8. Ionic Equilibrium – Multiple Choice Questions

1. Electrical Conductors, Arrhenius Theory and Ostwald's Dilution Law

1. Which of the following acids is stronger than benzoic acid ($K_a = 6.3 \times 10^{-5}$)

(a) $A(K_a = 1.67 \times 10^{-8})$ (b) $B(pK_a = 6.0)$

(c) $C(pK_a = 4.0)$ (d) $D(K_a = 1.0 \times 10^{-5})$

2. Which will not affect the degree of ionisation

(a) Temperature (b) Concentration

(c) Type of solvent (d) Current

3. The addition of a polar solvent to a solid electrolyte results in

(a) Polarization (b) Association

(c) Ionization (d) Electron transfer

4. A 0.010 *M* solution of maleic acid, amonoprotic organic acid, is 14% ionised. What is K_a for maleic acid

(a) 2.3×10^{-3} (b) 2.3×10^{-4}

(c) 2.0×10^{-4} (d) 2.0×10^{-6}

5. Which one of the following is the correct quadratic form of the Ostwald's dilution law equation

(a) $\alpha^2 C + \alpha K - K = 0$ (b) $\alpha^2 C - \alpha K - K = 0$

(c) $\alpha^2 C - \alpha K + K = 0$ (d) $\alpha^2 C + \alpha K + K = 0$

6. One litre of water contains 10^{-7} *mole* hydrogen ions. The degree of ionization in water will be

(a) $1.8 \times 10^{-7}\%$ (b) $0.8 \times 10^{-9}\%$

(c) $3.6 \times 10^{-7}\%$ (d) $3.6 \times 10^{-9}\%$

7. For a diprotic acid, which of the following is true for 1^{st} and 2^{nd} ionization constants (K_{a_1} and K_{a_2})

(a) $K_{a_1} = K_{a_2}$ (b) $K_{a_1} > K_{a_2}$

(c) $K_{a_2} > K_{a_1}$ (d) $K_{a_2} \geq K_{a_1}$

8. *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

(a) $7.07 \times 10^{-5}\ m$ (b) $5 \times 10^{-9}\ m$

(c) $5 \times 10^{-7}\ m$ (d) $7 \times 10^{-4}\ m$

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

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

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

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

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

(a) $K_{a_3} = K_{a_1} \times K_{a_2}$ (b) $K_{a_3} = K_{a_1} + K_{a_2}$

(c) $K_{a_3} = K_{a_1} - K_{a_2}$ (d) $K_{a_3} = K_{a_1} / K_{a_2}$

10. Accumulation of lactic acid ($HC_3H_5O_3$), a monobasic acid in tissues leads to pain and a feeling of fatigue. In a 0.10 *M* aqueous solution, lactic acid is 3.7% dissociates. The value of dissociation constant *Ka*, for this acid will be

(a) 1.4×10^{-5} (b) 1.4×10^{-4}

(c) 3.7×10^{-4} (d) 2.8×10^{-4}

11. For a concentrated solution of a weak electrolyte A_xB_y of concentration 'C', the degree of dissociation α is given as

(a) $\alpha = \sqrt{K_{eq} / C(x+y)}$

(b) $\alpha = \sqrt{K_{eq} C / (xy)}$

(c) $\alpha = (K_{eq} / C^{x+y-1} X^x Y^y)^{1/(x+y)}$

(d) $\alpha = (K_{eq} / Cxy)$

(e) $\alpha = (K_{eq} / C^{xy})$

12. A weak monobasic acid is 1% ionized in 0.1 *M* solution at 25°C. The percentage of ionization in its 0.025 *M* solution is

(a) 1 (b) 2

(c) 3 (d) 4

(e) 5

2. Acids and Bases

1. Would gaseous *HCl* be considered as an Arrhenius acid

(a) Yes

(b) No

(c) Not known

(d) Gaseous *HCl* does not exist

2. In the given reaction, the oxide of sodium is ....
$\begin{bmatrix} 4Na + O_2 \rightarrow 2Na_2O \\ Na_2O + H_2O \rightarrow 2NaOH \end{bmatrix}$

(a) Acidic (b) Basic

(c) Amphoteric (d) Neutral

3. H^+ is a

(a) Lewis acid (b) Lewis base

(c) Bronsted-Lowry base (d) None of the above

4. In the reaction $I_2 + I^- \rightarrow I_3^-$, the Lewis base is

(a) I_2 (b) I^-

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

5. Acidity of BF_3 can be explained on the basis of which of the following concepts

(a) Arrhenius concept

(b) Bronsted Lowry concept

(c) Lewis concept

(d) Bronsted Lowry as well as Lewis concept

6. Which of the following is not a Lewis acid

(a) CO (b) $SiCl_4$

(c) SO_3 (d) Zn^{2+}

7. Which of the following is the strongest Lewis acid

(a) BI_3 (b) BBr_3

(c) BCl_3 (d BF_3

8. In the reaction $SnCl_2 + 2Cl^- \rightarrow SnCl_4$, Lewis acid is

(a) $SnCl_2$ (b) Cl^-

(c) $SnCl_4$ (d) None of these

9. The concentration of which ion is to be decreased, when NH_3 solution is added

(a) OH^- (b) NH_4^+

(c) H_3O^+ (d) O_2^-

10. Which one is a Lewis acid

(a) ClF_3 (b) H_2O

(c) NH_3 (d) None of these

11. Which of the following is Lewis acid

(a) S (b) $:CH_2$

(c) $(CH_3)_3B$ (d) All of these

12. According to hard and soft acid base principle, a hard acid

(a) Has low charge density

(b) Shows preference for soft bases

(c) Shows preference for donor atoms of low electronegativity

(d) Is not polarizable

13. Which halide of nitrogen is least basic

(a) NBr_3 (b) NI_3

(c) NCl_3 (d) NF_3

14. Review the equilibrium and choose the correct statement
$HClO_4 + H_2O \rightleftharpoons H_3O^+ + ClO_4^-$

(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 $HClO_4$

15. Ammonia gas dissolves in water to give NH_4OH. In this reaction water acts as

(a) An acid (b) A base

(c) A salt (d) A conjugate base

16. 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

(a) NH_3 (b) H^+

(c) NH_4^+ (d) H_2O

17. In the reaction $H_2O + HCl \longrightarrow H_3O^+ + Cl^-$, the species that acts as Bronsted base is

(a) H_2O (b) HCl

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

18. In the following reaction

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

Which are the two Bronsted bases

(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 $C_2O_4^{--}$

19. The compound HCl behaves as .... in the reaction, $HCl + HF \rightarrow H_2^+Cl + F^-$

(a) Weak base (b) Weak acid

(c) Strong base (d) Strong acid

20. Which one of the following is called amphoteric solvent

(a) Ammonium hydroxide (b) Chloroform

(c) Benzene (d) Water

21. Self-ionisation of liquid ammonia occurs as, $2NH_3 \rightleftharpoons NH_4^+ + NH_2^-; K = 10^{-10}$. In this solvent, an acid might be

(a) NH_4^+

(b) NH_3

(c) Any species that will form NH_4^+

(d) All of these

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

(a) $HCOOH$ (b) CH_3COOH

(c) $ClCH_2COOH$ (d) FCH_2COOH

23. pK_a values of two acids A and B are 4 and 5. The strengths of these two acids are related as

(a) Acid A is 10 times stronger than acids B

(b) Strength of acid A : strength 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

24. The relative basic character of the following is

(a) $ClO^- < ClO_2^- < ClO_3^- < ClO_4^-$

(b) $ClO_4^- < ClO_3^- < ClO_2^- < ClO^-$

(c) $ClO_3^- < ClO_4^- < ClO_2^- < ClO^-$

(d) $ClO_2^- < ClO^- < ClO_3^- < ClO_4^-$

25. Arrange NH_4^+, H_2O, H_3O^+, HF and OH^- in increasing order of acidic nature

(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) $H_3O^+ > HF > H_2O > NH_4^+ > OH^-$

