YAKEEN NEET 2.0

2026

Ionic Equilibrium

Physical Chemistry | Lecture -10

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Topics to be covered

1. Medics Test, Revision of Last Class
2. Buffer solution numericals
3. Indicators and its use
4. ★★★★★ trick
   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.

pH of an aqueous NaCl solution at 50°C should be :

(a) 7 (b) > 7 (c) < 7 (d) 0

NaCl(aq.) → salt of S.A. & S.B. → neutral

T↑ pH↓

Upon hydrolysis of sodium carbonate, the reaction takes place between:

(a) Na^+ and water (b) Na^+ and OH^- (c) CO_3^{2-} and water (d) CO_3^{2-} and H^+

$Na_2^+CO_3^{2-}$ $\quad CO_3^{2-} + 2H_2O \rightarrow H_2CO_3 + 2OH^-$

NaOH S.B. $\quad H_2CO_3$ W.A.

Carbonic acid (H_2CO_3), a diprotic acid has $K_{a_1} = 4.0 \times 10^{-7}$ and $K_{a_2} = 7.0 \times 10^{-11}$. What is the $[CO_3^{2-}]$ of a 0.025 M solution of carbonic acid?

(a) 5.5×10^{-9} (b) 5.5×10^{-8} (c) 7.0×10^{-9} (d) 7.0×10^{-11}

$[CO_3^{2-}] = K_{a_2} = 7 \times 10^{-11}$

Selenious acid (H_2SeO_3), a diprotic acid has $K_{a_1} = 3.0 \times 10^{-3}$ and $K_{a_2} = 5.0 \times 10^{-8}$. What is the $[OH^-]$ of a 0.30 M solution of a selenious acid?

(a) 2.85×10^{-3} (b) 5.0×10^{-6} (c) 3.5×10^{-12} (d) 3.5×10^{-13}

$[OH^-] = \frac{K_w}{[H^+]}$

$= \frac{10^{-14}}{3 \times 10^{-2}}$

$= $

$K_{a_1} = \frac{[H^+]^2}{[H_2SeO_3]}$

$\sqrt{3 \times 10^{-3} \times 3 \times 10^{-1}} = [H^+] = 3 \times 10^{-2}$

$$\frac{1}{3} \times 10^{-12}$$

$$= 0.33 \times 10^{-12}$$

$$= 3.3 \times 10^{-13}$$

$A^- + H_2O \rightarrow HA + OH^-$

Consider the following salts. Which one(s) when dissolved in water will produce a basic solution?

