ ↑ ∴ pH ↓ but $CH_3COO^- + H^+ \rightarrow CH_3COOH$ ∴ pH don't Change

base ∴ $[OH^-]$ ↑ ∴ pH ↑ ⟿ $H^+ + OH^- \rightarrow H_2O$ ∴ CH_3COOH dissociate more ∴ pH don't Change.

salt → $1\,HCOO^-Na + H_2O \longrightarrow 1\,HCOO^- + Na^+$

$\underset{0.5M}{HCOO^-Na}$ → $\underset{0.5M}{HCOO^-}$

acidic buffer ⇒ $\underset{0.1M}{HCOOH} + \underset{0.2M}{(HCOO)_2Ca}$

$1\,(HCOO)_2Ca + H_2O \longrightarrow 2\,HCOO^- + 1\,Ca^{2+}$

$\underset{0.2M}{(HCOO)_2Ca}$ → $\underset{0.4M}{2\,HCOO^-}$

$$pH = pK_a + \log \frac{[HCOO^-]^x}{[HCOOH]_{initial}}$$

$$= pK_a + \log \frac{(0.4)^2}{0.1}$$

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

OH^-

$$CH_3COO^-Na^+ + H_2O \longrightarrow CH_3COO^- + Na^+$$

acid ↑ $[H^+]$ ↑ ∴ pH ↓

base ↑ $[OH^-]$ ↑ ∴ pH ↑

$$H^+ + OH^- \rightarrow H_2O$$

Basic Buffer

(Conj. acid)
(Cation of W.B.)

Mixture of W.B. + Salt of W.B. & S.A.

1. NH_4OH + $NH_4^+ Cl^-$
2. $R-NH_2$ or $R-NH_3OH$ + $RNH_3^+ Cl^-$
3. NH_4OH + $(NH_4)_2SO_4$

pH of Basic Buffer

#MIT

① $pOH = pK_b + \log \frac{[\text{Cation of W.B.}]^{x}_{\text{salt}}}{[\text{W.B.}]^{y}_{\text{initial}}}$

② $pH = 14 - pOH$

③ no. of basic buffer made by W.B. = acidity

④ $C_{NH_4OH} > C_{HCl}$

⑤ water ↑ C ↓ ∴ pH don't change

acid ↑ $[H^+]$ ↑ ∴ pH should dec but $H^+ + OH^- \rightarrow H_2O$ & eq. forward shift ∴ pH not change

base ↑ $[OH^-]$ ↑ ∴ ——— inc — $OH^- + NH_4^+ \rightarrow NH_4OH$ eq backward ———

$NH_4OH + HCl \longrightarrow NH_4^+Cl^- + H_2O$

	NH_4OH	HCl	$NH_4^+Cl^-$
$C_1 = C_2$	C_1	C_2	$C_1 = C_2$
$C_1 > C_2$	$C_1 - C_2$ ✓	X	C_2 ✓ → Basic buffer
$C_1 < C_2$	X	$C_2 - C_1$	C_1

$NH_4OH + H_2O \rightleftharpoons NH_4^+ + OH^-$

H^+

$[H^+]\uparrow \therefore pH \downarrow$

$[OH^-]\uparrow \therefore pH \uparrow$

$NH_4^+Cl^- + H_2O \longrightarrow NH_4^+ + Cl^-$

QUESTION – (NEET 2015 Re)

Which one of the following pairs of solution is not an acidic buffer?

w.A

(A) H_3PO_4 and Na_3PO_4

(B) $HClO_4$ and $NaClO_4$

(C) CH_3COOH and CH_3COONa

(D) H_2CO_3 and Na_2CO_3

QUESTION – (NEET 2019)

Which will make basic buffer?

(A) 50 mL of 0.1 M $NaOH$ + 25 mL of 0.1 M CH_3COOH ✗

(B) 100 mL of 0.1 M CH_3COOH + 100 mL of 0.1 M $NaOH$ ✗

(C) 100 mL of 0.1 M HCl + 200 mL of 0.1 M NH_4OH ✓

(D) 100 mL of 0.1 M HCl + 100 mL of 0.1 M $NaOH$

QUESTION – (AIIMS 2003)

Which one of the following is NOT a buffer solution?

(A) $0.8\ M\ H_2S + 0.8\ M\ KHS$

(B) $2\ M\ C_6H_5NH_2 + 2\ M\ C_6H_5\overset{+}{N}H_3Br^-$

(C) $3\ M\ H_2CO_3 + 3\ M\ KHCO_3$

(D) $0.05\ M\ KClO_4 + 0.05\ M\ HClO_4$

QUESTION

Which of the following is a buffer solution?