26. According to Bronsted-Lowry concept, the correct order of relative strength of bases follows the order

(a) $CH_3COO^- > Cl^- > OH^-$

(b) $CH_3COO^- > OH^- > Cl^-$

(c) $OH^- > CH_3COO^- > Cl^-$

(d) $OH^- > Cl^- > CH_3COO^-$

27. The correct order of acidity for the following is

(a) $HCN > ClCH_2COOH > HCOOH > CH_3COOH$

(b) $HCN > HCOOH > ClCH_2COOH > CH_3COOH$

(c) $ClCH_2COOH > HCOOH > CH_3COOH > HCN$

(d) $ClCH_2COOH > HCN > HCOOH > CH_3COOH$

28. The strongest acid is

(a) H_3AsO_4 (b) H_3AsO_3

(c) H_3PO_3 (d) H_3PO_4

29. Which of the following is the strongest base

(a) $C_2H_5^-$ (b) $C_2H_5COO^-$

(c) $C_2H_5O^-$ (d) OH^-

30. The ionisation constant of phenol is higher than that of ethanol because

(a) Phenoxide ion is bulkier than ethoxide

(b) Phenoxide ion is stronger base than ethoxide

(c) Phenoxide ion is stabilised through delocalisation

(d) Phenoxide ion is less stable than ethoxide

31. The correct order of increasing $[H_3O^+]$ in the following aqueous solutions is

(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) $0.01\ M\ H_2S < 0.01\ M\ NaNO_2 < 0.01\ M\ NaCl < 0.01\ M\ H_2SO_4$

32. The correct order of decreasing acidic nature of $H_2O, ROH, CH \equiv CH$ and NH_3 is

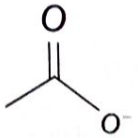
(a) $CH \equiv CH > H_2O > ROH > NH_3$

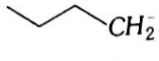
(b) $H_2O > ROH > CH \equiv CH > NH_3$

(c) $ROH > NH_3 > CH \equiv CH > H_2O$

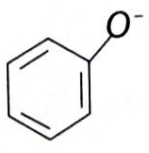
(d) $H_2O > ROH > NH_3 > CH \equiv CH$

33. Order of the base strength of the compounds

(i) 

(ii) 

(iii) NH_2^-

(iv) 

(a) iv > iii > i > ii (b) iii > ii > iv > i

(c) ii > iii > iv > i (d) ii > iii > i > iv

34. Which of the following dissolves in water to give a neutral solution

(a) $(NH_4)_2SO_4$ (b) $Ba(NO_3)_2$

(c) $CrCl_3$ (d) $CuSO_4$

35. Which oxychloride has maximum pH

(a) $NaClO$ (b) $NaClO_2$

(c) $NaClO_3$ (d) $NaClO_4$

36. A solution of sodium borate has a pH of approximately

(a) < 7 (b) > 7

(c) $= 7$ (d) Between 4 to 5

37. Which one is not an acid salt

(a) NaH_2PO_2 (b) NaH_2PO_3

(c) NaH_2PO_4 (d) None

38. In which of the following solvents is silver chloride most soluble

(a) 0.1 $mol\ dm^{-3}$ $AgNO_3$ solution

(b) 0.1 $mol\ dm^{-3}$ HCl solution

(c) H_2O

(d) Aqueous ammonia

39. NH_4HF_2 ionises in aqueous medium as

(a) $NH_4HF^+F^-$ (b) $NH_4^+HF_2^-$

(c) $NH_3HF^-H^+$ (d) $NH_4F_2^-H^+$

40. The most stable Lewis acid–base adduct among the following is

(a) $H_2O \rightarrow BCl_3$ (b) $H_2S \rightarrow BCl_3$

(c) $H_3N \rightarrow BCl_3$ (d) $H_3P \rightarrow BCl_3$

3. Common Ion Effect, Isohydric Solutions, Solubility Product, Ionic Product of Water and Salt Hydrolysis

1. The addition of HCl will not suppress the ionization of

(a) Acetic acid (b) Benzoic acid

(c) H_2S (d) Sulphuric acid

2. Why pure $NaCl$ is precipitated when HCl gas is passed in a saturated solution of $NaCl$

(a) Impurities dissolve 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

3. The concentration of KI and KCl in certain solution containing both is $0.001M$ each. If 20 mL of this solution is added to 20 mL of a saturated solution of AgI in water? What will happen

(a) $AgCl$ will be precipitated

(b) AgI will be precipitated

(c) Both $AgCl$ and AgI will be precipitated

(d) There will be no precipitated

4. In a solution of acetic acid, sodium acetate is added, then its pH value

(a) Decreases

(b) Increases

(c) Remains unchanged

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

5. Blood pH is controlled by concentration of H_2CO_3 and HCO_3^-. In presence of $NaHCO_3$, pH of blood is

(a) Increased (b) Decreased

(c) No change (d) Statement is wrong

6. Which pair will show common ion effect

(a) $BaCl_2 + Ba(NO_3)_2$ (b) $NaCl + HCl$

(c) $NH_4OH + NH_4Cl$ (d) $AgCN + KCN$

7. Solubility of BaF_2 in a solution $Ba(NO_3)_2$ will be represents by the concentration term

(a) $[Ba^{++}]$ (b) $[F^-]$

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

8. If the solubility of $PbBr_2$ is S g-mole per litre, its solubility product, considering it to be 80% ionized, is

(a) $2.048S^2$ (b) $20.48S^3$

(c) $2.048S^3$ (d) $2.048S^4$

9. 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

(a) 1.4×10^{-4} (b) 8.16×10^{-4}

(c) 0.816 (d) 1.4

10. 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

(a) 8×10^{-24} (b) 16×10^{-24}

(c) 1.6×10^{-18} (d) 16×10^{-18}

11. Select incorrect sequence of solubility product values among the following

(a) $CoS > CuS$ (b) $NiS > PbS$

(c) $Fe(OH)_3 > Fe(OH)_2$ (d) $Ni(OH)_2 > Cr(OH)_3$

12. 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

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

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

13. In the reaction: $H_2S \rightleftharpoons 2H^+ + S^{--}$, when NH_4OH is added, then

(a) S^{--} is precipitate

(b) No action takes places

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

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

14. One dm^3 solution containing 10^{-5} moles each of Cl^- ions and CrO_4^{-2} ions is treated with 10^{-4} moles of silver nitrate. Which one of the following observations is made

$[K_{sp}Ag_2CrO_4 = 4\times10^{-12}]$ $[K_{sp}AgCl = 1\times10^{-10}]$

(a) Precipitation does not occur

(b) Silver chromate gets precipitated first

(c) Silver chloride gets precipitated first

(d) Both silver chromate and silver chloride start precipitation simultaneously

15. Upto what pH must a solution containing a precipitate of $Cr(OH)_3$ be adjusted so that all of precipitate dissolves

(When $Cr^{3+} = 0.1 mol/l, K_{sp} = 6\times10^{-31}$)

(a) Upto 4.4 (b) Upto 4.1

(c) Upto 4.2 (d) Upto 4.0

16. $Fe(OH)_3$ can be separated from $Al(OH)_3$ by the addition of

(a) $NaCl$ solution (b) Dil. HCl solution

(c) $NaOH$ solution (d) NH_4Cl and NH_4OH

17. At $25°C$, the solubility product of Hg_2Cl_2 in water is 3.2×10^{-17} mol^3 dm^{-9}. What is the solubility of Hg_2Cl_2 in water at 25°C

(a) $1.2\times10^{-12}M$ (b) $3.0\times10^{-6}M$

(c) $2\times10^{-6}M$ (d) $1.2\times10^{-16}M$

(e) $5.2\times10^{-6}M$

18. Which of the following represents hydrolysis

(a) $HCO_3^- + H_2O \rightleftharpoons CO_3^{2-} + H_3O^+$

(b) $HCO_3^- + H_2O \rightleftharpoons H_2CO_3 + OH^-$

(c) $H_3BO_3 + H_2O \rightleftharpoons H_2BO_3^- + H_3O^+$

(d) $H_2PO_4^- + H_2O \rightleftharpoons HPO_4^{2-} + H_3O^+$

19. The values of Ksp of $CaCO_3$ and CaC_2O_4 are 4.7×10^{-9} and 1.3×10^{-9} respectively at $25°C$. If the mixture of these two is washed with water, what is the concentration of Ca^{2+} ions in water