1. $RbClO_4^-$ 2. $NaNO_2^-$ 3. NH_4Cl^- 4. NaCl

(a) 1 and 3 (b) only 2 (c) 1 and 2 (d) 3 and 4

Tomorrow → lec-7 & lec-8 → Ionic eq. → Revise

Revision of Last Class

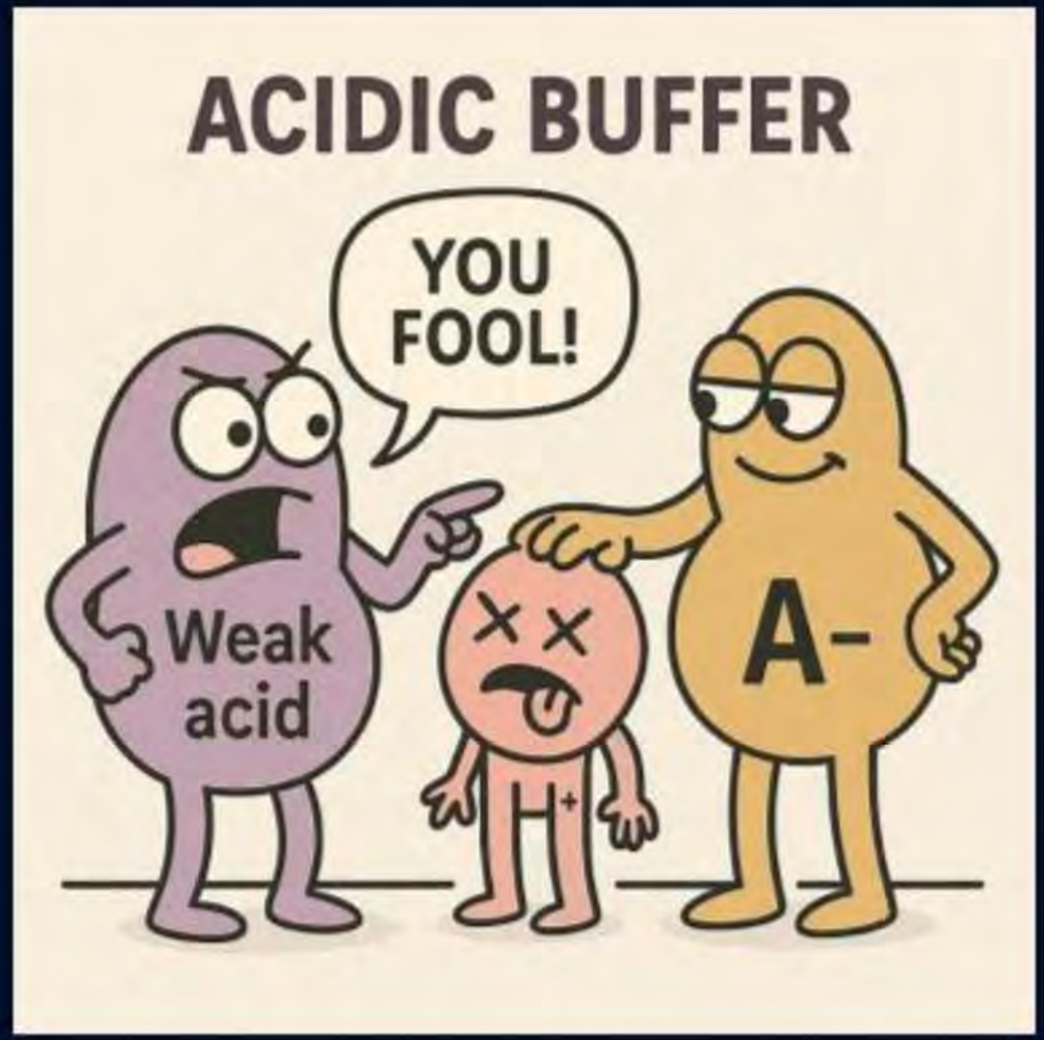
$$K_a = \frac{[H^+][CH_3COO^-]'}{[CH_3COOH]}$$

Acidic Buffer

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

$$\underset{0.2M}{1(CH_3COO)_2Ca} + H_2O \rightarrow \underset{0.4M}{2CH_3COO^-} + 1Ca^{2+}$$

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



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.

(b)

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

millimoles: $0.1 \times 1000 = 100$

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

millimoles: $0.15 \times 1000 = 150$ → 150 → 150

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

$1 \times 1 = 1$ millimoles

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

1 millimoles H^+ ↓

$[CH_3COOH] = 100 - 1 = 99$

$[CH_3COO^-] = 150 + 1 = 151$

$pH = 4.76 + \log \frac{151}{99}$

$= 4.76 + 2.18 - 1.99$

$= 4.95$

© $[H^+]$ 1 millimole ↑

$\therefore [CH_3COOH] = 100 + 1 = 101$

$[CH_3COO^-] = 150 - 1 = 149.$

$$pH = 4.76 + \log \frac{149.}{101}$$

$$= 4.76 + 2.17 - 2.$$

$$= 4.76 + .17 \approx 4.93$$

Buffer Capacity (ϕ)

no of moles of acid or base added to 1 L of buffer so that pH changes by 1

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

moles acid or base	V of buffer	Change in pH	ϕ
6	1 L	1	$\frac{6}{1} = 6$
6	2 L	1	$\frac{3}{1} = 3$
6	1 L	2	$\frac{6}{2} = 3$

Rushda → Pitashree

10 hrs → self study.

