IONIC EQUILIBRIUM

INTRODUCTION

1. If pH = 3.31, then find out $[H^+]$ (Approxy)

(1) 3.39×10^{-4} (2) 5×10^{-4}

(3) 3.0×10^{-3} (4) None

2. Find out pH of solution having 2×10^{-3} moles of OH^- ion's in 2 litre solution :-

(1) pH = 3 (2) pH = 3 + log2

(3) pH = 3 – log2 (4) pH = 11

3. 8 g NaOH is dissolved in one litre of solution, the molarity of the solution is:-

(1) 0.2 M (2) 0.4 M (3) 0.02 M (4) 0.8 M

4. The number of milli equivalents of acid in 100 mL of 0.5N HCl solution is:-

(1) 50 (2) 100 (3) 25 (4) 200

5. If the molar concentration of PbI_2 is 1.5×10^{-3} mol L^{-1}, the concentration of iodide ions in g ion L^{-1} is:-

(1) 3.0×10^{-3} (2) 6.0×10^{-3}

(3) 0.3×10^{-3} (4) 0.6×10^{-6}

OSTWALD'S DILUTION LAW

6. Order of dissociation of 0.1 N CH_3COOH is :- (Dissociation constant = 1×10^{-5})

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

7. If α is the degree of dissociation of weak dibasic organic acid and y is the hydrogen ion concentration, what is the initial concentration of acid (assume both H dissociate in one step) :-

(1) $\frac{\alpha(y)^{-1}}{2}$ M (2) $y(\alpha)^{-1}$M

(3) $\frac{y(\alpha)^{-1}}{2}$ M (4) None of them

8. The pH of 0.15 M solution of HOCl ($K_a = 9.6 \times 10^{-6}$) is:-

(1) 4.42 (2) 2.92 (3) 3.42 (4) None

9. The extent of ionisation increases (weak electrolytes)

(1) With the increase in concentration of solute

(2) On decreasing the temp. of solution

(3) On addition of excess of water to the solution

(4) On stirring the solution vigorously

EXPLANATION OF WATER

10. Ionic product of water will increase, if :-

(1) Dissociation the pressure

(2) Add H^+

(3) Add OH^-

(4) Increase the temperature

11. At 25^0C, the dissociation constant for pure water is given by :-

(1) $(55.4 \times 10^{14})^{-1}$ (2) 1×10^{-14}

(3) $\frac{1 \times 10^{-14}}{18}$ (4) None of these

12. At 90^0C, pure water has $[H_3O^+] = 10^{-6.7}$ mol L^{-1} what is the value of K_W at 90^0C:-

(1) 10^{-6} (2) 10^{-12}

(3) 10^{-67} (4) $10^{-13.4}$

13. At 373 K, temp. the pH of pure H_2O can be:-

(1) < 7 (2) > 7 (3) = 7 (4) = 0

14. If it is known that H_2S is a weak acid and it is ionised into $2H^+$ and S^{-2}. Then in this solution HCl is added so, pH becomes less, then what will happen :-

(1) Decrease in S^{-2} ion concentration

(2) Concentration of S^{-2} is not affected

(3) Increase in S^{-2} ion concentration

(4) It is not possible, to add HCl in solution

HYDROLYSIS OF SALTS

15. $HCOO^- + H_2O \rightleftharpoons HCOOH + OH^-$ is related:-

(1) $h = \sqrt{K_h}$ (2) $h = \sqrt{\frac{K_h}{C}}$

(3) $h = \sqrt{\frac{K_h}{V}}$ (4) $K_h = \sqrt{hc}$

16. The highest pH value is of :-

(1) 0.1 M NaCl

(2) 0.1 M NH_4Cl

(3) 0.1 M CH_3COONa

(4) 0.1 M CH_3COONH_4

17. A weak acid react with strong base, ionisation constant of weak acid is 10^{-4}. Find out equilibrium constant for this reaction :-

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

18. Hydroxyl ion concentration [OH^-] in the case of sodium acetate can be expressed as (where K_a is dissociation constant of CH_3COOH and C is the concentration of sodium acetate):-

