Exercise-1

Marked Questions may have for Revision Questions.

OBJECTIVE QUESTIONS

Section (A) : Basics and acid base concept

A-1. 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^+

A-2. In the equilibrium

$CH_3COOH + HF \rightleftharpoons CH_3COOH_2^+ + F^-$ **[BHU 1987]**

(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.

A-3. Boric acid H_3BO_3 is a :

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

A-4. Identify the amphoteric species from the following ?

fuEu esa ls mHk;/kehZ iztkfr igpkfu, %

(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

A-5. Which one is strongest electrolyte in the following : **[CPMT 1990]**

(1*) NaCl (2) CH_3COOH (3) NH_4OH (4) $C_6H_{12}O_6$

A-6. The following equilibrium exists in aqueous solution, $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$. If dil HCl is added, without change in temperature: **[UPSEAT 2000, 02]**

(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

A-7. 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

A-8. Review the equilibrium and choose the correct statement ; $HClO_4 + H_2O \longrightarrow H_3O^+ + ClO_4^-$ **[RPMT 2000]**

(1) $HClO_4$ is the conjugate acid of H_2O (2) H_3O^+ is the conjugate base of H_2O

(3) H_2O is the conjugate acid of H_3O^+ (4*) ClO_4^- is the conjugate base of $HClO_4$

A-9. Which of the following can act both as Bronsted acid and Bronsted base ?

[MP PET 1995; MP PET/PMT 1998]

(1) Cl^- (2*) HCO_3^- (3) H_3O^+ (4) OH^-

A-10. Which of the following is the strongest conjugate base?
[MADT Bihar 1983; CBSE PMT 1999; KCET (Med.) 2001]

(1) Cl^- (2*) CH_3COO^- (3) SO_4^{--} (4) NO_2^-

A-11. The conjugate base of NH_2^- is: **[EAMCET 1998]**

(1) NH_3 (2*) NH^{2-} (3) NH_4^+ (4) N_3^-

A-12. 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*) $[Al(H_2O)_2(OH)_4]^-$

A-13. Which of the following is the strongest acid? **[AMU 1982]**
(1) H_3PO_4 (2*) H_2SO_4 (3) HNO_2 (4) CH_3COOH

A-14. Theory of ionization was given by: **[AMU 1983; DPMT 1985]**
(1) Rutherford (2) Graham (3) Faraday (4*) Arrhenius

A-15. Accepting the definition that an acid is a proton donor, the acid in the following reaction
$NH_3 + H_2O \rightarrow NH_4^+ + OH^-$ is **[Kerala (Med.) 2003]**

(1) NH_3 (2) H^+ (3) NH_4^+ (4*) H_2O

A-16. In the following reaction
$HC_2O_4^- + PO_4^{---} \rightleftharpoons HPO_4^{--} + C_2O_4^{--}$,
Which are the two Bronsted bases? **[MP PMT 1991]**
(1) $HC_2O_4^-$ and PO_4^{---} (2) HPO_4^{--} and $C_2O_4^{--}$ (3) $HC_2O_4^-$ and HPO_4^{--} (4*) PO_4^{---} and $C_2O_4^{--}$

A-17. The conjugate acid of $S_2O_8^{2-}$ is:
[EAMCET 1984]

(1) $H_2S_2O_8$ (2) H_2SO_4 (3) HSO_4^- (4*) $HS_2O_8^-$

A-18. In the reaction $BCl_3 + PH_3 \rightarrow Cl_3B-PH_3$, Lewis base is: **[EAMCET 1986]**
(1) BCl_3 (2*) PH_3 (3) Cl_3B-PH_3 (4) None of these

A-19. The correct order of acid strength is : **[CBSE PMT 2005]**
(1*) $HClO < HClO_2 < HClO_3 < HClO_4$ (2) $HClO_4 < HClO < HClO_2 < HClO_3$
(3) $HClO_2 < HClO_3 < HClO_4 < HClO$ (4) $HClO_4 < HClO_3 < HClO_2 < HClO$

A-20. According to Bronsted law, water is a/an: **[MP PET/PMT 1988]**
(1) Base (2) Acid (3*) Acid and base both (4) Salt

Section (B) : Ostwald dilution concept, property of water, pH definition

B-1. pH of NaCl solution is 7 at 298 K. If the solution is heated to 320 K, 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

B-2. 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

B-3. pH of human blood is 7.4. Then H^+ concentration will be: **[RPMT 2002]**

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

B-4. The ionic product of water at 25°C is 10^{-14} . The ionic product at 90°C will be : **[CBSE PMT 1996]**

(1) 1×10^{-20} (2*) 1×10^{-12} (3) 1×10^{-14} (4) 1×10^{-16}

B-5. Ostwald's dilution law gives satisfactory results with the solution of which electrolyte ?

