YAKEEN NEET 2.0

2026

Ionic Equilibrium

Physical Chemistry | Lecture -06

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Topics to be covered

1. Medics Test, Revision of Last Class
2. Ph of mixtures
3. Salt Hydrolysis
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

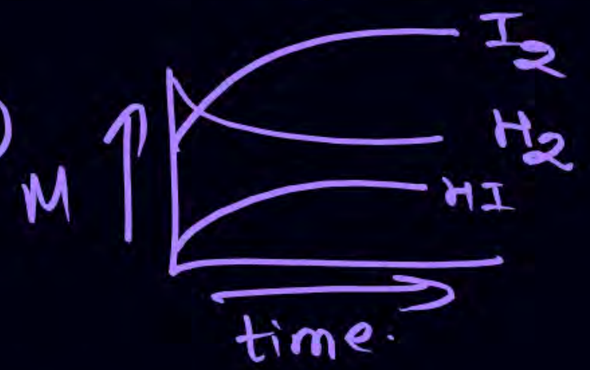
5. Try to make maximum notes during the class if something is left then u can use the notes pdf after the class to complete the remaining class.
6. Always ask your doubts in doubt section to get answer from faculty. Before asking any doubt please check whether same doubt has been asked by someone or 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 !!!

Q) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

attainment of eq. is predicted correctly by :-

(a)



(b)

(c)

(d) None of these

Q2 $x \gtrsim y$ $k_1 = 1$ ①

$y \gtrsim z$ $k_2 = 3$ ②

$z \gtrsim w$ $k_3 = 4$ ③

find k for $x \gtrsim w$

add eq ①, ②, ③

$x + y + z \gtrsim x + z + w$

$K = k_1 \times k_2 \times k_3 = 1 \times 3 \times 4 = 12$

(a) 6

(b) 12 ✓

(c) 8

(d) 7

Q 3

$3 \times 2A \rightleftharpoons 2B + C \quad K_1$

$\frac{3}{2}A \rightleftharpoons \frac{3}{2}B + \frac{3}{4}C \quad K_2$

$K_2 = (K_1)^{3/4}$

(A) $K_1 = \sqrt{K_2}$

(B) $K_2 = \sqrt{K_1}$

(C) $K_2 = (K_1)^{3/4}$

(D) $K_1 = (K_2)^{3/4}$

Q.4 $PCl_3 + Cl_2 \rightleftharpoons PCl_5$ $\quad K_C = 20$

0.2 M	0.1 M	0.4 M
$0.2 - x$	$0.3 - x$	$0.4 + x$

If 0.2 mol of Cl_2 added at same T, find new eqv. Conc. of PCl_5

$$K_C = 20 = \frac{0.4 + x}{(0.2 - x)(0.3 - x)}$$

Q5 at -20°C & 1 atm P, a Cylinder has equal moles of H_2, I_2 & HI

$$H_2(g) + I_2 \rightleftharpoons 2HI(g)$$

$$\frac{x}{V} \quad \frac{x}{V} \quad \frac{x}{V}$$

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

$$K_c = \frac{\left(\frac{x}{V}\right)^2}{\left(\frac{x}{V}\right) \times \left(\frac{x}{V}\right)} = 1 = K_p$$

$$K_p = x \times 10^{-1}$$

Revision of Last Class

S.A. mix. $\rightarrow [H^+] = \frac{\sum \text{g-eq acid}}{V(L)}$

S.B. mix. $\rightarrow [OH^-] = \frac{\sum \text{g eq base}}{V(L)}$

S.A + S.B. $\rightarrow$ mix $\Rightarrow [H^+]_{left} = \frac{|\text{g-eq acids} - \text{g-eq base}|}{V(L)}$

or

$[OH^-]_{left}$

Polyprotic w.A.

H_2S, H_2CO_3.

$Ka_1 >> Ka_2$

$[H^+]_{Total} = [H^+]_{1st\ step}$

$pH = -\log [H^+]_{1st\ step}$.

pH of Mixture of Weak Acids

MIT

$[H^+]_{Total} = \sqrt{K_{a_1} C_1 + K_{a_2} C_2}$

C_1 = Conc. of Ist w.A.

