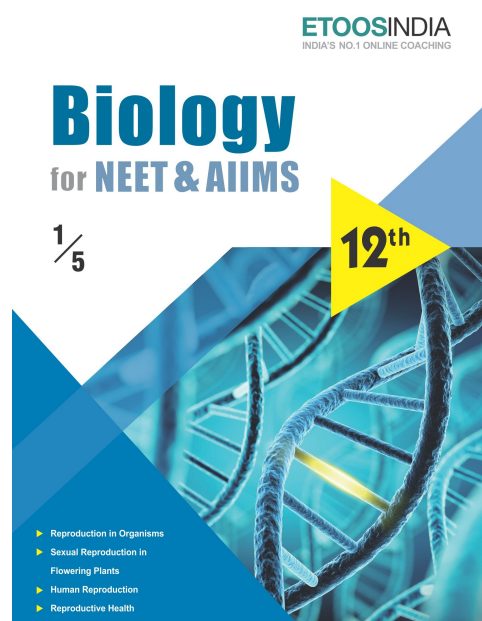
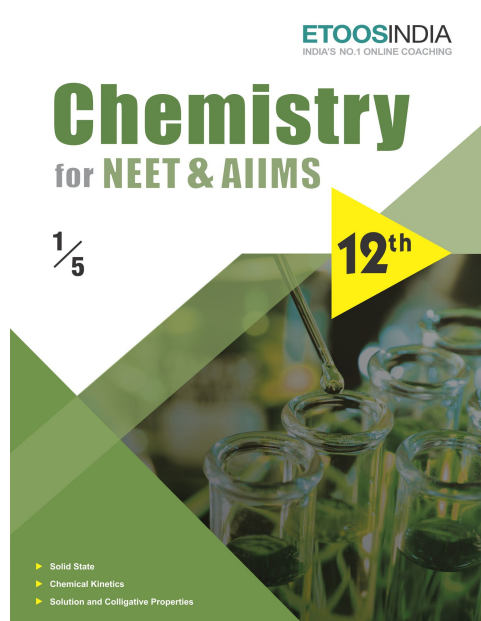
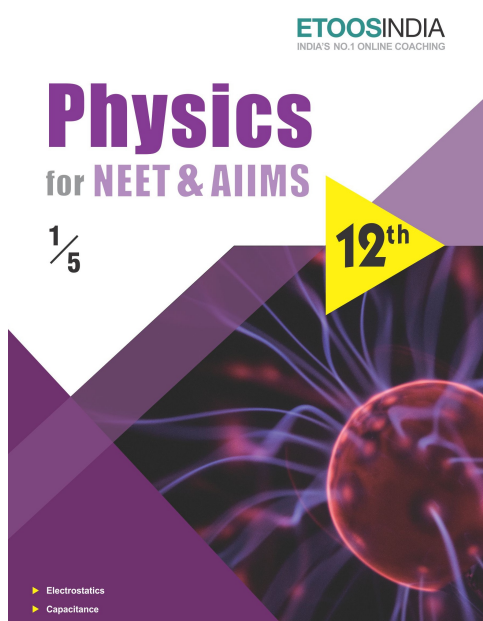
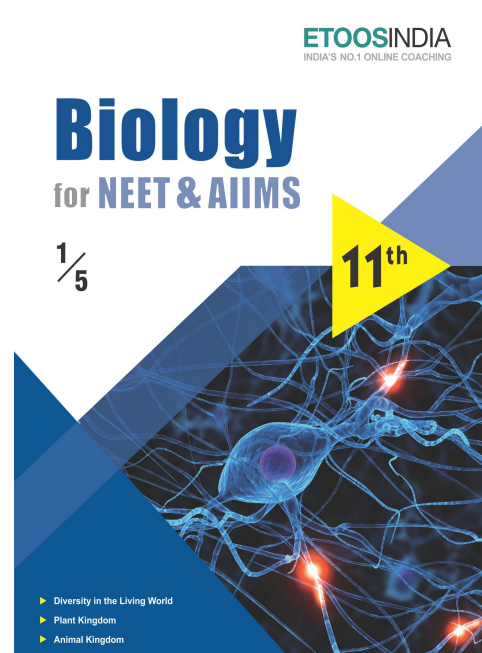
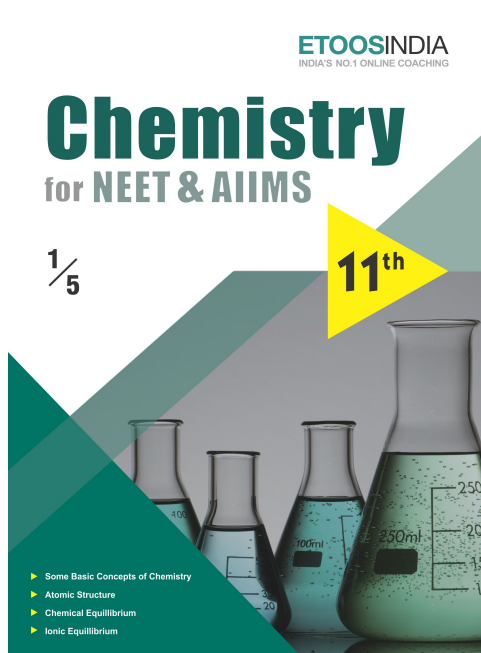
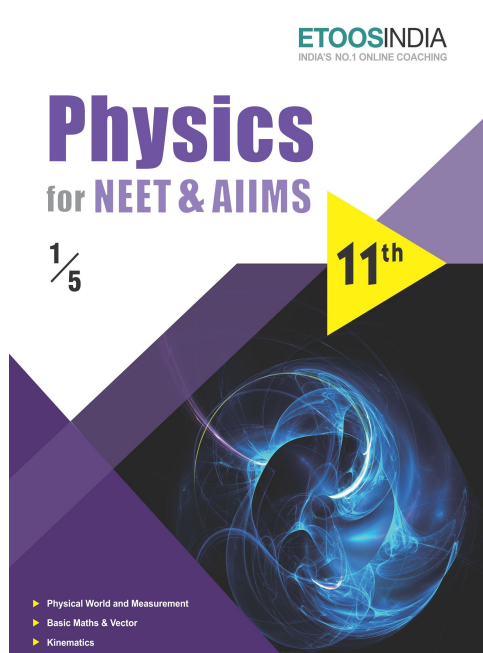