(1) HCl (2) HNO_3 (3*) CH_3COOH (4) NaOH

B-6. 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

B-7. The pH of a 0.1 M solution of weak base is 11. On diluting the solution :

(1) pH increases (2) $[OH^-]$ increases (3) α decreases (4*) pH decreases

B-8. The pK_w of water at 50°C is 13.40. An aqueous solution at 50°C has pH = 7. This solution is –

(1) Acidic (2*) Alkaline (3) Neutral (4) Amphoteric

B-9. Pure water ionises as :

$$2H_2O\,(l) \rightleftharpoons H_3O^+(aq) + OH^-\,(aq)$$

At 25°C the pH of pure water is approximately 7. At 37°C its pH is :

(1) More than 7.0 (2*) Less than 7.0 (3) Equal to 7.0 (4) None of these

B-10. A monoprotic acid in 1.00 M solution is 0.01% ionised. The dissociation constant of this acid is : **[BVP 2003]**

(1*) 1×10^{-8} (2) 1×10^{-4} (3) 1×10^{-6} (4) 1×10^{-5}

B-11. If α is the degree of ionization, C the concentration of a weak electrolyte and K_a the acid ionization constant, then the correct relationship between α ,C and K_a is :

[CET Pune 1998; Pb. PMT 1998; RPMT 2002]

(1) $\alpha^2 = \sqrt{\frac{K_a}{C}}$ (2) $\alpha^2 = \sqrt{\frac{C}{K_a}}$ (3*) $\alpha = \sqrt{\frac{K_a}{C}}$ (4) $\alpha = \sqrt{\frac{C}{K_a}}$

B-12. K_{a_1}, K_{a_2} and K_{a_3} are the respective ionisation constants for the following reactions.

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

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

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

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

(1*) $K_{a_3} = K_{a_1} \times K_{a_2}$ (2) $K_{a_3} = K_{a_1} + K_{a_2}$ (3) $K_{a_3} = K_{a_1} - K_{a_2}$ (4) $K_{a_3} = K_{a_1} / K_{a_2}$

B-13. At infinite dilution, the percentage ionisation for both strong and weak electrolytes is : **[CPMT 1999]**

(1) 1% (2) 20% (3) 50% (4*) 100%

B-14. For a weak acid *HA* , Ostwald's dilution law is represented by the equation :

(1) $K_a = \frac{\alpha c}{1-\alpha^2}$ (2*) $K_a = \frac{\alpha^2 c}{1-\alpha}$ (3) $\alpha = \frac{K_a c}{1-c}$ (4) $K_a = \frac{\alpha^2 c}{1-\alpha^2}$

B-15. The hydrogen ion concentration in weak acid of dissociation constant K_a and concentration c is nearly equal to: **[CBSE PMT 1989; RPMT 2000]**

(1) $\sqrt{K_a / c}$ (2) c / K_a (3) K_ac (4*) $\sqrt{K_a c}$

B-16. Degree of dissociation of 0.1 M CH_3COOH is : (Dissociation constant $=1\times10^{-5}$) **[MP PET 1997]**

0.1 M CH_3COOH dh fo;kstu dh dksfV gS : (fo;kstu fLFkjkad $=1\times10^{-5}$) **[MP PET 1997]**

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

B-17. 0.2 molar solution of formic acid is 3.2% ionized. Its ionization constant is: **[MP PMT 1991]**

(1) 9.6×10^{-3} (2*) 2.1×10^{-4} (3) 1.25×10^{-6} (4) 4.8×10^{-5}

B-18. The values of dissociation constants of some acids (at 25°C) are as follows. Indicate which is the strongest acid in water ? **[MP PMT 1991]**

(1*) 1.4×10^{-2} (2) 1.6×10^{-4} (3) 4.4×10^{-10} (4) 4.3×10^{-7}

B-19. The degree of dissociation in a weak electrolyte increases : **[CBSE PMT 1989; MP PMT 1997]**

(1*) On increasing dilution (2) On increasing pressure

(3) On decreasing dilution (4) None of these

B-20. pH value of a solution, whose hydronium ion concentration is 6.2×10^{-9} mol/ l, is :

[AFMC 1999; AIIMS 2000]

(1) 6.21 (2) 7.21 (3) 7.75 (4*) 8.21

B-21. pH of a solution is 5. Its hydroxyl ion concentration is : **[JIPMER 1999]**

(1) 5 M (2) 10 M (3) 10^{-5} M (4*) 10^{-9} M

B-22. The pOH of beer is 10.0. The hydrogen ion concentration will be : **[MP PMT 1994]**

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

Section (C) : Strong Acid, Strong Base and their mixture

C-1. 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

C-2. What will be the pH when 0.01 mole of HNO_3 is dissolved in V volume of water and $V \to \infty$?

(1) 1 (2) 2 (3*) 7 (4) 0

C-3. 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

C-4. 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

C-5. 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^-

C-6. The pH of HCl solution is 1.10 ml of this solution is reacted with 40 ml of NaOH solution whose pH = 12. The pH of resulting solution is : (log (1.2) = 0.108)

(1) 2.892 (2*) 1.892 (3) 3.892 (4) 1.108

C-7. 10^{-6} M HCl is diluted to 100 times. Its pH is :

(1) 6.0 (2) 8.0 (3*) 6.95 (4) 9.5

C-8. 100 ml of 0.2 M H_2SO_4 is added to 100 ml of 0.2 M NaOH . The resulting solution will be :

(1*) Acidic (2) Basic (3) Neutral (4) Slightly basic

C-9. When 100 ml of 1M NaOH solution is mixed with 10 ml of 10 M H_2SO_4 , the resulting mixture will be :

