Exercise-1

ONLY ONE OPTION CORRECT TYPE

Section (A) : Acid base Concepts

1. Which of the following is not a strong electrolyte ?
(1) Fused NaCl (2) Acetic acid (3) Perchloric acid (aq.) (4) Sodium hydroxide (aq.)

2. Which of the following is the strongest acid?
(1) H_3PO_4 (2) H_2SO_4 (3) HNO_2 (4) CH_3COOH

3. Select Polyprotic Arrhenius acids from the following :
(1) H_3PO_2 (2) H_3PO_3 (3) H_3BO_3 (4) HCOOH

4. According to Bronsted and Lowrry concept, water is a/an:
(1) Base (2) Acid (3) Amphoteric (4) Salt

5. Which of the following salts of H_3PO_3 exist(s) ?
(I) NaH_2PO_3 (II) Na_2HPO_3 (III) Na_3PO_3
(1) I and II only (2) I, II and IIII (3) II and III only (4) III only

6. An acid with molelcular formula $C_7H_6O_3$ forms three types of sodium salts. i.e., $C_7H_5O_3Na$, $C_7H_4O_3Na_2$ and $C_7H_3O_3Na_3$. The basicity of the acid is:
(1) One (2) Two (3) Three (4) Four

7. In a reaction,
$HCO_3^- + H_2O \rightleftharpoons CO_3^{-2} + H_3O^+$
Which two substances are Bronsted bases ?
(1) CO_3^{-2} & H_3O^+ (2) HCO_3^- & H_3O^+ (3) HCO_3^- & CO_3^{-2} (4) CO_3^{-2} & H_2O

8. Consider various species generated when H_3PO_4 dissolved in water. Among these, the conjugate acid of HPO_4^{2-} is :
(1) H_3PO_4 (2) $H_2PO_4^-$ (3) PO_4^{3+} (4) H_3O^+

9. The following equilibrium is established when $HClO_4$ is dissolved in weak acid HF.
$HF + HClO_4 \rightleftharpoons ClO_4^- + H_2F^+$
Which of the following is correct set of conjugate acid base pair ?
(1) HF and $HClO_4$ (2) HF and ClO_4^- (3) HF and H_2F^+ (4) $HClO_4$ & H_2F^+

10. In the equilibrium
$CH_3COOH + HF \rightleftharpoons CH_3COOH_2^+ + F^-$
(1) F^- is the conjugate acid of CH_3COOH
(2) F^- is the conjugate base of HF
(3) CH_3COOH is the conjugate acid of $CH_3COOH_2^+$
(4) $CH_3COOH_2^+$ is the conjugate base of CH_3COOH

11. Boric acid H_3BO_3 is a :

(1) Arrhenius acid (2) Bronsted acid (3) Lewis acid (4) All of these

12. Which of the following can act both as Bronsted acid and Bronsted base ?
(1) Cl^- (2) HCO_3^- (3) H_3O^+ (4) OH^-

13. Identify the amphoteric species from the following ?
(I) H_2O (II) NH_3 (III) $H_2PO_4^-$ (IV) HCO_3^-
(1) I, II (2) III, IV (3) I, II, III (4) I, II, III, IV

14. Which of the following is the strongest conjugate base?
(1) Cl^- (2) CH_3COO^- (3) SO_4^{--} (4) NO_2^-

15. Which of the reagents listed below could be added to water to make 0.1M solution of NH_4^+ ?
(1) NH_3 (0.1 M) (2) NH_4Cl (0.1 M) (3) both (4) none of these

Section (B) : Ostwald dilution law, Property of water, pH scale, Relation between K_a and K_b for conjugated acid and base

1. The degree of dissociation in a weak electrolyte increases :
(1) On increasing dilution (2) On increasing pressure
(3) On decreasing dilution (4) None of these

2. At infinite dilution, the percentage ionisation for both strong and weak electrolytes is :
(1) 1% (2) 20% (3) 50% (4) 100%

3. Ostwald's dilution law gives satisfactory results with the solution of which electrolyte ?
(1) HCl (2) HNO_3 (3) CH_3COOH (4) NaOH

4. Aniline is a very weak base. Which of the given aniline solution will have highest degree of dissociation?
(1) 1M aniline (2) 0.1 M aniline (3) 0.01 M aniline (4) 0.02 M aniline

5. pH of human blood is 7.4. Then H^+ concentration will be:
(1) 4×10^{-8} (2) 2×10^{-8} (3) 4×10^{-4} (4) 2×10^{-4}

6. The concentration of H_3O^+ ions in pure water is 10^{-6} mol dm^{-3}. The corresponding concentration of OH^- ions will be :
(1) 10^{-14} mol dm^{-3} (2) 10^{-8} mol dm^{-3} (3) 10^{-6} mol dm^{-3} (4) 10^{-7} mol dm^{-3}

7. pH of pure water is 7 at 298K. If the solution is heated to 320K, which of the following statement is true?
(1) pH will decrease (2) pOH will increase
(3) pH will increase (4) pH will decrease and pOH will increase

8. The ionic product of water at 25°C is 10^{-14} . The ionic product at 90°C will be :
(1) 1×10^{-20} (2) 1×10^{-12} (3) 1×10^{-14} (4) 1×10^{-16}

9. The values of dissociation constants of some acids (at 25°C) are as follows. Indicate which is the strongest acid in water ?
(1) 1.4×10^{-2} (2) 1.6×10^{-4} (3) 4.4×10^{-10} (4) 4.3×10^{-7}

10. For two acids A and B, $pK_a = 1.2$, $pK_b = 2.8$ respectively in value, then which is true ?
(1) A and B both are equally acidic (2) A is stronger than B
(3) B is stronger than A (4) Neither A nor B is strong

11. Select the correct statement :
(1) If $[H^+] = y \times 10^{-x}$ M then pH = x – log y (2) If $[H^+] = \frac{1}{y} \times 10^{-x}$ M then pH = x + log y
(3) At 25°C, pH of a solution = 14 + log $[OH^-]$ (4) All of the above

Section (C) : p^H Calculations : Solutions of Strong Acid, Strong Base and their mixture

1. The pH of M/10 HCl is :
(1) 3 (2) 4 (3) 2 (4) 1

2. The pH of solution obtained by mixing 500 ml of 0.15 M H_2SO_4 with 500 ml of 0.1 M NaOH is :
(1) 0 (2) 1 (3) 2 (4) 7

3. The pH value of 10^{-4} M NaOH solution is :
(1) 4 (2) 10 (3) 6 (4) between 6-7

4. What will be the pH of a solution formed by mixing 40 cm^3 of 0.1 M HCl with 10 cm^3 of 0.45 M NaOH ?
(1) 10 (2) 8 (3) 5 (4) 12

5. Which one has pH =12 ?
(1) 0.01 M KOH (2) 1 M KOH (3) 1 M NaOH (4) 0.5 M $Ca(OH)_2$

6. Given pH of a solution A is 3 and it is mixed with another solution B having pH 2 keeping the volume same. If both are mixed, then resultant pH of the solution will be :
(1) 3.2 (2) 2.26 (3) 3.4 (4) 3.5

7. On adding 0.04 g solid NaOH to a 100 mL, $\frac{M}{200}$ $Ba(OH)_2$ solution, determine change in pH :
(1) 0 (2) +0.3 (3) –0.3 (4) +0.7

8. The pH value of 1.0×10^{-8} M HCl solution is less than 8 because
(1) HCl is completely ionised at this concentration
(2) The ionization of water is negligible
(3) The ionization of water cannot be assumed negligible in comparison with this low concentration of HCl
(4) The pH cannot be calculated at such a low concentration of HCl

9. The pH of 10^{-7} M NaOH is
(1) 7.01 (2) Between 7 and 8 (3) Between 9 and 10 (4) Greater than 10

Section (D) : p^H Calculations : Weak Acid, Weak Base, Polyprotic acid

1. The pH of 0.1 M NH_4OH ($K_b = 1.8 \times 10^{-5}$) is :
(1) 1 (2) 13 (3) 5.7 (4) 11.1

2. The pH of 0.1M CH_3COOH (dissociation constant of acetic acid is 1.80×10^{-5} at 25ºC) will be :
(1) 5 (2) 2.873 (3) 1 (4) 0.18

3. The concentration of a weak monoprotic acid is C moles L^{-1} and ionisation constant K_a. The pH of the solution is :

(1) $\frac{1}{2} pK_a - \frac{1}{2} \log C$ (2) $(K_a \times C)^{1/2}$ (3) $\frac{1}{2} pK_a + \frac{1}{2} \log C$ (4) $\alpha.c$

4. Pure water is kept in a vessel and it remains exposed to atmospheric CO_2 which is absorbed. Then its pH will be :

(1) Greater than 7 (2) Less than 7

(3) 7 (4) Depends on ionic product of water

5. Find the percentage ionisation of 0.2 M acetic acid solution, whose dissociation constant is 1.8×10^{-5}

(1) 0.198 (2) 0.290 (3) 0.950 (4) None of these

6. The pH of a 0.1 M aqueous solution of a weak acid (HA) is 3. What is its degree of dissociation ?

(1) 1% (2) 10% (3) 50% (4) 25%

7. 0.02 M monobasic acid dissociates 2%. Hence, pH of the solution is :

(1) 0.3979 (2) 1.3979 (3) 1.699 (4) 3.3979

8. Concentration of CH_3COO^- is 0.001 M, when 0.1 moles of CH_3COOH were dissolved in 1L water. K_a of CH_3COOH is :

(1) 2×10^{-5} (2) 10^{-5} (3) 10^{-6} (4) 2×10^{-4}

9. For two weak acis A and B, the ratio of their percent ionization is 4 : 9. The ratio of their K_a would be :

(1) 4 : 9 (2) 2 : 3 (3) 16 : 81 (4) 3 : 2

10. The ionisation constant of an acid, K_a, is the measure of strength of an acid. The K_a values of acetic acid, hypochlorous acid and formic acid are 1.74×10^{-5}, 3.0×10^{-8} and 1.8×10^{-4} respectively. Which of the following orders of pH of 0.1 mol dm^{-3} solutions of these acids is correct?