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IONIC EQUILIBRIUM

The point of life is to find equilibrium in what is inherently unstable

“PIERRE REVERDY”

INTRODUCTION

Ionic equilibrium is the equilibrium established between the unionized molecules and the ions in a solution of weak electrolytes. In this lesson we learn about the equilibrium involving ionic species. The equilibrium involving acids and bases are critically important for a wide variety of reactions.

After reading this lesson, we will be able to discuss

Define and explain various concepts of acids and bases

Define conjugate acid base pairs and identify them in an acid-base equilibrium;

Define pH and correlate it with the nature of aqueous solutions-neutral, acidic or basic:

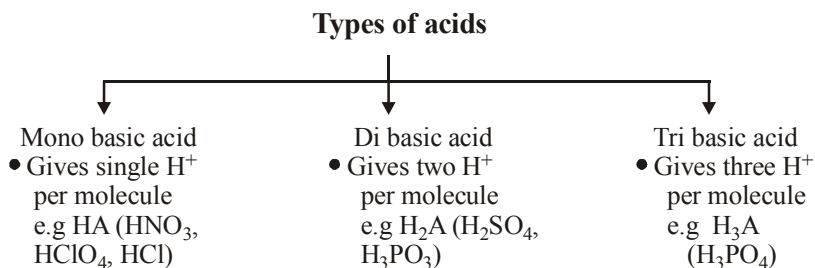
Define and explain common ion effect in ionisation of weak acids and bases:

Identify the relationship between solubility and solubility product for salts of AB, AB₂, A₂B₂ and A₂B₃ types

It is number of H^+ ions furnished by a molecule of an acid. An acid may be classified according to its basicity. Thus we may have,

- (i) Mono basic or Mono protic acids like HCl, HNO_3 , CH_3COOH , HCN etc.
- (ii) Dibasic or Diprotic acids like, H_2SO_4 , H_2CO_3 , H_2SO_3 , H_2S etc.
- (iii) Tribasic or Triprotic acids like H_3PO_4 , H_3AsO_4 etc.

Basicity or Proticity of an Acid

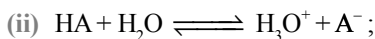


It may be defined as the number of OH^- ions furnished by a molecule of a base. A base can be,

- (i) Mono acidic or Monohydroxic like NaOH, NH_4OH , AgOH etc.
- (ii) Diacidic or dihydroxic like $Ba(OH)_2$, $Mg(OH)_2$, $Ca(OH)_2$, $Sr(OH)_2$ etc.
- (iii) Triacidic or trihydroxic like $Fe(OH)_3$, $Al(OH)_3$ etc.

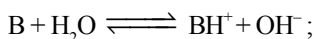
Strength of Acid or Base :

- (i) Strength of Acid or Base depends on the extent of its ionisation. Hence equilibrium constant K_a or K_b respectively of the following equilibria give a quantitative measurement of the strength of the acid or base.



$$K_a = \frac{[H_3O^+][A^-]}{[HA]}$$

- (iii) Similarly

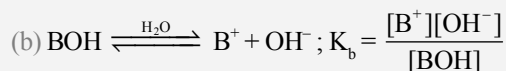
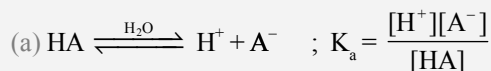


$$K_b = \frac{[BH^+][OH^-]}{[B]} \text{ here } H_2O \text{ is solvent.}$$



ETOOS KEY POINTS

- (i) The other ways to represent above equilibrium is :



- (ii) The larger the value of K_a or K_b , the more complete the ionisation, the higher the concentration of H_3O^+ or OH^- and stronger is the acid or base.

1. A strong electrolyte is defined as a substance which dissociates almost completely into ions in aqueous solution and hence is a very good conductor of electricity Ex., NaOH, KOH, HCl, H₂SO₄, NaCl, KNO₃ etc.
2. A weak electrolyte is defined as a substance which dissociates to a small extent in aqueous solution and hence conducts electricity also to a small extent e.g. NH₄OH, CH₃COOH etc.
3. Degree of dissociation :- The fraction of the total amount of an electrolyte which dissociates into ions is called the degree of dissociation (α),

i.e.
$$\alpha = \frac{\text{Number of moles dissociated}}{\text{Number of moles taken}}$$

4. According to Arrhenius concept of acids and bases, an acid is a substance which gives H⁺ ions in the aqueous solution whereas a base is a substance which gives OH⁻ ions in the aqueous solution.
5. According to Bronsted-Lowry concept of acids and bases, an acid is a substance which can give a proton and a base is a substance which accepts a proton.
6. According to Lewis concept of acids and bases, an acid is a substance which can accept a lone pair of electrons whereas a base is a substance which can donate a lone pair of electrons.