(1*) Acidic (2) Alkaline (3) Neutral (4) Strongly alkaline

C-10. The pH of a 10^{-10} M NaOH solution is nearest to : **[UPSEAT 2001, 02]**

(1) 10 (2*) 7 (3) 4 (4) –10

C-11. Which one has pH 12 ? **[Roorkee 1995]**

(1*) 0.01 M KOH (2) 1 M KOH (3) 1 M NaOH (4) 0.5 M $Ca(OH)_2$

C-12. 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 : **[BHU 2005]**

(1) 3.2 (2*) 1.9 (3) 3.4 (4) 3.5

C-13. 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

1.0×10^{-8} M HCl foy;u dk pH eku 8 ls de gS] D;ksafd

C-14. The pH of 10^{-7} M NaOH is **[MP PMT 2001]**

(1) 7.01 (2*) Between 7 and 8 (3) Between 9 and 10 (4) Greater than 10

Section (D) : Weak Acid, Weak Base and their pH, Polyprotic acid

D-1. 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}

D-2. 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

D-3. Pure water is kept in a vessel and it remains exposed to atmospheric CO_2 which is absorbed. Then its pH will be : **[MADT Bihar 1984; DPMT 2002]**

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

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

D-4. 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) α.c

D-5. 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

D-6. 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

D-7. If the dissociation constant of an acid HA is 1×10^{-5} , the pH of a 0.1 molar solution of the acid will be approximately **[NCERT 1979]**

(1*) Three (2) Five (3) One (4) Six

D-8. 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

D-9. 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 PMT 2005]**

(1) 2.0×10^{-6} mol L^{-1} (2) 1.0×10^{-5} mol L^{-1} (3) 1.0×10^{-6} mol L^{-1} (4*) 1.0×10^{-7} mol L^{-1}

D-10. 0.02 M monobasic acid dissociates 2%. Hence, pH of the solution is : **[MH CET 2000]**

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

D-11. 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

Section (E) : Mixture of acid and bases

E-1. 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

E-2. 100 ml of 1M HCl is mixed with 900 ml of 0.1 M NaOH. In the final solution :

(1) $[H^+] = 10^{-1}$ M (2*) $[Cl^-] = 10^{-1}$M (3) $[Na^+] = [Cl^-]$ (4) $[OH^-] = 10^{-2}$ M

E-3. For H_2A , $K_a = 10^{-20}$. What is the concentration of A^{2-} in a solution that is 0.01 M in H_2A and 0.1 M in HCl?

(1) 10^{-19} M (2*) 10^{-20} M (3) 2 × 10^{-19} M (4) 2 × 10^{-20} M

E-4. 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

E-5. What will be $[HS^-]$ in a 0.1 M H_2S solution when 0.05 M H_2SO_4 is added to it ? (K_{a_1} & K_{a_2} are dissociation constants of H_2S)

(1*) K_{a_1} (2) K_{a_2} (3) $K_{a_1} \times K_{a_2}$ (4) $\frac{K_{a_1}}{K_{a_2}}$

E-6. H_3PO_3 is weak diprotic acid. What will be its pH in its 0.2 M solution? ($K_{a_1} = 5 \times 10^{-6}$, $K_{a_2} = 10^{-13}$)

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

E-7. By how muich will the pH change if 0.1 M HCl is added in the above solution (E-6) without changing the volume ?

(1) 1 (2*) 2

(3) 3 (4) pH will be approximately same.

E-8. In the above question (E-7), What will be the $[HPO_3^{2-}]$?

(1) 10^{-14} M (2) 10^{-4} M (3*) 10^{-17} M (4) 10^{-10} M

E-9. 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) $\alpha_{\text{aniline}} > \alpha_{NH3}$ (2) $\alpha_{\text{aniline}} = \alpha_{NH3}$

(3*) $\alpha_{NH3} > \alpha_{\text{aniline}}$ (4) Can’t be predicted from the given information.

Section (F) : Salt Hydrolysis

F-1. Which of the following salts undergo anionic hydrolysis ?

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

F-2. Which one is a mixed salt ?

(1) $NaHSO_4$ (2*) $NaKSO_4$ (3) $K_4Fe(CN)_6$ (4) Mg(OH)Cl

F-3. 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

F-4. 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

F-5. 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

F-6. $pOH = 7 - 0.5\ pK_a + 0.5\ pK_b$ 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^-

F-7. 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*) $Al_2(SO_4)_3$

F-8. 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 ; $K_a = 4 \times 10^{-10}$

F-9. The reverse process of neutralisation is:

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

F-10. The pH of 0.01 M ammonium sulphate solution is : $[K_b(NH_3)] = 2 \times 10^{-5}$

(1*) 5.5 (2) 6.8 (3) 8.6 (4) 7

F-11. 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

F-12. A certain weak acid has a dissociation contant 1.0×10^{-4} . The equilibrium constant for its reaction with a strong base is :

(1) 1.0×10^{-4} (2) 1.0×10^{-10} (3*) 1×10^{10} (4) 1.0×10^{-14}

F-13. % 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}

F-14. $[H^+] = \sqrt{\dfrac{K_w K_a}{C}}$ is suitable for :

(1) NaCl, NH_4Cl (2*) CH_3COONa, NaCN
(3) CH_3COONa, $(NH_4)_2SO_4$ (4) CH_3COONH_4, $(NH_4)_2CO_3$

F-15. The solution of blue vitriol in water is acidic because :