C_2 = ~~~~ IInd))

K_{a_1} = dsctn Constt of Ist w.A.

K_{a_2} = ~~~~~~~~ IInd))

if $[H^+]_{Total} < 10^{-6}$ M.

then $[H^+]_{H_2O}$ also added

$\downarrow$

10^{-7} M

$[H^+]_{Total} = 10^{-8}$ M

pH = ~~8~~

QUESTION

0.1 M HA ($K_{a_1} = 10^{-5}$) and 0.2 M HB ($K_{a_2} = 4 \times 10^{-5}$). Calculate $[H^+]$, $[A^-]$, $[B^-]$ and pH in solution.

$$[H^+]_{Total} = \sqrt{K_{a_1}C_1 + K_{a_2}C_2}$$

$$= \sqrt{10^{-5} \times 10^{-1} + 4 \times 10^{-5} \times 2 \times 10^{-1}}$$

$$= \sqrt{10^{-6} + 8 \times 10^{-6}}$$

$$= \sqrt{10^{-6}(1+8)}$$

$$= \sqrt{9 \times 10^{-6}}$$

$$= 3 \times 10^{-3} \text{ M}.$$

$$pH = 3 - \log 3 = 3 - 0.48 = 2.52$$

$$K_{a_1} = \frac{[H^+][A^-]}{[HA]}, \quad [H^+] = 3 \times 10^{-3}, \quad [HA] \approx 0.1$$

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

$$HB + H_2O \rightleftharpoons H^+ + B^-$$

$$K_{a_2} = \frac{[H^+][B^-]}{[HB]}$$

$$4 \times 10^{-2} = \frac{3 \times 10^{-3}\,[B^-]}{2 \times 10^{-1}}$$

$$\frac{8}{3} \times 10^{-3} = [B^-]$$

$$[B^-] = 2.66 \times 10^{-3}\ M$$

Compare Acidic strength of different Weak Acids

#MIT

$K_a \uparrow$ $pK_a \downarrow$ $[H^+] \uparrow$ $pH \downarrow$ $[OH^-] \downarrow$ $pOH \uparrow$ $\therefore$ acid strong.

$$\frac{[H^+]_{\text{Ist acid}}}{[H^+]_{\text{IInd acid}}} = \frac{C_1\alpha_1}{C_2\alpha_2} = \frac{C_1\sqrt{\frac{K_{a_1}}{C_1}}}{C_2\sqrt{\frac{K_{a_2}}{C_2}}} = \sqrt{\frac{K_{a_1}C_1}{K_{a_2}C_2}} = \sqrt{\frac{K_{a_1}}{K_{a_2}}}$$

if $C_1 = C_2$

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

QUESTION

HCOOH CH_3COOH

The dissociation constants of formic and acetic acids are 1.77×10^{-4} and 1.75×10^{-5}, respectively. Which of the following statement is correct?

$\sqrt{\frac{K_{a\,HCOOH}}{K_{a\,CH_3COOH}}} = \frac{[H^+]_{HCOOH}}{[H^+]_{CH_3COOH}}$

(A) Formic acid is 3.18 times stronger than acetic acid at equal concentration.

(B) Acetic acid is 3.18 times stronger than formic acid at equal concentrations.

$\sqrt{\frac{1.77 \times 10^{-4}}{1.75 \times 10^{-5}}} = \sqrt{10} \approx 3.2$

(C) Formic acid is 10.11 times stronger than acetic acid at equal concentrations.

(D) Formic acid is 10.11 times stronger than acetic acid at different concentrations.