Types of Lewis Bases

- (i) Neutral molecules containing a lone pair of electrons on the central atom like : NH₃, R \ddot{O} H, H₂ \ddot{O} : etc. (ii) All negative ions like F⁻, Cl⁻, Br⁻, I⁻, OH⁻ etc.

Types of Lewis Acids

- (i) Molecules having central atom with incomplete octet e.g. BF₃, AlCl₃ etc.
(ii) Simple cations e.g. Ag⁺, Cu²⁺, Fe³⁺ etc.
(iii) Molecules having central atom with empty d-orbitals e.g. SnCl₄, SiF₄, PF₅ etc.
(iv) Molecules containing multiple bonds between different atoms e.g. O = C = O.

SOLVED EXAMPLE

- Ex. 1** Stomach acid is a solution of HCl with concentration of 2.2×10^{-3} M. what is the pH of stomach acid :
 (A) 3.92 (B) 2.65
 (C) 4.92 (D) 1.92
- Sol.** (B) HCl is 100 % ionised so
 $[H_3O^+] = 2.2 \times 10^{-3}$ M
 $pH = -\log(2.2 \times 10^{-3} \text{ M})$ or $pH = 2.65$
- Ex. 2** Calculate the $[H_3O^+]$ of blood, the pH of which is 7.2 (slightly basic).
 (A) 5×10^{-8} M (B) 6.3×10^{-8} M
 (C) 5×10^{-9} M (D) 4×10^{-7} M
- Sol.** (B) $pH = 7.2$ so $[H_3O^+] = \text{antilog}(-7.2) = 6.3 \times 10^{-8}$ M
- Ex. 3** The pH of an aqueous solution at 25°C made up to 0.3 M, with respect to NaOH and 0.5 M, with respect to acetic acid ($pK_a = 4.76$) would be nearly :
 (A) 4.25 (B) 4.93
 (C) 4.75 (D) 5.05
- Sol.** (B) $pH = pK_a - \log \frac{[\text{acid}]}{[\text{salt}]}$
 0.3 M NaOH will react with acid to form 0.3 M CH_3COONa and therefore CH_3COOH concentration will be reduced to 0.2 M.
 $pH = 4.76 - \log \frac{0.2}{0.3} = 4.93$
- Ex. 4** Calculate the pOH and pH of a 0.1 M CH_3COO^- solution ($K_a = 1.8 \times 10^{-5}$).
 $\text{CH}_3\text{COO}^- + \text{H}_2\text{O} \rightleftharpoons \text{CH}_3\text{COOH} + \text{OH}^-$
 (A) 6.12, 7.88 (B) 4.12, 9.88
 (C) 5.13, 8.87 (D) none of the above
- Sol.** (C) $pH = 7 + \frac{1}{2} pK_a + \frac{1}{2} \log C$
 $= 7 + \frac{1}{2} \times 4.74 + \frac{1}{2} \log(0.1)$
 $pH = 8.87$
 $pOH = 14 - 8.87 = 5.13$
- Ex. 5** The pH of a solution of NH_3 is 5.806. If its concentration is 0.95 M then what is the value of its dissociation constant ?
 (A) $\text{anti log}[28 + \log(0.95) - 23.242]$
 (B) $\text{anti log}[11.612 - \log(0.95) - 28]$
 (C) $\text{anti log}[11.612 - \log(0.95) - 14]$
 (D) $\text{anti log}[14 + \log(0.95) - 11.612]$
- Sol.** (B) Since $pH = 14 - pOH$ and $pOH = \frac{1}{2} pK_b - \frac{1}{2} \log C$
 or $pH = 14 - \frac{1}{2} pK_b + \frac{1}{2} \log C$
 or $pK_b = 2(14 + \frac{1}{2} \log C - pH)$
 or $K_b = \text{antilog}[11.612 - \log(0.95) - 28]$
- Ex. 6** The solubility product of BaSO_4 is 1.5×10^{-9} . The precipitation in a 0.01 M Ba^{2+} ions solution will start on adding H_2SO_4 of concentration :
 (A) 10^{-9} M (B) 10^{-8} M
 (C) 10^{-7} M (D) 10^{-6} M
- Sol.** (D) $[\text{Ba}^{2+}][\text{SO}_4^{2-}] = 1.5 \times 10^{-9}$ (K_{sp}) and $[\text{Ba}^{2+}] = 0.01$ M
 so Required $[\text{SO}_4^{2-}] = \frac{1.5 \times 10^{-9}}{0.01} = 1.5 \times 10^{-7}$
 so $[\text{H}_2\text{SO}_4] > 1.5 \times 10^{-7}$ for precipitation of BaSO_4 .
- Ex. 7** pH of a saturated solution of $\text{Ca}(\text{OH})_2$ is 12. Its solubility product is :
 (A) 10^{-6} (B) 4×10^{-6}
 (C) 5×10^{-7} (D) None of these
- Sol.** (C) $pH = 12$ so $[\text{OH}^-] = 10^{-2}$ M
 Now $\text{Ca}(\text{OH})_{2(s)} \rightleftharpoons \text{Ca}^{2+} + 2\text{OH}^-$
 $5 \times 10^{-3} \text{ M} \quad 10^{-2} \text{ M}$
 so $K_{sp} = [\text{Ca}^{2+}][\text{OH}^-]^2$
 $= (5 \times 10^{-3})(10^{-2})^2 = 5 \times 10^{-7}$
- Ex. 8** A sample of 100 ml of 0.10 M acid HA ($K_a = 1 \times 10^{-7}$) is titrated with standard 0.10 M KOH. How many mL of KOH will have to be added when the pH in the titration flask will be 7.00 ?
 (A) 0 (B) 10
 (C) 100 (D) 50
- Sol.** (D) $pH = pK_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$
 $7 = 7 + \log \frac{[N_2 V_2]}{[N_1 V_1 - N_2 V_2]}$
 $1 = \frac{0.1 \times V_2}{0.1 \times 100 - 0.1 \times V_2}$
 or $10 - 0.1 V_2 = 0.1 V_2$
 or $V_2 = 50 \text{ mL}$

