



Resonance[®]
Educating for better tomorrow



CHEMISTRY

Target : JEE(Main)

IONIC EQUILIBRIUM

IONIC EQUILIBRIUM

Contents

Topic	Page No.
Theory	01 – 21
Exercise - 1	22 – 33
Exercise - 2	33 – 37
Part - I : Objective Questions	
Part - II : Assertion/Reasoning	
Exercise - 3	37 – 40
Part - I : JEE (Main) /AIEEE Questions	
Part - II : JEE (Adv.)/ IIT-JEE Questions	
Answer Key	41 – 42
JEE(Main) Practice Test Paper	43 – 46
JEE(Main) Test Paper Answers	47
JEE(Main) Test Paper Solutions	47 – 49

JEE(MAIN) SYLLABUS

Ionic equilibrium: Weak and strong electrolytes, ionization of electrolytes, various concepts of acids and bases (Arrhenius, Bronsted – Lowry and Lewis) and their ionization, acid – base equilibria (including multistage ionization) and ionization constants, ionization of water, pH scale, common ion effect, hydrolysis of salts and pH of their solutions, solubility of sparingly soluble salts and solubility products, buffer solutions.

JEE(ADVANCED) SYLLABUS

Solubility product, common ion effect, pH and buffer solutions; Acids and bases (Bronsted and Lewis concepts); Hydrolysis of salts.

© Copyright reserved.

All rights reserved. Any photocopying, publishing or reproduction of full or any part of this study material is strictly prohibited. This material belongs to enrolled student of RESONANCE only any sale/resale of this material is punishable under law, subject to Kota Jurisdiction only.

Ionic Equilibrium

Introduction

Degree of dissociation

- When an electrolyte is dissolved in a solvent (H₂O), it spontaneously dissociates into ions.
 - It may dissociate partially ($\alpha \ll 1$) or sometimes completely ($\alpha \approx 1$)
- Eg. $\text{NaCl} + \text{aq} \rightleftharpoons \text{Na}^+(\text{aq}) + \text{Cl}^-(\text{aq})$ ($\alpha \approx 1$)
 $\text{CH}_3\text{COOH} + \text{aq} \rightleftharpoons \text{CH}_3\text{COO}^-(\text{aq}) + \text{H}^+(\text{aq})$ ($\alpha \ll 1$)
- The degree of dissociation of an electrolyte (α) is the fraction of one mole of the electrolyte that has dissociated under the given conditions.

$$\alpha = \frac{\text{No. of moles dissociated}}{\text{No. of moles taken initially}}$$

The value of α depends

- (a) **Nature of electrolyte** : Strong electrolyte dissociate completely where as weak electrolytes dissociate partially.
- (b) **Nature of solvent** : A solvent having high value of **dielectric constant** and high **solvation (in water hydration)** will favour dissociation.
- (c) **Dilution** : For some electrolytes degree of dissociation will increase by dilution (**Ostwald's dilution law**)
- (d) **Temperature** : On increasing temperature generally degree of dissociation increases.
- (e) **Presence of other solute** :
When a substance is present it may affect the solubility of the another solute. Generally common ion present in both the substance affects most.

Ostwald's Dilution Law (for weak electrolyte's)

- For a weak electrolyte A^+B^- dissolved in water, if α is the degree of dissociation then

	$\text{AB} \rightleftharpoons \text{A}^+ + \text{B}^-$
initial conc	C 0 0
conc-at eq.	$C(1-\alpha)$ $C\alpha$ $C\alpha$

Then according to law of mass action,

$$K_{\text{eq}} = \frac{[\text{A}^+][\text{B}^-]}{[\text{AB}]} = \frac{C\alpha \cdot C\alpha}{C(1-\alpha)} = \frac{C\alpha^2}{(1-\alpha)}$$

