Miscellaneous Exercise Question Bank

1. An acidic indicator HIn $\left(K_{HIn} = 10^{-6}\right)$ ionises as $HIn \rightleftharpoons H^+ + In^-$. The acid colour predominates over the basic colour when HIn is at least 10 times more concentrated than In^- ion. On the other hand basic colour predominates over the acid colour when the In^- ion is at least 5 times more concentrated than HIn. Hence pH range of the indicator is :

(A) 5.0 – 6.7 **(B)** 7.0 – 8.7 **(C)** 5.3 – 7.0 **(D)** 7.0 – 8.1

2. The correct statement amongst the following is

(A) A strong electrolyte remains completely dissociated at all dilutions.

(B) Upon dilution the degree of dissociation of a weak electrolyte and number of ions per unit volume of its solution both increase.

(C) A strong electrolyte is completely ionised at all dilutions but not completely dissociated.

(D) pH of solution of a weak acid decreases with dilution.

3. 4M solution of a weak monobasic acid (x % ionized and pH = 3.0) is diluted to 1 M by adding water (distilled). Percentage ionisation and pH of solution after dilution will be respectively.

(A) 2x and 2.7 **(B)** 0.25x and 3.3

(C) 0.5x and 2.7 **(D)** 2x and 3.3

4. pH of a buffer solution changes from 6.20 to 6.17 when 0.003 mole of acid is added to 500 mL of the buffer. The buffer capacity of the system is, therefore :

(A) 0.1 **(B)** 0.3 **(C)** 0.2 **(D)** 0.4

5. K_{sp} of $CaSO_4$ is 2.4×10^{-5} at 25°C. In a solution containing Ca^{2+} ions the precipitation of $CaSO_4$ begins to occur when SO_4^{2-} ion concentration in the solution is made just to exceed the value of 4.8×10^{-3}M. Hence concentration of Ca^{2+} ion in the solution is : (Assume density of solution is 1 g/ml)

(A) 200 ppm **(B)** 40 ppm **(C)** 400 ppm **(D)** 100 ppm

6. Correct statement regarding pure water amongst the following is :

(A) It contains only single species i.e. H_2O molecules

(B) It contains three species: H_2O (molecules), H^+ and OH^-

(C) It contains only two species H_3O^+ and OH^-

(D) It contains three species H_2O (molecules), H_3O^+ and OH^-

7. There is a solution which is one molar w.r.t. each M^{2+} and X^{3+} ions present in it. The K_{sp} of $M(OH)_2$ and $X(OH)_3$ are 4.0×10^{-10} and 2.7×10^{-14} respectively. If NH_4OH solution is added gradually to the above solution which of the following will happen?

(A) Both $M(OH)_2$ and $X(OH)_3$ will precipitate together

(B) $M(OH)_2$ will precipitate first

(C) $X(OH)_3$ will precipitate first

(D) None of these will precipitate with NH_4OH solution

8. 20 mL of a weak acid HX is titrated against 0.1 M NaOH. At the point of half equivalence the pH of solution is 5.7. Hence Ka of acid is :

(A) 7.0×10^{-5} **(B)** 2.0×10^{-5} **(C)** 7.0×10^{-4} **(D)** 2.0×10^{-6}

9. If an aqueous solution at 25°C has twice as many OH^- as pure water its pOH will be :

(A) 6.699 **(B)** 7.307 **(C)** 7 **(D)** 6.98

10. Solubility of AgCl in water, 0.01M $CaCl_2$, 0.01M NaCl and 0.05M $AgNO_3$ are S_1, S_2, S_3 and S_4 respectively then :

(A) $S_1 > S_2 > S_3 > S_4$ **(B)** $S_1 > S_3 > S_2 > S_4$

(C) $S_1 > S_2 = S_3 > S_4$ **(D)** $S_1 > S_3 > S_4 < S_2$

11. pH of $Ba(OH)_2$ solution is 12. Its solubility product is :

(A) $10^{-6}M^3$ **(B)** $4\times10^{-6}M^3$ **(C)** $0.5\times10^{-7}M^3$ **(D)** $5\times10^{-7}M^3$