Exercise # 1

SINGLE OBJECTIVE

NEET LEVEL

1. Which of the following is non-electrolyte
(A) NaCl (B) CaCl₂
(C) C₁₂H₂₂O₁₁ (D) CH₃COOH
2. Ammonium hydroxide is a
(A) Strong electrolyte
(B) Weak electrolyte
(C) Both under different conditions
(D) Non-electrolyte
3. Ammonium hydroxide is a weak base because
(A) It has low vapour pressure
(B) It is only slightly ionized
(C) It is not a hydroxide of any metal
(D) It has low density
4. Electrolytes when dissolved in water dissociate into their constituent ions. The degree of dissociation of an electrolyte increases with
(A) Increasing concentration of the electrolyte
(B) Decreasing concentration of the electrolyte
(C) Decreasing temperature
(D) Presence of a substance yielding a common ion
5. An electrolyte
(A) Gives complex ions in solution
(B) Dissolves in water to give ions
(C) Is ionized in the solid state
(D) Generates ions on passing electric current
6. A monoprotic acid in 1.00 M solution is 0.01% ionised. The dissociation constant of this acid is
(A) 1×10^{-8} (B) 1×10^{-4}
(C) 1×10^{-6} (D) 10^{-5}
7. Molten sodium chloride conducts electricity due to the presence of
(A) Free electrons
(B) Free ions
(C) Free molecules
(D) Atoms of sodium and chlorine
8. An example for a strong electrolyte is
(A) Urea
(B) Ammonium hydroxide
(C) Sugar
(D) Sodium acetate
9. Which one is strongest electrolyte in the following
(A) NaCl (B) CH₃COOH
(C) NH₄OH (D) C₆H₁₂O₆
10. The equivalent conductance at infinite dilution of a weak acid such as HF
(A) Can be determined by measurement of very dilute HF solution
(B) Can be determined by extrapolation of measurements on dilute solutions of HCl, HBr and HI
(C) Can best be determined from measurements on dilute solutions of NaF, NaCl and HCl
(D) Is an undefined quantity
11. Which of the following is not a Lewis acid
(A) CO (B) SiCl₄
(C) SO₃ (D) Zn²⁺
12. Review the equilibrium and choose the correct statement $\text{HClO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_3\text{O}^+ + \text{ClO}_4^-$
(A) HClO₄ is the conjugate acid of H₂O
(B) H₃O⁺ is the conjugate base of H₂O
(C) H₂O is the conjugate acid of H₃O⁺
(D) ClO₄⁻ is the conjugate base of HClO₄
13. A solution of FeCl₃ in water acts as acidic due to
(A) Hydrolysis of Fe³⁺ (B) Acidic impurities
(C) Dissociation (D) Ionisation
14. A white substance having alkaline nature in solution is
(A) NaNO₃ (B) NH₄Cl
(C) Na₂CO₃ (D) Fe₂O₃
15. Which of the following can act both as Bronsted acid and Bronsted base
(A) Cl⁻ (B) HCO₃⁻
(C) H₃O⁺ (D) OH⁻
16. Lewis acid
(A) Presence of H atom is necessary
(B) Is a electron pair donor
(C) Always a proton donor
(D) Is a electron pair acceptor
17. For two acids A and B, pK_a = 1.2, pK_b = 2.8 respectively in value, then which is true
(A) A and B both are equally acidic
(B) A is stronger than B
(C) B is stronger than A
(D) Neither A nor B is strong
(E) None of these