(a) $5.831\times10^{-5}M$ (b) $6.856\times10^{-5}M$

(c) $3.606\times10^{-5}M$ (d) $7.746\times10^{-5}M$

20. Aqueous solution of $CuSO_4.5H_2O$ changes blue litmus paper to red due to

(a) Presence of Cu^{++} ions

(b) Presence of SO_4^{--} ions

(c) Hydrolysis taking place

(d) Reduction taking place

21. The different colours of litmus in acidic, neutral and basic solutions are, respectively

(a) Red, orange and blue (b) Blue, violet and red

(c) Red, colourless and blue (d) Red, violet and blue

22. The aqueous solution of which one of the following is basic

(a) $HOCl$ (b) $NaHSO_4$

(c) NH_4NO_3 (d) $NaOCl$

23. The degree of hydrolysis in hydrolytic equilibrium $A^- + H_2O \rightleftharpoons HA + OH^-$ at salt concentration of $0.001M$ is $(K_a = 1\times10^{-5})$

(a) 1×10^{-3} (b) 1×10^{-4}

(c) 5×10^{-4} (d) 1×10^{-6}

24. 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

(a) 1.0×10^{-6} (b) 1.0×10^{-7}

(c) 1.0×10^{-8} (d) 1.0×10^{-9}

25. The pH at the equivalence point of a titration may differ from 7.0 because of

(a) The self ionisation of water

(b) Hydrolysis of the salt formed

(c) The indicator used

(d) The concentration of the standard solution

26. 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

(a) 50% (b) 35%

(c) 75% (d) 100%

27. 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

(a) 10^{-3} (b) 10^{-4}

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

28. When 1.88g of $AgBr(s)$ is added to a $10^{-3}M$ aqueous solution of KBr, the concentration of Ag is $5 \times 10^{-10}M$. If the same amount of $AgBr(s)$ is added to a $10^{-2}M$ aqueous solution of $AgNO_3$, the concentration of Br^- is

(a) $9.4 \times 10^{-9}M$ (b) $5 \times 10^{-10}M$

(c) $1 \times 10^{-11}M$ (d) $5 \times 10^{-11}M$

29. $Mg(OH)_2$ is precipitated when $NaOH$ is added to a solution of Mg^{2+}. If the final concentration of Mg^{2+} is $10^{-10}M$, the concentration of $OH^-(M)$ in the solution is

[Solubility product for $Mg(OH)_2 = 5.6 \times 10^{-12}$]

(a) 0.056 (b) 0.12

(c) 0.24 (d) 0.025

4. Hydrogen Ion Concentration- pH Scale and Buffer Solution

1. 100 mL of $HCl + 35mL$ of $NaOH$, colour of methyl orange in the solution will be

(a) Red

(b) Yellow

(c) Can't be predicted

(d) Methyl orange is not a suitable indicator

2. For a weak acid, the incorrect statement is

(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

3. Which of the following will decrease the pH of a 50 mL solution of 0.01 M HCl

(a) Addition of 5 mL of 1 M HCl

(b) Addition of 50 mL of 0.01 M HCl

(c) Addition of 50 mL of 0.002 M HCl

(d) Addition of Mg

4. A solution of $MgCl_2$ in water has pH

(a) < 7 (b) > 7

(c) 7 (d) 14.2

5. The pH of 0.05 M solution of dibasic acid is

(a) +1 (b) –1

(c) +2 (d) –2

6. Which of the following does not make any change in pH when added to 10 mL dilute HCl

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

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

7. The concentration of hydronium (H_3O^+) ion in water is

(a) Zero (b) 1×10^7 g $ion/litre$

(c) 1×10^{-14} g $ion/litre$ (d) 1×10^{-7} g $ion/litre$

8. When a strong acid is titrated using a weak base, the pH at the equivalence point is

(a) 7 (b) > 7

(c) < 7 (d) ≈ 7

9. 10^{-6} M $NaOH$ is diluted 100 times. The pH of the diluted base is

(a) Between 5 and 6 (b) Between 6 and 7

(c) Between 10 and 11 (d) Between 7 and 8

10. 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

(a) 0 (b) 1

(c) > 7 (d) 7

11. If pK_a of acetic acid and pK_b of ammonium hydroxide are 4.76 each. The pH of ammonium acetate is

(a) 7 (b) Less than 7

(c) More than 7 (d) Zero

12. The pH of a solution obtained by mixing equal volumes of $\frac{N}{10}NaOH$ and $\frac{N}{20}HCl$

(a) 13.4 (b) 12.4

(c) 7.6 (d) 1.6

13. pK_a of acetic acid is 4.74. The concentration of CH_3COONa is 0.01 M. The pH of CH_3COONa is

(a) 8.37 (b) 4.37

(c) 4.74 (d) 0.474

14. 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

(a) 3.3 (b) 4.3

(c) 4.0 (d) 4.5

15. The pH of pure water or neutral solution at 50°C is .... ($pK_w = 13.26 = 13.26$ at 50°C)

(a) 7.0 (b) 7.13

(c) 6.0 (d) 6.63

16. The pH of neutral water at 25°C is 7.0. As the temperature increases, ionisation of water increases, however, the concentration of H^+ ions and OH^- ions are equal. What will be the pH of pure water at 60°C

(a) Equal to 7.0 (b) Greater than 7.0

(c) Less than 7.0 (d) Equal to zero

17. The ionisation constant of an acid, K_a is the measure of strength of an acid. The K_a values of acetic acid, hypochlorous acid and formic acid are 1.74×10^{-5}, 3.0×10^{-8} and 1.8×10^{-4} respectively. Which of the following orders of pH of $0.1 mol\, dm^{-3}$ solutions of these acids is correct

(a) Acetic acid > hypochlorous acid > formic acid

(b) Hypochlorous acid > acetic acid > formic acid

(c) Formic acid > hypochlorous acid > acetic acid

(d) Formic acid > acetic acid > hypochlorous acid

18. What will be the value of pH of $0.01\ mol\ dm^{-3}$ CH_3COOH ($K_a = 1.74\times10^{-5}$)

(a) 3.4 (b) 3.6

(c) 3.9 (d) 3.0

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

(a) 7.005 (b) 4.75

(c) 7.0 (d) Between 6 and 7

20. Approximate relationship between dissociation constant of water (K) and ionic product of water (K_w) is

(a) $K_w = K$ (b) $K_w = 55.6\times K$

(c) $K_w = 18\times K$ (d) $K_w = 14\times K$

21. A 100 mL 0.1 M solution of ammonium acetate is diluted by adding 100 mL of water. The pH of the resulting solution will be (pK_a of acetic acid is nearly equal to pK_a of NH_4OH)

(a) 4.9 (b) 5.0

(c) 7.0 (d) 10.0

22. What is the pH for a neutral solutions at the normal temperature of the human body

(a) 7.2 (b) 14.0

(c) 6.8 (d) 6.0

23. pH of HCl ($10^{-12}M$) is

(a) 12 (b) –12

(c) ≈ 7 (d) 14

24. Which one of the following electrolytes would dissolve in water to give a 0.1M solution with pH about 9

(a) CH_3COOH (b) CH_3COONa

(c) NH_4Cl (d) KOH

(e) NaCl

25. The K_{sp} of $Mg(OH)_2$ is 1×10^{-12}, 0.01M $Mg(OH)_2$ will precipitate at the limiting pH

(a) 3 (b) 9

(c) 5 (d) 8

26. 0.1 M HCl and 0.1 M H_2SO_4, each of volume 2 mL are mixed and the volume is made up to 6 mL by adding 2 mL of 0.01 N $NaCl$ solution. The pH of the resulting mixture is

(a) 1.17 (b) 1.0

(c) 0.3 (d) $\log 2 - \log 3$

27. On adding which of the following the pH of 20 mL of 0.1N HCl will not alter

(a) 1 mL of 1 N HCl (b) 20 mL of distilled water

(c) 1 mL of 0.1 N $NaOH$ (d) 500 mL of HCl of $pH = 1$

28. pH of water is 7.0 at $25°C$. If water is heated to $80°C$

(a) pH will increase

(b) pH will decrease

(c) pH remains 7.0

(d) H^+ ion concentration will increase but OH^- ion concentration will decrease

29. At $100°C$ the K_w of water is 55 times its value at $25°C$. What will be the pH of neutral solution $(\log 55 = 1.74)$

(a) 7.00 (b) 7.87

(c) 5.13 (d) 6.13

30. 200 mL of a strong acid solution of pH 2.0 is mixed with 800 mL of another acid solution of pH 3.0. The pH of the resultant solution is