12. The hydrolysis constant for $ZnCl_2$ will be :

(A) $K_h = \frac{K_w}{K_b}$ **(B)** $K_h = \frac{K_w^2}{K_b}$ **(C)** $K_h = \frac{K_w^2}{K_b^2}$ **(D)** $K_h = \frac{K_b}{K_w^2}$

Where K_b is effective dissociation constant of base Zn^{2+}

13. If the degree of ionization of water be 1.8×10^{-9} at 298K. Its ionization constant will be :

(A) 1.8×10^{-16} **(B)** 1×10^{-14} **(C)** 1×10^{-16} **(D)** 1.67×10^{-14}

14. When a solution of benzoic acid was titrated with NaOH the pH of the solution when half the acid neutralized was 4.2. Dissociation constant of the acid is :

(A) 6.31×10^{-5} **(B)** 3.2×10^{-5} **(C)** 8.7×10^{-8} **(D)** 6.42×10^{-4}

15. 10^{-2} mole of NaOH was added to 10 litre of water. The pH will change by :

(A) 4 **(B)** 3 **(C)** 11 **(D)** 7

16. 0.1M solution of which of the following substances is most acidic :

(A) NH_4Cl **(B)** KCN **(C)** $AlCl_3$ **(D)** CH_3COONa

17. Which is/are lewis acid out of $CH_3^+, CH_5^+, CH_3^\ominus$

(A) $CH_5^\oplus, CH_3^\oplus$ **(B)** $CH_3^\oplus$ **(C)** $CH_5^\oplus, CH_3^\ominus$ **(D)** $CH_5^\oplus$

18. The solubility of A_2X_5 is x mole dm^{-3}. Its solubility product is :

(A) $36x^6$ **(B)** $64\times10^{-4}x^7$

(C) $126x^7$ **(D)** $1.25\times10^4x^7$

19. The solubility of CH_3CO_2Ag would be least amongst the following solvents in :

(A) acidic solution of pH = 3 **(B)** basic solution of pH = 8

(C) neutral solution of pH = 7 **(D)** pure water

20. If K_h (hydrolysis constant) for anilinium ion is 2.4×10^{-5}M, then K_b for aniline will be :

(A) 4.1×10^{10} **(B)** 4.1×10^{-10}

(C) 2.4×10^{9} **(D)** 2.4×10^{-19}

21. Acetic acid dissolved in ammonia will be :

(A) Highly conducting **(B)** Less conducting

(C) Can't say **(D)** More conducting than that in water

22. The equilibrium constant of the reaction $A^- + H_2O \rightleftharpoons HA + OH^-$ is 10^8 times of ionic product of water at 25°C. Hence K_a of weak acid will be :

(A) 10^{-8} **(B)** 10^{-6} **(C)** 10^{-14} **(D)** None of these

23. If we plot α^2 verses volume V we will get : (n = number of moles)

(A) a straight line with slope value equal to $\frac{K_{dissociation}}{n}$

(B) a straight line with slope equal to K_{eq}

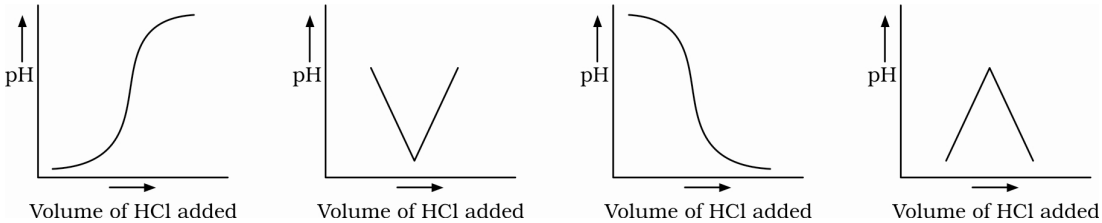
(C) an exponential curve

(D) a parabola

24. Equal volumes of two solutions of a strong acid having pH 3 and pH 4 are mixed together. The pH of the resulting solution will then be equal to :

(A) 3.5 **(B)** 3.26 **(C)** 7 **(D)** 1.0

25. Titration curve if a strong base is titrated with strong acid is :



(A) **(B)** **(C)** **(D)**

26. Let K_w at 100°C be $5.5\times10^{-13}M^2$. If an aqueous solution at this temperature has pH = 6.2. Its nature will be :

