Ordinary Thinking

Objective Questions

Electrical conductors, Arrhenius theory and Ostwald's dilution law

1. Which of the following is non-electrolyte [CPMT 2001]
   - (a) $NaCl$
   - (b) $CaCl_2$
   - (c) $C_{12}H_{22}O_{11}$
   - (d) CH_3COOH

2. Ammonium hydroxide is a [CPMT 1977]
   - (a) Strong electrolyte
   - (b) Weak electrolyte
   - (c) Both under different conditions
   - (d) Non-electrolyte

3. Ammonium hydroxide is a weak base because [MP PET 2000]
   - (a) It has low vapour pressure
   - (b) It is only slightly ionized
   - (c) It is not a hydroxide of any metal
   - (d) It has low density

4. Electrolytes when dissolved in water dissociate into their constituent ions. The degree of dissociation of an electrolyte increases with [CPMT 1974]
   - (a) Increasing concentration of the electrolyte
   - (b) Decreasing concentration of the electrolyte
   - (c) Decreasing temperature
   - (d) Presence of a substance yielding a common ion

5. An electrolyte [MP PMT/PET 1988; CPMT 1974]
   - (a) Gives complex ions in solution
   - (b) Dissolves in water to give ions
   - (c) Is ionized in the solid state
   - (d) Generates ions on passing electric current

6. A monoprotic acid in 1.00 M solution is 0.01% ionised. The dissociation constant of this acid is [BVP 2003]
   - (a) 1×10^{-8}
   - (b) 1×10^{-4}
   - (c) 1×10^{-6}
   - (d) 10^{-5}

7. Molten sodium chloride conducts electricity due to the presence of
   - (a) Free electrons
   - (b) Free ions
   - (c) Free molecules
   - (d) Atoms of sodium and chlorine

8. An example for a strong electrolyte is [KCET 2002]
   - (a) Urea
   - (b) Ammonium hydroxide
   - (c) Sugar
   - (d) Sodium acetate

9. Which one is strongest electrolyte in the following [CPMT 1990]
   - (a) $NaCl$
   - (b) CH_3COOH
   - (c) NH_4OH
   - (d) $C_6H_{12}O_6$

10. The equivalent conductance at infinite dilution of a weak acid such as HF [Pb. PMT 1998]
    - (a) Can be determined by measurement of very dilute HF solution
    - (b) Can be determined by extrapolation of measurements on dilute solutions of HCl, HBr and HI
    - (c) Can best be determined from measurements on dilute solutions of NaF, $NaCl$ and HCl
    - (d) Is an undefined quantity

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]
    - (a) $\alpha^2=\sqrt{\frac{K_a}{C}}$
    - (b) $\alpha^2=\sqrt{\frac{C}{K_a}}$
    - (c) $\alpha=\sqrt{\frac{K_a}{C}}$
    - (d) $\alpha=\sqrt{\frac{C}{K_a}}$

12. Theory of ionization was given by [AMU 1983; DPMT 1985]
    - (a) Rutherford
    - (b) Graham
    - (c) Faraday
    - (d) Arrhenius

13. An ionizing solvent has
    - (a) Low value of dielectric constant
    - (b) High value of dielectric constant
    - (c) A dielectric constant equal to 1
    - (d) Has a high melting point

14. The extent of ionization increases [MNR 1982]
    - (a) With the increase in concentration of solute
    - (b) On addition of excess water to solution
    - (c) On decreasing the temperature of solution
    - (d) On stirring the solution vigorously

15. Which is generally true about ionic compounds [Pb. PMT 2002]
    - (a) Have low boiling point
    - (b) Have low melting point
    - (c) Soluble in non polar solvents
    - (d) Conduct electricity in the fused state

16. At infinite dilution, the percentage ionisation for both strong and weak electrolytes is [CPMT 1999]
    - (a) 1%
    - (b) 20%
    - (c) 50%
    - (d) 100%

17. The degree of ionization of a compound depends on [MNR 1980]
    - (a) Size of solute molecules
    - (b) Nature of solute molecules
    - (c) Nature of vessel used [BHU 2001]
    - (d) Quantity of electricity passed

18. For a weak acid HA, Ostwald's dilution law is represented by the equation
    - (a) $K_a=\frac{\alpha c}{1-\alpha^2}$
    - (b) $K_a=\frac{\alpha^2 c}{1-\alpha}$
    - (c) $\alpha=\frac{K_a c}{1-c}$
    - (d) $K_a=\frac{\alpha^2 c}{1-\alpha^2}$

19. Acetic acid is a weak electrolyte because [CPMT 1974]
    - (a) Its molecular weight is high
    - (b) It is covalent compound
    - (c) It does not dissociate much or its ionization is very less
    - (d) It is highly unstable

20. In which of the following dissociation of NH_4OH will be minimum [MP PET 2000]
    - (a) $NaOH$
    - (b) H_2O
    - (c) NH_4Cl
    - (d) $NaCl$

21. Vant hoff factor of $BaCl_2$ of conc. $0.01M$ is 1.98. Percentage dissociation of $BaCl_2$ on this conc. Will be [Kerala CET 2005]

(a) 49 (b) 69
(c) 89 (d) 98
(e) 100

22. In which of the following solutions, ions are present [NCERT 1981]

(a) Sucrose in water (b) Sulphur in CS_2
(c) Caesium nitrate in water (d) Ethanol in water

23. The following equilibrium exists inaqueous solution, $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$ if dil *HCl* is added, without change in temperature, the [UPSEAT 2000, 02]

(a) Concentration of CH_3COO^- will increase
(b) Concentration of CH_3COO^- will decrease
(c) The equilibrium constant will increase
(d) The equilibrium constant will decrease

24. Which will not affect the degree of ionisation [MP PMT 1994]

(a) Temperature (b) Concentration
(c) Type of solvent (d) Current

25. The addition of a polar solvent to a solid electrolyte results in [NCERT 1973]

(a) Polarization (b) Association
(c) Ionization (d) Electron transfer

26. The degree of dissociation of $0.1 M\, HCN$ solution is 0.01%. Its ionisation constant would be [RPMT 1999]

(a) 10^{-3} (b) 10^{-5}
(c) 10^{-7} (d) 10^{-9}

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

(a) $\sqrt{K_a / c}$ (b) c / K_a
(c) $K_a c$ (d) $\sqrt{K_a c}$

28. Degree of dissociation of $0.1\, N\ CH_3COOH$ is

(Dissociation constant $= 1 \times 10^{-5}$) [MP PET 1997]

(a) 10^{-5} (b) 10^{-4}
(c) 10^{-3} (d) 10^{-2}

29. Which of the following substance is an electrolyte [MADT Bihar 1980]

(a) Chloroform
(b) Benzene
(c) Toluene
(d) Magnesium chloride

30. In weak electrolytic solution, degree of ionization

(a) Will be proportional to dilution
(b) Will be proportional to concentration of electrolyte
(c) Will be proportional to the square root of dilution
(d) Will be reciprocal to the dilution

31. 0.2 molar solution of formic acid is ionized 3.2%. Its ionization constant is [MP PMT 1991]

(a) 9.6×10^{-3} (b) 2.1×10^{-4}
(c) 1.25×10^{-6} (d) 4.8×10^{-5}

32. The best conductor of electricity is a 1.0 *M* solution of [NCERT 1973]

(a) Boric acid (b) Acetic acid
(c) Sulphuric acid (d) Phosphoric acid

33. The colour of an electrolyte solution depends on [DPMT 1985]

(a) The nature of the anion
(b) The nature of the cation
(c) The nature of both the ions
(d) The nature of the solvent

34. Ionisation depends upon [CPMT 2004]

(a) Pressure (b) Volume
(c) Dilution (d) None of these

35. The values of dissociation constants of some acids (at $25^o C$) are as follows. Indicate which is the strongest acid in water

(a) 1.4×10^{-2} (b) 1.6×10^{-4}
(c) 4.4×10^{-10} (d) 4.3×10^{-7}

36. Concentration CN^- in $0.1 M\, HCN$ is $[K_a = 4 \times 10^{-10}]$ [RPET 2000]

(a) $2.5 \times 10^{-6} M$ (b) $4.5 \times 10^{-6} M$
(c) $6.3 \times 10^{-6} M$ (d) $9.2 \times 10^{-6} M$

Acids and Bases

1. Which of the following is not a Lewis acid [MP PET 2002]

(a) CO (b) $SiCl_4$
(c) SO_3 (d) Zn^{2+}

2. Review the equilibrium and choose the correct statement $HClO_4 + H_2O \rightleftharpoons H_3O^+ + ClO_4^-$ [RPMT 2000]

(a) $HClO_4$ is the conjugate acid of H_2O
(b) H_3O^+ is the conjugate base of H_2O
(c) H_2O is the conjugate acid of H_3O^+
(d) ClO_4^- is the conjugate base of $HClO_4$

3. A solution of $FeCl_3$ in water acts as acidic due to [BVP 2003]

(a) Hydrolysis of Fe^{3+} (b) Acidic impurities
(c) Dissociation (d) Ionisation

4. A white substance having alkaline nature in solution is [BVP 2003]

(a) $NaNO_3$ (b) NH_4Cl
(c) Na_2CO_3 (d) Fe_2O_3

5. Which of the following can act both as Bronsted acid and Bronsted base [MP PET 1995; MP PET/PMT 1998]

(a) Cl^- (b) HCO_3^-
(c) H_3O^+ (d) OH^-

6. Lewis acid [MP PMT 1987]

(a) Presence of *H* atom is necessary
(b) Is a electron pair donor
(c) Always a proton donor
(d) Is a electron pair acceptor

7. For two acids A and B, $pK_a = 1.2$, $pK_b = 2.8$ respectively in value, then which is true [Bihar MEE 1998]
(a) A and B both are equally acidic
(b) A is stronger than B
(c) B is stronger than A
(d) Neither A nor B is strong
(e) None of these

8. Aq. solution of sodium cyanide is [BHU 1981]
(a) Acidic (b) Amphoteric
(c) Basic (d) Netural

9. Which of the following is the strongest conjugate base [MADT Bihar 1983; CBSE PMT 1999; KCET (Med.) 2001]
(a) Cl^- (b) CH_3COO^-
(c) SO_4^{--} (d) NO_2^-

10. $NaOH$ is a strong base because [AIIMS 2001]
(a) It gives OH^- ion (b) It can be oxidised
(c) It can be easily ionised (d) Both (a) and (c)

11. Which one of the following can be classified as a Bronsted base
(a) NO_3^- (b) H_3O^+
(c) NH_4^+ (d) CH_3COOH

12. Which one of the following substance has the highest proton affinity [AIEEE 2003]
(a) H_2O (b) H_2S
(c) NH_3 (d) PH_3

13. Which of the following is the strongest Lewis acid [EAMCET 1998]
(a) BI_3 (b) BBr_3
(c) BCl_3 (d BF_3

14. An aqueous solution of ammonia consists of [MP PET 2001]
(a) H^+ (b) OH^-
(c) NH_4^+ (d) NH_4^+ and OH^-

15. Which of the following is not a Lewis acid [CBSE PMT 1996]
(a) BF_3 (b) $FeCl_3$
(c) SiF_4 (d) C_2H_4

16. The conjugate base of NH_2^- is [EAMCET 1998]
(a) NH_3 (b) NH^{2-}
(c) NH_4^+ (d) N_3^-

17. The strength of an acid depends on its tendency to [MP PET 1996]
(a) Accept protons (b) Donate protons
(c) Accept electrons (d) Donate electrons

18. Which is not a electrophile [RPET 1999]
(a) $AlCl_3$ (b) BF_3
(c) $(CH_3)_3C^+$ (d) NH_3

19. Ammonia gas dissolves in water to give NH_4OH. In this reaction water acts as [CPMT 1990; MP PMT 1990]
(a) An acid (b) A base
(c) A salt (d) A conjugate base

20. In the equilibrium

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

(a) F^- is the conjugate acid of CH_3COOH
(b) F^- is the conjugate base of HF
(c) CH_3COOH is the conjugate acid of $CH_3COOH_2^+$
(d) $CH_3COOH_2^+$ is the conjugate base of CH_3COOH

21. The compound that is not a Lewis acid is [IIT 1985]
(a) BF_3 (b) $AlCl_3$
(c) $BeCl_2$ (d) NH_3

22. Which of the following dissolves in water to give a neutral solution [Bihar MAD
(a) $(NH_4)_2SO_4$ (b) $Ba(NO_3)_2$
(c) $CrCl_3$ (d) $CuSO_4$

23. Which of the following is the strongest acid [AMU 1982]
(a) H_3PO_4 (b) H_2SO_4
(c) HNO_2 [KCET 2001] (d) CH_3COOH

24. An example of a Lewis acid is [MADT Bihar 1982; AMU 1982; MNR 1994; RPMT 1997; KCET 2000; Orissa JEE 2005]
(a) $NaCl$ (b) $MgCl_2$
(c) $AlCl_3$ (d) $SnCl_4$

25. In the equilibrium $HClO_4 + H_2O \rightleftharpoons H_2O + ClO_4^-$ [BHU 1981, 86]
(a) $HClO_4$ is the conjugate acid of H_2O
(b) H_2O is the conjugate acid of H_3O^+
(c) H_3O^+ is the conjugate base of H_2O
(d) ClO_4^- is the conjugate base of $HClO_4$

26. Which of the following would be expected to form ionic solution in water [CPMT 1976; Kurukshetra CEE 1998]
(a) CCl_4 (b) O_2
(c) $NaBr$ (d) $CHBr_3$

27. A solution of sodium bicarbonate in water turns [NCERT 1971]
(a) Phenolphthalein pink (b) Methyl orange yellow
(c) Methyl orange red (d) Blue litmus red

28. 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]
(a) NH_3 (b) H^+
(c) NH_4^+ (d) H_2O

29. With reference to protonic acids, which of the following statements is correct [CPMT 1990]
(a) PH_3 is more basic than NH_3
(b) PH_3 is less basic than NH_3
(c) PH_3 is equally basic as NH_3
(d) PH_3 is amphoteric while NH_3 is basic

30. NH_4OH is weak base because [CPMT 1979]
(a) It has low vapour pressure
(b) It is only slightly ionized
(c) It is not a hydroxide of metal
(d) It has low density

31. HNO_3 in liquid hydrogen fluoride behaves

(a) As an acid
(b) As a base
(c) Neither as a base nor as an acid
(d) As a base and as an acid

32. Aqueous solution of $CuSO_4.5H_2O$ changes blue litmus paper to red due to [CPMT 1979; MP PMT 1989]

(a) Presence of Cu^{++} ions
(b) Presence of SO_4^{--} ions
(c) Hydrolysis taking place
(d) Reduction taking place

33. In the following reaction

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

Which are the two Bronsted bases [MP PMT 1991]

(a) $HC_2O_4^{-}$ and PO_4^{---}
(b) HPO_4^{--} and $C_2O_4^{--}$
(c) $HC_2O_4^{-}$ and HPO_4^{--}
(d) PO_4^{---} and $C_2O_4^{--}$

34. Which of the following is the weakest acid [CPMT 2001]

(a) *HF*
(b) *HCl*
(c) *HBr*
(d) *HI*

35. The degree of dissociation in a weak electrolyte increases [CBSE PMT 1989; MP PMT 1997]

(a) On increasing dilution
(b) On increasing pressure
(c) On decreasing dilution
(d) None of these

36. H^+ is a [MADT Bihar 1983]

(a) Lewis acid
(b) Lewis base
(c) Bronsted-Lowry base
(d) None of the above

37. Dissociation of H_3PO_4 takes place in following steps [CPMT 1976; NCERT 1987]

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

38. The aqueous solution of disodium hydrogen phosphate is [MADT Bihar 1982]

(a) Acidic
(b) Neutral
(c) Basic
(d) None

39. Which of the following is a conjugated acid-base pair [MADT Bihar 1984; DPMT 2001]

(a) $HCl,\ NaOH$
(b) $NH_4Cl,\ NH_4OH$
(c) $H_2SO_4,\ HSO_4^{-}$
(d) $KCN,\ HCN$

40. The solution of strong acid and weak base $(FeCl_3)$ is [MADT Bihar 1981; CPMT 1979, 83, 84]

(a) Acidic
(b) Basic
(c) Neutral
(d) None of the above

41. The conjugate acid of HPO_3^{2-} is [EAMCET 1989]

(a) H_3PO_4
(b) H_3PO_3
(c) $H_2PO_3^{-}$
(d) PO_4^{3-}

42. What name is given to the reaction between hydrogen ion and hydroxyl ion [MP PMT 1990]

(a) Hydrogenation
(b) Hydroxylation
(c) Hydrolysis
(d) Neutralization

43. Among the following, the weakest Lewis base is [NCERT 1981]

(a) H^-
(b) OH^-
(c) Cl^-
(d) HCO_3^-

44. The pKa for acid *A* is greater than pKa for acid *B*. The strong acid is [DPMT 2000]

(a) Acid *B*
(b) Acid *A*
(c) Both *A* and *B*
(d) Neither *A* nor *B*

45. The conjugate acid of NH_2^- is [IIT 1985; Roorkee 1995; EAMCET 1997;CBSE PMT PMT 2000; MP PET 1996,2000]

(a) NH_3
(b) NH_4^+
(c) NH_2OH
(d) N_2H_4

46. Correct statement is [CPMT 1985]

(a) NH_4Cl gives alkaline solution in water
(b) CH_3COONa gives acidic solution in water
(c) CH_3COOH is a weak acid
(d) NH_4OH is a strong base

47. pK_a of a weak acid is defined as [JIPMER 1999]

(a) $\log_{10} K_a$
(b) $\dfrac{1}{\log_{10} K_a}$
(c) $\log_{10} \dfrac{1}{K_a}$
(d) $-\log_{10} \dfrac{1}{K_a}$

48. A salt $'X'$ is dissolved in water $(pH = 7)$, the resulting solution becomes alkaline in nature. The salt is made of [CPMT 1983]

(a) A strong acid and strong base
(b) A strong acid and weak base
(c) A weak acid and weak base
(d) A weak acid and strong base

49. Which one is not an acid salt [MNR 1984]

(a) NaH_2PO_2
(b) NaH_2PO_3
(c) NaH_2PO_4
(d) None

50. A white substance was alkaline in solution. Which of the following substances could it be [CPMT 1989]

(a) Fe_2O_3
(b) Na_2CO_3
(c) NH_4Cl
(d) $NaNO_3$

51. An aqueous solution of ammonium carbonate is [MP PMT 1989]

(a) Weakly acidic
(b) Weakly basic
(c) Strongly acidic
(d) Neither acidic nor basic

52. $100\ ml$ of $0.2\ M\ H_2SO_4$ is added to $100\ ml$ of $0.2\ M\ NaOH$. The resulting solution will be [BHU 1996]

(a) Acidic
(b) Basic
(c) Neutral
(d) Slightly basic

53. H_3BO_3 is [IIT Screening 2003]

(a) Monobasic and weak Lewis acid
(b) Monobasic and weak Bronsted acid
(c) Monobasic and strong Lewis acid
(d) Tribasic and weak Bronsted acid

54. In the reaction $SnCl_2 + 2Cl^- \rightarrow SnCl_4$, Lewis acid is [EAMCET 1987]

(a) $SnCl_2$
(b) Cl^-
(c) $SnCl_4$
(d) None of these

55. Lewis base is [RPMT 1997]

(a) CO_2
(b) SO_3
(c) SO_2
(d) ROH

56. $10\ ml$ of $1\ M\ H_2SO_4$ will completely neutralise

(a) $10\ ml$ of $1\ M\ NaOH$ solution

(b) $10\ ml$ of $2\ M\ NaOH$ solution

(c) $5\ ml$ of $2\ M\ KOH$ solution

(d) $5\ ml$ of $1\ M\ Na_2CO_3$ solution

57. Which of the following compounds are diprotic [Pb. PMT 2000]

(a) H_2PO_5 (b) H_2S

(c) $HClO_3$ (d) H_3PO_3

58. When 100 ml of 1M $NaOH$ solution is mixed with 10 ml of 10 M H_2SO_4, the resulting mixture will be [AMU 2002]

(a) Acidic (b) Alkaline

(c) Neutral (d) Strongly alkaline

59. The pH indicators are [KCET 1996]

(a) Salts of strong acids and strong bases

(b) Salts of weak acids and weak bases

(c) Either weak acids or weak bases

(d) Either strong acids or strong bases

60. Which of the following is not Lewis acid [BHU 1997]

(a) BF_3 (b) $AlCl_3$

(c) $FeCl_3$ (d) PH_3

61. A solution of sodium acetate in water will [MNR 1979]

(a) Turn red litmus blue (b) Turn blue litmus red

(c) Not effect litmus (d) Decolourises litmus

62. Cl^- is the conjugate base of [NCERT 1979; CPMT 1976; MP PET/PMT 1988]

(a) $HClO_4$ (b) HCl

(c) $HOCl$ (d) $HClO_3$

63. Which of the following behaves as both Lewis and Bronsted base

(a) BF_3 (b) Cl^-

(c) CO (d) None of these

64. The conjugate acid of a strong base is a [EAMCET 1979]

(a) Strong acid (b) Weak acid

(c) Strong base (d) Weak base

65. Which one is the weakest acid [DPMT 2002]

(a) HNO_3 (b) $HClO_4$

(c) H_2SO_4 (d) HBr

66. Conjugate base of HPO_4^{2-} is [MP PMT 1995]

(a) PO_4^{3-} (b) $H_2PO_4^-$

(c) H_3PO_4 (d) H_4PO_3

67. Which of the following is not Lewis acid [RPET/PMT 2002]

(a) $FeCl_3$ (b) $AlCl_3$

(c) BCl_3 (d) NH_3

68. (i) A strong acid has a weak conjugate base

(ii) An acid is an electron pair acceptor

The above statements (i) and (ii)

(a) Correct

(b) Wrong

(c) (i) Correct and (ii) Wrong

(d) (i) Wrong and (ii) Correct

69. The pH is less than 7, of the solution of [Pb. PMT 2002; MP PMT 2003]

(a) $FeCl_3$ (b) $NaCN$

(c) $NaOH$ (d) $NaCl$

70. In the reaction $I_2 + I^- \rightarrow I_3^-$, the Lewis base is [CPMT 1997; RPMT 2002; BCECE 2005]

(a) I_2 (b) I^-

(c) I_3^- (d) None of these

71. The strength of an acid depends on its tendency to [UPSEAT 2001]

(a) Accept protons (b) Donate protons

(c) Accept electrons (d) Donate electrons

72. In Lewis acid-base theory, neutralization reaction may be considered as [NCERT 1977]

(a) Formation of salt and water

(b) Competition for protons by acid and base

(c) Oxidation reduction

(d) Coordinate covalent bond formation

73. The salt that forms neutral solution in water is [EAMCET 1981]

(a) NH_4Cl (b) $NaCl$

(c) Na_2CO_3 (d) K_3BO_3

74. Which of the following cannot act as a Lewis or Bronsted acid

(a) BF_3 (b) $AlCl_3$

(c) $SnCl_4$ (d) CCl_4

75. Which one of the following salts gives an acidic solution in water

(a) CH_3COONa (b) NH_4Cl

(c) $NaCl$ (d) CH_3COONH_4

76. Which of the anhydrous salts when come in contact with water turns blue [AMU 1981, 82] [MP PMT 2003]

(a) Ferrous sulphate (b) Copper sulphate

(c) Zinc sulphate (d) Cobalt sulphate

77. The species among the following, which can act as an acid and a base is [AIEEE 2002; KCET 2005]

(a) HSO_4^- (b) SO_4^{2-}

(c) H_3O^+ (d) Cl^-

78. The strongest base from the following species is [KCET 1996]

(a) NH^{2-} (b) OH^-

(c) O^{2-} (d) S^{2-}

79. Which one is Lewis acid [CPMT 1997]

(a) Cl^- (b) Ag^+

(c) C_2H_5OH (d) S^{2-}

80. The conjugate acid of $H_2PO_4^-$ is [MP PET 1990]

(a) H_3PO_4 (b) $H_2PO_4^-$

(c) PO_4^{3-} (d) H_3O^+

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

(a) $H_2S_2O_8$ (b) H_2SO_4

(c) HSO_4^- (d) $HS_2O_8^-$

82. In the reaction $BCl_3 + PH_3 \rightarrow Cl_3B - PH_3$, Lewis base is [EAMCET 1986]

(a) BCl_3 (b) PH_3

(c) $Cl_3B - PH_3$ (d) None of these

83. Which of the following statement is true [MP PMT 1996]

(a) The conjugate base of a strong acid is a strong base
(b) The conjugate base of a weak acid is a strong base
(c) The conjugate base of a weak acid is a weak base
(d) The base and its conjugate acid react to form a neutral solution

84. What is the conjugate base of OH^- [AIEEE 2005]

(a) O_2 (b) H_2O
(c) O^- (d) O^{2-}

85. Which of the following is a Lewis base [BHU 1995]

(a) CH_4 (b) C_2H_5OH
(c) Acetone (d) Secondary amine

86. The correct order of acid strength is [CBSE PMT 2005]

(a) $HClO < HClO_2 < HClO_3 < HClO_4$
(b) $HClO_4 < HClO < HClO_2 < HClO_3$
(c) $HClO_2 < HClO_3 < HClO_4 < HClO$
(d) $HClO_4 < HClO_3 < HClO_2 < HClO$

87. The strongest acid is [DPMT 2000]

(a) H_3AsO_4 (b) H_3AsO_3
(c) H_3PO_3 (d) H_3PO_4

88. Which of the following is the strongest base [Roorkee 2000]

(a) $C_2H_5^-$ (b) $C_2H_5COO^-$
(c) $C_2H_5O^-$ (d) OH^-

89. The aqueous solution of which one of the following is basic [MP PMT 2001]

(a) $HOCl$ (b) $NaHSO_4$
(c) NH_4NO_3 (d) $NaOCl$

90. Which of the following is the weakest base [IIT 1980]

(a) $NaOH$ (b) $Ca(OH)_2$
(c) NH_4OH (d) KOH

91. The suitable indicator for strong acid and weak base is [RPMT 1997; UPSEAT 2002]

(a) Methyl orange (b) Methyl red
(c) Phenol red (d) Phenolphthalein

92. Among the following acids, the weakest one is [NCERT 1984]

(a) HF (b) HCl
(c) HBr (d) HI

93. The compound HCl behaves as .... in the reaction, $HCl + HF \rightarrow H_2^+Cl + F^-$ [JIPMER 2001]

(a) Weak base (b) Weak acid
(c) Strong base (d) Strong acid

94. The conjugate base of a strong acid is a [EAMCET 1978]

(a) Strong base (b) Strong acid
(c) Weak acid (d) Weak base

95. Which among the following is strongest acid [BHU 2005]

(a) $H(ClO)O_2$ (b) $H(ClO)O_3$
(c) $H(ClO)O$ (d) $H(ClO)$

96. In the reaction $2H_2O \rightleftarrows H_3O^+ + OH^-$, water is [MP PET 1989]

(a) A weak base
(b) A weak acid
(c) Both a weak acid and a weak base
(d) Neither an acid nor a base

97. In the reaction $HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$ [NCERT 1978; EAMCET 1982, 89]

(a) H_2O is the conjugate base of HCl acid
(b) Cl^- is the conjugate base of HCl acid
(c) Cl^- is the conjugate acid of H_2O base
(d) H_3O^+ is the conjugate base of HCl

98. According to Lewis concept, an acid is a substance which [EAMCET 1981; NCERT 1981; CPMT 1986; MP PMT 1987]

(a) Accepts protons
(b) Donates protons
(c) Accepts a lone pair of electrons
(d) Donates a lone pair of electrons

99. Water is a [KCET 2002]

(a) Amphoteric acid (b) Aprotic solvent
(c) Protophobic solvent (d) None of these

100. Conjugate base of NH_3 is [RPMT 2002]

(a) $NH_4^{\oplus}$ (b) $NH_2^{\oplus}$
(c) $NH_2^{\ominus}$ (d) N_2

101. Which of the following species is an acid and also a conjugate base of another acid [NCERT 1981]

(a) HSO_4^- (b) H_2SO_4
(c) OH^- (d) H_3O^+

102. Which of the following is Lewis acid [NCERT 1978; EAMCET 1987; MP PET 1994; CPMT 1990; AFMC 1997; RPMT 1999]

(a) BF_3 (b) Cl^-
(c) H_2O (d) NH_3

103. According to Bronsted-Lowry concept, base is a substance which is[NCERT 1982

(a) A proton donor
(b) An electron pair acceptor
(c) A proton acceptor
(d) An electron pair donor

104. Which of the following is known as hydronium ion [NCERT 1976]

(a) H^+ (b) H_2O^+
(c) H_3O^+ (d) $H_2O_2^+$

105. An aqueous solution of aluminium sulphate would show [NCERT 1977]

(a) An acidic reaction
(b) A neutral reaction
(c) A basic reaction
(d) Both acidic and basic reaction

106. The aqueous solution of aluminium chloride is acidic due to [MNR 1986, 88]

(a) Cation hydrolysis
(b) Anion hydrolysis
(c) Hydrolysis of both anion and cation
(d) Dissociation

107. HSO_4^- is the conjugate base of [NCERT 1977]

(a) H^+ (b) H_2SO_3
(c) SO_4^{2-} (d) H_2SO_4

108. An acid is a compound which furnishes (Bronsted-Lowry concept)[EAMCET 197

(a) An electron (b) A proton
(c) An electron and a proton (d) None of the above

109. The conjugate base of sulphuric acid is [EAMCET 1974]
(a) Sodium hydroxide (b) Hydrochloric acid
(c) Bisulphate ion (d) Barium hydroxide

110. Which is strongest Lewis base [CPMT 1994]
(a) SbH_3 (b) AsH_3
(c) PH_3 (d) NH_3

111. According to Bronsted principle, an aqueous solution of HNO_3 will contain [MP PMT/PET 1988]
(a) NO_2^- (b) NO_3^-
(c) NO_2^+ (d) NO^+

112. Aqueous solution of an acid is characterised by the presence of [NCERT 1977]
(a) H^+ ions (b) H_2^+ ions
(c) H_3O^+ ions (d) H_4O^+ ions

113. Ammonium ion is [RPMT 1999; KCET 2002]
(a) Neither an acid nor base (b) Both an acid and a base
(c) A conjugate acid (d) A conjugate base

114. Aqueous solution of $AlCl_3$ is [RPMT 2002]
(a) Acidic (b) Basic
(c) Amphoteric (d) None of these

115. The species which acts as a Lewis acid but not a Bronsted acid is [MP PMT 1999; Kurukshetra CET 2002]
(a) NH_2^- (b) O^{2-}
(c) BF_3 (d) OH^-

116. Among the following, the weakest base is [MP PMT 2002]
(a) H^- (b) CH_3^-
(c) CH_3O^- (d) Cl^-

117. Which of the following is not lewis base [EAMCET 1975; RPMT 2002]
(a) NH_3 (b) PH_3
(c) $(CH_3)_3N$ (d) HN_3

118. pK_a value of the strongest acid among the following is [MP PMT 1990]
(a) 3.0 (b) 4.5
(c) 1.0 (d) 2.0

119. The most acidic compound in water is [CBSE PMT 2001]
(a) $AlCl_3$ (b) $BeCl_2$
(c) $FeCl_3$ (d) None of these

120. BF_3 is used as a catalyst in several industrial processes due to its
(a) Strong reducing agent
(b) Weak reducing agent
(c) Strong Lewis acid nature
(d) Weak Lewis acid character

121. The aqueous solution of $AlCl_3$ is acidic due to the hydrolysis of
(a) Aluminium ion
(b) Chloride ion
(c) Both aluminium and chloride ion
(d) None of these

122. Which shows weak ionisation in water [MH CET 2001]
(a) H_2SO_4 (b) $NaCl$
(c) HNO_3 (d) NH_3

123. An organic dye, cosine used to detect end point of precipitation titration by adsorption is called [MH CET 1999]
(a) Absorption indicator (b) Adsorption indicator
(c) Chemical indicator (d) None of these

124. The indicator used in the titration of iodine against sodium thiosulphate is [AFMC 2002]
(a) Starch (b) $K_3Fe(CN)_6$
(c) K_2CrO_4 (d) Potassium

125. Phenolphthalein does not act as an indicator for the titration between [Pb. PMT 2002]
(a) $NaOH$ and CH_3COOH
(b) $H_2C_2O_4$ and $KMnO_4$
(c) $Ba(OH)_2$ and HCl
(d) KOH and H_2SO_4

126. Which is not example of Bronsted Lowry theory [AIEEE 2003]
(a) $AlCl_3$ (b) H_2SO_4
(c) SO_2 (d) HNO_3

127. An aqueous solution of sodium carbonate is alkaline because sodium carbonate is a salt of [MP PET 2002]
(a) Weak acid and weak base
(b) Strong acid and weak base
(c) Weak acid and strong base
(d) Strong acid and strong base

128. The acid that results when a base accepts a proton is called [Kerala (Med.) 2002]
(a) Conjugate base of the acid
(b) Conjugate protonated base
(c) Lewis base
(d) Conjugate acid of the base
(e) None of these

129. Ammonia gas dissolves in water to form NH_4OH. In this reaction water acts as [KCET (Engg./Med.) 1999]
(a) A conjugate base (b) A non-polar solvent
(c) An acid (d) A base