↓ selection

2 hrs

dosent: 1 hrs → 5 → 10; 2 → 3 → 15

S.C = $\frac{10}{2} = 5$

QUESTION

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

2 L → 4 moles

1 L → $\frac{4}{2}$ = 2 moles

$$\phi = \frac{2}{1} = 2$$

Range of a Buffer

pH range where it can act as buffer.

Range

Acidic Buffer :- act as buffer $\frac{[A^-]}{[HA]} = \frac{10}{1}$ or $\frac{1}{10}$ $\quad pK_a \pm 1$

Basic Buffer → ~~~~~~~~ $\frac{[B^+]}{[BOH]} = \frac{10}{1}$ or $\frac{1}{10}$ $\quad pK_b \pm 1$

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

$$= pK_a + \log \frac{10}{1}$$

$$= pK_a + 1$$

$$= pK_a + \log \frac{1}{10}$$

$$= pK_a - 1$$

$$\log \frac{1}{10} = \log 1 - \log 10$$

$$= 0 - 1 = -1$$

QUESTION

At what pH action of Buffer is maximum.

Acidic buffer $[A^-] = [HA] \Rightarrow pH = pK_a$

Basic buffer $[B^+] = [BOH] \Rightarrow pOH = pK_b$

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

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

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

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

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

$$= pK_a$$

Indicators

① extremely W.A. or W.B. they have different Colour in dissociated & undissociated form.

$$HA + H_2O \rightleftharpoons H^+ + A^-$$

undissociated form → Colour A

dissociated form → Colour B

② at eq. pt dey show Color Change

$HA = HIn$

$K_a = K_{In}$

$$HIn + H_2O \rightleftharpoons H^+ + In^-$$

Red — Yellow

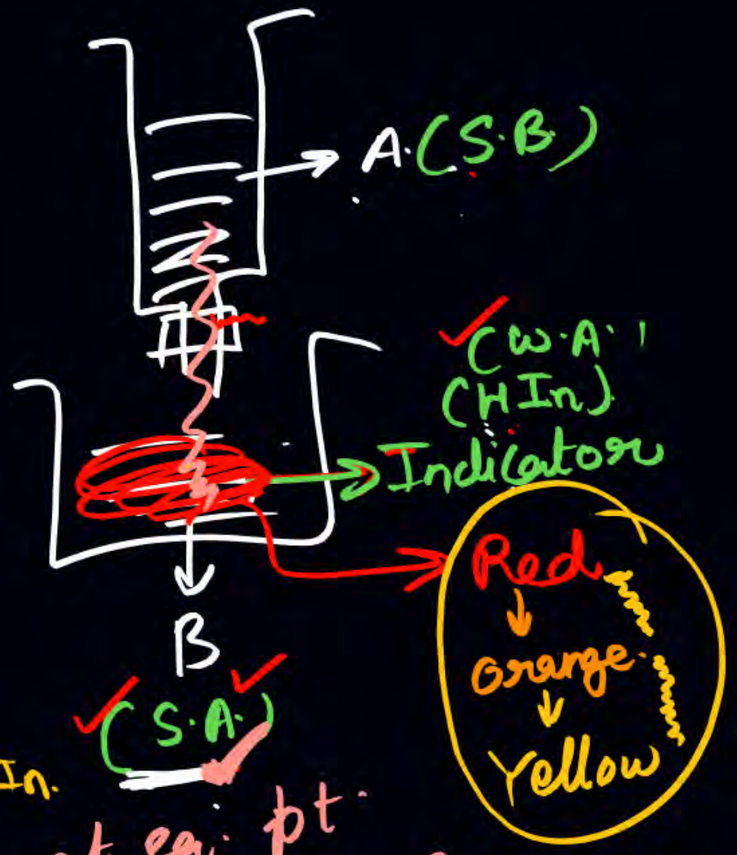
$$K_{In} = \frac{[H^+][In^-]}{[HIn]}$$

If $[In^-] = [HIn]$ = 50% dissociation.

$$K_{In} = [H^+] \Rightarrow pH = -\log[H^+] = -\log K_{In} = pK_{In}$$

$$\frac{[In^-]}{[HIn]} = \frac{10}{1} \text{ or } \frac{1}{10}$$

$$K_{In} = \frac{[H^+] \times 10}{1} \Rightarrow -\log K_{In} = -\log[H^+] - \log 10$$



at eq. pt.