(A) acidic **(B)** alkaline

(C) neutral **(D)** can't say

27. Dissociation constant of two acids HA & HB are respectively 4×10^{-8} & 1.8×10^{-5}. Whose pH value will be higher for a given molarity :

(A) HA **(B)** HB **(C)** Both same **(D)** Can't say

28. pH value of pure water at 0°C will be :

(A) Greater than 7 **(C)** Less than 7

(C) 7 **(D)** All the three

29. The pH of a buffer is 6.745. When 0.01 mole of NaOH is added to 1 litre of it, the pH changes to 6.832. Its buffer capacity is :

(A) 0.187 **(B)** 0.0115

(C) 0.076 **(D)** 0.896

30. The aqueous solution of potash alum is acidic due to hydrolysis of :

(A) K^+ **(B)** Al^{3+}

(C) SO_4^- **(D)** presence of acid in its crystal as impurity

31. In which of the following solvents will AgBr has highest solubility ?

(A) 10^{-3}M NaBr **(B)** 10^{-3}M NH_4OH

(C) Pure water **(D)** 10^{-3}M HBr

32. The pK_b value of ammonium hydroxide is 4.75. An aqueous solution of ammonium hydroxide is treated with HCl. The pH of the solution at the point where half of ammonium hydroxide has been neutralized will be

(A) 9.25 **(B)** 8.25 **(C)** 7.50 **(D)** 4.75

33. The maximum pH of a solution which is 0.1 M in Mg^{2+} from which $Mg(OH)_2$ is not precipitated is [Given that K_{sp} for $Mg(OH)_2 = 1.2\times10^{-11}$]

(A) 4.96 **(B)** 6.96 **(C)** 7.54 **(D)** 9.04

34. The pK_a of HCN is 9.30. The pH of a solution prepared by mixing 2.5 moles KCN and 2.5 moles of HCN in water and making up the total volume of 500 mL is :

(A) 9.30 **(B)** 7.30 **(C)** 10.30 **(D)** 8.30

35. Fear or excitement, generally cause one to breath rapidly and it results in the decrease of concentration of CO_2 in blood. In what way it will change pH of blood ?

(A) pH will increase **(B)** pH will decrease

(C) No change **(D)** pH will be 7

36. The solubility of A_2X_3 is S mol dm^{-3}. Its solubility product is :

(A) $6s^4$ **(B)** $64s^4$

(C) $36s^5$ **(D)** $108s^5$

37. K_b for the hydrolysis of reaction $B^+ + H_2O \rightleftharpoons BOH + H^+$ is 1.0×10^{-6}. The hydrolysis constant of the salt is :

(A) 10^{-6} **(B)** 10^{-7} **(C)** 10^{-8} **(D)** 10^{-9}

38. If pK_b for CN^- at 25°C is 4.7, the pH of 0.5 M aqueous NaCN solution is :

(A) 12 **(B)** 10 **(C)** 11.5 **(D)** 11

39. In decinormal solution, CH_3COOH is ionised to the extent of 1.3%. If log 1.3 = 0.11 what is the pH of the solution ?

(A) 3.89 **(B)** 4.89 **(C)** 2.89 **(D)** 2.89

40. The pH at neutralisation point of 0.1 N ammonium hydroxide (pK_b = 4.75) with 0.1N HCl is:

(A) 6 **(B)** 7 **(C)** 9 **(D)** None of these

41. The maximum amount of $BaSO_4$ precipitated on mixing equal volume of $BaCl_2(0.5\,M)$ and $H_2SO_4(1\,M)$ will correspond to :

(A) 0.25 M **(B)** 1.0 M **(C)** 1.5 M **(D)** 2.0 M

42. K_a for HCN is 5×10^{-10} at 25°C. For maintaining a constant pH, the volume of 5 M KCN solution required to be added to 2 mL of 2 M HCN solution is :