(1) $CuSO_4$ reacts with water (2*) Cu^{2+} reacts with water

(3) SO_4^{2-} reacts with water (4) $CuSO_4$ removes OH^- ions from water

F-16. 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) $HCl < NaCl < NaCN < NH_4Cl$

F-17. 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

F-18. Which of the following dissolves in water to give a neutral solution ? **[Bihar MADT 1980]**

(1) $(NH_4)_2SO_4$ (2*) $Ba(NO_3)_2$ (3) $CrCl_3$ (4) $CuSO_4$

F-19. A solution of $FeCl_3$ in water acts as acidic due to : **[BVP 2003]**

(1*) Hydrolysis of Fe^{3+} (2) Acidic impurities

(3) Dissociation (4) Ionisation

F-20. A white substance having alkaline nature in solution is : **[BVP 2003]**

(1) $NaNO_3$ (2) NH_4Cl (3*) Na_2CO_3 (4) Fe_2O_3

F-21. The aqueous solution of disodium hydrogen phosphate is : **[MADT Bihar 1982]**

(1) Acidic (2) Neutral (3*) Basic (4) None

F-22. The salt that forms neutral solution in water is : **[EAMCET 1981]**

(1) NH_4Cl (2*) NaCl (3) Na_2CO_3 (4) K_3BO_3

F-23. pH of water is 7. When a substance Y is dissolved in water, the pH becomes 13. The substance Y is a salt of : **[MP PMT 1997]**

(1) Strong acid and strong base (2) Weak acid and weak base

(3) Strong acid and weak base (4*) Weak acid and strong base

F-24. The aqueous solution of which of the following salt has the lowest pH ? **[CBSE PMT 2002]**

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

F-25. A compound whose aqueous solution will have the highest pH is :

[CPMT 1974, 75, 78; MP PET 1996; DPMT 1982, 83]

(1) NaCl (2*) Na_2CO_3 (3) NH_4Cl (4) $NaHCO_3$

F-26. The compound whose 0.1 M solution is basic is : **[IIT 1986; MP PMT 1991]**

(1) Ammonium acetate (2) Calcium carbonate

(3) Ammonium sulphate (4*) Sodium acetate

F-27. 0.5 M ammonium benzoate is hydrolysed to 0.25 percent, hence its hydrolysis constant is :

[MH CET 2004]

(1) 2.5×10^{-5} (2) 1.5×10^{-4} (3) 3.125×10^{-6} (4*) 6.25×10^{-6}

F-28. In hydrolysis of a salt of weak acid and strong base, $A^- + H_2O \rightleftharpoons HA + OH^-$, the hydrolysis constant (K_h) is equal to…. **[Orissa JEE 2002]**

(1*) $\frac{K_w}{K_a}$ (2) $\frac{K_w}{K_b}$ (3) $\sqrt{\frac{K_a}{C}}$ (4) $\frac{K_w}{K_a \times K_b}$

F-29. K_a for CH_3COOH is 1.8×10^{-5} and K_b for NH_4OH is 1.8×10^{-5} . The pH of ammonium acetate will be :

(1) 7.005 (2) 4.75 (3*) 7.0 (4) Between 6 and 7

F-30. Hydrolysis constant for a salt of weak acid and weak base would be : **[RPMT 1999]**

(1) $K_h = \frac{K_w}{K_a}$ (2) $K_h = \frac{K_w}{K_b}$ (3*) $K_h = \frac{K_w}{K_a K_b}$ (4) None of these

Section (G) : Buffer Solution and Buffer capacity

G-1. 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

G-2. The pH of an acidic buffer mixture is:

(1) > 7 (2*) < 7 (3) = 7 (4) Depends upon K_a of acid

G-3. The pH of buffer of $NH_4OH + NH_4Cl$ type is given by :

(1) $pH = pK_b$ (2) $pH = 1/2pK_b - 1/2 \log [Salt]/[base]$

(3*) $pH = 14 - pK_b - \log [Salt]/[base]$ (4) $pH = pOH - pK_b + [Salt]/[base]$

G-4. 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

G-5. $H_2CO_3 + NaHCO_3$ found in blood helps in maintaining pH of the blood close to 7.4. An excess of acid entering the blood stream is removed by –

(1*) HCO_3^- (2) H_2CO_3 (3) H^+ ion (4) CO_3^{2-} ion

G-6. 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

G-7. 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. [$K_b = 1.8 \times 10^{-5}$] **[UPSEAT 2001]**

(1) 3.4 (2) 2.6 (3) 1.5 (4*) 1.8

G-8. 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

G-9. 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) 0.02 M CH_3COOH & 0.02 CH_3COONa (4*) 0.001 M CH_3COOH & 0.001 M CH_3COONa

G-10. A certain buffer solution contains equal concentration of X^- and HX. The K_b for X^- is 1×10^{-10}. The pH of the buffer is –

(1*) 4 (2) 7 (3) 10 (4) 14

G-11. For preparing a buffer solution of pH 6 by mixing sodium acetate and acetic acid, the ratio of the concentration of salt and acid should be : ($K_a = 10^{-5}$) **[MP PET 1997]**

(1) 1 : 10 (2*) 10 : 1 (3) 100 : 1 (4) 1 : 100

G-12. Which of the following mixtures forms an acid buffer ?