= dissociation constant of the weak electrolyte

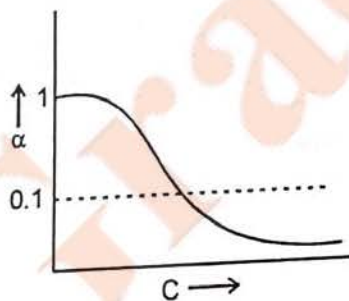
[$C = \frac{1}{V}$, then $V = 1/C$ (volume of Solution in which 1 mole is present) is called **dilution**, so $k_{\text{eq}} = \frac{\alpha^2}{(1-\alpha)V}$]

If α is negligible in comparison to unity then, $1 - \alpha \approx 1$. So $k_{\text{eq}} = \alpha^2 C \Rightarrow \alpha = \sqrt{\frac{k_{\text{eq}}}{C}} = \sqrt{k_{\text{eq}} \cdot V}$.

$$\alpha \propto \frac{1}{\text{concentration}}$$

{ Thumb rule }

- as concentration increases $\Rightarrow \alpha$ decreases
- at infinite dilution α reaches its maximum value, unity.



Resonance
Educating for better tomorrow

Corporate Office: CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.)-324005
 Website : www.resonance.ac.in | E-mail : contact@resonance.ac.in
 Toll Free : 1800 200 2244 | 1800 258 5555 | CIN: U80302RJ2007PLC024029

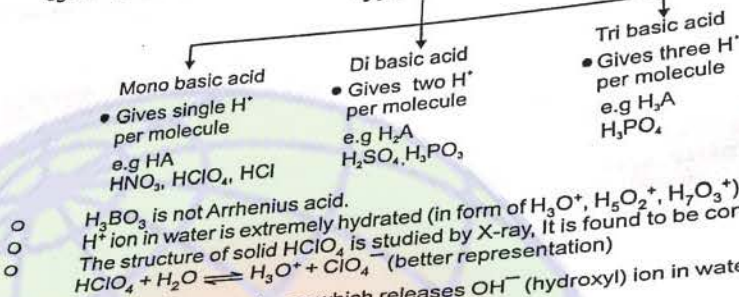
MAINIQ - 1

Ionic Equilibrium

ACIDS BASES AND SALTS :
Arrhenius concept :

Arrhenius Acid : Substance which gives H⁺ ion on dissolving in water (H⁺ donor)
 eg. HNO₃, HClO₄, HCl, HI, HBr, H₂SO₄, H₃PO₄ etc.

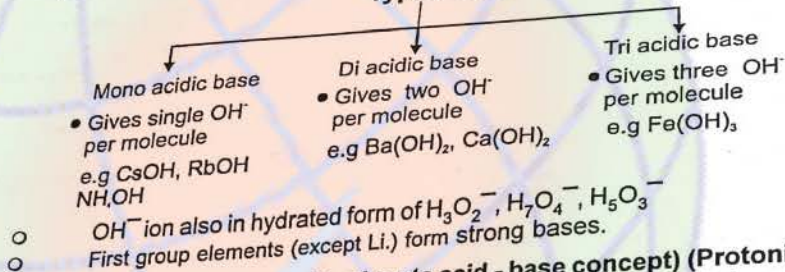
Types of acids :



○ H₃BO₃ is not Arrhenius acid.
 ○ H⁺ ion in water is extremely hydrated (in form of H₃O⁺, H₅O₂⁺, H₇O₃⁺) and have high charge density.
 ○ The structure of solid HClO₄ is studied by X-ray. It is found to be consisting of H₃O⁺ and ClO₄⁻.
 HClO₄ + H₂O ⇌ H₃O⁺ + ClO₄⁻ (better representation)

Arrhenius base : Any substance which releases OH⁻ (hydroxyl) ion in water (OH⁻ ion donor)

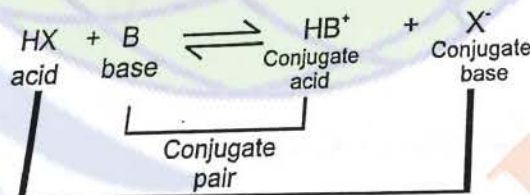
Types of base



○ OH⁻ ion also in hydrated form of H₃O₂⁻, H₇O₄⁻, H₅O₃⁻
 ○ First group elements (except Li.) form strong bases.