(A) 4 mL **(B)** 7.95 mL **(C)** 2 mL **(D)** 9.3 mL

43. In which case pH will not change on dilution :

(A) 0.01M CH_3COONa + 0.01M CH_3COOH buffer

(B) 0.01M CH_3COONH_4

(C) 0.01M NaH_2PO_4

(D) in all cases

44. $M(OH)_x$ has K_{sp} 4×10^{-12} and solubility 10^{-4}M. Then the value of x is :

(A) 1 **(B)** 2 **(C)** 3 **(D)** –4

45. pH of a mixture of 1M benzoic acid (pK_a = 4.20) and 1M C_6H_5COONa is 4.5. In 300 ml buffer, benzoic acid is : [log 2 = 0.3]

(A) 200 ml **(B)** 150 ml **(C)** 100 ml **(D)** 50 ml

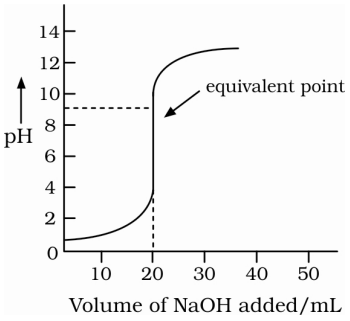
46. 10 ml of 0.2 M acid is added to 250 ml of a buffer solution with pH = 6.34 and the pH of the solution becomes 6.32. The buffer capacity of the solution is :

(A) 0.1 **(B)** 0.2 **(C)** 0.3 **(D)** 0.4

47. A weak base $B(OH)_2$ has dissociation constant 10^{-8}. The equilibrium constant for its reaction with excess of strong acid will be :

(A) 10^{20} **(B)** 10^{-6} **(C)** 10^{-20} **(D)** 10^{-16}

48. Following is the titration curve of CH_3COOH against NaOH added with phenolphthalein as the indicator. K_{ln} value of phenolphthalein is 4.0×10^{-10}. Thus, incorrect statement is :



(A) it begins to change colour from the pH 9.4

(B) it begins to change colour from acid colourless at pH 8.4 to the base form (reddish pink) at pH 10.4

(C) phenolphthalein is suitable indicator for $CH_3COOH - NaOH$ titration

(D) phenolphthalein is a weak acid

49. A weak monobasic acid (0.1 M) has a pH of 3 at a particular temperature (25°C). When this acid is neutralized by strong base (NaOH), what is the value of equilibrium constant at equivalence point at 25°C ?

(A) 10^{9} **(B)** 10^{-4} **(C)** 10^{-7} **(D)** 10^{-14}

50. The concentration of $[OH^-]$ left in a solution after mixing 50 ml of 0.2 M ACl_2 with 50 ml of 0.4 M NaOH. $[K_{sp}$ of $A[OH]_2 = 1.2\times10^{-11}]$

(A) 2.8×10^{-4} M **(B)** 1.4×10^{-4} M

(C) 2×10^{-2} M **(D)** 4×10^{-2} M

51. A weak acid HA after treatment with 12 mL of 0.1 M strong base BOH has a pH of 5. To reach at end point, the volume of same base required is 20 mL then K_a of acid is

(A) 1.5×10^{-5} **(B)** 8.12×10^{-6}

(C) 1.8×10^{-6} **(D)** 8.2×10^{-5}

52. The H^+ ion concentration in 0.001M $CH_3COOH(K_a = 1.8\times10^{-5})$ is 1.34×10^{-4} g ion / L. The H^+ ion concentration if 0.164 g of CH_3COONa is added to a litre of 0.001M CH_3COOH will be :

(A) 9×10^{-6} **(B)** 18×10^{-6} **(C)** 4.5×10^{-6} **(D)** 5×10^{-6}

53. The pH at which an acid indicator with $K_a = 1\times10^{-5}$ changes colours when indicator concentration is 1×10^{-5}M is :

(A) 4 **(B)** 5 **(C)** 6 **(D)** 3

54. If K_b for fluoride ion at 25°C is 1.48×10^{-11}, the ionization constant of hydrofluoric acid in water at this temperature is :

(A) 1.7×10^{-5} **(B)** 3.52×10^{-3} **(C)** 6.75×10^{-4} **(D)** 5.38×10^{-2}

55. If 50 ml of 0.2 M KOH is added to 40 ml of 0.5 M HCOOH, the pH of the resulting solution is :
$(K_a = 1.8\times10^{-4})$