(a) 2.55 (b) 2.97

(c) 2.40 (d) 2.10

31. K_a of H_2O_2 is of the order of

(a) 10^{-12} (b) 10^{-14}

(c) 10^{-16} (d) 10^{-10}

32. The pH of the solution produced by mixing equal volume of $2.0\times10^{-3}M$ $HClO_4$ and $1.0\times10^{-2}M$ $KClO_4$ is

(a) 2.7 (b) 2.3

(c) 3.0 (d) 1.0

33. 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 $(K_a = 10^{-5})$

(a) 1 : 10 (b) 10 : 1

(c) 100 : 1 (d) 1 : 100

34. Which is incorrect for buffer solution

(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

35. A buffer solution is prepared by mixing equal concentration of acid (ionisation constant K_a) and a salt. The pH of buffer is

(a) $pK_a + 7$ (b) $14 - pK_a$

(c) pK_a (d) $pK_a + 1$

36. Consider the following solutions of equal concentrations

$A = NH_4Cl$ $B = CH_3COONa$

$C = NH_4OH$ $D = CH_3COOH$

A buffer solution can be obtained by mixing equal volumes of

(a) C and D (b) A and B

(c) A and C (d) A and D

37. The most important buffer in the blood consists of

(a) HCl and $Cl^{\oplus}$ (b) H_2CO_3 and $HCO_3^{\ominus}$

(c) H_2CO_3 and $Cl^{\ominus}$ (d) HCl and $HCO_3^{\ominus}$

38. Henderson's equation is $pH = pK_a + \log\frac{[salt]}{[acid]}$. If the acid gets half neutralized the value of pH will be : $[pK_a = 4.30]$

(a) 4.3 (b) 2.15

(c) 8.60 (d) 7

39. 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

(a) 1 M CH_3COOH (b) 5 M CH_3COOH

(c) 5 M HCl (d) 1 M NH_4OH

40. A weak acid of dissociation constant 10^{-5} is being titrated with aqueous $NaOH$ solution. The pH at the point of one-third neutralization of the acid will be

(a) $5 + \log 2 - \log 3$ (b) $5 - \log 2$

(c) $5 - \log 3$ (d) $5 - \log 6$

41. Which of the following will produce a buffer solution when mixed in equal volumes

(a) 0.1 $mol\ dm^{-3}$ NH_4OH and 0.1 $mol\ dm^{-3}$ HCl

(b) 0.05 $mol\ dm^{-3}$ NH_4OH and 0.1 $mol\ dm^{-3}$ HCl

(c) 0.1 $mol\ dm^{-3}$ NH_4OH and 0.05 $mol\ dm^{-3}$ HCl

(d) 0.1 $mol\ dm^{-3}$ CH_4COONa and 0.1 $mol\ dm^{-3}$ $NaOH$

42. Which one is buffer solution

(a) $[PO_4^{--}]\ [[HPO_4^{--}]$ (b) $[PO_3^{3-}]\ [[H_2PO_4^{--}]$

(c) $[HPO_4^{--}]\ [[H_2PO_4^{--}]$ (d) All of these

43. Which buffer solution out of the following will have $pH > 7$

(a) $CH_3COOH + CH_3COONa$

(b) $HCOOH + HCOOK$

(c) CH_3COONH_4

(d) $NH_4OH + NH_4Cl$

44. 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

(a) 4.50 (b) 8.00

(c) 7.00 (d) 10.00

45. Why are strong acids generally used as standard solutions in acid-base titrations

(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

46. The suitable indicator for strong acid and weak base is

(a) Methyl orange (b) Methyl red

(c) Phenol red (d) Phenolphthalein

47. The indicator used in the titration of iodine against sodium thiosulphate is

(a) Starch (b) $K_3Fe(CN)_6$

(c) K_2CrO_4 (d) Potassium

48. Phenolphthalein does not act as an indicator for the titration between

(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

49. The indicator used in the titration of sodium carbonate with sulphuric acid is

(a) Phenolphthalein (b) Methyl orange

(c) Potassium ferrocynide (d) Potassium ferricynide

50. An aqueous solution of HCl has a pH of 2.0 . When water is added to increase the pH to 5.0 the hydrogen ion concentration

(a) Remains the same (b) Decreases three–fold

(c) Increases three–fold (d) Decreases thousand–fold

51. The pK_a of a weak acid 5.85 . The concentrations of the acid and its conjugate base are equal at a pH of

(a) 6.85 (b) 5.85

(c) 4.85 (d) 7.85

52. The pH of $0.1M$ aqueous solution of $NaCl, CH_3COONa$ and NH_4Cl will follow the order

(a) $NaCl < CH_3COONa < NH_4Cl$

(b) $NH_4Cl < NaCl < CH_3COONa$

(c) $NH_4Cl < CH_3COONa < NaCl$

(d) $NaCl < NH_4Cl < CH_3COONa$

53. The pH of $1N$ aqueous solutions of HCl, CH_3COOH and $HCOOH$ follows the order

(a) $HCl > HCOOH > CH_3COOH$

(b) $HCl = HCOOH > CH_3COOH$

(c) $CH_3COOH > HCOOH > HCl$

(d) $CH_3COOH = HCOOH > HCl$

5. IIT-JEE/ AIEEE

1. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionization constant, K_a of the acid is **[2012]**

(a) 3×10^{-1} (b) 1×10^{-3}

(c) 1×10^{-5} (d) 1×10^{-7}

2. The first and second dissociation constants of an acid H_2A are 1.0×10^{-5} and 5.0×10^{-10} respectively. The overall dissociation constant of the acid will be **[2007]**

(a) 5.0×10^{-5} (b) 5.0×10^{15}

(c) 5.0×10^{-15} (d) 0.0×10^{5}

3. The dissociation of water at $25^\circ C$ is $1.9\times10^{-7}\%$ and the density of water is $1.0\,g/cm^3$. The ionisation constant of water is **[1995]**

(a) 3.42×10^{-6} (b) 3.42×10^{-8}

(c) 1.00×10^{-14} (d) 2.00×10^{-16}

4. 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 **[2004]**

(a) 25% (b) 50%

(c) 75% (d) 85%

5. In aqueous solution the ionization constants for carbonic acid are

$K_1 = 4.2\times10^{-7}$ and $K_2 = 4.8\times10^{-11}$

Select the correct statement for a saturated 0.034 M solution of the carbonic acid **[2010]**

(a) The concentration of H^+ is double that of CO_3^{2-}

(b) The concentration of CO_3^{2-} is 0.034 M

(c) The concentration of CO_3^{2-} is greater than that of HCO_3^-

(d) The concentration of H^+ and HCO_3^- are approximately equal

6. The compound that is not a Lewis acid is **[1985; 2002]**

(a) BF_3 (b) $AlCl_3$

(c) $BeCl_2$ (d) NH_3

7. Which is strongest Lewis base **[1989]**

(a) SbH_3 (b) AsH_3

(c) PH_3 (d) NH_3

8. H_3BO_3 is **[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

9. The species among the following, which can act as an acid and a base is **[2002]**

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

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

10. Three reactions involving $H_2PO_4^-$ are given below

(i) $H_3PO_4 + H_2O \rightarrow H_3O^+ + H_2PO_4^-$

(ii) $H_2PO_4^- + H_2O \rightarrow HPO_4^{2-} + H_3O^+$

(iii) $H_2PO_4^- + OH^- \rightarrow H_3PO_4 + O^{2-}$

In which of the above does $H_2PO_4^-$ act as an acid **[2010]**

(a) (i) only (b) (ii) only

(c) (i) and (ii) (d) (iii) only

11. The conjugate base of $H_2PO_4^-$ is **[2004]**

(a) H_3PO_4 (b) P_2O_5

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

12. Which one of the following substance has the highest proton affinity **[2003]**

(a) H_2O (b) H_2S

(c) NH_3 (d) PH_3

13. What is the conjugate base of OH^- **[2005]**

(a) O_2 (b) H_2O

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

14. Four species are listed below

(i) HCO_3^- (ii) H_3O^+

(iii) HSO_4^- (iv) HSO_3F

Which one of the following is the correct sequence of their acid strengt **[2008]**