[MP PMT 1993; IIT 1981; CPMT 1989; CBSE PMT 1989]

(1) NaOH + HCl (2*) CH_3COOH + CH_3COONa
(3) NH_4OH + NH_4Cl (4) H_2CO_3 +$(NH_4)_2CO_3$

G-13. Which of the following solutions can act as buffer ? **[JIPMER 1997]**

(1) 0.1 molar aq. NaCl (2) 0.1 molar aq. CH_3COOH + 0.1 molar NaOH
(3*) 0.1 molar aq. ammonium acetate (4) None of the above

G-14. A buffer solution is a mixture of : **[MP PMT 1987]**

(1) Strong acid and strong base (2) Weak acid and weak base
(3) Weak acid and conjugate acid (4*) Weak acid and conjugate base

G-15. Which of the following solutions cannot act as a buffer ? **[EAMCET 1998]**

(1) NaH_2PO_4 + H_3PO_4 (2) CH_3COOH + CH_3COONa
(3*) HCl + NH_4Cl (4) H_3PO_4 +Na_2HPO_4

G-16. The condition for minimum change in pH for a buffer solution is **[RPMT 2000]**

(1) Isoelectronic species are added (2) Conjugate acid or base is added
(3*) pH = pK_a (4) None of these

Section (H) : Acid base Titration and Indicator

H-1. 100 mL of 0.02 M benzoic acid (pK_a = 4.2) is titrated using 0.02 M NaOH. pH after 50 mL and 100 mL of NaOH have been added are

(1) 3.50, 7 (2) 4.2, 7 (3*) 4.2, 8.1 (4) 4.2, 8.25

H-2. 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 'kwU;

H-3. 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

H-4. 10 ml of 1 M H_2SO_4 will completely neutralise :

(1) 10 ml of 1 M NaOH solution (2*) 10 ml of 2 M NaOH solution
(3) 5 ml of 2 M KOH solution (4) 5 ml of 1 M Na_2CO_3 solution

H-5. In an experiment , 100 ml of 0.1M HCOOH solution is titrated with 0.1 M NaOH. What will be the pH after addition of 50 ml of NaOH ? (K_a (HCOOH) = 2×10^{-4} , log 2 = 0.3)

(1) 4.7 (2*) 3.7 (3) 4.3 (4) 3.3

H-6. 0.1 M acetic acid solution is titrated against 0.1 M NaOH solution. What would be the difference in pH between 1/4 and 3/4 stages of neutralisation of acid ?

(1) 2 log 3/4 (2) 2 log 1/4 (3) log 1/3 (4*) 2 log 3

H-7. An acid base indicator is a weak acid with $K_a = 10^{-5}$. What is the pH of the solution in which the indicator shows the color half way between those of its acidic & basic form ?
(1*) 5 (2) 9 (3) 2.5 (4) 9.5

H-8. The pH indicators are : **[KCET 1996]**
(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

H-9. The suitable indicator for strong acid and weak base is : **[RPMT 1997; UPSEAT 2002]**
(1*) Methyl orange (2) Methyl red (3) Phenol red (4) Phenolphthalein

H-10. An organic dye, cosine used to detect end point of precipitation titration by adsorption is called : **[MH CET 1999]**
(1) Absorption indicator (2*) Adsorption indicator
(3) Chemical indicator (4) None of these

H-11. Phenolphthalein does not act as an indicator for the titration between : **[Pb. PMT 2002]**
(1) NaOH and CH_3COOH (2*) $H_2C_2O_4$ and $KMnO_4$
(3) $Ba(OH)_2$ and HCl (4) KOH and H_2SO_4

H-12. Neutralization of an acid with a base invariably results in the production of : **[CPMT 1983]**
(1) H_3O^+ (2) OH^- (3*) H_2O (4) H^+ and OH^-

H-13. The indicator used in the titration of sodium carbonate with sulphuric acid is : **[DPMT 2001]**
(1) Phenolphthalein (2*) Methyl orange
(3) Potassium ferrocynide (4) Potassium ferricynide

H-14. Why are strong acids generally used as standard solutions in acid-base titrations **[Pb. PMT 1998]**
(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

Section (I) : Solubility product and solubility calculation

I-1. The correct relation between K_{sp} and solubility for the salt $KAl(SO_4)_2$ is :
(1) $4s^3$ (2*) $4s^4$ (3) $27s^4$ (4) None

I-2. The expression for the solubility product of $Al_2(SO_4)_3$ is :
(1) $K_{sp} = [Al^{3+}]\,[SO_4^{2-}]$ (2*) $K_{sp} = [Al^{3+}]^2\,[SO_4^{2-}]^3$
(3) $K_{sp} = [Al^{3+}]^3\,[SO_4^{2-}]^2$ (4) $K_{sp} = [Al^{3+}]^2\,[SO_4^{2-}]^2$

I-3. Which is the correct representation of the solubility product constant of Ag_2CrO_4 ? **[NCERT 1974, 75]**
(1*) $[Ag^+]^2\,[CrO_4^{-2}]$ (2) $[Ag^+]\,[CrO_4^{-2}]$ (3) $[2Ag^+]\,[CrO_4^{-2}]$ (4) $[2Ag^+]^2\,[CrO_4^{-2}]$

I-4. The solubility product of Ag_2CrO_4 is 32×10^{-12} . What is the concentration of CrO_4^- ions in that solution
(1*) 2×10^{-4} M (2) 16×10^{-4} M (3) 8×10^{-4} M (4) 8×10^{-8} M

I-5. Which one of the following is most soluble ? **[CBSE PMT 1994; RPMT 2000]**

(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 ($K_{sp} = 6\times10^{-51}$)

I-6. The solubility of $PbCl_2$ is: **[MP PMT 1995; DCE 1999]**

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

I-7. 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

I-8. 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

I-9. 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) $[Ag^+] = 10^{-2}M$, $[Cl^-] = 10^{-8.5}M$

I-10. 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

I-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

I-12. 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.