130. The conjugate base in the following reaction

$$H_2SO_4 + H_2O \rightleftarrows H_3O^+ + HSO_4^-$$ [DCE 1999]

(a) H_2O (b) HSO_4^-
(c) H_3O^+ (d) SO_2

[Kerala (Med.) 2002]

131. An aqueous solution of aluminium sulphate shows [DPMT 2001]
(a) A basic nature
(b) An acidic nature
(c) A neutral nature
(d) Both acidic and basic nature

[UPSEAT 2001, 02]

132. Neutralization of an acid with a base invariably results in the production of [CPMT 1983]
(a) H_3O^+ (b) OH^-

(c) H_2O (d) H^+ and OH^-

133. The conjugate acid of HPO_4^{2-} is [MP PMT 1987, 90, 91; EAMCET 1993]

(a) $H_2PO_4^-$ (b) PO_4^{3-}

(c) H_3PO_4 (d) H_3PO_3

134. Which of the following is not used as a Lewis acid [MP PET 2000]

(a) $SnCl_4$ (b) $FeCl_3$

(c) KCl (d) BF_3

135. Orthoboric acid in aqueous medium is [AMU 2000]

(a) Monobasic (b) Dibasic

(c) Tribasic (d) All are correct

136. According to Lewis concept which one of the following is not a base [MP PET/PMT 1988; Pb. CET 2003]

(a) OH^- (b) H_2O

(c) Ag^+ (d) NH_3

137. The aqueous solution of ammonium chloride is [CPMT 1987]

(a) Neutral (b) Basic

(c) Acidic (d) Amphoteric

138. In the process $BCl_3 + PH_3 \rightarrow BCl_3 : PH_3$ The Lewis acid is [RPMT 2000]

(a) PH_3 (b) BCl_3

(c) Both (d) None

139. The conjugate acid of NH_3 is [BHU Varanasi 1999; Pb. PMT 2004]

(a) NH_3 (b) NH_4^+

(c) N_2H_4 (d) NH_2OH

140. Which halide of nitrogen is least basic [DPMT 2001]

(a) NBr_3 (b) NI_3

(c) NCl_3 (d) NF_3

141. When $FeCl_3$ gets soluble in water, then its solution represents which of the characteristics [MP PET/PMT 1988]

(a) Amphoteric (b) Acidic

(c) Basic (d) Neutral

142. Lewis acid are those substances [MP PMT 1987]

(a) Which accept electron pair

(b) Which provide H^+ ion in the solution

(c) Which give electron pair

(d) Which accept OH^- ion

143. The conjugate base of HCO_3^- is

(a) H_2CO_3 (b) CO_3^{2-}

(c) CO_2 (d) H_2O

144. In the reaction $NH_3 + BF_3 \rightleftharpoons NH_3 \rightarrow BF_3$, BF_3 is [MP PMT 1989; MHCET 2001]

(a) Lewis acid

(b) Lewis base

(c) Neither Lewis acid nor Lewis base

(d) Lewis acid and Lewis base both

145. The strongest Lewis base in the following [MP PET/PMT 1988]

(a) CH_3^- (b) F^-

(c) NH_2^- (d) OH^-

146. The aqueous solution of $CuSO_4$ is [CPMT 1985]

(a) Acidic (b) Basic

(c) Neutral (d) Amphoteric

147. The acid having the highest pK_a value among the following is

(a) $HCOOH$ (b) CH_3COOH

(c) $ClCH_2COOH$ (d) FCH_2COOH

148. The indicator used in the titration of sodium carbonate with sulphuric acid is [DPMT 2001]

(a) Phenolphthalein

(b) Methyl orange

(c) Potassium ferrocynide

(d) Potassium ferricynide

149. According to Bronsted law, water is a/an [MP PET/PMT 1988]

(a) Base (b) Acid

(c) Acid and base both (d) Salt

150. Which of the following can give base OH^- [MP PET/PMT 1988]

(a) H_2O (b) H_3O^+

(c) H_2 (d) HCl

151. Conjugate base of HBr is [MP PET/PMT 1988]

(a) H_2Br^+ (b) H^+

(c) Br^- (d) Br^+

152. Molar heat of neutralization of $NaOH$ with HCl in comparison to that of KOH with HNO_3 is [MP PMT 1989]

(a) Less (b) More

(c) Equal (d) Depends on pressure

153. Which of the following is not a Lewis acid [J & K 2005]

(a) BF_3 (b) $AlCl_3$

(c) HCl (d) $LiAlH_4$

154. The solvent which neither accepts proton nor donates proton is called [RPMT 2000]

(a) Amphoteric (b) Neutral

(c) Aprotic (d) Amphiprotic

155. For the reaction in aqueous solution $Zn^{2+} + X^- \rightleftharpoons ZnX^+$, the K_{eq} is greatest when X is [Pb. PMT 1998]

(a) F^- (b) NO_3^-

(c) ClO_4^- (d) I^-

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

(a) The pH at the equivalence point will always be 7

(b) They can be used to titrate both strong and weak bases

(c) Strong acids form more stable solutions than weak acids

(d) The salts of strong acids do not hydrolysed

157. For an aqueous solution, the characteristic species of acid is [RPMT 1999]

(a) H^+ ion (b) H_3O^+ ion

(c) H_2^+ ion (d) H_4O^+ ion

158. Which is a Lewis base [CPMT 1988; JEE Orissa 2004]

(a) B_2H_6 (b) $LiAlH_4$

(c) AlH_3 (d) NH_3

159. For a weak acid, the incorrect statement is [Pb. PMT 2004]

(a) Its dissociation constant is low

(b) Its pK_a is very low

(c) It is partially dissociated

(d) Solution of its sodium salt is alkaline in water

160. Boron halides behave as Lewis acids, because of their [CBSE PMT 1996; BHU 2004]

(a) Ionic nature (b) Acidic nature

(c) Covalent nature (d) Electron deficient nature

161. Would gaseous *HCl* be considered as an Arrhenius acid [UPSEAT 2004]

(a) Yes

(b) No

(c) Not known

(d) Gaseous *HCl* does not exist

162. Which one of the following is called amphoteric solvent [UPSEAT 2004]

(a) Ammonium hydroxide (b) Chloroform

(c) Benzene (d) Water

163. Strongest conjugate base is [DPMT 2004]

(a) Cl^- (b) Br^-

(c) F^- (d) I^-

164. The conjugate base of $H_2PO_4^-$ is [AIEEE 2004]

(a) H_3PO_4 (b) P_2O_5

(c) PO_4^{3-} (d) HPO_4^{2-}

165. Conjugate base of HSO_4^- is [MH CET 2004]

(a) SO_4^{2-} (b) H_2SO_4

(c) $H_3SO_4^+$ (d) None of these

Common ion effect, Isohydric solutions, Solubility product, Ionic product of water and Salt hydrolysis

1. The expression for the solubility product of $Al_2(SO_4)_3$ is

(a) $K_{sp} = [Al^{3+}](SO_4^{2-}]$ (b) $K_{sp} = [Al^{3+}]^2 (SO_4^{2-}]^3$

(c) $K_{sp} = [Al^{3+}]^3 (SO_4^{2-}]^2$ (d) $K_{sp} = [Al^{3+}]^2 (SO_4^{2-}]^2$

2. On addition of ammonium chloride to a solution of ammonium hydroxide [CPMT 1976, 80, 81, 99; NCERT 1976, 77; MP PMT 1989, 99; DPMT 1983]

(a) Dissociation of NH_4OH increases

(b) Concentration of OH^- increases

(c) Concentration of OH^- decreases

(d) Concentration of NH_4^+ and OH^- increases

3. The solubility product of a salt having general formula MX_2, in water is : 4×10^{-12}. The concentration of M^{2+} ions in the aqueous solution of the salt is [AIEEE 2005]

(a) $2.0 \times 10^{-6} M$ (b) $1.0 \times 10^{-4} M$

(c) $1.6 \times 10^{-4} M$ (d) $4.0 \times 10^{-10} M$

4. In a saturated solution of electrolyte, the ionic product of their concentration are constant at constant temperature and this constant for electrolyte is known as [CPMT 1983]

(a) Ionic product (b) Solubility product

(c) Ionization constant (d) Dissociation constant

5. 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* at this temperature will be [RPMT 2000]

(a) 2.46×10^{14} (b) 1.36×10^{-4}

(c) 2.60×10^{-7} (d) 1.20×10^{-10}

6. The unit of ionic product of water K_w are [UPSEAT 2001, 02]

(a) $Mol^{-1}L^{-1}$ (b) $Mol^{-2}L^{-2}$

(c) $Mol^{-2}L^{-1}$ (d) Mol^2L^{-2}

7. A solution which is $10^{-3} M$ each in $Mn^{2+}, Fe^{2+}, Zn^{2+}$ and Hg^{2+} is treated with $10^{-16} M$ sulphide ion. If K_{sp} of MnS, FeS, ZnS and HgS are $10^{-15}, 10^{-23}, 10^{-20}$ and 10^{-54} respectively, which one will precipitate first [IIT Screening 2003]

(a) FeS (b) MgS

(c) HgS (d) ZnS

8. Let the solubility of an aqueous solution of $Mg(OH)_2$ be *x* then its k_{sp} is [AIEEE 2002]

(a) $4x^3$ (b) $108x^5$

(c) $27x^4$ (d) $9x$

9. 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 $0.01 M\ Ba^{2+}$ ions [RPMT 1999]

(a) 10^{-9} (b) 10^{-8}

(c) 10^{-7} (d) 10^{-6}

10. The solubility in water of a sparingly soluble salt AB_2 is $1.0 \times 10^{-5} mol\, l^{-1}$. Its solubility product number will be [AIEEE 2003]

(a) 4×10^{-15} (b) 4×10^{-10}

(c) 1×10^{-15} (d) 1×10^{-10}

11. The solubility of CaF_2 is a *moles/litre*. Then its solubility product is ..... [Orissa JEE 2002]

(a) s^2 (b) $4s^3$

(c) $3s^2$ (d) s^3

12. On passing a current of HCl gas in a saturated solution of $NaCl$, the solubility of $NaCl$ [CPMT 1989; CBSE PMT 1989]

(a) Increases (b) Decreases

(c) Remains unchanged (d) $NaCl$ decomposes

13. Which is the correct representation of the solubility product constant of Ag_2CrO_4 [NCERT 1974, 75]

(a) $[Ag^+]^2 [CrO_4^{-2}]$ (b) $[Ag^+][CrO_4^{-2}]$

(c) $[2Ag^+][CrO_4^{-2}]$
(d) $[2Ag^+]^2\ [CrO_4^{-2}]$

14. The solubility of CaF_2 is $2\times10^{-4}\ moles/litre$ Its solubilily product (K_{sp}) is [NCERT 1981; BHU 1983, 86; MP PET 1992; CBSE PMT 1999]

(a) 2.0×10^{-4}
(b) 4.0×10^{-3}
(c) 8.0×10^{-12}
(d) 3.2×10^{-11}

15. Solubility product of a sulphide *MS* is 3×10^{-25} and that of another sulphide *NS* is 4×10^{-40}. In ammoniacal solution [NCERT 1981]

(a) Only *NS* gets precipitated
(b) Only *MS* gets precipitated
(c) No sulphide precipitates
(d) Both sulphides precipitate

16. Which of the following salts when dissolved in water will get hydrolysed [MNR 1985; CPMT 1989; CBSE PMT 1989; MP PET 1999]

(a) $NaCl$
(b) NH_4Cl
(c) KCl
(d) Na_2SO_4

17. The aqueous solution of $FeCl_3$ is acidic due to [CPMT 1972, 79, 83, 84; MP PET/PMT 1988; RPMT 2000]

(a) Acidic impurities
(b) Ionisation
(c) Hydrolysis
(d) Dissociation

18. A precipitate of $AgCl$ is formed when equal volumes of the following are mixed. $[K_{sp}$ for $AgCl=10^{-10}]$ [KCET 2005]

(a) $10^{-4}\ M\ AgNO_3$ and $10^{-7}\ M\ HCl$
(b) $10^{-5}\ M\ AgNO_3$ and $10^{-6}\ M\ HCl$
(c) $10^{-5}\ M\ AgNO_3$ and $10^{-4}\ M\ HCl$
(d) $10^{-6}\ M\ AgNO_3$ and $10^{-6}\ M\ HCl$

19. The solubility of silver chromate in 0.01 *M* K_2CrO_4 is $2\times10^{-8}\ mol\ dm^{-3}$. The solubility product of silver chromate will be [MH CET 2000]

(a) 8×10^{-24}
(b) 16×10^{-24}
(c) 1.6×10^{-18}
(d) 16×10^{-18}

20. Some salts although containing two different metallic elements give test for only one of them in solution. Such salts are [MNR 1979]

(a) Double salts
(b) Normal salts
(c) Complex salts
(d) Basic salts

21. What is the pH value of $\frac{N}{1000}\ KOH$ solution [CPMT 1975; MNR 1986, 91; Pb. CET 2004]

(a) 10^{-11}
(b) 3
(c) 2
(d) 11

22. Mohr's salt is a [MNR 1986]

(a) Normal salt
(b) Acid salt
(c) Basic salt
(d) Double salt

23. Aqueous solution of sodium acetate is [MNR 1978; CPMT 1971, 80, 81; MADT Bihar 1982; MP PMT 1985;]

(a) Neutral
(b) Weakly acidic
(c) Strongly acidic
(d) Alkaline

24. Which is the correct alternate for hydrolysis constant of NH_4CN [CBSE PMT

(a) $\sqrt{\frac{K_w}{K_a}}$
(b) $\frac{K_w}{K_a\times K_b}$
(c) $\sqrt{\frac{K_b}{c}}$
(d) $\frac{K_a}{K_b}$

25. Which of the following salts undergoes hydrolysis [CPMT 1972, 74, 78; DPMT 1985]

(a) CH_3COONa
(b) KNO_3
(c) $NaCl$
(d) K_2SO_4

26. What will happen if CCl_4 is treated with $AgNO_3$ [DPMT 1983]

(a) A white ppt. of $AgCl$ will form
(b) NO_2 will be evolved
(c) CCl_4 will dissolve in $AgNO_3$
(d) Nothing will happen

27. The correct representation for solubility product of SnS_2 is [CPMT 1977; MP PET 1999;RPMT 2000]

(a) $[Sn^{4+}][S^{2-}]^2$
(b) $[Sn^{2+}][S^{2-}]^2$
(c) $[Sn^{2+}][2S^{2-}]$
(d) $[Sn^{4+}][2S^{2-}]^2$

28. A precipitate of calcium oxalate will not dissolve in [CPMT 1971, 89; IIT 1986]

(a) HCl
(b) HNO_3
(c) Aquaregia
(d) CH_3COOH

29. Baking soda is [RPMT 2000]

(a) Basic salt
(b) Acidic salt
(c) Complex salt
(d) Double salt

30. Which one of the following substances will be a mixed salt [DPMT 1982; CPMT 1972]

(a) $NaHCO_3$
(b) $Ca(OCl)Cl$
(c) $K_2SO_4\ Al_2(SO_4)_3.24H_2O$
(d) $Mg(OH)Br$

31. Solubility product of $BaCl_2$ is 4×10^{-9}. Its solubility in moles/litre would be [AFMC 1982; Roorkee 1990; BHU 2000]

(a) 1×10^{-3}
(b) 1×10^{-9}
(c) 4×10^{-27}
(d) 1×10^{-27}

32. Which hydroxide will have lowest value of solubility product at normal temperature $(25^\circ C)$ [IIT 1990; RPMT 1997]

(a) $Mg(OH)_2$
(b) $Ca(OH)_2$
(c) $Ba(OH)_2$
(d) $Be(OH)_2$

33. Which will not be hydrolysed [MP PMT 1989]

(a) Potassium nitrate
(b) Potassium cyanide
(c) Potassium succinate
(d) Potassium carbonate

34. Which pair will show common ion effect [MP PMT 1990, 99; Pb. PMT 2001]

(a) $BaCl_2+Ba(NO_3)_2$
(b) $NaCl+HCl$
(c) NH_4OH+NH_4Cl
(d) $AgCN+KCN$

35. Which is least soluble in water [UPSEAT 1999]

(a) $AgCl$ (b) AgF

(c) AgI (d) Ag_2S

36. A white salt is readily soluble in water and gives a colourless solution with a pH of about 9. The salt would be [Pb. PMT 1998]

(a) NH_4NO_3 (b) CH_3COONa

(c) CH_3COONH_4 (d) $CaCO_3$

37. If acetic acid mixed with sodium acetate, then H^+ ion concentration will be [Roorkee 1995]

(a) Increased (b) Decreased

(c) Remains unchanged (d) pH decreased

38. Solubility of $AgCl$ will be minimum in [CBSE PMT 1995]

(a) $0.001\,M\,AgNO_3$ (b) Pure water

(c) $0.01\,M\,CaCl_2$ (d) $0.01\,M\,NaCl$

39. In absence of formation of complex ions by the addition of a common ion, the solubility of a given salt is [BHU 1979]

(a) Increased

(b) Decreased

(c) Unaffected

(d) First increased and then decreased

40. At 298 *K*, the solubility product of $PbCl_2$ is 1.0×10^{-6}. What will be the solubility of $PbCl_2$ in moles/litre [MP PMT 1990; CPMT 1985, 96]

(a) 6.3×10^{-3} (b) 1.0×10^{-3}

(c) 3.0×10^{-3} (d) 4.6×10^{-14}

41. Solubility product is [CET Pune 1998]

(a) The ionic product of an electrolyte in its saturated solution

(b) The product of the solubilities of the ions of the electrolyte

(c) The product of solubilities of the salts

(d) The product of the concentration of the ions

42. Ionic product of water increases, if [AMU 1983; MP PET 1986; MP PET/PMT 1988; JIPMER 2002]

(a) Pressure is reduced (b) H^+ is added

(c) OH^- is added (d) Temperature increases

43. Which one is a mixed salt [DPMT 1985]

(a) $NaHSO_4$ (b) $NaKSO_4$

(c) $K_4Fe(CN)_6$ (d) $Mg(OH)Cl$

44. If K_{sp} for $HgSO_4$ is 6.4×10^{-5}, then solubility of the salt is [AFMC 1997; KCET 2000; CPMT 2000; JIPMER 2001]

(a) 8×10^{-3} (b) 8×10^{-6}

(c) 6.4×10^{-5} (d) 6.4×10^{-3}

45. The solubility of $BaSO_4$ in water is $2.33 \times 10^{-3}\ gm/litre$ Its solubility product will be (molecular weight of $BaSO_4 = 233$) [AIIMS 1998]

(a) 1×10^{-5} (b) 1×10^{-10}

(c) 1×10^{-15} (d) 1×10^{-20}

46. The solubility of $AgCl$ in $0.2\ M\ NaCl$ solution (K_{sp} for $AgCl = 1.20 \times 10^{-10}$) is [MP PET 1996]

(a) $0.2\ M$ (b) $1.2 \times 10^{-10}\ M$

(c) $0.2 \times 10^{-10}\ M$ (d) $6.0 \times 10^{-10}\ M$

47. The solubility of AgI in NaI solution is less than that in pure water because [UPSEAT 2001]

(a) *AgI* forms complex with *NaI*

(b) Of common ion effect

(c) Solubility product of *AgI* is less than that of *NaI*

(d) The temperature of the solution decreases

48. The solubility product of $BaSO_4$ is 1.5×10^{-9}. The precipitation in a 0.01 $M\ Ba^{2+}$ solution will start, on adding H_2SO_4 of concentration [CPMT 1988]

(a) $10^{-9}\,M$ (b) $10^{-8}\,M$

(c) $10^{-7}\,M$ (d) $10^{-6}\,M$

49. At $20^o C$, the Ag^+ ion concentration in a saturated solution of Ag_2CrO_4 is $1.5 \times 10^{-4}\ mole/litre$ At $20^o C$, the solubility product of Ag_2CrO_4 would be [MP PET 1997; MP PMT 1999]

(a) 3.3750×10^{-12} (b) 1.6875×10^{-10}

(c) 1.6875×10^{-12} (d) 1.6875×10^{-11}

50. The solubility of $PbCl_2$ is [MP PMT 1995; DCE 1999]

(a) $\sqrt{K_{sp}}$ (b) $\sqrt[3]{K_{sp}}$

(c) $\sqrt[3]{\frac{K_{sp}}{4}}$ (d) $\sqrt{8K_{sp}}$

51. The solubility product of $AgCl$ is 1.44×10^{-4} at $100^o C$. The solubility of silver chloride in boiling water may be [MP PMT 1994; Bihar MEE 1998]

(a) $0.72 \times 10^{-4}\ M$ (b) $1.20 \times 10^{-2}\ M$

(c) $0.72 \times 10^{-2}\ M$ (d) $1.20 \times 10^{-4}\ M$

52. If the solubility of a sparingly soluble salt of the type BA_2 (giving three ions on dissociation of a molecule) is x moles per litre, then its solubility product is given by [BHU 1987]

(a) x^2 (b) $2x^3$

(c) $4x^2$ (d) $4x^3$

53. The solubility product of Ag_2CrO_4 is 32×10^{-12}. What is the concentration of CrO_4^- ions in that solution [BHU 1997; DPMT 2004]

(a) $2 \times 10^{-4}\ m/s$ (b) $16 \times 10^{-4}\ m/s$

(c) $8 \times 10^{-4}\ m/s$ (d) $8 \times 10^{-8}\ m/s$

54. The addition of HCl will not suppress the ionization of [MP PET 1993]

(a) Acetic acid (b) Benzoic acid

(c) H_2S (d) Sulphuric acid

55. On the addition of a solution containing CrO_4^{2-} ions to the solution of Ba^{2+}, Sr^{2+} and Ca^{2+} ions, the precipitate obtained first will be of [MP PMT 1993]

(a) $CaCrO_4$ (b) $SrCrO_4$

(c) $BaCrO_4$ (d) Mixture of (a), (b), (c)

56. The solubility product of a sparingly soluble salt AB at room temperature is 1.21×10^{-6}. Its molar solubility is [CPMT 1987; MP PET 2001]

(a) 1.21×10^{-6} (b) 1.21×10^{-3}

(c) 1.1×10^{-4} (d) 1.1×10^{-3}

57. The precipitation occurs if ionic concentration is [AFMC 1995; J & K 2005]

(a) Less than solubility product
(b) More than solubility product
(c) Equal to solubility product
(d) None of these

58. If S and K_{sp} are respectively solubility and solubility product of a sparingly soluble binary electrolyte, then [CPMT 1988; MP PMT 1999]

(a) $S = K_{sp}$ (b) $S = K_{sp}^2$
(c) $S = \sqrt{K_{sp}}$ (d) $S = \frac{1}{2}K_{sp}$

59. Any precipitate is formed when [AIIMS 1982; DPMT 1985; KCET 1999; MP PMT 2004]

(a) Solution becomes saturated
(b) The value of ionic product is less that than the value of solubility product
(c) The value of ionic product is equal than the value of solubility product
(d) The value of ionic product is greater than the value of solubility product

60. The solubility product of $AgCl$ is 4.0×10^{-10} at $298\ K$. The solubility of $AgCl$ in $0.04\,m\ CaCl_2$ will be [KCET 1996]

(a) $2.0\times10^{-5}\ m$ (b) $1.0\times10^{-4}\ m$
(c) $5.0\times10^{-9}\ m$ (d) $2.2\times10^{-4}\ m$

61. Hydrolysis of sodium acetate will give [MNR 1978]

(a) Acidic solution (b) Basic solution
(c) Neutral solution (d) Normal solution

62. If the solubility product of $BaSO_4$ is 1.5×10^{-9} in water, its solubility in moles per litre, is [BHU 1995; MP PET 1995; UPSEAT 204]

(a) 1.5×10^{-9} (b) 3.9×10^{-5}
(c) 7.5×10^{-5} (d) 1.5×10^{-5}

63. On passing H_2S gas through a highly acidic solution containing Cd^{2+} ions, CdS is not precipitated because

(a) Of common ion effect
(b) The solubility of CdS is low
(c) Cd^{2+} ions do not form complex with H_2S
(d) The solubility product of CdS is low

64. Which of the following will occur if a 0.1 M solution of a weak acid is diluted to $0.01M$ at constant temperature [UPSEAT 2001, 02]

(a) $[H^+]$ will decrease to 0.01 M
(b) pH will decrease
(c) Percentage ionization will increase
(d) K_a will increase

65. If solubility of calcium hydroxide is $\sqrt{3}$, then its solubility product will be [MH CET 2002]

(a) 27 (b) 3
(c) 9 (d) $12\sqrt{3}$

66. When NH_4Cl is added to NH_4OH solution, the dissociation of ammonium hydroxide is reduced. It is due to [MP PMT 1993]

(a) Common ion effect (b) Hydrolysis
(c) Oxidation (d) Reduction

67. At 298 K, the solubility of $PbCl_2$ is $2\times10^{-2}\,mol/lit$, then k_{sp} = [RPMT 2002]

(a) 1×10^{-7} (b) 3.2×10^{-7}
(c) 1×10^{-5} (d) 3.2×10^{-5}

68. The solubility product of silver sulphide is 3.2×10^{-11}. Its solubility at the experimental temperature is

(a) 2×10^{-4} *moles per litre*
(b) 6×10^{-6} *moles per litre*
(c) 1.2×10^{-5} *moles per litre*
(d) 8×10^{-4} *moles per litre*

69. The solubility of $CaCO_3$ in water is $3.05\times10^{-4}\,moles/litre$ Its solubility product will be [MP PMT 1997]

(a) 3.05×10^{-4} (b) 10
(c) 6.1×10^{-4} (d) 9.3×10^{-8}

70. Solubility of BaF_2 in a solution $Ba(NO_3)_2$ will be represents by the concentration term [UPSEAT 2001, 02; CPMT 2002]

(a) $[Ba^{++}]$ (b) $[F^-]$
(c) $\frac{1}{2}[F^-]$ (d) $2[NO_3^-]$

71. The solubility of $PbCl_2$ at 25^oC is 6.3×10^{-3} *mole/litre*. Its solubility product at that temperature is [NCERT 1979; CPMT 1985]

(a) $(6.3\times10^{-3})\times(6.3\times10^{-3})$
(b) $(6.3\times10^{-3})\times(12.6\times10^{-3})$
(c) $(6.3\times10^{-3})\times(12.6\times10^{-3})^2$
(d) $(12.6\times10^{-3})\times(12.6\times10^{-3})$

72. Which of the following cannot be hydrolysed [MP PMT 1996]

(a) A salt of weak acid and strong base
(b) A salt of strong acid and weak base
(c) A salt of weak acid and weak base
(d) A salt of strong acid and strong base

73. 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]

(a) Strong acid and strong base
(b) Weak acid and weak base
(c) Strong acid and weak base
(d) Weak acid and strong base

74. Which is a basic salt [MP PMT 1985]

(a) PbS (b) $PbCO_3$
(c) $PbSO_4$ (d) $2PbCO_3.Pb(OH)_2$

75. The saturated solution of Ag_2SO_4 is $2.5\times10^{-2}\ M$. Its solubility product (K_{sp}) is [NCERT 1980]

(a) 62.5×10^{-6} (b) 6.25×10^{-4}

(c) 15.625×10^{-6} (d) 3.125×10^{-6}

76. K_{sp} for sodium chloride is $36\ mol^2/litre^2$. The solubility of sodium chloride is [BHU 1981]

(a) $\frac{1}{36}$ (b) $\frac{1}{6}$

(c) 6 (d) 3600

77. Sodium chloride is purified by passing hydrogen chloride gas in an impure solution of sodium chloride. It is based on [MP PMT 1996]

(a) Buffer action (b) Common ion effect

(c) Association of salt (d) Hydrolysis of salt

78. If the concentration of lead iodide in its saturated solution at 25^oC be 2×10^{-3} moles per litre, then its solubility product is[CPMT 1984]

(a) 4×10^{-6} (b) 8×10^{-12}

(c) 6×10^{-9} (d) 32×10^{-9}

79. The precipitate of CaF_2 $(K_{sp}=1.7\times10^{-10})$ is obtained when equal volumes of the following are mixed [IIT 1992; UPSEAT 2000]

(a) $10^{-4}M\ Ca^{2+}+10^{-4}M\ F^-$

(b) $10^{-2}M\ Ca^{2+}+10^{-3}M\ F^-$

(c) Both

(d) None of these

80. In the reaction: $H_2S \rightleftarrows 2H^+ + S^{--}$, when NH_4OH is added, then [KCET (Med.) 1999; AFMC 2000]

(a) S^{--} is precipitate

(b) No action takes places

(c) Concentration of S^{--} decreases

(d) Concentration of S^{--} increases

81. What is the minimum concentration of SO_4^{2-} required to precipitate $BaSO_4$ in a solution containing $1.0\times10^{-4}mol\ Ba^{2+}$? ($K_{sp}$ for $BaSO_4$ is 4×10^{-10}) [MP PMT 2000]

(a) $4\times10^{-10}M$ (b) $2\times10^{-7}M$

(c) $4\times10^{-6}M$ (d) $2\times10^{-3}M$

82. Solubility product for salt AB_2 is 4×10^{-12}. Calculate solubility [RPET 2003]

(a) $1\times10^{-3}\ gm\ mol/litre$

(b) $1\times10^{-5}\ gm\ mol/litre$

(c) $1\times10^{-4}\ gm\ mol/litre$

(d) $1\times10^{-2}\ gm\ mol/litre$

83. Solubility product of a salt AB is 1×10^{-8} in a solution in which concentration of A is $10^{-3}M$. The salt will precipitate when the concentration of B becomes more than [MP PET 1990; KCET 2003]

(a) $10^{-4}M$ (b) $10^{-7}M$

(c) $10^{-6}M$ (d) $10^{-5}M$

84. At equilibrium, if to a saturated solution of $NaCl, HCl$ is passed, $NaCl$ gets precipitated because [RPMT 1999]

(a) HCl is a strong acid

(b) Solubility of $NaCl$ decreases

(c) Ionic product of $NaCl$ becomes greater than its K_{sp}

(d) HCl is a weak acid

85. The solubility product of $BaSO_4$ is 1.3×10^{-9}. The solubility of this salt in pure water will be [MP PET 2002]

(a) $1.69\times10^{-9}\ mol\ litre^{-1}$ (b) $1.69\times10^{-18}\ mol\ litre^{-1}$

(c) $3.6\times10^{-18}\ mol\ litre^{-1}$ (d) $3.6\times10^{-5}\ mol\ litre^{-1}$

86. The solubility product of $AgCl$ under standard conditions of temperature is given by [Kerala (Med.) 2003]

(a) 1.6×10^{-5} (b) 1.5×10^{-8}

(c) 3.2×10^{-10} (d) 1.5×10^{-10}

87. An aqueous solution of CH_3COONa will be [MP PET 2001]

(a) Acidic (b) Alkaline

(c) Neutral (d) None of these

88. In which of the following salt hydrolysis takes place [CPMT 1974, 78]

(a) KCl (b) $NaNO_3$

(c) CH_3COOK (d) K_2SO_4

89. At 90^oC pure water has $[H_3O^+]=10^{-6}M$, the value of K_w at this temperature will be [IIT 1981; MNR 1990; CBSE PMT 1993; UPSEAT 1999]

(a) 10^{-6} (b) 10^{-12}

(c) 10^{-14} (d) 10^{-8}

90. Solubility of MX_2 type electrolyte is 0.5×10^{-4} *mole/litre*. The value of K_{sp} of the electrolyte is [CBSE PMT 2002]

(a) 5×10^{-13} (b) 25×10^{-10}

(c) 1.25×10^{-13} (d) 5×10^{12}

91. According to the reaction $PbCl_2 = Pb^2 + 2Cl^-$, the solubility coefficient of $PbCl_2$ is [MP PET/PMT 1988]

(a) $[Pb^{2+}][Cl^-]^2$ (b) $[Pb^{2+}][Cl^-]$

(c) $[Pb^{2+}]^2[Cl^-]$ (d) None of these

92. K_{sp} value of $Al(OH)_3$ and $Zn(OH)_2$ are 8.5×10^{-23} and 1.8×10^{-14} respectively. If NH_4OH is added in a solution of Al^{3+} and Zn^{2+}, which will precipitate earlier [MP PMT 1989; CPMT 1989]

(a) $Al(OH)_3$ (b) $Zn(OH)_2$

(c) Both together (d) None

93. Why pure $NaCl$ is precipitated when HCl gas is passed in a saturated solution of $NaCl$ [NCERT 1977; MP PMT 1987; CPMT 1974, 78, 81]

(a) Impurities dissolves in HCl

(b) The value of $[Na^+]$ and $[Cl^-]$ becomes smaller than K_{sp} of $NaCl$

(c) The value of $[Na^+]$ and $[Cl^-]$ becomes greater than K_{sp} of $NaCl$

(d) HCl dissolves in the water

94. Pure $NaCl$ is prepared by saturating a cold saturated solution of common salt in water with HCl gas. The principle used is

(a) Le Chatelier principle (b) Displacement law

(c) Common ion effect (d) Fractional distillation

95. What is the solubility of calcium fluoride in a saturated solution, if its solubility product is 3.2×10^{-11} [CPMT 1997]

(a) $2.0\times10^{-4}\ mole/litre$ (b) $12.0\times10^{-3}\ mole/litre$
(c) $0.2\times10^{-4}\ mole/litre$ (d) $2\times10^{-3}\ mole/litre$