(1) $[OH^-] = (CK_w . K_a)^{1/2}$

(2) $[OH^-] = C.K_w\sqrt{K_a}$

(3) $[OH^-] = \left(\frac{C.K_w}{K_a}\right)^{1/2}$

(4) $[OH^-] = C. K_a. K_w.$

19. K_a for cyano acetic acid is 3.5×10^{-3}. Then the degree of hydrolysis of 0.05 M. sodium cyano acetate solution will have the following value :-

(1) 4.559×10^{-6} (2) 5.559×10^{-6}

(3) 6.559×10^{-6} (4) 7.559×10^{-6}

SOLUBILITY & SOLUBILITY PRODUCT(K_{sp})

20. At 25°C, the K_{sp} value of AgCl is 1.8×10^{-10}. If 10^{-5} moles of Ag^+ are added to solution then K_{sp} will be :-

(1) 1.8×10^{-15} (2) 1.8×10^{-10}

(3) 1.8×10^{-5} (4) $18 \times 10^{+10}$

21. Concentration of Ag^+ ions in saturated solution of Ag_2CrO_4 at 20°C is 1.5×10^{-4} mol L^{-1}. At 20°C, the solubility product of Ag_2CrO_4 is :-

(1) 3.3750×10^{-12} (2) 1.6875×10^{-10}

(3) 1.68×10^{-12} (4) 1.6875×10^{-11}

22. If the solubility of lithium sodium hexeafluoro aluminate $Li_3Na_3(AlF_6)_2$ is 'S' mol L^{-1}. Its solubility product is equal to :-

(1) S^8 (2) $12\ S^3$

(3) $18S^3$ (4) $2916\ S^8$

APPLICATION OF SOLUBILITY PRODUCT(K_{sp})

23. The solubility product of CuS , Ag_2S and HgS are 10^{-37}, 10^{-44} and 10^{-54} respectively. The solubility of these sulphides will be in the order

(1) HgS > Ag_2S > CuS (2) Ag_2S > HgS > CuS

(3) CuS > Ag_2S > HgS (4) Ag_2S > CuS > HgS

24. If the maximum concentration of $PbCl_2$ in water is 0.01 M at 298 K, Its maximum concentration in 0.1 M NaCl will be:-

(1) 4×10^{-3} M (2) 0.4×10^{-4} M

(3) 4×10^{-2} M (4) 4×10^{-4} M

25. In which of the following, the solubility of AgCl will be maximum :-

(1) 0.1 M $AgNO_3$ (2) Water

(3) 0.1 M NaCl (4) 0.1 M KCl

26. 0.5 M HCl solution has ions- Hg^{++}, Cd^{++}, Sr^{++}, Fe^{++}, Cu^{++}. To pass the H_2S gas in this solution, which are precipitated out :-

(1) Cd^{+2}, Fe^{+2}, Sr^{+2} (2) Cd^{+2}, Hg^{+2}, Cu^{+2}

(3) Hg^{+2}, Cu^{+2}, Fe^{+2} (4) Cu^{+2}, Sr^{+2}, Fe^{+2}

27. What will happen if the pH of the solution of 0.001 M $Mg(NO_3)_2$ solution is adjusted to pH = 9

($K_{sp}Mg(OH)_2 = 8.9 \times 10^{-12}$)

(1) ppt will take place

(2) ppt will not take place

(3) Solution will be saturated

(4) None of these

28. Why only As^{3+} gets precipitated as As_2S_3 and not Zn^{2+} as ZnS when H_2S is passed through an acidic solution containing As^{3+} and Zn^{2+} :-

(1) Enough As^{3+} are present in acidic medium

(2) Zinc salt does not ionise in acidic medium

(3) Solubility product of As_2S_3 is less than that of ZnS

(4) Solubility product changes in presence of an acid

29. H_2S is passed through a solution of cations in HCl medium to precipitate cation of :-

(1) II - A group of cation analysis

(2) II - B group of cation analysis

(3) IV group of cation analysis

(4) Both II - A and II-B gps.