(A) 3.75 **(B)** 5.6 **(C)** 7.5 **(D)** 3.4

56. If the degree of ionization of water be 1.8×10^{-9} at 298K. Its ionization constant will be :

(A) 1.8×10^{-16} **(B)** 1×10^{-14} **(C)** 1×10^{-16} **(D)** 1.67×10^{-14}

57. When a solution of benzoic acid was titrated with NaOH, the pH of the solution, when half of the acid was neutralized, will be 4.2. Dissociation constant of the acid is :

(A) 6.31×10^{-5} **(B)** 3.2×10^{-5} **(C)** 8.7×10^{-8} **(D)** 6.42×10^{-4}

58. 10^{-2} mole of NaOH was added to 10 litre of water. The pH will change by :

(A) 4 **(B)** 3 **(C)** 11 **(D)** 7

59. For an aqueous solution to be neutral it must have :

(A) pH = 7 **(B)** $[H^+] = [OH^-]$ **(C)** $[H^+] = \sqrt{K_W}$ **(D)** $[H^+] < [OH^-]$

60. If an acidic indicator HIn Ionizes as $HIn \rightleftharpoons H^+ + In^-$. To what maximum pH value its solution has distinct colour characteristic of HIn?

(A) $pK_{In} - 1$ **(B)** $pK_{In} \pm 1$ **(C)** pK_{In} **(D)** 7

61. If first dissociation of $X(OH)_3$ is 100% where as second dissociation is 50% and third dissociation is negligible then the pH of 4×10^{-3} M $X(OH)_3$ is:

(A) 11.78 **(B)** 10.78 **(C)** 2.5 **(D)** 2.22

***62.** Which of the following will have nearly equal H^+ concentration?

(A) 100 mL 0.1 M HCl mixed with 50 mL water

(B) 50 mL 0.1 M H_2SO_4 mixed with 50 mL water

(C) 50 mL 0.1 M H_2SO_4 mixed with 100 mL water

(D) 50 mL 0.1 M HCl mixed with 50 mL water

***63.** Which of the following statement(s) is (are) correct?

(A) The pH of 1.0×10^{-5}M HCl solution is 8

(B) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}

(C) Auto protolysis 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 = ½ pK_a

***64.** A buffer solution can be prepared from a mixture of

(A) sodium acetate and acetic acid in water

(B) sodium acetate and hydrochloric acid in water

(C) ammonia and ammonium chloride in water

(D) ammonia and sodium hydroxide in water

***65.** Choose the correct statement (s) out of the following

(A) In CH_3COOH/CH_3COONa buffer, the reserve acidity of the solution is due to CH_3COO^- ions

(B) It is not necessary that an acidic substance must contain hydrogen ions

(C) HCO_3^- is both Bronsted base and Bronsted acid

(D) Sodium carbonate does not contain OH^- ions and thus is not a base

***66.** Which of the following will function as buffer?

(A) NaCl + NaOH **(B)** Borax + Boric acid

(C) $NaH_2PO_4 + Na_2HPO_4$ **(D)** $NH_4Cl + NH_4OH$

67. K_a for HCN is 5×10^{-10} at 25°C. For maintaining a constant pH = 9, the volume of 5 M KCN solution required to be added to 10 ml of 2 M HCN solution is

(A) 4 ml **(B)** 7.95 ml **(C)** 2 ml **(D)** 9.3 ml

68. The pH of 0.5 M solution of $NaHCO_3$ is almost equal to :

(for H_2CO_3; $K_1 = 2\times10^{-7}$ & $K_2 = 4\times10^{-11}$)

(A) 10.52 **(B)** 9.8 **(C)** 8.55 **(D)** 7.2

69. The number of H^+ present in 1mL of a solution whose pH is 13 :

(A) 6×10^{7} **(B)** 6×10^{10} **(C)** 6×10^{23} **(D)** 6×10^{22}

70. Some or more species given below have pH less than 7.

(A) 10^{-8} M HCl

(B) 10^{-8} M NaOH

(C) 10 mL of 10^{-6} N-HCl diluted to 100 mL

(D) 10 mL of 0.01 M CH_3COOH at the end-point after addition of 10 mL of 0.01 M NaOH

71. K_a for the reaction; $Fe^{3+}(aq.) + H_2O(l) \rightleftharpoons Fe(OH)^{2+}(aq.) + H_3O^+(aq.)$ is 6.5×10^{-3}. What is the max. pH value which could be used so that at least 80% of the total iron (III) in a dilute solution exists as Fe^{3+} ?

