Multiple Choice Questions

Types of electrolytes, concepts of acids and bases

[MHT-CET 2021]

1. Which of the following species is amphoteric in nature ?
   a) H_2O b) HCl c) NaOH d) CH_3COOH
2. Which among the following salt solutions in water is basic in nature ?
   a) $CuSO_4$ b) KNO_3 c) CH_3COONa d) NaCl
3. Which among the following is NOT an example of salt of weak acid and weak base ?
   a) NH_4F b) NH_4Cl c) CH_3COONH_4 d) NH_4CN
4. Which of the following species is an example of Lewis acid ?
   a) NH_3 b) H_2O c) C_2H_5OH d) BF_3
5. Which from following compounds accepts proton from water molecule according to Bronsted-Lowry theory ?
   a) $NaOH_{(aq)}$ b) $HCl_{(aq)}$ c) $NH_{3(aq)}$ d) $NH_4OH_{(aq)}$
6. A substance containing hydrogen and releasing H^+ in aqueous medium is acid. Identify theory suggesting this concept from following.
   a) Ostwald theory b) Bronsted – Lowry theory
   c) Arrhenius theory d) Lewis theory
7. Which among the following salts turns blue litmus red in its aqueous solution ?
   a) NH_4CN b) NH_4F c) CH_3COONa d) CH_3COONH_4
8. Which of the following salt solutions is highly acidic ?
   a) Ammonium acetate b) Ammonium cyanide
   c) Sodium chloride d) Ammonium nitrate
9. Identify conjugate acid – base pair in the following reaction.
   $HCl_{(aq)} + H_2O_{(l)} \rightleftharpoons H_3O^+_{(aq)} + Cl^-_{(aq)}$
   a) $H_3O^+_{(aq)}$ and $Cl^-_{(aq)}$ b) $H_3O^+_{(aq)}$ and $H_2O_{(l)}$
   c) $HCl^2_{(aq)}$ and $H_2O_{(l)}$ d) $Cl^-_{(aq)}$ and $H_2O_{(l)}$

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10. Which among the following is NOT Lewis acid ?
    a) Ag^+ b) BF_3 c) H_2O d) $AlCl_3$
11. Which among the following species can act as an acid as well as base according to Bronsted-Lowry theory ?
    a) HSO^-_4 b) H_3O^+ c) Cl^- d) SO_4^{2-}
12. Identify the conjugate acid-base pair in the following reaction .
    $H_2O + HCl \longrightarrow H_3O^+ + Cl^-$
    a) H_2O and HCl b) H_3O^+ and H_2O c) H_3O^+ and Cl^- d) Cl^- and H_2O
13. Identify conjugate acid and conjugate base respectively in following reaction.
    $H_2O + HCl_{(aq)} \rightleftharpoons H_3O^+ + Cl^-_{(aq)}$
    a) HCl and H_3O^+ b) H_2O^+ and H_3O^+ c) H_3O^+ and H_2O d) Cl^- and HCl

14. Identify weak acid weak base salt from following.
a) Ammonium acetate
b) Potassium bromide
c) Ammonium chloride
d) Ammonium sulphate

15. Which among the following salts is formed of strong base and weak acid ?
a) NaCl
b) KCN
c) $CuSO_4$
d) $NaNO_3$

16. Which among the following is an example of salt of weak acid and strong base ?
a) NH_4CN
b) Na_2SO_4
c) KCl
d) KCN

17. According to Bronsted-Lowry theory, the acids in the following reaction are

$$ClO_4^- + HCO_3^- \longrightarrow HClO_4 + CO_3^{2-}$$

a) ClO_4^- and CO_3^{2-}
b) ClO_4^- and HCO_3^-
c) HCO_3^- and $HClO_4$
d) $HClO_4$ and CO_3^{2-}

18. Which of the following aqueous solutions of salts will have highest pH value ?
a) CH_3COONH_4
b) NaCl
c) NH_4Cl
d) Na_2CO_3

19. Which of the following is a Lewis acid but not a Bronsted acid ?
a) HNO_3
b) HSO_4^-
c) NH_3
d) BCl_3

20. Which among the following salts' solution in water is not acidic ?
a) $CuSO_4$
b) NH_4NO_3
c) $CuCl_2$
d) $NaNO_3$

21. Which among the following is the conjugate acid of $R - NH_2$?
a) $R^{\oplus}$
b) $R-\overset{\oplus}{N}H_3$
c) $R-\overset{\oplus}{N}H$
d) $R-NH-OH$