96. The following equilibrium exists in an aqueous solution of hydrogen sulphide :

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

If dilute HCl is added to an aqueous solution of H_2S without any change in temperature **[NCERT 1989]**

(a) The equilibrium constant will change
(b) The concentration of HS^- will increase
(c) The concentration of undissociated H_2S will decrease
(d) The concentration of HS^- will decrease

97. Solubility of a salt M_2X_3 is $y\ mol\ dm^{-3}$. The solubility product of the salt will be

[IIT 1990, 97; AFMC 1991; RPMT 1999; MP PET 2001; MP PMT 2003; Orissa JEE 2005]

(a) $6y^4$ (b) $64y^4$
(c) $36y^5$ (d) $108y^5$

98. Which one of the following is most soluble **[CBSE PMT 1994; RPMT 2000]**

(a) $CuS\ (K_{sp} = 8\times10^{-37})$ (b) $MnS\ (K_{sp} = 7\times10^{-16})$
(c) $Bi_2S_3\ (K_{sp} = 1\times10^{-70})$ (d) $Ag_2S\ (K_{sp} = 6\times10^{-51})$

99. The solubility product of $PbCl_2$ at 20^oC is 1.5×10^{-4}. Calculate the solubility **[Bihar CEE 1995; BHU 2002]**

(a) 3.75×10^{-4} (b) 3.34×10^{-2}
(c) 3.34×10^{2} (d) None of these

100. Which one of the following compounds is a Lewis acid **[EAMCET 1997]**

(a) PCl_3 (b) BCl_3
(c) NCl_3 (d) $CHCl_3$

101. Which one of the following salt is most acidic in water **[IIT 1995]**

(a) $NiCl_2$ (b) $BeCl_2$
(c) $FeCl_3$ (d) $AlCl_3$

102. Which of the following aqueous solution will have a pH less than 7.0 **[MP PMT 1991, 92]**

(a) KNO_3 (b) $NaOH$
(c) $FeCl_3$ (d) $NaCN$

103. Hydrolysis constant for a salt of weak acid and weak base would be

(a) $K_h = \frac{K_w}{K_a}$ (b) $K_h = \frac{K_w}{K_b}$
(c) $K_h = \frac{K_w}{K_a K_b}$ (d) None of these

104. Which salt will give basic solution on hydrolysis **[RPMT 1997]**

(a) KCN (b) KCl
(c) NH_4Cl (d) CH_3COONH_4

105. Which of the following sulphides has the lowest solubility product **[KCET 1996]**

(a) FeS (b) MnS
(c) PbS (d) ZnS

106. The concentration of which ion is to be decreased, when NH_3 solution is added **[RPMT 1997]**

(a) OH^- (b) NH_4^+
(c) H_3O^+ (d) O_2^-

107. The compound insoluble in acetic acid is **[IIT 1986]**

(a) Calcium oxide
(b) Calcium carbonate
(c) Calcium oxalate
(d) Calcium hydroxide

108. A saturated solution of Ag_2SO_4 is 2.5×10^{-2} *M*; The value of its solubility product is **[Pb.CET 2004]**

(a) 62.5×10^{-6} (b) 6.25×10^{-4}
(c) 15.625×10^{-6} (d) 3.125×10^{-6}

109. Solubility product of $AgCl$ is 1×10^{-6} at 298 *K*. Its solubility in mole $litre^{-1}$ would be **[Pb.CET 2001]**

(a) $1\times10^{-6}\ mol/litre$
(b) $1\times10^{-3}\ mol/litre$
(c) $1\times10^{-12}\ mol/litre$
(d) None of these

110. A litre of solution is saturated with *AgCl*. To this solution if 1.0×10^{-4} mole of solid *NaCl* is added, what will be the $[Ag^+]$, assuming no volume change **[UPSEAT 2004]**

(a) More (b) Less
(c) Equal (d) Zero

111. The concentration of *KI* and *KCl* in certain solution containing both is 0.001*M* each. If 20 *ml* of this solution is added to 20 *ml* of a saturated solution of *AgI* in water? What will happen **[MP PMT 2004]**

(a) *AgCl* will be precipitated
(b) *AgI* will be precipitated
(c) Both *AgCl* and *AgI* will be precipitated
(d) There will be no precipitated

112. The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-11}. Its solubility (in moles / litres) is **[CBSE PMT 2004]**

(a) 2×10^{-4} (b) 4×10^{-4}
(c) 5.6×10^{-6} (d) 3.1×10^{-4}

113. 0.5 *M* ammonium benzoate is hydrolysed to 0.25 percent, hence its hydrolysis constant is **[MH CET 2004]**

(a) 2.5×10^{-5} (b) 1.5×10^{-4}
(c) 3.125×10^{-6} **[RPMT 1999]** (d) 6.25×10^{-4}

114. The solubility of Sb_2S_3 in water is 1.0×10^{-5} mol / litre at 298 *K*. What will be its solubility product **[CPMT 2004]**

(a) 108×10^{-25} (b) 1.0×10^{-25}
(c) 144×10^{-25} (d) 126×10^{-24}

115. The ionic product of water at 25^oC is 10^{-14}. The ionic product at 90^oC will be **[CBSE PMT 1996]**

(a) 1×10^{-20} (b) 1×10^{-12}
(c) 1×10^{-14} (d) 1×10^{-16}

116. In hydrolysis of a salt of weak acid and strong base, $A^- + H_2O \rightleftarrows HA + OH^-$, the hydrolysis constant (K_h) is equal to....

(a) $\frac{K_w}{K_a}$ (b) $\frac{K_w}{K_b}$

(c) $\sqrt{\frac{K_a}{C}}$ (d) $\frac{K_w}{K_a \times K_b}$

Hydrogen ion concentration- *pH* scale and Buffer solution

1. The pH of blood does not appreciably change by a small addition of an acid or a base because blood **[CBSE PMT 1995]**
   (a) Contains serum protein which acts as buffer
   (b) Contains iron as a part of the molecule
   (c) Can be easily coagulated
   (d) It is body fluid

2. The pH of a $0.001 M\ NaOH$ will be **[MP PMT 1995; UPSEAT 2001]**
   (a) 3   (b) 2
   (c) 11   (d) 12

3. *pH* value of a solution, whose hydronium ion concentration is $6.2 \times 10^{-9} mol/l$, is **[AFMC 1999; AIIMS 2000]**
   (a) 6.21   (b) 7.21
   (c) 7.75   (d) 8.21

4. 0.1 mole of CH_3NH_2 (K_b = 5 × 10^{-4}) is mixed with 0.08 mole of *HCl* and diluted to one litre. What will be the *H* concentration in the solution? **[IIT 2005]**
   (a) 8 × 10^{-2} *M*   (b) 8 × 10^{-11} *M*
   (c) 1.6 × 10^{-11} *M*   (d) 8 × 10^{-5} *M*

5. What will be the sum of pH and pOH in an aqueous solution ?
   (a) 7   (b) pk_w
   (c) Zero   (d) 1

6. Hydrogen ion concentration in *mol/L* in a solution of $pH = 5.4$ will be **[AIEEE 2005]**
   (a) 3.98×10^8 (b) 3.88×10^6
   (c) 3.68×10^{-6} (d) 3.98×10^{-6}

7. When solid potassium cyanide is added in water then **[CPMT 2002; BHU 2002]**
   (a) *pH* will increase
   (b) *pH* will decrease
   (c) *pH* will remain the same
   (d) Electrical conductivity will not change

8. *pH* of a $10^{-3} M$ solution of hydrochloric acid will be **[MP PET 2000]**
   (a) 1.3   (b) 2.0
   (c) 3.0   (d) 4.5

9. The pH of water at $25^o C$ is nearly **[CPMT 1986, 89, 90, 93; CBSE PMT 1989; MADT Bihar 1995]**
   (a) 2   (b) 7
   (c) 10   (d) 12

10. pH of a solution is 5. Its hydroxyl ion concentration is **[JIPMER 1999]**
    (a) 5   (b) 10
    (c) 10^{-5} (d) 10^{-9}

11. The pH of a solution in which the $[H^+] = 0.01$, is **[MADT Bihar 1980]**
    (a) 2   (b) 1
    (c) 4   (d) 3

12. 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]**
    (a) $2.0 \times 10^{-6} mol\ L^{-1}$ (b) $1.0 \times 10^{-5} mol\ L^{-1}$
    (c) $1.0 \times 10^{-6} mol\ L^{-1}$ (d) $1.0 \times 10^{-7} mol\ L^{-1}$

13. Aqueous solution of HCl has the $pH = 4$. Its molarity would be
    (a) 4 *M*   (b) 0.4 *M*
    (c) 0.0001 *M*   (d) 10 *M*

14. Which is a buffer solution **[CPMT 1985, 88; AIIMS 1980; MP PMT 1994; AFMC 2004]**
    (a) $CH_3COOH + CH_3COONa$
    (b) $CH_3COOH + CH_3COONH_4$
    (c) $CH_3COOH + NH_4Cl$
    (d) $NaOH + NaCl$

15. The addition of solid sodium carbonate to pure water causes **[NCERT 1973]**
    (a) An increase in hydronium ion concentration
    (b) An increase in alkalinity
    (c) No change in acidity
    (d) A decrease in hydroxide ion concentration

16. The aqueous solution of which of the following salt has the lowest *pH* **[CBSE PMT 2002]**
    (a) $NaClO$ **[MP PET/PMT 1998]**   (b) $NaClO_2$
    (c) $NaClO_3$ (d) $NaClO_4$

17. The pH of a $10^{-10} M\ NaOH$ solution is nearest to **[UPSEAT 2001, 02]**
    (a) 10   (b) 7
    (c) 4   (d) -10

18. Which will have maximum pH **[NCERT 1979]**
    (a) Distilled water
    (b) $1 M\ NH_3$
    (c) $1 M\ NaOH$
    (d) Water saturated by chlorine

19. *pH* of a solution is 9.5. The solution is **[MH CET 2000]**
    (a) Neutral   (b) Acidic
    (c) Basic   (d) Amphoteric

20. The pH of a $10^{-9} M$ solution of HCl in water is **[UPSEAT 2000, 02]**
    (a) 8   (b) – 8
    (c) Between 7 and 8   (d) Between 6 and 7

21. $pH + pOH$ equal to **[NCERT 1975]**
    (a) Zero   (b) Fourteen
    (c) A negative number   (d) Infinity

22. Which of the following 0.1*M* solution will contain the largest concentration of hydronium ions **[NCERT 1971, 73]**
    (a) $NaHCO_3$ (b) NH_4Cl

(c) HCl

(d) NH_3

23. Which one has pH 12 **[Roorkee 1995]**

(a) $0.01 M\ KOH$

(b) $1 N\ KOH\ ml$

(c) $1 N\ NaOH\ ml$

(d) $1 N\ Ca(OH)_2\ ml$

24. 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)? **[CBSE PMT 2005]**

(a) $pH_1 > pH_2 = pH_3 > pH_4$

(b) $pH_1 < pH_2 < pH_3 < pH_4$

(c) $pH_1 < pH_2 < pH_3 = pH_4$

(d) $pH_1 > pH_2 > pH_3 > pH_4$

25. Given *pH* of a solution *A* is 3 and it is mixed with another solution *B* having *pH* 2. If both mixed then resultant *pH* of the solution will be **[BHU 2005]**

(a) 3.2

(b) 1.9

(c) 3.4

(d) 3.5

26. On adding solid potassium cyanide to water **[MP PMT 1989]**

(a) *pH* will increase

(b) *pH* will decrease

(c) *pH* will not change

(d) Electrical conductance will not change

27. *A* is an aqueous acid; *B* is an aqueous base. They are diluted separately, then **[KCET 2002]**

(a) pH of *A* increases and pH of *B* decreases

(b) pH of *A* increases and pH of *B* decreases till pH in each case is 7

(c) pH of *A* and *B* increase

(d) pH of *B* and *A* decrease

28. The compound whose 0.1 *M* solution is basic is **[IIT 1986; MP PMT 1991]**

(a) Ammonium acetate

(b) Calcium carbonate

(c) Ammonium sulphate

(d) Sodium acetate

29. The following reaction is known to occur in the body $CO_2 + H_2O \rightleftharpoons H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$. If CO_2 escapes from the system**[NCERT 1973; RPMT 1997]**

(a) pH will decrease

(b) Hydrogen ion concentration will decrease

(c) H_2CO_3 concentration will be unaltered

(d) The forward reaction will be promoted

30. 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]**

(a) $1:10$

(b) $10:1$

(c) $100:1$

(d) $1:100$

31. Which is incorrect for buffer solution **[CPMT 1985]**

(a) It contains weak acid and its conjugate base

(b) It contains weak base and its conjugate acid

(c) In this there is very less change is pH value when very less amount of acid and base is mixed

(d) None of the above

32. pH values of HCl and $NaOH$ solutions each of strength $\frac{N}{100}$ will be respectively **[MP PMT 1999]**

(a) 2 and 2

(b) 2 and 12

(c) 12 and 2

(d) 2 and 10

33. When rain is accompained by a thunderstorm, the collected rain water will have a *pH* value **[AIEEE 2003]**

(a) Slightly lower than that of rain water without thunderstorm

(b) Slightly higher than that when the thunderstorm is not there

(c) Uninfluenced by occurrence of thunderstorm

(d) Which depends on the amount of dust in air

34. Which of the following is the buffer solution of strong acidic nature **[MP PET 2002]**

(a) $HCOOH + HCOO^-$

(b) $CH_3COOH + CH_3COO^-$

(c) $H_2C_2O_4 + C_2O_4^{2-}$

(d) $H_3BO_3 + BO_3^{3-}$

35. The dissociation constant of an acid *HA* is 1×10^{-5}. The pH of 0.1 molar solution of the acid will be **[KCET (Engg./Med.) 1999]**

(a) Five

(b) Four

(c) Three

(d) One

36. The *pH* value of $1.0 \times 10^{-8} M\ HCl$ solution is less than 8 because

(a) HCl is completely ionised at this concentration

(b) The ionization of water is negligible

(c) The ionization of water cannot be assumed to be negligible in comparison with this low concentration of HCl

(d) The *pH* cannot be calculated at such a low concentration of HCl

37. What is the *pH* for a neutral solutions at the normal temperature of the human body **[JIPMER 2000]**

(a) 7.2

(b) 14.0

(c) 6.8

(d) 6.0

38. 1 *M* $NaCl$ and 1 *M* HCl are present in an aqueous solution. The solution is **[AIEEE 2002]**

(a) Not a buffer solution with *pH* < 7

(b) Not a buffer solution with *pH* > 7

(c) A buffer solution with *pH* < 7

(d) A buffer solution with *pH* > 7

39. A solution has $pH = 5$, it is diluted 100 times, then it will become**[NCERT 197**

(a) Neutral

(b) Basic

(c) Unaffected

(d) More acidic

40. 0.02 *M* monobasic acid dissociates 2% hence, pH of the solution is **[MH CET 2000]**

(a) 0.3979

(b) 1.3979

(c) 1.699

(d) 3.3979

41. Components of buffer solution are $0.1 M\ HCN$ and $0.2 M\ NaCN$. What is the *pH* of the solution **[RPET 2000]**

(a) 9.61

(b) 6.15

(c) 2.0

(d) 4.2

42. *pH* of a solution of $10\,ml$. 1*N* sodium acetate and $50\,ml$ 2*N* acetic acid $(K_a = 1.8 \times 10^{-5})$, is approximately **[MP PMT 2003]**

(a) 4

(b) 5

(c) 6

(d) 7

43. By adding $20\,ml$ $0.1\,N\,HCl$ to $20\,ml$ $0.001\,N$ KOH, the *pH* of the obtained solution will be [KCET 2000]

(a) 2
(b) 1.3
(c) 0
(d) 7

44. The *pH* of the solution containing $10\,ml$ of a $0.1\,N\,NaOH$ and $10\,ml$ of $0.05\,N$ H_2SO_4 would be [Pb. PMT 2002, 04]

(a) 1
(b) 0
(c) 7
(d) > 7

45. The pH of $10^{-7}\,M\,NaOH$ is [MP PMT 2001]

(a) 7.01
(b) Between 7 and 8
(c) Between 9 and 10
(d) Greater than 10

46. The hydrogen ion concentration of $0.1\,N$ solution of CH_3COOH, which is 30% dissociated, is [JIPMER 2002]

(a) 0.03
(b) 3.0
(c) 0.3
(d) 30.0

47. What is the *pH* of $0.1\,M\,NH_3$ [RPET 2000]

(a) 11.27
(b) 11.13
(c) 12.0
(d) 9.13

48. By adding a strong acid to the buffer solution, the *pH* of the buffer solution [DPMT 1996]

(a) Remains constant
(b) Increases
(c) Decreases
(d) Becomes zero

49. The *pH* of $0.1\,M\,NaOH$ is [MP PET 2003]

(a) 11
(b) 12
(c) 13
(d) 14

50. *pH* of human blood is 7.4. Then H^+ concentration will be [RPMT 2002]

(a) 4×10^{-8}
(b) 2×10^{-8}
(c) 4×10^{-4}
(d) 2×10^{-4}

51. Assuming complete ionisation, the *pH* of $0.1\,M\,HCl$, is 1. The molarity of H_2SO_4 with the same *pH* is [Pb. PMT 2002]

(a) 0.1
(b) 0.2
(c) 0.05
(d) 2.0

52. Highest *pH* 14 is given by [DCE 1999]

(a) $0.1\,M\,H_2SO_4$
(b) $0.1\,M\,NaOH$
(c) $1N\,NaOH$
(d) $1N\,HCl$

53. What will be the pH of a 10^{-8} $M\,HCl$ solution [MP PET/PMT 1998; RPET 1999;MP PMT 2000]

(a) 8.0
(b) 7.0
(c) 6.98
(d) 14.0

54. When 10 *ml* of 0.1 *M* acetic acid $(pK_a = 5.0)$ is titrated against 10 *ml* of 0.1*M* ammonia solution $(pK_b = 5.0)$, the equivalence point occurs at *pH* [AIIMS 2005]

(a) 5.0
(b) 6.0
(c) 7.0
(d) 9.0

55. Which on reaction with water will have pH less than 7 [MH CET 2001]

(a) BaO
(b) CaO
(c) Na_2O
(d) P_2O_5

56. A solution of $MgCl_2$ in water has *pH* [MP PMT 2002]

(a) < 7
(b) > 7
(c) 7
(d) 14.2

57. *pH* of completely dissociated $0.005\,M\,H_2SO_4$ is [RPET 2003]

(a) 3
(b) 4
(c) 2
(d) 5

58. The pK_a of a weak acid is 4.8. What should be the ratio of [Acid]/[Salt] of a buffer if $pH = 5.8$ is required [MP PET 2003]

(a) 10
(b) 0.1
(c) 1
(d) 2

59. Which of the following salt is acidic [CPMT 1979, 81; NCERT 1979, 81; MP PET 1990; JIPMER 2002]

(a) Na_2SO_4
(b) $NaHSO_3$
(c) Na_2SO_3
(d) Na_2S

60. $20\,ml$ of $0.5\,N\,HCl$ and $35\,ml$ of $0.1\,N\,NaOH$ are mixed. The resulting solution will [KCET 2005]

(a) Be neutral
(b) Be basic
(c) Turn phenolphthalein solution pink
(d) Turn methyl orange red

61. The pH of a 0.02 *M* solution of hydrochloric acid is [MP PMT 1993]

(a) 2.0
(b) 1.7
(c) 0.3
(d) 2.2

62. A sample of $Na_2CO_3.H_2O$ weighing $0.62\ g$ is added to $100\ ml$ of $0.1\,N$ $(NH_4)_2SO_4$ solution. What will be the resulting solution [BHU 1997]

(a) Acidic
(b) Neutral
(c) Basic
(d) None of these

63. The *pH* of the solution is 4. The hydrogen ion concentration of the solution in *mol/litre* is [UPSEAT 2000]

(a) 9.5
(b) 10^{-4}
(c) 10^{4}
(d) 10^{-2}

64. $NaOH_{(aq)}, HCl_{(aq)}$ and $NaCl_{(aq)}$ concentration of each is $10^{-3}\,M$. Their *pH* will be respectively [BHU 2003]

(a) 10, 6, 2
(b) 11, 3, 7
(c) 10, 2, 6
(d) 3, 4, 7

65. The pH of 10^{-5} *M* aqueous solution of $NaOH$ is [MP PET 1996]

(a) 5
(b) 7
(c) 9
(d) 11

66. The pH of 0.05 *M* solution of dibasic acid is [MH CET 2002]

(a) $+1$
(b) -1
(c) $+2$
(d) -2

67. A buffer solution contains $0.1\ M$ of acetic acid and $0.1\ M$ of sodium acetate. What will be its pH, if pK_a of acetic acid is 4.75

(a) 4.00
(b) 4.75
(c) 5.00
(d) 5.25

68. To obtain a buffer which should be suitable for maintaining a pH of about $4-5$, we need to have in solution, a mixture of

(a) A strong base + its salt with a weak acid
(b) A weak base + its salt with a strong acid
(c) A strong acid + its salt with a weak base

(d) A weak acid + its salt with a strong base

69. The concentration of $NaOH$ solution is $10^{-8}\,M$. Find out the (OH^-) concentration [CPMT 1993]

(a) 10^{-8}

(b) Greater than 10^{-6}

(c) 10^{-6}

(d) Lies between 10^{-6} and 10^{-7}

70. The pH of 0.0001 N solution of KOH will be [BHU 1997; CET Pune 1998]

(a) 4 (b) 6

(c) 10 (d) 12

71. Given that the dissociation constant for H_2O is $K_w = 1\times 10^{-14}$ $mole^2\ litre^{-2}$, what is the pH of a 0.001 $molar\ KOH$ solution [MP PET 1995; MP PET/PMT 1998]

(a) 10^{-11} (b) 3

(c) 14 (d) 11

72. An acidic buffer solution can be prepared by mixing solution of [MNR 1983]

(a) Ammonium acetate and acetic acid

(b) Ammonium chloride and hydrochloric acid

(c) Sulphuric acid and sodium sulphate

(d) Acetic acid and sulphuric acid

(e) $NaCl$ and $NaOH$

73. Which of the following mixtures forms an acid buffer [MP PMT 1993; IIT 1981; CPMT 1989; CBSE PMT 1989]

(a) $NaOH + HCl$

(b) $CH_3COOH + CH_3COONa$

(c) $NH_4OH + NH_4Cl$

(d) $H_2CO_3 + (NH_4)_2CO_3$

74. A buffer solution has equal volumes of $0.2M\ NH_4OH$ and $0.02M\ NH_4Cl$. The pK_b of the base is 5. The pH is [CBSE PMT 1989; KCET 2005]

(a) 10 (b) 9

(c) 4 (d) 7

75. The pH of a simple sodium acetate buffer is given by

$$pH = pK_a + \log\frac{[Salt]}{[Acid]}$$

K_a of acetic acid $= 1.8\times 10^{-5}$

If [Salt] = [Acid] = 0.1 M, the pH of the solution would be about [BHU 1987]

(a) 7 (b) 4.7

(c) 5.3 (d) 1.4

76. Amongst the following solutions, the buffer solution is [MP PMT 1999]

(a) $NH_4Cl + NH_4OH$ solution

(b) $NH_4Cl + NaOH$ solution

(c) $NH_4OH + HCl$ solution

(d) $NaOH + HCl$ solution

77. The pH of solution having $[OH^-] = 10^{-7}$ is [AIIMS 1996]

(a) 7 (b) 14

(c) Zero (d) -7

78. $50\ ml$ water is added to a $50\ ml$ solution of $Ba(OH)_2$ of strength $0.01\ M$. The pH value of the resulting solution will be [MP PMT 1999]

(a) 8 (b) 10

(c) 12 (d) 6

79. pH of a solution can be expressed as [CPMT 1999; UPSEAT 2001]

(a) $-\log_e(H^+)$ (b) $-\log_{10}(H^+)$

(c) $\log_e(H^+)$ (d) $\log_{10}(H^+)$

80. The solution of sodium carbonate has pH [MP PET 2000]

(a) Greater than 7 (b) Less than 7

(c) Equal to 7 (d) Equal to zero

81. The pH of $10^{-7}\,N\ HCl$ is [RPMT 2000]

(a) 6.0 (b) 6.97

(c) 8.0 (d) 10.0

82. If the pH of a solution is 2, its normality will be [MADT Bihar 1982; MP PET 2000]

(a) $2N$ (b) $\frac{1}{2}N$

(c) 0.01 N (d) None of these

83. The buffer solution of 100 ml having a pH value 4 when added to 1 ml dilute HCl, then the pH of buffer solution [NCERT 1976, 77]

(a) Converts to 7 (b) Does not change

(c) Converts to 2 (d) Changes to 10

84. In a solution of acetic acid, sodium acetate is added, then its pH value[NCERT 1977; DPMT 1985; MP PMT 1994]

(a) Decreases

(b) Increases

(c) Remains unchanged

(d) (a) and (b) both are correct

85. If pOH of a solution is 6.0, then its pH will be [MP PMT 1987]

(a) 6 (b) 10

(c) 8 (d) 14

86. In a solution of $pH = 5$, more acid is added in order to reduce the $pH = 2$. The increase in hydrogen ion concentration is[MP PET 1989; CPMT 19

(a) 100 times (b) 1000 times

(c) 3 times (d) 5 times

87. Which solution contains maximum number of H^+ ion

(a) 0.1 M HCl (b) 0.1 M NH_4Cl

(c) 0.1 M $NaHCO_3$ (d) 0.1 M

88. 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 [IIT 1984; RPMT 1997; CPMT 1996; DPMT 2004]

(a) 4 (b) 7

(c) 10 (d) 14

89. The defination of pH is [EAMCET 1980; UPSEAT 2001]

(a) $pH = \log\frac{1}{[H^+]}$ (b) $pH = \log[H^+]$

(c) $pH = -\log\frac{1}{[H^+]}$ (d) $pH = -\log^{[H^+]}$

90. Which of the following does not make any change in pH when added to $10\ ml$ dilute HCl [NCERT 1975]

(a) 5 ml pure water (b) 20 ml pure water

(c) 10 ml HCl (d) Same 20 ml dilute HCl

91. A compound whose aqueous solution will have the highest pH [CPMT 1974, 75, 78; MP PET 1996; DPMT 1982, 83]

(a) $NaCl$
(b) Na_2CO_3
(c) NH_4Cl
(d) $NaHCO_3$

92. At $80^o C$, distilled water has $[H_3O^+]$ concentration equal to 1×10^{-6} $mole/litre$ The value of K_w at this temperature will be [CBSE PMT 1994; RPMT 2000; AFMC 2001; AIIMS 2002; BHU 2002]

(a) 1×10^{-6}
(b) 1×10^{-9}
(c) 1×10^{-12}
(d) 1×10^{-15}

93. The pH value of $0.1\ M\ NaOH$ solution is (when there is a given reaction $[H^+][OH^-]=10^{-15}$) [CPMT 1997]

(a) 13
(b) 12
(c) 11
(d) 2

94. Which oxychloride has maximum pH [CPMT 1997]

(a) $NaClO$
(b) $NaClO_2$
(c) $NaClO_3$
(d) $NaClO_4$

95. pH of $HCl(10^{-12}\ M)$ is [CPMT 1997; Pb. PET/PMT 1999]

(a) 12
(b) -12
(c) ≈ 7
(d) 14

96. Which one is buffer solution [CPMT 1997]

(a) $[PO_4^{--}]\ [[HPO_4^{--}]$
(b) $[PO_3^{3-}]\ [[H_2PO_4^{--}]$
(c) $[HPO_4^{--}]\ [[H_2PO_4^{--}]$
(d) All of these

97. When $100\ ml$ of $M/10\ NaOH$ solution and $50\ ml$ of $M/5\ HCl$ solution are mixed, the pH of resulting solution would be [RPMT 1997]

(a) 0
(b) 7
(c) Less than 7
(d) More than 7

98. How many millilitres of $6.0\ M$ hydrochloric acid should be used to prepare $150\ ml$ of a solution which is $0.30\ M$ in hydrogen ion [Pb. PMT 1998]

(a) 3.0
(b) 7.5
(c) 9.3
(d) 30

99. The pH of 0.1 M acetic acid is 3, the dissociation constant of acid will be

(a) 1.0×10^{-4}
(b) 1.0×10^{-5}
(c) 1.0×10^{-3}
(d) 1.0×10^{-8}

100. The pH of a buffer solution containing $25\,ml$ of $1\,M\,CH_3COONa$ and $25\ ml$ of $1\ M\ CH_3COOH$ will be appreciably affected by $5\ ml$ of [CPMT 1987]

(a) $1\ M\ CH_3COOH$
(b) $5\ M\ CH_3COOH$
(c) $5\ M\ HCl$
(d) $1\ M\ NH_4OH$

101. The pH value of decinormal solution of NH_4OH which is 20% ionised, is [CBSE PMT 1998]

(a) 13.30
(b) 14.70
(c) 12.30
(d) 12.95

102. A physician wishes to prepare a buffer solution at $pH=3.58$ that efficiently resists changes in pH yet contains only small concentration of the buffering agents. Which of the following weak acids together with its sodium salt would be best to use [CBSE PMT 1997]

(a) $m-$chlorobenzoic acid $(pK_a=3.98)$
(b) $p-$chlorocinnamic acid $(pK_a=4.41)$
(c) $2,\ 5-$dihydroxy benzoic acid $(pK_a=2.97)$
(d) Acetoacetic acid $(pK_a=3.58)$

103. In a mixture of a weak acid and its salt, the ratio of concentration of acid to salt is increased ten-fold. The pH of the solution

(a) Decreases by one
(b) Increases by one-tenth
(c) Increases by one
(d) Increases ten-fold

104. When an acid or alkali is mixed with buffer solution, then pH of buffer solution [CPMT 1997]

(a) Not changes
(b) Changes slightly
(c) Increases
(d) Decreases

105. How much sodium acetate should be added to a $0.1\ m$ solution of CH_3COOH to give a solution of $pH=5.5\,(pK_a$ of $CH_3COOH=4.5)$ [KCET 1996]

(a) $0.1\ m$
(b) $0.2\ m$
(c) $1.0\ m$
(d) $10.0\ m$

106. The pH of the aqueous solution containing $0.49\ gm$ of H_2SO_4 in one litre is [EAMCET 1997]

(a) 2
(b) 1
(c) 1.7
(d) 0.3

107. Which of the following solutions can act as buffer [JIPMER 1997]

(a) 0.1 molar aq. $NaCl$
(b) 0.1 molar aq. $CH_3COOH+0.1$ molar $NaOH$
(c) 0.1 molar aq. ammonium acetate
(d) None of the above

108. The pH of a solution obtained by mixing $50\ ml$ of $0.4\ N\ HCl$ and $50\ ml$ of $0.2\ N\ NaOH$ is [KCET 1996]

(a) $-\log 2$
(b) $-\log 0.2$
(c) 1.0
(d) 2.0

109. Which of the following is a buffer [MP PMT 1991; BHU 1995]

(a) $NaOH+CH_3COONa$
(b) $NaOH+Na_2SO_4$
(c) $K_2SO_4+H_2SO_4$
(d) $NH_4OH+CH_3COONH_4$

110. If 4.0 gm $NaOH$ is present in 1 *litre* solution, then its pH will be [CPMT 1989]

(a) 6
(b) 13
(c) 18
(d) 24

111. The pOH of beer is 10.0. The hydrogen ion concentration will be

(a) 10^{-2}
(b) 10^{-10}
(c) 10^{-8}
(d) 10^{-4}

112. When a buffer solution of sodium acetate and acetic acid is diluted with water [CPMT 1985]

(a) Acetate ion concentration increases
(b) H^+ ion concentration increases
(c) OH^- ion concentration increases
(d) H^+ ion concentration remain unaltered

113. What is the pH of $Ba(OH)_2$ if normality is 10 [CPMT 1996]

(a) 4
(b) 10
(c) 7
(d) 9

114. What will be the pH of a solution formed by mixing $40\ ml$ of $0.10\ M\ HCl$ with $10\ ml$ of $0.45\ M\ NaOH$ **[Manipal MEE 1995]**

(a) 12 (b) 10
(c) 8 (d) 6

115. The pH of a solution having $[H^+] = 10 \times 10^{-4}\ moles/litre$ will be **[BHU 1981]**

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

116. If $0.4\ gm\ NaOH$ is present in 1 *litre* solution, then its pH will be **[CPMT 1985; BHU 1980]**

(a) 2 (b) 10
(c) 11 (d) 12

117. Which of the following is not a Bronsted acid **[BHU 1997]**

(a) $CH_3NH_4^+$ (b) CH_3COO^-
(c) H_2O (d) HSO_4^-

118. pH of 0.005 $M\ H_2SO_4$ solution will be **[NCERT 1980]**

(a) 0.005 (b) 2
(c) 1 (d) 0.01

119. A buffer solution is a mixture of **[MP PMT 1987]**

(a) Strong acid and strong base
(b) Weak acid and weak base
(c) Weak acid and conjugate acid
(d) Weak acid and conjugate base