$\sqrt{9} = 3$

$\sqrt{16} = 4$

Relation Between K_a, K_b and K_w

#MIT

Conj. acid

$HA \rightarrow K_a$

Conj base

$A^- \rightarrow K_b$

$K_a \times K_b = K_w$

$pK_w = 14$ at $25^\circ C$

$-\log K_a - \log K_b = -\log K_w$

$pK_a + pK_b = pK_w$

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

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

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

$K_b = \frac{[HA][OH^-]}{[A^-]}$

$K_a \times K_b = [H^+][OH^-] = K_w$

$\frac{[H^+][A^-]}{[HA]} \times \frac{[HA][OH^-]}{[A^-]}$

Salt Hydrolysis

① Acid + base → salt + H_2O

$HCl_{(aq.)} + NaOH_{(aq)} \longrightarrow \underset{\text{from base}}{Na^+}\underset{\text{from acid}}{Cl^-} + H_2O$

② Hydrolysis → Cation or Anion react with water
(C^+) (A^-)

(i) Cation hydrolysis → soln acidic in nature

$C^+ + H_2O \longrightarrow COH^+ + H^+$

(H^+ ← H_2O → OH^-)

(ii) Anion hydrolysis → soln basic nature

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

(A^- ← H_2O → H^+ + OH^- ✓)

MIT

① Cation hydrolyse → soln acidic, Anion hydrolyse → soln basic

② Anion → Don't hydrolyse

S C Ne C B I Ko bola

SO_4^{2-}, ClO_4^-, NO_3^-, Cl^-, Br^-, I^-

Cation → don't hydrolyse

Ist grp Cation: Li^+, Na^+, K^+, Rb^+, Cs^+

BSC karunge: Ba^{2+}, Sr^{2+}, Ca^{2+}

③ ion hydrolyse → which comes from W.A or W.B

Q $Ba^{2+}F_2^-$

Anion hydrolysis → Basic nature → pH > 7

Q $Zn^{2+}Cl_2^-$

Cation hydrolysis → acidic nature → pH < 7

Q $NH_4^+Br^-$

↳ C. hyd. → acidic → pH < 7

Types of Salts

There are 4 Types of Salts

- Salt of S.A. & S.B.
- Salt of W.A. & S.B.
- Salt of S.A. & W.B.
- Salt of W.A. & W.B.

Salt of Strong Acid and Strong Base

HNO_3 — KOH

Salt → $K^+NO_3^-$ → neither cation nor anion will hydrolyses ∴ sol^n neutral

↳ at 25°C pH = 7

↓ dissociate in water

$$KNO_3 + H_2O \longrightarrow K^+(aq.) + NO_3^-(aq.)$$

#IIT

① Salt → which ion is hydrolysed & nature of soln.

② write → K_h & h relation

K_h ↓ hydrolysis Constt.

h ↓ degree of hydrolysis.

$\alpha = \frac{x}{c}$ | $h = \frac{x}{c}$ ✓

③ $\frac{K_h}{K_w} \times K_a$ or K_b or $K_a \cdot K_b = 1$

K_a ↓ w.A

K_b ↓ w.B

$K_a \cdot K_b$ ↓ w.A & w.B

④ $[H^+] \Rightarrow pH = -\log[H^+]$

or

$[OH^-] \Rightarrow pOH = -\log[OH^-] \Rightarrow pH = 14 - pOH$

Salt of Strong Acid and Weak Base

HCl ↓ Strong Acid

$NH_4^+OH^-$ ↓ Weak Base

Salt → $NH_4^+Cl^-$ ⇒ soln is acidic nature.

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

C	0	0
C − x	x	x
C − Ch	Ch	Ch
C(1 − h)		

$\alpha \neq \frac{x}{C}$ $\quad h = \frac{x}{C}$ $\quad x = Ch$

$$K_h = \frac{[NH_4OH][H^+]}{[NH_4^+]} = \frac{Ch \times Ch}{C(1-h)} = \frac{Ch^2}{1-h}$$