22. Which among the following is a salt of weak acid and weak base ?
a) NH_4Cl
b) NH_4NO_3
c) CH_3COONH_4
d) KCN

23. In the reaction, $HCl + NH_3 \rightleftharpoons NH_4^+ + Cl^-$; conjugate acid - base pair is
a) NH_4^+ and HCl
b) HCl and NH_4^+
c) HCl and Cl^-
d) Cl^- and NH_3

24. Aqueous solutions of ammonium chloride, potassium cyanide and sodium formate are respectively.
a) basic, acidic, basic
b) acidic, acidic, basic
c) acidic, basic, acidic
d) acidic, basic, basic

Degree of dissociation, Ionization of acids & bases, Ostwald's dilution Law & Ionic product

[MHT-CET 2021]

25. Dissociation constant of NH_4OH is 1.6×10^{-5}. What is its degree of dissociation in 0.01 M solution ?
a) 0.3
b) 0.02
c) 0.1
d) 0.04

26. What is the value of Ionic product of water at 298 K ?
a) 1×10^{-16}
b) 1×10^{-14}
c) 1×10^{-7}
d) 1×10^{-12}

40. What is the percentage of 0.1 M acetic acid ? ($K_a = 10^{-5}$)
a) 0.1 % b) 0.01 % c) 1 % d) 10 %

41. The degree of dissociation of weak acid is 7.2×10^{-4}. What is the value of its percent dissociation in 0.025 M solution ?
a) 0.072 % b) 0.062 % c) 8.2 % d) 0.80 %

42. A weak monobasic acid is 2% dissociated in its 0.01 M solution. What is the dissociation constant of weak acid ?
a) 4×10^{-6} b) 2.5×10^{-6} c) 3×10^{-6} d) 2×10^{-6}

43. An organic weak monobasic acid is 0.001 percent dissociated in its 0.05 M solution. What is its dissociation constant ?
a) 6×10^{-12} b) 5×10^{-12} c) 4×10^{-12} d) 3×10^{-12}

44. An acid dissociated to 1.5 % in its 0.1 M solution. Calculate its dissociation constant.
a) 1.2×10^{-5} b) 1.1×10^{-5} c) 1.5×10^{-5} d) 2.25×10^{-5}

45. A weak monobasic acid is 2% dissociated in its 0.1 M solution. What is its dissociation constant ?
a) 4.0×10^{-5} b) 2.0×10^{-5} c) 1.0×10^{-5} d) 2.5×10^{-5}

46. A weak monoacidic base is 1.2 % dissociated in its 0.2 M solution. What is the value of dissociation constant ?
a) 2.88×10^{-5} b) 1.44×10^{-5} c) 1.21×10^{-5} d) 2.54×10^{-5}

47. The percent dissociation of weak monobasic acid is 3% in its 0.02 M solution. What is the dissociation constant of acid ?
a) 3×10^{-2} b) 1.8×10^{-5} c) 9×10^{-4} d) 2×10^{-2}

48. A weak monobasic acid dissociated to 0.001 % in its 0.01 M solution. What is its dissociation constant ?
a) 1×10^{-8} b) 1×10^{-12} c) 1×10^{-3} d) 1×10^{-6}

49. A centimolar solution of weak acid is 1.3 % dissociated at 298 K. What is its dissociation constant ?
a) 1.9×10^{-6} b) 1.3×10^{-6} c) 1.5×10^{-6} d) 1.7×10^{-6}

50. What is the pH of 2×10^{-3} M solution of monoacidic weak base if it ionizes to the extent of 5% ?
a) 14 b) 4 c) 6 d) 10

51. A weak monobasic acid is 8% dissociated in its 0.02 M solution. What is its dissociation constant ?
a) 1.5×10^{-4} b) 2.5×10^{-4} c) 1.28×10^{-4} d) 2×10^{-4}

52. A weak monobasic acid is 0.2 % dissociated in its 0.01 M solution. What is the dissociation constant of weak acid ?
a) 3×10^{-8} b) 2×10^{-8} c) 1×10^{-8} d) 4×10^{-8}

53. A weak monoacidic base is 4% dissociated in its 0.01 M solution. What is the dissociation constant of weak base ?
a) 1.6×10^{-5} b) 1.0×10^{-5} c) 4.1×10^{-5} d) 6.1×10^{-5}

69. The pH of monoacidic weak base is 10.9. Calculate the percent dissociation in 0.02 M solution.
a) 7.92 % b) 3.95 % c) 6.25 % d) 2.51 %

70. What is the pH of 0.005 M H_2SO_4 solution ?
a) 5.0 b) 2.3 c) 3.3 d) 2.0

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71. What is the pH of solution having H^+ ion concentration 3.981×10^{-7} M ? (log 3.981 = 0.6000)
a) 4.6 b) 7.6 c) 6.4 d) 5.6