Bronsted - Lowry concept : (Conjugate acid - base concept) (Protonic concept)
Acid : substances which donate H⁺ are Bronsted Lowry acids (H⁺ donor)
Base : substances which accept H⁺ are Bronsted Lowry bases (H⁺ acceptor)

Conjugate acid - base pairs
 In a typical acid base reaction



○ Forward reaction – Here HX being a proton donor is an acid
 B being a proton acceptor is a base.

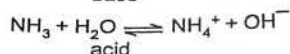
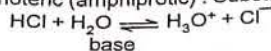
○ Backward reaction – Here HB⁺ being a proton donor is an acid
 X⁻ being a proton acceptor is a base.

Acid	Base	Conjugate Acid	Conjugate Base
○ HCl	+ H ₂ O	⇌ H ₃ O ⁺	+ Cl ⁻
○ HSO ₄ ⁻	+ NH ₃	⇌ NH ₄ ⁺	+ SO ₄ ⁻²
○ [Fe(H ₂ O) ₆] ³⁺	+ H ₂ O	⇌ H ₃ O ⁺	+ [Fe(H ₂ O) ₅ (OH)] ²⁺

Ionic Equilibrium

- Conjugate acid - base pair differ by only one proton
- Strong acid will have weak conjugate base and vice versa
- Reaction will always proceed from strong acid to weak acid or from strong base to weak base.

Amphoteric (amphiprotic) : Substances which can act as acid as well as base are known as amphoteric



Solved Examples

Ex.1. Write the conjugate bases of HCl, H₂SO₄, HSO₄⁻, H₂O and conjugate acids of NH₃, H₂O and RNH₂.

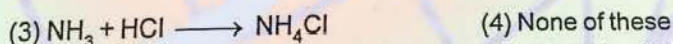
Sol.	Acid	Conjugate base	Base	Conjugate acid
	HCl	Cl ⁻	NH ₃	NH ₄ ⁺
	H ₂ SO ₄	HSO ₄ ⁻	H ₂ O	H ₃ O ⁺
	HSO ₄ ⁻	SO ₄ ²⁻	RNH ₂	RNH ₃ ⁺
	H ₂ O	OH ⁻		

Lewis concept (electronic concept) :

- An acid is a molecule/ion which can accept an electron pair with the formation of a coordinate bond.
Acid → e⁻ pair acceptor
e.g. Electron deficient molecules : BF₃, AlCl₃
Cations : H⁺, Fe²⁺, Na⁺
Molecules with vacant orbitals : SF₄, PF₃
- A base is any molecule/ion which has a lone pair of electrons which can be donated.
Base → (One electron pair donate)
e.g. Molecules with lone pairs : NH₃, PH₃, H₂O, CH₃OH

Solved Examples

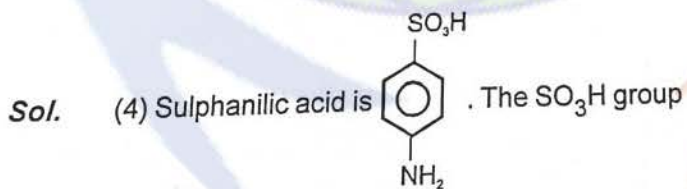
Ex.2. In which of the following reactions does NH₃ act as an acid ?



Sol. (B) In the following reaction, NH₃ changes to NaNH₂ which contains NH₂⁻ ion. This means that NH₃ has donated a proton to Na and hence acts as an acid.

Ex.3. Sulphanilic acid is a/an

- (1) Arrhenius acid (2) Lewis base
(3) Neither (1) or (2) (4) Both (1) and (2)




is capable of donating H⁺ and hence it acts as arrhenius acid while nitrogen in the NH₂ group contains lone pair of electrons and hence can act as lewis base by donating it.

Ex.4. Ammonium ion is

- (1) A Lewis acid (2) Lewis base (3) Bronsted acid (4) Bronsted base

Sol. Correct answer is (3).

