YAKEEN NEET 2.0

2026

Ionic Equilibrium

Physical Chemistry | Lecture -05

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Topics to be covered

1. Revision of Last Class
2. Ph of mixtures
3. Ph of polyprotic weak acid or base
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 !!!

JEE M April 7 2025 (I)

Q1 aq. soln of HCl with pH 1 is diluted by adding equal Vol. of H_2O. pH of solution would be.

(a) reduce to 0.5

(b) inc. to 1.3

(c) remain same.

(d) inc. to 2.

10^{-1}

$\frac{10^{-1}}{2} = 0.5 \times 10^{-1}$

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

$2 - \log 5$

$2 - .7 = 1.3$

JEE M April M 2025 (II)

Q. x mg of $Mg(OH)_2$ (Molar mass = 58) is req. to be dissolved in 1 L of H_2O to produce pH 10 at 298 K.

$$Mg(OH)_2 \rightarrow 2OH^-$$

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

$pOH = 4$

$[OH^-] = 10^{-4}$

$$[Mg(OH)_2] = \frac{10^{-4}}{2} = 0.5\times 10^{-4} = 5\times 10^{-5}\ 10^{-2}$$

$$\frac{x}{1000\times 58\times 1}$$

$$x = 290\times 10^{-2}$$

$$= 2.9\ mg$$

$$\simeq 3$$

Q 3 w.A. H.A has d.o.d α which option correct

for pH − pKa.

(a) $\log(1+2\alpha)$

(b) $\log\frac{1-\alpha}{\alpha}$

(c) 0

(d) $\log\frac{\alpha}{1-\alpha}$

JEE(M) Jan 28 2023 (I)

$-pK_a = +\log K_a = +\log\frac{c\alpha^2}{1-\alpha}$

$pH = -\log[H^+] = -\log c\alpha$

$pH - pK_a = -\log c\alpha + \log\frac{c\alpha^2}{1-\alpha}$

$= \log\frac{c\alpha^2}{c\alpha(1-\alpha)}$

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

Q 4. pH water 7 at 25°C, water heated to 80°C

pH will

JEE M → Jan 23 2025 (I)

(a) ↓ ✓

(b) same

(c) ↑

(d) $[H^+]$ ↑ $[OH^-]$ ↓

Revision of Last Class

$M_1V_1 = M_2V_2$

pH of Weak Acid or Weak Base

- **Ostwald's Dilution Law:-**

$[H^+] = C\alpha = \sqrt{K_a C}$

$\alpha \leq 0.05$

$[H^+] = C\alpha$

$\alpha > 0.05$

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

pH of Mixture of Strong Acids or Strong Base

$$[H^+]_{Total} = \frac{\sum \text{g-eq. acids}}{V(L)}$$

$$pH = -\log [H^+]_{Total}$$

pH of Mixture of Strong Acids and Strong Base

① g·eq acid > g·eq base

acid left → $[H^+]_{left}$

② g eq of acid < g eq of base

base left → $[OH^-]_{left}$

② $[H^+]_{left}$ or $[OH^-]_{left}$ $= \dfrac{\left|\text{Total g·eq acid} - \text{Total g·eq base}\right|}{\text{Total Vol. (L)}}$

③ $pH = -\log[H^+]_{left}$

$pOH = -\log[OH^-]_{left}$

$pH = 14 - pOH$

QUESTION – (NEET 2015 Re)

What is the pH of the resulting solution when equal volumes of 0.1 M NaOH and 0.01 M HCl are mixed?

(A) 2.0

(B) 7.0

(C) 1.04

(D) 4

$$[OH^-]_{Total} = \frac{|V \times 0.01 \times 1 - V \times 0.1 \times 1|}{2V}$$

$$= \frac{0.09}{2} = 4.5 \times 10^{-2} = 45 \times 10^{-3}$$

$$pOH = 3 - \log 45$$

$$= 3 - 1.66 = 1.34$$

$$pOH = 14 - 1.34$$

$$= 12.66$$

$\log 5 + 2\log 3$

$0.7 + 2 \times 0.48$

$.96$

7

1.66

QUESTION (JEE(M) & NEET)

milli g-eq = V(ml) × M × n_f

Following solution were prepared by mixing different volumes of NaOH and HCl of different concentrations:

(1) 60 mL $\frac{M}{10}$ HCl + 40 mL $\frac{M}{10}$ NaOH

(2) 55 mL $\frac{M}{10}$ HCl + 45 mL $\frac{M}{10}$ NaOH

(3) 75 mL $\frac{M}{10}$ HCl + 25 mL $\frac{M}{10}$ NaOH

(4) 100 mL $\frac{M}{10}$ HCl + 100 mL $\frac{M}{10}$ NaOH

pH of which of solution is equal to

$[H^+]_{left} = \frac{|\text{milli eq. acid} - \text{milli eq base}|}{\text{Total Vol (ml)}}$

$= \frac{75 \times 0.1 \times 1 - 25 \times 0.1 \times 1}{100}$

$= \frac{5}{100} = 5 \times 10^{-2}$

$pH = 2 - \log 5$

$= 2 - 0.7$

$= 1.3$

A 2

B 1

C 4

D 3

QUESTION

Three solutions of strong electrolytes, 25 ml of 0.1 M HX, 25 ml of 0.1 M H_2Y and 50 ml of 0.1 N $Z(OH)_2$ are mixed, the pOH of the resulting solution is:

A. 1.6

B. 7.0

C. 12.4

D. 11.6

$$[H^+]_{left} = \frac{|7.5 - 5|}{100} = \frac{2.5}{100} = 25 \times 10^{-3}$$

$$pH = 3 - 2\log 5$$

$$= 3 - 2 \times 0.7$$

$$= 1.6$$

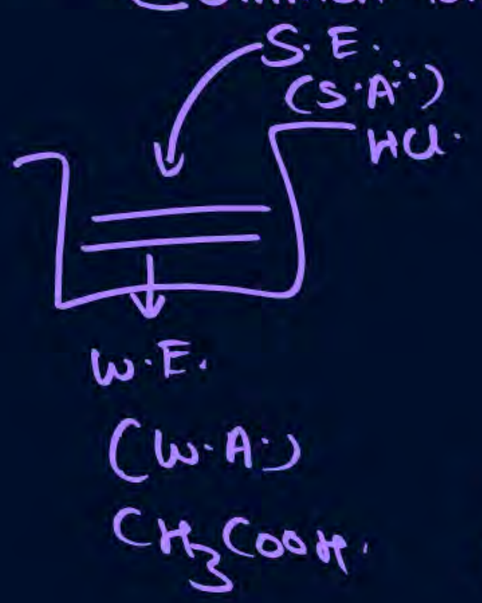
$$pOH = 14 - 1.6$$

$$= 12.4$$

pH of Mixture of Strong Base and Weak Base

or pH of mix. of W.A. + S.A.

Common ion effect :



$CH_3COOH + H_2O \rightleftharpoons \underset{C\alpha}{CH_3COO^-} + H^+$

$C - C\alpha$

$HCl + H_2O \longrightarrow Cl^- + \underset{yM}{H^+}$

$\underset{yM}{HCl}$

MIT

$[H^+]_{Total} \approx [H^+]_{S.A.}$

$[W.E.]_{initial} = [W.E.]_{eq.}$

$[Anion\ of\ W.A.] = C\alpha$

$K_a = \dfrac{[Anion\ of\ W.A.][H^+]_{S.A.}}{[W.E.]_{initial}}$

#

MIT

Mixture of W.B. + S.B.

NH_4OH KOH

$NH_4OH \overset{+H_2O}{\rightleftharpoons} NH_4^+ + OH^-$

$C\alpha$

$KOH + H_2O \rightarrow K^+ + OH^-$

$[OH^-]_{Total} \approx [OH^-]_{S.B.}$

$[W.E.]_{eq} = [W.E.]_{initial}$

$[Cation\ of\ W.B.] = C\alpha$

$$K_b = \frac{[Cation\ W.B.][OH^-]_{S.B.}}{[W.B.]_{initial}}$$

QUESTION

$10^{-5} = \frac{[HCOO^-] \times 10^{-1}}{10^{-1}} \Rightarrow [HCOO^-] = 10^{-5}$

Find pH, $[H^+]$, $[HCOO^-]$, $[OH^-]$ and α of solution containing 0.1 M HCOOH ($K_a = 10^{-5}$) and 0.1 M HNO_3?

(HCOOH: ↓ W.A; HNO_3: ↓ S.A)

Ans

$[H^+] = 10^{-1}$ M

$pH = 1$

$[OH^-] = \frac{K_w}{[H^+]} = \frac{10^{-14}}{10^{-1}} = 10^{-13}$ M.