72. What is the pH of the solution containing 1.342×10^{-3} M H^+ ions ? (log 1.342 = 0.1277)
a) 2.38 b) 1.28 c) 2.87 d) 3.57

73. What is the pH of a 2.6×10^{-8} M H^+ ions solution ? (log 2.6 = 0.4150)
a) 8.4 b) 7.6 c) 6.5 d) 10.6

74. What is the pH at which $Mg(OH)_2$ starts to precipitate from a solution containing 0.1 M Mg^{2+} ions ? (Given K_{SP} for $Mg(OH)_2 = 1.0 \times 10^{-11}$)
a) 6 b) 4 c) 7 d) 9

75. What is the pH of millimolar solution of NaOH ?
a) 13 b) 11 c) 3 d) 12

76. What is the concentration of H_3O^+ ions in a solution having pOH value 9 ?
a) 2.0×10^{-5} M b) 1.5×10^{-5} M c) 1.0×10^{-5} M d) 2.5×10^{-5} M

77. A solution has $[H^+] = 0.001$ M. What is the value of $[OH^-]$?
a) 1 M b) 10^{-3} M c) 10^{-11} M d) 10^{-2} M

78. The increasing order of pH of 0.1 M solution of the following compounds is
a) $HCl < NH_4NO_3 < NaCl < NaCN$ b) $NH_4NO_3 < HCl < NaCl < NaCN$
c) $HCl < NaCl < NaCN < NH_4NO_3$ d) $NaCN < NaCl < NH_4NO_3 < HCl$

79. The $[H^+]$ in lemon juice is found to be 0.0063 M. What is pH value of lemon juice (log 6.3 = 0.7993) ?
a) 2.8 b) 5.2 c) 3.8 d) 2.2

80. Why the pH of aqueous solution of copper sulphate is less than 7 ?
a) It is a salt of strong acid and weak base.
b) It is a salt of weak acid and weak base.
c) It is a salt of strong acid and strong base.
d) It is a salt of weak acid and strong base.

81. What is the pH of solution containing H^+ ion concentration 2.5×10^{-3} mol dm^{-3} ? (Given log 2.5 = 0.3979)
a) 5.2 b) 3.9 c) 3.6 d) 2.6

82. The concentration of $[H^+]$ in acidic solution is 0.01 M. What is the concentration of $[OH^-]$ in solution ?
a) 1×10^{-1} M b) 1×10^{-12} M c) 1×10^{-7} M d) 1×10^{-2} M

83. The pH of 10^{-3} M aqueous solution of NaCl is
a) 7 b) 14 c) 11 d) 3

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97. Solubility product of AgBr is 5.2×10^{-13}. What is its solubility in mol dm^{-3} ?
a) 7.2×10^{-7} b) 8.8×10^{-7} c) 2.6×10^{-7} d) 5.2×10^{-7}

98. What is relationship between solubility and solubility product for aluminium hydroxide ?
a) $K_{sp} = S^2$ b) $K_{sp} = 8S^3$ c) $K_{sp} = 4S^3$ d) $Ksp = 27S^4$

99. The solubility of $BaSO_4$ at 298 K is 1.03×10^{-5} mol dm^{-3}. What is its solubility product?
a) 2.1×10^{-10} b) 1.56×10^{-5} c) 1.06×10^{-10} d) 2.5×10^{-5}

100. The solubility of AgCl in its solution is 1.25×10^{-5} mol dm^{-3}. What is solubility product of AgCl?
a) 1.56×10^{-10} b) 3.50×10^{-6} c) 1.10×10^{-5} d) 2.53×10^{-3}

101. Solubility of AgCl is 7.2×10^{-7} mol dm^{-3}. What is its solubility product ?
a) 3.6×10^{-13} b) 7.2×10^{-14} c) 2.59×10^{-14} d) 5.18×10^{-13}

102. The solubility product of a sparingly soluble salt AX_2 is 3.2×10^{-8}. What is its solubility in mol dm^{-3} ?
a) 2.8×10^{-4} b) 1.6×10^{-5} c) 2.0×10^{-3} d) 4.0×10^{-4}

103. Solubility product of AgBr is 4.9×10^{-13}. What is its solubility ?
a) 2.4×10^{-7} mol dm^{-3} b) 3.2×10^{-7} mol dm^{-3}
c) 4.9×10^{-7} mol dm^{-3} d) 7.0×10^{-7} mol dm^{-3}

104. The solubility of $Ag_2C_2O_4$ is 2×10^{-4} mol L^{-1} at 298 K. What is its solubility product ?
a) 1.6×10^{-6} b) 3.2×10^{-11} c) 1.6×10^{-11} d) 3.2×10^{-6}