30. The solubility product of hydroxides of Mg^{+2}, Zn^{+2}, and Fe^{+3} decreases as

K_{sp} $Mg(OH)_2$ > K_{sp} $Zn(OH)_2$ > K_{sp} $Fe(OH)_3$ The order of precipitation of hydroxides is:-

(1) $Fe(OH)_3$, $Zn(OH)_2$, $Mg(OH)_2$

(2) $Mg(OH)_2$, $Zn(OH)_2$, $Fe(OH)_3$

(3) $Zn(OH)_2$, $Fe(OH)_3$, $Mg(OH)_2$

(4) $Zn(OH)_2$, $Mg(OH)_2$, $Fe(OH)_3$

pH

31. pH of water is 7. When any substance Y is dissolved in water then pH becomes 13. Substance Y is a salt of :-

(1) Strong acid and strong base

(2) Weak acid and weak base

(3) Strong acid and weak base

(4) Weak acid and strong base

32. In the following solutions, the conc. of different acids are given, which mixture of the acid has highest pH (If equal volume of each mixed together) :-

(1) $\frac{M}{10}H_2SO_4$, $\frac{M}{20}HNO_3$, $\frac{M}{10}HClO_4$

(2) $\frac{M}{20}H_2SO_4$, $\frac{M}{10}HNO_3$, $\frac{M}{20}HClO_4$

(3) $\frac{M}{20}H_2SO_4$, $\frac{M}{10}HNO_3$, $\frac{M}{40}HClO_4$

(4) $\frac{M}{20}H_2SO_4$, $\frac{M}{5}HNO_3$, $\frac{M}{5}HClO_4$

33. The pH of solution is increased from 3 to 6. Its H^+ ion concentration will be :-

(1) Reduced to half

(2) Doubled

(3) Reduced by 1000 times

(4) Increased by 1000 times

34. Which of the following statements are (is) correct

(a) The pH of 1.0×10^{-8} M solution of HCl is 8.

(b) The conjugate base of $H_2PO^-_4$ is HPO_4^{2-}.

(c) Autoprotolysis constant of water increases with temperature.

(d) When a solution of a weak monoprotic acid is titrated against a strong base, at half neutralization point pH = 1/2 pKa

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

35. The hydrogen ion concentration in a given solution is 6×10^{-4} M. Its pH will be :-

(1) 6 (2) 3.22 (3) 4 (4) 2.

36. The pOH of beer is 10.0. The hydrogen ion concentration will be :–

(a) 10^{-10} (b) $\frac{Kw}{10^{-10}}$ (c) $\frac{Kw}{10^{-8}}$ (d) 10^{-4}

(1) a, d (2) b, c (3) a, b, c (4) None

37. Following five solution of KOH were prepare as–

First → 0.1 moles in 1 L

Second → 0.2 moles in 2 L

Third → 0.3 moles in 3 L

Fourth → 0.4 moles in 4 L

Fifth → 0.5 moles in 5 L

The pH of resultant solution is :–

(1) 2 (2) 1 (3) 13 (4) 7

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

(1) 1 (2) 0.02 (3) 0.009 (4) 0.01

39. What is the quantity of NaOH present in 250 cc of the solution, so that it gives a pH = 13 :-

(1) 10^{-13} g (2) 10^{-1} g

(3) 1.0 g (4) 4.0 g

BUFFER SOLUTIONS and INDICATOR

40. In a buffer solution the ratio of concentration of NH_4Cl and NH_4OH is 1 : 1 when it changes in 2 : 1 what will be the value of pH of buffer :-

(1) Increase (2) Decrease

(3) No effect (4) N.O.T.