(a) ii < iii < i < iv (b) i < iii < ii < iv

(c) iii < i < iv < ii (d) iv < ii < iii < i

15. The correct order of increasing basicity of the given conjugate bases ($R = CH_3$) is **[2010]**

(a) $RCO\overline{O} < HC \equiv \overline{C} < \overline{N}H_2 < \overline{R}$

(b) $RCO\overline{O} < HC \equiv \overline{C} < \overline{R} < \overline{N}H_2$

(c) $\overline{R} < HC \equiv \overline{C} < RCO\overline{O} < \overline{N}H_2$

(d) $RCO\overline{O} < \overline{N}H_2 < HC \equiv \overline{C} < \overline{R}$

16. The compound whose 0.1 M solution is basic is **[1986]**

(a) Ammonium acetate (b) Calcium carbonate

(c) Ammonium sulphate (d) Sodium acetate

17. The species present in solution when CO_2 is dissolved in water are **[2006]**

(a) $CO_2, H_2CO_3, HCO_3^-, CO_3^{2-}$

(b) H_2CO_3, CO_3^{2-}

(c) CO_3^2, HCO_3

(d) CO_2, H_2CO_3

18. A precipitate of calcium oxalate will not dissolve in **[1986]**

(a) HCl (b) HNO_3

(c) Aquaregia (d) CH_3COOH

19. The pH of 0.1 M solution of the following salts increases in the order **[1999]**

(a) $NaCl < NH_4Cl < NaCN < HCl$

(b) $HCl < NH_4Cl < NaCl < NaCN$

(c) $NaCN < NH_4Cl < NaCl < HCl$

(d) $HCl < NaCl < NaCN < NH_4Cl$

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

(a) $NiCl_2$ (b) $BeCl_2$

(c) $FeCl_3$ (d) $AlCl_3$

21. 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 **[1988]**

(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

22. 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 **[2005]**

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

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

23. 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 **[2003]**

(a) FeS (b) MnS

(c) HgS (d) ZnS

24. The solubility in water of a sparingly soluble salt AB_2 is $1.0\times10^{-5} mol\, l^{-1}$. Its solubility product number will be **[2003]**

(a) 4×10^{-15} (b) 4×10^{-10}

(c) 1×10^{-15} (d) 1×10^{-10}

25. Solid $Ba(NO_3)_2$ is gradually dissolved in a $1.0\times10^{-4} M$ Na_2CO_3 solution. At what concentration of Ba^{2+} will a precipitate begin to form (K_{sp} for $BaCO_3 = 5.1\times10^{-9}$) **[2009]**

(a) $4.1\times10^{-5} M$ (b) $5.1\times10^{-5} M$

(c) $8.1\times10^{-8} M$ (d) $8.1\times10^{-7} M$

26. Solubility of a salt M_2X_3 is $y\ mol\, dm^{-3}$. The solubility product of the salt will be **[1990, 97]**

(a) $6y^4$ (b) $64y^4$

(c) $36y^5$ (d) $108y^5$

27. 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 **[2004]**

(a) $s = (256K_{sp})^{1/5}$ (b) $s = (128K_{sp})^{1/4}$

(c) $s = (K_{sp}/128)^{1/4}$ (d) $s = (K_{sp}/256)^{1/5}$

28. Which hydroxide will have lowest value of solubility product at normal temperature ($25^\circ C$) **[1990]**

(a) $Mg(OH)_2$ (b) $Ca(OH)_2$

(c) $Ba(OH)_2$ (d) $Be(OH)_2$

29. Solubility product constant (K_{sp}) of salts of types MX_1, MX_2 and M_3X at temperature 'T' are 4.0×10^{-8}, 3.2×10^{-14} and 2.7×10^{-15}, respectively. Solubilities ($moldm^{-3}$) of the salts at temperature 'T' are in the order **[2008]**

(a) $MX_1 > MX_2 > M_3X$ (b) $M_3X > MX_2 > MX_1$

(c) $MX_2 > M_3X > MX_1$ (d) $MX_1 > M_3X > MX_2$

30. In a saturated solution of the sparingly soluble strong electrolyte $AgIO_3$ (Molecular mass = 283) the equilibrium which sets in is

$$AgIO_{3(s)} \rightleftharpoons Ag^{+}_{(aq)} + IO^{-}{}_{3(aq)}$$

If the solubility product constant K_{sp} of $AgIO_3$ at a given temperature is 1.0×10^{-8}, what is the mass of $AgIO_3$ contained in 100 mL of its saturated solution **[2007]**

(a) $28.3\times10^{-2}\ g$ (b) $2.83\times10^{-3}\ g$

(c) $1.0\times10^{-7}\ g$ (d) $1.0\times10^{-4}\ g$

31. The precipitate of CaF_2 ($K_{sp} = 1.7\times10^{-10}$) is obtained when equal volumes of the following are mixed **[1982, 92]**

(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

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

(a) Calcium oxide (b) Calcium carbonate

(c) Calcium oxalate (d) Calcium hydroxide

33. Solubility product of silver bromide is 5.0×10^{-13}. The quantity of potassium bromide (molar mass taken as 120 $g\ mol^{-1}$) to be added to 1 *litre* of 0.05 M solution of silver nitrate to start the precipitation of $AgBr$ is **[2010]**

(a) $5.0\times10^{-8}\ g$ (b) $1.2\times10^{-10}\ g$

(c) $1.2\times10^{-9}\ g$ (d) $6.2\times10^{-5}\ g$

34. At 25°C, the solubility product of $Mg(OH)_2$ is 1.0×10^{-11}. At which pH, *will* Mg^{2+} ions start precipitating in the form of $Mg(OH)_2$ from a solution of $0.001M$ Mg^{2+} ions **[2010]**

(a) 8 (b) 9

(c) 10 (d) 11

35. For a sparingly soluble salt A_pB_q, the relationship of its solubility product (L_S) with its solubility (S) is **[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) $L_s = S^{pq}.(p.q)^{p+q}$

36. Passing H_2S gas into a mixture of $Mn^{2+}, Ni^{2+}, Cu^{2+}$ and Hg^{2+} ions in an acidified aqueous solution precipitates **[2011]**

(a) CuS and HgS (b) MnS and CuS

(c) MnS and NiS (d) NiS and HgS

37. 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 **[2004]**

(a) 0.0001% (b) 0.01%

(c) 0.1% (d) 0.15%

38. $2.5mL$ of $\frac{2}{5} M$ weak monoacidic base ($K_b = 1\times10^{-12}$ at $25^\circ C$) is titrated with $\frac{2}{15} M\, HCl$ in water at $25^\circ C$. The concentration of H^+ at equivalence point is ($K_w = 1\times10^{-14}$ at $25^\circ C$) **[2008]**

(a) $3.7\times10^{-13} M$ (b) $3.2\times10^{-7} M$

(c) $3.2\times10^{-2} M$ (d) $2.7\times10^{-2} M$

39. pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4, respectively. The pH of their salt (AB) solution is **[2017]**

(a) 6.9 (b) 7.0

(c) 1.0 (d) 7.2

40. Which of the following salts is the most basic in aqueous solution **[2018]**

(a) $FeCl_3$ (b) $Pb(CH_3COO)_2$

(c) $Al(CN)_3$ (d) CH_3COOK

41. An aqueous solution contains an unknown concentration of Ba^{2+}. When $50\,mL$ of a 1M solution of Na_2SO_4 is added, $BaSO_4$ just begins to precipitate. The final volume is $500\,mL$. The solubility product of $BaSO_4$ is 1×10^{-10}. What is the original concentration of Ba^{2+} **[2018]**

(a) $1.1\times10^{-9}\,M$ (b) $1.0\times10^{-10}\,M$

(c) $5\times10^{-9}\,M$ (d) $2\times10^{-9}\,M$

42. An aqueous solution contains $0.10M$ H_2S and $0.20M$ HCl. If the equilibrium constant for the formation of HS^- from H_2S is 1.0×10^{-7} and that of S^{2-} from HS^- ions is 1.2×10^{-13} then the concentration of S^{2-} ions in aqueous solution is **[2018]**

(a) 6×10^{-21} (b) 5×10^{-19}

(c) 5×10^{-8} (d) 3×10^{-20}

43. $1\,M$ $NaCl$ and $1\,M$ HCl are present in an aqueous solution. The solution is **[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 $pH > 7$

44. The pH of 10^{-8} molar aqueous solution of HCl is **[1981]**

(a) -8

(b) 8

(c) $6 > 7$ (Between 6 and 7)