120. When pH of a solution decreases, its hydrogen ion concentration

(a) Decreases (b) Increases
(c) Rapidly increases (d) Remains always constant

121. If the pH of a solution is 4.0 at 25^oC, its pOH would be $(K_w = 10^{-14})$ **[MP PMT 1989]**

(a) 4.0 (b) 6.0
(c) 8.0 (d) 10.0

122. An aqueous solution whose $pH = 0$ is **[CPMT 1976; DPMT 1982]**

(a) Alkaline (b) Acidic
(c) Neutral (d) Amphoteric

123. In a solution of acid H^+ concentration is $10^{-10}\ M$. The *pH* of this solution will be

(a) 8 (b) 6
(c) Between 6 and 7 (d) Between 3 and 6

124. The concentration of hydronium (H_3O^+) ion in water is **[CET Pune 1998]**

(a) Zero (b) $1 \times 10^7\ gm\ ion/litre$
(c) $1 \times 10^{-14}\ gm\ ion/litre$ (d) $1 \times 10^{-7}\ gm\ ion/litre$

125. A solution whose *pH* value is less than 7 will be

(a) Basic (b) Acidic
(c) Neutral (d) Buffer

126. When the pH of a solution is 2, the hydrogen ion concentration in moles per litre is **[NCERT 1973; MNR 1979]**

(a) 1×10^{-14} (b) 1×10^{-2}
(c) 1×10^{-7} (d) 1×10^{-12}

127. A base is dissolved in water yields a solution with a hydroxide ion concentration of 0.05 $mol\ litre^{-1}$. The solution is **[AFMC 1997]**

(a) Basic (b) Acid
(c) Neutral (d) Both (a) and (b)

128. The pH of a solution is increased from 3 to 6. Its H^+ ion concentration will be **[EAMCET 1998]**

(a) Reduced to half
(b) Doubled
(c) Reduced by 1000 times
(d) Increased by 1000 times

129. 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]**

(a) Greater than 7
(b) Less than 7
(c) 7
(d) Depends on ionic product of water

130. The pH of a solution is 2. If its pH is to be raised to 4, then the $[H^+]$ of the original solution has to be **[MP PET 1994]**

(a) Doubled
(b) Halved
(c) Increased hundred times
(d) Decreased hundred times

131. Which of the following solutions cannot act as a buffer **[EAMCET 1998]**

(a) $NaH_2PO_4 + H_3PO_4$
(b) $CH_3COOH + CH_3COONa$ **[MADT Bihar 1981]**
(c) $HCl + NH_4Cl$
(d) $H_3PO_4 + Na_2HPO_4$

132. Assuming complete ionisation, the pH of $0.1\ M\ HCl$ is 1. The molarity of H_2SO_4 with the same pH is **[KCET 1998]**

(a) 0.2 (b) 0.1
(c) 2.0 (d) 0.05

133. The pH of blood is

(a) 5.2 (b) 6.3
(c) 7.4 (d) 8.5

134. The *pH* of 10^{-8} molar aqueous solution of HCl is **[CPMT 1988; MNR 1983, 90; MP PMT 1987; IIT 1981; BHU 1995; AFMC 1998; MP PET 1989, 99; BCECE 2005]**

(a) -8
(b) 8
(c) $6 > 7$ (Between 6 and 7)
(d) $7 > 8$ (Between 7 and 8)

135. As the temperature increases, the pH of a KOH solution **[UPSEAT 2001]**

(a) Will decreases
(b) Will increases
(c) Remains constant
(d) Depends upon concentration of KOH solution

136. The hydrogen ion concentration in a given solution is 6×10^{-4}. Its pH will be **[EAMCET 1978]**

(a) 6 (b) 4
(c) 3.22 (d) 2

137. The pH of $\frac{N}{100}$ *HCl* would be approximately

[CPMT 1971; DPMT 1982, 83; MP PMT 1991; Bihar MEE 1996]

(a) 1 (b) 1.5

(c) 2 (d) 2.5

138. A solution which is resistant to change of pH upon the addition of an acid or a base is known as [BHU 1979]

(a) A colloid (b) A crystalloid

(c) A buffer (d) An indicator

139. $10^{-6} M$ HCl is diluted to 100 times. Its pH is

[CPMT 1984]

(a) 6.0 (b) 8.0

(c) 6.95 (d) 9.5

140. The pH of a 10^{-10} molar HCl solution is approximately

[NCERT 1977]

(a) 10 (b) 7

(c) 1 (d) 14

141. The H^+ ion concentration is 1.0×10^{-6} *mole/litre* in a solution. Its *pH* value will be

[MP PMT 1985; AFMC 1982]

(a) 12 (b) 6

(c) 18 (d) 24

142. The pH of a solution is the negative logarithm to the base 10 of its hydrogen ion concentration in

[Manipal MEE 1995]

(a) Moles per litre (b) Millimoles per litre

(c) Micromoles per litre (d) Nanomoles per litre

143. When 10^{-8} mole of HCl is dissolved in one litre of water, the pH of the solution will be

[CPMT 1973, 94; DPMT 1982]

(a) 8 (b) 7

(c) Above 8 (d) Below 7

144. The pH of the solution containing 10 ml of 0.1 N $NaOH$ and 10 ml of 0.05 N H_2SO_4 would be

[CPMT 1987; Pb. PMT 2002,04]

(a) 0 (b) 1

(c) > 7 (d) 7

145. The pH of 0.001 molar solution of HCl will be

[MP PET 1986; MP PET/PMT 1988; CBSE PMT 1991]

(a) 0.001 (b) 3

(c) 2 (d) 6

146. Which salt can be classified as an acid salt [CPMT 1989]

(a) Na_2SO_4 (b) $BiOCl$

(c) $Pb(OH)Cl$ (d) Na_2HPO_4

147. Given a 0.1*M* solution of each of the following. Which solution has the lowest pH [MNR 1987]

(a) $NaHSO_4$ (b) NH_4Cl

(c) HCl (d) NH_3

148. Out of the following, which pair of solutions is not a buffer solution

(a) $NH_4Cl + NH_4OH$

(b) $NaCl + NaOH$

(c) $Na_2HPO_4 + Na_3PO_4$

(d) $CH_3COOH + CH_3COONa$

149. 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]

(a) Three (b) Five

(c) One (d) Six

150. pH value of $N/10$ $NaOH$ solution is

[CBSE PMT 1996;Pb. CET 2001; Pb. PMT 2002]

(a) 10 (b) 11

(c) 12 (d) 13

151. A solution of sodium borate has a pH of approximately

[JIPMER 2001]

(a) < 7 (b) > 7

(c) $= 7$ (d) Between 4 to 5

152. If pH of A, B, C and D are 9.5, 2.5, 3.5 and 5.5 respectively, then strongest acid is [AFMC 1995]

(a) A (b) C

(c) D (d) B

153. At $25°C$ the pH value of a solution is 6. The solution is

[AFMC 2001]

(a) Basic (b) Acidic

(c) Neutral (d) Both (b) and (c)

154. A certain buffer solution contains equal concentration of X^- and HX. The K_a for *HX* is 10^{-8}. The pH of the buffer is

[UPSEAT 2001]

(a) 3 (b) 8

(c) 11 (d) 14

155. The dissociation constant of *HCN* is 5×10^{-10}. The pH of the solution prepared by mixing 1.5 *mole* of *HCN* and 0.15 *moles* of *KCN* in water and making up the total volume to $0.5\,dm^3$ is

(a) 7.302 (b) 9.302

(c) 8.302 (d) 10.302

156. Which buffer solution out of the following will have $pH > 7$

[MP PET 2001]

(a) $CH_3COOH + CH_3COONa$

(b) $HCOOH + HCOOK$

(c) CH_3COONH_4

(d) $NH_4OH + NH_4Cl$

157. The pK_a of equimolecular sodium acetate and acetic acid mixture is 4.74. If pH is [DPMT 2001]

(a) 7 (b) 9.2

(c) 4.74 (d) 14

158. pH of $NaCl$ solution is [CET Pune 1998]

(a) 7 (b) Zero

(c) > 7 (d) < 7

159. A solution of sodium chloride in contact with atmosphere has a pH of about [NCERT 1972, 77]

(a) 3.5 (b) 5

(c) 7 (d) 1.4

160. Which would decrease the pH of $25\,cm^3$ of a $0.01\,M$ solution of hydrochloric acid [MH CET 2001]

(a) The addition of $25\,cm^3$ $0.005\,M$ hydrochloric acid

(b) The addition of $25\,cm^3$ of $0.02\,M$ hydrochloric acid

(c) The addition of magnesium metal

(d) None of these

161. The condition for minimum change in pH for a buffer solution is

(a) Isoelectronic species are added

(b) Conjugate acid or base is added

(c) $pH = pK_a$

(d) None of these

162. 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]**

(a) 3.4
(b) 2.6
(c) 1.5
(d) 1.8

163. The ionization constant of a certain weak acid is 10^{-4}. What should be the [salt] to [acid] ratio if we have to prepare a buffer with $pH = 5$ using this acid and one of the salts **[CPMT 2000; KCET 2000; Pb. CET 2000]**

(a) $1:10$
(b) $10:1$
(c) $5:4$
(d) $4:5$

164. Which solution has the highest pH value **[JIPMER 2000]**

(a) $1\,M\ KOH$

(b) $1\,M\ H_2SO_4$

(c) Chlorine water

(d) Water containing carbon dioxide

165. One weak acid (like CH_3COOH) and its strong base together with salt (like CH_3COONa) is a buffer solution. In which pair this type of characteristic is found **[AIIMS 1982; CPMT 1994; MP PET 1994]**

(a) HCl and $NaCl$
(b) $NaOH$ and $NaNO_3$
(c) KOH and KCl
(d) NH_4OH and NH_4Cl

166. If the pH of a solution of an alkali metal hydroxide is 13.6, the concentration of hydroxide is **[JIPMER 2000]**

(a) Between 0.1 M and 1 M

(b) More than 1 M

(c) Less than 0.001 M

(d) Between 0.01 M and 1 M

167. The pK_a of acetylsalicylic acid (aspirin) is 3.5. The pH of gastric juice in human stomach is about 2-3 and the pH in the small intestine is about 8. Aspirin will be **[IIT 1988; KCET 2003]**

(a) Unionized in the small intestine and in the stomach

(b) Completely ionized in the small intestine and in the stomach

(c) Ionized in the stomach and almost unionized in the small intestine

(d) Ionized in the small intestine and almost unionized in the stomach

168. The concentration of hydrogen ion in water is **[MP PET 1990]**

(a) 8
(b) 1×10^{-7}
(c) 7
(d) $1/7$

169. pH of a 10 M solution of HCl is **[CBSE PMT 1995]**

(a) Less than 0
(b) 2
(c) 0
(d) 1

170. The pH of $1\,N\ H_2O$ is **[CPMT 1988]**

(a) 7
(b) >7
(c) <7
(d) 0

171. If H^+ ion concentration of a solution is increased by 10 times its pH will be **[DCE 2000]**

(a) Increase by one
(b) Remains unchanged
(c) Decrease by one
(d) Increase by 10

172. The gastric juice in our stomach contains enough HCl to make the hydrogen ion concentration about $0.01\ mole/litre$ The pH of gastric juice is **[NCERT 1974]**

(a) 0.01
(b) 1
(c) 2
(d) 14

173. Addition of which chemical will decrease the hydrogen ion concentration of an acetic acid solution **[MP PMT 1990]**

(a) NH_4Cl
(b) $Al_2(SO_4)_3$
(c) $AgNO_3$
(d) HCN

174. The one which has the highest value of pH is

(a) Distilled water

(b) NH_3 solution in water

(c) NH_3

(d) Water saturated with Cl_2

175. The solution of Na_2CO_3 has pH **[AMU 1988]**

(a) Greater than 7
(b) Less than 7
(c) Equal to 7
(d) Equal to zero

176. Which is not a buffer solution **[CPMT 1990]**

(a) $NH_4Cl + NH_4OH$

(b) $CH_3COOH + CH_3COONa$

(c) CH_3COONH_4

(d) Borax + Boric acid

177. What will be hydrogen ion concentration in moles $litre^{-1}$ of a solution, whose pH is 4.58 **[UPSEAT 2001]**

(a) 2.63×10^{-5}
(b) 3.0×10^{-5}
(c) 4.68
(d) None of these

178. Assuming complete dissociation, the pH of a 0.01 M $NaOH$ solution is equal to **[NCERT 1975; CPMT 1977; DPMT 1982; BHU 1997]**

(a) 2.0
(b) 14.0
(c) 12.0
(d) 0.01

179. 50 ml of $2\,N$ acetic acid mixed with $10\,ml$ of $1\,N$ sodium acetate solution will have an approximate pH of **[MP PMT/PET 1988]**

(a) 4
(b) 5
(c) 6
(d) 7

180. The hydrogen ion concentration of 0.001 M $NaOH$ solution is

(a) $1 \times 10^{-2}\ mole/litre$
(b) $1 \times 10^{-11}\ mole/litre$
(c) $1 \times 10^{-14}\ mole/litre$
(d) $1 \times 10^{-12}\ mole/litre$

181. A weak monoprotic acid of 0.1 M, ionizes to 1% in solution. What will be the pH of solution **[MNR 1988]**

(a) 1
(b) 2
(c) 3
(d) 11

182. pH of a solution is 4. The hydroxide ion concentration of the solution would be **[NCERT 1981; CBSE PMT 1991; MP PMT 1994]**

(a) 10^{-4}
(b) 10^{-10}
(c) 10^{-2}
(d) 10^{-12}

183. The pH of an aqueous solution containing $[H^+] = 3 \times 10^{-3}\,M$ is **[MP PET 2001,04]**

(a) 2.471
(b) 2.523
(c) 3.0
(d) – 3

184. pH of blood is maintained constant by mechanism of [MH CET 2002]

(a) Common ion effect
(b) Buffer
(c) Solubility
(d) All of these

185. The pH of normal KOH is [MP PET 1990]

(a) 1
(b) 0
(c) 14
(d) 7

186. The concentration of hydrogen ion $[H^+]$ in 0.01 M HCl is [EAMCET 1979]

(a) 10^{12}
(b) 10^{-2}
(c) 10^{-1}
(d) 10^{-12}

187. A solution of weak acids is diluted by adding an equal volume of water. Which of the following will not change [JIPMER 1997]

(a) Strength of the acid
(b) The value of $[H_3O^+]$
(c) pH of the solution
(d) The degree of dissociation of acid

188. Ka of H_2O_2 is of the order of [DCE 2004]

(a) 10^{-12}
(b) 10^{-14}
(c) 10^{-16}
(d) 10^{-10}

189. Equivalent weight of an acid [UPSEAT 2004]

(a) Depends on the reaction involved
(b) Depends upon the number of oxygen atoms present
(c) Is always same
(d) None of the above

190. pH scale was introduced by [UPSEAT 2004]

(a) Arrhenius
(b) Sorensen
(c) Lewis
(d) Lowry

191. Buffer solution is prepared by mixing [MH CET 2003]

(a) Strong acid + its salt of strong base
(b) Weak acid + its salt of weak base
(c) Strong acid + its salt of weak base
(d) Weak acid + its salt of strong base

192. The pH of millimolar HCl is [MH CET 2004]

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

193. Which of the following is a Lewis base [CPMT 2004]

(a) $NaOH$
(b) NH_3
(c) BCl_3
(d) All of these

194. What will be the pH value of 0.05 M $Ba(OH)_2$ solution [CPMT 2004]

(a) 12
(b) 13
(c) 1
(d) 12.96

195. In a mixing of acetic acid and sodium acetate the ratio of concentration of the salts to the acid is increased ten times. Then the pH of the solution [KCET 2004]

(a) Increase by one
(b) Decreases by one
(c) Decrease ten fold
(d) Increases ten fold

196. 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 the concentrations of the conjugate acid (HIn) and base (In^-) forms of the indicator by the expression

(a) $\log\frac{[HIn]}{[In^-]} = pH - pK_{In}$
(b) $\log\frac{[In^-]}{[HIn]} = pH - pK_{In}$
(c) $\log\frac{[In^-]}{[HIn]} = pK_{In} - pH$
(d) $\log\frac{[HIn]}{[In^-]} = pK_{In} - pH$

197. Which of the following statement(s) is(are) correct [IIT 1998]

(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 $pH = \frac{1}{2}pK_a$

198. An aqueous solution of sodium carbnate has a pH greater than 7 becaue [DCE 2003]

(a) It contains more carbonate ions than H_2O molecules
(b) Contains more hydroxide ions than carbonate ions
(c) Na^+ ions react with water
(d) Carbonate ions react with H_2O

199. A pH of 7 signifies [CPMT 1974; DPMT 1982]

(a) Pure water
(b) Neutral solution
(c) Basic solution
(d) Acidic solution

200. Assuming complete dissociation, which of the following aqueous solutions will have the same pH value [Roorkee Qualifying 1998]

(a) 100 ml of 0.01 M HCl
(b) 100 ml of 0.01 M H_2SO_4
(c) 50 ml of 0.01 M HCl
(d) Mixture of 50 ml of 0.02 M H_2SO_4 and 50 ml of 0.02 M $NaOH$

201. A buffer solution can be prepared from a mixture of [IIT 1999; KCET 1999; MP PMT 2002]

(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

202. Which of the following will not function as a buffer solution [Roorkee 2000]

(a) $NaCl$ and $NaOH$
(b) $NaOH$ and NH_4OH
(c) CH_3COONH_4 and HCl
(d) Borax and boric acid

203. Which one of the following statements is not true [AIEEE 2003]

(a) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}
(b) $pH + pOH = 14$ for all aqueous solutions
(c) The pH of $1\times10^{-8}\,M\,HCl$ is 8
(d) 96,500 coulombs of electricity when passed through a $CuSO_4$ solution deposits 1 *gram* equivalent of copper at the cathode

204. The pH value of 0.1 M HCl is approximately 1. What will be the approximate pH value of 0.05 M H_2SO_4 [MP PMT 1991]

(a) 0.05 [CBSE PMT 2004]
(b) 0.5
(c) 1
(d) 2

205. The K_{sp} of $Mg(OH)_2$ is $1\times10^{-12}, 0.01M\, Mg(OH)_2$ will precipitate at the limiting pH [DPMT 2005]

(a) 3
(b) 9
(c) 5
(d) 8

206. The pH of an aqueous solution having hydroxide ion concentration as 1×10^{-5} is [MP PMT 1991]

(a) 5 (b) 9

(c) 4.5 (d) 11

Critical Thinking

Objective Questions

1. The K_{SP} of AgI is 1.5×10^{-16}. On mixing equal volumes of the following solutions, precipitation will occur only with [AMU 2000]

(a) $10^{-7}\,M\,Ag^+$ and $10^{-19}\,M\,I^-$

(b) $10^{-8}\,M\,Ag^+$ and $10^{-8}\,M\,I^-$

(c) $10^{-16}\,M\,Ag^+$ and $10^{-16}\,M\,I^-$

(d) $10^{-9}\,M\,Ag^+$ and $10^{-9}\,M\,I^-$

2. The strongest Bronsted base in the following anion is [IIT 1981; MP PET 1992, 97; MP PMT 1994; RPMT 1999; KCET 2000; AIIMS 2001; UPSEAT 2002; AFMC 2002; Pb. CET 2004]

(a) ClO^- (b) ClO_2^-

(c) ClO_3^- (d) ClO_4^-

3. Which one of the following compound is not a protonic acid [CBSE PMT 2003]

(a) $SO_2(OH)_2$ (b) $B(OH)_3$

(c) $PO(OH)_3$ (d) $SO(OH)_2$

4. Calculate the hydrolysis constant of the salt containing NO_2^-. Given the K_a for HNO_2 $=4.5\times10^{-10}$ [UPSEAT 2001]

(a) 2.22×10^{-5} (b) 2.02×10^{5}

(c) 4.33×10^{4} (d) 3.03×10^{-5}

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

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

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

6. Electrophiles are [RPET 2000]

(a) Lewis acids (b) Lewis base

(c) Bronsted acid (d) Bronsted base

7. Total number of moles for the reaction $2HI \rightleftharpoons H_2+I_2$. if α is degree of dissociation is [CBSE PMT 1996]

(a) 2 (b) $2-\alpha$

(c) 1 (d) $1-\alpha$

8. Which one is a Lewis acid [RPMT 1997]

(a) ClF_3 (b) H_2O

(c) NH_3 (d) None of these

9. Heat of neutralisation of weak acid and strong base is less than the heat of neutralisation of strong acid and strong base due to

(a) Energy has to be spent for the total dissociation of weak acid

(b) Salt of weak acid and strong base is not stable

(c) Incomplete dissociation of weak acid

(d) Incomplete neutralisation of weak acid

10. pK_a values of two acids A and B are 4 and 5. The strengths of these two acids are related as [KCET 2001]

(a) Acid A is 10 times stronger than acids B

(b) Strength of acid A : strengtha of acid $B=4:5$

(c) The strengths of the two acids can not be compared

(d) Acid B is 10 times stronger than acid A

11. The dissociation constant of two acids HA_1 and HA_2 are 3.14×10^{-4} and 1.96×10^{-5} respectively. The relative strength of the acids will be approximately [RPMT 2000]

(a) 1 : 4 (b) 4 : 1

(c) 1 : 16 (d) 16 : 1

12. An aqueous solution of ammonium acetate is [NCERT 1980, 81; RPMT 1999]

(a) Faintly acidic (b) Faintly basic

(c) Fairly acidic (d) Almost neutral

13. The dissociation constant of a weak acid is 1.0×10^{-5}, the equilibrium constant for the reaction with strong base is [MP PMT 1990]

(a) 1.0×10^{-5} (b) 1.0×10^{-9}

(c) 1.0×10^{9} (d) 1.0×10^{14}

14. The pH of $0.1\ M$ solution of the following salts increases in the order [IIT 1999]

(a) $NaCl<NH_4Cl<NaCN<HCl$

(b) $HCl<NH_4Cl<NaCl<NaCN$

(c) $NaCN<NH_4Cl<NaCl<HCl$

(d) $HCl<NaCl<NaCN<NH_4Cl$

15. Which of the following is the strongest acid [AMU 1999; MH CET 1999, 2002]

(a) $SO(OH)_2$ (b) $SO_2(OH)_2$

(c) $ClO_3(OH)$ (d) $PO(OH)_3$

16. The strongest of the four acids listed below is [NCERT 1984]

(a) $HCOOH$ (b) CH_3COOH

(c) $ClCH_2COOH$ (d) FCH_2COOH

17. Which equilibrium can be described as an acid-base reaction using the Lewis acid-base definition but not using the Bronsted-Lowry definition [AIIMS 1980]

(a) $2NH_3+H_2SO_4 \rightleftharpoons 2NH_4^++SO_4^{2-}$

(b) $NH_3+CH_3COOH \rightleftharpoons NH_4^++CH_3COO^-$

(c) $H_2O+CH_3COOH \rightleftharpoons H_3O^++CH_3COO^-$

(d) $[Cu(H_2O)_4]^{2+}+4NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+}+4H_2O$

18. The hydride ion H^- is stronger base than its hydroxide ion OH^-. Which of the following reaction will occur if sodium hydride (NaH) is dissolved in water [CBSE PMT 1997]

(a) $H^-(aq)+H_2O\rightarrow H_2O$

(b) $H^-(aq)+H_2O(l)\rightarrow OH^-+H_2$

[KCET 2002]

(c) $H^- + H_2O \rightarrow$ No reaction

(d) None of these

19. Dissociation constant of a weak acid is 1×10^{-4}. Equilibrium constant of its reaction with strong base is **[UPSEAT 2003]**

(a) 1×10^{-4} (b) 1×10^{10}

(c) 1×10^{-10} (d) 1×10^{14}

20. Arrange the acids (I) H_2SO_3 (II) H_3PO_3 and (III) $HClO_3$ in the decreasing order of acidity **[UPSEAT 2001]**

(a) I > III > II (b) I > II > III

(c) II > III > I (d) III > I > II

21. Self-ionisation of liquid ammonia occurs as, $2NH_3 \rightleftarrows NH_4^+ + NH_2^-; K = 10^{-10}$. In this solvent, an acid might be **[JIPMER 2001]**

(a) NH_4^+

(b) NH_3

(c) Any species that will form NH_4^+

(d) All of these

22. $\Delta H_f(H_2O) = X;$ Heat of neutralisation of CH_3COOH and $NaOH$ will be **[BHU 2003]**

(a) Less than $2X$ (b) Less than X

(c) X (d) Between X and $2X$

23. Which of the following oxides will not give OH^- in aqueous solution **[NCERT 1980]**

(a) Fe_2O_3 (b) MgO

(c) Li_2O (d) K_2O

24. A precipitate of CaF_2 $(K_{sp} = 1.7\times10^{-10})$ will be obtained when equal volume of the following are mixed

[MP PMT 1990, 95; IIT 1982; MNR 1992]

(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 $10^{-5}\,M\,F^-$

25. The degree of hydrolysis of a salt of weak acid and weak base in its 0.1 *M* solution is found to be 50%. If the molarity of the solution is 0.2 *M*, the percentage hydrolysis of the salt should be **[AMU 1999]**

(a) 50% (b) 35%

(c) 75% (d) 100%

26. The pH of 0.1 *M* solution of a weak monoprotic acid 1% ionized is **[UPSEAT 2001; Pb. PMT 2001]**

(a) 1 (b) 2

(c) 3 (d) 4

27. Which one is the strongest acid

[MH CET 1999; AMU 1999,2000; Pb.CET 2001,03; MP PET 2001]

(a) $HClO$ (b) $HClO_2$

(c) H_2SO_4 (d) $HClO_4$

28. Which of the following is Lewis acid **[Pb. CET 2000]**

(a) S (b) $:CH_2$

(c) $(CH_3)_3B$ (d) All of these

29. The solubility product of $Mg(OH)_2$ is 1.2×10^{-11}. The solubility of this compound in gram per $100\,cm^3$ of solution is

[Roorkee 2000]

(a) 1.4×10^{-4} (b) 8.16×10^{-4}

(c) 0.816 (d) 1.4

30. What is $[H^+]$ of a solution that is $0.01\,M$ in HCN and $0.02\,M$ in $NaCN$

$(K_a$ for $HCN = 6.2\times10^{-10})$ **[MP PMT 2000]**

(a) 3.1×10^{10} (b) 6.2×10^{5}

(c) 6.2×10^{-10} (d) 3.1×10^{-10}

31. Which is neucleophile **[DPMT 2001; RPMT 2002]**

(a) BF_3 (b) NH_3

(c) $BeCl_2$ (d) H_2O

32. The solubility of $CuBr$ is $2\times10^{-4}\,mol/l$ at $25°C$. The K_{sp} value for $CuBr$ is **[AIIMS 2002]**

(a) $4\times10^{-8}\,mol^2l^{-2}$ (b) $4\times10^{-11}\,mol^2L^{-1}$

(c) $4\times10^{-4}\,mol^2l^{-2}$ (d) $4\times10^{-15}\,mol^2l^{-2}$

33. A 0.004 *M* solution of Na_2SO_4 is isotonic with a 0.010 *M* solution of glucose at same temperature. The apparent degree of dissociation of Na_2SO_4 is

[IIT JEE Screening 2004]

(a) 25% (b) 50%

(c) 75% (d) 85%

34. K_{sp} for $Cr(OH)_3$ is 2.7×10^{-31}. What is its solubility in *moles / litre*. **[JEE Orissa 2004]**

(a) 1×10^{-8} (b) 8×10^{-8}

(c) 1.1×10^{-8} (d) 0.18×10^{-8}

35. pK_a of acetic acid is 4.74. The concentration of CH_3COONa is 0.01 *M*. The *p*H of CH_3OONa is

[Orissa JEE 2004]

(a) 3.37 (b) 4.37

(c) 4.74 (d) 0.474

36. If the solubility product of $AgBrO_3$ and Ag_2SO_4 are 5.5×10^{-5} and 2×10^{-5} respectively, the relationship between the solubilities of these can be correctly represented as **[EAMCET 1985]**

(a) $S_{AgBrO_3} > S_{Ag_2SO_4}$ (b) $S_{AgBrO_3} < S_{Ag_2SO_4}$

(c) $S_{AgBrO_3} = S_{Ag_2SO_4}$ (d) $S_{AgBrO_3} \approx S_{Ag_2SO_4}$

37. The ionisation constant of phenol is higher than that of ethanol because **[JIPMER 2002]**

(a) Phenoxide ion is bulkier than ethanoxide

(b) Phenoxide ion is stronger base than ethanoxide

(c) Phenoxide ion is stabilised through delocalisation

(d) Phenoxide ion is less stable than ethoxide

38. A weak acid *HX* has the dissociation constant $1\times10^{-5}\,M$. It forms a salt *NaX* on reaction with alkali. The degree of hydrolysis of 0.1 *M* solution of *NaX* is

[IIT JEE Screening 2004]

(a) 0.0001% (b) 0.01%

(c) 0.1% (d) 0.15%

39. In the equilibrium $A^- + H_2O \rightleftharpoons HA + OH^-$ $(K_a = 1.0 \times 10^{-5})$. The degree of hydrolysis of 0.001 M solution of the salt is **[AMU 1999]**

(a) 10^{-3}
(b) 10^{-4}
(c) 10^{-5}
(d) 10^{-6}

40. The sulphide ion concentration $[S^{2-}]$ in saturated H_2S solution is 1×10^{-22}. Which of the following sulphides should be quantitatively precipitated by H_2S in the presence of dil. HCl

Sulphide	**Solubility Product**
(I)	1.4×10^{-16}
(II)	1.2×10^{-22}
(III)	8.2×10^{-46}
(IV)	5.0×10^{-34}

(a) I, II
(b) III, IV
(c) II, III, IV
(d) Only I

41. When equal volumes of the following solutions are mixed, precipitation of $AgCl (K_{sp} = 1.8 \times 10^{-10})$ will occur only with **[IIT 1988; CBSE PMT PMT 1992; DCE 2000]**

(a) $10^{-4} M\ Ag^+$ and $10^{-4} M\ Cl^-$
(b) $10^{-5} M\ Ag^+$ and $10^{-5} M\ Cl^-$
(c) $10^{-6} M\ Ag^+$ and $10^{-6} M\ Cl^-$
(d) $10^{-10} M\ Ag^+$ and $10^{-10} M\ Cl^-$

42. K_{sp} of an electrolyte AB is 1×10^{-10}. $[A^+] = 10^{-5} M$, which concentration of B^- will not give precipitate of AB **[BHU 2003]**

(a) 5×10^{-6}
(b) 1×10^{-5}
(c) 2×10^{-5}
(d) 5×10^{-5}

43. One litre of water contains 10^{-7} *mole* hydrogen ions. The degree of ionization in water will be **[CPMT 1985, 88, 93]**

(a) $1.8 \times 10^{-7}\%$
(b) $0.8 \times 10^{-9}\%$
(c) $3.6 \times 10^{-7}\%$
(d) $3.6 \times 10^{-9}\%$

44. If the solubility products of $AgCl$ and $AgBr$ are 1.2×10^{-10} and 3.5×10^{-13} respectively, then the relation between the solubilities (denoted by the symbol 'S') of these salts can correctly be represented as **[MP PET 1994]**

(a) S of $AgBr$ is less than that of $AgCl$
(b) S of $AgBr$ is greater than that of $AgCl$
(c) S of $AgBr$ is equal to that of $AgCl$
(d) S of $AgBr$ is 10^6 times greater than that of $AgCl$

45. If the solubility product of lead iodide (PbI_2) is 3.2×10^{-8}, then its solubility in moles/litre will be **[MP PMT 1990]**

(a) 2×10^{-3}
(b) 4×10^{-4}
(c) 1.6×10^{-5}
(d) 1.8×10^{-5}

46. Calculate the solubility of $AgCl(s)$ in $0.1 M\ NaCl$ at 25°C. $K_{sp}(AgCl) = 2.8 \times 10^{-10}$ **[UPSEAT 2001]**

(a) $3.0 \times 10^{-8} ML^{-1}$
(b) $2.5 \times 10^{-7} ML^{-1}$
(c) $2.8 \times 10^{-9} ML^{-1}$
(d) $2.5 \times 10^{7} ML^{-1}$

47. The solubility product of a binary weak electrolyte is 4×10^{-10} at $298\,K$. Its solubility in mol dm^{-3} at the same temperature is **[KCET 2001]**

(a) 4×10^{-5}
(b) 2×10^{-5}
(c) 8×10^{-10}
(d) 16×10^{-20}

48. Solubility of $AgCl$ at $20^o C$ is 1.435×10^{-3} *gm per litre*. The solubility product of $AgCl$ is **[CPMT 1989; BHU 1997; AFMC 2000; CBSE PMT 2002]**

(a) 1×10^{-5}
(b) 1×10^{-10}
(c) 1.435×10^{-5}
(d) 108×10^{-3}

49. pK_a value for acetic acid at the experimental temperature is 5. The percentage hydrolysis of $0.1\ M$ sodium acetate solution will be

(a) 1×10^{-4}
(b) 1×10^{-2}
(c) 1×10^{-3}
(d) 1×10^{-5}

50. At $30^o C$, the solubility of $Ag_2CO_3 (K_{sp} = 8 \times 10^{-12})$ would be greatest in one litre of **[MP PMT 1990]**

(a) $0.05\,M\ Na_2CO_3$
(b) $0.05\,M\ AgNO_3$
(c) Pure water
(d) $0.05\,M\ NH_3$

51. The values of K_{sp} for CuS, Ag_2S and HgS are $10^{-31}, 10^{42}$ and 10^{-54} respectively. The correct order of their solubility in water is **[MP PMT 2003]**