A) 500 mL of 0.1 N CH_3COOH + 500 mL of 0.1 N NaOH

B) 500 mL of 0.1 N CH_3COOH + 500 mL of 0.1 N HCl ✗

C) 500 mL of 0.1 N CH_3COOH + 500 mL of 0.2 N NaOH

D) 5000 mL of 0.2 N CH_3COOH + 500 mL of 0.1 N NaOH ✓

$\frac{500\cancel{0} \times 0.2}{1000}$ 50

QUESTION – (AIIMS 2002)

$1 - 0.48$
$= 0.52$

$CH_3COO^- Na^+$ CH_3COOH

The pH of a solution containing 0.10 M sodium acetate and 0.03 M acetic acid is (pK_a for $CH_3COOH = 4.57$)

(A) 4.09

(B) 6.09

(C) 5.09

(D) 7.09

$pK_a (CH_3COOH) = 4.57)$

$[CH_3COOH] = 0.03$

$[CH_3COO^-] = 0.1$

$$pH = pK_a + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$= 4.57 + \log \frac{0.10}{0.03}$$

$= 4.57 + \log 10 - \log 3$

$= 4.57 + 1 - 0.48$

$= 4.57 + 0.52 = 5.09$

QUESTION – (AIIMS 2009)

A weak acid, HA is found to be 10% ionized in 0.01 M aqueous solution. Calculate the pH of a solution which is 0.1 M in HA and 0.05 M in NaA.

(A) 5.365

(B) 6.355

(C) 3.653

(D) 6.593

$HA \rightarrow C = 0.1\,M$

$Na^{+}A^{-} \rightarrow C = 0.05\,M$

HA, % age $\alpha = 10\%$

$\alpha = \frac{10}{100} = 0.1$

$C = 0.01\,M$

$K_a = \frac{C\alpha^2}{1-\alpha}$

$= \frac{10^{-2}(10^{-1})^2}{0.9}$

$= \frac{10^{-4}}{0.9} = \frac{10^{-3}}{9} \times 10 = 1.1 \times 10^{-4} = 11 \times 10^{-5}$

$pK_a = 5 - 1.04 = 3.96$

$pH = pK_a + \log\frac{[A^-]}{[HA]}$

$= 3.96 + \log\frac{5 \times 10^{-2}}{10^{-1}}$

$= 3.96 + 0 - 0.3$

$= 3.66$

QUESTION

$\log 9\times 2 = \log 3^2 + \log 2.$
$= 2\times 0.48 + 0.3 = 1.26$

A buffer solution is prepared in which the concentration of NH_3 is 0.30 M and the concentration of NH_4^+ is 0.20 M. If the equilibrium constant (K_b) for NH_3 equals 1.8 x 10^{-5}, what is the pH of this solution? (log 2.7 = 0.43)

(A) 9.08

(B) 9.43

(C) 11.72

(D) 8.73

$[NH_3] = 0.3\ M$

$[NH_4^+] = 0.2\ M$

$pK_b = -\log 18\times 10^{-6}$
$= 6 - \log 18$
$= 6 - 1.26$
$= 4.74$

$pOH = pK_b + \log \frac{[NH_4^+]}{[NH_3]}$

$= 4.74 + \log \frac{0.2}{0.3}$

$= 4.74 + 0.3 - 0.48$

$pOH = 4.56$

$pH = 14 - 4.56 = 9.44$

QUESTION – (NEET Kar. 2013)

$pKa = 4$

The dissociation constant of a weak acid is 1×10^{-4}. In order to prepare a buffer solution with a pH = 5 the [Salt]/[Acid] ratio should be

(A) 1 : 10

(B) 4 : 5

(C) 10 : 1

(D) 5 : 4

$$5 = 4 + \log \frac{[A^-]}{[HA]}$$

$$1 = \log \frac{[A^-]}{[HA]}$$

$$\frac{[A^-]}{[HA]} = \text{antilog } 1 = 10^1 = \frac{10}{1}$$

QUESTION

Calculate pH after mixing 60g CH_3COOH and 82g CH_3COONa. If pK_a of CH_3COOH is 4.75.

$M = 82$

Ans $pH = pK_a + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$

$= pK_a + \log \frac{1}{1}$

$= 4.75 + 0$

$= 4.75$

$[CH_3COO^-] = \frac{n}{V} = \frac{82}{82 \times 1} = 1$

$[CH_3COOH] = \frac{n}{V} = \frac{60}{60 \times 1} = 1$

QUESTION

(a) Find pH of buffer 0.1 M CH_3COOH, 0.15 M Sodium acetate (CH_3COONa). If pK_a of $CH_3COOH = 4.76$.

(b) Find pH when 1 ml of 1 M NaOH is added to it.

(c) Find pH when 1 ml of 1 M HCl is added to it.

(a) $pH = 4.94$

$$pH = pK_a + \log \frac{[CH_3COO^-]}{[CH_3COOH]}$$

$$= 4.76 + \log \frac{0.\cancel{15}\,3}{0.\cancel{10}\,2}$$

$$= 4.76 + 0.48 - 0.3$$

$$= 4.94$$

(b)

Buffer Capacity

$$\phi = \frac{\text{no. of moles of acid or base added to 1 L of Buffer}}{\text{Change in pH}}$$

QUESTION

If 4 moles of acid are added to 2L of buffer solution to change it's by pH by unity. Find buffer capacity?

Range of a Buffer

pH range where it can act as buffer.

QUESTION

At what pH action of Buffer is maximum.

Home work from modules

Prarambh → Q 95 to Q 103

Prabal → Q 27, 28

PYQ → Q 5, 7

THANK
YOU