(1) acetic acid > hypochlorous acid > formic acid

(2) hypochlorous acid > acetic acid > formic acid

(3) formic acid > hypochlorous acid > acetic acid

(4) formic acid > acetic acid > hypochlorous acid

11. For diprotic acid H_2S, which is the best way to represent its ionisation in water ?

(1) $H_2S \rightleftharpoons 2H^+ + S^{2-}$ (2) $H_2S \rightleftharpoons H^+ + HS^-$; $HS^- \rightleftharpoons H^+ + S^{2-}$

(3) both (4) none of these

12. The ionisation constant of a tribasic acid is K_a. If its first , second and third ionisation constant are K_{a_1}, K_{a_2} and K_{a_3} respectively then :

(1) $K_a = K_{a_1} \times K_{a_2} \times K_{a_3}$ (2) $K_a = \frac{K_{a_1}}{K_{a_2} \times K_{a_3}}$

(3) $K_{a_2} = \frac{K_{a_1} \times K_a}{K_{a_3}}$ (4) None of these

13. What will be the pH of a 0.01 M H_3PO_4 solution having $[PO_4^{3-}] = 10^{-5}$ M ? $\left[K_{a_1} = 10^{-4}, K_{a_2} = 10^{-6}, K_{a_3} = 10^{-8}\right]$

(1) 3 (2) 4 (3) 5 (4) 6

14. K_a for a weak acid HA is 1.44×10^{-5}. What is the concentration of A^- when 0.01 mole of HA is dissolved in 1L of 0.01M HCl solution ?

(1) 0.01 M (2) 1.2×10^{-3} M (3) 1.44×10^{-5}M (4) 0.012 M

Section (E) : Salt Hydrolysis

1. The reverse process of neutralisation is :

(1) Hydrolysis (2) Decomposition (3) Dehydration (4) Synthesis

2. When a salt 'X' is dissolved in water at pH = 7, the resulting solution becomes alkaline in nature. Salt 'X' is made up of :

(1) strong acid and strong base (2) weak acid and weak base
(3) weak acid and strong base (4) strong acid and weak base

3. The salt that when added to water will not change its pH is :

(1) Na_2CO_3 (2) NaCl (3) KCN (4) NH_4Cl

4. The most acidic aqueous solution is :

(1) CH_3COONa (2) Na_2CO_3 (3) NH_4Cl (4) Na_2HPO_4

5. The pH a 0.01 M solution of ammonium acetate can be changed by changing :

(1) the temperature (2) the volume of solution
(3) the concentration (4) the pressure on solution

6. Which of the following salts undergo anionic hydrolysis ?

(1) Na_3PO_4 (2) NaCl (3) NH_4Cl (4) $FeSO_4$

7. The aqueous solution of which of the following salt has the lowest pH ?

(1) NaClO (2) $NaClO_2$ (3) $NaClO_3$ (4) $NaClO_4$

8. Select the correct combination :

(1) The aqueous solution of each Na_3BO_3 and Na_3PO_4 – Acidic nature

(2) The aqueous solution of each Na_3BO_3 and CH_3COONa – basic nature

(3) The aqueous solutions of each CH_3COONa and NaCN – acidic nature

(4) The aqueous solutions of each Na_3PO_4 and NH_4Cl – acidic nature

9. What is the pH of an aqueous solution of ammonium acetate ($K_a = K_b = 1.8 \times 10^{-5}$) ?

(1) > 7 (2) 7.0 (3) < 7.0 (4) Zero

10. If $pK_b > pK_a$ then the solution of the salt of weak acid and weak base will be –

(1) Neutral (2) Acidic (3) Basic (4) Amphoteric

11. $pOH = 7 - 0.5\ pK_a + 0.5\ pK_b$ is true for which pair of cation and anion?

(1) $C_6H_5NH_3^+$, CH_3COO^- (2) Na^+, CN^-

(3) Al^{3+}, Cl^- (4) NH_4^+, NO_3^-

12. The hydrolysis constant of 0.5 M ammonium benzoate is 6.25×10^{-6}. The percentage hydrolysis of the salt is :

(1) 0.25 (2) 0.177 (3) 0.125 (4) 0.50

13. A solution of 0.10 M NaZ has pH = 8.90. The K_a of HZ is :
(1) 1.6×10^{-4} (2) 1.6×10^{-5} (3) 6.3×10^{-10} (4) 6.3×10^{-11}

14. The pH of 0.01 M sodium acetate solution is : $[K_a(CH_3COOH)] = 2 \times 10^{-5}$
(1) 7.25 (2) 6.5 (3) 8.05 (4) 8.35

Section (F) : Buffer Solutions

1. pH of circulating blood is maintained around 7.4 by the action of buffer system of :
(1) $H_2PO_4^-/HPO_4^{2-}$ (2) CO_2 / HCO_3^- (3) NH_4Cl/NH_4OH (4) CH_3COO^-/CH_3COONa.

2. Which of the following does not act as a buffer solution ?
(1) Sodium acetate and acetic acid (2) Boric acid and borax
(3) Na_3PO_4 and Na_2HPO_4 (4) Sodium acetate and sodium citrate

3. Addition of sodium acetate solution to acetic acid cause the following change
(1) pH increases (2) pH decreases (3) pH remains unchanged (4) pH becomes 7

4. Buffer solutions have constant acidity and alkalinity because :
(1) these give unionised acid or base on reaction with added acid or alkali.
(2) acids and alkalies in these solution are shielded from attack by other ions.
(3) they have large excess of H^+ or OH^- ions.
(4) they have fixed value of pH.

5. In which of the following respective volume ratios should 0.1 M NH_4OH solution & 0.1 M HCl solution be mixed, so that the resulting solution behaves like a buffer solution ?
(1) 1 : 1 (2) 2 : 1
(3) 1 : 2 (4) No such volume ratio is possible

6. Which may be added to one litre of water to act a buffer:
(1) One mole of CH_3COOH and one mole of HCl (2) One mole of NH_4OH and one mole of NaOH
(3) One mole of NH_4Cl and one mole of HCl (4) One mole of CH_3COOH and 0.5 mole of NaOH

7. Which of these mixtures constitute buffer solutions ?
Mixture 1 : 25 mL of 0.10 M HNO_3 and 25 mL of 0.10 M $NaNO_3$
Mixture 2 : 25 mL of 0.10 M $(COOH)_2$ and 25 mL of 0.10 M NaOH
(1)1 only (2) 2 only (3) both 1 and 2 (4) neither 1 nor 2

8. Calculate the pH of a solution made by mixing 150 cm^3 of 0.10 M CH_3 COONa and 250 cm^3 of 0.10 M CH_3COOH. [K_a of $CH_3COOH = 1.8 \times 10^{-5}$]
(1) 237 (2) 4.52 (3) 4.74 (4) 4.97

9. A buffer solution is prepared by mixing 0.050 moles of a weak acid HA and 0.20 moles of NaA in sufficient amount of water to give 500 mL of solution (K_a for HA is 4.5×10^{-4}). The pH of this solution is :
(1) 1.97 (2) 2.17 (3) 2.74 (4) 3.95

10. A buffer solution with pH 9 is to be prepared by mixing NH_4Cl and NH_4OH . Calculate the number of moles of NH_4Cl that should be added to one litre of 1.0 M NH_4OH. [$K_b = 1.8 \times 10^{-5}$]
(1) 3.4 (2) 2.6 (3) 1.5 (4) 1.8

11. Which of the given solutions have pOH = pK_b (NH_3) ?

(1) 10 ml of 0.1 M HCl + 10 ml of 0.2 M NH_3 (2) 10 ml of 0.1 M HCl + 20 ml of 0.1 M NH_3

(3) 50 ml of 0.2 M HCl + 20 ml of 1M NH_3 (4) all of these

12. K_b of aniline is 10^{-10}. A solution containing equal moles of aniline and anilinium chloride will be :

(1) basic (2) neutral (3) acidic (4) can't be predicted

13. The ionization constant of a certain weak acid is 10^{-4}. What should be the [salt] to [acid] ratio if we have to prepare a buffer with pH = 5 using this acid and one of the salts ?

(1) 1 : 10 (2) 10 : 1 (3) 5 : 4 (4) 4 : 5

14. In a mixing of acetic acid and sodium acetate the ratio of concentration of the salts to the acid is increased ten times. Then the pH of the solution :

(1) Increases by one (2) Decreases by one (3) Decrease ten fold (4) Increase ten fold

Section (G) : Acid base Titration and Indicator

1. Which indicator will be suitable for the titration of acetic acid vs NaOH ?

(1) methyl orange [pK_{in} = 3.7] (2) bromocresol green [pK_{In} = 4.7]

(3) chlorophenol red [pK_{In} = 6.1] (4) phenolphthalein [pK_{In} = 9.6]

2. The pH indicators are :

(1) Salts of strong acids and strong bases (2) Salts of weak acids and weak bases

(3) Either weak acids or weak bases (4) Either strong acids or strong bases

3. The pH range of methyl red indicator is :

(1) 4.2 to 6.3 (2) 8.3 to 10.0 (3) 8.0 to 9.6 (4) 6.8 to 8.4

4. What is the pH of the solution at half neutralization in the titration of 0.1 M CH_3COOH and 0.1 M KOH : ($K_a = 1.8 \times 10^{-5}$)

(1) 4.75 (2) 1 (3) 13 (4) Zero

5. A 0.200 g sample of benzoic acid, C_6H_5COOH, is titrated with a 0.120 M $Ba(OH)_2$ solution. What volume of the $Ba(OH)_2$ solution is required to reach the equivalence point ?