(a) $Ag_2S > HgS > CuS$
(b) $HgS > CuS > Ag_2S$
(c) $HgS > Ag_2S > CuS$
(d) $Ag_2S > CuS > HgS$

52. The *pH* of a soft drink is 3.82. Its hydrogen ion concentration will be **[MP PET 1990]**

(a) 1.96×10^{-2} mol/l
(b) 1.96×10^{-3} mol/l
(c) 1.5×10^{-4} mol/l
(d) 1.96×10^{-1} mol/l

53. The *pH* of a solution at 25°C containing $0.10\,m$ sodium acetate and $0.03\,m$ acetic acid is (pK_a for $CH_3COOH = 4.57$) **[AIIMS 2002; BHU**

(a) 4.09
(b) 5.09
(c) 6.10
(d) 7.09

54. A weak acid is 0.1% ionised in 0.1 M solution. Its *pH* is **[BVP 2004]**

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

55. The solubility product of As_2S_3 is 2.8×10^{-72}. What is the solubility of As_2S_3 **[Pb. CET 2003]**

(a) 1.09×10^{-15} $mole/litre$
(b) 1.72×10^{-15} $mole/litre$
(c) 2.3×10^{-16} $mole/litre$
(d) 1.65×10^{-36} $mole/litre$

56. For a weak acid HA with dissociation constant 10^{-9}, pOH of its 0.1 M solution is **[CBSE PMT 1989]**

(a) 9
(b) 3
(c) 11
(d) 10

57. The dissociation of water at $25^o C$ is $1.9 \times 10^{-7}\%$ and the density of water is $1.0\,g/cm^3$. The ionisation constant of water is **[IIT 1995]**

(a) 3.42×10^{-6}
(b) 3.42×10^{-8}
(c) 1.00×10^{-14}
(d) 2.00×10^{-16}

58. What is the *p*H of 0.01 M glycine solution? For glycine, $Ka_1 = 4.5 \times 10^{-3}$ and $Ka_2 = 1.7 \times 10^{-10}$ at 298 K **[AIIMS 2004]**

(a) 3.0 (b) 10.0
(c) 6.1 (d) 7.2

59. The concentration of $[H^+]$ and concentration of $[OH^-]$ of a 0.1 aqueous solution of 2% ionised weak acid is
[Ionic product of water $= 1 \times 10^{-14}$] **[DPMT 2004; CBSE PMT 1999]**
(a) $2 \times 10^{-3}\,M$ and $5 \times 10^{-12}\,M$
(b) $1 \times 10^{3}\,M$ and $3 \times 10^{-11}\,M$
(c) $0.02 \times 10^{-3}\,M$ and $5 \times 10^{-11}\,M$
(d) $3 \times 10^{-2}\,M$ and $4 \times 10^{-13}\,M$

60. If solubility product of $HgSO_4$ is 6.4×10^{-5}, then its solubility is **[BHU 2004]**
(a) $8 \times 10^{-3}\,mole/litre$ (b) $6.4 \times 10^{-5}\,mole/litre$
(c) $6.4 \times 10^{-3}\,mole/litre$ (d) $2.8 \times 10^{-6}\,mole/litre$

61. At 298*K* a 0.1 *M* CH_3COOH solution is 1.34% ionized. The ionization constant K_a for acetic acid will be **[AMU 2002; AFMC 2005]**
(a) 1.82×10^{-5} (b) 18.2×10^{-5}
(c) 0.182×10^{-5} (d) None of these

62. Hydrogen ion concentration of an aqueous solution is $1 \times 10^{-4}\,M$. The solution is diluted with equal volume of water. Hydroxyl ion concentration of the resultant solution in terms of *mol* dm^{-3} is **[KCET 2001]**
(a) 1×10^{-8} (b) 1×10^{-6}
(c) 2×10^{-10} (d) 0.5×10^{-10}

63. Which one of the following is not a buffer solution **[AIIMS 2003]**
(a) $0.8\,M\,H_2S + 0.8\,M\,KHS$
(b) $2\,M\,C_6H_5NH_2 + 2\,M\,C_6H_5\overset{+}{N}H_3\,Br$
(c) $3\,M\,H_2CO_3 + 3\,M\,KHCO_3$
(d) $0.05\,M\,KClO_4 + 0.05\,M\,HClO_4$

64. The hydrogen ion concentration of a $0.006\,M$ benzoic acid solution is $(K_a = 6 \times 10^{-5})$ **[MP PET 1994]**
(a) 0.6×10^{-4} (b) 6×10^{-4}
(c) 6×10^{-5} (d) 3.6×10^{-4}

65. Calculate the amount of $(NH_4)_2SO_4$ in grams which must be added to 500 *ml* of $0.200\,M\,NH_3$ to yield a solution with $pH = 9.35$ (K_b for $NH_3 = 1.78 \times 10^{-5}$) **[UPSEAT 2001]**
(a) 10.56 *gm* (b) 15 *gm*
(c) 12.74 *gm* (d) 16.25 *gm*

66. *pH* of a solution produced when an aqueous solution of pH 6 is mixed with an equal volume of an aqueous solution of pH 3 is about **[KCET 2001]**
(a) 3.3 (b) 4.3
(c) 4.0 (d) 4.5

67. Calculate the H^+ ion concentration in a $1.00\,(M)$ HCN *litre* solution $(K_a = 4 \times 10^{-10})$ **[Bihar CEE 1995]**
(a) 4×10^{-14} *mole/litre*
(b) 2×10^{-5} *mole/litre*
(c) 2.5×10^{-5} *mole/litre*
(d) None of these

68. The number of moles of hydroxide (OH^-) ion in 0.3 *litre* of 0.005 *M* solution of $Ba(OH)_2$ is **[JIPMER 2001]**
(a) 0.0050 (b) 0.0030
(c) 0.0015 (d) 0.0075

69. The *pH* of pure water or neutral solution at $50°C$ is .... $(pK_w = 13.26 = 13.26$ at $50°C)$ **[Pb. PMT 2002; DPMT 2002]**
(a) 7.0 (b) 7.13
(c) 6.0 (d) 6.63

70. *pH* of 0.1 *M* solution of a weak acid (*HA*) is 4.50. It is neutralised with $NaOH$ solution to decrease the acid content to half *pH* of the resulting solution **[JIPMER 2002]**
(a) 4.50 (b) 8.00
(c) 7.00 (d) 10.00

71. 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 $(K_a = 1.8 \times 10^{-4})$ **[MH CET 2000]**
(a) 3.4 (b) 7.5
(c) 5.6 (d) 3.75

72. The Bronsted acids in the reversible reaction are
$HCO_3^-(aq.) + OH^-(aq.) \rightleftarrows CO_3^{2-}(aq.) + H_2O$ **[DPMT 2002]**
(a) OH^- and CO_3^{2-}
(b) OH^- and H_2O
(c) HCO_3^- and H_2O
(d) HCO_3^- and CO_3^{2-}

73. A 0.1*N* solution of an acid at room temperature has a degree of ionisation 0.1. The concentration of OH^- would be **[MH CET 1999]**
(a) $10^{-12}\,M$ (b) $10^{-11}\,M$
(c) $10^{-9}\,M$ (d) $10^{-2}\,M$

74. Increasing order of acidic character would be **[RPMT 1999]**
(a) $CH_3COOH < H_2SO_4 < H_2CO_3$
(b) $CH_3COOH < H_2CO_3 < H_2SO_4$
(c) $H_2CO_3 < CH_3COOH < H_2SO_4$
(d) $H_2SO_4 < H_2CO_3 < CH_3COOH$

75. The correct order of increasing $[H_3O^+]$ in the following aqueous solutions is **[UPSEAT 2000]**
(a) 0.01 *M* H_2S < 0.01 *M* H_2SO_4 < 0.01 *M* *NaCl* < 0.01 $M\,NaNO_2$
(b) 0.01 *M* *NaCl* < 0.01 *M* $NaNO_2$ < 0.01 *M* H_2S < 0.01 *M* H_2SO_4
(c) 0.01 *M* $NaNO_2$ < 0.01 *M* *NaCl* < 0.01 *M* H_2S < 0.01 *M* H_2SO_4
(d) 0.01 *M* H_2S < 0.01 *M* $NaNO_2$ < 0.01 *M* *NaCl* < 0.01 *M* H_2SO_4

76. A base dissolved, in water, yields a solution with a hydroxyl ion concentration of $0.05\,mol\,litre^{-1}$. The solution is **[CBSE PMT 2000]**
(a) Basic (b) Acid
(c) Neutral (d) Either (b) or (c)

77. In the given reaction, the oxide of sodium is ....
$$\left[\begin{array}{l} 4Na + O_2 \rightarrow 2Na_2O \\ Na_2O + H_2O \rightarrow 2NaOH \end{array}\right]$$
[Orissa JEE 2002]
(a) Acidic (b) Basic
(c) Amphoteric (d) Neutral

78. What is the pH of a 1M CH_3COOH a solution K_a of acetic acid $= 1.8 \times 10^{-5}$.

$K = 10^{-14} mol^2 litre^{-2}$ **[DPMT 2002]**

(a) 9.4
(b) 4.8
(c) 3.6
(d) 2.4

AR Assertion & Reason

For AIIMS Aspirants

Read the assertion and reason carefully to mark the correct option out of the options given below :

(a) *If both assertion and reason are true and the reason is the correct explanation of the assertion.*
(b) *If both assertion and reason are true but reason is not the correct explanation of the assertion.*
(c) *If assertion is true but reason is false.*
(d) *If the assertion and reason both are false.*
(e) *If assertion is false but reason is true.*

1. Assertion : *p*H of hydrochloric acid solution is less than that of acetic acid solution of the same concentration.
Reason : In equimolar solutions, the number of titrable protons present in hydrochloric acid is less than that persent in acetic acid. [NDA 1999]

2. Assertion : A ionic product is used fro any types of electrolytes whereas solubility product is applicable only to sparingly soluble salts.
Reason : Ionic product is defined at any stage of the raction whereas solubility product is only appicable to the saturation stage. [AIIMS 2001]

3. Assertion : A solution of $FeCl_3$ in water produce brown precipitate on standing.
Reason : Hydrolysis of $FeCl_3$ takes place in water

4. Assertion : $BaCO_3$ is more soluble in HNO_3 than in plain water.
Reason : Carbonate is a weak base and reacts with the H^+ from the strong acid, casuing the barium salt to dissociate.

5. Assertion : $CHCl_3$ is more acidic than CHF_3.
Reason : The conjugate base of $CHCl_3$ is more stable than CHF_3.

6. Assertion : Addition of silver ions to a mixture of aqueous sodium chloride and sodium bromide solution will first precipitate $AgBr$ rather than $AgCl$.
Reason : K_{sp} of $AgCl < K_{sp}$ of $AgBr$. [AIIMS 2004]

7. Assertion : The pK_a of acetic acid is lower than that of phenol.
Reason : Phenoxide ion is more resonance stabilized. [AIIMS 2004]

8. Assertion : *Sb* (III) is not precipitated as sulphide when in its alkaline solution H_2S is passed.
Reason : The concentration of S^{2-} ion in alkaline medium is inadequate for precipitation. [AIIMS 2004]

9. Assertion : Ionic reactions are not instantaneous.
Reason : Oppositely charged ions exert strong forces.

Answers

Electrical conductors, Arrenius theory and Ostwald's dilution law

1	c	2	b	3	b	4	b	5	b
6	a	7	b	8	d	9	a	10	a
11	c	12	d	13	b	14	b	15	d
16	d	17	b	18	b	19	c	20	c
21	a	22	c	23	b	24	d	25	c
26	d	27	a	28	d	29	d	30	c
31	b	32	c	33	c	34	c	35	a
36	c								

Acids and Bases

1	a	2	d	3	a	4	c	5	b
6	d	7	b	8	c	9	b	10	a
11	a	12	c	13	a	14	d	15	d
16	b	17	b	18	d	19	a	20	b
21	d	22	b	23	b	24	c	25	d
26	c	27	c	28	d	29	b	30	b
31	b	32	c	33	d	34	a	35	a
36	a	37	c	38	c	39	c	40	a
41	c	42	d	43	c	44	a	45	a
46	c	47	c	48	d	49	a	50	b
51	b	52	a	53	a	54	a	55	d
56	b	57	ab	58	a	59	c	60	d
61	a	62	b	63	b	64	b	65	a
66	a	67	d	68	a	69	a	70	b
71	b	72	d	73	b	74	d	75	b
76	b	77	a	78	a	79	b	80	a
81	d	82	b	83	b	84	d	85	bd
86	a	87	d	88	a	89	d	90	c
91	a	92	a	93	a	94	d	95	b
96	c	97	b	98	c	99	d	100	c
101	a	102	a	103	c	104	c	105	a
106	a	107	d	108	b	109	c	110	d
111	b	112	c	113	c	114	a	115	c
116	d	117	d	118	c	119	c	120	c
121	a	122	d	123	b	124	a	125	b
126	c	127	c	128	d	129	c	130	b
131	b	132	c	133	a	134	c	135	a
136	c	137	c	138	b	139	b	140	b
141	b	142	a	143	b	144	a	145	a
146	a	147	b	148	b	149	c	150	a
151	c	152	c	153	d	154	c	155	a
156	b	157	a	158	d	159	b	160	d
161	b	162	d	163	c	164	d	165	a

Common ion effect, Isohydric solutions, Solubility product, Ionic product of water and Salt hydrolysis

1	b	2	c	3	b	4	b	5	b
6	d	7	c	8	a	9	c	10	a
11	b	12	b	13	a	14	d	15	d
16	b	17	c	18	c	19	d	20	c
21	d	22	d	23	d	24	b	25	a

26	d	27	a	28	d	29	b	30	b
31	a	32	d	33	a	34	c	35	d
36	b	37	b	38	c	39	b	40	a
41	a	42	d	43	b	44	a	45	b
46	d	47	b	48	c	49	c	50	c
51	b	52	d	53	a	54	d	55	c
56	d	57	b	58	c	59	d	60	c
61	b	62	b	63	a	64	bc	65	d
66	a	67	d	68	a	69	d	70	c
71	c	72	d	73	d	74	d	75	a
76	c	77	b	78	d	79	b	80	d
81	c	82	c	83	d	84	c	85	d
86	d	87	b	88	c	89	b	90	a
91	a	92	a	93	c	94	c	95	a
96	d	97	d	98	b	99	b	100	ab
101	d	102	c	103	c	104	a	105	c
106	c	107	c	108	a	109	b	110	b
111	b	112	a	113	a	114	a	115	b
116	a								

Hydrogen ion concentration - *pH* scale and Buffer solution

1	a	2	c	3	d	4	b	5	b
6	d	7	a	8	c	9	b	10	d
11	a	12	d	13	c	14	a	15	b
16	d	17	b	18	c	19	c	20	d
21	b	22	c	23	a	24	d	25	b
26	a	27	a	28	d	29	b	30	b
31	d	32	b	33	a	34	a	35	c
36	c	37	c	38	a	39	a	40	d
41	a	42	a	43	b	44	d	45	b
46	a	47	b	48	a	49	c	50	a
51	a	52	c	53	c	54	c	55	d
56	a	57	c	58	b	59	b	60	c
61	b	62	c	63	b	64	b	65	c
66	a	67	b	68	d	69	a	70	c
71	d	72	a	73	b	74	a	75	b
76	a	77	a	78	c	79	b	80	a
81	b	82	c	83	b	84	b	85	c
86	b	87	a	88	a	89	a	90	d
91	b	92	c	93	a	94	a	95	c
96	b	97	b	98	b	99	b	100	b
101	c	102	c	103	a	104	a	105	c
106	a	107	c	108	c	109	d	110	b
111	d	112	d	113	b	114	a	115	c
116	d	117	b	118	b	119	d	120	c
121	d	122	b	123	c	124	d	125	b
126	b	127	a	128	c	129	b	130	d
131	c	132	d	133	c	134	c	135	a
136	c	137	c	138	c	139	c	140	b
141	b	142	a	143	d	144	b	145	b
146	d	147	c	148	b	149	a	150	d
151	b	152	d	153	b	154	b	155	c
156	d	157	c	158	a	159	c	160	d
161	c	162	d	163	b	164	a	165	d
166	a	167	d	168	b	169	c	170	a
171	c	172	c	173	d	174	b	175	a
176	c	177	a	178	c	179	a	180	b
181	c	182	b	183	b	184	b	185	c
186	b	187	b	188	a	189	a	190	b
191	d	192	b	193	b	194	b	195	a
196	b	197	b	198	b	199	a	200	ad
201	ac	202	a bc	203	c	204	c	205	b
206	b								

Critical Thinking Questions

1	b	2	a	3	b	4	a	5	d
6	a	7	c	8	a	9	a	10	a
11	b	12	d	13	c	14	d	15	c
16	d	17	d	18	b	19	b	20	d
21	a	22	b	23	a	24	b	25	a
26	c	27	d	28	d	29	b	30	d
31	b	32	a	33	c	34	a	35	a
36	b	37	c	38	b	39	a	40	b
41	a	42	a	43	a	44	a	45	a
46	c	47	b	48	b	49	b	50	c
51	d	52	c	53	b	54	c	55	a
56	d	57	d	58	c	59	a	60	a
61	a	62	c	63	d	64	b	65	a
66	a	67	b	68	b	69	d	70	b
71	a	72	c	73	a	74	c	75	c
76	a	77	b	78	a				

Assertion & Reason

1	c	2	b	3	a	4	a	5	a
6	c	7	c	8	a	9	e		

Answers and Solutions

Electrical conductors, Arrhenius theory and Ostwald's dilution law

1. (c) $C_{12}H_{22}O_{11}$ is a sugar and non-electrolyte.

2. (b) It is a weak electrolyte since it is slightly ionized.

3. (b) It is a weak electrolyte since slightly ionized.

4. (b) Because the degree of dissociation is inversely proportional to the concentration of the electrolyte.

5. (b) Electrolytes are those substances which on dissolving in water give ions.

6. (a) $K = \frac{\alpha^2 C}{1-\alpha}$; $\alpha = \frac{0.01}{100} \approx 1 \therefore K = \alpha^2 C = \left[\frac{0.01}{100}\right]^2 \times 1$

$= 1 \times 10^{-8}$.

7. (b) As $NaCl$ ionises completely to yield free ions.

8. (d) $CH_3COONa \rightleftharpoons CH_3COO^- + Na^+$

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

$CH_3COOH + NaOH$

9. (a) $NaCl$, being a salt, is a strong electrolyte.

10. (a) We can determine by measurement of very dilute HF solutions.

11. (c) According to the Ostwald's dilution formula $\alpha^2 = \frac{K(1-\alpha)}{C}$.

But for weak electrolytes α is very small. So that $(1-\alpha)$ can be neglected. So that $\alpha = \sqrt{\frac{K_a}{C}}$.

12. (d) Arrhenius proposed the theory of ionisation.

13. (b) higher the dielectric constant of a solvent more of its ionising power.

14. (b) $\alpha \propto$ dilution of solution.

15. (d) Generally ionic compound are conduct electricity in fused state.

16. (d) According to Ostwald's dilution law because degree of ionization is directly proportional to the dilution.

17. (b) The degree of ionisation of a solute depends upon its nature, concentration, and temperature.

18. (b) Mathematical form of Ostwald's dilution law.

19. (c) It is a weak electrolyte because it's ionization is very less.

20. (c) When we add NH_4OH in NH_4Cl solution ionization of NH_4OH is decreased due to common ion effect.

21. (a)

	$BaCl_2$ $\rightleftharpoons$	Ba^{2+} +	$2Cl^-$
Initially	1	0	0
After dissociation	$a-\alpha$	α	2α

Total = $1-\alpha+\alpha+2\alpha = 1+2\alpha$

$\alpha = \frac{1.98-1}{\alpha} = \frac{0.98}{\alpha} = 0.49$

for a mole $\alpha = 0.49$

For 0.01 mole $\alpha = \frac{0.49}{0.01} = 49$

22. (c) It is an ionic salt.

23. (b) Due to common ion effect of H^+.

24. (d) Current does not affect the degree of ionization.

25. (c) Polar solvent facilitate ionisation of strong electrolytes due to dipole-ion attraction.

26. (d) $HA \rightleftharpoons H^+ + A^-$

$K = Ca^2 = 0.1 \times (10^{-4})^2 = 10^{-9}$

28. (d) Degree of dissociation α = ?

Normality of solution = 0.1 $N = \frac{1}{10} N$

Volume = 10 *litre*

Dissociation constant $K = 1 \times 10^{-5}$

$K = \frac{\alpha^2}{V}$; $\alpha = \sqrt{KV} = \sqrt{1 \times 10^{-5} \times 10}$; $\alpha = 1 \times 10^{-2}$

29. (d) $MgCl_2 \rightleftharpoons Mg^{++} + 2Cl^-$ in aqueous solution it is dissociated into ions.

30. (c) Ostwald's dilution formula is $\alpha^2 = K(1-\alpha)/C$ but for weak electrolyte α is very small. So that $(1-\alpha)$ is neglected for weak electrolytes. So for weak electrolyte the dilution formula is $\alpha = \sqrt{\frac{K}{C}}$.

31. (b) $K_a = C\alpha^2 = 0.2 \times \left(\frac{32}{100}\right)^2 = 2.048 \times 10^{-4}$.

32. (c) $H_2SO_4 \rightleftharpoons H^+ + H^-SO_4 \rightleftharpoons H^+ + SO_4^{--}$

Because of it is completely ionised.

33. (c) Colour of electrolyte depends on the nature of both ions.

e.g. $CuSO_4$ is blue because Cu^{2+} ions are blue.

34. (c) Ionisation depends upon dilution, when dilution increases then ionisation is also increased.

35. (a) More is K_a, lesser is $pK_a\,(pK_a = -\log K_a)$ more is acidic strength.

Acids and Bases

1. (a) CO doesn't have a vacant *d*-orbital.

2. (d) $\underbrace{HClO_4 + H_2O \rightleftharpoons H_3O^+ + ClO_4^-}_{\text{Conjugate acid and base pair}}$

3. (a) $FeCl_3 + 3H_2O \rightleftharpoons Fe(OH)_3 + 3HCl$. Strong acid and weak base.

4. (c) $Na_2CO_3 + 2H_2O \rightleftharpoons 2NaOH + H_2CO_3$

5. (b) Those substance accept the proton are called Bronsted base and which is donate the proton are called Bronsted acid.

$HCO_3^- + H^+ \rightleftharpoons H_2CO_3$ Bronsted base.

$HCO_3^- \rightleftharpoons H^+ + CO_3^{--}$ Bronsted acid.

7. (b) The value of pK_a for strong acid is less.

8. (c) Because it is a salt of strong base and weak acid.

9. (b) Because it is conjugate base of weak acid.

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$.

11. (a) Those compound which accept H^+ is called bronstad base NO_3^- accept H^+ and form HNO_3. So it is a base.

13. (a) Larger the size of halogen atom less is the back donation of electrons into empty $2p$ orbital of B.

14. (d) $H_2O + NH_3 \rightleftharpoons NH_4{}^+ + OH^-$

16. (b) $NH_2^- \rightleftharpoons NH^{-2} + H^+$

Conjugate acid, base pair.

17. (b) Those substances which lose proton are called acid.

e.g. strong acid have a strong tendency to donate a proton.

18. (d) Electron donating species called nucleophile. NH_3 have a lone pair of electron.

19. (a) H_2O acts as acid as it provides H^+ to NH_3 .

20. (b) $CH_3COOH + HF \rightleftharpoons CH_3COOH_2^+ + F^-$. HF gives H^+ to the CH_3COOH . So it is a conjugate base of HF.

22. (b) $Ba(NO_3)_2$ does not undergo hydrolysis.

23. (b) H_2SO_4 is a mineral acid.

24. (c) Because it is a electron pair acceptor it's central atom have a vacant *d*-orbital.

25. (d) $HClO_4$ is a acid and their conjugate base is ClO_4^- .

26. (c) It is completely ionised because their ionization is very high.

27. (c) $NaHCO_3$ in water is alkaline in nature due to hydrolysis of HCO_3^- ion. $NaCO_3 \rightleftharpoons Na^+ + HCO_3^-$

28. (d) In this reaction H_2O acts as a acid.

29. (b) The basic character of hydride decreases down the group.

30. (b) Its ionization is very less.

32. (c) Hydrolysis of Cu^{2+} produces H^+ ions in solution.

$$Cu^{2+} + 2H_2O \rightarrow Cu(OH)_2 + 2H^+$$

33. (d) Both possess the tendancy to accept proton.

34. (a) *HF* does not give proton easily.

35. (a) In weak electrolyte the degree of dissociation is very small. So it increases with increasing dilution.

36. (a) Because it is a electron pair acceptor.

37. (c) $H_3PO_4 \overset{\text{I step}}{\rightleftharpoons} H^+ + H_2PO_4^-$

$$H_2PO_4^- \overset{\text{II step}}{\rightleftharpoons} H^+ + HPO_4^{--}$$

$$HPO_4^{--} \overset{\text{III step}}{\rightleftharpoons} H^+ + PO_4^{---}$$

38. (c) Na_2HPO_4 on hydrolysis of HPO_4^{2-} ion produces free OH^- ion in solution.

39. (c) $H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$.

40. (a) $Fe^{3+} + 3H_2O \rightarrow Fe(OH)_3 + 3H^+$

41. (c) $\underset{\text{Conjugate acid}}{H_2PO_4^-} \rightleftharpoons H^+ + HPO_4^{2-}$ action.

42. (d) $H^+ + OH^- \rightleftharpoons H_2O$, it is a neutralization reaction.

43. (c) It is a conjugate base of the strong acid.

44. (a) Because those acid have higher pK_a value are weak acid.

45. (a) Conjugate acid is obtained from the base by gain of H^+ .

46. (c) CH_3COOH is weak acid shows dissociation equilibrium as

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

47. (c) $pK_a = \log_{10}\dfrac{1}{K_a}$

48. (d) A weak acid and strong base.

49. (a) In NaH_2PO_2 both hydrogen are bonded with '*P*,' so it is not replaceable.

50. (b) Aqueous solution of Na_2CO_3 is alkaline due to hydrolysis of CO_3^{--} .

51. (b) Because they give CO_3^{--} in solution.

52. (a) M.eq. of 0.2*M* $H_2SO_4 = \dfrac{2 \times 0.2M}{1000} \times 100 = 0.04$ *m*/*l*

M.eq. of .2*M* $NaOH = \dfrac{0.2}{1000} \times 100 = 0.02$ *m*/*l*

left $[H^+] = .04 - .02 = .02$.

Total volume $= 200 = \dfrac{.02}{200} = .0001 = 10^{-4}$ *M*

$pH = 4$.

53. (a) H_3BO_3 is a weak monobasic acid it does not act as a H^+ donor but behaves as a Lewis acid.

54. (a) Because $SnCl_2$ is a electron acceptor according to Lewis concept.

55. (d) *ROH* is a Lewis base because it has an lone pair of electron.

56. (b) $H_2SO_4 + 2H_2O \rightleftharpoons 2H_3O^+ + SO_4^{--}$

$NaOH \rightleftharpoons Na^+ + OH^-$

1 mole of H_2SO_4 acid gives 2 moles of H_3O^+ ions. So 2 moles of OH^- are required for complete neutralization.

57. (ab) Diprotic solvents give $2H^+$ ions or OH^- ions.

58. (a) $N_{NaOH} = 1 \times 1 = 1N$

$N_{H_2SO_4} = 2 \times 10 = 20N$

M.eq. of $NaOH = 1 \times 100 = 100$

M.eq. of $H_2SO4 = 20 \times 10 = 200$

Thus M.eq. of acid are left and therefore $pH < 7$, so the resulting mixture will be acidic.

60. (d) PH_3 is a Lewis base.

61. (a) Because of CH_3COONa is a salt of weak acid and strong base.

62. (b) Acid $\xrightarrow{-H^+}$ conjugate base.

Base $\xrightarrow{+H^+}$ conjugate acid.

63. (b) $\underset{\text{Acid}}{HCl} \rightarrow \underset{\text{Base}}{Cl^-}$

65. (a) $\underset{\text{Aciediccharacterdecreases}}{HClO_4 > H_2SO_4 > HCl > HNO_3}$.

66. (a) Those substances which accept the H^+ are called conjugate base.

67. (d) NH_3 is a Lewis base, which donate a lone pair of electron.

69. (a) $FeCl_3 + 3H_2O \rightleftharpoons Fe(OH)_3 + 3HCl$. Strong acid have less than 7 *pH*.

70. (b) It donates their e^- pair.

71. (b) The strength of the acid will depend upon the proton donation.

73. (b) Because it is a salt of strong acid and strong base.

$$H^+_{(aq)} + Cl^-_{(aq)} + Na^+_{(aq)} + OH^-_{(aq)} \rightleftharpoons$$

$$H_2O_{(l)} + Na^+_{(aq)} + Cl^-$$

74. (d) CCl_4 is not a Lewis or bronsted acid. It does not contain H^+ .

75. (b) $NH_4Cl + H_2O \rightleftharpoons \underset{\text{Weak base}}{NH_4OH} + \underset{\text{Strong acid}}{HCl}$. So it is acidic in nature.

76. (b) *Cu*(II) complexes are blue. The four water molecules are attached with secondary valencies of the metal atom e.g. $[Cu(H_2O)_4]SO_4 . H_2O$.

77. (a) The species which can accept as well as donate H^+ can act both as an acid and a base.

$$\underset{\text{base}}{HSO_4^-} + H^+ \rightleftharpoons H_2SO_4$$

$$\underset{\text{acid}}{HSO_4^-} \rightleftharpoons SO_4^{2-} + H^+$$

78. (a) NH_4^+ is the weakest acid. So its conjugate base is strongest.

79. (b) Ag^+ is an electron deficient compound and hence is a Lewis acid.

80. (a) $\underset{\text{Conjugate acid}}{H_3PO_4} \rightleftharpoons H^+ + H_2PO_4^-$

81. (d) $\underset{\text{Conjugate acid}}{HS_2O_8^-} \rightleftharpoons H^+ + \underset{\text{Conjugate base}}{S_2O_8^{--}}$

82. (b) PH_3 donates electron pair to BCl_3.

83. (b) The conjugate base of weak acid is a strong base.

84. (d) $OH^- \rightarrow \underset{\text{Conjugate base of } OH^-}{O^{2-}} + H^+$

85. (bd) Presence of lone pair of electron and they donate two electron pairs.

86. (a) *On increasing oxidation number Acidic strength increases.*

87. (d) H_3PO_4 is shows +5 maximum oxidation state.

88. (a) $C_2H_5^-$ is a strongest base.

89. (d) $NaOCl$ is a mixture of strong base and weak acid.

90. (c) NH_4OH gives minimum OH^- ion. So it is a weak base.

91. (a) Solution become acidic and methyl orange act on acidic *pH*.

92. (a) Larger is bond length, more is acidic nature (for halogen acids). *HF* bond length is small.

93. (a) *HCl* is accepting proton in *HF* medium and acts as weak base.

95. (b) For oxoacids of the same element, the acidic strength increases with increase in the oxidation number of that element.

$$\overset{+1}{HClO} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4}$$

96. (c) Because their conjugate base and conjugate acids are strong.

97. (b) *HCl* is a strong acid and their conjugate base is a very weak base.

100. (c) $NH_3 \rightleftharpoons NH_2^- + H^+$

101. (a) $H_2SO_4 \rightleftharpoons H^+ + HSO_4^- \rightleftharpoons H^+ + SO_4^{--}$

HSO_4^- is conjugate base. But it is also an acid because it lose H^+.

102. (a) BF_3 is a Lewis acid because '*B*' has incomplete octet.

104. (c) H_3O^+, however it exists as $H_9O_4^+$.

105. (a) $Al_2(SO_4)_3$ is a salt of weak base $Al_2(OH)_3$ and strong acid H_2SO_4.

106. (a) Al^{+++} of $AlCl_3$ undergoes hydrolysis.

107. (d) $H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$

109. (c) Conjugate base of H_2SO_4 is HSO_4^-.

110. (d) Presence of lone pair.

111. (b) According to Bronsted principle HNO_3 is acid they give H^+ in aqueous solution and form NO_3^-.

112. (c) $H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$.

113. (c) NH_4^+ is a conjugate acid;

$$NH_4^+ \rightleftharpoons NH_3 + H^+$$

114. (a) $AlCl_3 + 3H_2O \rightleftharpoons Al(OH)_3 + \underset{\text{Stron acid}}{3HCl}$

116. (d) HCl is a strong acid its conjugate base means Cl^- is a weak base.

117. (d) Hydrazoic acid (HN_3) is a Lewis acid.

118. (c) Smaller the pK_a value than. Stronger the acid.

120. (c) BF_3 is acidic because due to Lewis concept it accept a lone pair of electron.

122. (d) Because it is a weak electrolyte.

126. (c) $AlCl_3$ and SO_2 both are example of Lewis theory.

127. (c) $Na_2CO_3 + 2H_2O \rightleftharpoons 2NaOH + H_2CO_3$. It is a strong base and weak acid so it is a basic.

129. (c) $\underset{\text{Acid}}{H_2O} + \underset{\text{base}}{NH_3} \rightleftharpoons NH_4^+ + OH^-$.

In this reaction H_2O acts as acid because it donate a proton.

