IONIC EQUILIBRIUM

1. Out of the following, amphiprotic species are

(I) HPO_3^{2-} (II) OH^- (III) $H_2PO_4^-$ (IV) HCO_3^-

(A) I, III, IV (B) I and III (C) III and IV (D) All

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

(A) $K_a = K_{a_1} \times K_{a_2} \times K_{a_3}$ (B) $K_a = \dfrac{K_{a_1}}{K_{a_2} \times K_{a_3}}$

(C) $K_{a_2} = \dfrac{K_{a_1} \times K_a}{K_{a_3}}$ (D) None of these

3. Ostwald's dilution law gives satisfactory results with the solution of the electrolyte –

(A) HCl (B) HNO_3 (C) CH_3COOH (D) NaOH

4. In the aqueous solution of $MgCl_2$

(A) The number of Mg^{2+} and Cl^- ions are equal

(B) The number of Mg^{2+} ions is half that of Cl^- ions

(C) The number of Mg^{2+} ions is double that of Cl^- ions

(D) None of these

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

(A) Acidic (B) alkaline (C) Neutral (D) Amphoteric

6. The pH of two equimolar weak acids are 3.0 and 5.0 respectively. Their relative strength is –

(A) 3 : 5 (B) 5 : 3 (C) 100 : 1 (D) 1 : 100

7. The pH of two solutions are 5 and 3 respectively. What will be the pH of the solution made by mixing the equal volumes of the above solutions –

(A) 3.5 (B) 4.5 (C) 3.3 (D) 4.0

8. At 298 K, the ratio of number of pure water molecules to number of hydroxyl ions is –

(A) 1.8×10^{-9} (B) 5.55×10^8 (C) 10^7 (D) 6.02×10^{23}

9. A sufficient quantity of acid is added to change its pH from 5 to 2. Its hydrogen ion concentration is increased by –

(A) 100 times (B) 1000 times (C) 2.50 times (D) 5 times

10. How many moles of HCl must be removed from 1 litre of aqueous HCl solution to change its pH from 2 to 3

(A) 1 (B) 0.02 (C) 0.009 (D) 0.01

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

(A) 4 (B) 7 (C) 10 (D)14

12. In a buffer solution of a weak acid and its salt, if the ratio of concentration of salt to acid is raised 10 times then pH of the solution will-

(A) Increase ten times (B) Decrease by one unit

(C) Decrease ten times (D) Increase by one unit

13. The pH of 0.001M sodium acetate solution is $[K_a (CH_3COOH) = 1.8 \times 10^{-5}]$ –

(A) ≈ 11 (B) ≈ 6.5 (C) ≈ 14 (D) ≈ 8.0

14. An aqueous solution of aluminium sulphate would show –

(A) An acidic reaction

(B) A neutral reaction

(C) A basic reaction

(D) Both acidic and basic reactions

15. Select the correct combination –

(A) The aqueous solutions of each Na_3BO_3 and Na_3PO_4 – Acidic nature

(B) The aqueous solutions of each Na_3BO_3 and CH_3COONa – Basic nature

(C) The aqueous solutions of each CH_3COONa and NaCN – Acidic nature

(D) The aqueous solutions of each Na_3PO_4 and NH_4Cl – Acidic nature

16. Expression $pK_h = pK_w - pK_a - pK_b$ is not applicable to –

(A) Ammonium acetate (B) Ammonium cyanide

(C) Aniline acetate (D) Ammonium chloride

17. The salt of which of the following four weak acids will be most hydrolysed –

(A) HA ; $K_a = 1 \times 10^{-8}$ (B) HB ; $K_a = 2 \times 10^{-6}$

(C) HC ; $K_a = 3 \times 10^{-8}$ (D) HD ; $K_a = 4 \times 10^{-10}$

18. A basic buffer solution can be prepared by mixing the solution of –

(A) Ammonium chloride and Ammonium acetate

(B) Ammonium acetate and acetic acid

(C) Ammonium chloride and ammonium hydroxide

(D) Ammonium cyanide and Ammonium hydroxide

19. H^+ ion concentration of water does not change by adding –

(A) CH_3 COONa (B) $NaNO_3$ (C) NaCN (D) Na_2CO_3

20. 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-

(A) HCO_3^- (B) H_2CO_3 (C) H^+ ion (D) CO_3^{2-} ion

21. For the indicator thymol blue, pH is 2.0 when half the indicator is in unionised form. What is the % of indicator in unionised form in the solution with $[H^+] = 4 \times 10^{-3}$ M ?

(A) 28.6 (B) 35 (C) 65 (D) 71.4

22. What indicator should be used for the titration of 0.10 M KH_2BO_3 with 0.10 M HCl ?
[Given : K_a (H_3BO_3) = 7.2×10^{-10}].

Indicators	**pH range**
Methyl Orange	3.1-4.4
Methyl red	4.2-6.3
Litmus	5.5-7.5
Phenol red	6.8-8.4

(A) Litmus (B) Methyl red (C) Phenol red (D) Methyl orange

23. Bromophenol blue is an indicator with a K_a value of 6×10^{-5} . What % of this indicator is in its basic form at a pH of 5 ?
(A) 40 (B) 85.7 (C) 14.3 (D) 60

24. Let the solubility of AgCl in water, in 0.01 M $CaCl_2$, in 0.01 M NaCl and in 0.05 M $AgNO_3$ be s_1 ,s_2, s_3 and s_4 respectively. Which of the following relations between these quantities is correct –
(A) $s_1 > s_2 > s_3 > s_4$ (B) $s_1 > s_2 = s_3 > s_4$ (C) $s_4 > s_2 > s_3 > s_1$ (D) $s_1 > s_3 > s_2 > s_4$