I-13. In a saturated solution of Ag_2CO_3, silver ion concentration is 2×10^{-4} M. Its solubility product is :

(1*) 4×10^{-12} (2) 3.2×10^{-11} (3) 8×10^{-12} (4) 10^{-12}

I-14. 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.

I-15. The solubility product of $BaCrO_4$ is 2.4×10^{-10} M^2. The maximum concentration of $Ba(NO_3)_2$ possible without precipitation in a 6×10^{-4} M K_2CrO_4 solution is :

(1*) 4×10^{-7} M (2) 1.2×10^{10} M (3) 6×10^{-4} M (4) 3×10^{-4} M.

I-16. The precipitate of CaF_2 ($K_{sp} = 1.7 \times10^{-10}$) is obtained when equal volumes of the following are mixed :

(1) 10^{-4} MCa^{2+} $+10^{-4}$ M F^- (2*) 10^{-2} MCa^{2+} $+10^{-3}$ M F^-
(3) Both (4) None of these

I-17. 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.

I-18. 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 ($K_{sp} = 1.1 \times 10^{-30}$)

I-19. 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

I-20. The K_{sp} of $BaSO_4$ is 10^{-10}. What is its solubility in a solution which is 0.1 M in Na_2SO_4 ?

(1) 10^{-5} M (2) 0.1 M (3*) 10^{-9} M (4) 10^{-3} M

I-21. What is the solubility of $Cd(OH)_2$ in a buffer solution having pH = 8 ? [K_{sp} ($Cd(OH)_2$) = 2.5×10^{-14}]

(1) 2.5 (2) 0.25 (3*) 0.025 (4) 0.0025

I-22. 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

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

K_{sp} (ZnS) = 1.6×10^{-24}

I-23. A solution of 0.02 M $MgCl_2$ is mixed with equal volume of a solution which is 0.01 M in $Na_2C_2O_4$. If $K_{sp}$of MgC_2O_4 is 7×10^{-7} , then which of the following are true ?

(1) [Mg^{2+}] = 0.01 M in final solution (2) [Mg^{2+}] = 0 in final solution

(3*) [Mg^{2+}] = 0.005 M in final solution (4) [$C_2O_4^{2-}$] = 0.005 M in final solution

I-24. If the solubility product K_{sp} of a sparingly soluble salt MX_2 at 25°C is 1.0×10^{-11}, the solubility of the salt in mole litre^{-1} at this temperature will be : **[RPMT 2000]**

(1) 2.46×10^{14} (2*) 1.36×10^{-4} (3) 2.60×10^{-7} (4) 1.20×10^{-10}

I-25. The solubility product of $BaSO_4$ at 25°C is 1.0×10^{-9} . What would be the concentration of H_2SO_4 necessary to precipitate $BaSO_4$ from a solution of 0.01M Ba^{2+} ions ? **[RPMT 1999]**

(1) 10^{-9} M (2) 10^{-8} M (3*) 10^{-7} M (4) 10^{-6} M

I-26. At equilibrium, if to a saturated solution of NaCl, HCl is passed, NaCl gets precipitated because :

(1) HCl is a strong acid (2) Solubility of NaCl decreases

(3*) Ionic product of NaCl becomes greater than its K_{sp} (4) HCl is a weak acid

I-27. Which pair will show common ion effect ? **[MP PMT 1990, 99; Pb. PMT 2001]**

(1) $BaCl_2 + Ba(NO_3)_2$ (2) NaCl + HCl (3*) $NH_4OH + NH_4Cl$ (4) AgCN + KCN

I-28. 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

I-29. The solubility of $BaSO_4$ in water is 2.33×10^{-3} g/litre. Its solubility product will be (molecular weight of $BaSO_4 = 233$) **[AIIMS 1998]**

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

I-30. The solubility of AgCl in 0.2 M NaCl solution is : (K_{sp} for AgCl = 1.20×10^{-10}) **[MP PET 1996]**

(1) 0.2 M (2) 1.2×10^{-10} M (3) 0.2×10^{-10} M (4*) 6.0×10^{-10} M

Additional Problems For Self Practice (APSP)

Marked Questions may have for Revision Questions.

PART - I : PRACTICE TEST PAPER

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

Max. Marks : 120 **Max. Time : 1 Hr.**

Important Instructions

1. The test is of **1 hour** duration.

2. The Test Booklet consists of **30** questions. The maximum marks are **120.**

3. Each question is allotted **4 (four)** marks for correct response.

4. Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question.
¼ (one fourth) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.

5. There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 4 above.

Note : *Take water as solvent and temperature as 25ºC, if not specified.*
Take log 2 = 0.3, log 3 = 0.48, log 5 = 0.7, log 7 = 0.845, if not specified.