130. (b) $\underbrace{H_2SO_4 + H_2O \rightleftharpoons H_3O^+ + HSO_4^-}_{\text{Conjugate acid and base pair}}$

131. (b) $Al_2(SO_4)_3 \rightleftharpoons 2Al^{3+} + 3SO_4{}^{2-}$

$$\underset{\text{Weak base}}{Al(OH)_3} + \underset{\text{Strong acid}}{H_2SO_4}$$

132. (c) $NaOH + HCl \underset{\text{Reaction}}{\overset{\text{Neutralization}}{\rightleftharpoons}} \underset{\text{Salt}}{NaCl} + H_2O$

133. (a) Conjugate acid is obtained from the base by gain of H^+.

134. (c) KCl is a ionic compound .

135. (a) $H_3BO_3 + H_2O \rightleftharpoons [B(OH)_4]^- + H^+$

H_3BO_3 is a weak monobasic acid if does not act as a H^+ donar but behaves as a Lewis acid.

136. (c) Because it is not accept the proton.

137. (c) NH_4Cl is a salt of weak base (NH_4OH)and strong acid (*HCl*).

138. (b)Because it accept electron pair from the PH_3

139. (b) $NH_4^+ \rightleftharpoons NH_3 + H^+$

141. (b) Hydrolysis of Fe^{3+}

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

142. (a) According to the Lewis concept.

143. (b) Conjugate base is obtained from the acid by loss of H^+.

144. (a) BF_3 accept electron pair from NH_3 so it is Lewis acid.

145. (a) CH_4 has almost no acidic nature and thus CH_3^- is strongest base.

146. (a) $CuSO_4$ is a salt of weak base, $(Cu(OH)_2)$ and strong acid (H_2SO_4).

147. (b) Weak acid consists of highest pK_a value and strongest acid consist of less pK_a value.

149. (c) Because it gain and also lose the proton

$$H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$$

150. (a) $H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$

151. (c) $HBr + H_2O \rightleftharpoons H_3O^+ + Br^-$

152. (c) Because both are strong acid and strong base.

153. (d) $LiAlH_4$ is a nucleophilic and capable of donating electron pair, thus acts as a Lewis base.

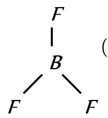
154. (c) The solvent which neither accept proton nor donates.

155. (a) Because of F^- is a highly electronegative. So it is easily lose the electron and reaction occur rapidly.

156. (b) Strong acid can be used titrate both strong and weak base.

159. (b) For a weak acid value of pKa will be vary high but in case of strong acid value of pKa will be vary low.

160. (d) Boron halides behave as Lewis acid because of their electron deficient nature *eg*., as



(Deficiency of two electron for inert configuration)

161. (b) Gaseous *HCl* does not give H^+ but liquid *HCl* gives H^+ in aquous solution there for gaseous *HCl* is not a Arrhenius acid due to covalent bonding in gaseous condition.

162. (d) $\underset{\text{Acid}}{H_2O} \rightarrow H^+ + OH^-$ [Acid due to donation of proton]

$\underset{\text{Base}}{H_2O} + H^+ \rightarrow H_3O^+$ [Basic due to gaining of proton]

163. (c) F^- strongest conjugate base due to it smallest size in a group and gain proton due to most electronegative capacity.

$$H^+ + F^- \rightarrow HF$$

164. (d) $\underset{\text{Conjugate acid}}{H_2PO_4^-} \rightarrow H^+ + \underset{\text{Conjugate base}}{HPO_4^{2-}}$

165. (a) $\underset{\text{Conjugate acid}}{HSO_4^-} \rightarrow H^+ + \underset{\text{Conjugate base}}{SO_4^{2-}}$

Common ion effect, Isohydric solutions, Solubility product, Ionic product of water and Salt hydrolysis

1. (b) Solubility of $Al_2(SO_4)_3$

$$Al_2(SO_4)_3 \rightleftharpoons 2Al^{+++} + 3SO_4^{--}$$

$$K_{sp} = [Al^{3+}]^2\ [SO_4^{2-}]^3$$

2. (c) Due to common ion effect.

3. (b) $MX_2 \rightleftharpoons \underset{S}{M^{2+}} + \underset{2S}{2X^-}$

$$K_{sp} = (2S)^2(S) = 4S^3$$

$$\Rightarrow\ S = 2\sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{4\times10^{-12}}{4}} = 1.0\times10^{-4}\,M\,.$$

5. (b) $MX_2 \rightleftharpoons \underset{(S)}{M^+} + \underset{(2S)^2}{2X^-}\ ;\ K_{sp} = 4S^3$

$$S = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{1\times10^{-11}}{4}} = 1.35\times10^{-4}$$

8. (a) $Mg(OH)_2 \rightleftharpoons \underset{(X)}{Mg^{++}} + \underset{(2X)^2}{2OH^-}$

$$K_{sp} = 4X^3$$

9. (c) $BaSO_4 \rightleftharpoons \underset{\substack{(S)\\0.01}}{Ba^{++}} + \underset{\substack{(S)\\5}}{SO_4^{--}}$

$$K_{sp} = S^2 = S\times S = 0.01\times S$$

$$S_{(SO_4^{2-})} = \frac{K_{sp}}{S_{(Ba^{++})}} = \frac{1\times10^{-9}}{0.01} = 10^{-7}\ \textit{mole/litre}$$

10. (a) $AB_2 \rightleftharpoons \underset{1\times10^{-5}}{A^+} + \underset{2\times10^{-5}}{2B^-}$

$$K_{sp} = [1\times10^{-5}][2\times10^{-5}]^2 = 4\times10^{-15}$$

11. (b) $CaF_2 \rightleftharpoons \underset{(S)}{Ca^{++}} + \underset{(2S)^2}{2F^-}\ ; K_{sp} = 4S^3$

12. (b) Due to common ion effect.

13. (a) $Ag_2CrO_4 \rightleftharpoons [2Ag^+] + [CrO_4^{--}]$

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

14. (d) K_{sp} for $CaF_2 = 4s^3 = 4\times[2\times10^{-4}]^3 = 3.2\times10^{-11}$.

15. (d) The concentration of S^{2-} ions in group II is lowered by maintaining acidic medium in the presence of NH_4Cl. The ionization of H_2S is supressed due to common ion effect. So the ionic product is less than solubility product.

16. (b) NH_4Cl is hydrolysed and give $[H^+]$

$$NH_4Cl + H.OH \rightleftharpoons NH_4OH + HCl$$

$$NH_4^+ + H.OH \rightleftharpoons NH_4OH + H^+$$

17. (c) $FeCl_3$ is a salt of weak base $(Fe(OH)_3)$ and strong acid (*HCl*).

18. (c) For the precipitation of an electrolyte, it is necessary that the ionic product must exceed its solubility product.

19. (d) $K_{sp} = [Ag^+]^2[Cro_4^{--}] = [2S]^2[0.01]$

$= 4S^2[0.01] = 4[2\times10^{-8}]^2\times0.01 = 16\times10^{-18}$.

20. (c) Complex salts contain two different metallic elements but give test for only one of them. *e.g.* $K_4Fe(CN)_6$ does not give test for Fe^{3+} ions.

21. (d) $10^{-3}N$ *KOH* will give $[OH^-] = 10^{-2}\,M$

$$pOH = 2$$

$$\because pH + pOH = 14,\ pH = 14 - 2 = 12$$

22. (d) It is $FeSO_4(NH_4)_2SO_4\,.\,10H_2O$.

23. (d) Salt of a strong base with a weak acid.

24. (b) NH_4CN is a salt of weak acid and weak base and thus for it

25. (a) Because it is a salt of strong base with a weak acid.

26. (d) Because CCl_4 is a organic solvent and $AgNO_3$ is insoluble in organic solvent.

27. (a) $SnS_2 \rightleftharpoons Sn^{4+} + 2S^{2-}$

$\therefore K_{sp} = [Sn^{4+}][S^{2-}]^2$

28. (d) It does not dissociate much or its ionization is very less.

29. (b) $NaHCO_3$ has one replaceable hydrogen.

30. (b) $CaOCl_2$ has two anions Cl^- and OCl^- along with Ca^{2+} ions.

31. (a) $K_{sp} = 4S^3$, $S^3 = \frac{4\times10^{-9}}{4} = 10^{-9}$

$\therefore S = 10^{-3} M$.

32. (d) $Be(OH)_2$ has lowest solubility and hence lowest solubility product.

33. (a) Because it is a salt of strong acid and strong base.

34. (c) $NH_4OH \rightleftharpoons \boxed{NH_4^+} + OH^-$

$NH_4Cl \rightleftharpoons \boxed{NH_4^+} + Cl^-$

Common ion

35. (d) It is a less ionic, so that least soluble in water.

36. (b) pH of 9 means the salt solution should be fairly basic.

37. (b) $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

On adding CH_3COONa, $[H^+]$ decreases.

38. (c) 0.01 M $CaCl_2$ gives maximum Cl^- ions to keep K_{sp} of $AgCl$ constant, decrease in $[Ag^+]$ will be maximum.

39. (b) Due to the common ion effect.

40. (a) $K_{sp} = 4s^3$

$S = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{1.0\times10^{-6}}{4}} = 6.3\times10^{-3}$.

42. (d) K_w increases with increase in temperature.

43. (b) It contains two cations and one anion.

44. (a) $HgSO_4$ of $K_{sp} = S^2$

$S = \sqrt{K_{sp}}$; $S = \sqrt{6.4\times10^{-5}}$; $S = 8\times10^{-3}$ *m/l.*

45. (b) The solubility of $BaSO_4$ in *g/litre* is given 2.33×10^{-3}

$\because$ in *mole/litre.* $n = \frac{W}{m.wt} = 1\times10^{-5} = \frac{2.33\times10^{-3}}{233}$

Because $BaSO_4$ is a compound

$K_{sp} = S^2 = [1\times10^{-5}]^2 = 1\times10^{-10}$

46. (d) $\underset{a}{AgCl} \rightleftharpoons \underset{a}{Ag^+} + \underset{a}{Cl^-}$

$\underset{0.02}{NaCl} \rightleftharpoons \underset{0.02}{Na^+} + \underset{0.02}{Cl^-}$

$K_{sp}\ AgCl = 1.20\times10^{-10}$

$K_{sp}\ AgCl = [Ag^+][Cl^-] = a\times[a+0.2] = a^2 + 0.2a$

a^2 is a very small so it is a neglected.

$K_{sp}\ AgCl = 0.2a$

$1.20\times10^{-10} = 0.2a$

$a = \frac{1.20\times10^{-10}}{0.20} = 6\times10^{-10}$ *mole*

47. (b) Solubility is decreased due to common ion effect.

$AgI \rightleftharpoons Ag^+ + \boxed{I^-}$

$NaI \rightleftharpoons Na^+ + \boxed{I^-}$

Common ion

48. (c) K_{sp} of $BaSO_4 = 1.5\times10^{-9}$; $Ba^{++} = 0.01M$

$SO_4^{--} = \frac{1.5\times10^{-9}}{0.01} = 1.5\times10^{-7}$

49. (c) $AgCrO_4 \rightleftharpoons \underset{(2S)^2}{2Ag^+} + \underset{S}{CrO_4^-}$

$K_{sp} = 4S^3$ given $2S = 1.5\times10^{-4}$

$\therefore K_{sp} = (2S)^2 \times S$

$= (1.5\times10^{-4})^2 \times \left(\frac{1.5\times10^{-4}}{2}\right) = 1.6875\times10^{-12}$

50. (c) $PbCl_2 \rightleftharpoons \underset{S}{Pb^{2+}} + \underset{S}{2Cl^-}$

K_{sp} of $PbCl_2 = [Pb^{2+}]\times[Cl^-]^2$; $K_{sp} = S\times(2S)^2$

$K_{sp} = S\times4S^2 = 4S^3$; $S^3 = \frac{K_{sp}}{4}$; $S = \sqrt[3]{\frac{K_{sp}}{4}}$

51. (b) $AgCl \rightleftharpoons [Ag^+][Cl^-]$; $K_{sp} = S\times S$; $K_{sp} = S^2$

$S = \sqrt{K_{sp}} = \sqrt{1.44\times10^{-4}} = 1.20\times10^{-2}$ *M.*

52. (d) By formula $BA_2 \to B^+ + 2A^-$

$K_{sp} = 4x^3$

53. (a) $\underset{S}{AgCrO_4} \to \underset{2S}{2Ag^+} + \underset{S}{CrO_4^{--}}$

$K_{sp} = (2S)^2 S = 4S^3$

$S = \left(\frac{K_{sp}}{4}\right)^{\frac{1}{3}} = \left(\frac{32\times10^{-12}}{4}\right)^{\frac{1}{3}} = 2\times10^{-4}$ *M.*

54. (d) Common ion effect is noticed only for weak electrolyte dissociation. H_2SO_4 is strong electrolyte.

55. (c) When we added barium ion in chromate ion solution we obtained yellow ppt of $BaCrO_4$.

$BaCl_2 + K_2CrO_4 \to \underset{\text{Yellow ppt.}}{BaCrO_4\downarrow} + 2KCl$

56. (d) *AB is a* binary electrolyte.

$S = \sqrt{K_{sp}} = \sqrt{1.21\times10^{-6}} = 1.1\times10^{-3} M$

57. (b) Precipitation occurs when ionic product > solubility.

58. (c) For a binary electrolyte, so that

$K_{sp} = S\times S = S^2$

$S = \sqrt{K_{sp}}$.

61. (b) CH_3COONa is a salt of weak acid and strong base. Hence its aqueous solution is alkaline.

62. (b) $BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{--}$

Solubility constant $= S \times S$

$$1.5\times10^{-19} = S^2 ; S = \sqrt{1.5\times10^{-19}} ; S = 3.9\times10^{-5}$$

65. (d) $Ca(OH)_2 \rightleftharpoons \underset{(S)}{Ca^{++}} + \underset{(2S)^2}{2OH^-}$

$$K_{sp} = 4S^3 = 4\times\sqrt{3}\times\sqrt{3}\times\sqrt{3} = 12\sqrt{3}$$

66. (a) Due to common ion effect.

67. (d) $PbCl_2 \rightleftharpoons \underset{(S)}{Pb^{2+}} + \underset{(2S)^2}{2Cl^-}$

$$K_{sp} = 4S^3 = 4\times(2\times10^{-2})^3 = 3.2\times10^{-5}$$

68. (a) $Ag_2S \rightleftharpoons 2Ag^+ + S^{--}$

$K_{sp} = 4S^3$

$$S = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{3.2\times10^{-11}}{4}} = 2\times10^{-6}$$

69. (d) $\underset{S}{CaCO_3} \rightleftharpoons \underset{S}{Ca^{++}} + \underset{S}{CO_3^{--}}$

Solubility product of $CaCO_3$

$K_{sp} = S^2 ;\ S = \sqrt{K_{sp}}$

It is a binary electrolyte.

$$S^2 = K_{sp} ;\ (3.05\times10^{-4})^2 = K_{sp} ; K_{sp} = 9.3\times10^{-8}$$

71. (c) $PbCl_2 \rightarrow \underset{S}{Pb^{++}} + \underset{2S}{2Cl^-}$

$$K_{sp} = S\times(2S)^2 = [6.3\times10^{-3}]\times[12.6\times10^{-3}]^2 .$$

72. (d) A salt of strong acid and strong base cannot be hydrolysed. In this case the equilibrium cannot shifted towards the backward.

73. (d) If we mixed any substance into the solution. Then the value of pH is increased these substance is a salt of weak acid and strong base.

74. (d) It is a salt of strong base and weak acid.

75. (a) $K_{sp} = 4s^3 = 4\times[2.5\times10^{-2}]^3 = 62.5\times10^{-6}$.

76. (c) $NaCl \rightleftharpoons \underset{S}{Na^+} + \underset{S}{Cl^-}$

$$K_{sp} = S^2 ,\ S = \sqrt{K_{sp}} = \sqrt{36} = 6 .$$

78. (d) $\underset{K_{sp}}{PbI_2} \rightleftharpoons \underset{S}{Pb^{++}} + \underset{2S}{2I^-}$

$$K_{sp} = 4S^3 = 4\times[2\times10^{-3}]^3 = 32\times10^{-9} .$$

79. (b) When ionic product is greater than K_{sp} then precipitation occur

$$K_{sp} < 10^{-2}M\ Ca^{2+} + 10^{-3}M\ F^-$$

80. (d) In IV group the S^{2-} concentration increase when added the NH_4OH because

$$NH_4OH \rightleftharpoons NH_4^+ + OH^-$$

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

$OH^- + H^+ \rightleftharpoons H_2O$. So that S^{2-} is increased.

81. (c) $BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$

$$K_{sp} = S^2 \Rightarrow S = \sqrt{K_{sp}} ; K_{sp} = [Ba^{2+}]\times[SO_4^{2-}]$$

$$4\times10^{-10} = [1\times10^{-4}]\times[SO_4^{2-}]$$

$$[SO_4^{2-}] = \frac{4\times10^{-10}}{1\times10^{-4}} = 4\times10^{-6} .$$

82. (c) $AB_2 \rightleftharpoons \underset{(S)}{A^{2+}} + \underset{(2S)^2}{2B^-}$

$K_{sp} = 4S^3$

$$S = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{4\times10^{-12}}{4}} = 1\times10^{-4}\ gm.mol/litre$$

83. (d) $[B] = \frac{K_{sp}AB}{[A]} = \frac{1\times10^{-8}}{10^{-3}} = 1\times10^{-5}M$

Where ionic product > K_{sp}, ppt formed

∴ 8 should be more then $10^{-5}M$.

84. (c) $NaCl_{(s)} \rightleftharpoons Na^+_{(aq)} + Cl^-_{(aq)}$

$HCl \rightleftharpoons H^+ + Cl^-$. The increase in $[Cl^-]$ brings in an increase in $[Na^+]\,[Cl^-]$ which will lead for backward reaction because

$$K_{sp}(NaCl) = [Na^+]\,[Cl^-]$$

means Ionic product $\geq K_{sp}$

85. (d) $BaSO_4 \rightleftharpoons \underset{(S)}{Ba^{++}} + \underset{(S)}{SO_4^{--}}$

$$K_{sp} = S^2 ;\ S = \sqrt{K_{sp}} = \sqrt{1.3\times10^{-9}}$$

$$= 3.6\times10^{-5}\ mol/litre$$

87. (b) Alkaline,

$$CH_3COONa + H_2O \rightleftharpoons \underset{\text{Weak acid}}{CH_3COOH} + \underset{\text{Strong base}}{NaOH}$$

88. (c) Because it is a strong base.

89. (b) For pure water $[H^+] = [OH^-]$, $\therefore K_w = 10^{-12}$ s

90. (a) $MX_2 \rightleftharpoons \underset{(S)}{M^{2+}} + \underset{(2S)^2}{2X^-}$; $4S^3 = 4\times(0.5\times10^{-4})^3$

$$= 5\times10^{-13}$$

91. (a) Solubility coefficient $= [Pb^{2+}]\,[Cl^-]^2$

92. (a) Solubility of $Al(OH)_3$ is lesser than $Zn(OH)_2$.

93. (c) $NaCl_{(s)} \rightleftharpoons Na^+{}_{(aq)} + Cl^-{}_{(aq)}$

$$HCl \rightleftharpoons H^+ + Cl^-$$

The increase in $[Cl^-]$ brings in an increase in $[Na^+]$ $[Cl^-]$ which will lead for backward reaction because $K_{sp}\ NaCl = [Na^+]\,[Cl^-]$.

94. (c) Common ion effect.

95. (a) $\underset{S}{CaF_2} \rightleftharpoons \underset{S}{Ca^{++}} + \underset{(2S)^2}{2F^-}$

$$K_{sp} = 4S^3$$

$$S = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{3.2\times10^{-11}}{4}} = 2\times10^{-4}\ m/l.$$

96. (d) In aqueous solution following euilibrium is exist. $H_2S \rightleftharpoons H^+ + HS^-$

While adding the dilute HCl solution

$(HCl \rightleftharpoons H^+ + Cl^-)$ equilibrium is shift to the left side in $H_2S \rightleftharpoons H^+ + HS^-$

97. (d) $\underset{K_{sp}}{M_2X_3} \rightleftharpoons \underset{(2y)^2}{2M^{+++}} + \underset{(3y)^3}{3X^{--}}$

Solubility product $K_{sp} = 108y^5\ mol\frac{d}{m^3}$

98. (b) Solubility is directly proportional to the K_{sp} .

99. (b) $\underset{S}{PbCl_2} \rightleftharpoons \underset{S}{Pb^{++}} + \underset{(2S)^2}{2Cl^-}$

$K_{sp} = S\times(2S)^2 = 4S^3$

$S = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{1.5\times10^{-4}}{4}} = 3.34\times10^{-2}$.

101. (d) $AlCl_3$ on hydrolysis gives weak base and strong acid among all.

102. (c) Fe^{3+} ions are hydrolysed to develop acidic nature.

103. (c) $K_h = \frac{K_w}{K_a\times K_b}$

104. (a) KCN is salt of strong base and weak acid.

105. (c) Sulphides of Group-II radicals have low solubility product.

106. (c) Because NH_3 acts as Lewis acid and they give electron pair to H_3O^+ ion. H_3O^+ is a Lewis base. Which accept the electron pair from NH_3 .

107. (c) Due to common ion effect.

108. (a) For $Ag_2SO_4 \rightarrow \underset{2x}{2Ag^+} + \underset{x}{SO_4^{--}}$

$K_{sp} = (2x)^2.x$; $K_{sp} = 4x^3$; $K_{sp} = 4\times(2.5\times10^{-2})^3$

$K_{sp} = 62.5\times10^{-6}$

109. (b) For $AgCl \rightarrow \underset{x}{Ag^+} + \underset{x}{Cl^-}$

$K_{sp} = x^2$; $x = \sqrt{K_{sp}}$, $\sqrt{1\times10^{-6}} = 1\times10^{-3}\ mole/litre.$

110. (b) $AgCl \rightarrow \underset{x}{Ag^=} + \underset{x}{Cl^-}$

After $NaCl$ is added x $\quad x + 1\times10^{-4}$

That is why Ag^+ will be less.

111. (b) Because of ionic product of $AgI >>$ solubility product of its.

112. (a) $AX_2 \rightarrow \underset{x}{A} + \underset{2x}{2X}$

$K_{sp} = 4x^3$; $x = \sqrt[3]{\frac{3.2\times10^{-11}}{4}}$; $x = 2\times10^{-4}$ mole/litre.

113. (c) $C_6H_5COONH_4 \rightarrow C_6H_5COO^- + NH_4^+$

$0.5 - \frac{.25}{100}\quad \frac{.25}{100}\quad \frac{.25}{100}$

According to Ostwald dilution law.

$K = \frac{\alpha^2 C}{1-\alpha}$ $\qquad \left(\therefore\ \alpha = \frac{.25}{100}\right)$

$K = \alpha^2 C$ $\qquad (\because\ 1-\alpha = \text{Very small})$

$K = \frac{.25}{100}\times\frac{.25}{100}\times.5$; $K = 3.125\times10^{-6}$

114. (a) $Sb_2S_3 \rightarrow \underset{2x}{2Sb^{+2}} + \underset{3x}{3S^{--}}$; $K_{sp} = (2x)^2.(3x)^3$

$K_{sp} = 108x^5$; $K_{sp} = 108\times(1\times10^{-5})^5 = 108\times10^{-25}$.

115. (b) When increasing the temperature the value of ionic product also increases.

116. (a) Hydrolysis constant $h = \frac{K_w}{K_a}$

Hydrogen ion concentration - *p*H scale and Buffer solution

1. (a) pH of blood does not change because it is a buffer solution.

2. (c) 0.001 M of $NaOH$ means $[OH^-] = .001$

$= 10^{-3}M \Rightarrow pOH = 3$

$pH + pOH = 14 \Rightarrow pH = 14 - 3 = 11$

3. (d) $[H_3O^+]$ means $[H^+] = 6.2\times10^{-9}\ mol/l$

$pH = -\log(6.2\times10^{-9}) = 8.21$

4. (b) $CH_3NH_2 + HCl \longrightarrow CH_3NH_3^+Cl^-$

0.1 $\quad$ 0.08 $\quad$ 0

0.02 $\quad$ 0 $\quad$ 0.08

(Basic buffer solution)

$pOH = pK_b + \log\frac{0.08}{0.02}$

$= pK_b + 0.602$

$= 3.30 + 0.602 = 3.902$

$\therefore\ pH = 10.09$

$[H] = 7.99\times10^{-11} \approx 8\times10^{-11}\ M$

5. (b) $pH + pOH = pK_w$

6. (d) $pH = -\log[H^+]$

$5.4 = -\log[H^+]$; $[H^+] = 3.98\times10^{-6}$.

7. (a) $KCN + H_2O \rightleftharpoons KOH + HCN$. KOH is a strong base and HCN is a weak acid.

8. (c) $[H^+] = 10^{-3}M,\ pH = -\log[10^{-3}],\ pH = 3$

9. (b) $[H^+] = [OH^-]$

$K_w = [H^+][OH^-] = 10^{-14}$

$\therefore [H^+] = 10^{-7},\ pH = -\log[H^+] = 7$.

10. (d) $pH = 5$ means $[H^+] = 10^{-5}$

$pOH = 14 - pH = 14 - 5 = 9$

$[OH^-] = 10^{-pOH} = 10^{-9}$

11. (a) $pH = -\log[H^+]; [H^+] = 0.01\,N$

$pH = -\log[10^{-2}]; pH = 2$

12. (d)

$$\begin{array}{lccccc} & BOH & \rightleftharpoons & B & + & OH \\ \text{Initial} & C & & 0 & & 0 \\ \text{At eq.} & C-C\alpha & & C\alpha & & C\alpha \end{array}$$

$$K_b = \frac{C^2\alpha^2}{C(1-\alpha)} = C\alpha^2 \text{ assuming } \alpha << 1 ; 1-\alpha \simeq 1$$

$$10^{-12} = 10^{-2} \times \alpha^2 ;\ \alpha^2 = 10^{-10} ;\ \alpha = 10^{-5}$$

$$[OH^-] = C\alpha = .01 \times 10^{-5} = 10^{-7}$$

13. (c) $pH = 4$ means; $[H^+] = 10^{-4}\ mol$

14. (a) Buffer solution is a mixture of weak acid and its conjugate base.

15. (b) Adding Na_2CO_3 to water makes the solution basic and hence a pH increases from 7.

16. (d) $NaClO_4$ is a salt of strong acid $HClO_4$. So it is a strong acid salt.

17. (b) $NaOH$ is a base, so that its $pH > 7$

18. (c) It is a strong base.

1 M $NaOH$ has maximum $[OH^-]$ and minimum $[H^+]$ and maximum pH.

19. (c) When $pH = 7$ means neutral, $pH < 7$ means acidic, $pH > 7$ means basic.

20. (d) As the solution is acidic, $pH < 7$. This is because $[H^+]$ from $H_2O[10^{-7}M]$ cannot be neglected in comparison to 10^{-10} M

22. (c) It is a strong acid and they lose proton in a solution.

23. (a) $[OH^-] = 10^{-2}\ M$; $pOH = 2$

$$pH + pOH = 14 ; pH = 14 - pOH$$

$$pH = 14 - 2 = 12$$

24. (d) Order of acidic strength is $H_2Te > H_2Se > H_2S > H_2O$

Na_2O is a salt of NaOH $+ H_2O$ and H_2O is least acidic among given acids hence pH in this case will be $\max^m$.

25. (b) pH of the solution $A = 3$

$[H]_A = 10^{-3}\ M.$

pH of the solution $B = 2$

$[H]_B = 10^{-2}\ M$

$[H] = 10^{-3} + 10^{-2} = 10^{-3} + 10 \times 10^{-3} = 11 \times 10^{-3}.$

$pH = -\log(11 \times 10^{-3}) = 3 - \log 11$

$= 3 - 1.04 = 1.95$

26. (a) $CN^- + H_2O \rightarrow HCN + OH^-$

Because OH^- concentration is increased.

27. (a) On dilution the pH of acid A increases while pH of base B decreases.

28. (d) CH_3COONa is a salt of weak acid, (CH_3COOH) and strong base $(NaOH)$.

29. (b) The equilibrium will shift in the backward direction.

30. (b) $K_a = 10^{-5}$; $pH = 6$

$$pH = -\log K_a + \log\frac{[\text{Salt}]}{[\text{Acid}]} ;\quad 6 = -\log 10^{-5} + \log\frac{[\text{Salt}]}{[\text{Acid}]}$$

$$6 = 5\log 10 + \log\frac{[\text{Salt}]}{[\text{Acid}]};\ 6 = 5 + \log\frac{[\text{Salt}]}{[\text{Acid}]}$$

$$\log\frac{[\text{Salt}]}{[\text{Acid}]} = 6 - 5 = 1 ;\ \frac{[\text{Salt}]}{[\text{Acid}]} = \frac{10}{1}$$

31. (d) All are true – (a) is true for acid buffer, (b) for basic buffer, (c) is called buffer solution.

32. (b) $\frac{N}{100} = 0.01\,N\,HCl ; [H^+] = 10^{-2}\,M ;\ pH = 2$

$[OH] = 10^{-2}\,M$ for $NaOH$

$pH + pOH = 14 ;\ pH = 14 - 2 ; pH = 12$

34. (a) It is a buffer solution of strong acid and its weak conjugate base.

35. (c) $HA \rightleftharpoons H^+ + A^-$

$[H^+] = 0.1\ M ;\ [H^+]^2 = K_a \times C$

$[H^+] = \sqrt{K_a \times C} = \sqrt{1 \times 10^{-5} \times 0.1} = \sqrt{10^{-6}}$

$[H^+] = 10^{-3}M;\ pH = 3$

36. (c) As the solution is acidic, $pH < 7$. This is because $[H^+]$ from H_2O cannot be neglected in comparison to 10^{-8}.

37. (c) Human body contain buffer solution. Its pH = 6.8

38. (a) It is a neutral solution and its pH = 7

39. (a) $pH = 5$, means $[H^+] = 10^{-5}M.$

After dilution $[H^+] = 10^{-5}/100 = 10^{-7}M$

$[H^+]$ from H_2O cannot be neglected.

Total $[H^+] = 10^{-7} + 10^{-7} = 2 \times 10^{-7}$

$pH = 7 - 0.3010 = 6.6990 = 7$ (neutral).

40. (d) $[H^+] = \alpha.C = \frac{2}{100} \times .02 ;\ [H^+] = 4 \times 10^{-4}\,M$

$pH = -\log[H^+] = 4 - \log 4 ;\ pH = 3.3979$

41. (a) $pH = pK_a + \log\left[\frac{\text{salt}}{\text{acid}}\right]$

$= 9.30 + \log\left[\frac{0.2}{0.1}\right] = 9.30 + 0.3010 = 9.6.$

42. (a) $pH = pK_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$

$$pH = -\log(1.8 \times 10^{-5}) + \log\frac{[10]}{[100]}$$

$$= -\log 1.8 + 5 + \log 10^{-1}$$

$$= -0.2553 + 5 - 1 = 3.7447 \text{ or } = 4$$

43. (b) 20 ml of 0.1 $NHCl$ = $\frac{0.1}{1000} \times 20g$ eq. = $2 \times 10^{-3}g$ eq.

20ml of 0.001 KOH = $\frac{0.001}{1000} \times 20\,gm$ eq.

$= 2 \times 10^{-5}g$ eq.

$\therefore$ HCl left unneutralised = $2(10^{-3} - 10^{-5})$

$= 2 \times 10^{-3}(1 - 0.01) = 2 \times 0.99 \times 10^{-3} = 1.98 \times 10^{-3}g\,eq.$

Volume of solution = 40 ml

$\therefore$ $[HCl] = \frac{1.98 \times 10^{-3}}{40} \times 1000M = 4.95 \times 10^{-2}$

$\therefore$ pH = 2 − log 4.95 = 2 − 0.7 = 1.3.

45. (b) $10^{-7}M\ NaOH$ means $[OH^-] = 10^{-7}$; $pOH = 7$

$pH = 14 - 7 = 7$

46. (a) $[H^+] = c \times \alpha = 0.1 \times \frac{30}{100} = 0.03\ M$

48. (a) The pH of buffer solution never changed.

49. (c) $[H^+] = \frac{10^{-14}}{10^{-1}} = 10^{-13}\ mol/litre\ \ pH = 13.$

50. (a) $pH = -\log[H^+]\,; 7.4 = -\log[H^+]\,;\ [H^+] = 4 \times 10^{-8}\,M$

51. (a) The pH of $0.1M$ $HCl = 1$ Ionization of H_2SO_4 takes place in two steps.

$H_2SO_4 \rightleftharpoons H^+ + HSO_4^-\ ;\ HSO_4^- \rightleftharpoons H^+ + SO_4^{--}$

52. (c) $1N$ $NaOH$ solution have highest pH

$[OH^-] = 1;\ pOH = 0\,;\ pH + pOH = 14$

$pH = 14 - 0 = 14$

53. (c) $H_2O \rightleftharpoons [H^+]\,[OH^-]$

$HCl \rightleftharpoons [H^+]\,[Cl^-]$

Total $[H^+] = [H^+]_{H_2O} + [H^+]_{HCl} \quad = 10^{-7} + 10^{-8}$

$= 10^{-7}[1 + 10^{-1}]$

$[H^+] = 10^{-7} \times \frac{11}{10}$

$pH = -\log[H^+] = -\log\left(10^{-7} + \frac{11}{10}\right); pH = 6.958$

54. (c) $pK_a = -\log K_a$, $pK_b = -\log K_b$

$pH = -\frac{1}{2}[\log K_a + \log K_w - \log K_b]$

$= -\frac{1}{2}[-5 + \log(1 \times 10^{-14}) - (-5)]$

$= -\frac{1}{2}[-5 - 14 + 5] = -\frac{1}{2}(-14) = 7$

55. (d) BaO, CaO and Na_2O are shows more than 7 pH because of their basic nature.