25. K_{sp} of AgCl is 1×10^{-10} . Its solubility in 0.1 M KNO_3 will be –
(A) 10^{-5} moles/litre (B) > 10^{-5} moles/litre (C) < 10^{-5} moles/litre (D) None of these

26. At 25ºC what will be the solubility of silver carbonate in 0.1 M Na_2CO_3 solution. At this temperature K_{sp} of silver carbonate is 4×10^{-13}
(A) 2×10^{-7} (B) 2×10^{-6} (C) 10^{-6} (D) 10^{-7}

27. When equal volumes of the following solutions are mixed, precipitation of CaF_2 ($K_{sp} = 1.7 \times 10^{-10}$) will occur only with –
(A) 10^{-4} M Ca^{2+} and 10^{-4} M F^- (B) 10^{-2} M Ca^{2+} and 10^{-3} M F^-
(C) 10^{-5} M Ca^{2+} and 10^{-3} M F^- (D) 10^{-3} M Ca^{2+} and 10^{-5} M F^-

28. Which of the following would increase the solubility of Pb $(OH)_2$ –
(A) Add hydrochloric acid
(B) Add a solution of $Pb(NO_3)_2$
(C) Add a solution of NaOH
(D) None of the above–the solubility of a compound is constant at constant temperature

29. Which of the following expressions shows the saturated solution of $PbSO_4$ –

(A) K_{sp} ($PbSO_4$) = $[Pb^{2+}]$ $[SO_4^{2-}]$ (B) K_{sp} ($PbSO_4$) > $[Pb^{2+}]$ $[SO_4^{2-}]$

(C) K_{sp} ($PbSO_4$) = $[Pb^{+}]$ $[SO_4^{-}]$ (D) K_{sp} ($PbSO_4$) < $[Pb^{2+}]$ $[SO_4^{2-}]$

30. The solubility procduct of chalk is 9.3×10^{-8}. Calculate its solubility in gram per litre –

(A) 0.3040 gram / litre (B) 0.0304 gram / litre

(C) 2.0304 gram / litre (D) 4.0304 gram / litre

Assertion & Reasoning Type Questions :

Each of the questions given below consist of Statement – I and Statement – II. Use the following Key to choose the appropriate answer.

(A) If both Statement- I and Statement- II are true, and Statement - II is the correct explanation of Statement– I.

(B) If both Statement - I and Statement - II are true but Statement - II is not the correct explanation of Statement – I.

(C) If Statement - I is true but Statement - II is false.

(D) If Statement - I is false but Statement - II is true.

31. **Statement-1** pH of 10^{-7} M NaOH solution is exist between 7 to 7.3 at 25ºC.
Statement-2 Due to common ion effect ionization of water is reduced.

32. **Statement-1** In general phenolphthalein is used as an indicator for the titration of weak acid (HA) against strong base (NaOH).
Statement-2 At equivalent point solution is basic.

33. **Statement-1** Solubility of $BaSO_4$ in 0.1 M Na_2SO_4 is 10^{-9} M hence its K_{SP} is 10^{-18}
Statement-2 For $BaSO_4$, $K_{SP} = S^2$

34. **Statement-1** It is difficult to distinguish the strength of the strong acids such as HCl, HBr, HI or $HClO_4$ in dilute aqueous solutions.
Statement-2 In dilute aqueous solution all strong acids donate a proton to water and 100% ionised to produce a solution containing H_3O^+ ions & the anions of strong acid.

35. **Statement-1** Hydrolysis of salt is an exothermic phenomenon.
Statement-2 It involves breaking up of water molecule to produce acid and base respectively.

36. **Statement-1** A mixture of the solutions of a weak acid and its conjugate base acts as a good buffer.
Statement-2 The pH of buffer solution does not change substantially when small amount of acid or alkaly is added to the buffer.

37. **Statement-1 .** H_2SO_4 is a strong acid.
Statement-2. H_2SO_4 undergoes almost complete ionization in aqueous solutions.

Comprehension (Q.38 to Q.40)

A buffer solution is a solution which resists any change in its pH value on dilution or on addition of solution of an acid or alkali. The property of buffer solution to resist alteration in its pH value is known as buffer capacity. Quantitatively, buffer capacity may be defined as the number of moles of acid or base added to one litre of solution so as to change the pH by unity. pH of a buffer solution lies in the range given below

$$pH = pK_a \pm 1$$

The above relation reveals following facts.

(i) that any buffer solution can be used as buffer upto two pH units only.

(ii) a buffer is said to be efficient when $pH = pK_a$

38. Th pOH limits of a buffer of acetic acid (pK_a = 4.8) and sodium acetate will be -

(A) 3.8 and 5.8 (B) 4.8 and 3.8 (C) 8.2 and 10.2 (D) None of the three

39. Which of the following buffer solutions is expected to be the most efficient buffer ?

(A) 0.1 M NH_4Cl + 0.1 M NH_4OH (B) 0.001 M CH_3COOH + 0.001 M CH_3COONa

(C) 0.05 M HCOOH + 0.05 M HCOONa (D) All of the three

40. Which of the following is correct relation ?

(A) pH = pK_b (B) pOH = pK_a (C) pOH = pK_b (D) All the three

41. Amongst the following, the total number of compounds whose aqueous solution turns red litmus paper blue is

KCN K_2SO_4 $(NH_4)_2C_2O_4$ NaCl $Zn(NO_3)_2$

$FeCl_3$ K_2CO_3 NH_4NO_3 LiCN

42. In 1 L saturated solution of AgCl [K_{sp}(AgCl) = 1.6×10^{-10}], 0.1 mol of CuCl [K_{sp}(CuCl) = 1.0×10^{-6}] is added. The resultant concentration of Ag^+ in the solution is 1.6×10^{-x}. The value of "x" is

ANSWER KEY

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