[C_6H_5COOH,Molar Mass = 122.1 g mol^{-1}]

(1) 6.82 mL (2) 13.6 mL (3) 17.6 mL (4) 35.2 mL

6. 0.1 dm^3 of 0.1 M acetic acid is titrated against 0.1 M NaOH. When 50 cm^3 of 0.1 M NaOH are added, the pH of the solution will be : (pK_a = 4.74)

(1) 2.37 (2) 4.74 (3) 1.34 (4) 5.74

Section (H) : Solubility product and solubility calculation

1. Which is the correct representation of the solubility product constant of Ag_2CrO_4 ?

(1) $[Ag^+]^2[CrO_4^{-2}]$ (2) $[Ag^+][CrO_4^{-2}]$ (3) $[2Ag^+][CrO_4^{-2}]$ (4) $[2Ag^+]^2[CrO_4^{-2}]$

2. If the solubility of calcium fluoride in pure water is x mol/L, Its solubility product is :

(1) $\sqrt{2}x$ (2) $2x^2$ (3) $4x^3$ (4) x^2

3. The solubility of $PbCl_2$ is:

(1) $\sqrt{K_{sp}}$ (2) $\sqrt[3]{K_{sp}}$ (3) $\sqrt[3]{\frac{K_{sp}}{4}}$ (4) $\sqrt{8K_{sp}}$

4. The aqueous solution of which of the following sulphides would contain maximum concentration of S^{2-} ions:

(1) MnS ($K_{sp} = 1.1 \times 10^{-21}$) (2) ZnS ($K_{sp} = 1.1 \times 10^{-23}$)

(3) PbS ($K_{sp} = 1.1 \times 10^{-35}$) (4) CuS ($K_{sp} = 1.1 \times 10^{-30}$)

5. The solubility product of Ag_2CrO_4 is 32×10^{-12} . What is the concentration of CrO_4^{2-} ions in that solution

(1) 2×10^{-4} M (2) 16×10^{-4} M (3) 8×10^{-4} M (4) 8×10^{-8} M

6. The solubility of $BaSO_4$ in water is 2.33×10^{-3} g / litre. Its solubility product will be (molecular weight of $BaSO_4$ = 233)

(1) 1×10^{-5} (2) 1×10^{-10} (3) 1×10^{-15} (4) 1×10^{-20}

7. K_{sp} of AgCl is 1.8×10^{-11}. The minimum volume of water required to dissove 1.9 mg of AgCl is approximetaly ?

(1) 10L (2) 2L (3) 1L (4) 20L

8. If the K_{sp} of CaF_2 at 25ºC is 1.6×10^{-10}, then the number of moles of the salt must be dissolved in 2.0 L of water at 25ºC to form a saturated solution is :

(1) 2.6×10^{-2} mol (2) 1.3×10^{-3} mol (3) 6.8×10^{-4} mol (4) 3.4×10^{-4} mol

9. Solubility of BaF_2 in a solution of $Ba(NO_3)_2$ will be represented by the concentration term:

(1) $[Ba^{2+}]$ (2) $[F^-]$ (3) $1/2[F^-]$ (4) $2[NO_3^-]$

10. The solubility of CaF_2 ($K_{sp} = 3.4 \times 10^{-11}$) in 0.005 M solution of BaF_2 is :

(1) 3.4×10^{-19} M (2) 1.36×10^{-6} M (3) 3.4×10^{-7} M (4) 1.36×10^{-7} M

11. K_{sp} of AgCl is 1×10^{-10}. Its solubility in 0.1 M KNO_3 will be :

(1) 10^{-5} moles/litre (2) $> 10^{-5}$ moles/litre (3) $< 10^{-5}$ moles/litre (4) None of these

12. Solubility of AgCl will be minimum in :

(1) 0.001M $AgNO_3$ (2) Pure water (3) 0.01 M $CaCl_2$ (4) 0.01 M NaCl

13. The necessary condition for saturated solution is :

(1) Product of ionic concentrations raised to power their number produced from one formula unit = Solubility product

(2) Products of ionic concentrations raised to power their number produced from one formula unit < solubility products

(3) Product of ionic concentrations raised to power their number produced from one formula unit > solubility product

(4) None of the above

14. Which one of the following is most soluble ?

(1) CuS ($K_{sp} = 8\times10^{-37}$) (2) MnS ($K_{sp} = 7\times10^{-16}$)

(3) Bi_2S_3 ($K_{sp} = 1\times10^{-70}$) (4) Ag_2S ($K_{sp} = 6\times10^{-51}$)

15. If each of the following salts has $K_{sp} = 1 \times 10^{-9}$, which of them is the least soluble in water ?

(1) XY (2) XY_2 (3) X_2Y (4) X_3Y

16. Equal volumes of two solutions are mixed. The one in which $CaSO_4$ ($K_{sp} = 2.4 \times 10^{-5}$) is precipitated is :
(1) 0.02 M $CaCl_2$ + 0.004 M Na_2SO_4 (2) 0.002 M $CaCl_2$ + 0.04 M Na_2SO_4
(3) 0.2 M $CaCl_2$ + 0.004 M Na_2SO_4 (4) 0.2 M $CaCl_2$ + 0.0004 M Na_2SO_4.

17. If K_{sp} (AgCl) is 10^{-10} , then which of the solution are saturated with AgCl ?
(1) $[Ag^+] = 10^{-10}$, $[Cl^-] = 1M$ (2) $[Ag^+] = 10^{-11}$, $[Cl^-] = 1M$
(3) $[Ag^+] = 10^{-6}$ M $[Cl^-] = 10^{-5}$ M (4) $[Ag^+] = 10^{-2}M$, $[Cl^-] = 10^{-8.5}M$

18. K_{sp} of AgBr is 5×10^{-13} . Precipitation of AgBr will take place in a solution having :
(1) 0.1 M $AgNO_3$ and 5×10^{-12} M NaBr (2) 5×10^{-12} M $AgNO_3$ and 0.1 M NaBr
(3) 2×10^{-6} M $AgNO_3$ and 4×10^{-8} M NaBr (4) 2×10^{-6} M $AgNO_3$ and 4×10^{-6} M NaBr

Exercise-2

1. The conjugate base of $[Al(H_2O)_3(OH)_3]$ is :
(1) $[Al(H_2O)_3(OH)_2]^+$ (2) $[Al(H_2O)_3(OH)_2O]^-$ (3) $[Al(H_2O)_3(OH)_3]^-$ (4) $[Al(H_2O)_2(OH)_4]^-$

2. Following specis are classified into acid, base and amphiprotic species on the basis of protonic concept
(i) $H_2PO_2^-$ (ii) $H_2PO_3^-$ (iii) $H_2PO_4^-$ (iv) HPO_3^{2-}
(v) HPO_4^{2-} (vi) NH_4^+ (vii) $CH_3COOH_2^+$
which is correct match:
(1) Acidic – (vi), (vii) (2) Basic – (i), (iv) (3) Amphiprotic – (ii), (iii), (v) (4) All are correct

3. Which of the following correctly explains the nature of boric acid in aqueous medium ?
(1) $H_3BO_3 \xrightarrow{H_2O} H_3O^+ + H_2BO_3^-$ (2) $H_3BO_3 \xrightarrow{2H_2O} 2H_3O^+ + HBO_3^{2-}$
(3) $H_3BO_3 \xrightarrow{3H_2O} 3H_3O^+ + BO_3^{3-}$ (4) $H_3BO_3 \xrightarrow{H_2O} B(OH)_4^- + H^+$

4. For an acid solution, at 25°C the $[OH^-]$ is:
(1) $> 10^{-7}$ M (2) $< 10^{-7}$ M (3) 10^{-14} M (4) 10^{-7} M

5. In pure HCOOH liquid, concentration of $HCOO^- = 10^{-3}$ M at 27ºC. What is the self ionisation constant at 27ºC ($K = [HCOOH_2^+][HCOO^-]$) ?
(1) 10^{-3} (2) 10^3 (3) 10^6 (4) 10^{-6}

6. K_{a1} , K_{a2} and K_{a3} values for H_3PO_4 are 10^{-3}, 10^{-8} and 10^{-12} respectively. If K_w (H_2O) = 10^{-14}, then which is correct :
(1) Dissociation constant of HPO_4^{2-} is 10^{-12} (2) K_b of HPO_4^{2-} 10^{-6}
(3) K_b of $H_2PO_4^-$ 10^{-11} (4) All are correct

7. Which of the following solutions are not correctly matches with its pH :
(1) 0.001 M HNO_3 ; (pH = 3) (2) 0.005 M H_2SO_4 ; (pH = 2)
(3) 10^{-8} M NaOH ; (pH = 7.02) (4) 0.0008 M $Ba(OH)_2$; (pH = 11)

8. Which solution has pH exactly equal to 6 at 25ºC ?
(1) 10^{-6} M CH_3COOH solution (2) 10^{-8} M NaOH solution
(3) 10^{-6} M H^+ solution (4) 5×10^{-7} M H_2CO_3 solution

9. The pH of 1L NaOH solution can be changed from 13 to 12 by :

(1) Diluting it to 10L (2) Adding 0.1 mole of NaOH
(3) Removing 0.9 mole of OH^- (4) Removing 0.01 mole of OH^-

10. Which would decrease the pH of 25cm^3 of a 0.01M solution of hydrochloric acid ?
(1) The addition of 25cm^3 of 0.005 M hydrochloric acid
(2) The addition of 25 cm^3 of 0.02 M hydrochloric acid
(3) The addition of magnesium metal
(4) None of these

11. 10^{-6} M HCl is diluted to 100 times. Its pH is :
(1) 6.0 (2) 8.0 (3) 6.95 (4) 9.5

12. The hydrogen ion concentration of 0.1 M solution of CH_3COOH, which is 30% dissociated, is :
(1) 0.03 (2) 3.0 (3) 0.3 (4) 30.0

13. The pK_a of acetic acid is 4.74, which implies that :
(1) pH of 1 N acetic acid is 4.74.
(2) at pH 4.74, the dissociation of acetic acid is maximum.
(3) at pH 4.74, half of the acetic acid molecules are dissociated in the solution.
(4) at pH 4.74, the dissociation of acetic acid is minimum.