Exercise # 2

SINGLE OBJECTIVE

AIIMS LEVEL

- Which of the following is not correct :
 - $[H^+] = [OH^-] = \sqrt{K_w}$ for a neutral solution at all temperatures
 - $[H^+] = [OH^-] = 10^{-7}$ for a neutral solution at all temperatures
 - $[H^+] > \sqrt{K_w}$ and $[OH^-] < \sqrt{K_w}$ for an acidic solution
 - $[H^+] < \sqrt{K_w}$ and $[OH^-] > \sqrt{K_w}$ for an alkaline solution
- Which of the following correctly explains the nature of boric acid in aqueous medium:
 - $H_3BO_3 \xrightarrow{H_2O} H_3O^+ + H_2BO_3^-$
 - $H_3BO_3 \xrightarrow{2H_2O} 2H_3O^+ + HBO_3^{2-}$
 - $H_3BO_3 \xrightarrow{3H_2O} 3H_3O^+ + BO_3^{3-}$
 - $H_3BO_3 \xrightarrow{H_2O} B(OH)_4^- + H^+$
- pH for the solution of salt undergoing anionic hydrolysis (say CH_3COONa) is given by:
 - $pH = 1/2 [pK_w + pK_a + \log C]$
 - $pH = 1/2 [pK_w + pK_a - \log C]$
 - $pH = 1/2 [pK_w + pK_b - \log C]$
 - None of these
- The pH of 0.1 M solution of the following salts increases in the order:
 - $NaCl < NH_4Cl < NaCN < HCl$
 - $HCl < NH_4Cl < NaCl < NaCN$
 - $NaCN < NH_4Cl < NaCl < HCl$
 - $HCl < NaCl < NaCN < NH_4Cl$
- The pH of the solution obtained by mixing 10 mL of $10^{-1} N$ HCl and 10 mL of $10^{-1} N$ NaOH is:
 - 8
 - 2
 - 7
 - None of these
- pH of water is 7.0 at $25^\circ C$. If water is heated to $70^\circ C$, the:
 - pH will decrease and solution becomes acidic
 - pH will increase
 - pH will remain constant as 7
 - pH will decrease but solution will be neutral
- The ratio of dissociation constant of two weak acids HA and HB is 4. At what molar concentration ratio, the two acids will have same pH in separate solutions:
 - 2
 - 0.5
 - 4
 - 0.25
- The reverse process of neutralisation is:
 - Hydrolysis
 - Decomposition
 - Dehydration
 - Synthesis
- $10^{-6} M$ HCl is diluted to 100 times. Its pH is:
 - 6.0
 - 8.0
 - 6.95
 - 9.5
- Which solution will have pH closer to 1.0:
 - 100 mL of (M/10) HCl + 100 mL of (M/10) NaOH
 - 55 mL of (M/10) HCl + 45 mL of (M/10) NaOH
 - 10 mL of (M/10) HCl + 90 mL of (M/10) NaOH
 - 75 mL of (M/5) HCl + 25 mL of (M/5) NaOH
- $Ca_3(PO_4)_2$ is insoluble in water. On adding a few drops of HCl to solid $Ca_3(PO_4)_2$ in contact with water, the solid dissolves. The reason is:
 - The solvent becomes more polar on adding HCl
 - $Ca_3(PO_4)_2$ combines with HCl to form soluble $CaCl_2$ and H_3PO_4
 - $Ca(H_2PO_4)_2$ is formed, which dissolves
 - H_3PO_4 , a weak acid is formed and the solubility product of $Ca_3(PO_4)_2$ decrease
- A certain weak acid has a dissociation constant 1.0×10^{-4} . The equilibrium constant for its reaction with a strong base is:
 - 1.0×10^{-4}
 - 1.0×10^{-10}
 - 1×10^{-10}
 - 1.0×10^{-14}
- K_a for the acid HA is 1×10^{-6} . The value of K for the reaction $A^- + H_3O^+ \rightleftharpoons HA + H_2O$ is
 - 1×10^{-6}
 - 1×10^{12}
 - 1×10^{-12}
 - 1×10^6
- The degree of hydrolysis of a salt of weak acid and weak base in its 0.1 M solution is found to be 50%. If the molarity of the solution is 0.2M, the percentage hydrolysis of the salt should be:
 - 100 %
 - 50 %
 - 25 %
 - None of these

Exercise # 3

PART - 1

MATRIX MATCH COLUMN

1. (Use $\log 1.8 = 0.26$, K_a of formic acid $= 1.8 \times 10^{-4}$, K_a of acetic acid $= 1.8 \times 10^{-5}$, K_b of ammonia $= 1.8 \times 10^{-5}$, K_a of $H_2S = 10^{-7}$ and K_a of $H_2S = 10^{-14}$, for the following matchings)

Match the entries of column II for which the equality or inequality given in the column I are satisfied.

Column I

- (A) 10^{-5} M HCl solution > 0.1 M H_2S solution
 (B) CH_3COOH solution at pH equal to 4.74
 = NH_4OH solution at pH equal to 9.26
 (C) 0.1 M CH_3COOH solution
 = 1.0 M $HCOOH$ solution
 (D) 0.1 M of a weak acid HA_1 ($K_a = 10^{-5}$) solution
 < 0.01 M of a weak acid HA_2 ($K_a = 10^{-6}$) solution

Column II

- (p) α_{water} (degree of dissociation of water)
 (q) $[OH^-]$
 (r) α (degree of dissociation)
 (s) pH

2. Match the effect of addition of 1 M NaOH to 50 ml of 1 M $H_2C_2O_4$ (diprotic acid) in column I with column II (Given: $K_{a1} = 10^{-4}$, $K_{a2} = 10^{-9}$)

Column I

- (A) 25 mL of NaOH
 (B) 50 mL of NaOH
 (C) 75 mL of NaOH
 (D) 100 mL of NaOH

Column II

- (p) Buffer solution
 (q) pH is independent of concentration of species present in the solution.
 (r) anionic hydrolysis
 (s) $pH > 7$