105. The solubility of sparingly soluble salt AB_2 is 1.0×10^{-4} mol dm^{-3}. What is its solubility product?
a) 2×10^{-12} b) 4×10^{-8} c) 4×10^{-12} d) 2×10^{-8}

106. The solubility product expression for $Ca_3(PO_4)_2$ is represented as
a) $K_{sp} = [Ca^{2+}]^2 [PO_4^{3-}]$ b) $K_{sp} = [Ca^{2+}]^3 [PO_4^{3-}]^2$
c) $K_{sp} = [Ca^{2+}]^2 [PO_4^{2-}]^3$ d) $K_{sp} = [Ca^{2+}] [PO_4^{2-}]$

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107. What is the solubility product of $Al_2(SO_4)_3$, if its solubility at 298 K is 1×10^{-3} mol L^{-1} ?
a) 4.3×10^{-13} b) 2.5×10^{-13} c) 1.08×10^{-13} d) 1.3×10^{-13}

108. The solubility of sparingly soluble electrolyte A_3B_2 is 'S' mol L^{-1}. What is its solubility product ?
a) $27\ S^3$ b) $108\ S^5$ c) $2\ S^3$ d) $8\ S^4$

109. The solubility of $CaCO_3$ is 7×10^{-5} at 298 K. What is its solubility product at the same temperature ?
a) 3.5×10^{-9} b) 5.4×10^{-9} c) 2.4×10^{-9} d) 4.9×10^{-9}

133. Which of the following equations represents the relation between solubility and solubility product for salt BA_3 ?

a) $S = \left(\frac{K_{sp}}{27}\right)^{1/4}$ b) $S = (27 \times K_{sp})^{1/4}$ c) $S = \left(\frac{K_{sp}}{4}\right)^{1/4}$ d) $S = (4 \times K_{sp})^{1/4}$

134. Calculate the molar mass of nonvolatile solute when 1.5 g of it is dissolved in solvent decreases its freezing point by 0.25 K. [$K_f = 1.2$ K kg mol^{-1}]

a) 72 g mol^{-1} b) 80 g mol^{-1} c) 88 g mol^{-1} d) 96 g mol^{-1}

135. Calculate the pH of buffer solution containing 0.027 M weak acid and 0.054 M of its salt with strong base if pK_a is 4.2.

a) 4.5 b) 3.2 c) 5.6 d) 6.4

136. Which of the following compounds is amphoteric in nature ?

a) HCl b) H_2O c) CH_3COOH d) NaOH

137. Calculate pH of 0.002 M KOH solution.

a) 10.4 b) 11.3 c) 12.4 d) 13.2

138. Calculate 'α' for 0.1 M acetic acid ($K_a = 1.0 \times 10^{-5}$)

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

139. Which from following mixtures in water acts as a basic buffer ?

a) $NH_4OH + NH_4Cl$ b) $C_6H_5COOH + C_6H_5COONa$

c) $HCOOH + HCOOK$ d) $CH_3COOH + CH_3COONa$

140. Calculate the pH of a buffer solution containing 0.35 M weak acid and 0.70 M of its salt with strong base if pK_a is 4.56.

a) 6.11 b) 3.72 c) 4.86 d) 5.65

141. Calculate the concentration of weak monobasic acid if its degree of dissociation and dissociation constant are 5.0×10^{-4} and 5.0×10^{-9} respectively.

a) 0.1 M b) 0.02 M c) 0.03 M d) 0.04 M

142. 200 ml of 0.2 M solution of NaOH is mixed with 400 ml of 0.5 M NaOH solution. Molarity of mixture is

a) 0.4 b) 0.6 c) 4 M d) 0.8 M **[JEE Main-2025 Phase-1]**

143. What is the relation between K_{sp} and S of $Zr_3(PO_4)_4$. **[JEE Main-2025 Phase-1]**

a) $S = \left(\frac{K_{sp}}{6912}\right)^{\frac{1}{7}}$ b) $S = \left(\frac{K_{sp}}{144}\right)^{\frac{1}{7}}$ c) $S = \frac{K_{sp}}{6912}$ d) None

144. At 25°C, the concentration of H^+ ions in 1.00×10^{-3} M aqueous solution of a weak monobasic acid having acid dissociation constant (K_a) of 4.00×10^{-11} is $X \times 10^{-7}$ M. The value of X is

Use: Ionic product of water (K_w) = 1.00×10^{-14} at 25°C **(JEE (Advanced) Paper I - 2025)**

Ans: $x \equiv 2.24$