$h << 1$

$1 - h \approx 1$

$K_h = Ch^2 \Rightarrow h = \sqrt{\frac{K_h}{C}}$

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

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_4OH]}$$

$$\frac{K_h}{K_w} \times K_b = 1$$

$$\frac{[NH_4OH][H^+]}{[NH_4^+][OH^-]} \cdot \frac{[NH_4^+][OH^-]}{[H^+][OH^-][NH_4OH]} = 1$$

$$K_h = \frac{K_w}{K_b} \qquad pK_w = -\log K_w$$

$$h = \sqrt{\frac{K_w}{K_b \times c}}$$

$$[H^+] = c\,h$$

$$= \sqrt{\frac{K_w \times c^2}{K_b \times c}}$$

$$[H^+] = \left(\frac{K_w \times c}{K_b}\right)^{1/2}$$

$$pH = -\log[H^+] = -\frac{1}{2}\log\frac{K_w \times c}{K_b}$$

$$= +\frac{1}{2}\left[-\log K_w + \log c + \log K_b\right]$$

$$= \frac{1}{2}\left[pK_w - pK_b - \log c\right)$$

$$= \frac{1}{2}\left[14 - pK_b - \log c\right]$$

$$= 7 - \frac{1}{2}\left(pK_b + \log c\right)$$

Salt of Weak Acid and Strong Base

HCOOH KOH

Salt $HCOO^-K^+$

$HCOO^- + H_2O \rightleftharpoons HCOOH + OH^-$

$C-Ch \qquad Ch \qquad Ch$

$$K_h = \frac{[HCOOH][OH^-]}{[HCOO^-]}$$

$$= \frac{\cancel{C}h \times Ch}{\cancel{C}(1-h)} = \frac{Ch^2}{1-h}$$

$h <<< 1 \Rightarrow 1-h \approx 1$

$K_h = Ch^2 \Rightarrow h = \sqrt{\frac{K_h}{C}}$

$HCOOH + H_2O \rightleftharpoons HCOO^- + H^+$

$$K_a = \frac{[HCOO^-][H^+]}{[HCOOH]}$$

$$\frac{K_h}{K_w} \times K_a = 1 = \frac{\cancel{[HCOOH]}[OH^-] \times \cancel{[HCOO^-]}[H^+]}{\cancel{[HCOO^-]}\cancel{[H^+]}[OH^-]\cancel{[HCOOH]}}$$

$$K_h = \frac{K_w}{K_a} \Rightarrow h = \sqrt{\frac{K_w}{K_a \times C}}$$

$$[OH^-] = \sqrt{\frac{K_w \cdot c}{K_a \times c}} = \sqrt{\frac{K_w \times c}{K_a}}$$

$$pOH = 7 - \frac{1}{2}(pK_a + \log c)$$

$$pH = 14 - pOH = 7 + \frac{1}{2}(pK_a + \log c)$$

#
MIT

Salt of S.A. & W.B.

① Cation hydrolysis ⇒ sol^{n} acidic

② $h = \sqrt{\frac{K_h}{C}}$

③ $K_h = \frac{K_w}{K_b}$

④ $[H^+] = Ch = \sqrt{\frac{K_w \times C}{K_b}}$

⑤ $pH = 7 - \frac{1}{2}(pK_b + \log C)$

$7 = \frac{pK_w}{2} = \frac{14}{2}$ (at 25°C)

C = Conc. salt Cation.

Salt of W.A. & S.B.

① Anion hydrolysis ⇒ sol^{n} basic

② $h = \sqrt{\frac{K_h}{C}}$ C = Conc. salt → anion.

③ $K_h = \frac{K_w}{K_a}$

④ $[OH^-] = Ch = \sqrt{\frac{K_w \times C}{K_a}}$

⑤ $pH = 7 + \frac{1}{2}(pK_a + \log C)$

$7 = \frac{pK_w}{2} = \frac{14}{2}$ (at 25°C)

Salt of Weak Acid and Weak Base

$HCOOH$ NH_4OH

#MIT

Salt → $HCOO^-$ NH_4^+ → both Cation & anion hydrolysis.

$h = \sqrt{K_h}$

$\frac{K_h}{K_w} \times K_a \times K_b = 1$

$pH = 7 + \frac{1}{2}(pK_a - pK_b)$ ⇒ pH does not depend upon Conc.

if $K_a > K_b \Rightarrow pK_a < pK_b \Rightarrow pH < 7$ sol^n acidic.