3. Match the correct value of K_{sp} expression in term of solubility (s)

Column-I

- (A) Al_2O_3
 (B) CaO
 (C) $Al(OH)_3$
 (D) CaF_2

Column-II

- (p) $4s^3$
 (q) $27s^4$
 (r) $108s^5$
 (s) s^2

4. Match the effect of addition of 1 M NaOH to 100 mL 1 M CH_3COOH (in Column I) with pH (in Column II) :

Column-I

- (A) 25 mL of NaOH
 (B) 50 mL of NaOH
 (C) 75 mL of NaOH
 (D) 100 mL of NaOH

Column-II

- (p) pK_a
 (q) $pK_a + \log 3$
 (r) $pK_a - \log 3$
 (s) $\frac{1}{2} [pK_w + pK_a - \log 2]$

5. When we titrate sodium carbonate solution (in beaker) with hydrochloric acid.

Column-I

- (A) At the start of titration
 (B) Before the first equivalent point
 (C) At the first equivalent point
 (D) Between the first and second equivalent points

Column-II

- (p) Buffer solution of HCO_3^- and CO_3^{2-}
 (q) Buffer solution of H_2CO_3 and HCO_3^-
 (r) Amphiprotic anion,
 $pH = 1/2(pK_{a1} + pK_{a2})$
 (s) Hydrolysis of CO_3^{2-}

Exercise # 4

PART - 1

PREVIOUS YEAR (NEET/AIPMT)

- The conjugate acid of NH_2^- is [CBSE AIPMT 2000]

(A) N_2H_4 (B) NH_4^+
(C) NH_2OH (D) NH_3
- Which of the following statements about pH and H^+ ion concentration is incorrect? [CBSE AIPMT 2000]

(A) Addition of one drop of concentrated HCl in NH_4OH solution decreases pH of the solution
(B) A solution of the mixture of one equivalent of each of CH_3COOH and NaOH has a pH of 7
(C) pH of pure neutral water is not zero
(D) A cold and concentrated H_2SO_4 has lower H^+ ions concentration than a dilute solution of H_2SO_4
- Which one of the following is true for any diprotic acid, H_2X ? [CBSE AIPMT 2000]

(A) $K_{a_2} = K_{a_1}$ (B) $K_{a_2} > K_{a_1}$
(C) $K_{a_2} < K_{a_1}$ (D) $K_{a_2} = \frac{1}{K_{a_1}}$
- Ionisation constant of CH_3COOH is 1.7×10^{-5} and concentration of H^+ ions is 3.4×10^{-4} . Then, find out initial concentration of CH_3COOH molecules. [CBSE AIPMT 2001]

(A) 3.4×10^{-4} (B) 3.4×10^{-3}
(C) 6.8×10^{-4} (D) 6.8×10^{-3}
- Solubility of a M_2S type salt is 3.5×10^{-6} , then find out its solubility product. [CBSE AIPMT 2007]

(A) 1.7×10^{-6} (B) $17. \times 10^{-16}$
(C) 1.7×10^{-18} (D) 1.7×10^{-12}
- Solubility of MX_2 type electrolytes is 0.5×10^{-4} mol/L, then find out K_{sp} of electrolytes. [CBSE AIPMT 2002]

(A) 5×10^{-12} (B) 25×10^{-10}
(C) 1×10^{-13} (D) 5×10^{-13}
- Which has highest pH? [CBSE AIPMT 2002]

(A) $\text{CH}_3\text{CO-OK}^+$ (B) Na_2CO_3
(C) NH_4Cl (D) NaNO_3
- Solution of 0.1 N NH_4OH and 0.1 N NH_4Cl has pH 9.25, then find out pK_b of NH_4OH . [CBSE AIPMT 2002]

(A) 9.25 (B) 4.75
(C) 3.75 (D) 8.25
- The solubility product of AgI at 25°C is 1.0×10^{-16} $\text{mol}^2 \text{L}^{-2}$. The solubility of AgI in 10^{-4} N solution of KI at 25°C is approximately (in mol L^{-1}) [CBSE AIPMT 2002]

(A) 1.0×10^{-10} (B) 1.0×10^{-8}
(C) 1.0×10^{-16} (D) 1.0×10^{-12}
- The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-11} . Its solubility (in mol/L) is [CBSE AIPMT 2004]

(A) 5.6×10^{-6} (B) 3.1×10^{-4}
(C) 2×10^{-4} (D) 4×10^{-4}
- The rapid change of pH near the stoichiometric point of an acid base titration is the basis of indicator detection. pH of the solution is related to ratio of the concentrations of the conjugate acid (HIn) and bas (In^-) forms of the indicator given by the expression [CBSE AIPMT 2004]

(A) $\log \left[\frac{\text{In}^-}{\text{HIn}} \right] = \text{pK}_{\text{In}} - \text{pH}$
(B) $\log \left[\frac{\text{HIn}}{\text{In}^-} \right] = \text{pK}_{\text{In}} - \text{pH}$
(C) $\log \left[\frac{\text{HIn}}{\text{In}^-} \right] = \text{pH} - \text{pK}_{\text{In}}$
(D) $\log \left[\frac{\text{In}^-}{\text{HIn}} \right] = \text{pH} - \text{pK}_{\text{In}}$
- 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 [CBSE AIPMT 2005]

(A) $2.0 \times 10^{-6} \text{ mol L}^{-1}$ (B) $1.0 \times 10^{-5} \text{ mol L}^{-1}$
(C) $1.0 \times 10^{-6} \text{ mol L}^{-1}$ (D) $1.0 \times 10^{-7} \text{ mol L}^{-1}$
- What if the correct relationship between the pH of isomolar solutions of sodium oxide (pH_1), sodium sulphide (pH_2), sodium selenide (pH_3) and sodium telluride (pH_4)? [CBSE AIPMT 2005]