 Resonance [®] Educating for better tomorrow	Corporate Office: CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.)-324005	MAINIEQ - 3
	Website : www.resonance.ac.in E-mail : contact@resonance.ac.in	
	Toll Free : 1800 200 2244 1800 258 5555 CIN: U80302RJ2007PLC024029	

Ionic Equilibrium

PROPERTIES OF WATER :

● **Amphoteric (amphiprotic) Acid/base nature:**
 Water - an acid as well as base according to Arrhenius and Bronsted-Lowry theory but according to Lewis concept it can only be taken as base.
 In pure water $[H^+] = [OH^-]$ so it is Neutral.

● **Molar concentration / Molarity of water :**
 Molarity = No. of moles/litre = $\frac{1000\text{gm/litre}}{18\text{gm/mole}} = 55.55 \text{ mole/litre} = 55.55 \text{ M}$ (density = 1 gm/cc)

● **Ionic product of water :** According to Arrhenius concept
 $H_2O \rightleftharpoons H^+ + OH^-$ so, ionic product of water, $K_w = [H^+][OH^-] = 10^{-14}$ at 25° (exp.)
 ○ dissociation of water, is endothermic, so on increasing temperature K_{eq} increases
 K_w increases with increase in temperature.

Now $pH = -\log[H^+] = 7$ and $pOH = -\log[OH^-] = 7$ for water at 25° (experimental)

$pH = 7 = pOH \Rightarrow$ neutral
 $pH < 7$ or $pOH > 7 \Rightarrow$ acidic
 $pH > 7$ or $pOH < 7 \Rightarrow$ Basic } at $25^\circ C$

○ Ionic product of water is always a constant whatever has been dissolved in water since its an equilibrium constant so will be dependent only on temperature.

● **Degree of dissociation of water :**

$H_2O \rightleftharpoons H^+ + OH^- \Rightarrow \alpha = \frac{\text{no. of moles dissociated}}{\text{Total No. of moles initially taken}} = \frac{10^{-7}}{55.55} = 18 \times 10^{-10}$ or $1.8 \times 10^{-7}\%$

● **Absolute dissociation constant of water :**

$H_2O \rightleftharpoons H^+ + OH^- \quad K_a = K_b = \frac{[H^+][OH^-]}{[H_2O]} = \frac{10^{-7} \times 10^{-7}}{55.55} = 1.8 \times 10^{-16}$
 So, $pK_a = pK_b = -\log(1.8 \times 10^{-16}) = 16 - \log 1.8 = 15.74$

Acidity and pH scale :

- Acidic strength means the tendency of an acid to give H_3O^+ or H^+ ions in water.
 So greater the tendency to give H^+ , more will be the acidic strength of the substance.
- Basic strength means the tendency of a base to give OH^- ions in water.
 So greater the tendency to give OH^- ions, more will be basic strength of the substance.
- The concentration of H^+ ions is written in a simplified form introduced by Sorenson known as pH scale.
 pH is defined as negative logarithm of activity of H^+ ions.

$\therefore pH = -\log a_{H^+}$ (where a_{H^+} is the activity of H^+ ions)

- Activity of H^+ ions is the concentration of free H^+ ions or H_3O^+ ions in a Solution.
- For dilute Solutions $[H^+] \leq 1M$ concentration can be taken as activity of H^+ ions while for higher concentrations the activity would be much less than the concentration itself, so it is calculated experimentally.
- The pH scale was marked from 0 to 14 with central point at 7 at $25^\circ C$ taking water as solvent.
- If the temperature is changed, the pH range of the scale will also change. For **Example**

0 - 14	at $25^\circ C$	Neutral point, pH = 7
0 - 13	at $80^\circ C$ ($K_w = 10^{-13}$)	Neutral point, pH = 6.5
- pH can also be negative or > 14

Resonance[®]
 Educating for better tomorrow

Corporate Office: CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Raj.)-324005
 Website : www.resonance.ac.in | E-mail : contact@resonance.ac.in
 Toll Free : 1800 200 2244 | 1800 258 5555 | CIN: U80302RJ2007PLC024029