(d) $7 > 8$ (Between 7 and 8)

45. If pK_b for fluoride ion at $25°C$ is 10.83, the ionisation constant of hydrofluoric acid in water at this temperature is **[1997]**

(a) 1.74×10^{-3} (b) 3.52×10^{-3}

(c) 6.75×10^{-4} (d) 5.38×10^{-2}

46. The pK_a of a weak acid, HA is 4.8. The pK_b of a weak base, BOH, is 4.78. The pH of an aqueous solution of the corresponding salt, BA, will be **[2008]**

(a) 4.79 (b) 7.01

(c) 9.22 (d) 9.58

47. Which one of the following statements is not true **[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

48. How many litres of water must be added to $1\,L$ of aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2 **[2013]**

(a) $0.1\,L$ (b) $0.9\,L$

(c) $2.0\,L$ (d) $9.0\,L$

49. When rain is accompanied by a thunderstorm, the collected rain water will have a pH value **[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

50. 0.1 mole of CH_3NH_2 ($K_b = 5\times10^{-4}$) is mixed with 0.08 mole of HCl and diluted to one litre. What will be the H^+ concentration in the solution **[2005]**

(a) $8\times10^{-2}\,M$ (b) $8\times10^{-11}\,M$

(c) $1.6\times10^{-11}\,M$ (d) $8\times10^{-5}\,M$

51. The pK_a of a weak acid (HA) is 4.5. The pOH of an aqueous buffered solution of HA in which 50% of the acid is ionized is **[2007]**

(a) 4.5 (b) 2.5

(c) 9.5 (d) 7.0

52. An alkali is titrated against an acid with methyl orange as indicator, which of the following is a correct combination **[2018]**

	Base	Acid	End point
(a)	Weak	Strong	Yellow to pinkish red
(b)	Strong	Strong	Pink to colourless
(c)	Weak	Strong	Colourless to pink
(d)	Strong	Strong	Pinkish red to yellow

6. NEET/ AIPMT/ CBSE-PMT

1. The hydrogen ion concentration in weak acid of dissociation constant K_a and concentration c is nearly equal to **[1989]**

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

(c) $K_a c$ (d) $\sqrt{K_a c}$

2. A weak acid HA has a K_a of 1.00×10^{-5}. If 0.100 mol of this acid is dissolved in one litre of water the percentage of acid dissociated at equilibrium is close to **[2007]**

(a) 99.0% (b) 1.00%

(c) 99.9% (d) 0.100%

3. The percentage of pyridine (C_5H_5N) that forms pyridinium ion $(C_5H_5N^+H)$ in a 0.10 M aqueous pyridine solution (K_b for $C_5H_5N = 1.7 \times 10^{-9}$) is **[2016]**

(a) 1.6 % (b) 0.0060 %

(c) 0.013 % (d) 0.77 %

4. Which of the following is not a Lewis acid **[1996]**

(a) BF_3 (b) $FeCl_3$

(c) SiF_4 (d) C_2H_4

5. Which of the following is least likely to behave as Lewis base **[2011; 2013]**

(a) OH^- (b) H_2O

(c) NH_3 (d) BF_3

6. Which of the following fluoro-compounds is most likely to behave as a Lewis base **[2016]**

(a) SiF_4 (b) BF_3

(c) PF_3 (d) CF_4

7. Which of the following molecules acts as a Lewis acid **[2009]**

(a) $(CH_3)_3B$ (b) $(CH_3)_2O$

(c) $(CH_3)_3P$ (d) $(CH_3)_3N$

8. Boric acid is an acid because its molecule **[2016]**

(a) Combines with proton from water molecule

(b) Contains replaceable H^+ ion

(c) Gives up a proton

(d) Accepts OH^- from water releasing proton

9. Which of the following is the strongest conjugate base **[1999]**

(a) Cl^- (b) CH_3COO^-

(c) SO_4^{--} (d) NO_2^-

10. The conjugate acid of NH_2^- is **[1985; 2000]**

(a) NH_3 (b) NH_4^+

(c) NH_2OH (d) N_2H_4

11. Which one of the following compound is not a protonic acid **[2003]**

(a) $SO_2(OH)_2$ (b) $B(OH)_3$

(c) $PO(OH)_3$ (d) $SO(OH)_2$

12. The correct order of acid strength is **[2005, 2016]**

(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) $HClO_4 < HClO_3 < HClO_2 < HClO$

13. Equimolar solutions of the following were prepared in water separately. Which one of the solutions will record the highest pH **[2008; 2012]**

(a) $MgCl_2$ (b) $CaCl_2$

(c) $SrCl_2$ (d) $BaCl_2$

14. Which one is the strongest acid **[1989; 2013]**

(a) $HClO$ (b) $HClO_2$

(c) H_2SO_4 (d) $HClO_4$

15. Acidity of diprotic acids in aqueous solutions increases in the order **[2014]**

(a) $H_2Te < H_2S < H_2Se$ (b) $H_2Se < H_2Te < H_2S$

(c) $H_2S < H_2Se < H_2Te$ (d) $H_2Se < H_2S < H_2Te$

16. The aqueous solution of which of the following salt has the lowest pH **[2002]**

(a) $NaClO$ (b) $NaClO_2$

(c) $NaClO_3$ (d) $NaClO_4$

17. Which of the following salts will give highest pH in water **[2014]**

(a) Na_2CO_3 (b) $CuSO_4$

(c) KCl (d) $NaCl$

18. 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) **[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) $pH_1 > pH_2 > pH_3 > pH_4$

19. On passing a current of HCl gas in a saturated solution of $NaCl$, the solubility of $NaCl$ **[1989]**

(a) Increases (b) Decreases

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

20. Solubility of $AgCl$ will be minimum in **[1995]**

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

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

21. Consider the nitration of benzene using mixed conc. H_2SO_4 and HNO_3. If a large amount of $KHSO_4$ is added to the mixture, the rate of nitration will be **[2016]**

(a) Faster (b) Slower

(c) Unchanged (d) Doubled

22. Solubility of MX_2 type electrolyte is $0.5\times10^{-4}\,mole/litre$. The value of K_{sp} of the electrolyte is **[2002]**

(a) 5×10^{-13} (b) 25×10^{-10}

(c) 1.25×10^{-13} (d) 5×10^{12}

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

(a) 2×10^{-4} (b) 4×10^{-4}

(c) 5.6×10^{-6} (d) 3.1×10^{-4}

24. The solubility product of AgI at $25°C$ is $1.0\times10^{-16}\,mol^2l^{-2}$. The solubility of AgI in $10^{-4}N$ solution of KI at $25°C$ is approximately (in mol l^{-1}) **[2003]**

(a) 1.0×10^{-8} (b) 1.0×10^{-16}

(c) 1.0×10^{-12} (d) 1.0×10^{-10}

25. In which of the following solvents will $AgBr$ have the highest solubility **[1992]**

(a) $10^{-3}\,M\ NaBr$ (b) $10^{-3}\,M\ NH_4OH$

(c) Pure water (d) $10^{-3}\,M\ HBr$

26. pH of a saturated solution of $Ba(OH)_2$ is 12. The value of solubility product (K_{sp}) of $Ba(OH)_2$ is **[2012]**

(a) 3.3×10^{-7} (b) 5.0×10^{-7}

(c) 4.0×10^{-6} (d) 5.0×10^{-6}

27. The K_{sp} of $Ag_2CrO_4, AgCl, AgBr$ and AgI are respectively, $1.1\times10^{-12}, 1.8\times10^{-10}, 5.0\times10^{-13}, 8.3\times10^{-17}$. Which one of the following salts will precipitate last if $AgNO_3$ solution is added to the solution containing equal moles of $NaCl, NaBr, NaI$ and Na_2CrO_4 **[2015]**

(a) $AgCl$ (b) $AgBr$

(c) Ag_2CrO_4 (d) AgI

28. MY and NY_3, two nearly insoluble salts, have the same K_{sp} values of 6.2×10^{-13} at room temperature, Which statement would be **true** in regard to MY and NY_3 **[2016]**

(a) The molar solubilities of MY and NY_3 in water are identical

(b) The molar solubility of MY in water is less than that of NY_3

(c) The salts MY and NY_3 are more soluble in 0.5 M KY than in pure water

(d) The addition of the salt of KY to solution of MY and NY_3 will have no effect on their solubilities