$K_a < K_b \Rightarrow pK_a > pK_b \Rightarrow pH > 7$ sol^n basic.

$K_a = K_b \Rightarrow pK_a = pK_b \Rightarrow pH = 7$ sol^n neutral

QUESTION

Which of the following salts is the most basic in aqueous solution?

(A) $Al(CN)_3$

(B) CH_3COOK

(C) $FeCl_3$

(D) $Pb(CH_3COO)_2$

QUESTION – (NEET 2014)

Which of the following salts will give highest pH in water?

(A) $NaCl$

(B) Na_2CO_3

(C) $CuSO_4$

(D) KCl

QUESTION

The pH of a 0.02 M NH_4Cl solution will be [Given $K_b(NH_4OH) = 10^{-5}$ and log2 = 0.301]

A 4.65

B 2.65

C 5.35

D 4.35

QUESTION – (NEET 2021)

The pK_b of dimethylamine and pK_a of acetic acid are 3.27 and 4.77 respectively at T(K). The correct option for the pH of dimethylammonium acetate solution is:

A 5.50

B 7.75

C 6.25

D 8.50

QUESTION

pH of 0.005 M calcium acetate (pK_a of CH_3COOH = 4.74) is

A 7.04

B 9.37

C 9.26

D 8.37

QUESTION – (AIIMS 2007)

The pH of the solution obtained on neutralization of 40 mL 0.1 M NaOH with 40 mL 0.1 M CH_3COOH is:

A 7

B 8

C 6

D 3

QUESTION – (NCERT Exemplar)

K_a for CH_3COOH is 1.8×10^{-5} and K_b for NH_4OH is 1.8×10^{-5}. The pH of ammonium acetate will be

A 7.005

B 4.75

C 7.0

D Between 6 and 7

QUESTION

HX is a weak acid ($K_a = 10^{-5}$). If forms a salt NaX (0.1 M) on reacting with caustic soda. The degree of hydrolysis of NaX is:

A 0.01%

B 0.0001%

C 0.1%

D 0.5%

QUESTION – (AIPMT 2009)

The ionization constant of ammonium hydroxide is 1.77×10^{-5} at 298 K. Hydrolysis constant of ammonium chloride is:

A 6.50×10^{-12}

B 5.65×10^{-13}

C 5.65×10^{-12}

D 5.65×10^{-10}

QUESTION

From separate solutions of four sodium salts NaW, NaX, NaY and NaZ had pH 7.0, 9.0, 10.0 and 11.0 respectively, when each solution was 0.1 M, the weakest acid is:

A HW

B HX

C HY

D HZ

QUESTION

What will be the pH and % α (degree of hydrolysis) respectively for the salt BA of 0.1 M concentration? Given K_a for HA 10^{-6} and K_b for BOH = 10^{-6}.

A 5, 19%

B 7, 10%

C 9, 0.01%

D 7, 0.01%

QUESTION – (AIIMS 2006)

40 mL of 0.1 M ammonia solution is mixed with 40 mL of 0.1 M HCl. What is the pH of the mixture? (pK_b of ammonia solution is 4.74).

A 4.74

B 2.26

C 9.26

D 5.00

QUESTION

A 100 mL 0.1 M solution of ammonium acetate is diluted by adding 100 mL of water. The pH of he resulting solution will be (pK_a of acetic acid is nearly equal to pK_a of NH_4OH):

A 4.9

B 5.0

C 7.0

D 10.0

Home work from modules

attempt all questions of Salt hydrolysis.

Magarmach Practice Questions (MPQ)

QUESTION

Number of equivalents of H_2SO_4 present in 500 mL solution of pH = 2 is

A 5×10^{-3}

B 1×10^{-3}

C 1×10^{-2}

D 5×10^{-2}

QUESTION

A solution has a pH = 9, it is 1000 times more basic than the original solution. What was the of the original solution?