1. Which of the following is not a Lewis acid ? **[MP PET 2002]**
(1) $SiCl_4$ (2) SO_3 (3) Zn^{2+} (4*) CO

2. If the degree of ionization of water at a particular temperature was found to be 1.8×10^{-9}, the K_a of water is:
(1) 10^{-14} (2) 1.8×10^{-12} (3*) 1.8×10^{-16} (4) 10^{-7}

3. An aqueous solution whose pH = 0 is : **[CPMT 1976; DPMT 1982]**
(1) Alkaline (2*) Acidic (3) Neutral (4) Not possible

4. The pH, when 10^{-2} M H_2SO_4 solution is prepared in 10^{-3} M Na_2SO_4 solution, is :
(1) 2 (2*) 1.7 (3) 2.3 (4) 7

5. A 100 mL solution of a strong acid of pH = 1 is mixed with a 100 mL solution of another strong acid of pH = 2. The resulting pH will be nearly : (log 11 = 1.04)
(1) 1.74 (2) 0.96 (3*) 1.26 (4) 1.5

6. V_1 mL of 0.1 M HNO_3 is mixed with V_2 mL of 0.1 M $Sr(OH)_2$. The final solution :
(1) is neutral, if $2V_1 = V_2$ (2) is acidic, if $V_1 > V_2$
(3) is neutral, if $V_1 = V_2$ (4*) is neutral, if $V_1 = 2V_2$

7. The dissociation constants of two bases B_1OH and B_2OH are 2.56×10^{-4} and 1.6×10^{-5} respectively. The relative strength of the bases will be respectively : **[RPMT 2000]**

(1) 1 : 4 (2*) 4 : 1 (3) 1 : 16 (4) 16 : 1

8. What will be the effect of adding 10^{-3} M HCl solution to a solution of HA having concentration 0.1 M ? (K_a of HA = 10^{-5})

(1) Both degree of dissociation of HA and pH will decrease.

(2) Degree of dissociation of HA will decrease but pH of solution will remain constant.

(3) Effect on degree of dissociation of HA and pH of solution can be predicted only by knowing the volumes of both solutions.

(4*) Neither pH nor degree of dissociation of HA will change.

9. The pH of the solution of 0.2 M acetic acid and 0.1 M benzoic acid is :

($K_a(C_6H_5COOH) = 6.5 \times 10^{-5}$, $K_a(CH_3COOH) = 1.75 \times 10^{-5}$)

(1) 2.65 (2*) 2.5 (3) 5.3 (4) 2.4

10. H_3A is a weak triprotic acid ($K_{a_1} = 10^{-5}$, $K_{a_2} = 10^{-9}$, $K_{a_3} = 10^{-13}$). What is the value of pX of 0.1 M H_3A (aq) solution ? Where pX = – log X and X = $\frac{[A^{3-}]}{[HA^{2-}]}$

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

11. When $FeCl_3$ gets soluble in water, then its solution represents which of the following characteristics ?

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

[MP PET/PMT 1988]

Sol. Hydrolysis of Fe^{3+} takes place :

$Fe^{3+} + 3\,H_2O \longrightarrow Fe(OH)_3 + 3\,H^+$

12. The salt NaA of weak acid HA is dissolved to form its 0.01 M solution. If the degree of hydrolysis is 0.01, the pH of solution and K_a of HA at 25ºC respectively are :

(1) 4, 10^{-8} (2) 10, 10^{-6} (3*) 10, 10^{-8} (4) 4, 10^{-6}

13. 10 mL of $\frac{M}{5}$ CH_3COOH solution is mixed with 10 mL of $\frac{M}{5}$ NH_4OH solution. The change in pH of solution upon diluting each solution to double volume will be : (pK_a of CH_3COOH = 4.76, pK_b of NH_4OH = 4.74)

(1) – 0.3 (2) + 0.3 (3) + 1 (4*) No change

14. H_2A is a diprotic acid for which $K_{a_1} = 10^{-7}$ and $K_{a_2} = 10^{-11}$. The solution which will have a pH closest to 9 is :

(1) 0.1 M H_2A (2) 0.1 M Na_2A (3*) 0.1 M NaHA (4) 0.1 M NaHA + 0.1 M Na_2A

15. **S_1 :** The pH of solution made by dissolving 1 mole each of HCl, NaOH & CH_3COONH_4 in the same beaker is 7, if pK_a (CH_3COOH) = pK_b (NH_3).

S_2 : Methyl orange can be used as an indicator in the titration of CH_3COOH with NaOH.

S_3 : Water act as an acid when ammonia is dissolved in water.

(1*) T F T (2) T F F (3) F T T (4) T T T

16. Which of following cannot act as buffer ?

(1) NH_4CN (2) $NaHCO_3 + H_2CO_3$ (3) $NaH_2PO_4 + Na_2HPO_4$ (4*) None of these

17. 500 mL of 0.01 M CH_3COOH + 500 mL of 0.02 M CH_3COONa gives a pH equal to 5.3. The pK_b of CH_3COO^- is : **[P. Bahadur]**

(1) 10 (2*) 9 (3) 4 (4) 5

18. HCl gas is passed through an aqueous solution of 0.1 M 1-aminopropane ($PrNH_2$) till the pH reaches 9.7. Calculate the ratio of $[PrNH_2]/[PrNH_3^+]$ in this solution. [K_b ($PrNH_2$) = 5×10^{-4}]

(1*) 0.1 (2) 0.25 (3) 10 (4) 4

19. What fraction of indicator is in acidic form at a solution pH of 5, if pK_a of the indicator is 4.7 ?

(1) $\frac{2}{3}$ (2*) $\frac{1}{3}$ (3) $\frac{1}{2}$ (4) $\frac{1}{11}$

20. **Statement-1 :** In a titration of weak monoacidic base with strong acid, the pOH at the half equivalent point is pK_b.