41. In the volumetric estimation of HCl, if we make use of phenolphthalein as an indicator, which base is unsuitable for the titration :-

(1) NaOH (2) RbOH

(3) KOH (4) NH_4OH

42. Phenolphthalein does not act as an indicator for the titration between :-

(1) KOH and H_2SO_4

(2) NaOH and CH_3COOH

(3) Oxalic acid and $KMnO_4$

(4) $Ba(OH)_2$ and HCl

43. Which can act as buffer :-

(1) NH_4OH + NaOH

(2) HCOOH + CH_3COONa

(3) 40 mL 0.1 M NaCN + 20 mL of 0.1 M HCl

(4) None of them

44. From the following in which titration methyl orange is a best indicator :-

(1) CH_3COOH + NaOH

(2) $H_2C_2O_4$ + NaOH

(3) HCl + NaOH

(4) CH_3COOH + NH_4OH

45. The pH of blood is maintained by CO_2 and H_2CO_3 in the body and chemical constituents of blood. This phenomenon is called :-

(1) Colloidal (2) Buffer action

(3) Acidity (4) Salt balance

46. Which of the following solutions does not act as buffer :–

(1) $H_3PO_4 + NaH_2PO_4$

(2) $NaHCO_3 + H_2CO_3$

(3) $NH_4Cl + HCl$

(4) $CH_3COOH + CH_3COONa$

47. Half of the formic acid solution is neutralised on addition of a KOH solution to it. If K_a (HCOOH) = 2×10^{-4} then pH of the solution is : (log 2 = 0.3010)

(1) 3.6990 (2) 10.3010

(3) 3.85 (4) 4.3010

48. 0.05 M ammonium hydroxide solution is dissolved in 0.001 M ammonium chloride solution. What will be the OH^- ion concentration of this solution: $K_b(NH_4OH) = 1.8 \times 10^{-5}$

(1) 3.0×10^{-3} (2) 9.0×10^{-4}

(3) 9.0×10^{-3} (4) 3.0×10^{-4}

49. What amount of sodium propanoate should be added to one litre of an aqueous solution containing 0.02 mole of propanoic acid (Ka = 1.34×10^{-5} at 25°C) to obtain a buffer solution of pH 4.75 :-

(1) 4.52×10^{-2} M (2) 3.52×10^{-2} M

(3) 2.52×10^{-2} M (4) 1.52×10^{-2} M

50. Calculate the ratio of pH of a solution containing 1 mole of CH_3COONa + 1 mole of HCl per litre and of other solution containing 1 mole CH_3COONa + 1mole of acetic acid per litre :-

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

51. 10 mL of a solution contains 0.1 M NH_4Cl+ 0.01 M NH_4OH. Which addition would not change the pH of solution :–

(1) Adding 1 mL water

(2) Adding 5 mL of 0.1 M NH_4Cl

(3) Adding 5 mL of 0.1 M NH_4OH

(4) Adding 10 mL of 0.1 M NH_4Cl

ACID AND BASE

52. In the reaction $NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$ water behaves as :-

(1) Acid (2) Base

(3) Neutral (4) Both acid & Base

53. The conjugated base of $(CH_3)_2\overset{+}{N}H_2$ is :-

(1) CH_3NH_2 (2) $(CH_3)_2N^+$

(3) $(CH_3)_2N$ (4) $(CH_3)_2NH$

54. Which of the following is not a Bronsted acid :-

(1) $CH_3NH_4^+$ (2) CH_3COO^-

(3) H_2O (4) HSO_4^-

55. The conjugate base of the weak acid in the reaction $HBr + H_2O \rightleftharpoons H_3O^+ + Br^-$ is

(1) HBr (2) H_2O (3) Br^- (4) H_3O^+

56. Mg^{2+} is ------- than Al^{3+} :-

(1) Strong Lewis acid (2) Strong Lewis base

(3) Weak Lewis acid (4) Weak Lewis base

57. The two Bronsted bases in the reaction

$HC_2O_4^- + PO_4^{3-} \rightleftharpoons HPO_4^{2-} + C_2O_4^{2-}$ are

(1) $HC_2O_4^-$ and PO_4^{2-}

(2) HPO_4^{2-} and $C_2O_4^{2-}$

(3) PO_4^{3-} and $C_2O_4^{-2}$

(4) $HC_2O_4^-$ and HPO_4^{2-}

58. In which of the following reactions NH_3 acts as acid

(1) $NH_3 + HCl \rightarrow NH_4Cl$

(2) $NH_3 + H^+ \rightarrow NH_4^+$

(3) $NH_3 + Na \rightarrow NaNH_2 + \frac{1}{2}H_2$

(4) NH_3 cannot act as acid

59. Consider the following reactions :-

(i) $CO_3^{2-} + H_2O \rightleftharpoons HCO_3^- + OH^-$

(ii) $CO_2 + H_2O \rightleftharpoons H_2CO_3$

(iii) $NH_3 + H_2O \rightleftharpoons NH_4OH$

(iv) $HCl + H_2O \rightleftharpoons Cl^- + H_3O^+$

Which of the pairs of reactions proves that water is amphoteric in character :-

(1) (i) and (ii) (2) (ii) and (iii)