56. (a) $MgCl_2 + 2H_2O \rightleftharpoons Mg(OH)_2 + 2HCl$

57. (c) H_2SO_4 ionized in two step.

58. (b) $pH = pK_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$

$5.8 = 4.8 + \log\frac{[\text{Salt}]}{[\text{Acid}]}$ or $\log\frac{[\text{Salt}]}{[\text{Acid}]} = 1.0$

$\frac{[\text{Salt}]}{[\text{Acid}]} = \text{antilog}\,1.0 = 10$

$\therefore \quad \frac{[\text{Acid}]}{[\text{Salt}]} = \frac{1}{10} = 0.1$

59. (b) It contains replacable H atom.

60. (c) (i) 20 ml of 0.5 N HCl

$0.5N \Rightarrow 1000\,ml\ 0.5\,mole\ HCl$ is present in $20\,ml$

$= \frac{20 \times 0.5}{1000} = 1.0 \times 10^{-2}$

(ii) 35 ml of 0.1 N $NaOH$

$0.1N \Rightarrow 1000ml$ of 0.1 mole $NaOH$ is 35 ml

$= \frac{35 \times 0.1}{1000} = 0.35 \times 10^{-2}$

Total = 20 + 35 = 55 ml.

$\Rightarrow$ $(1.0 - 0.35)10^{-2} = 0.65 \times 10^{-2}$ mole HCl

$HCl = H^+ + Cl^-$

$\Rightarrow$ $[HCl] = [H^+] + [Cl^-]$

55 ml contains 0.65×10^{-2} mole of H^+ ions

$1000\,ml - \frac{0.65 \times 10^{-2} \times 10^3}{55} = \frac{6.5}{55}$

$pH = -\log[H^+] = -\log(6.5/55)$

$= \log 55 - \log 6.5 = 0.92$

Due to acidic nature of solutions the colour of phenolphthalein becomes pink.

61. (b) $[H^+] = 2 \times 10^{-2}\ M$

$\because pH = -\log\,[2 \times 10^{-2}]\,;$

$pH = 1.7$ *i.e.* in between 1 and 2.

63. (b) $pH = 4,\ (H^+) = 10^{-pH} \ = 10^{-4}\ M$

65. (c) $NaOH \rightleftharpoons Na^+ + OH^-$

$[OH^-] = 10^{-5}\ M\,; [H^+]\,[OH^-] = 10^{-14}$

$[H^+] = \frac{10^{-14}}{10^{-5}}\ ;\ [H^+] = 10^{-9}\ M\,;\ pH = 9\,.$

67. (b) $pH = pK_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}; pH = 4.75 + \log\frac{0.1}{0.1}$

$pH = 4.75 + \log 1\,; pH = 4.75$

68. (d) A weak acid and its salt with a strong base maintain pH 4 – 5

69. (a) $NaOH \rightleftharpoons\ Na^+ + OH^- \ = [OH^-] = 10^{-8}\ MMM.$

70. (c) $[OH^-] = 0.0001\ N,\ \ pOH = 4\,,\ pH + pOH = 14$

$pH = 14 - pOH \ \ = 14 - 4 = 10$

71. (d) 0.001 M KOH solution

$[OH^-] = 0.001\,M = 1 \times 10^{-3}\,M$

$[H^+] \times [OH^-] = 1 \times 10^{-14}$

$[H^+] = \frac{1 \times 10^{-14}}{[OH^-]}$

$[H^+] = \frac{1 \times 10^{-14}}{1 \times 10^{-3}} \ = 1 \times 10^{-14} \times 10^{+3}$

$[H^+] = 10^{-11}\ M$

$pH = 11$

72. (a) An acid buffer solution consists of solution of weak acid with strong base of its salt.

73. (b) An acid buffer solution consists of a weak acid and its salt with strong base. *i.e.* $CH_3COOH + CH_3COONa$

74. (a) $pOH = pK_b + \log\frac{[\text{salt}]}{[\text{base}]}$

$= 5 + \log\frac{0.02}{0.2} = 5 + \log\frac{1}{10} = 5 + (-1) = 4$

$pH = 14 - pOH = 14 - 4 = 10$

75. (b) [Salt]= 0.1 *M*, [Acid]= 0.1 *M*

$K_a = 1.8\times10^{-5}$; $pH = -\log K_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$

$= -\log 1.8\times10^{-5} + \log\frac{0.1}{0.1} = -\log 1.8\times10^{-5}$

$pH = 4.7$.

76. (a) NH_4Cl and NH_4OH is a buffer solution (weak base and salt of strong acid).

77. (a) $pH + pOH = 14$; $pH = 14 - pOH$

$\because [OH^-] = 10^{-7}$

$pOH = 7$

$\therefore pH = 14 - 7 = 7$.

78. (c) 0.01 *M* $Ba(OH)_2 = 0.02N\ Ba(OH)_2$

$N_1V_1 = N_2V_2$

$[0.02N]\times[50\ ml] = N_2 \times 100\ ml$

$N_2 = \frac{0.02\times50}{100} = 10^{-2}N$; $[OH^-] = 10^{-2}\ N$

$pOH = 2$ or $pH = 12$

79. (b) $pH = -\log[H^+]$.

80. (a) Na_2CO_3 is a mixture of weak acid and strong base, so it is a base.

81. (b) $10^{-7}\ N\ HCl$ means $(H^+) = 10^{-7}\ M$

$pH = -\log(H^+)$, $pH = 7$

82. (c) $pH = 2$; $pH = -\log[H^+]$; $2 = -\log\ [H^+]$

$[H^+] = 10^{-2} = 0.01\ N$

83. (b) *pH* does not change on addition of some concentration of *HCl*.

84. (b) Solution of CH_3COONa on addition to acid shows a decrease in dissociation of acid due to common ion effect. To decrease in $[H^+]$ or increase *pH*.

85. (c) $pH + pOH = 14$; $pH = 14 - pOH$; $pH = 14 - 6 = 8$.

86. (b) $[H^+]_{\text{I}} = 10^{-5}$ $[H^+]_{\text{II}} = 10^{-2}$

Thus increase in $[H^+] = \frac{10^{-2}}{10^{-5}} = 1000$ times

87. (a) The *HCl* is a strong acid and they lose easily H^+ in solution.

88. (a) $X^- + H_2O \rightleftharpoons OH^- + HX$

$K_b = \frac{[OH^-]\,[HX]}{[X^-]}$

$HX \rightleftharpoons H^+ + X^-$

$K_a = \frac{[H^+]\,[X^-]}{[HX]}$

$\therefore K_a \times K_b = [H^+]\,[OH^-] = K_w = 10^{-14}$

Hence $K_a = 10^{-4}$

Now as $[X^-] = [HX]$, $pH = pK_a = 4$.

90. (d) Buffer solution is formed. So the *pH* will not change.

91. (b) Na_2CO_3 when react with water form strong base and weak acid. So its aqueous solution is basic.

92. (c) $K_w = [H_3O^+][OH^-]$

Concentration of H_3O^+ in distilled water $= 1\times10^{-6}$ *mol/l*.

Now $[H_3O^+] = [OH^-]$

$K_w = [1\times10^{-6}]\times[1\times10^{-6}] = 1\times10^{-12}$.

93. (a) $[OH^-] = 10^{-1}M$; $pOH = 1$

$pH + pOH = 14$; $pH = 14 - 1 = 13$.

94. (a) Maximum *pH HClO* is a weak acid all of these. So that the salt of weak acid is also weak.

95. (c) As the solution is acidic $pH < 7$. This is because $[H^+]$ from $H_2O\ [10^{-7}]$ cannot be neglected in comparison to 10^{-12} *M*.

96. (b) [Normal salt + acidic salt] is a buffer solution.

97. (b) 100 *ml* of $\frac{M}{10}$ *NaOH* = 50*ml* of $\frac{M}{5}$ *NaOH*. They exactly neutralise 50 *ml* $\frac{N}{5}$ *HCl*. Hence *pH* of resulting solution = 7.

98. (b) $M_1 = 6.0$ *M* of *HCl*; $V_1 = ?$

M_2 =0.30 *M* is H^+ concentration in solution.

V_2 = 150 *ml* of solution.

$M_1V_1 = M_2V_2$; $6.0\times V_1 = .30\times150$

$V_1 = \frac{.30\times150}{6} = 7.5$ *ml*.

99. (b) $pH = 3$, $[H^+] = 10^{-3}M$

$\because [H^+] = \sqrt{K\times c}$

$[10^{-3}]^2 = K\times c$; $\frac{[10^{-6}]}{0.1} = K = 10^{-5}$

100. (b)When ratio of concentration of acid to salt is increased *pH* decrease.

101. (c) For NH_4OH.

$[OH^-] = C.\alpha$; $C = \frac{1}{10}M$, $\alpha = 0.2$

$[OH^-] = \frac{1}{10} \times 0.2 = 2 \times 10^{-2}\, M$

$pOH = -\log[OH^-] = \log[2 \times 10^{-2}]$; $pOH = 1.7$

$pH = 14 - pOH \;= 14 - 1.7 = 12.30$.

102. (c) $pH = pK_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$. For small concentration of buffering agent and for maximum buffer capacity $\frac{[\text{Salt}]}{[\text{Acid}]} \approx 1$.

103. (a) $[H^+]$ = increased ten fold means pH of solution decreased by one.

$pH = \log\frac{1}{[H^+]}$

104. (a) Because the pH of buffer are not changed.

105. (c) $pH = pK_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$; $5.5 = 4.5 + \log\frac{[\text{Salt}]}{[0.1]}$

$\log\frac{[\text{Salt}]}{0.1} = 5.5 - 4.5 = 1$

$\frac{[\text{Salt}]}{0.1}$ = antilog 1 = 10 ; $[\text{Salt}] = 1$

106. (a) Moles of $H_2SO_4 = \frac{0.49}{98} = 5 \times 10^{-3}$ moles of H_2SO_4 present per litre of solution (molarity) $= \frac{.005}{1} = .005\, M$.

$H_2SO_4 + 2H_2O \rightleftharpoons 2H_3O^+ + SO_4^{--}$

one mole of H_2SO_4 give 2 moles of H_3O^+ ions.

$H_3O^+ = 2 \times (H_2SO_4) = 2 \times 0.005 = 0.01\, M$

$[H^+] = 10^{-2}\, M$; $pH = 2$

107. (c) CH_3COONH_4 is a simple buffer and called salt of weak acid.

108. (c) N.eq. for $HCl = \frac{0.4}{1000} \times 50 = 0.02$

N.eq. for $NaOH = \frac{0.2}{1000} \times 50 = 0.1$

Now $[OH^-]$ left $= 0.1 - 0.02$

$[OH^-] = .08 = 8 \times 10^{-2}\, M$

$pOH = -\log 8 \times 10^{-2}\, M$; $pOH = 1.0$

109. (d) Buffer is mixture of weak base and its acid salt.

110. (b) $[NaOH] = 0.4/40\; mole/l. = 0.1\, M$

$[OH^-] = 10^{-1}\, M$, $[H^+] = 10^{-13}\, M$, $pH = 13$

111. (d) $pH + pOH = 14$, $pH = 4$, $H^+ = 10^{-4}$ mole/litre.

112. (d) Buffer solution have constant pH. When we add the water into this buffer solution. So no effect on it.

113. (b) $Ba(OH)_2 \rightleftharpoons Ba^{2+} + 2OH^-$

One molecule on dissociation furnishes $2OH^-$ ions.

So, $[OH^-] = 2 \times 10^{-4}\, N$

$N = M \times 2$; $M = \frac{N}{2} = \frac{2 \times 10^{-4}}{2} = 10^{-4}$

$pOH = -\log[OH^-] = -\log(1 \times 10^{-4}) = -4$

$pH + pOH = 14$; $pH = 14 - 4 = 10$.

114. (a) M.eq. of 0.10 M $HCl = \frac{0.10}{1000} \times 40 = 0.004M$

M.eq. of 0.45 M $NaOH = \frac{0.45 \times 10}{1000} = 0.0045M$

Now left $[OH^-] = 0.0045 - 0.004 = 5 \times 10^{-4}\, M$

Total volume = 50 ml.

$[OH^-] = \frac{5 \times 10^{-4}}{50} \times 1000$; $[OH^-] = 1 \times 10^{-2}$

$pOH = 2$; $pH = 14 - pOH = 12$.

115. (c) 0.001 M $HCl = 10^{-3}\, M[H^+]$, $pH = 3$.

116. (d) $[NaOH] = \frac{0.4}{40} = 0.01M$; $[OH^-] = 10^{-2}\, M$

$[H^+] = 10^{-12}$, $pH = -\log[H^+] = 12$

117. (b) Those substance which give a proton is called Bronsted acid while CH_3COO^- doesn't have proton so it is not a Bronsted acid.

120. (c) $pH = -\log[H^+]$

121. (d) $pH + pOH = 14, pH = 4.0$

$pOH = 14 - pH$; $pOH = 14 - 4.0 = 10.0$

122. (b) $pH = 0$ means $[H^+] = 10^o = 1M$. Hence solution is strongly acidic.

123. (c) As the solution is acidic, $pH < 7$. This is because $[H^+]$ from $H_2O\ (10^{-7}\, M)$ cannot be neglected in comparison to $10^{-10}\, M\ HCl$.

124. (d) $H_3O^+ \rightleftharpoons OH^- + H_2$

$pOH + pH = 14$; $7 + 7 = 14$; $[H^+] + [OH^-] = 10^{-14}$

$10^{-7} + 10^{-7} = 10^{-14}$; $[OH^-] = 10^{-7}$ gm ion/l.

126. (b) When $pH = 2$, $[H^+] = 10^{-2}\, M$

127. (a) $[OH^-]$ ion conc. $= 0.05\frac{mol}{l} = 5 \times 10^{-2}\frac{mol}{l}$

$pOH = -\log[OH^-] = -\log[5 \times 10^{-2}]$

$pOH = 1.30$; $pH + pOH = 14$

$pH = 14 - pOH = 14 - 1.30 = 12.7$

128. (c) When $pH = 3$, then $[H^+] = 10^{-3}\, M$ after that we increased the pH from 3 to 6 then $[H^+] = 10^{-6}\, M$ means reduced 1000 times.

129. (b) CO_2 is acidic oxide which on dissolution in water develops acidic nature.

130. (d) If pH of any solution is 2.

Then $[H^+] = 10^{-2}\, M$

If *pH* of any solution is just double then $pH = 4$ and $[H^+]$ will be 10^{-4}.

131. (c) A strong acid is not used to make a buffer.

132. (d) $pH = 1$ means $[H^+] = 10^{-1}\,M$

Hence $[H_2SO_4] = \frac{10^{-1}}{2} = \frac{1}{20} = 0.05\,M$

133. (c) The *pH* of blood is 7.4 due to presence of bicarbonates ions

134. (c) As the solution is acidic, *pH* < 7. This is because $[H^+]$ from $H_2O\ [10^{-7}]$ cannot be neglected in comparison to 10^{-8}

135. (a) *pH* will decrease because $[OH^-]$ increased due to this pOH is decreased.

136. (c) $[H^+] = 6 \times 10^{-4}\,M$

$pH = -\log[H^+] = -\log[6 \times 10^{-4}] = 3.22$.

137. (c) $0.01\,M\,HCl = 10^{-2}\,M[H^+],\ pH = 2$.

138. (c) Because buffer solution have a constant *pH*.

139. (c) $10^{-6}\,M\,HCl = 10^{-8}\,M[H^+]$. Also from H_2O

$[H^+] = 10^{-7}\,M$

Total $[H^+] = 10^{-7} + 10^{-8} = 10^{-7}[1 + 0.1] = 10^{-7}[1.1]$

Hence $pH = 7 - 0.0414 = 6.96$.

140. (b) $10^{-10}\,M\ HCl = 10^{-10}\,M[H^+]$. But $pH \neq 10$ because solution is acidic. This is because H^+ from $H_2O(10^{-7}\,M)$ cannot be neglected.

Total $[H^+] = 10^{-7} + 10^{-10}$

$= 10^{-7} + (1 + 10^{-3}) = 10^{-7}(1.001)$

That is why $pH = 7$ (slightly less than 7)

141. (b) $[H^+] = 1.00 \times 10^{-6}$ *mole/litre*

$pH = -\log[1.00 \times 10^{-6}]$; *pH* = 6.

142. (a) $[H^+]$ is in moles per litre.

143. (d) As the solution is acidic, $pH < 7$. This is because $[H^+]$ from $H_2O\ (10^{-7}\,M)$ cannot be neglected in comparison to 10^{-8}.

145. (b) *pH* of 0.001 *M HCl* $= 10^{-3}\,M[H^+]$, *pH* = 3.

146. (d) Because it can furnish H^+ ions in solutions.

147. (c) Because it is a strong acid.

$H^+ = 10^{-1}$

$pH = -\log[H^+] = -\log[10^{-1}];\ pH = 1$.

148. (b) Buffer solution is a combination of weak acid and conjugate base. *NaCl* is a salt and *NaOH* is the base.

149. (a) $[H^+] = \sqrt{Kc} = \sqrt{10^{-5} \times 0.1} = 10^{-3},\ pH = 3$.

150. (d) In $\frac{N}{10}$ *NaOH* have $[OH^-] = 10^{-1}\,M$ means $pOH = 1$ and then $pH + pOH = 14$

$pH = 14 - pOH = 13$.

151. (b) Borate ions are hydrolyzed to develop alkaline nature in solution.

152. (d) Less the *pH*, more acidic is the solution.

154. (b) The equal conc. of salt and acid.

155. (c) $pH = -\log K_a + \log\frac{[KCN]}{[HCN]}$

$pH = -\log[5 \times 10^{-10}] + \log\left(\frac{0.15}{1.5}\right) = 8.302$

157. (c) $pH = pK_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$ equimolar means

$\frac{[\text{Salt}]}{[\text{Acid}]} = 1;\quad pH = 4.74 + 0 = 4.74$

158. (a) Because of *NaCl* is a salt of strong acid and strong base. So that it is neutral.

159. (c) When strong acid and strong base are react neutral salt are formed. So that *NaCl* is a neutral salt.

162. (d) $pH = -\log K_b + \log\frac{[\text{Salt}]}{[\text{Acid}]}$

$pH = -\log[1.8 \times 10^{-5}] + \log\frac{[\text{Salt}]}{1.0}$

$9 = 4.7 + \log\frac{[\text{Salt}]}{1.0}$; $\log\frac{[\text{Salt}]}{1.0} = 4.7 - 9 = -4.3$

$\frac{[\text{Salt}]}{1.0} = \text{Antilog}\frac{1}{4.3}$; $[\text{Salt}] = 1.8$

163. (b) $pH = -\log K_b + \log\frac{[\text{salt}]}{[\text{acid}]}$

$5 = -\log 10^{-4} + \log\frac{[\text{salt}]}{[\text{acid}]}$

$\log\frac{[\text{salt}]}{[\text{acid}]} = 1$

$\frac{[\text{salt}]}{[\text{acid}]} = \text{antilog}1 = 10:1$

164. (a) 1 *M KOH* show highest *pH* value because it is a strong base.

165. (d) NH_4OH is a weak acid and NH_4Cl is a strong base salt.

166. (a) $pH = 13.6$

$pOH = 14 - 13.6 = 0.4$

$[OH^-] = \text{Antilog}(-0.4) = 0.3979$. So the value of $[OH^-]$ between $0.1\ M$ and $1\ M$

167. (d) Aspirin is a weak acid. Due to common ion effect it is unionised in acid medium but completely ionised in alkaline medium.

168. (b) $[H^+][OH^-] = 10^{-14}; (10^{-7})(10^{-7}) = 10^{-14}$

169. (c) $HCl = 10^0\,M$ has $pH = 0$. The value of *pH* decreases as concentration further increases.

170. (a) Because pure water has a 7 *pH*.

171. (c) When concentration of $[H^+]$ increased then the value of *pH* is decreases.

$$pH = \log\frac{1}{[H^+]}$$

172. (c) The concentration of $[H^+] = 10^{-2}$ mole/litre

$$pH = -\log[H^+] = -\log[10^{-2}]\,;\, pH = 2$$

173. (d) Due to common ion effect.

174. (b) In water solution.

$$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$$

concentration of OH^- is increased so that solution become more basic and the *pH* is increased.

175. (a) Na_2CO_3 is basic in nature. So its *pH* is greater than 7.

176. (c) It is not a mixture of weak acid or base and their strong salt.

177. (a) $[H^+] = \text{Antilog}(-4.58)\,;$

$$[H^+] = 2.63 \times 10^{-5}\ moles/litre$$

178. (c) $10^{-2}\ M\ NaOH$ will give $[OH^-] = 10^{-2}$

$\therefore pOH = 2$, Also $pH + pOH = 14$

$\therefore pH = 12$.

179. (a) $pH = pK_a + \log\frac{[\text{Salt}]}{[\text{Acid}]} = -\log 2\times10^{-5} + \log\frac{10\times1}{50\times2} = 4$.

180. (b) 0.001 *M* $NaOH$ means $[OH^-] = 10^{-3}$; $pOH = 3$

$$pH + pOH = 14;\ pH = 14 - 3$$

$pH = 11$; $[H^+] = 10^{-11}$ *mole-litre*

181. (c) $[H^+] = C.\alpha$

$$[H^+] = 0.1 \times \frac{1}{100} = 10^{-3}$$

$$pH = -\log[H^+] = -\log 10^{-3} = 3$$

182. (b) $pH = 4$

$$pH + pOH = 14\ ;\ pOH = 14 - pH$$

$$pOH = 14 - 4 = 10\,;\ [OH^-] = 10^{-10}\ M$$

183. (b) $pH = \log\frac{1}{[H^+]} = \log\frac{1}{[3\times10^{-3}]} = 2.523$

185. (c) It is a strong base.

186. (b) $[H^+]$ Concentration in 0.01*M* *HCl* is $10^{-2}\ M$ because 0.01 *M* *HCl* have only H^+

$$HCl \rightleftharpoons H^+ + Cl^-.$$

187. (b) The value of H_3O^+ ions will not changed.

$$CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+.$$

188. (a) H_2O_2 (Hydrogen peroxide) is a corrosive volatile liquid. It is slightly acidic in nature. Its pKa value is approximately 10^{-12}.

192. (b) $pH = \log\frac{1}{H^+}$; $pH = \log\frac{1}{10^{-3}}$; $pH = 3$.

193. (b) NH_3 is Lewis base because of one lone pair of electron.

194. (b) $Ba(OH)_2 \rightarrow \underset{.05M}{Ba^{+2}} + \underset{2\times0.5M}{2OH^-}$

$$pOH = \log\frac{1}{[OH]^-} = \log\frac{1}{.1} = 1$$

$$pH + pOH = 14\,;\ pH + 1 = 14\,;\ pH = 14 - 1 = 13$$

195. (a) If concentration of acid is increases ten times in a buffer then pH of the solution is increase by one.

198. (b) $pH > 7 =$ Basic

It means contain more hydroxide ions than carbonate ions.

199. (a) At 7*pH* the concentration of OH^- and H^+ are equal.

200. (a,d) M.eq. of 0.01 $M\ HCl = \frac{.01\times100}{1000} = 1\times10^{-3}$

$$pH = 3$$

M.eq. of .02 $M\ H_2SO_4 = \frac{.04\times50}{1000} = 2\times10^{-3}$

M.eq. of .02 $M\ NaOH = \frac{0.02\times50}{1000} = 1\times10^{-3}$

Left $[H^+] = 2\times10^{-3} - 1\times10^{-3} = 1\times10^{-3}\,;\ pH = 3$

202. (a,b,c) Because buffer solution are mixture of weak acid or weak base and their salt.

203. (c) Because $pH = 8$ is basic nature but HCl is a strong acid.

204. (c) $H_2SO_4 = 0.05\times2$

$$\therefore [H^+] = 0.1 \text{ and } pH = 1$$

205. (b) $Mg(OH)_2 \rightleftharpoons Mg^{2+} + 2OH^-$

$$K_{sp} = [Mg^{2+}][OH^-]^2$$

$$1\times10^{-12} = 0.01[OH^-]^2$$

$$[OH^-]^2 = 1\times10^{-10} \Rightarrow [OH^-] = 10^{-5}$$

$$[H^+] = 10^{-14}/10^{-5} = 10^9$$

$$pH = -\log[H^+] = -\log[10^{-9}] = 9$$

206. (b) $[OH^-] = 1\times10^{-5}$

$$pOH = -\log[OH^-] = 5$$

$$pH + pOH = 14 \Rightarrow pH = 14 - 5 = 9.$$

Critical Thinking Questions

1. (b) K_{sp} of $AgI = 1.5\times10^{-16}$

$10^{-8}\ M\ Ag^+$ and $10^{-8}\ M\ I^-$

$$\text{Ionic product} = 10^{-16}$$

$$K_{sp} = \text{Ionic product}$$

2. (a) $HClO$ is the weakest acid. Its conjugate base ClO^- is the strongest base.

3. (b) $B(OH)_3$ not have H^+

4. (a) $h = \frac{k_w}{k_a} = \frac{1\times10^{-14}}{4.5\times10^{-10}} = 2.22\times10^{-5}$

5. (d) $MX_4 \rightarrow \underset{s}{M} + \underset{4s}{4X}$; $K_{sp} = (4s)^4 s$; $K_{sp} = 256s^5$

$$s = \left(\frac{K_{sp}}{256}\right)^{1/5}.$$

6. (a) Lewis acid are electrophiles because they accept election pairs.

7. (c) $$\begin{array}{lccc} \text{Initial} & \underset{2}{2HI} & \rightleftharpoons & \underset{0}{H_2}+\underset{0}{I_2} \end{array}$$

At equilibrium $2-\alpha \quad \frac{\alpha}{2} \quad \frac{\alpha}{2} \quad = 2-\alpha+\frac{\alpha}{2}+\frac{\alpha}{2}=2$.

8. (a) Because they have vacant *d*-orbital in central atom.

9. (a) Energy has to be spent for the total dissociation of weak acid.

10. (a) pK_a of acid $A=4$; pK_a of acid $B=5$

We know that $pK_a=-\log K_a$

$\therefore$ Acid A $K_a=10^{-4}$

Acid B $K_a=10^{-5}$

Hence *A* is ten times stronger than that of *B*.

11. (b) $\frac{\alpha_1}{\alpha_2}=\sqrt{\frac{K_{a_1}}{K_{a_2}}}=\sqrt{\frac{3.14\times10^{-4}}{1.6\times10^{-5}}}=4:1$

12. (d) It is a salt of weak acid and weak base.

13. (c) $HA \rightleftharpoons H^+ + A^-$; $K_a=\frac{[H^+][A^-]}{[HA]}$ ......(i)

neutralization of the weak acid with strong base is

$HA+OH^- \rightleftharpoons A^- + H_2O$

$K=\frac{[A^-]}{[HA]\,[OH^-]}$ ......(ii)

dividing (i) by (ii) $\frac{K_a}{K}=[H^+][OH^-]=K_w=10^{-14}$

$K=\frac{K_a}{K_w}=\frac{10^{-5}}{10^{-14}}=10^9$.

14. (d) NH_4Cl undergoes cationic hydrolysis hence *pH* is >7 because the solution due to cationic hydrolysis in acids.

NaCN undergoes anionic hydrolysis hence *pH* is >7.

HCl is strong acid and *NaCl* is neutral solution.

Hence the *pH* of given solutions will increases.

$HCl < NaCl < NaCN < NH_4Cl$

15. (c) It is a $HClO_4$

16. (d) Smaller the ${}_pK_a$ value, strong the acid.

17. (d) It involves gain and loss of electron pair (Lewis concept).

18. (b) $H^-_{(aq.)}+H_2O_{(l)} \rightarrow OH^- + H_2$.

19. (b) $K_H=\frac{K_a}{K_w}=\frac{10^{-4}}{10^{-14}}=\frac{1}{10^{-10}}=10^{10}$.

20. (d) Acidity is directly propotional to oxidation number. As the O.No. of *S*, *P* and *Cl* in H_2SO_3, H_3PO_3 & $HClO_3$ is +4, +3 & +5 respectively so decreasing order of acidity will be III > I > II.

21. (a) A substance which can donate a proton is known as acid so NH_4^+ will be a acid.

22. (b) Acetic acid is a weak acid.

23. (a) Because it is a acidic oxide.

24. (b) $[Ca^{2+}][F^-]^2=\left[\frac{10^{-2}\times V}{2V}\right]\times\left[\frac{10^{-3}\times V}{2V}\right]^2=1.25\times10^{-9}$.

25. (a) The degree of hydrolysis of a salt of weak acid and weak base is independent of concentration of salt.

26. (c) $C=0.1M;\ \alpha=1\%;\ (H^+)=C\times\alpha$

$=0.1\times\frac{1}{100}=10^{-3}$; $(H^+)=10^{-3}$; $pH=3$.

27. (d) $HClO_4$ is a strong acid, because its oxidation no is + 7.

28. (d) Acceptor of electron pair is known as lewis acid. *S*, : $CH_2, (CH_3)_3B$ all can accept an electron pair so answer is (d).

29. (b) $Mg(OH)^2 \rightleftharpoons \underset{(s)}{Mg^{2+}}+\underset{(2s)^2}{2OH^-}$

$K_{sp}=4S^3 \Rightarrow S=\sqrt[3]{\frac{K_{sp}}{4}}=\sqrt[3]{\frac{1.2\times10^{-11}}{4}}$

$S=8.16\times10^{-4}$

30. (d) $K_a=\frac{[H^+][CN^-]}{[HCN^-]}$

$6.2\times10^{-10}=\frac{[H^+][0.02]}{[0.01]}$

$[H^+]=\frac{6.2\times10^{-10}\times0.01}{0.02}=3.1\times10^{-10}$

31. (b) $\ddot{N}H_3$ presence of lone pair of electrons.

32. (a) $\underset{K_{sp}}{CuBr} \rightleftharpoons \underset{(S)}{Cu^+}+\underset{(S)}{Br^-}$

$K_{sp}=S^2=(2\times10^{-4})^2=4\times10^{-8}\,\frac{mol^2}{l^2}$

33. (c) $\underset{(0.004-x)}{Na_2SO_4} \rightleftharpoons \underset{2x}{2Na^+}+\underset{x}{SO_4^{2-}}$

Since both the solution are isotonic $0.004+2x=0.01$

$\therefore\ x=3\times10^{-3}$

$\therefore$ Percent dissociation $=\frac{3\times10^{-3}}{0.004}\times100=75\%$.

34. (a) $Cr(OH)_3 \rightarrow \underset{x}{Cr^{+3}}+\underset{3x}{3OH^-}$

$K_{sp}=x.(3x)^3=27x^4$

$x=\sqrt[4]{\frac{K_{sp}}{27}}$; $x=\sqrt[4]{\frac{2.7\times10^{-31}}{27}}$

$x=1\times10^{-8}$ *mole/litre.*

35. (a) $H^+=c.\alpha=\sqrt{K_a.c}$

$pH=-\log\left(\sqrt{K_a.c}\right)^{1/2}=\frac{1}{2}[-\log K_a-\log c]$

$= \frac{1}{2}[4.74 - \log 10^{-2}] = \frac{1}{2}[4.74 + 2] = 3.37$.

36. (b) $Ag_2SO_4 \rightleftharpoons \underset{4S^2}{2Ag^+} + \underset{S}{SO_4^{--}}$

$K_{sp} = 4S^3;\ K_{sp} = 2\times10^{-5}$

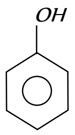
$S = \sqrt[3]{\frac{2\times10^{-5}}{4}} = 0.017\, m/l = 1.7\times10^{-2}$

$AgBrO_3 \rightleftharpoons \underset{S}{Ag^+} + \underset{S}{BrO_3^-}$

$K_{sp} = S^2;\ K_{sp} = 5.5\times10^{-5}$

$S = \sqrt{5.5\times10^{-5}} = 7.4\times10^{-3}\, m/l.$

37. (c)



Phenol are more acidic than ethanol because of stabilization of phenoxide as compare to ethoxide ion.

38. (b) $X^- + H_2O \rightleftharpoons HX + OH^-$

$K_h = \frac{10^{-14}}{10^{-5}}$ so $h = \sqrt{\frac{10^{-9}}{10^{-1}}} = 10^{-4}$

$100\times10^{-4} = 10^{-2}$

So, 0.01%.

39. (a) $K_a = 1.0\times10^{-5}$

$K_h = \text{hydrolysisconstant}$

$K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{10^{-5}} = 10^{-9}$

degree of hydrolysis $(h) = \sqrt{\frac{K_h}{C}}$

$= \sqrt{\frac{10^{-9}}{0.001}} = \sqrt{10^{-6}} = 10^{-3};\quad h = 10^{-3}$

40. (b) Basic radicals of group II & IV are precipitated by H_2S in the form of their sulphides. IInd group in acidic medium & IV group in alkaline medium. They precipitate when ionic product increases than solubility product.