$C = 0.1$ M

$[HCOO^-] = 10^{-5} = C\alpha$

$10^{-5} = 10^{-1}\alpha$

$\alpha = 10^{-4}$

QUESTION

What is the $HCOO^-$ in the solution that contains 0.015 M HCOOH and 0.02 N HCl is Ka HCOOH = 1.8×10^{-4}

A. 1.8×10^{-4}

B. 1.35×10^{-4}

C. 1.8×10^{-2}

D. 8×10^{-3}

$[HCOO^-] = C\alpha$

$\alpha \neq \sqrt{\frac{Ka}{C}}$

$Ka = \frac{[HCOO^-][H^+]_{S.A.}}{[HCOOH]_{in.}}$

$\frac{Ka}{C} = \frac{1.8 \times 10^{-4} \times 10^{-1}}{1.5 \times 10^{-2}} = 1.2 \times 10^{-1} \times 7.25 \times 10^{-4}$

$1.8 \times 10^{-5} = \frac{[HCOO^-] 8 \times 10^{-2}}{(5 \times 10^{-2}) 10^{-1}}$

$1.35 \times 10^{-4} = 135 \times 10^{-6} = [HCOO^-]$

QUESTION

What is $[NH_4^+]$ in a solution that contain 0.02 M NH_3 ($K_b = 1.8 \times 10^{-5}$) and 0.01 M KOH?

A. 9×10^{-6}

B. 1.8×10^{-5}

C. 3.6×10^{-5}

D. None of these

$$K_b = \frac{[NH_4^+][OH^-]_{S.B.}}{[NH_3]_{eq.}}$$

$$1.8 \times 10^{-6} = \frac{[NH_4^+] \times 10^{-2}}{2 \times 10^{-2}}$$

$$36 \times 10^{-6} = [NH_4^+]$$

pH of Polyprotic Weak Acids

gives more than 1 H^+

forex : H_2S, H_2CO_3, H_3PO_3, H_3PO_4

$K_{a_1} >> K_{a_2} >> K_{a_3}$

$$H_2S + H_2O \rightleftharpoons H^+ + HS^- \quad K_{a_1}$$

	C	0	0
	C − x	x + y	x − y

$$K_{a_1} = \frac{[H^+][HS^-]}{[H_2S]} = \frac{(x+y)(x-y)}{C-x}$$

$$HS^- + H_2O \rightleftharpoons H^+ + S^{2-} \quad K_{a_2}$$

	x − y	x + y	y

$$K_{a_2} = \frac{[H^+][S^{2-}]}{[HS^-]} = \frac{(x+y)\,y}{(x-y)}$$

$y <<<< x \Rightarrow x + y \approx x$

$x - y \approx x$

H_2S is extremely W.A. $C - x \approx C$

$$K_{a_1} = \frac{x \times x}{c}$$

$$K_{a_2} = \frac{x \times y}{x}$$

MIT

H_2S ✓, $[H^+]$ ✓, $[HS^-]$ ✓, $[S^{2-}]$ ✓, K_{a_1}, K_{a_2}, pH ✓

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

② $[HS^-] = [H^+]_{1st\ step}$ $\quad K_{a_1} >> K_{a_2}$

③ $[H_2S]_{in.} = [H_2S]_{eq.}$

④ $K_{a_1} = \frac{[H^+][HS^-]}{[H_2S]} = \frac{x^2}{c}$

⑤ $K_{a_2} = \frac{[H^+]_{1st\ step}[S^{2-}]}{[HS^-]} \Rightarrow [S^{2-}] = K_{a_2} = y$

QUESTION – (AIPMT 2000)

For dibasic acid correct order is:

A $K_{a_1} < K_{a_2}$

B $K_{a_1} > K_{a_2}$

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

D not certain

QUESTION

Find pH, $[H^+]$, $[HS^-]$, $[S^{2-}]$ in 0.1 M H_2S solution having $K_{a_1} = 10^{-7}$ and $K_{a_2} = 10^{-14}$.

H^+ 10^{-x} 10^{-x} 10^{-14}

$$K_{a_1} = \frac{[H^+][HS^-]}{[H_2S]_{in.}}$$

$pH = x$

$K_{a_2} = [S^{2-}] = y \times 10^{-14}$

$$10^{-7} = \frac{x^2}{10^{-1}}$$

$$x^2 = 10^{-8}$$

$$x = 10^{-4} = [H^+] = [HS^-]$$

pH of Mixture of Weak Acids

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QUESTION

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

Compare Acidic strength of different Weak Acids

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QUESTION

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?

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.

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.

trick.

Ear plugs while studying.

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