(3) (iii) and (iv) (4) (i) and (iii)

60. Aluminium chloride is :-

(1) Bronsted Lowry acid (2) Arrhenius acid

(3) Lewis acid (4) Lewis base

61. Water is a :-

(1) Protogenic solvent (2) Protophilic solvent

(3) Amphiprotic solvent (4) Aprotic solvent

62. Species which do not act both as Bronsted acid and base is :-

(1) $(HSO_4)^{-1}$ (2) Na_2CO_3

(3) NH_3 (4) OH^{-1}

ANSWER KEY

IONIC EQUILIBRIUM																				
Que.	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
Ans.	2	4	1	1	1	4	3	2	3	4	1	4	1	1	2	3	2	3	4	2
Que.	**21**	**22**	**23**	**24**	**25**	**26**	**27**	**28**	**29**	**30**	**31**	**32**	**33**	**34**	**35**	**36**	**37**	**38**	**39**	**40**
Ans.	3	4	4	4	2	2	2	3	4	1	4	3	3	4	2	4	3	3	3	2
Que.	**41**	**42**	**43**	**44**	**45**	**46**	**47**	**48**	**49**	**50**	**51**	**52**	**53**	**54**	**55**	**56**	**57**	**58**	**59**	**60**
Ans.	4	3	3	3	2	3	1	2	4	3	1	1	4	2	2	3	3	3	3	3
Que.	**61**	**62**																		
Ans.	3	2																		

SOLUTION

1. pH = 3.31

$-\log H^+ = 3.31$

$[H^+]$ = Antilog (–3.31)

= Antilog (–4 +.69)

$= 5 \times 10^{-4}$

2. $[OH^-] = \dfrac{2\times10^{-3}}{2} = 10^{-3}$

pOH = 3 ; pH = 11

3. $[NaOH] = \dfrac{8/40}{1} = \dfrac{1}{5} = 0.2\,M$

4. no. of milli equivalent of HCl $= N \times V_{ml}$

$= 0.5 \times 100$ ml

= 50

5. $[PbI_2] = 1.5 \times 10^{-3}$ M

$[I^-] = 2 \times 1.5 \times 10^{-3} = 3 \times 10^{-3}$ M

6. 0.1N CH_3COOH = 0.1M CH_3COOH

$\dfrac{ka}{C} = \dfrac{1\times10^{-5}}{.1} = 10^{-4} < 10^{-2}$

So α neglected

$\alpha = \sqrt{ka/c} = \sqrt{10^{-4}}$

$= 10^{-2}$

7. Let α is dissociation if both H ionises simultaneously in diabasic Acid H_2A

H_2A	$\rightleftharpoons$	$2H^+$	+	A^{2-}
C		–		–
C(1-α)		2.Cα		Cα

$[H^+] = 2C\alpha = y$

$$C = \frac{y}{2}\alpha^{-1}$$

8. HOCl (weak Acid)

$$\frac{ka}{C} = \frac{9.6\times10^{-6}}{0.15} < 10^{-5}$$

$$[H^+] = \sqrt{ka.c} = \sqrt{9.6\times10^{-6}\times0.15}$$

$pH = -\log (9.6 \times 1.5 \times 10^{-6})^{1/2}$

$= \dfrac{1}{2}[6 - \log (9.6 \times 1.5]$

= 2.92

9. $\alpha_{weak} \propto \sqrt{v}$ (monobasic)

10. $Kw = [H^+][OH^-]$

T↑, Kω↑

11. $H_2O \rightleftharpoons H^+ + OH^-$

$$k_d = \frac{[H^+][OH^-]}{[H_2O]} = \frac{1\times10^{-14}}{55.55}$$

$= (55.55 \times 10^{14})^{-1}$

12. $[H_3O^+] = [H^+] = 10^{-6.7}$ at 90°C

pure H_2O

So [OH–] = $10^{-6.7}$

$k\omega = [H^+][OH^-] = 10^{-13.4}$

13. pH (pure H_2O) < 7 at 373 k

At 373 k $kw(H_2O) > 10^{-14}$

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

weak acid

Addition of HCl result B.D.

