

## Chemical Equilibrium -3

**1. Arrhenius neutralisation involves**

1. Formation of dative bond
2. Formation of water by the combination of  $H^+$  with  $OH^-$
3. Transfer of proton
4. All of these

**2.  $NH_3$  is not a base according to**

1. Bronsted theory
2. Lewis theory
3. Arrhenius theory
4. Lowry theory

**3. Assertion A: According to Bronsted concept  $H_2O$  is an amphoteric substance.**

**Reason R:  $H_2O$  molecule can accept as well as donate a proton.**

- 1) 'A' and 'R' are true, 'R' is correct explanation of 'A'.
- 2) 'A' and 'R' are true. 'R' is not correct explanation of 'A'.
- 3) 'A' is true and 'R' are false.
- 4) Both A and R are false

**4. Which of the following can act as both Bronsted acid and a Bronsted base?**

- (i)  $HCOO^-$                       (ii)  $NH_3$                       (iii)  $O^{2-}$                       (iv)  $HSO_4^-$

1. i and ii
2. ii and iii
3. ii and iv
4. i and iv

**5. Which of the following is only Bronsted - Lowry acid but not an Arrhenius acid?**

- 1)  $HCl$                       2)  $NH_4^+$                       3)  $BF_3$                       4)  $CH_3COOH$

**6. Which of the following species acts as Bronsted base but not as acid?**

- 1)  $CH_3COO^-$                       2)  $HCO_3^-$                       3)  $H_2PO_2^-$                       4) both 1 & 3

7. The conjugate base of hydrazoic acid is

- 1)  $\text{N}^{3-}$                       2)  $\text{N}_3^-$                       3)  $\text{NH}_2^-$                       4)  $\text{N}_3\text{H}_2^+$

8. Conjugate acid of  $\text{HPO}_4^{2-}$  is

- 1)  $\text{H}_3\text{PO}_4$                       2)  $\text{H}_2\text{PO}_4^-$                       3)  $\text{PO}_4^{3-}$                       4)  $\text{H}_3\text{PO}_4$

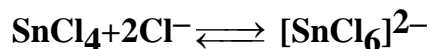
9. The conjugate acid of water is

- 1)  $\text{OH}^-$                       2)  $\text{H}^+$                       3)  $\text{H}_3\text{O}^+$                       4)  $\text{H}_3\text{O}^-$

10. In aqueous solution,  $\text{HCl}$  and  $\text{HNO}_3$  are equally strong. This is because

- 1) Their basic ties are same                      2) Both are oxy acids of non-metals  
3) Both have lower molecular weights                      4) Leveling effect of water

11. Which of the following acts as a Lewis acid in the following reaction?



- 1)  $\text{Cl}^-$                       2)  $[\text{SnCl}_6]^{2-}$                       3)  $\text{SnCl}_4$                       4)  $2\text{Cl}^-$

12. Which of the following is relatively strong Lewis acid?

- 1)  $\text{BF}_3$                       2)  $\text{BCl}_3$                       3)  $\text{BBr}_3$                       4)  $\text{BI}_3$

13. In a complex compound ligand acts as

- 1) Lewis acid                      2) Lewis base                      3) Lowry-Bronsted acid                      4) Arrhenius base

14. Which of the following species acts as a Lewis acid and also as a Lewis base?

- 1)  $\text{SO}_2$                       2)  $\text{SCl}_4$                       3) Both  $\text{SO}_2$  and  $\text{SCl}_4$                       4)  $\text{SO}_3$

15. Strength of a weak acid or a weak base depends upon its

- 1) Temperature                      2) Nature of solvent  
3) Degree of dissociation                      4) All the above

16. Conjugate base of  $[Al(H_2O)_6]^{3+}$  is

- 1)  $[Al(H_2O)_6]^{2+}$                       2)  $[Al(H_2O)_5OH]^{2+}$   
3)  $[Al(H_2O)_4OH]^{2+}$                 4)  $[Al(H_2O)_4(OH)_2]^{2+}$

17. What is the decreasing order of strength of the bases  $OH^-$ ,  $NH_2^-$ ,  $H-C\equiv C^-$  and  $CH_3-CH_2^-$

- 1)  $CH_3 - CH_2^- > NH_2^- > H - C \equiv C^- > OH^-$   
2)  $H - C \equiv C^- > CH_3 - CH_2^- > NH_2^- > OH^-$   
3)  $OH^- > NH_2^- > H - C \equiv C^- > CH_3 - CH_2^-$   
4)  $NH_2^- > H - C \equiv C^- > OH^- > CH_3 - CH_2^-$

18. Which of the following is an acidic salt?

- 1)  $Na_3PO_4$                       2)  $Na_2HPO_3$                       3)  $NaH_2PO_2$                       4)  $NaH_2PO_4$

19. Which of the following has least tendency to act as Lewis acid ?

- 1)  $I^-$                               2)  $I^+$                               3)  $SnCl_2$                               4)  $AlCl_3$

20. Which of the following relatively more strong acid in aqueous solutions?

- 1)  $HCl$                               2)  $HClO_4$                               3)  $HI$                               4) All are equally strong.