A 12

B 6

C 9

D 10

QUESTION – (NEET Kar. 2013)

Accumulation of lactic acid ($HC_3H_5O_3$), a monobasic acid in tissues leads to pain and a feeling of fatigue. In a 0.10 M aqueous solution lactic acid is 3.7% dissociated. The value of dissociation constant K_a, for this acid will be:

A 2.8×10^{-4}

B 1.4×10^{-5}

C 1.4×10^{-4}

D 3.7×10^{-4}

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

QUESTION

10^{-5} M NaOH solution at 25°C is diluted 1000 times. The pH of the resultant solution will.

A. Be equal to 8

B. Lie between 7 and 8

C. Lie between 6 and 7

D. Remain unchanged

QUESTION – (AIIMS 2018, 26 May)

Which of the following have maximum pH?

A. Black coffee

B. Blood

C. Gastric juice

D. Saliva

QUESTION

Calcium hydroxide is a strong base. Compute $[Ca^{2+}]$ and $[OH^-]$ for a solution that is prepared by dissolving 0.60 g of $Ca(OH)_2$ in enough water to make a 1500 mL of solution. Atomic weights: Ca = 40, O = 16, H = 1]

A $5.4 \times 10^{-3}, 9.1 \times 10^{-13}$

B $5.4 \times 10^{-3}, 1.08 \times 10^{-2}$

C $5.4 \times 10^{-3}, 5.4 \times 10^{-3}$

D $8.1 \times 10^{-3}, 8.1 \times 10^{-3}$

QUESTION

How much water must be added to 300 mL of 0.2 M solution of CH_3COOH ($K_a = 1.8 \times 10^{-5}$) for the D.O.I. (α) of the to double?

A 600 mL.

B 900 mL.

C 1200 mL.

D 1500 mL.

QUESTION

1 mL of HCl of pH 5 is dilute to 1000 mL. Thus, pH of the final solution is

A 8.0

B 5.0

C 6.96

D 7.0

QUESTION – (NCERT Exemplar)

K_{a_1}, K_{a_2}, and K_{a_3} are the respective ionisation constants for the following reactions.

$H_2S \quad H^+ + HS^-$

$HS^- \quad H^+ + S^{2-}$

$H_2S \quad 2H^+ + S^{2-}$

The correct relationship between K_{a_1}, K_{a_2} and K_{a_3} is

A $K_{a_3} = K_{a_1} \times K_{a_2}$

B $K_{a_3} = K_{a_1} + K_{a_2}$

C $K_{a_3} = K_{a_1} - K_{a_2}$

D $K_{a_3} = K_{a_1} / K_{a_2}$

QUESTION – (NCERT Exemplar)

What will be the value of pH of 0.01 mol dm^{-3} CH_3COOH ($K_a = 1.74 \times 10^{-5}$)?

A 3.4

B 3.6

C 3.9

D 3.0

QUESTION – (AIPMT 2007)

Calculate the pOH of a solution at 25°C that contains 1×10^{-10} M of hydronium ions, i.e. H_3O^+.

A 4.0

B 9.0

C 1.0

D 7.0

QUESTION – (AIPMT 2007)

A weak acid, HA, has a K_a of 1.00×10^{-5}. If 0.100 mol of this acid is dissolved in one litre of water, the percentage of acid dissociated at equilibrium closest to

(A) 1.00%

(B) 99.9%

(C) 0.100%

(D) 99.0%

QUESTION – (AIPMT 2005)

At 25°C, the dissociation constant of a base BOH is 1.0×10^{-12}. The concentration of hydroxyl ions in 0.01 M aqueous solution of the base would be

A 1.0×10^{-5} mol L^{-1}

B 1.0×10^{-6} mol L^{-1}

C 2.0×10^{-6} mol L^{-1}

D 1.0×10^{-7} mol L^{-1}

QUESTION – (AIPMT 2000)

A base when dissolved in water yields a solution with a hydroxyl ion concentration of 0.05 mol litre^{-1}. The solution is:

A. Basic

B. Acidic

C. Neutral

D. Either 'B' or 'C'

THANK YOU