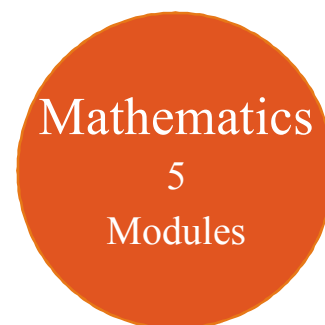
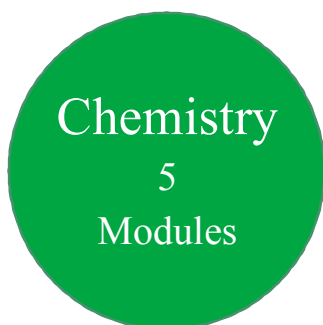
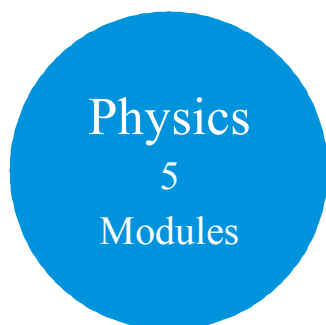
(A) $\text{pH}_1 > \text{pH}_2 \approx \text{pH}_3 > \text{pH}_4$
(B) $\text{pH}_1 < \text{pH}_2 < \text{pH}_3 < \text{pH}_4$
(C) $\text{pH}_1 < \text{pH}_2 < \text{pH}_3 \approx \text{pH}_4$
(D) $\text{pH}_1 > \text{pH}_2 > \text{pH}_3 > \text{pH}_4$

- The following equilibrium is established when hydrogen chloride is dissolved in acetic acid

$$\text{HCl (aq)} + \text{CH}_3\text{COOH (aq)} \rightleftharpoons \text{Cl}^- \text{ (aq)} + \text{CH}_3\text{COOH}_2^+ \text{ (aq)}$$
 The set that characterises the conjugate acid-base pairs is
 (A) (HCl, CH₃COOH) and (CH₃COOH₂⁺, Cl⁻) (B) (HCl, CH₃COOH₂⁺) and (CH₃COOH, Cl⁻)
 (C) (CH₂COOH₂⁺, HCl) and (Cl⁻, CH₃COOH) (D) (HCl, Cl⁻) and (CH₃COOH₂⁺, CH₃COOH).
- The following equilibrium is established when HClO₄ is dissolved in weak acid HF.

$$\text{HF} + \text{HClO}_4 \rightleftharpoons \text{ClO}_4^- + \text{H}_2\text{F}^+$$
 Which of the following is correct set of conjugate acid base pair ?
 (A) HF and HClO₄ (B) HF and ClO₄⁻ (C) HF and H₂F⁺ (D) HClO₄ & H₂F⁺
- Identify the amphoteric species from the following :
 (I) H₂O (II) NH₃ (III) H₂PO₄⁻ (IV) HCO₃⁻
 (A) I, II (B) III, IV (C) I, II, III (D) I, II, III, I
- Which of the following relations is correct ?
 (A) $\Delta G^\circ = RT \ln K_{\text{eq}}$ (B) $[\text{H}_3\text{O}^+] = 10^{\text{pH}}$
 (C) $\log \frac{K_{w2}}{K_{w1}} = \frac{\Delta H^\circ}{2.303R} \left(\frac{1}{T_1} - \frac{1}{T_2} \right)$ (D) $[\text{OH}^-] = 10^{-7}$, for pure water at all temperatures.
- Which of the following is incorrect ?
 (A) K_a (weak acid). K_b (conjugate weak base) = K_w
 (B) K_a (strong acid). K_b (conjugate weak base) = K_w
 (C) K_a (weak acid). K_b (weak base) = K_w
 (D) K_a (weak acid). K_b (conjugate strong base) = K_w
- K_a for the acid HA is 1 × 10⁻⁶. The value of K for the reaction $\text{A}^- + \text{H}_3\text{O}^+ \rightleftharpoons \text{HA} + \text{H}_2\text{O}$ is
 (A) 1 × 10⁻⁶ (B) 1 × 10¹² (C) 1 × 10⁻¹² (D) 1 × 10⁶
- The pK_a value of NH₄⁺ is 9. The pK_b value of NH₄OH would be :
 (A) 9 (B) 5 (C) 7 (D) 8
- Which of the following solution will have a pH exactly equal to 8 ?
 (A) 10⁻⁸ M HCl solution at 25°C (B) 10⁻⁸ M H⁺ solution at 25°C
 (C) 2 × 10⁻⁶ M Ba(OH)₂ solution at 25°C (D) 10⁻⁵ M NaOH solution at 25°C
- Which of the following solution will have pH close to 1.0 ?
 (A) 100 ml of M/10 HCl + 100 ml of M/10 NaOH (B) 55 ml of M/10 HCl + 45 ml of M/10 NaOH
 (C) 10 ml of M/10 HCl + 90 ml of M/10 NaOH (D) 75 ml of M/5 HCl + 25 ml of M/5 NaOH.
- 0.1 mol HCl is dissolved in distilled water of volume V then at $\lim_{V \rightarrow \infty} (\text{pH})_{\text{solution}}$ is equal to
 (A) zero (B) 1 (C) 7 (D) 14
- Dissociation constant of mono basic acids A, B, C and D are 6 × 10⁻⁴, 5 × 10⁻⁵, 3.6 × 10⁻⁶ and 7 × 10⁻¹⁰ respectively. The pH values of their 0.1M aqueous solution are in the order.
 (A) D > C > B > A (B) A > B > C > D (C) D > C > A > B (D) None