29. The solubility of $AgCl(s)$ with solubility product 1.6×10^{-10} is in $0.1\,M\ NaCl$ solution would be **[2016]**

(a) Zero (b) $1.26\times10^{-5}\,M$

(c) $1.6\times10^{-9}\,M$ (d) $1.6\times10^{-11}\,M$

30. In qualitative analysis, the metals of Group I can be separated from other ions by precipitating them as chloride salts. A solution initially contains Ag^+ and Pb^{2+} at a concentration of 0.10 M. Aqueous HCl is added to this solution until the Cl^- concentration is 0.10 M. What will the concentrations of Ag^+ and Pb^{2+} be at equilibrium **[2011]**

(K_{sp} for $AgCl = 1.8\times10^{-10}, K_{sp}$ for $PbCl_2 = 1.7\times10^{-5}$)

(a) $[Ag^+] = 1.8\times10^{-9}M;\ [Pb^{2+}] = 1.7\times10^{-3}M$

(b) $[Ag^+] = 1.8\times10^{-11}M;\ [Pb^{2+}] = 1.7\times10^{-4}M$

(c) $[Ag^+] = 1.8\times10^{-7}M;\ [Pb^{2+}] = 1.7\times10^{-6}M$

(d) $[Ag^+] = 1.8\times10^{-11}M;\ [Pb^{2+}] = 8.5\times10^{-5}M$

31. AlF_3 is soluble in HF only in presence of KF. It is due to the formation of **[2016]**

(a) $K[AlF_3H]$ (b) $K_3[AlF_3H_3]$

(c) $K_3[AlF_6]$ (d) AlH_3

32. Which of the following salts when dissolved in water will get hydrolysed **[1989]**

(a) $NaCl$ (b) NH_4Cl

(c) KCl (d) Na_2SO_4

33. The ionization constant of ammonium hydroxide is 1.77×10^{-5} at $298\,K$. Hydrolysis constant of ammonium chloride is **[2009]**

(a) 5.65×10^{-10} (b) 6.50×10^{-12}

(c) 5.65×10^{-13} (d) 5.65×10^{-12}

34. The most acidic compound in water is **[2001]**

(a) $AlCl_3$ (b) $BeCl_2$

(c) $FeCl_3$ (d) None of these

35. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is $2.2\times10^{-4}\,mol\,L^{-1}$. Solubility product of $Ag_2C_2O_4$ is **[2017]**

(a) 2.42×10^{-8} (b) 2.66×10^{-12}

(c) 4.5×10^{-11} (d) 5.3×10^{-12}

36. The solubility of $BaSO_4$ in water $2.42\times10^{3}\,gL^{-1}$ at $298K$. The value of solubility product (K_{sp}) will be

(Given molar mass of $BaSO_4 = 233\,g\,mol^{-1}$) **[2018]**

(a) $1.08\times10^{-10}\,mol^2L^{-2}$ (b) $1.08\times10^{-12}\,mol^2L^{-2}$

(c) $1.08\times10^{-14}\,mol^2L^{-2}$ (d) $1.08\times10^{-8}\,mol^2L^{-2}$

37. At $90^\circ C$ pure water has $[H_3O^+]=10^{-6}\,M$, the value of K_w at this temperature will be **[1981; 1993]**

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

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

38. The ionic product of water at $25^\circ C$ is 10^{-14}. The ionic product at $90^\circ C$ will be **[1996]**

(a) 1×10^{-20} (b) 1×10^{-12}

(c) 1×10^{-14} (d) 1×10^{-16}

39. At $25^\circ C$, 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 **[2005]**

(a) $2.0\times10^{-6}\,mol\,L^{-1}$ (b) $1.0\times10^{-5}\,mol\,L^{-1}$

(c) $1.0\times10^{-6}\,mol\,L^{-1}$ (d) $1.0\times10^{-7}\,mol\,L^{-1}$

40. Calculate the pOH of a solution at $25^\circ C$ that contains $1\times10^{-10}\,M$ of hydronium ions, *i.e.*, H_3O^+ **[2007]**

(a) 7.000 (b) 4.000

(c) 9.000 (d) 1.000

41. The pH of 0.001 molar solution of HCl will be **[1991]**

(a) 0.001 (b) 3

(c) 2 (d) 6

42. pH value of $N/10$ $NaOH$ solution is **[1996]**

(a) 10 (b) 11

(c) 12 (d) 13

43. pH of a solution is 4. The hydroxide ion concentration of the solution would be **[1991]**

(a) 10^{-4} (b) 10^{-10}

(c) 10^{-2} (d) 10^{-12}

44. What is the pH of the resulting solution when equal volumes of $0.1\,M$ $NaOH$ and $0.01\,M$ HCl are mixed **[2015]**

(a) 12.65 (b) 2.0

(c) 7.0 (d) 1.04

45. The concentration of $[H^+]$ and concentration of $[OH^-]$ of a 0.1 aqueous solution of 2% ionised weak acid is

[Ionic product of water $=1\times10^{-14}$] **[1999]**

(a) $2\times10^{-3}\,M$ and $5\times10^{-12}\,M$

(b) $1\times10^{3}\,M$ and $3\times10^{-11}\,M$

(c) $0.02\times10^{-3}\,M$ and $5\times10^{-11}\,M$

(d) $3\times10^{-2}\,M$ and $4\times10^{-13}\,M$

46. In which of the following arrangements the given sequence is not strictly according to the property indicated against it **[2012]**

(a) $HF < HCl < HBr < HI$; increasing acidic strength

(b) $H_2O < H_2S < H_2Se < H_2Te$; increasing pK_a values

(c) $NH_3 < PH_3 < AsH_3 < SbH_3$; increasing acidic character

(d) $CO_2 < SiO_2 < SnO_2 < PbO_2$; increasing oxidizing power

47. What is the $[OH^-]$ in the final solution prepared by mixing 20.0 mL of 0.050 M HCl with 30.0 mL of 0.10 M $Ba(OH)_2$ **[2009]**

(a) 0.10 M (b) 0.40 M

(c) 0.0050 M (d) 0.12 M

48. Equal volumes of three acid solutions of pH 3,4 and 5 are mixed in a vessel. What will be the H^+ ion concentration in the mixture **[2008]**

(a) $3.7\times10^{-3}M$ (b) $1.11\times10^{-3}M$

(c) $1.11\times10^{-4}M$ (d) $3.7\times10^{-4}M$

49. The hydrogen ion concentration of a $10^{-8}M$ HCl aqueous solution at 298 K ($K_w=10^{-14}$) is **[2006]**

(a) $9.525\times10^{-8}M$ (b) $1.0\times10^{-8}M$

(c) $1.0\times10^{-6}M$ (d) $1.0525\times10^{-7}M$

50. pH of a 10 M solution of HCl is **[1995]**

(a) Less than 0 (b) 2

(c) 0 (d) 1

51. The pH of blood does not appreciably change by a small addition of an acid or a base because blood **[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

52. Which of the following mixtures forms an acid buffer **[1981; 1989]**

(a) $NaOH + HCl$

(b) $CH_3COOH + CH_3COONa$

(c) $NH_4OH + NH_4Cl$

(d) $H_2CO_3 + (NH_4)_2CO_3$

53. 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 **[1989]**

(a) 10 (b) 9

(c) 4 (d) 7

54. Which of the following pairs constitutes a buffer **[2006]**

(a) HNO_3 and NH_4NO_3 (b) HCl and KCl

(c) HNO_2 and $NaNO_2$ (d) $NaOH$ and $NaCl$

55. Which one of the following pairs of solution is not an acidic buffer **[2015]**

(a) $HClO_4$ and $NaClO_4$

(b) CH_3COOH and CH_3COONa

(c) H_2CO_3 and Na_2CO_3

(d) H_3PO_4 and Na_3PO_4

56. 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 **[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 ($pK_a = 3.58$)

57. A buffer solution is prepared in which the concentration of NH_3 is $0.30M$ and the concentration of NH_4^+ is $0.20M$. If the equilibrium constant, K_b for NH_3 equals 1.8×10^{-5}, what is the pH of this solution (log 2.7=0.43) **[2011]**

(a) 8.73 (b) 9.08

(c) 9.43 (d) 11.72

58. Following solutions were prepared by mixing different volumes of $NaOH$ and HCl of different concentrations **[2018]**