$[S^{2-}]$ Decreases

Although effective $[H^+]$ increases

So pH decreases.

15. $HCOO^- + H_2O \rightleftharpoons HCOOH + OH^-$

C		0	0
C(1–h)		Ch	Ch

$$k_h = \frac{Ch^2}{1-h}\,(1\text{-}h \simeq 1)$$

$k_h = Ch^2$

$$h = \sqrt{\frac{k_h}{C}}$$

16. CH_3COONa(Salt = wA + S.B)

So pH will be High

17. HX + NaOH $\rightleftharpoons$ NaX + H_2O (Let)

W.A S.B

$$K_C = \frac{1}{kh(X^-)}$$

$NaX + H_2O \rightleftharpoons Hx + NaOH$

$X^- + H_2O \rightleftharpoons HX + OH^-$

$$\text{So } K_C = \frac{1}{k_h(X^-)} = \frac{1}{k_b(X^-)}$$

$$= \frac{1}{\frac{kw}{ka(HX)}} = \frac{ka(HX)}{k\omega}$$

$$= \frac{10^{-4}}{10^{-14}} = 10^{10}$$

18. $CH_3COONa + H_2O \rightleftharpoons CH_3COOH + NaOH$

C

$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$

C – –

C(1-h) Ch Ch

$$h = \sqrt{\frac{k_h}{c}} \qquad \left(k_h = \frac{kw}{k_a}\right)$$

$[OH^-] = Ch = \sqrt{k_h C}$

$$[OH^-] = \sqrt{\frac{kw}{k_a}.C}$$

19. $$h = \sqrt{\frac{kw}{k_a}.C}$$

$$= \sqrt{\frac{10^{-14}\times 0.05}{3.5\times 10^{-3}}}$$

$= 7.559 \times 10^{-6}$

20. K_{sp} value does not change on changing concentration of ions.

21. $Ag_2CrO_4 \rightleftharpoons 2\,Ag^+ + CrO_4^{2-}$

1.5×10^{-4} $\quad \frac{1.5\times10^{-4}}{2}$

Saturated solution

$K_{sp} = [Ag^+]^2\,[CrO_4^{2-}]$

$$= (1.5\times10^{-4})^2\left(\frac{1.5\times10^{-4}}{2}\right)$$

$= 1.68 \times 10^{-12}$

22. $Li_3\,Na_3\,(AlF_6)_2 \rightleftharpoons 3Li^+ + 3\,Na^+ + 2AlF_6^{3-}$

3S 3S

2S $K_{sp} = 3^3\,3^3\,2^2\,S^{3+3+2}$

$K_{sp} = 2916\,S^8$

23. $K_{sp}\,(CuS) = S_1^2 = 10^{-37}$

$K_{sp}\,(Ag_2S) = 4S_2^3 = 10^{-44}$

$Ksp\,(HgS) = S_3^2 = 10^{-54}$

So $S_2 > S_1 > S_3$

24. In H_2O

$PbCl_2 \rightleftharpoons Pb^{2+} + 2Cl^-$

0.01 $\quad 2 \times 0.01$

$K_{sp} = (0.01)(2 \times 0.01)^2 = 4 \times 10^{-6}$

In 0.1 M NaCl

$PbCl_2 \rightleftharpoons Pb^{2+} + 2Cl^-$

S $\quad 0.1 + 2S$

$K_{sp} = (S)\,(0.1 + 2S)2$

$4 \times 10^{-6} = S.(0.1)^2$

$S = 4 \times 10^{-4}$ M

25. Solubility of AgCl is maximum in H_2O among given option because in other case due to common ion effect solubility decreases.