41. (a) After mixing $[Ag^+][Cl^-] > K_{sp}$

42. (a) $K_{sp} >$ ionic product $1\times10^{-10} > 5\times10^{-11}$

43. (a) 1 litre of water contains 1000/18 mole.

So degree of ionization $= \frac{10^{-7}\times18}{1000} = 1.8\times10^{-7}$ %.

44. (a) $AgCl\ K_{sp} = 1.2\times10^{-10}$

$S = \sqrt{1.2\times10^{-10}};\ S = 1.09\times10^{-5}$

$AgBr\ K_{sp} = 3.5\times10^{-13}$

$S = \sqrt{3.5\times10^{-13}} = 5.91\times10^{-6}$

So that S of $AgBr$ is less than that of $AgCl$.

45. (a) $K_{sp} = 4S^3$

$4S^3 = 3.2\times10^{-8};\ S = 2\times10^{-3}M$.

46. (c) $\frac{2.8\times10^{-10}}{0.1} = 2.8\times10^{-9}\, ML^{-1}$.

47. (b) $AB \rightleftharpoons A^+ + B^-; K_{sp} = S^2$

$S = \sqrt{K_{sp}} = \sqrt{4\times10^{-10}} = 2\times10^{-5}$

48. (b) $S = 1.435\times10^{-3}\, g/l, = \frac{1.435\times10^{-3}}{143.5} = 10^{-5}\, M$

$K_{sp} = S\times S = 10^{-10}$

49. (b) $pKa = 5$, so $Ka = 1\times10^{-5}$

$\alpha = \sqrt{\frac{Ka}{C}} = \sqrt{\frac{1\times10^{-5}}{0.1}} = 1\times10^{-2}$

50. (c) Presence of common ion decreases the solubility of salt.

51. (d) $Ag_2S > CuS > HgS$.

Solubility of $CuS = \sqrt{10^{-31}} = 3.16\times10^{-16}\ mol/lit$

Solubility of Ag_2S

$= \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{10^{-42}}{4}} = 6.3\times10^{-5}\, mole/litre$

Solubility of $HgS = \sqrt{K_{sp}} = \sqrt{10^{-54}} = 10^{-27}\ mol/litre$

52. (c) $pH = 3.82 = -\log[H^+]$

$\therefore [H^+] = 1.5\times10^{-4}$ *mole/litre.*

53. (b) $pH = pK_a + \log\frac{[\text{salt}]}{\text{acid}} = 4.57 + \log\frac{0.10}{0.03} = 5.09$

54. (c) For a monobasic acid

$[H^+] = C\alpha$

$= \frac{1}{10}\times0.001 = 10^{-4} \Rightarrow pH = 4$

55. (a) $K_{sp} = [As^{3+}][S^{2-}],\ S = \sqrt[5]{\frac{K_{sp}}{108}}$

$= \sqrt[5]{\frac{2.8\times10^{-72}}{108}} = 1.09\times10^{-15}$

56. (d) Dissociation constant of $HA = 10^{-9}$

$HA \rightleftharpoons H^+ + A^-$

$[H^+] = \sqrt{\frac{K_a}{C}} = \sqrt{\frac{10^{-9}}{0.1}};\ [H^+] = 10^{-4}$

$\therefore pH = 4$

$\because pH + pOH = 14$

$pOH = 14 - pH = 14 - 4;\ pOH = 10$

57. (d) $\alpha = 1.9\times10^{-9}$; $C = \dfrac{1000}{18}$

$$K = \frac{[H^+][OH^-]}{(H_2O)} = C\alpha^2$$

$$= 1.9\times10^{-9}\times1.9\times10^{-9}\times\frac{1000}{18} = 2.0\times10^{-16}.$$

58. (c) $K = Ka_1\times Ka_2 = 4.5\times10^{-3}\times1.7\times10^{10}$

$$H^+ = \sqrt{Kc} = \sqrt{4.5\times10^{-3}\times1.7\times10^{-10}\times.01}$$

$$= .87\times10^{-7}$$

$$pH = -\log 0.87\times10^{-7} = 7-0.93 = 6.07.$$

59. (a) Given that

Concentration of solution $=.1$

Degree of ionisation $= 2\% = \dfrac{2}{100} = .02$

Ionic product of water $= 1\times10^{-14}$

Concentration of $[H^+]$ = Concentration of solution X degree of ionisation $= .1\times.02 = 2\times10^{-3}\,M$

Concentration of $[OH^-] = \dfrac{\text{Ionic product of water}}{[H^+]}$

$$= \frac{1\times10^{-14}}{2\times10^{-3}} = 0.5\times10^{-11} = 5\times10^{-12}\,M.$$

60. (a) $HgSO_4 \rightarrow \underset{x}{Hg^{++}} + \underset{x}{SO_4^{--}}$

$$K_{sp} = x^2;\ x = \sqrt{K_{sp}};\ x = \sqrt{6.4\times10^{-5}}$$

$x = 8\times10^{-3}$ *mole/litre.*

61. (a) $K = c\alpha^2 = 0.1\times\left(\dfrac{1.34}{100}\right)^2 = 1.8\times10^{-5}$.

62. (c) $[H^+] = 1\times10^{-4}\,M \Rightarrow [H^+][OH^-] = 1\times10^{-14}$

$$\therefore [OH^-] = \frac{1\times10^{-14}}{0.5\times10^{-4}} = 2\times10^{-10}\,M$$

63. (d) Because $HClO_4$ is a strong acid. While buffer is a mixture of weak acid and their salt.

64. (b) Initial concentration = 0.006 M $\Rightarrow$ $K_a = 6\times10^{-5}$

equilibrium reaction.

$$\underset{\substack{C\\ C(1-a)}}{C_6H_5COOH} \rightleftharpoons \underset{\substack{O\\ Ca}}{C_6H_5COO^-} + \underset{\substack{O\ \text{initial}\\ Ca}}{H^+}$$

$K_a = C\alpha^2$ $\quad(\because 1-\alpha\approx1)$ ***for weak electrolyte***

$$\alpha = \sqrt{\frac{K_a}{C}};\ \alpha = \sqrt{\frac{6\times10^{-5}}{0.006}};\ \alpha = 10^{-1}$$

$\because [H^+] = C\alpha = 0.006\times10^{-1} = 6\times10^{-4}$ *M.*

65. (a) $pOH = pKb + \log\dfrac{[Salt]}{[Base]}$

$$14 - 9.35 = -\log(1.78\times10^{-5}) + \log\frac{[Salt]}{100}$$

$$[Salt] = 79.9 \Rightarrow \frac{w}{132}\times1000 = 79.9 \Rightarrow w = 10.56$$

66. (a) $pH = 6$ means $[H^+] = 10^{-6}\,M$

$pH = 3$ means $[H^=] = 10^{-3}\,M$

After mixing,

Total $[H^+] = \dfrac{(10^{-6}+10^{-3})}{2} = \dfrac{1.001\times10^{-3}}{2}$

$= 5.005\times10^{-4}$

$pH = 4 - \log 5.005$; $pH = 3.301$.

67. (b) $[H^+] = \sqrt{K\times C}$

$[H^+] = \sqrt{4\times10^{-10}\times1}$; $[H^+] = 2\times10^{-5}$ *mole/litre*

68. (b) Moles of $[OH^-] = M\times V$

Number of $NaOH = 0.3\times0.005\times2 = 0.0030$

69. (d) $[H^+][OH^-] = 10^{-13.26}$

$\therefore\ [H^+]=[OH^-],\ \therefore\ [H^+]^2 = 10^{-13.26}$

$$[H^+] = 10^{\frac{-13.26}{2}}$$

pH = 6.63.

70. (b) $pH = pKa + \log\dfrac{[Salt]}{[Acid]}$

$pH = pKa$

$Ka = 0.1\times(10^{-3.5})^2 = 0.1\times10^{-7} = 10^{-8} \Rightarrow pH = 8$

71. (a) $pH = -\log K_a + \log\dfrac{[\text{Salt}]}{[\text{Acid}]}$

$$[\text{Salt}] = \frac{0.2\times50}{1000} = 0.01;\ [\text{Acid}] = \frac{0.5\times40}{1000} = 0.02$$

$$pH = -\log(1.8\times10^{-4}) + \log\frac{0.01}{0.02}$$

$pH = 4 - \log(1.8) + \log 0.5$

$pH = 4 - \log(1.8) - 0.301$

$pH = 3.4$

72. (c) HCO_3^- and H_2O

73. (a) $[H^+] = C\times\alpha = 0.1\times0.1 = 10^{-2}\,M$

pH = 2; pOH = 12 ; $[OH^-] = 10^{-12}\,M$.

74. (c) Decreasing order of acidic character is $H_2SO_4 > CH_3COOH > H_2CO_3$

75. (c) The acidic nature increases in the order.

$NaNO_2 < NaCl < H_2S < H_2SO_4$

76. (a) $[OH^-] = 0.05 = 5\times10^{-2}\,M$

$$pOH = 2 - \log 5 = 1.3$$

$$pH + pOH = 14$$

$$pH = 14 - 1.3 = 12.7$$

77. (b) Na_2O form *NaOH*. So that it is basic oxide.

78. (a) $CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$

$$\therefore [OH^-] = c \times h; \quad h = \sqrt{\frac{K_w}{K_a} \times c} = \sqrt{\frac{10^{-14}}{1.8 \times 10^{-5}} \times 1}$$

$$= 2.35 \times 10^{-5}$$

$$\therefore pOH = 4.62; \quad pH = 9.38 \approx 9.4$$

Assertion & Reason

1. (c) *HCl* is a strong electrolyte since it will produce more H^+, comparison than that of CH_3COOH. Hence assertion is true but reason false.

2. (b) For sparingly soluble salts, reason is not a correct explanation. Hence both assertion and reason are true but reason is not a correct explanation of assertion.

3. (a) Aq. solution of $FeCl_3$ on standing produce brown ppt. Due to hydrolysis it produce ppt. of $Fe(OH)_3$ which is of brown colour. Hence both are correct and reason is a correct explanation.

4. (a) Barium carbonate is more soluble in HNO_3 than in water become carbonate is a weak base and reacts with the H^+ ion of HNO_3 causing the barium salt to dissociate.

$$BaCO_3 + HNO_3 \rightarrow Ba(NO_3)_2 + CO_2 + H_2O$$

5. (a) The conjugate base of $CHCl_3$ is more stable than conjugate base of $CHF_3(CF_3)$. CCl_3 stabilized by $-I$ effect of chlorine atoms as well as by the electrons. But conjugate base of $CH_3(CH_3)$ is stabilized only by $-I$ effect of flourine atoms. Here both assertion and reason are true and reason is correct explanation of assertion.

6. (c) Ionic product of $AgBr$ is greater than that of $AgCl$ in comparison with there solubility product $AgBr$ will precipitate. First rather than that of $AgCl$.

9. (e) It is fact that ionic reactions are instantaneous due to the fact that oppositely charged ions exert strong forces and combine immediately.

Ionic Equilibrium

SET Self Evaluation Test - 9

1. The most important buffer in the blood consists of **[BHU 1981]**

(a) HCl and $Cl^{\oplus}$ (b) H_2CO_3 and $HCO_3^{\ominus}$

(c) H_2CO_3 and $Cl^{\ominus}$ (d) HCl and $HCO_3^{\ominus}$

2. The solubility product of AgI at $25°C$ is $1.0\times10^{-16}\,mol^2L^{-2}$. The solubility if AgI in $10^{-4}\,N$ solution of KI at $25°C$ is approximately (in mol l^{-1}) **[CBSE PMT 2003]**

(a) 1.0×10^{-8} (b) 1.0×10^{-16}

(c) 1.0×10^{-12} (d) 1.0×10^{-10}

3. The pH of the solution: $5\ mL$ of $\frac{M}{5}$, $HCl + 10\ mL$ of $\frac{M}{10}$ $NaOH$ is **[MH CET 2004]**

(a) 5 (b) 3

(c) 7 (d) 8

4. Given that the dissociation constant for H_2O is $K_w = 1\times10^{-14}\,mole^2/litre^2$. What is the pH of a 0.001 *molar* KOH solution **[UPSEAT 2000; MP PET 2001]**

(a) 10^{-11} (b) 10^{-3}

(c) 3 (d) 11

5. The pH of 0.1 M solution of the following salts increases in the order **[Pb. CET 2004]**

(a) $NaCl < NH_4Cl < NaCN < HCl$

(b) $HCl < NH_4Cl < NaCl < NaCN$

(c) $NaCN < NH_4Cl < NaCl < HCl$

(d) $HCl < NaCl < NaCN < NH_4Cl$

6. The degree of hydrolysis in hydrolytic equilibrum

$A^- + H_2O \rightleftharpoons HA + OH^-$ at salt concentration of 0.001 M is

$(K_a = 1\times10^{-5})$ **[UPSEAT 2004]**

(a) 1×10^{-3} (b) 1×10^{-4}

(c) 5×10^{-4} (d) 1×10^{-6}

7. If pK_b for fluoride ion at 25^oC is 10.83, the ionisation constant of hydrofluoric acid in water at this temperature is **[IIT 1997]**

(a) 1.74×10^{-3} (b) 3.52×10^{-3}

(c) 6.75×10^{-4} (d) 5.38×10^{-2}

8. If the hydrogen ion concentration of a given solution is $5.5\times10^{-3}\,mol\ litre^{-1}$, the pH of the solution will be **[AMU 1985]**

(a) 2.26 (b) 3.40

(c) 3.75 (d) 2.76

9. Henderson's equation is $pH = pK_a + \log\frac{[\text{salt}]}{[\text{acid}]}$. If the acid gets half neutralized the value of pH will be : $[pK_a = 4.30]$ **[RPMT 2000]**

(a) 4.3 (b) 2.15

(c) 8.60 (d) 7

10. The pH of a $0.01M$ solution of acetic acid having degree of dissociation 12.5% is **[JIPMER 2000]**

(a) 5.623 (b) 2.903

(c) 3.723 (d) 4.509

11. Which of the following solutions will have pH close to 1.0 **[IIT 1992; MP PET 1993; AMU 1999]**

(a) $100\ ml$ of $\frac{M}{10}HCl + 100\ ml$ of $\frac{M}{10}NaOH$

(b) $55\ ml$ of $\frac{M}{10}HCl + 45\ ml$ of $\frac{M}{10}NaOH$

(c) $10\ ml$ of $\frac{M}{10}HCl + 90\ ml$ of $\frac{M}{10}NaOH$

(d) $75\ ml$ of $\frac{M}{5}HCl + 25\ ml$ of $\frac{M}{5}NaOH$

12. In which of the following solvents will $AgBr$ have the highest solubility **[CBSE PMT 1992]**

(a) $10^{-3}\ M\ NaBr$ (b) $10^{-3}\ M\ NH_4OH$

(c) Pure water (d) $10^{-3}\ M\ HBr$

13. How many grams of CaC_2O_4 will dissolve in distilled water to make one litre of saturated solution ? (Solubility product of CaC_2O_4 is $2.5\times10^{-9}\,mole^2litre^{-2}$ and its molecular weight is 128) **[MP PET 1993; MP PMT 2000]**

(a) 0.0064 *gm* (b) 0.0128 *gm*

(c) 0.0032 *gm* (d) 0.0640 *gm*

14. The solubility product of CuS, Ag_2S, HgS are 10^{-31}, 10^{-44}, 10^{-54} respectively. The solubilities of these sulphides are in the order **[CBSE PMT 1997]**

(a) $Ag_2S > CuS > HgS$ (b) $Ag_2S > HgS > Cus$

(c) $HgS > Ag_2S > Cus$ (d) $CuS > Ag_2S > HgS$

15. The solubility product constant K_{sp} of $Mg(OH)_2$ is 9.0×10^{-12}. If a solution is $0.010\ M$ with respect to Mg^{2+} ion, what is the maximum hydroxide ion concentration which could be present without causing the precipitation of $Mg(OH)_2$

(a) $1.5\times10^{-7}\ M$ (b) $3.0\times10^{-7}\ M$

(c) $1.5 \times 10^{-5}\ M$ (d) $3.0 \times 10^{-5}\ M$

16. If the K_b value in the hydrolysis reaction $B^+ + H_2O \rightleftharpoons BOH + H^+$ is 1.0×10^{-6}, then the hydrolysis constant of the salt would be [Roorkee Qualifying 1998]

(a) 1.0×10^{-6} (b) 1.0×10^{-7}

(c) 1.0×10^{-8} (d) 1.0×10^{-9}

17. For a sparingly soluble salt A_pB_q, the relationship of its solubility product (L_S) with its solubility (S) is

[IIT Screening 2001]

(a) $L_s = S^{p+q}.p^p.q^q$ (b) $L_s = S^{p+q}.p^q.q^p$

(c) $L_s = S^{pq}.p^p.q^q$ (d) $L_s = S^{pq}.(p.q)^{p+q}$

18. Arrange NH_4^+, H_2O, H_3O^+, HF and OH^- in increasing order of acidic nature [BVP 2003]

(a) $H_3O^+ < NH_4^+ < HF < OH^- < H_2O$

(b) $NH_4^+ < HF < H_3O^+ < H_2O < OH^-$

(c) $OH^- < H_2O < NH_4^+ < HF < H_3O^+$

(d) $H_3O^+ > HF > H_2O > NH_4^+ > OH^-$

19. How many grams of CaC_2O_4 (molecular weight = 128) on dissolving in distilled water will give a saturated solution $[K_{sp}(CaC_2O_4) = 2.5 \times 10^{-9}\ mol^2l^{-2}]$ [KCET 2003]

(a) 0.0064 *g* (b) 0.1280 *g*

(c) 0.0128 *g* (d) 1.2800 *g*

20. If the concentration of CrO_4^- ions in a saturated solution of silver chromate is 2×10^{-4}. Solubility product of silver chromate will be

(a) 4×10^{-8} (b) 8×10^{-12}

(c) 12×10^{-12} (d) 32×10^{-12}

21. According to Bronsted-Lowry concept, the correct order of relative strength of bases follows the order

[Pb. PMT 2001]

(a) $CH_3COO^- > Cl^- > OH^-$

(b) $CH_3COO^- > OH^- > Cl^-$

(c) $OH^- > CH_3COO^- > Cl^-$

(d) $OH^- > Cl^- > CH_3COO^-$

22. $H_2SO_4^- + OH^- \rightarrow SO_4^{2-} + H_2O$ Which is correct about conjugate acid base pair [JEE Orissa 2004]

(a) HSO_4^{2-} is conjugate acid of base SO_4^{2-}

(b) HSO_4^- is conjugate base of acid SO_4^{2-}

(c) SO_4^- is conjugate acid of base HSO_4^-

(d) None of these

23. Which may be added to one litre of water to act as a buffer

[JIPMER 2000]

(a) One mole of $HC_2H_3O_2$ and 0.5 mole of $NaOH$

(b) One mole of NH_4Cl and one mole of HCl

(c) One mole of NH_4OH and one mole of $NaOH$

(d) One mole of $HC_2H_3O_2$ and one mole of HCl

24. Which of the following base is weakest [DCE 2003]

(a) $NH_4OH : K_b = 1.6 \times 10^{-6}$

(b) $C_6H_5NH_2 : K_b = 3.8 \times 10^{-10}$

(c) $C_2H_5NH_2 : K_b = 5.6 \times 10^{-4}$

(d) $C_6H_7N : K_b = 6.3 \times 10^{-10}$

25. $HClO$ is a weak acid. The concentration of H^+ ions in $0.1\,M$ solution of $HClO(K_a = 5 \times 10^{-8})$ will be equal to

[CPMT 1993]

(a) $7.07 \times 10^{-5}\ m$ (b) $5 \times 10^{-9}\ m$

(c) $5 \times 10^{-7}\ m$ (d) $7 \times 10^{-4}\ m$

26. Upto what *pH* must a solution containing a precipitate of $Cr(OH)_3$ be adjusted so that all of precipitate dissolves

(When $Cr^{3+} = 0.1 mol/l, K_{sp} = 6 \times 10^{-31}$) [MP PET 2003]

(a) Upto 4.4 (b) Upto 4.1

(c) Upto 4.2 (d) Upto 4.0

27. NH_4Cl is acidic, because [JEE Orissa 2004]

(a) On hydrolysis NH_4Cl gives weak base NH_4OH and strong acid HCl

[MP PET 1992; CPMT 1993]

(b) Nitrogen donates a pair of electron

(c) It is a salt of weak acid and strong base

(d) On hydrolysis NH_4Cl gives strong base and weak acid

28. A solution of weak acid *HA* containing 0.01 *moles* of acid *per litre* of solutions has $pH = 4$. The percentage degree of ionisation of the acid and the ionisation constant of acid are respectively [UPSEAT 2001]

(a) $1\%, 10^{-6}$ (b) $0.01\%, 10^{-4}$

(c) $1\%, 10^{-4}$ (d) $0.01\%, 10^{-6}$

29. The *pH* of a buffer solution containg 0.2 *mole per litre* CH_3COONa and 1.5 *mole per litre* CH_3COOH is (*Ka* for acetic acid is 1.8×10^{-5}) [CPMT 2001]

(a) 4.87 (b) 5.8

(c) 2.4 (d) 9.2

30. 100 *mL* of $0.04\ N\ HCl$ aqueous solution is mixsed with 100 *mL* of 0.02 *N NaOH* solution. The *p*H of the resulting solution is [UPSEAT 2004]

(a) 1.0 (b) 1.7

(c) 2.0 (d) 2.3

31. An alcoholic drink substance $pH = 4.7$ then OH ion concentration of this solution is $(K_w = 10^{-14} mol^2/l^2)$

[RPMT 2002]

(a) 3×10^{-10} (b) 5×10^{-10}

(c) 1×10^{-10} (d) 5×10^{-8}

32. In its 0.2 *M* solution, an acid ionises to an extent of 60%. Its hydrogen ion concentration is

(a) 0.6 *M* (b) 0.2 *M*

(c) 0.12 *M* (d) None of these

33. *p*H of 0.1 *M* NH_3 aqueous solution is

$(K_b = 1.8\times10^{-5})$ [UPSEAT 2004]

(a) 11.13 (b) 12.5

(c) 13.42 (d) 11.55

34. 40 *mg* of pure sodium hydroxide is dissolved in 10 litres of distilled water. The *p*H of the solution is

[Kerala PMT 2004]

(a) 9.0 (b) 10

(c) 11 (d) 12

(e) 8

35. Solubility of PbI_2 is 0.005 *M*. Then, the solubility product of PbI_2 is [BVP 2004]

(a) 6.8×10^{-6}

(b) 6.8×10^{6}

(c) 2.2×10^{-9}

(d) None of these

36. A monoprotic acid in a $0.1\ M$ solution ionizes to 0.001%. Its ionisation constant is

[MP PET 1985,88,99; MP PMT1988; CPMT 2003]

(a) 1.0×10^{-3} (b) 1.0×10^{-6}

(c) 1.0×10^{-8} (d) 1.0×10^{-11}

37. Select the pK_a value of the strongest acid from the following

[KCET 2004]

(a) 1.0 (b) 3.0

(c) 2.0 (d) 4.5

38. At 90°*C*, pure water has H_3O^+ ion concentration of $10^{-6} mol/L^{-1}$. The K_w at 90°*C* is [DCE 2004]

(a) 10^{-6} (b) 10^{-14}

(c) 10^{-12} (d) 10^{-8}

39. By adding 20 ml $0.1\ N\ HCl$ to 20 ml $0.1\ N\ KOH$, the pH of the obtained solution will be [CPMT 1975, 86, 93]

(a) 0 (b) 7

(c) 2 (d) 9

Answers and Solutions

(SET -9)

1. (b) Blood consists of $H_2CO_3 + HCO_3^-$ buffer solution.

2. (c) $AgI \rightleftharpoons \underset{(s)}{Ag^+} + \underset{(s)}{I^-}$; $K_{sp} = S^2 = 10^{-4}\times S$

$$S = \frac{1.0\times10^{-16}}{10^{-4}} = 1\times10^{-12}\frac{mol^2}{l^2}$$

3. (c) Milliequivalents of $HCl = 5\times\frac{1}{5} = 1$

Milliequivalents of $NaOH = 10 \times \frac{1}{10} = 1$

$$\therefore\ 5ml\ \frac{M}{5}HCl = 10\,ml\ \frac{M}{5}HCl$$

Hence the solution will be neutral *i.e.*, $pH = 7$.

4. (d) $pH = 14 - pOH = 14 - 3 = 11$

5. (b) *HCl* is strong acid. In its *.1M* solution, $[H^+] = 0.1M$ and hence, $pH = 1$

$NH_4Cl_{(aq)}$ hydrolyses in solution and give acidic solution which is less acidic than *.1M HCl*. *NaCl* is not hydrolysed in aqueous solutions. Its $pH = 7$ *NaCN* undergoes hydrolysis in solution to give alkaline solution. So that pH increases in the order, $HCl < NH_4Cl < NaCl < NaCN$

6. (a) $K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{1 \times 10^{-5}} = 10^{-9}$

$$K_h = \alpha^2 C;\ \alpha = \sqrt{\frac{K_h}{C}} = \sqrt{\frac{1\times 10^{-9}}{.001}} = 1 \times 10^{-3}$$

7. (c) $K_a \times K_b = K_w$

$$\therefore K_a = \frac{K_w}{K_b} = \frac{10^{-14}}{1.48 \times 10^{-11}} = 6.75 \times 10^{-4}$$

8. (a) $[H^+] = 5.5 \times 10^{-3}$ *mole/litre*

$$pH = -\log[H^+]\ ;\ pH = -\log[5.5 \times 10^{-3}];\ pH = 2.26$$

9. (a) $pH = pK_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$

$$pH = 4.3 + \log\frac{\frac{1}{2}}{\frac{1}{2}} = 4.3 + \log 1;\ pH = 4.3 + 0 = 4.3$$

10. (b) $[H^+] = C\alpha = 0.01 \times \frac{1.25}{100}$

$$H^+ = 1.25 \times 10^{-3};\ pH = \text{between } 2 \text{ or } 3 = 2.90$$

11. (d) M.eq. of $HCl = \frac{1}{5} \times 75 = 15$

M.eq. of $NaOH = 25 \times \frac{1}{5} = 5$

Total No. of eq. $= 15 - 5 = 10$

Total volume = 100

Normality $= \frac{10}{100} = \frac{1}{10},\ [H^+] = 10^{-1}\,M$

12. (b) *AgBr* are not dissolved in *NaBr* and *HBr* due to common ion effect. And pure water is a neutral solvent. They do not have ions.

13. (a) CaC_2O_4 is a binary electrolyte. Then solubility is

$$S = \sqrt{K_{sp}} = \sqrt{2.5 \times 10^{-9}}$$

$$= 5 \times 10^{-5}\ mole/l. = 0.0064\ gm/l.$$

14. (a)

15. (d) $\underset{K_{sp}}{Mg(OH)_2}\ \underset{=}{\rightleftharpoons}\ \underset{S}{Mg^{++}} + \underset{(2S)^2}{2OH^-}$

$$K_{sp} = S \times 4S^2$$

$$\frac{K_{sp}}{S \times 4} = S^2 = \frac{9 \times 10^{-12}}{.010 \times 4} = 2.25 \times 10^{-10}$$

$$S = \sqrt{2.25 \times 10^{-10}} = 1.5 \times 10^{-5}\ m/l$$

16. (c) For hydrolysis of B^+; $K_H = \frac{K_w}{K_b} = \frac{10^{-14}}{10^{-6}} = 10^{-8}$.

17. (a) $A_pB_q \rightleftharpoons pA^{1+} + qB^{p-}$

$$L_s = [A^{q+}]^p[B^{p-}]^q = (p \times S)^p(q \times S)^q = S^{p+q}.p^p.q^q.$$

18. (c) $H_3O^+ > HF > NH_4^+ > H_2O > OH^-$.

Acidic nature is decreasing order.

19. (a) Solubility of $CaC_2O_4 = \sqrt{K_{sp}} = \sqrt{2.5 \times 10^{-9}}$

$$= 5 \times 10^{-5} molL^{-1}$$

$$= 5 \times 10^{-5} \times 128 = 640 \times 10^{-5} = 0.0064g$$

20. (d) K_{sp} of $Ag_2CrO_4 = [Ag^+]^2\,[CrO_4^{--}]$

$CrO_4^{--} = 2 \times 10^{-4}$ then $Ag^+ = 2 \times 2 \times 10^{-4}$

$$K_{sp} = (4 \times 10^{-4})^2\,(2 \times 10^{-4}) = 32 \times 10^{-12}$$

21. (c) Relative strength of bases can be shown by their conjugated acids.

Conjugate acid of OH^- is H_2O which is a weak acid conjugate acid of CH_3COO^- is CH_3COOH which is stronger than H_2O. while conjugate acid of Cl^- is HCl which is strongest out of there. so the order of relative strength of bases is $OH^- > CH_3COO^- > Cl^-$.

22. (a) $\underset{\text{Conjugate acid}}{HSO_4^-} + OH^- \rightarrow \underset{\text{Conjugate base}}{SO_4^{2-}} + H_2O$

23. (a) One mole oxalic acid & 0.5 mole of $NaOH$ will make.

24. (b) Smallest value of K_b indicates that aniline $(C_2H_5NH_2)$ is the weakest base.

25. (a) $[H^+]^2 = C.\alpha = 0.1 \times 5 \times 10^{-8}$

$$H^+ = \sqrt{5 \times 10^{-9}} = 7.07 \times 10^{-5}\ M.$$

26. (d) $K_{sp} = [Cr^{3+}][OH^-]^3$

$$[OH]^{-3} = K_{sp\,/\,Cr^{3+}} = \frac{6 \times 10^{31}}{1 \times 10^{-1}} = 6 \times 10^{-30}$$

$$[OH]^- = 1.8 \times 10^{-10}$$

$$pOH = (\log 1.8 + \log 10^{10}) = 10 + 0.25 + 1 = 11.25$$

$$pH = 14 - 11.25 = 2.27$$

27. (a) $NH_3Cl + H_2O \rightleftharpoons NH_4OH + HCl$

NH_4Cl is a salt of weak base & strong acid so solution will be acidic.

28. (a) $H^+ = C\alpha$

$$\alpha = \frac{H^+}{C} = \frac{10^{-4}}{10^{-2}} = 10^{-6}$$

29. (a) $pH = -\log K_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$

$$= -\log\,[1.8\times 10^{-5}] + \log\frac{0.2}{0.1} = 4.87$$

30. (c) $N_1V_1 = .04\times 100 = 4$

$N_2V_2 = .02\times 100 = 2$

$N_1V_1 - N_2V_2 = N_3V_3$

$4 - 2 = N_3\times 200\,,\ N_3 = 10^{-2}\,M$

$$pH = \log 10\frac{1}{H^+} = \log 10\frac{1}{10^{-2}} = 2\,.$$

31. (b) $pH = 4.7$

$pH + pOH = 14\ ;\ pH = 14 - 4.7\ ;\ pOH = 9.3$

$[OH^-] = \text{Antilog}\ [-pOH] = \text{Antilog}\,[-9.3]$

$[OH^-] = 5\times 10^{-10}$

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32. (c) $[H^+] = C.\alpha,\ \ = 0.2\times 0.60 = 0.12\,M$

33. (a) $NH_4OH \rightleftharpoons NH_4^+ + OH^-$

$$K_b = C\alpha^2\ ;\ \frac{1.8\times 10^{-5}}{.1} = \alpha^2\,;\alpha = 1.34\times 10^{-3}$$

$[OH^-] = \alpha\,.\,C = 1.34\times 10^{-3}\times .1$

$$pOH = \log 10\frac{1}{1.34\times 10^{-4}}\ ;\ pOH = 2.87$$

$pH + pOH = 14\,;\ pH + 2.87 = 14$

$pH = 14 - 2.87\,;\ pH = 11.13$

34. (b) $M = \frac{\text{Solute in 1 litre solution}}{\text{Molecular weight of solute}}$

$$= \frac{40\times 10^{-3}}{40}\times\frac{1}{10} = 10^{-4}\,M$$

$$pOH = \log 10\frac{1}{[OH^-]} = \log 10\frac{1}{10^{-4}} = 4$$

$pH + pOH = 14\,;\ pH + 4 = 14 \Rightarrow\ pH = 10\,.$

35. (d) $PbI_2 \rightarrow \underset{x}{Pb} + \underset{2x}{I_2}$

$K_{sp} = 4x^3 = 4(.005)^3 = 4\times .005\times .005 = .4\times 10^{-6}\,.$

36. (d) $\therefore$ Monoprotic acid HA

$HA \rightleftharpoons H^+ + A^-$

Ionisation constant = ?

$$\alpha = 0.001\% = \frac{0.001}{100} = 10^{-5}$$

$$K = \frac{\alpha^2}{V} = \frac{[10^{-5}]^2}{10} = 10^{-11}\,.$$

37. (a) $pKa <<$ then strongest acid

$pKa >>$ then weak acid

$$pKa \propto \frac{1}{\text{Acidic strength}}$$

38. (c) $\underset{10^{-6}}{H_3O^+} \rightarrow \underset{10^{-6}}{H_2O} + \underset{10^{-6}}{H^+}$

$K_w = [H_2O][H^+] = [10^{-6}][10^{-6}] = 10^{-12}$

39. (b) Neutralization reaction will takes place and form salt of strong acid and strong base. Which does not hydrolysed and thus $pH = 7$.