MAINIEQ - 4

Ionic Equilibrium

Solved Examples

- Ex.5. For which temperature the pK_w of pure water can be greater than 14.
 (1) 20 °C (2) 30 °C (3) 40 °C (4) 50 °C Ans. (1)
- Ex.6. For pure water at 10 °C and 60 °C, the correct statement is
 (1) $pOH_{10°C} = pOH_{60°C}$ (2) $pOH_{10°C} > pOH_{60°C}$ (3) $pOH_{60°C} > pOH_{10°C}$ (4) Can't say Ans. (2)
- Ex.7. For pure water at 25 °C and 50 °C the correct statement is
 (1) $pH_{25°C} = pH_{50°C}$ (2) $pH_{25°C} > pH_{50°C}$ (3) $pH_{50°C} > pH_{25°C}$ (4) Can't say Ans. (2)

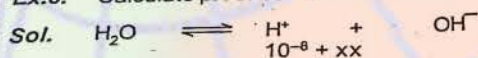
pH Calculations of Different Types of Solutions :

(a) Strong acid Solution :

- (i) If concentration is greater than 10^{-6} M
 In this case H^+ ions coming from water can be neglected,
 so $[H^+] =$ normality of strong acid Solution
- (ii) If concentration is less than 10^{-6} M
 In this case H^+ ions coming from water cannot be neglected,
 So $[H^+] =$ normality of strong acid + H^+ ions coming from water in presence of this strong acid

Solved Examples

Ex.8. Calculate pH of 10^{-8} M HCl Solution.



$K_w = [H^+][OH^-]$
 $10^{-14} = x(x + 10^{-8})$
 $\Rightarrow x^2 + x \times 10^{-8} - 10^{-14} = 0$

$$x = \frac{-10^{-8} \pm \sqrt{10^{-16} + 4 \times 10^{-14}}}{2} = \frac{-10^{-8} + 10^{-7} \sqrt{4 + \frac{1}{100}}}{2} = \frac{(\sqrt{401} - 1)10^{-8}}{2} = 0.95 \times 10^{-7}$$

$[H^+] = 10.5 \times 10^{-8} = 1.05 \times 10^{-7}$

$[pH] = 7 - \log 1.05 \approx 6.98$

10^{-9} M HCl pH ≈ 7

10^{-16} M HCl pH ≈ 7

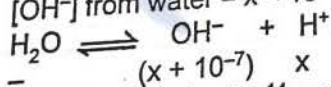
(b) Strong base Solution :

Calculate the $[OH^-]$ which will be equal to normality of the strong base solution and then use $K_w = [H^+] \times [OH^-] = 10^{-14}$, to calculate $[H^+]$.

Solved Examples

Ex.9. Calculate pH of 10^{-7} M of NaOH Solution

Sol. $[OH^-]$ from NaOH = 10^{-7}
 $[OH^-]$ from water = $x < 10^{-7}$ M (due to common ion effect)



$K_w = [H^+][OH^-] = 10^{-14} = x(x + 10^{-7})$
 $x^2 + 10^{-7}x - 10^{-14} = 0$

$\Rightarrow x = \frac{\sqrt{5} - 1}{2} \times 10^{-7} = 0.618 \times 10^{-7} \quad (\sqrt{5} = 2.236)$

$[OH^-] = 10^{-7} + 0.618 \times 10^{-7} = 1.618 \times 10^{-7}$

$pOH = 7 - \log (1.618) = 6.79$

$pH = 14 - 6.79 = 7.21$

Ionic Equilibrium

(c) pH of mixture of two strong acids :

If V_1 volume of a strong acid solution of normality N_1 is mixed with V_2 volume of another strong acid solution of normality N_2 , then
 Number of H^+ ions from I-solution = $N_1 V_1$
 Number of H^+ ions from II-solution = $N_2 V_2$

If final normality is N and final volume is V , then
 $NV = N_1 V_1 + N_2 V_2$
 [dissociation equilibrium of none of these acids will be disturbed as both are strong acid]

$$[H^+] = N = \frac{N_1 V_1 + N_2 V_2}{V_1 + V_2}$$

(d) pH of mixture of two strong bases :
 similar to above calculation

$$[OH^-] = N = \frac{N_1 V_1 + N_2 V_2}{V_1 + V_2} \quad [H^+] = \frac{10^{-14}}{[OH^-]}$$