21. Which of the following is strong Lewis acid?

- 1)  $Na^+$                               2)  $Mg^{2+}$                               3)  $Al^{3+}$                               4) All show equal strength

22. Which of the following acts as Lewis acid?

- 1)  $Zn^{2+}$                               2)  $FeCl_3$                               3)  $CO_2$                               4) All the above

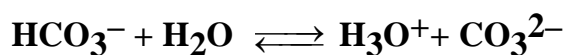
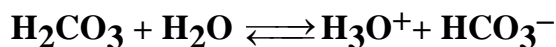
23. Which of the following acts as Lewis base?

- 1)  $C_2H_2$                               2)  $C_2H_4$                               3) Pyridine                              4) All the above

24. The no. of conjugate acid-base pairs present in the aqueous solution of  $\text{H}_3\text{PO}_3$  is

- 1) 2                      2) 3                      3) 4                      4) 5

25.  $\text{H}_2\text{CO}_3$  ionises in two stages as represented below



The no. of conjugate acid-base pairs in the above reaction are

- 1) 2                      2) 3                      3) 4                      4) 5

26. A:  $\text{HCl}$  is not acidic in benzene.

R: Benzene does not accept protons.

- 1) 'A' and 'R' are true, 'R' is correct explanation of 'A'.
- 2) 'A' and 'R' are true. 'R' is not correct explanation of 'A'.
- 3) 'A' is true and 'R' are false.
- 4) Both A and R are false.

27. A:  $\text{H}_3\text{O}^+$  is the strongest acid in aqueous solution

R: water levels the strength of hydronium ion.

- 1) 'A' and 'R' are true, 'R' is correct explanation of 'A'.
- 2) 'A' and 'R' are true. 'R' is not correct explanation of 'A'.
- 3) 'A' is true and 'R' are false.
- 4) Both A and R are false

28.A:  $\text{ClO}_4^-$  is the weakest base.

R: In  $\text{ClO}_4^-$ , chlorine atom is  $\text{SP}^3$  hybridised.

- 1) 'A' and 'R' are true, 'R' is correct explanation of 'A'.
- 2) 'A' and 'R' are true. 'R' is not correct explanation of 'A'.
- 3) 'A' is true and 'R' are false.

4) Both A and R are false.

**29. A: All Bronsted bases are Lewis bases.**

**R: A species that accepts a proton necessarily should donate a lone pair of electrons.**

- 1) 'A' and 'R' are true, 'R' is correct explanation of 'A'.
- 2) 'A' and 'R' are true. 'R' is not correct explanation of 'A'.
- 3) 'A' is true and 'R' are false.
- 4) Both A and R are false

**30. The number of protons present in 10ml of water at 298K is**

- 1)  $6.023 \times 10^{14}$
- 2)  $6.023 \times 10^{16}$
- 3)  $6.023 \times 10^{19}$
- 4)  $6.023 \times 10^{21}$

**31. At 25<sup>0</sup>C, for an acid**

- 1)  $[H^+] > 10^{-7}M$
- 2)  $[OH^-] < 10^{-7}M$
- 3)  $pH < 7$
- 4) All the above

**32. Ionic product of water depends on**

- 1) Volume of the water
- 2) Amount of salt in water
- 3) Temperature
- 4) All the above

**33. At a given temperature, When an acid is added to water then the value of  $K_w$**

- 1) Decreases
- 2) Increases
- 3) Remains same
- 4) First decreases then increases.

**34. If the ionic product of water is  $1.96 \times 10^{-14}$  at 35<sup>0</sup>C, What is its value at 10<sup>0</sup>C**

- 1)  $1.96 \times 10^{-14}$
- 2)  $3.92 \times 10^{-14}$
- 3)  $1.56 \times 10^{-15}$
- 4)  $1.96 \times 10^{-13}$

**35. Which of the following is relatively stronger acid?  $K_a$  values are given in brackets**

- 1) HA ( $2 \times 10^{-4}$ )
- 2) HB ( $3 \times 10^{-5}$ )
- 3) HC ( $1.8 \times 10^{-3}$ )
- 4) HD ( $9.6 \times 10^{-10}$ )

**36. Which of the following is relatively stronger base?  $P^{kb}$  values are given in brackets.**

- 1) AOH (5.8)      2) BOH (6.8)      3) COH (2.4)      4) DOH (10.9)

**37. Which of the following statement is not correct?**

- 1)  $Cl^-$  is a Lewis acid
- 2) The  $P^H$  of  $10^{-8}$  M HCl solution is less than 7
- 3) The ionic product of water at  $25^{\circ}C$  is  $10^{-14} M^2$
- 4) Bronsted - Lowry theory could not explain the acidic nature of  $AlCl_3$