11th Class Modules Chapter Details



PHYSICS	CHEMISTRY	BIOLOGY
<p>Module-1</p> <ol style="list-style-type: none"> 1. Physical World & Measurements 2. Basic Maths & Vector 3. Kinematics <p>Module-2</p> <ol style="list-style-type: none"> 1. Law of Motion & Friction 2. Work, Energy & Power <p>Module-3</p> <ol style="list-style-type: none"> 1. Motion of system of particles & Rigid Body 2. Gravitation <p>Module-4</p> <ol style="list-style-type: none"> 1. Mechanical Properties of Matter 2. Thermal Properties of Matter <p>Module-5</p> <ol style="list-style-type: none"> 1. Oscillations 2. Waves 	<p>Module-1(PC)</p> <ol style="list-style-type: none"> 1. Some Basic Concepts of Chemistry 2. Atomic Structure 3. Chemical Equilibrium 4. Ionic Equilibrium <p>Module-2(PC)</p> <ol style="list-style-type: none"> 1. Thermodynamics & Thermochemistry 2. Redox Reaction 3. States Of Matter (Gaseous & Liquid) <p>Module-3(IC)</p> <ol style="list-style-type: none"> 1. Periodic Table 2. Chemical Bonding 3. Hydrogen & Its Compounds 4. S-Block <p>Module-4(OC)</p> <ol style="list-style-type: none"> 1. Nomenclature of Organic Compounds 2. Isomerism 3. General Organic Chemistry <p>Module-5(OC)</p> <ol style="list-style-type: none"> 1. Reaction Mechanism 2. Hydrocarbon 3. Aromatic Hydrocarbon 4. Environmental Chemistry & Analysis Of Organic Compounds 	<p>Module-1</p> <ol style="list-style-type: none"> 1. Diversity in the Living World 2. Plant Kingdom 3. Animal Kingdom <p>Module-2</p> <ol style="list-style-type: none"> 1. Morphology in Flowering Plants 2. Anatomy of Flowering Plants 3. Structural Organization in Animals <p>Module-3</p> <ol style="list-style-type: none"> 1. Cell: The Unit of Life 2. Biomolecules 3. Cell Cycle & Cell Division 4. Transport in Plants 5. Mineral Nutrition <p>Module-4</p> <ol style="list-style-type: none"> 1. Photosynthesis in Higher Plants 2. Respiration in Plants 3. Plant Growth and Development 4. Digestion & Absorption 5. Breathing & Exchange of Gases <p>Module-5</p> <ol style="list-style-type: none"> 1. Body Fluids & Its Circulation 2. Excretory Products & Their Elimination 3. Locomotion & Its Movement 4. Neural Control & Coordination 5. Chemical Coordination and Integration

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12th Class Modules Chapter Details

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Chemistry
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Mathematics
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Modules

PHYSICS	CHEMISTRY	BIOLOGY
<p>Module-1</p> <ol style="list-style-type: none"> 1. Electrostatics 2. Capacitance <p>Module-2</p> <ol style="list-style-type: none"> 1. Current Electricity 2. Magnetic Effect of Current and Magnetism <p>Module-3</p> <ol style="list-style-type: none"> 1. Electromagnetic Induction 2. Alternating Current <p>Module-4</p> <ol style="list-style-type: none"> 1. Geometrical Optics 2. Wave Optics <p>Module-5</p> <ol style="list-style-type: none"> 1. Modern Physics 2. Nuclear Physics 3. Solids & Semiconductor Devices 4. Electromagnetic Waves 	<p>Module-1(PC)</p> <ol style="list-style-type: none"> 1. Solid State 2. Chemical Kinetics 3. Solutions and Colligative Properties <p>Module-2(PC)</p> <ol style="list-style-type: none"> 1. Electrochemistry 2. Surface Chemistry <p>Module-3(IC)</p> <ol style="list-style-type: none"> 1. P-Block Elements 2. Transition Elements (d & f block) 3. Co-ordination Compound 4. Metallurgy <p>Module-4(OC)</p> <ol style="list-style-type: none"> 1. HaloAlkanes & HaloArenes 2. Alcohol, Phenol & Ether 3. Aldehyde, Ketone & Carboxylic Acid <p>Module-5(OC)</p> <ol style="list-style-type: none"> 1. Nitrogen & Its Derivatives 2. Biomolecules & Polymers 3. Chemistry in Everyday Life 	<p>Module-1</p> <ol style="list-style-type: none"> 1. Reproduction in Organisms 2. Sexual Reproduction in Flowering Plants 3. Human Reproduction 4. Reproductive Health <p>Module-2</p> <ol style="list-style-type: none"> 1. Principles of Inheritance and Variation 2. Molecular Basis of Inheritance 3. Evolution <p>Module-3</p> <ol style="list-style-type: none"> 1. Human Health and Disease 2. Strategies for Enhancement in Food Production 3. Microbes in Human Welfare <p>Module-4</p> <ol style="list-style-type: none"> 1. Biotechnology: Principles and Processes 2. Biotechnology and Its Applications 3. Organisms and Populations <p>Module-5</p> <ol style="list-style-type: none"> 1. Ecosystem 2. Biodiversity and Conservation 3. Environmental Issues

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