Solved Examples

Ex.10. Calculate pH of mixture of (400ml, $\frac{1}{200}$ M H_2SO_4) + (400ml, $\frac{1}{100}$ M HCl) + (200 ml of water)

Sol. $N_1 V_1 = \frac{1}{100} \times 400 = \frac{4}{1000}$, $N_2 V_2 = \frac{4}{1000}$, H^+ ions from water will be neglected
 $N_1 V_1 + N_2 V_2 = 8 \times 10^{-3}$ $[H^+] = \frac{8 \times 10^{-3}}{1} = 8 \times 10^{-3}$
 pH = $3 - \log 8 = 2.1$

(e) pH of mixture of a strong acid and a strong base :

- Acid Base neutralisation reaction will take place.
- The solution will be acidic or basic depending on which component has been taken in excess.
- If V_1 volume of a strong acid solution of normality N_1 is mixed with V_2 volume of a strong base solution of normality N_2 , then
 Number of H^+ ions from I-solution = $N_1 V_1$
 Number of OH^- ions from II-solution = $N_2 V_2$

If $N_1 V_1 > N_2 V_2$

$$[H^+] = N = \frac{N_1 V_1 - N_2 V_2}{V_1 + V_2}$$

solution will be acidic in nature

If $N_2 V_2 > N_1 V_1$

$$[OH^-] = N = \frac{N_2 V_2 - N_1 V_1}{V_1 + V_2}$$

solution will be basic in nature

$$[H^+] = \frac{10^{-14}}{[OH^-]}$$

Solved Examples

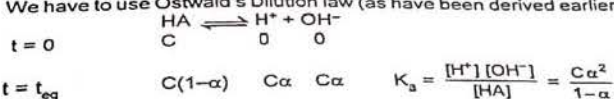
Ex.11. Calculate pH of mixture of (400ml, $\frac{1}{200}$ M $Ba(OH)_2$) + (400ml, $\frac{1}{50}$ M HCl) + (200ml of Water)

Sol. $[H^+] = \frac{400 \times \frac{1}{50} - 400 \times \frac{1}{200} \times 2}{1000} = 4 \times 10^{-3}$, so pH = $3 - 2 \log 2 = 2.4$

Ionic Equilibrium

(f) **pH of a weak acid (monoprotic) Solution :**

- Weak acid does not dissociate 100% therefore we have to calculate the percentage dissociation using K_a , dissociation constant of the acid.
- We have to use Ostwald's Dilution law (as have been derived earlier)



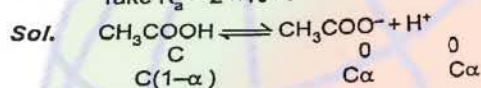
If $\alpha \ll 1 \Rightarrow (1-\alpha) \approx 1 \Rightarrow K_a \approx C\alpha^2 \Rightarrow \alpha = \sqrt{\frac{K_a}{C}}$ (is valid if $\alpha < 0.1$ or 10%)

$[H^+] = C\alpha = C\sqrt{\frac{K_a}{C}} = \sqrt{K_a \times C}$ So $pH = \frac{1}{2}(pK_a - \log C)$

on increasing the dilution $\Rightarrow C \downarrow \Rightarrow \alpha \uparrow$ and $[H^+] \downarrow \Rightarrow pH \uparrow$

Solved Examples

Ex.12. Calculate pH of $10^{-1} M CH_3COOH$
Take $K_a = 2 \times 10^{-5}$.



$K_a = \frac{C\alpha^2}{1-\alpha} \Rightarrow \alpha = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{2 \times 10^{-5}}{10^{-1}}} = \sqrt{2 \times 10^{-4}}$ ($\alpha \ll 0.1$)

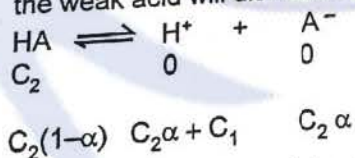
So, $[H^+] = 10^{-1} \times \sqrt{2} \times 10^{-2} \Rightarrow pH = 3 - \frac{1}{2} \log 2 = 2.85$ Ans.