26. Ions ppt by passing H_2S gas in presence of HCl are Cd^{2+}, Hg^{2+}, Cu^{2+}

27. IP $(Mg(OH)_2)$ at pH = 9

$= (Mg^{2+})\,(OH)^2$; [pOH = 6]

$= (.001)\,(10^{-6})^2$

$IP = 10^{-15} < K_{sp}\,(8.9 \times 10^{-12})$

So no ppt will take place

28. As^{3+} get ppt but not Zn^{2+} by passing H_2S in Acidic medium because $K_{sp}\,(As_2S_3) < K_{sp}\,(ZnS)$

29. H_2S gas ppt IIA & IIB groups ions in HCl medium.

30. Hydroxide having low K_{sp} will ppt 1st

31. generally salt Y having high pH (=13) value is composed of weak Acid and strong base.

32. $$[H^+]_R = \frac{N_1V_1 + N_2V_2 + N_3V_3}{V_1 + V_2 + V_3}$$

$pH = -\log[H^+]_R$

33. $pH_1 = 3$ to $pH_2 = 6$

$[H^+]_1 = 10^{-3}$ to $[H^+]_2 = 10^{-6}$

$[H^+]$ Reduced by 1000 times

34. (a) pH of 10^{-8}M HCl is less than 7

(b) $H_2PO_4^- \rightleftharpoons H^+ + HPO_4^{2-}$

Acid C.B

(c) $Kw = [H^+]\,[OH^-]$; T↑ , Kw↑

(d) $HX + NaOH \longrightarrow NaX + H_2O$

WA S.B

C_0 $\quad C_0/2$ – –

$\frac{C_0}{2}$ $\quad 0$ $\quad \frac{C_0}{2}$

Acidic buffer form at half neutralization point

So $$pH = pKa + \log\left(\frac{Salt}{Acid}\right)$$

$pH = pKa$ ([Salt] = [Acid])

35. $[H^+] = 6 \times 10^{-4}$

pH = 4 – log6 = 3.22

36. pOH = 10 ; pH = 4 ; $[H^+] = 10^{-4}$

37. In each given solution

[KOH] = 0.1M ; After mixing

$[OH^-]_R = 0.1$; pOH = 1

pH = 13

38. pH = 2 means 10^{-2} moles per lit

pH = 3 means 10^{-3} moles per lit

So n_{HCl} (removed) = $10^{-2} - 10^{-3}$ = 0.009 moles

39. pH = 13 ; pOH = 1 ; $[OH^-] = 10^{-1}$

or [NaOH] = 0.1 M

$$[NaOH] = \frac{n_{NaOH}}{v_{lit}}$$

$$0.1 = \frac{n}{250/1000}$$

$$n = \frac{0.1}{4}$$

$$w(NaOH) = \frac{0.1 \times 40}{4} = 1 \text{ gm}$$

40. buffer of NH_4Cl & NH_4OH is basic buffer

$$\text{Initialy } pOH = p^{k_b} + \log\left(\frac{1}{1}\right)$$

$$\text{finaly } pOH = p^{k_b} + \log\left(\frac{2}{1}\right)$$

Now pOH increases so

pH decreases.

41. Phenolphthalin indicator is suitable for titration of HCl with S.B.

42. Phenolphthalein is suitable for titration of SA+SB and WA+SB

43. Buffer may be solution of

(a) Salt (WA + WB)

(b) WA + its salt with S.B

(c) WB + its salt with S.A

44. Methyl orange is best indicator for titration of (SA + SB) and (SA + W.B) among given

45. pH of Blood is maintain by CO_2 and H_2CO_3 by making Buffer

46. Buffer may be

(a) Salt (WA + WB)