14. Equal volumes of 0.1 M aniline solution ($K_b = 10^{-10}$) is mixed with 0.1M NH_3 solution ($K_b = 10^{-6}$). Then, which of the following is correct ?
(1) $\alpha_{aniline} > \alpha_{NH3}$ (2) $\alpha_{aniline} = \alpha_{NH3}$
(3) $\alpha_{NH3} > \alpha_{aniline}$ (4) Can't be predicted from the given information.

15. The dissociation constant of two acids HA_1 and HA_2 are 3.14×10^{-4} and 1.96×10^{-5} respectively. The relative strength of the acids will be approximately :
(1) 1 : 4 (2) 4 : 1 (3) 1 : 16 (4) 16 : 1

16. The K_a of monobasic acid A, B and C are 10^{-6} , 10^{-8} and 10^{-10} respectively. The concentrations of A, B and C are respectively. 0.1M, 0.01 M and 0.001 M. Which of the following is correct for pOH of A, B & C ?
(1) pOH (A) < pOH (B) < pOH (C) (2) pOH (A) > pOH (B) > pOH (C)
(3) pOH (A) = pOH (B) = pOH (C) (4) pOH (C) < pOH (A) < pOH (B)

17. The following equilibrium exists in aqueous solution, $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$. If dil HCl is added, without change in temperature :
(1) Concentration of CH_3COO^- will increase (2) Concentration of CH_3COO^- will decrease
(3) The equilibrium constant will increase (4) The equilibrium constant will decrease

18. A diprotic, Carbonic acid has following the K_a values.

$H_2CO_3 + H_2O \rightleftharpoons HCO_3^- + H_3O^+$, $K_{a1} = 4.3 \times 10^{-7}$

$HCO_3^- + H_2O \rightleftharpoons CO_3^{-2} + H_3O^+$, $K_{a2} = 4.8 \times 10^{-11}$

What is the concentration of carbonate ion in saturated solution of H_2CO_3 that is 0.037 M ?

(1) 4.3×10^{-7} (2) 4.8×10^{-11} M (3) 4.6×10^{-11} M (4) 3.8×10^{-9} M

19. How many of the following are acidic salts ?

Na_2SO_4 Ca(OH)Cl Pb(OH)Cl $NaHSO_4$

$NaHSO_3$ Na_2SO_3 Na_2S BiOCl NaH_2PO_4

(1) 2 (2) 3 (3) 6 (4) 8

20. The salt of which of the following four weak acids will be most hydrolysed ?

(1) HA ; $K_a = 1 \times 10^{-6}$ (2) HB ; $K_a = 2 \times 10^{-6}$ (3) HC ; $K_a = 3 \times 10^{-8}$ (4) HD ; $K_a = 4 \times 10^{-10}$

21. The pH of 0.1 M solution of the following salts increases in the order:

(1) NaCl < NH_4Cl < NaCN < HCl (2) HCl < NH_4Cl < NaCl < NaCN

(3) NaCN < NH_4Cl < NaCl < HCl (4) HCl < NaCl < NaCN < NH_4Cl

22. The pH of NaA > pH of NaB solution. Then the correct relation is:

(1) $K_a(HA) > K_a(HB)$ (2) $K_a(HB) > K_a(HA)$ (3) $K_b(A^-) > K_b(B^-)$ (4) 2 & 3 both

23. % hydrolysis of 0.1 M CH_3COONH_4, when $K_a = K_b = 1.8 \times 10^{-5}$ is :

(1) 0.55 (2) 7.63 (3) 0.55×10^{-2} (4) 7.63×10^{-3}

24. What is the effect of pH on the solubility of $M(CN)_2$ (neglect hydrolysis of M^{2+} ion) ?

(1) pH decreases, solubility decreases. (2) pH increases, solubility increases.

(3) pH decreases, solubility increases. (4) no dependence on pH of solution.

25. Which of the following compound forms an aqueous solution which is acidic when compared with water

(1) NaOH (2) K_2CO_3 (3) $BaCl_2$ (4) $Al_2(SO_4)_3$

26. Which of the following solutions cannot act as a buffer ?

(1) $NaH_2PO_4 + H_3PO_4$ (2) $CH_3COOH + CH_3COONa$

(3) HCl + NH_4Cl (4) $H_3PO_4 + Na_2HPO_4$

27. Which of the following will produce a buffer solution when mixed in equal volumes?

(1) 0.1 mol dm^{-3} NH_4OH and 0.1 mol dm^{-3} HCl

(2) 0.05 mol dm^{-3} NH_4OH and 0.1 mol dm^{-3} HCl

(3) 0.1 mol dm^{-3} NH_4OH and 0.05 mol dm^{-3} HCl

(4) 0.1 mol dm^{-3} CH_4COONa and 0.1 mol dm^{-3} NaOH

28. A solution contain equal moles of CH_3COOH and CH_3COONa. The pH will change significantly if :

(1) small amount of CH_3 COONa is added without changing volume.

(2) small amount of CH_3COOH is added without changing volume.

(3) the solution is diluted

(4) moles of HCl equal to moles of CH_3COONa are added.

29. K_a for HCN is 5×10^{-10}. For maintaining a constant pH of 9, the volume of 5 M KCN solution required to be added to 10 mL of 2 M HCN solution is :
(1) 4 mL (2) 8 mL (3) 2 mL (4) 10 mL

30. 50 mL of 2M acetic acid mixed with 10 mL of 1M sodium acetate solution will have an approximate pH of: ($K_a = 10^{-5}$)
(1) 4 (2) 5 (3) 6 (4) 7

31. Which of the following solutions has minimum buffer capacity ?
(1) 0.1 M CH_3COOH & 0.1 M CH_3COONa (2) 0.01 M CH_3COOH & 0.01 M CH_3 COONa
(3) 0.1 M CH_3COOH & 0.2 CH_3COONa (4) 0.001 M CH_3COOH & 0.001 M CH_3COONa

32. The amount of sodium hydrogen carbonate, $NaHCO_3$, in an antacid tablet is to be determined by dissolving the tablet in water and then titrating the resulting solution with hydrochloric acid. Which indicator is the most appropriate for this titration ?

Acid	K_a
H_2CO_3	2.5×10^{-4}
HCO_3	2.4×10^{-8}

(1) methyl orange, $pK_{in} = 3.7$ (2) bromothymol blue, $pK_{in} = 7.0$
(3) phenolphthalein, $pK_{in} = 9.3$ (4) alizarin yellow, $pK_{in} = 12.5$

33. Why are strong acids generally used as standard solutions in acid-base titrations
(1) The pH at the equivalence point will always be 7
(2) They can be used to titrate both strong and weak bases
(3) Strong acids form more stable solutions than weak acids
(4) The salts of strong acids do not hydrolysed

34. The total number of different kind of buffers obtained during the titration of H_3PO_4 with NaOH are:
(1) 3 (2) 1 (3) 2 (4) Zero

35. A 50 ml sample of weak monobasic acid HA requires 100 ml of 0.25 M NaOH for complete neutralization. If the pH = 5 when 100 ml of same NaOH is added to 100 ml of original sample of HA., then pK_a of HA is :
(1) 5 (2) 5.5 (3) 6 (4) 9

36. The solubility product of AgCl is 10^{-10}. What volume of water (in L) is required to dissolve 2.87 mg of AgCl?
(1) 1L (2) 2L (3) 4L (4) 10L

37. The solubility of CaF_2 ($K_{sp} = 3.4 \times 10^{-11}$) in 0.1 M solution of NaF would be:
(1) 3.4×10^{-12} M (2) 3.4×10^{-10} M (3) 3.4×10^{-9} M (4) 3.4×10^{-13} M.

38. Which of the following would increase the solubility of Pb $(OH)_2$:
(1) Add hydrochloric acid
(2) Add a solution of $Pb(NO_3)_2$
(3) Add a solution of $Pb(CH_3COO)_2$
(4) None of the above – the solubility of a compound is constant at constant temperature.

39. The solubility $Fe(OH)_3$ will be maximum in :

(1) 0.1 M $Ca(OH)_2$ (2) 0.2 M HCl (3) 0.2M NaOH (4) 0.2 M H_2SO_4

40. The pH of a solution prepared by adding 1 mole of $Mg(OH)_2$ in 1L water is (K_{sp} $Mg(OH)_2$ = 1 × 10^{-11}, log = $\left(2\times(2.5)^{1/3}\right)0.433$) :

(1) 9 (2) 3.87 (3) 10.43 (4) 5

41. Solubility of As_2S_3 in 10^{-3}M Na_2S solution, assuming no hydrolysis of cationic or anionic part is :

(K_{sp} As_2S_3 = 16 × 10^{-27})

(1) 10^{-10} M (2) 2 × 10^{-9} M (3) 10^{-9} M (4) 2 × 10^{-8} M

42. The solubility product of Ag_2CO_3 and $FeCO_3$ in water at 25ºC are 4 × 10^{-12} and 2.5 × 10^{-11} respectively. If S_1 and S_2 are their solubilities in water respectively when dissolved separately, then S_1/S_2 is :

(1) 2 : 1 (2) 20 : 1 (3) 1 : 2 (4) 1 : 20

43. How many millimoles of NaOH should be added to 1L of 0.1M $FeCl_3$ solution to just start the precipitation of $Fe(OH)_3$? K_{sp} [$Fe(OH)_3$] = 8 × 10^{-13}.