- At very low concentration (at infinite dilution) weak electrolyte will be almost 100% dissociated, so behave as strong electrolyte
(pH) of $10^{-6} M HCl \approx pH$ of $10^{-6} M CH_3COOH \approx 6$

(g) **pH of a mixture of weak acid(monoprotic) and a strong acid Solution :**

- Weak acid and Strong acid both will contribute H^+ ion.
- For the first approximation we can neglect the H^+ ions coming from the weak acid Solution and calculate the pH of the Solution from the concentration of the strong acid only.
- To calculate exact pH, we have to take the effect of presence of strong acid on the dissociation equilibrium of the weak acid.

If $[SA] = C_1$ and $[WA] = C_2$, then $[H^+]$ from SA = C_1
the weak acid will dissociate as follows.



$K_a = \frac{(C_2\alpha + C_1)C_2\alpha}{C_2(1-\alpha)}$ ($\alpha \ll 1$)

(The weak acids dissociation will be further suppressed because of presence of strong acid, common ion effect)

Total H^+ ion concentration = $C_1 + C_2\alpha$

- If the total $[H^+]$ from the acid is less than $10^{-6} M$, then contribution from the water can be neglected at $25^\circ C$ temp., if not then we have to take $[H^+]$ from the water also.

(h) **pH of a Solution of a polyprotic weak acid :**

- Diprotic acid is the one, which is capable of giving 2 protons per molecule in water. Let us take a weak diprotic acid (H_2A) in water whose concentration is cM . In an aqueous Solution, following equilibria exist.

RESONANCE STUDY CENTRES (Self Owned)

KOTA (Head Office):
 Pre-Engineering Division: JEE (Advanced)
 Pre-Engineering Division: JEE (Main)
 Pre-Medical Division: AIIMS/ AIPMT
 Tel.: 0744-3012222, 3192222, 6635555
 e-mail: contact@resonance.ac.in

Commerce & Law Program Division (CLPD)
 Tel.: 0744-3192229, 6060663
 e-mail: clpd@resonance.ac.in

PCCP/PSD/MLs
 Tel.: 0744 2434727, 8824078330, 3192223, 2440498
 e-mail: pccp@resonance.ac.in

DLPD
 Tel.: 0744 6635555, 3012222
 e-mail: dlpd@resonance.ac.in

ELPD
 Tel.: 0744-3058242
 e-mail: elpd@resonance.ac.in

JAIPUR
 Tel.: 0141-6060661/ 64, 3103666, 6060662/63
 e-mail: jaipur@resonance.ac.in

BHOPAL
 Tel.: 0755-3206353, 3192222, 3256353
 e-mail: bhopal@resonance.ac.in

NEW DELHI
 Tel.: 011-6060660/ 2/ 3/ 4/ 5/ 6/ 7
 e-mail: delhi@resonance.ac.in

LUCKNOW
 Tel.: 0522-3192222, 3192223/ 4, 6060660/ 61/ 62
 e-mail: lko@resonance.ac.in

KOLKATA
 Tel.: 033-3192222, 6060660/ 01/ 02
 e-mail: kolkata@resonance.ac.in

NAGPUR
 Tel.: 0712-3017222, 3192222, 6060660
 e-mail: nagpur@resonance.ac.in

NANDED
 Tel.: 02462-250220, 6060660
 e-mail: nanded@resonance.ac.in

MUMBAI
 Tel.: 022-3192222, 6060660
 e-mail: andhen@resonance.ac.in

UDAIPUR
 Tel.: 0294-6060660, 5107510, 3192222
 e-mail: udaipur@resonance.ac.in

BHUBANESWAR
 Tel.: 0674-3192222, 3274919, 6060660/ 61
 e-mail: bbsr@resonance.ac.in

AHMEDABAD
 Tel.: 079-3192222/ 3/ 4 & 079-6060660/ 1/ 2
 e-mail: abad@resonance.ac.in