(i) $60mL\frac{M}{10}HCl + 40mL\frac{M}{10}NaOH$

(ii) $55mL\frac{M}{10}HCl + 45mL\frac{M}{10}NaOH$

(iii) $75mL\frac{M}{5}HCl + 25mL\frac{M}{5}NaOH$

(iv) $100mL\frac{M}{10}HCl + 100mL\frac{M}{10}NaOH$

pH of which one of them will be equal to 1

(a) (ii) (b) (i)

(c) (iv) (d) (iii)

7. AIIMS

1. $NaOH$ is a strong base because **[2001]**

(a) It gives OH^- ion (b) It can be oxidised

(c) It can be easily ionised (d) Both (a) and (c)

2. The strongest Bronsted base in the following anion is **[2001]**

(a) ClO^- (b) ClO_2^-

(c) ClO_3^- (d) ClO_4^-

3. The correct order of basic strength is **[2007]**

(a) $H_2O < OH^- < CH_3OH < CH_3O^-$

(b) $CH_3OH < H_2O < CH_3O^- < OH^-$

(c) $H_2O < CH_3OH < OH^- < CH_3O^-$

(d) $OH^- < H_2O < CH_3O^- < CH_3OH$

4. On adding 0.1 M solution each of $[Ag^+],[Ba^{2+}],[Ca^{2+}]$ in a Na_2SO_4 solution, species first precipitated is **[2008]**

$[K_{sp}BaSO_4 = 10^{-11}, K_{sp}CaSO_4 = 10^{-6}, K_{sp}Ag_2SO_4 = 10^{-5}]$

(a) Ag_2SO_4 (b) $BaSO_4$

(c) $CaSO_4$ (d) All of these

5. The solubility product of As_2O_3 is 10.8×10^{-9}. It is 50% dissociated in saturated solution. The solubility of salt is **[2007]**

(a) 10^{-2} (b) 2×10^{-2}

(c) 5×10^{-3} (d) 5.4×10^{-9}

6. pH value of a solution, whose hydronium ion concentration is $6.2\times10^{-9} mol/L$, is **[2000]**

(a) 6.21 (b) 7.21

(c) 7.75 (d) 8.21

7. What is the pH value of 1 M H_2SO_4 **[2008]**

(a) 0 (b) -0.213

(c) -2 (d) -0.3010

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

(a) 5.0 (b) 6.0

(c) 7.0 (d) 9.0

9. At 80^oC, distilled water has $[H_3O^+]$ concentration equal to 1×10^{-6} *mole / litre*. The value of K_w at this temperature will be **[1994; 2002]**

(a) 1×10^{-6} (b) 1×10^{-8}

(c) 1×10^{-12} (d) 1×10^{-15}

10. What is the pH of 0.01 M glycine solution? For glycine, $Ka_1 = 4.5\times10^{-3}$ and $Ka_2 = 1.7\times10^{-10}$ at 298 K **[2004]**

(a) 3.0 (b) 10.0

(c) 6.1 (d) 7.2

11. The pH of a solution at $25°C$ containing $0.10m$ sodium acetate and $0.03m$ acetic acid is (pK_a for $CH_3COOH = 4.57$) **[2002]**

(a) 4.09 (b) 5.09

(c) 6.10 (d) 7.09

12. Which one of the following is not a buffer solution **[2003]**

(a) $0.8\,M\,H_2S + 0.8\,M\,KHS$

(b) $2\,M\,C_6H_5NH_2 + 2\,M\,C_6H_5\overset{+}{N}H_3Br$

(c) $3\,M\,H_2CO_3 + 3M\,KHCO_3$

(d) $0.05\,M\,KClO_4 + 0.05\,M\,HClO_4$

13. 40 mL of 0.1 M ammonia solution is mixed with 20 mL of 0.1 M HCl. What is the pH of the mixture (pK_b of ammonia solution is 4.74) **[2006]**

(a) 4.74 (b) 2.26

(c) 9.26 (d) 5.00

8. Assertion and Reason

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 : pH 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 present in acetic acid.

[NDA 1999]

2. Assertion : An ionic product is used for any types of electrolytes whereas solubility product is applicable only to sparingly soluble salts.

Reason : Ionic product is defined at any stage of the reaction whereas solubility product is only applicable to the saturation stage.

[AIIMS 2001]

3. 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]

4. Assertion : The pK_a of acetic acid is lower than that of phenol.

Reason : Phenoxide ion is more resonance stabilized. **[AIIMS 2004]**

5. 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]

6. Assertion : On mixing 500 mL of $10^{-6} M\ Ca^{2+}$ ion and 500 mL of $30 \times 10^{-6}\ M\ F^-$ ion, the precipitate of CaF_2 will be obtained. $K_{sp}(CaF_2 = 10^{-18})$

Reason : If K_{sp} is greater than ionic product, a precipitate will develop. **[AIIMS 2007]**

7. Assertion : $NaCl$ is precipitated when HCl gas is passed in a saturated solution of $NaCl$.

Reason : HCl is strong acid. **[AIIMS 2007]**

8. Ionic Equilibrium – Answers Keys

1. Electrical Conductors, Arrhenius Theory and Ostwald's Dilution Law

1	c	2	d	3	c	4	c	5	a
6	a	7	b	8	a	9	a	10	b
11	c	12	b						

2. Acids and Bases

1	b	2	b	3	a	4	b	5	c
6	a	7	a	8	a	9	c	10	a
11	d	12	b	13	d	14	d	15	a
16	d	17	a	18	d	19	a	20	d
21	a	22	b	23	a	24	b	25	c
26	c	27	c	28	d	29	a	30	c
31	c	32	b	33	b	34	b	35	a
36	b	37	a	38	d	39	b	40	c

3. Common Ion Effect, Isohydric Solutions, Solubility Product, Ionic Product of Water and Salt Hydrolysis

1	d	2	c	3	b	4	b	5	a
6	c	7	c	8	c	9	b	10	d
11	c	12	c	13	d	14	c	15	c
16	d	17	c	18	b	19	d	20	c
21	d	22	d	23	a	24	c	25	b
26	a	27	a	28	d	29	c		

4. Hydrogen Ion Concentration- pH Scale and Buffer Solution

1	a	2	b	3	a	4	a	5	a
6	d	7	d	8	c	9	d	10	c
11	a	12	b	13	a	14	a	15	d
16	c	17	d	18	a	19	c	20	b
21	c	22	c	23	a	24	b	25	b
26	b	27	d	28	b	29	d	30	a
31	a	32	a	33	b	34	d	35	c
36	c	37	b	38	a	39	b	40	b
41	c	42	b	43	d	44	d	45	b
46	ab	47	a	48	b	49	b	50	d
51	b	52	b	53	c				

5. IIT-JEE/ AIEEE

1	c	2	c	3	d	4	c	5	d
6	d	7	d	8	a	9	a	10	b
11	d	12	c	13	d	14	b	15	a
16	d	17	a	18	d	19	b	20	d
21	d	22	b	23	c	24	a	25	b
26	d	27	d	28	d	29	d	30	b
31	b	32	c	33	c	34	c	35	a
36	a	37	b	38	c	39	a	40	d
41	a	42	d	43	a	44	c	45	c
46	b	47	c	48	d	49	a	50	b
51	c	52	a						

6. NEET/ AIPMT/ CBSE-PMT

1	a	2	b	3	c	4	d	5	d
6	c	7	a	8	d	9	b	10	a
11	c	12	a	13	d	14	d	15	c
16	d	17	a	18	d	19	b	20	c
21	b	22	a	23	a	24	c	25	b
26	b	27	c	28	b	29	c	30	a
31	c	32	b	33	a	34	c	35	d
36	a	37	b	38	b	39	d	40	b

41	b	**42**	d	**43**	b	**44**	a	**45**	a
46	b	**47**	a	**48**	d	**49**	d	**50**	c
51	a	**52**	b	**53**	a	**54**	c	**55**	a
56	d	**57**	c	**58**	a				

7. AIIMS

1	d	**2**	a	**3**	c	**4**	b	**5**	b
6	d	**7**	d	**8**	c	**9**	c	**10**	d
11	b	**12**	d	**13**	c				

8. Assertion & Reason

1	c	**2**	b	**3**	c	**4**	c	**5**	c
6	d	**7**	b						