(1) 2 (2) 4 (3) 0.2 (4) 0.4

44. K_{sp} (SnS) = 10^{-25}

K_{sp} (ZnS) = 1.6 × 10^{-24}

To a solution containing 0.01M Sn^{2+} and 0.2 M Zn^{2+}, S^{2-} is added gradually without changing the volume of solution. Which of the following is correct ?

(1) SnS precipitates first (2) ZnS precipitates first

(3) both precipitate together (4) No precipitation takes place

45. The solubility product of AgCl is 1.8 × 10^{-10}. Precipitation of AgCl will occur only when equal volumes of solutions of :

(1) 10^{-4}M Ag^+ and 10^{-4} M Cl^- are mixed (2) 10^{-7} M Ag^+ and 10^{-7} M Cl^- are mixed

(3) 10^{-5} M Ag^+ and 10^{-5} M Cl^- are mixed (4) 2 × 10^{-5} M Ag^+ and 2 × 10^{-5} M Cl^- are mixed.

Exercise-3

PART - I : NEET / AIPMT QUESTIONS (PREVIOUS 15 YEARS)

1. Ionisation constant of CH_3COOH is 1.7 x 10^{-5} and concentration of H^+ ions is 3.4 × 10^{-4}, Then, find out initial concentration of CH_3 COOH molecules. **[AIPMT-2001]**

(1) 3.4 ×10^{-4} (2) 3.4 × 10^{-3} (3) 6.8 × 10^{-4} (4) 6.8 × 10^{-3}

2. Solubility of a M_2S type salt is 3.5 × 10^{-16}, then find out its solubility product : **[AIPMT-2001]**

(1) 1.7 ×10^{-6} (2) 1.7 × 10^{-16} (3) 1.7 × 10^{-18} (4) 1.7 × 10^{-12}

3. Solubility of MX_2 type electrolytes is 0.5 ×10^{-4} mol/L, then find out K_{sp} of electrolytes. **[AIPMT-2002]**

(1) 5 ×10^{-12} (2) 25 × 10^{-10} (3) 1 × 10^{-13} (4) 5 × 10^{-13}

4. 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. **[AIPMT-2002]**

(1) 9.25 (2) 4.75 (3) 3.75 (4) 8.25

5. Which of the following has highest pH ? **[AIPMT-2002]**

(1) CH_3COOK (2) Na_2CO_3 (3) NH_4Cl (4) $NaNO_3$

6. The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-11}. Its solubility (in mol/L) is **[AIPMT-2003]**

(1) 5.6×10^{-6} (2) 3.1×10^{-4} (3) 2×10^{-4} (2) 4×10^{-4}

7. The solubility product of AgI at 25°C is 1.0×10^{-16} mol^2 L^{-2}. The solubility of AgI in 10^{-4} N solution of KI at 25°C is approximately (in mol^{-1}) **[AIPMT 03]**

(1) 1.0×10^{-16} (2) 1.0×10^{-12} (3) 1.0×10^{-10} (4) 1.0×10^{-8}

8. 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 concentration of conjugate acid (H In) and the base (In^-) forms of the indicator by the expression **[AIPMT 04]**

(1) $\log \frac{[In^-]}{[HIn]} = pK_{In} - pH$ (2) $\log \frac{[HIn]}{[In^-]} = pK_{In} + pH$

(3) $\log \frac{[HIn]}{[In^-]} = pH - pK_{In}$ (4) $\log \frac{[In^-]}{[HIn]} = pH - pK_{In}$

9. What is the correct relationship between the pHs of isomolar solutions of sodium oxide (pH_1), sodium sulphide (pH_2), sodium selenide (pH_3), and sodium telluride (pH_4) ? **[AIPMT-2005]**

(1) $pH_1 > pH_2 pH_3 > pH_4$ (2) $pH_1 < pH_2 < pH_3 < pH_4$ (3) $pH_1 < pH_2 < pH_3 pH_4$ (4) $pH_1 > pH_2 > pH_3 > pH_4$

10. Which of the following pairs constitutes a buffer ? **[AIPMT-2006]**

(1) HNO_2 and $NaNO_2$ (2) NaOH and NaCl (3) HNO_3 and NH_4NO_3 (4) HCl and KCl

11. The hydrogen ion concentration of a 10^{-8} M HCl aqueous solution at 298 K ($K_w = -10^{-14}$) is **[AIPMT 06]**

(1) 9.525×10^{-8} M (2) 1.0×10^{-8} M (3) 1.0×10^{-6} M (4) 1.0525×10^{-7} M

12. Calculate the pOH of a solution at 25°C that contains 1×10^{-10} M of hydronium ions. **[AIPMT-2007]**

(1) 7.00 (2) 4.00 (3) 9.00 (4) 1.00

13. A weak acid, HA, has a K_a of 1.00×10^{-5}. If 0.100 mol of the acid is dissolved in one litre of water, the percentage of the acid dissociated at equilibrium is closest to **[AIPMT 07]**

(1) 0.100% (2) 99.0% (3) 1.00% (4) 99.9%

14. Equal volumes of three acid solutions of pH 3,4 and 5 are mixed in a vessel. What will be the H^+ ion concentration in the mixture ? **[AIPMT 08]**

(1) 1.11×10^{-4} M (2) 3.7×10^{-4} (3) 3.7×10^{-3} (4) 1.11×10^{-3}

15. Solubility product constants (K_{sp}) of salts of types MX, MX_2 at M_3X at temperature T are 4.0×10^{-8}, 3.2×10^{-14} and 2.7×10^{-15} respectively. Solubility (mol dm^{-3}) of the salts at temperature T are order. **[AIPMT 08]**

(1) $MX > MX_2 > M_3X$ (2) $M_3X > MX_2 > MX$ (3) $MX_2 > M_3X > MX$ (4) $MX > M_3X > MX_2$

16. The ionisation constant of ammonium hydroxide is 1.77×10^{-5} at 298 K. Hydrolysis constant of ammonium chloride is : **[AIPMT-2009]**

(1) 5.65×10^{-10} (2) 6.50×10^{-12} (3) 5.65×10^{-13} (4) 5.65×10^{-12}

17. What is the $[OH^-]$ in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 M $Ba(OH)_2$? **[AIPMT-2009]**

(1) 0.10 M (2) 0.40 M (3) 0.0050 M (4) 0.12 M

18. If pH of a saturated solution of $Ba(OH)_2$ is 12, the value of its K_{sp} is: **[AIPMT-2010]**

(1) 4.00×10^{-6} M^3 (2) 4.00×10^{-7} M^3 (3) 5.00×10^{-6} M^3 (4) 5.00×10^{-7} M^3

19. What is $[H^+]$ in mol/L of a solution that is 0.20 M in CH_3COONa and 0.10 M in CH_3COOH ? (K_a for $CH_3COOH = 1.8 \times 10^{-5}$) **[AIPMT-2010]**

(1) 3.5×10^{-4} (2) 1.1×10^{-5} (3) 1.8×10^{-4} (4) 9.0×10^{-6}

20. In a buffer solution containing equal concentration of B^- and HB, the K_b for B^- is 10^{-10}. The pH of buffer solution is: **[AIPMT-2010]**

(1) 10 (2) 7 (3) 6 (4) 4

21. In qualitative analysis, the metals of Group I can be separated from other ions by precipitating them as chloride salts. A solution initially contains Ag^+ and Pb^{2+} at a concentration of 0.10 M. Aqueous HCl is added to this solution until the Cl^- concentration is 0.10 M. What will the concentrations of Ag^+ and Pb^{2+} be at equilibrium ? (K_{SP} for AgCl = 1.8×10^{-10}, K_{SP} for $PbCl_2 = 1.7 \times 10^{-5}$.) **[AIPMT-2011]**

(1) $[Ag^+] = 1.8 \times 10^{-7}$ M ; $[Pb^{2+}] = 1.7 \times 10^{-6}$ M (2) $[Ag^+] = 1.8 \times 10^{-11}$ M ; $[Pb^{2+}] = 8.5 \times 10^{-5}$ M

(3) $[Ag^+] = 1.8 \times 10^{-9}$ M ; $[Pb^{2+}] = 1.7 \times 10^{-3}$ M (4) $[Ag^+] = 1.8 \times 10^{-11}$ M ; $[Pb^{2+}] = 8.5 \times 10^{-4}$ M

22. A buffer solution is prepared in which the concentration of NH_3 is 0.30 M and the concentration of NH_4^+ is 0.20 M. If the equilibrium constant, K_b for NH_3 equals 1.8×10^{-5}, what is the pH of this solution ? (log 2.7 = 0.433). **[AIPMT-2011]**

(1) 9.08 (2) 9.43 (3) 11.72 (4) 8.73

23. pH of a saturated solution of $Ba(OH)_2$ is 12. The value of solubility product (K_{SP}) of $Ba(OH)_2$ is : **[AIPMT-2012]**

(1) 3.3×10^{-7} (2) 5.0×10^{-7} (3) 4.0×10^{-6} (4) 5.0×10^{-6}

24. Equimolar solutions of the following substances were prepared separately. Which one of these wil record the highest pH value ? **[AIPMT-2012]**

(1) $BaCl_2$ (2) $AlCl_3$ (3) LiCl (4) $BeCl_2$

25. Buffer solutions have constant acidity and alkalinity because : **[AIPMT-2012]**

(1) these give unionised acid or base on reaction with added acid or alkali.

(2) acids and alkalies in these solution are shielded from attack by other ions.

(3) they have large excess of H^+ or OH^- ions

(4) they have fixed value of pH.