PATNA
 Tel.: 0612-3192222, 3192222/ 3
 e-mail: patna@resonance.ac.in

JODHPUR
 Tel.: 0291-6060660
 e-mail: jodhpur@resonance.ac.in

AJMER
 Tel.: 0145-3192222, 6060660/ 65
 e-mail: ajmer@resonance.ac.in

INDORE
 Tel.: 0731-3192222, 4274200
 e-mail: indore@resonance.ac.in

SIKAR
 Tel.: 01572-319222, 6060660
 e-mail: sikar@resonance.ac.in

AGRA
 Tel.: 0562-3192222, 6060660
 e-mail: agra@resonance.ac.in

RANCHI
 Tel.: 0651-6060660
 e-mail: ranchi@resonance.ac.in

RAIPUR
 Tel.: 0771-6060660
 e-mail: raipur@resonance.ac.in

RAIPUR
 Tel.: 0771-6060660
 e-mail: raipur@resonance.ac.in

RAIPUR
 Tel.: 0771-6060660
 e-mail: raipur@resonance.ac.in

AURANGABAD
 Tel.: 0240-6060660
 e-mail: aurangabad@resonance.ac.in

JAGALPUR
 Tel.: 0761-6060660
 e-mail: jagalpur@resonance.ac.in

GWALIOR
 Tel.: 0751-6060660
 e-mail: gwalior@resonance.ac.in

CHANDRAPUR
 Tel.: 07172-6060660
 e-mail: chandrapur@resonance.ac.in

SURAT
 Tel.: 0261-6060660
 e-mail: surat@resonance.ac.in

RAJKOT
 Tel.: 0281-6002011
 e-mail: rajkot@resonance.ac.in

VADODARA
 Tel.: 0265-6060660
 e-mail: vadodara@resonance.ac.in

BASE STUDY CENTRES

Base Education Service Pvt. Ltd.
Bengaluru (Main Branch):
 Reg. Office : No.27, Next to Indian Oil
 Petrol Bunk, Bull Temple Road,
 Basavanagudi, Bengaluru- 560004
 Tel. No.: 42604600/ 95381 41504
 E-Mail : info@base-edu.in
 Website: www.base-edu.in

BANASANKARI II STAGE
 Tel.: 26710835/26710836

BELAGAVI
 Tel.: 0831-4208687 | Mobile: 9845228000

CHITRADURGA
 Mobile: 9886464755, 9972413844

HUBLI
 Tel.: 0836-2252685 | Mobile: 9844118615

INDIRANAGAR
 Tel.: 41179342/25201306

KALYAN NAGAR
 Tel.: 080-25443363/25443364

KORAMANGALA
 Tel.: 40925512/40925534

MALLESHWARAM
 Tel.: 41400008

MYSURU
 Tel.: 0821-4242100 /4258100/4243100

RAJAJINAGAR
 Tel.: 08023327588/41162135

SHIVAMOGGA
 Tel.: 08182-223980, 8884849590

TUMAKURU
 Tel.: 0816-2252387

UDUPI
 Tel.: 0820-2522449, 2522994, 9986663074

VIJAYANAGAR
 Tel.: 23111333/23111334

YELAHANKA
 Tel.: 08028463922/42289643

CHIKKAMAGALURU
 Mobile: 7411329369, 9448396890

HASSAN
 Mobile: 9481392014, 9972038283

J P NAGAR
 Tel.: 26595151/26595153.

KALABURGI
 Tel.: 08472-230914
 Mobile: 9845905200/9844510914



Corporate Office: CG Tower, A-46 & 52, IPIA, Near City Mall, Jhalawar Road, Kota (Rajasthan)- 324005
Reg. Office: J-2, Jawahar Nagar Main Road, Kota (Raj.)- 05 | **Tel. No.:** 0744-3192222, 3012222, 6635555 | **CIN:** U80302RJ2007PLC024029
To Know more: sms **RESO** at **56677** | **E-mail:** contact@resonance.ac.in | **Website:** www.resonance.ac.in

Toll Free : 1800 258 5555 | 08003 444 888 | [facebook.com/ResonanceEdu](https://www.facebook.com/ResonanceEdu) | twitter.com/ResonanceEdu | www.youtube.com/resowatch | blog.resonance.ac.in