eq. A = eq. B

$pK_{In} = pH - 1$

$pH = pK_{In} + 1$

if $\frac{[In^-]}{[HIn]} = \frac{1}{10}$

$pH = pK_{In} - 1$

Range of Indicator $= pK_{In} \pm 1$

Litmus $\rightarrow pK_{In} \approx 7$

Indicator ↓ $pK_{In} = 7$

Range indicator 6 - 8

QUESTION

For an acid indicator $K_a = 1 \times 10^{-5}$. The range of the pH for change of colour is:

$pK_a = pK_{In.} = -\log 10^{-5} = 5$

$pH\ range = pK_a \pm 1$

$= 4-6$

A 3-5

B 4-6

C 5-7

D 6-8

QUESTION

$\log 4 = 0.6$

$\log 5 = 0.7$

0.63

A given indicator when placed in a buffer solution of pH 4.63 was found to exhibit a colour which corresponds to 25% acid and 75% basic form. Find pK_a of the indicator.

$pH = 4.63$

$pK_{In} = ?$

$HA + H_2O \rightleftharpoons H^+ + A^-$

C.A. C.B.

25 75

$[H^+] = 10^{-4.63} = 10^{-4} \times 10^{-0.63}$

$= \frac{10^{-4}}{10^{0.63}} \approx \frac{1 \times 10^{-4}}{4.2}$

$K_{In} = \frac{[H^+][In^-]}{[HIn]}$

$= \frac{10^{-5} \times 75}{4.2 \times 25} = \frac{100 \times 10^{-5}}{14 \times 100} \approx 7 \times 10^{-5}$

$\Rightarrow pK_{In} = 5 - \log 7$

$= 5 - 0.85$

$= 4.15$

QUESTION

$HIn \rightarrow$ $In^- \equiv A^-$

Phenolphthalein is colourless in acidic solution and pink in basic solution. At what pH, indicator is 10% in colourless form? $p_{k_{In}} = 9.4$

Ans

$$HIn + H_2O \rightleftharpoons H^+ + In^-$$

10 90

$$K_{In} = \frac{[H^+][In^-]}{[HIn]}$$

$$pH = pK_{In} + \log \frac{[In^-]}{[HIn]}$$

$$= 9.4 + \log \frac{90}{10}$$

$$= 9.4 + 2\log 3$$

$$= 9.4 \times 2 \times 0.48$$

$$= 10.36$$

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

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

Indicators in acid-base titrations

Acid-base titrations	Indicators
1. Strong acid vs strong base	Bromothymol blue, phenolphthalein methyl orange, [redacted]
2. Strong acid vs weak base	Methyl orange, methyl red, [redacted]
3. Weak acid vs strong base	Phenolphthalein, [redacted]
4. Weak acid vs weak base	Phenol red

Colour

Indicator	Range	Acidic form	Basic form
Phenopthalin	8·3 – 10	Colourless	Pink
Methyl orange	3·1 – 4·4	Red	Orange
Methyl Red	4·1 – 6·3	Red	Yellow
Litmus	6 – 8	Red	Blue

Ph of amphiprotic anion

H^+ gain & H^+ loose

$H_2PO_4^-$, HPO_4^{2-} $\Rightarrow$ $pH_{HPO_4^{2-}} = \frac{pKa_2 + pKa_3}{2}$

$pH_{H_2PO_4^-} = \frac{pKa_1 + pKa_2}{2}$

$H_3PO_4 + NaOH \rightarrow NaH_2PO_4 + H_2O$ $\quad Ka_1$, pKa_1

$NaH_2PO_4 + NaOH \rightarrow Na_2HPO_4 + H_2O$ $\quad Ka_2$, pKa_2

$Na_2HPO_4 + NaOH \rightarrow Na_3PO_4 + H_2O$ $\quad Ka_3$, pKa_3


trick

Home work from modules

all questions of Buffer solution

THANK YOU