(A) 2 **(B)** 2.41 **(C)** 2.79 **(D)** 1.59

72. The solubility of $CsBr_3$ (MW = 373) in water is 746 ppm. The solubility product of $CsBr_3$ is, therefore :

(A) $1.6\times10^{-11}M^4$ **(B)** $4\times10^{-6}M^2$ **(C)** $8\times10^{-9}M^3$ **(D)** $3.2\times10^{-14}M^5$

73. If 500 mL of 0.4 M $AgNO_3$ is mixed with 500 mL of 2 M NH_3 solution then what is the concentration of $Ag(NH_3)^+$ is solution?

Given: $K_{f_1}[Ag(NH_3)]^+ = 10^3; K_{f_2}[Ag(NH_3)_2^+] = 10^4$

(A) 3.33×10^{-7} M **(B)** 3.33×10^{-5} M

(C) 3×10^{-4} M **(D)** 10^{-7} M

74. The simultaneous solubility of $AgCN(K_{sp} = 2.5\times10^{-16})$ and $AgCl(K_{sp} = 1.6\times10^{-10})$ in 1.0 M $NH_3(aq.)$ are respectively : [Given : $K_f[Ag(NH_3)_2^+] = 10^7$]]

(A) $0.037, 5.7\times10^{-8}$ **(B)** $5.78\times10^{-8}, 0.037$

(C) $0.04, 6.25\times10^{-8}$ **(D)** $1.58\times10^{-3}, 1.26\times10^{-5}$

75. The pH of a solution obtained by dissolving 5×10^{-4} moles of $Ca(OH)_2$ (strong electrolyte) to 100 ml solution at 298 K will be :

(A) 11 **(B)** 12 **(C)** 9.8 **(D)** 2

76. One litre of a saturated solution of $CaCO_3$ is evaporated to dryness due to which 7.0 mg of residue is left. The solubility product for $CaCO_3$ is :

(A) 4.9×10^{-8} **(B)** 4.9×10^{-5} **(C)** 4.9×10^{-9} **(D)** 4.9×10^{-7}

77. Equilibrium constants of T_2O (T or ${}_1^3H$ is an isotope of ${}_1^1H$) and H_2O are different at 298 K. Let at 298 K pure T_2O has pT (like pH) is 7.62. The pT of a solution prepare by adding 10 mL of 0.2 M TCl to 15 mL of 0.25 M NaOT is :

(A) $2 - \log 7$ **(B)** $14 + \log 7$ **(C)** $13.24 - \log 7$ **(D)** $13.24 + \log 7$

78. pK_{a_1}, pK_{a_2}, and pK_{a_3} of H_3PO_4 are respectively x, y and z. pH of 0.01 M Na_2HPO_4 solution is :

(A) 2 **(B)** $\left(\frac{x+y}{2}\right)$ **(C)** $\left(\frac{y+z}{2}\right)$ **(D)** $\left(\frac{x+y+z}{2}\right)$

79. The precipitate of $Ag_2CrO_4 (K_{sp} = 1.9\times10^{-12})$ is obtained when equal volumes of the following are mixed:

(A) 10^{-4} M $Ag^+ + 10^{-4}$ M CrO_4^{2-} **(B)** 10^{-2} M $Ag^+ + 10^{-3}$ M CrO_4^{2-}

(C) 10^{-5}M $Ag^+ + 10^{-3}$ M CrO_4^{2-} **(D)** 10^{-4}M $Ag^+ + 10^{-5}$ M CrO_4^{2-}

80. Consider the reaction $A^- + H_3O^+ \rightleftharpoons HA + H_2O$. The K_a value for acid HA is 1.0×10^{-6}. What is the value of K for this reaction.