26. Which is the strongest acid in the following : **[NEET 2013]**

(1) $HClO_3$ (2) $HClO_4$ (3) H_2SO_3 (4) H_2SO_4

27. Which of the following salts will give highest pH in water ? **[AIPMT 2014]**

(1) KCl (2) NaCl (3) Na_2CO_3 (4) $CuSO_4$

28. The K_{sp} of Ag_2CrO_4, AgCl, AgBr and AgI are respectively, 1.1×10^{-12}, 1.8×10^{-10} , 5.0×10^{-13}, 8.3×10^{-17}. Which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of NaCl, NaBr, NaI and Na_2CrO_4 ? **[AIPMT 2015]**

(1) AgCl (2) AgBr (3) Ag_2CrO_4 (4) AgI

29. MY and NY_3, two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature, which statements would be true in regard to MY and NY_3? **[NEET 2016]**

(1) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities.

(2) The molar solubilities of MY and NY_3 in water are identical.

(3) The molar solubility of MY in water is less than that of NY_3.

(4) The salts MY and NY_3 are more soluble in 0.5 M KY than in pure water.

30. The percentage of pyridine (C_5H_5N) that forms pyridinium ion ($C_5H_5N^+H$) in a 0.10 M aqueous pyridine solution (K_b for $C_5H_5N = 1.7 \times 10^{-9}$) is **[NEET-2 2016]**

(1) 1.6 % (2) 0.0060 % (3) 0.013 % (4) 0.77 %

31. The solubility of AgCl(s) with solubility product 1.6×10^{-10} is in 0.1 M NaCl solution would be **[NEET-2 2016]**

(1) Zero (2) 1.26×10^{-5} M (3) 1.6×10^{-9} M (4) 1.6×10^{-11} M

32. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.2×10^{-4} $molL^{-1}$. Solubility product of $Ag_2C_2O_4$ is : **[NEET- 2017]**

(1) 2.42×10^{-8} (2) 2.66×10^{-12} (3) 4.5×10^{-11} (4) 5.3×10^{-12}

33. Following solutions were prepared by mixing different volume of NaOH and HCl of different concentration ? **[NEET- 2018]**

a. 60 mL $\frac{M}{10}$ HCl + 40 mL $\frac{M}{10}$ NaOH

b. 55 mL $\frac{M}{10}$ HCl + 45 mL $\frac{M}{10}$ NaOH

c. 75 mL $\frac{M}{5}$ HCl + 25 mL $\frac{M}{5}$ NaOH

d. 100 mL $\frac{M}{10}$ HCl + 100 mL $\frac{M}{10}$ NaOH

pH of which one of them will be equal to 1 ?

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

34. The solubility of $BaSO_4$ in water is 2.42×10^{-3} gL^{-1} at 298 K. The value of its solubility product (K_{sp}) will be : (Given molar mass of $BaSO_4$ = 233 g mol^{-1}) **[NEET- 2018]**

(1) 1.08×10^{-10} mol^2 L^{-2} (2) 1.08×10^{-8} mol^2 L^{-2}

(3) 1.08×10^{-14} mol^2 L^{-2} (4) 1.08×10^{-12} mol^2 L^{-2}

35. Which will make basic buffer? **[NEET-1- 2019]**

(1) 100 mL of 0.1 M HCl + 100 mL of 0.1 M NaOH
(2) 50 mL of 0.1 M NaOH + 25 mL of 0.1 M CH_3COOH
(3) 100 mL of 0.1 M CH_3COOH + 100 mL of 0.1 M NaOH
(4) 100 mL of 0.1 M HCl + 200 mL of 0.1 M NH_4OH

36. pH of a saturated solution of $Ca(OH)_2$ is 9. The solubility product (K_{sp}) of $Ca(OH)_2$ is **[NEET-1- 2019]**
(1) 05. × 10^{-10} (2) 0.5 × 10^{-15} (3) 0.25 × 10^{-10} (4) 0.125 ×10^{-15}

37. Conjugate base for Bronsted acids H_2O and HF are : **[NEET-1- 2019]**
(1) H_3O^+ and H_2F^+, respectiveely (2) OH^- and H_2F^+, respectively
(3) H_3O^+ and F^-, respectively (4) OH^- and F^-, respectively

38. The pH of 0.01 M NaOH (aq) solution will be - **[NEET-2- 2019]**
(1) 7.01 (2) 2 (3) 12 (4) 9

39. Which of the following cannot act both as Bronsted acid and as Bronsted base ? **[NEET-2- 2019]**
(1) HCO_3^- (2) NH_3 (3) HCl (4) HSO_4^-

40. The molar solubility of CaF_2 (K_{sp} = 5.3 × 10^{-11}) in 0.1 M solution of NaF will be - **[NEET-2- 2019]**
(1) 5.3 × 10^{-11} mol L^{-1} (2) 5.3 × 10^{-8} mol L^{-1}
(3) 5.3 × 10^{-9} mol L^{-1} (4) 5.3 × 10^{-10}1 mol L^{-1}

PART - II : AIIMS QUESTIONS (PREVIOUS 15 YEARS)

1. At 25ºC the pH of a solution containing 0.10 M sodium acetate and 0.03 M acetic acid is :
[pK_a value of CH_3COOH = 4.57] **[AIIMS 2002]**
(1) 3.24 (2) 4.59 (3) 5.09 (4) 6.67

2. At 80ºC (H_3O^+) of distilled water is 10^{-6} mol/L. At the same temperature the value of K_w is : **[AIIMS 2002]**
(1) 1 × 10^{-3} (2) 1 × 10^{-6} (3) 1 × 10^{-9} (4) 1 × 10^{-12}

3. The solubility of AgCl in 0.2 M NaCl is :
[K_{sp} AgCl = 1.8 × 10^{-10}] **[AIIMS 2002]**
(1) 1.8 × 10^{-11} M (2) 9 × 10^{-10} M (3) 6.5 × 10^{-12} M (4) 5.6 × 10^{-11} M

4. Which one of the following is not a buffer solution ? **[AIIMS 2003]**
(1) 0.8 M H_2S + 0.8M KHS (2) 2M $C_6H_5NH_2$ + 2M C_6H_5 H_3Br^-
(3) 3M H_2CO_3 + 3M $KHCO_3$ (4) 0.05 M $KClO_4$ + 0.05M $HClO_4$

5. In which of the following acid-base titration, pH is greater than 8 at the equivalence point ? **[AIIMS 03]**
(1) Acetic acid versus ammonia (2) Acetic acid versus sodium hydroxide
(3) Hydrochloric acid versus ammonia (4) Hydrochloric acid versus sodium hydroxide

6. **Assertion :** Addition of silver ions to a mixture of aqueous sodium chloride and sodium bromide solution will first precipitate AgBr rather than AgCl.

Reason : K_{sp} of AgCl < K_{sp} of AgBr. **[AIIMS 2004]**

(1) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(3) If Assertion is true but Reason is false.
(4) If both Assertion and Reason are false.

7. When 10 ml of 0.1 M acetic acid (pK_a = 5.0) is titrated against 10 ml of 0.1 M ammonia solution (pK_b = 5.0), the equivalence point occurs at pH **[AIIMS 05]**

(1) 5.0 (2) 6.0 (3) 7.0 (4) 9.0

8. 40 ml of 0.1 M ammonia is mixed with 20 ml of 0.1 M HCl. What is the pH of the mixture? (pK_b of ammonia solution is 4.74) **[AIIMS 06]**

(1) 4.74 (2) 2.26 (3) 9.26 (4) 5.00

9. The solubility product of As_2O_3 is 10.8×10^{-9}. It is 50% dissociated in saturated solution. The solubility of salt is **[AIIMS 2007]**

(1) 10^{-2} (2) 2×10^{-2} (3) 5×10^{-3} (4) 5.4×10^{-9}

10. **Assertion :** On mixing 500 mL of 10^{-6} M Ca^{2+} ion and 500 mL of 10^{-6} M F^{-1} ion, the precipitate of CaF_2 will be obtained. K_{sp} ($CaF_2 = 10^{-18}$)

Reason : If K_{sp} is greater than ionic product, a precipitate will develop. **[AIIMS 2007]**

(1) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.
(2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.
(3) If Assertion is true but Reason is false.
(4) If both Assertion and Reason are false.

11. On adding 0.1 M solution each of $[Ag^+]$, $[Ba^{2+}]$, $[Ca^{2+}]$ in a Na_2SO_4 solution, species first precipitated is [K_{sp} $BaSO_4 = 10^{-11}$, K_{sp} $CaSO_4 = 10^{-6}$, K_{sp} $Ag_2SO_4 = 10^{-5}$] **[AIIMS 2008]**

(1) Ag_2SO_4 (2) $BaSO_4$ (3) $CaSO_4$ (4) All of these

12. If the dissociation constant of 5×10^{-4} M aqueous solution of diethylamine is 2.5×10^{-5}, its pH value is : **[AIIMS 2009]**

(1) 8 (2) 3.95 (3) 10.05 (4) 2

13. The number of hydroxyl ions in 100 mL of a solution having pH 10 is : **[AIIMS 2009]**

(1) 1×10^4 (2) 3.012×10^4 (3) 6.02×10^{18} (4) 6.023×10^{19}

14. The solubility product of a salt having formula M_2X_3 is 2.2×10^{-20}. If the solubility of an another salt having formula M_2X is twice the molar solubility of M_2X_3, the solubility product of M_2X is : **[AIIMS 2009]**

(1) 3×10^{-12} (2) 9.16×10^{-5} (3) 4.58×10^{-5} (4) 2.76×10^{-18}

15. The pH of the mixture obtained when equal volumes of N/10 NaOH and N/20 HCl are mixed, is : **[AIIMS 2010]**

(1) 1.6 (2) 12.4 (3) 13.4 (4) 10.8

16. 25 mL, 0.2 M $Ca(OH)_2$ is neutralised by 10 mL of 1 M HCl. Then pH of resulting solution is : **[AIIMS 2011]**

(1) 1.37 (2) 9 (3) 12 (4) 7

17. The pH of blood does not appreciably change by a small addition of acid or a base because blood : **[AIIMS 2012]**

(1) contains serum protein which acts as buffer (2) contains iron as a part of the molecule

(3) can be easily coagulated (4) is body fluid

18. An aqueous solution of 6.3 g of oxalic acid dihydrate ($H_2C_2O_4.2H_2O$) is made up to 250 ml. The volume of 0.1 N NaOH required to completely neutralise 10 ml of this solution is **[AIIMS 2013]**

(1) 20 ml (2) 40 ml (3) 10 ml (4) 4 ml

19. **Assertion :** Mixture of CH_3COOH and CH_3COONH_4 is an example of acidic buffer. **[AIIMS 2014]**

Reason : Acidic buffer contains equimolar mixture of weak acid and its salt with weak base.