(b) WA. + its salt with S.B

(c) WB + its salt with S.A

So NH_4Cl + HCl is not buffer

47. $HCOOH + KOH \rightleftharpoons HCOO^-K^+ + H_2O$

C_0	$\frac{C_0}{2}$	–	–
$\frac{C_0}{2}$	0	$\frac{C_0}{2}$	–

$$pH = pK_a + \log\left(\frac{C_0/2}{C_0/2}\right)$$

$pH = pK_a = 4 - \log 2$

pH = 3.699

48. 0.05 M NH_4OH + 0.001M NH_4Cl

Basic Buffer

$$pOH = p^{Kb} + \log\left(\frac{NH_4^+}{NH_4OH}\right)$$

$$= 4.74 + \log\left(\frac{0.001}{.05}\right) = 4.74 + \log\left(\frac{1}{50}\right)$$

pOH = 3.14

$[OH^-] = 9 \times 10^{-4}$

2nd methode

$$NH_4^+ + H_2O \rightleftharpoons NH_4OH + H^+$$

$$K_h(NH_4^+) = K_a(NH_4^+) = \frac{kw}{K_b(NH_4OH)}$$

$$K_h(NH_4^+) = \frac{[NH_4OH][H^+]}{[NH_4^+]}$$

$$\frac{kw}{1.8\times10^{-5}} = \frac{0.05}{0.001}[H^+]$$

$$\frac{[H^+][OH^-]}{1.8\times10^{-5}} = 50[H^+]$$

$[OH^-] = 9 \times 10^{-4}$

49. 0.02 mole C_2H_5COOH + a_0 mole C_2H_5COONa in one litre

So Acidic Bufter

$$pH = pKa + \log_{10}\left(\frac{Salt}{Acid}\right)$$

$$4.75 = 5 - \log 1.34 + \log_{10}\left(\frac{a_0}{0.02}\right)$$

$a_0 = 1.52 \times 10^{-2}$ M (in 1 liter solution)

50. 1 mole CH_3COONa +1 mole HCl in 1 liter means effectivily 1M CH_3COOH

$$pH_1 = \frac{1}{2}[pKa + \log C]$$

$$= \frac{1}{2}[pKa + \log 1]$$

$$= \frac{1}{2}pKa$$

1 mole CH_3COONa + 1 mole CH_3COOH in 1 litre

$$pH_2 = pKa + \log_{10}\left(\frac{Salt}{Acid}\right)$$

$$= pKa + \log_{10}\left(\frac{1M}{1M}\right)$$

$$= pka$$

So $pH_1 : pH_2 = \frac{1}{2}:1 = 1 : 2$

51. 10 ml of 0.1 M NH_4Cl + 0.01 M NH_4OH

pH of Solution does not change by adding small amount of H_2O

52. $NH_3 + \underset{\downarrow}{H_2O} \rightleftharpoons NH_4^+ + OH^-$

H^+doner

H_2O act as acid

53. $(CH_3)_2\overset{+}{N}H_2 \rightleftharpoons (CH_3)_2NH + H^+$

Acid C.B

54. Bronsted acid : H^+ doner

CH_3COO^- is not Bronsted acid

55.

$$\underset{\text{Acid}}{HBr} + \underset{\substack{\text{base}\\ H^+\text{ aceptor}}}{H_2O} \rightleftharpoons \underset{\text{C.A.}}{H_3O^+} + \underset{\text{C.B.}}{Br^-}$$

C.B. of weak Acid (H_3O^+) is H_2O

56. Mg^{2+} is weaker lewis acid than Al^{3+}

57.

$$\underset{\substack{H^+\text{doner}\\ \text{Acid}}}{HC_2O_4^-} + \underset{\substack{\text{Base}\\ \text{C.B}}}{PO_4^{3-}} \rightleftharpoons \underset{\substack{H^+\text{ doner}\\ \text{C.Acid}}}{HPO_4^{2-}} + C_2O_4^{2-}$$

So Bronsted base are $PO_4^{3-}, C_2O_4^{2-}$

58. $\underset{\substack{H^+\text{doner}\\ \text{Acid}}}{NH_3} + Na \longrightarrow NaNH_2 + \frac{1}{2}H_2$

59. Amphoteric : H^+ doner as well as H^+ aceptar

60. $AlCl_3$ is lone pair aceptor so it is lewis acid

61. H_2O can act as acid as well as base

62. Na_2CO_3 is neighter Bronsted acid nor bronsted base