(A) 1.0×10^{6} **(B)** 1.0×10^{-8} **(C)** 1.0×10^{8} **(D)** 1.0×10^{-6}

81. The ionization constant of HCO_2H is 1.8×10^{-4}. What is the percent ionization of a 0.001M solution ?

(A) 66 % **(B)** 42 % **(C)** 34 % **(D)** 58 %

82. At $-50°C$, the self–ionization constant (ionic product) of NH_3 is $K_{NH_3} = [NH_4^+][NH_2^-] = 10^{-30}$. How many amide ions are present per mm^3 of pure liquid ammonia ?

(A) 600 ions/mm^3 **(B)** 6×10^6 ions/mm^3

(C) 6×10^4 ions/mm^3 **(D)** 60 ions/mm^3

83. The degree of dissociation of anilinium acetate is :

(A) independent of initial concentration

(B) directly proportional to initial concentration

(C) inversely proportional to initial concentration

(D) inversely proportional to square root of initial concentration

***84.** A weak base (BOH) with $K_b = 10^{-5}$ is titrated with a strong acid HCl. At $3/4^{th}$ of the equivalence point, pH of the solution is :

(A) $5 + \log 3$ **(B)** $5 - \log 3$ **(C)** $14 - 5 - \log 3$ **(D)** 8.523

85. 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 :

(A) 9.58 **(B)** 4.79 **(C)** 7.01 **(D)** 9.22

86. Consider the following solutions of equal concentrations:

A = NH_4Cl ; B = CH_3COONa ;

C = NH_4OH ; D = CH_3COOH

A buffer solution can not be obtained by mixing equal volume of :

(A) C and D **(B)** A and B **(C)** A and C **(D)** B and D

87. At 25°C, the dissociation constants of CH_3COOH and NH_4OH in aqueous solution are almost the same. The pH of a solution of 0.01 N CH_3COOH is 4.0 at 25°C. The pH of 0.01 N NH_4OH solution at the same temperature would be :

(A) 3.0 **(B)** 4.0 **(C)** 10.0 **(D)** 10.5

88. An acid-base indicator has a $K_a = 3.0 \times 10^{-5}$. The acid form of the indicator is red and the basic form is blue. Then:

(A) pH is 4.05 when indicator is 75% red

(B) pH is 5.00 when indicator is 75% blue

(C) both (A) and (B) are correct

(D) None of these

89. pH of a solution made by mixing 50mL of 0.2 M NH_4Cl and 75 mL of 0.1 M NaOH is :
[pK_b of NH_3 (aq) = 4.74, log3 = 0.47]

(A) 7.02 **(B)** 13.0 **(C)** 7.02 **(D)** 9.73

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

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

91. Calculate the pH at the equivalence point of the titration between 0.1 M CH_3COOH(25ml) with 0.05 M NaOH. $K_a(CH_3COOH) = 1.8 \times 10^{-5}$.

92. A weak base BOH is titrated with a strong acid HA. When 10 ml of HA is added, the pH is 10.2 and when 25 ml is added the pH is 9.1. Calculate the volume of acid that would be required to reach equivalence point.

93. A 1.0×10^{-3}M solution of $AgNO_3$ is made 0.20M in NH_3. What are the concentration of Ag^+, $Ag(NH_3)^+$ and $Ag(NH_3)_2^+$ in the resulting solution. Given:

$$Ag(NH_3)_2^+ \rightleftharpoons Ag(NH_3)^+ + NH_3 \qquad K_1 = 1.4 \times 10^{-4}M$$

$$Ag(NH_3)^+ \rightleftharpoons Ag^+ + NH_3 \qquad K_2 = 4.3 \times 10^{-4}M$$

Paragraph for Question No. 94 – 97

If a sparingly soluble salt is placed in water, after some time an equilibrium is established when the rate of dissolution of ions from the solid equals the rate of precipitation of ions from the saturated solution at a particular temperature. Thus, a dynamic equilibrium exists between the undissociated solid species and the dissolved ionic species in a saturated solution at a particular temperature. For example, in AgCl, we have the following equilibrium :