(1) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(3) If Assertion is true but Reason is false.

(4) If both Assertion and Reason are false.

20. Calculate the degree of hydrolysis and pH of 0.02M ammonium cyanide (NH_4CN) at 298 K. [K_a of HCN = 4.99×10^{-9} , K_b for NH_4OH = 1.77×10^{-5}] **[AIIMS 2015]**

(1) 8.2 (2) 3.2 (3) 9.3 (4) 3.9

21. Assertion (A) : pH value of HCl solution is less than that of acetic acid of the some concentration.
Reason (R) : In equimolar solution, the number of titrable protons present in HCl is less than that present in acetic acid. **[AIIMS 2016]**

(1) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(3) If Assertion is true but Reason is false.

(4) If both Assertion and Reason are false.

22. pH of solution of a strong acid is 5.0. What will be the pH of solution obtained after diluting the given solution to 100 times ? **[AIIMS 2017]**

(1) 5.8 (2) 6.7 (3) 9.3 (4) 13

23. **Assertion (A)** : Buffer solution are composed of strong acids and strong bases. **[AIIMS 2017]**
Reason (R) : It maintain the pH to constant value of 7.4.

(1) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(3) If Assertion is true but Reason is false.

(4) If both Assertion and Reason are false.

24. **Assertion (A)** : The ionization of hydrogen sulphide in water is low in the presence of HCl **[AIIMS 2017]**
Reason (R) : H_2S is a weak acid.

(1) If both Assertion and Reason are true and Reason is the correct explanation of Assertion.

(2) If both Assertion and Reason are true but Reason is not the correct explanation of Assertion.

(3) If Assertion is true but Reason is false.

(4) If both Assertion and Reason are false.

25. When NH_3(0.1 M) 50 ml mix with HCl (0.1 M) 10 ml then what is pH of resultant solution (Pk_b = 4.75)

(1) 9.25 (2) 10 (3) 9.85 (4) 4.15 **[AIIMS 2018]**

26. When CH_3COOCH_3 + HCl is titrated with NaOH then at neutral point the colour of phenopthalein becomes colourless from pink due to : **[AIIMS 2018]**
(1) due to formation of CH_3OH
(2) due to formation of CH_3COOH which act as a weak acid.
(3) Phenophalein vaporizes.
(4) due to presence of HCl

27. Sulubility of a sparingly soluble salt XB_2 in water is x. What will be its solubility in a solution of yB having concentration of 0.001M? **[AIIMS 2018]**
(1) $x^2 \times 10^{-6}$ (2) $4x^3 \times 10^6$ (3) $4x^3 \times 10^{-6}$ (4) $4x^3 \times 10^3$

28. **Assertion :** Na_2SO_3 solution give basic solution in litmus solution **[AIIMS 2018]**
Reason : It react with water and H_2SO_3 form
(1) If both assertion and reason are true and reason is the correct explanation of assertion.
(2) If both assertion and reason are true but reason is not the correct explanation of assertion.
(3) If assertion is true but reason is false.
(4) If both assertion and reason are false.

PART - III : JEE (MAIN) / AIEEE PROBLEMS (PREVIOUS YEARS)

1. Species acting as both bronsted acid and base is : **[AIEEE-2002]**
(1) HSO_4^- (2) Na_2CO_3 (3) NH_2^- (4) OH^-

2. 1 M NaCl and 1 M HCl are present in an aqueous solution. The solution is **[AIEEE-2002]**
(1) not a buffer solution with pH < 7 (2) not a buffer solution with pH > 7
(3) a buffer solution with pH < 7 (4) a buffer solution with pH > 7

3. The solubility of $Mg(OH)_2$ is s moles/litre. The solubility product under the same condition is : **[AIEEE-2002]**
(1) $4s^3$ (2) $3s^4$ (3) $4s^2$ (4) s^3

4. Which one of the following statements is not true ? **[AIEEE-2003]**
(1) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}.
(2) pH + pOH = 14 for all aqueous solutions at 25ºC.
(3) The pH of 1×10^{-8} M HCl is 8.
(4) 96, 500 coulombs of electricity when passed through a $CuSO_4$ solution deposits 1 gram equivalent of copper at the cathode.

5. When rain is accompanied by a thunderstorm, the collected rain water will have a pH value : **[AIEEE-2003]**
(1) slightly lower than that of rain water without thunderstorm
(2) slightly higher than that when the thunderstorm is not there
(3) uninfluenced by occurrence of thunderstorm
(4) which depends on the amount of dust in air.

6. The solubility in water of a sparingly soluble salt AB_2 is 1.0×10^{-5} mol L^{-1}. Its solubility product will be : **[AIEEE-2003]**
(1) 4×10^{-15} (2) 4×10^{-10} (3) 1×10^{-15} (4) 1×10^{-10}

7. The conjugate base of $H_2PO_4^-$ is : **[AIEEE-2004]**
(1) PO_4^{3-} (2) P_2O_5 (3) H_3PO_4 (4) HPO_4^{2-}

8. The molar solubility (in mol L^{-1}) of a sparingly soluble salt MX_4 is s. The corresponding solubility product is $K_{sp.}$. s is given in terms of K_{sp} by the relation : **[AIEEE-2004]**

(1) $s = (K_{sp}/128)^{1/4}$ (2) $s = (128K_{sp})^{1/4}$ (3) $s = (256K_{sp})^{1/5}$ (4) $s = (K_{sp}/256)^{1/5}$

9. What is the conjugate base of OH^-? **[AIEEE-2005]**
(1) O_2 (2) H_2O (3) O^- (4) O^{2-}

10. Hydrogen ion concentration in mol/L in a solution of pH = 5.4 will be : **[AIEEE-2005]**
(1) 3.98×10^8 (2) 3.88×10^6 (3) 3.68×10^{-6} (4) 3.98×10^{-6}

11. The solubility product of a salt having general formula MX_2, in water is : 4×10^{-12}. The concentration of M^{2+} ions in the saturated aqueous solution of the salt is : **[AIEEE-2005]**
(1) 2.0×10^{-6} M (2) 1.0×10^{-4} M (3) 1.6×10^{-4} M (4) 4.0×10^{-10} M

12. The first and second dissociation constants of an acid H_2A are 1.0×10^{-5} and 5.0×10^{-10} respectively. The overall dissociation constant of the acid will be **[AIEEE-2007, 3/120]**
(1) 5.0×10^{-15} (2) 0.2×10^5 (3) 5.0×10^{-5} (4) 5.0×10^{15}

13. The pK_a of a weak acid (HA) is 4.5. The pOH of an aqueous buffered solution of HA, in which 50% of the acid is ionized, is : **[AIEEE-2007, 3/120]**
(1) 9.5 (2) 7.0 (3) 4.5 (4) 2.5

14. In a saturated solution of the sparingly soluble strong electrolyte $AgIO_3$ (Molecular mass = 283), the equilibrium which sets in is :

$$AgIO_3(s) \rightleftharpoons Ag^+(aq) + IO^-_3(aq)$$

If the solubility product constant K_{sp} of $AgIO_3$ at a given temperature is 1.0×10^{-8}, what is the mass of $AgIO_3$ contained in 100 mL of its saturated solution? **[AIEEE-2007, 3/120]**
(1) 1.0×10^{-7} g (2) 1.0×10^{-4} g (3) 28.3×10^{-2} g (4) 2.83×10^{-3} g

15. The pK_a of a weak acid, HA, is 4.80. The pK_b of a weak base, BOH, is 4.78. The pH of an aqueous solution of the corresponding salt, BA, will be : **[AIEEE-2008, 3/105]**
(1) 4.79 (2) 7.01 (3) 9.22 (4) 9.58

16. Solid $Ba(NO_3)_2$ is gradually dissolved in 1.0×10^{-4} M Na_2CO_3 solution. At what concentration of Ba^{2+} will a precipitate begin to form ? (K_{sp} for $BaCO_3 = 5.1 \times 10^{-9}$) **[AIEEE-2009, 4/144]**
(1) 5.1×10^{-5} M (2) 8.1×10^{-8} M (3) 8.1×10^{-7} M (4) 4.1×10^{-5} M

17. Three reactions involving $H_2PO_4^-$ are given below : **[AIEEE-2010, 4/144]**
(i) $H_3PO_4 + H_2O \rightarrow H_3O^+ + H_2PO_4^-$
(ii) $H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} + H_3O^+$
(iii) $H_2PO_4^- + OH^- \rightarrow H_3PO_4 + O^{2-}$
In which of the above, does $H_2PO_4^-$ act as an acid ?
(1) (ii) only (2) (i) and (ii) (3) (iii) only (4) (i) only

18. In aqueous solution the ionization constants for carbonic acid are **[AIEEE-2010, 4/144]**
$K_1 = 4.2 \times 10^{-7}$ and $K_2 = 4.8 \times 10^{-11}$
Select the correct statement for a saturated 0.034 M solution of the carbonic acid.
(1) The concentration of CO_3^{2-} is 0.034 M.
(2) The concentration of CO_3^{2-} is greater than that of HCO_3^-.
(3) The concentration of H^+ and HCO_3^- are approximately equal.
(4) The concentration of H^+ is double that of CO_3^{2-}.