Statement-2 : At half equivalence point, it will form buffer at its maximum capacity where [base] = [conjugate acid].

(1*) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.

(2) Statement-1 is true, statement-2 is true and statement-2 is not correct explanation for statement-1.

(3) Statement-1 is true, statement-2 is false.

(4) Statement-1 is false, statement-2 is true.

21. 8 g weak acid HX (molecular mass = 80 u ; $K_a = 10^{-4}$) is dissolved in 100 mL water. If it is titrated with 0.25 M NaOH, find pH at equivalence point :

(1) 9.35 (2*) 8.65 (3) 9 (4) 8.7

22. 10 mL of $\frac{M}{5}$ CH_3COONa solution is titrated with $\frac{M}{5}$ HCl solution. The pH value at equivalence point is : ($pK_a(CH_3COOH) = 4.76$)

(1) 0.7 (2) 1 (3) 1.88 (4*) 2.88

23. The minimum volume of water required to dissolve 10 mg $CaCO_3$ ($K_{sp} = 2.5 \times 10^{-9}$) is : (neglect hydrolysis of Ca^{2+} and CO_3^{2-}).

(1*) 2 L (2) 0.2 L (3) 20 L (4) 0.02 L

24. Which of the following sparingly soluble salts is most soluble in water, assuming all to have same K_{sp} values ?

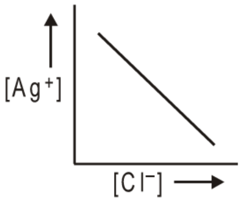
(1) AB (ionising into A^+ & B^-) (2) CD_2 (ionising into C^{2+} & D^-)

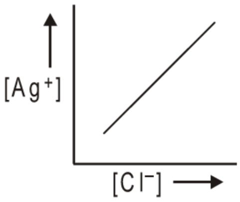
(3) E_2F_2 (ionising into E_2^{2+} & F^-) (4*) GH_3 (ionising into G^{3+} & H^-)

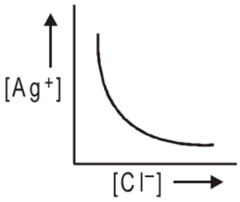
25. K_{sp} of Ag_2CrO_4 at a certian temperature is 8.64×10^{-13}. How many times is its solubility in water greater than in 0.6 M Na_2CrO_4 solution ?

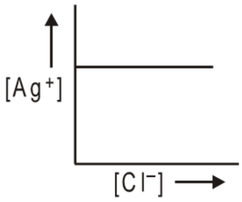
(1*) 10 (2) 10 (3) 1000 (4) ≈ 129

26. In a saturated solution of AgCl, NaCl is added gradually. The concentration of Ag^+ is plotted against the concentration of Cl^-. The graph appears as :

(1)


(2)


(3*)


(4)


27. $SrCO_3$ ($K_{sp} = 10^{-10}$) and $ZnCO_3$ ($K_{sp} = 1.5 \times 10^{-11}$) are dissolved together in a solution. The ratio of $[Sr^{2+}]/[Zn^{2+}]$ in the solution is :

(1) $\frac{10}{3}$ (2) $\frac{3}{10}$ (3*) $\frac{20}{3}$ (4) $\frac{3}{20}$

28. The solubility of $Fe(OH)_3$ would be maximum in :

(1) 0.1 M NaOH (2) 0.1 M HCl (3) 0.1 M KOH (4*) 0.1 M H_2SO_4.

29. **Statement-1 :** Solubility of AgCN in KCN (aq) is greater than in pure water.

Statement-2 : When AgCN dissolve in KCN(aq), complex ion $[Ag(CN)_2]^-$ formation takes place and solubility equilibrium of AgCN shifted in backward direction.

(1) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
(2) Statement-1 is true, statement-2 is true and statement-2 is not correct explanation for statement-1.
(3*) Statement-1 is true, Statement-2 is false.
(4) Statement-1 is false, Statement-2 is true.

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

(1) As pH decreases, solubility decreases.
(2) As pH decreases below 7 or increases above 7, solubility increases in both cases.
(3*) As pH decreases, solubility increases.
(4) No dependence on pH of solution.

Practice Test (IIT-JEE (Main Pattern))

OBJECTIVE RESPONSE SHEET (ORS)

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

PART - II : PRACTICE QUESTIONS

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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_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^{-6}, 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]**
[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) $pH_1>pH_2\approx pH_3>pH_4$ (2) $pH_1<pH_2<pH_3<pH_4$ (3) $pH_1<pH_2<pH_3\approx pH_4$ (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.

(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 $PbCl_2$ = 1.7×10^{-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).

(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]**

29. 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 $HClO_4$

30. 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