$$AgCl(s) \rightleftharpoons Ag^+(aq) + Cl^-(aq)$$

The equilibrium constant, $K_{eq} = \dfrac{[Ag^+][Cl^-]}{[AgCl]}$

$\because$ [AgCl] is constant $\therefore$ $K_{eq} \times [AgCl] = [Ag^+][Cl^-]$

$\Rightarrow \quad K_{sp(AgCl)} = [Ag^+][Cl^-] \quad ....(i)$

If there would not have been a saturated solution, then from equation (1), $K_{eq}.[AgCl] \neq K_{sp}.$ but $K_{eq}.[AgCl] = Q_{AgCl}$, where Q is ionic product. It implies that for a saturated solution, $Q = K_{sp}$, K_{sp} is temperature dependent.

When $Q < K_{sp}$, then the solution is unsaturated and no precipitation occurs.

When $Q = K_{sp}$, then solution will be saturated, precipitation starts.

When $Q > K_{sp}$, the solution will be supersaturated and there will be formation of precipitate.

94. pH of a saturated solution of $Ba(OH)_2$ is 12. Hence K_{sp} of $Ba(OH)_2$ is :

(A) $5\times10^{-7}M^3$ **(B)** $5\times10^{-4}M^2$ **(C)** $1\times10^{-6}M^3$ **(D)** $4\times10^{-6}M^3$

95. A solution is a mixture of 0.05M NaCl and 0.05M NaI. The concentration of iodide ion in the solution when AgCl just starts precipitating is equal to :

$(K_{sp}AgCl = 1\times10^{-10}M^2; K_{sp}AgI = 4\times10^{-16}M^2)$

(A) $4\times10^{-6}M$ **(B)** $2\times10^{-8}M$ **(C)** $2\times10^{-7}M$ **(D)** $8\times10^{-15}M$

96. Silver iodide is used in cloud seeding to produce rain $AgI \rightleftharpoons Ag^+(aq) + I^-(aq); \; K_{sp} = 8.5\times10^{-7}.$

$AgNO_3$ and KI are mixed to give $[Ag^+] = 0.010M; \; [I^-] = 0.015M$. Will AgI precipitate ?

(A) yes

(B) no

(C) can't say

(D) this depends on $[NO_3^-]$ and $[K^+]$ as well

97. Slaked lime, $Ca(OH)_2$ is used extensively in sewage treatment. What is the maximum pH that can be established in $Ca(OH)_2(aq)$

$$Ca(OH)_2(s) \rightleftharpoons Ca^{2+}(aq) + 2OH^-(aq); \qquad K_{sp} = 5.5\times10^{-6}$$

(A) 1.66 **(B)** 12.34

(C) 7 **(D)** 14

Paragraph for Question No. 98 – 100

Acidity or alkalinity of a solution depend upon the concentration of hydrogen ion relative to that of hydroxyl ions. The product of hydrogen ion & hydroxyl ion concentration is given by

$$K_W = [H^+][OH^-]$$

the value of which depends only on the temperature & not on the individual ionic concentration. If the concentration of hydrogen ions exceeds that of the hydroxyl ions, the solution is said to be acidic; whereas, if concentration of hydroxyl ion exceeds that of the hydrogen ions, the solution is said to be alkaline. The pH corresponding to the acidic and alkaline solutions at 25ºC will be less than and greater than seven, respectively. To confirm the above facts $0.5M\ CH_3COOH$ is taken for the experiments.

[Given : K_a of acetic acid $= 1.8\times10^{-5}$]

98. Degree of dissociation of acetic acid is :

(A) 66×10^{-2} **(B)** 6×10^{-3} **(C)** 3×10^{-3} **(D)** 5×10^{-3}

99. pH of the solution will be :

(A) 2.52 **(B)** 2.22 **(C)** 5 **(D)** 3.92

100. Now to increase the hydrogen ion concentration $100\,dm^3$ of $0.1\ M\ HCl$ solution is added to $100\,dm^3$ of $0.5M$ acetic acid solution, then what will be the pH of the final solution :

(A) 6 **(B)** 1.3 **(C)** 3 **(D)** 1