19. Solubility product of silver bromide is 5.0×10^{-13}. The quantity of potassium bromide (molar mass taken as 120 g mol^{-1}) to be added to 1 litre of 0.05 M solution of silver nitrate to start the precipitation of AgBr is : **[AIEEE-2010, 4/144]**
(1) 1.2×10^{-10} g (2) 1.2×10^{-9} g (3) 6.2×10^{-5} g (4) 5.0×10^{-8} g

20. At 25°C, the solubility product of $Mg(OH)_2$ is 1.0×10^{-11}. At what pH, will Mg^{2+} ions start precipitating in the form of $Mg(OH)_2$ from a solution of 0.001 M Mg^{2+} ions ? **[AIEEE-2010, 4/144]**

(1) 9 (2) 10 (3) 11 (4) 8

21. What is the best description of the change that occurs when $Na_2O(s)$ is dissolved in water ? **[AIEEE-2011]**

(1) Oxide ion accepts sharing in a pair of electrons
(2) Oxide ion donates a pair of electrons
(3) Oxidation number of oxygen increases
(4) Oxidation number of sodium decreases

22. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionization constant, K_a of the acid is **[AIEEE-2012, 4/120]**

(1) 3×10^{-1} (2) 1×10^{-3} (3) 1×10^{-5} (4) 1×10^{-7}

23. How many litres of water must be added to 1 litre an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2 ? **[JEE(Main) 2013, 4/120]**

(1) 0.1 L (2) 0.9 L (3) 2.0 L (4) 9.0 L

24. pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4, respectively. The pH of their salt (AB) solution is : **[JEE(Main) 2017, 4/120]**

(1) 6.9 (2) 7.0 (3) 1.0 (4) 7.2

25. Which of the following salts is the most basic in aqueous solution ? **[JEE(Main) 2018, 4/120]**

(1) $FeCl_3$ (2) $Pb(CH_3COO)_2$ (3) $Al(CN)_3$ (4) CH_3COOK

26. An alkali is titrated against an acid with methyl orange as indictor, which of the following is a correct combination? **[JEE(Main) 2018, 4/120]**

	Base	**Acid**	**End point**
(1)	Weak	Strong	Yellow to pinkish red
(2)	Strong	Strong	Pink to colourless
(3)	Weak	Strong	Colourless to pink
(4)	Strong	Strong	Pinkish red to yellow

27. An aqueous solution contains an unknown concentration of Ba^{2+}. When 50 mL of a 1 M solution of Na_2SO_4 is added, $BaSO_4$ just begins to precipitate. The final volume is 500 mL. The solubility product of $BaSO_4$ is 1×10^{-10}. What is the original concentration of Ba^{2+}. **[JEE(Main) 2018, 4/120]**

(1) 1.1×10^{-9} M (2) 1.0×10^{-10} M (3) 5×10^{-9} M (4) 2×10^{-9} M

28. An aqueous solution contains 0.10 M H_2S and 0.20 M HCl. If the equilibrium constant for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from HS^- ions is 1.2×10^{-13} then the concentration of S^{2-} ions in aqueous solution is : **[JEE(Main) 2018, 4/120]**

(1) 6×10^{-21} (2) 5×10^{-19} (3) 5×10^{-8} (4) 3×10^{-20}

29. 20 mL of 0.1 M H_2SO_4 solution is added to 30 mL of 0.2 M NH_4OH solution. The pH of the resultant mixture is : (pK_b of NH_4OH = 4.7) **[JEE(Main) 2019, 4/120]**

(1) 9.0 (2) 5.2 (3) 9.4 (4) 5.0

30. If K_{sp} of Ag_2CO_3 is 8×10^{-12}, the molar solubility of Ag_2CO_3 in 0.1 M $AgNO_3$ is : **[JEE(Main) 2019, 4/120]**

(1) 8×10^{-10} M (2) 8×10^{-12} M (3) 8×10^{-13} M (4) 8×10^{-11} M

Answers

EXERCISE - 1

SECTION (A)

1.	(2)	**2.**	(2)	**3.**	(2)	**4.**	(3)	**5.**	(1)	**6.**	(3)	**7.**	(4)
8.	(2)	**9.**	(3)	**10.**	(2)	**11.**	(3)	**12.**	(2)	**13.**	(4)	**14.**	(2)
15.	(2)												

SECTION (B)

1.	(1)	**2.**	(4)	**3.**	(3)	**4.**	(3)	**5.**	(1)	**6.**	(3)	**7.**	(1)
8.	(2)	**9.**	(1)	**10.**	(2)	**11.**	(4)						

SECTION (C)

1.	(4)	**2.**	(2)	**3.**	(2)	**4.**	(4)	**5.**	(1)	**6.**	(2)	**7.**	(2)
8.	(3)	**9.**	(2)										

SECTION (D)

1.	(4)	**2.**	(2)	**3.**	(1)	**4.**	(2)	**5.**	(3)	**6.**	(1)	**7.**	(4)
8.	(2)	**9.**	(3)	**10.**	(2)	**11.**	(2)	**12.**	(1)	**13.**	(3)	**14.**	(3)

SECTION (E)

1.	(1)	**2.**	(3)	**3.**	(2)	**4.**	(3)	**5.**	(1)	**6.**	(1)	**7.**	(4)
8.	(2)	**9.**	(2)	**10.**	(2)	**11.**	(1)	**12.**	(1)	**13.**	(2)	**14.**	(4)

SECTION (F)

1.	(2)	**2.**	(4)	**3.**	(1)	**4.**	(1)	**5.**	(2)	**6.**	(4)	**7.**	(4)
8.	(2)	**9.**	(4)	**10.**	(4)	**11.**	(4)	**12.**	(3)	**13.**	(2)	**14.**	(1)

SECTION (G)

1.	(4)	**2.**	(3)	**3.**	(1)	**4.**	(1)	**5.**	(1)	**6.**	(2)

SECTION (H)

1.	(1)	**2.**	(3)	**3.**	(3)	**4.**	(1)	**5.**	(1)	**6.**	(2)	**7.**	(3)
8.	(3)	**9.**	(3)	**10.**	(3)	**11.**	(1)	**12.**	(3)	**13.**	(1)	**14.**	(2)
15.	(1)	**16.**	(3)	**17.**	(1)	**18.**	(4)						

EXERCISE - 2

1.	(4)	**2.**	(4)	**3.**	(4)	**4.**	(2)	**5.**	(4)	**6.**	(4)	**7.**	(4)
8.	(3)	**9.**	(1)	**10.**	(2)	**11.**	(3)	**12.**	(1)	**13.**	(3)	**14.**	(3)
15.	(2)	**16.**	(2)	**17.**	(2)	**18.**	(2)	**19.**	(2)	**20.**	(4)	**21.**	(2)
22.	(4)	**23.**	(1)	**24.**	(3)	**25.**	(4)	**26.**	(3)	**27.**	(3)	**28.**	(4)
29.	(3)	**30.**	(1)	**31.**	(4)	**32.**	(1)	**33.**	(2)	**34.**	(1)	**35.**	(1)
36.	(2)	**37.**	(3)	**38.**	(1)	**39.**	(4)	**40.**	(3)	**41.**	(2)	**42.**	(2)
43.	(3)	**44.**	(2)	**45.**	(1)								

EXERCISE - 3

PART-I

1.	(4)	**2.**	(2)	**3.**	(4)	**4.**	(2)	**5.**	(2)	**6.**	(3)	**7.**	(2)
8.	(4)	**9.**	(4)	**10.**	(1)	**11.**	(4)	**12.**	(2)	**13.**	(3)	**14.**	(2)
15.	(4)	**16.**	(1)	**17.**	(1)	**18.**	(4)	**19.**	(4)	**20.**	(4)	**21.**	(3)
22.	(2)	**23.**	(2)	**24.**	(1)	**25.**	(1)	**26.**	(2)	**27.**	(3)	**28.**	(3)
29.	(3)	**30.**	(3)	**31.**	(3)	**32.**	(4)	**33.**	(2)	**34.**	(1)	**35.**	(4)
36.	(2)	**37.**	(4)	**38.**	(3)	**39.**	(3)	**40.**	(3)				

PART-II

1.	(3)	**2.**	(4)	**3.**	(2)	**4.**	(4)	**5.**	(2)	**6.**	(3)	**7.**	(3)
8.	(3)	**9.**	(2)	**10.**	(4)	**11.**	(2)	**12.**	(3)	**13.**	(3)	**14.**	(1)
15.	(2)	**16.**	(4)	**17.**	(1)	**18.**	(2)	**19.**	(4)	**20.**	(3)	**21.**	(3)
22.	(2)	**23.**	(2)	**24.**	(2)	**25.**	(3)	**26.**	(2)	**27.**	(2)	**28.**	(2)

PART-III

1.	(1)	**2.**	(1)	**3.**	(1)	**4.**	(3)	**5.**	(1)	**6.**	(1)	**7.**	(4)
8.	(4)	**9.**	(4)	**10.**	(4)	**11.**	(2)	**12.**	(1)	**13.**	(1)	**14.**	(4)
15.	(2)	**16.**	(1)	**17.**	(1)	**18.**	(3)	**19.**	(2)	**20.**	(2)	**21.**	(2)
22.	(3)	**23.**	(4)	**24.**	(1)	**25.**	(4)	**26.**	(1)	**27.**	(1)	**28.**	(4)
29.	(1)	**30.**	(1)										