**38. Which of the following statement is correct?**

- 1) Bronsted - Lowry theory could not explain the acidic nature of  $BCl_3$
- 2) The  $P^H$  of 0.01M NaOH solution is 2
- 3) The ionic product of water at  $25^{\circ}C$  is  $10^{-10} M^2$
- 4) The  $P^H$  of a solution can be calculated using the equation  $P^H = +\log[H^+]$

**39. The  $P^H$  of a solution of  $H_2O_2$  is 6.0. Some  $Cl_2$  gas is bubbled into this solution.**

**Which of the following is correct?**

- 1) The  $P^H$  of the resultant solution becomes 8
- 2)  $H_2$  gas is liberated
- 3) The  $P^H$  of the resultant solution becomes less than 6.0 and  $O_2$  gas is liberated.
- 4)  $Cl_2O$  is formed in the resultant solution.

**40. Which of the following is correct?**

- 1) The  $P^H$  of one liter solution containing 0.49g of  $H_2SO_4$  is 2.0.
- 2) The conjugate base of  $H_2S$  is  $S^{2-}$
- 3)  $BF_3$  is a Lewis base.

4)  $\text{CH}_3\text{COO}^-$  is amphoteric ion.

**41. Which one of the following statements is not correct?**

- 1)  $\text{pH} + \text{pOH} = 14$  for all aqueous solutions
- 2) The  $\text{pH}$  of  $10^{-8}$  M  $\text{HCl}$  is 8
- 3) The solution with  $\text{pH} = 3$  is 100 times more acidic than the solution with  $\text{pH} = 5$ .
- 4) The conjugate base of  $\text{H}_2\text{PO}_4^-$  is  $\text{HPO}_4^{2-}$

**42. Ostwald dilution law is applicable to**

- 1) Strong electrolytes
- 2) Weak electrolytes
- 3) Non - electrolytes
- 4) All types of electrolytes

**43. The correct expression for Ostwald's dilution law is**

- 1)  $K_a = \frac{\alpha^2}{(1-\alpha)V}$
- 2)  $K_a = \alpha^2 \cdot V$
- 3)  $K_a = \frac{\alpha^2}{1-V}$
- 4)  $K_a = \frac{\alpha^2}{C(1-\alpha)}$

**44. For a weak acid, the concentration of  $\text{H}^+$  ions is given by**

- 1)  $\sqrt{K_a \cdot C}$
- 2)  $K_a/C$
- 3)  $\sqrt{K_a/C}$
- 4)  $\sqrt{C/K_a}$

**45. Which of the following is wrong?**

- 1) Degree of dissociation of a weak electrolyte increases with dilution.
- 2) Increase in temperature increases the ionisation.
- 3) Strong electrolytes are ionised completely even at moderate concentrations.
- 4) Addition of  $\text{NH}_4\text{Cl}$  to  $\text{NH}_4\text{OH}$  increases the ionisation of the latter.

**46. Dissociation constant of water at  $25^\circ\text{C}$  is**

- 1)  $1.0 \times 10^{-14}$
- 2)  $1 \times 10^{14}$
- 3) 14
- 4)  $1.8 \times 10^{-16}$

**Solution;**  $K_a = K_w \times 18/1000$

47. One litre of water contains  $10^{-7}$  moles of  $H^+$  ions. Degree of ionisation of water (in percentage) is

- 1)  $1.8 \times 10^{-7}$       2)  $1.8 \times 10^{-9}$       3)  $3.6 \times 10^{-7}$       4)  $3.6 \times 10^{-9}$

**Solution:** One litre of water i.e 1000/18 moles contains  $10^{-7}$  moles of  $H^+$  ions

Then 100 moles of water contains  $(100 \times 18/1000)10^{-7} = 1.8 \times 10^{-7}\%$

48. The  $P^H$  of 0.005 M  $Ba(OH)_2$  is

- 1) 2.301      2) 11.699      3) 12      4) 7

**Solution;**  $N = M \times \text{acidity} = 0.005 \times 2 = 0.01 = 10^{-2}$ ,  $P^{OH} = -\log 10^{-2} = 2$  and  $P^H = 14 - 2 = 12$

49. Equal volumes of two solutions with  $P^H = 3$  and  $P^H = 11$  are mixed. Then the  $P^H$  of resulting solution is

- 1) 8      2) 7      3) 6      4) 0

**Solution;**  $P^H = 3$  i.e  $[H^+] = 10^{-3}$  and  $P^H = 11$  i.e  $P^{OH} = 3$ . As  $P^H = P^{OH}$ , solution is neutral.

50. The  $P^H$  of a solution is 3.0. This solution is diluted by 100 times. Then the  $P^H$  of the resulting solution is

- 1) 5      2) 7      3) 1      4) 11

**Solution;** As solution is diluted by 100 times,  $P^H$  increased by  $\log 100$  i.e 2 units.

### KEY

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