EQUILIBRIUM

CHEMISTRY

Single Correct Answer Type

1. Which may be added to one litre of water to act as a buffer?
   a) One mole of $HC_2H_3O_2$ and one mole of HCl
   b) One mole of NH_4OH and one mole of NaOH
   c) One mole of NH_4Cl and one mole of HCl
   d) One mole of $HC_2H_3O_2$ and 0.5 mole of NaOH
2. An aqueous solution of 1 M NaCl and 1 M HCl is
   a) not a buffer but $pH < 7$
   b) not a buffer but $pH > 7$
   c) a buffer with $pH < 7$
   d) a buffer with $pH > 7$
3. In the following reversible reaction,
   $2SO_2 + O_2 \rightleftharpoons 2SO_3 + Q$ cal
   Most suitable condition for the higher production of SO_3 is
   a) Low temperature and high pressure
   b) Low temperature and low pressure
   c) High temperature and high pressure
   d) High temperature and low pressure
4. Select the pK_a value of the strongest acid from the following
   a) 1.0
   b) 3.0
   c) 2.0
   d) 4.5
5. The pH of a 0.1 M solution of NH_4OH (having $K_b = 1.0 \times 10^{-5}$) is equal to
   a) 10
   b) 6
   c) 11
   d) 12
6. In the reaction, $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$
   a) $K_p \neq K_c$
   b) $K_p = K_c$
   c) $K_p > K_c$
   d) $K_p < K_c$
7. The total number of different kind of buffers obtained during the titration of H_3PO_4 with NaOH are:
   a) 3
   b) 1
   c) 2
   d) Zero
8. Which will not affect the degree of ionisation?
   a) Temperature
   b) Concentration
   c) Type of solvent
   d) Current
9. Which of the following has highest pH?
   a) $\frac{M}{4}$ KOH
   b) $\frac{M}{4}$ NaOH
   c) $\frac{M}{4}$ NH_4OH
   d) $\frac{M}{4}$ $Ca(OH)_2$
10. Solubility product constant $[K_{sp}]$ of salts of types MX, MX_2 and M_3X at temperature 'T' are $4.0 \times 10^{-8}, 3.2 \times 10^{-14}$ and 2.7×10^{-15} respectively. Solubilities ($\text{mol}, \text{dm}^{-3}$) of the salts at temperature 'T' are in the order
    a) $MX > MX_2 > M_3X$
    b) $M_3X > MX_2 > MX$
    c) $MX_2 > M_3X > MX$
    d) $MX > M_3X > MX_2$
11. Which of the following base is weakest?
    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_9H_7N; $K_b = 6.3 \times 10^{-10}$
12. One litre of water contains 10^{-7} mole H^+ ions. Degree of ionisation of water is:
    a) $1.8 \times 10^{-7}\%$
    b) $1.8 \times 10^{-9}\%$
    c) $3.6 \times 10^{-7}\%$
    d) $3.6 \times 10^{-9}\%$
13. A precipitate is formed when
    a) The ionic product is nearly equal to the solubility product
    b) A solution becomes saturated
    c) The ionic product exceeds the solubility product
    d) The ionic product is less than solubility product

14. The precipitation is noticed when an aqueous solution of HCl is added to an aqueous solution of:
a) $NaNO_2$ b) $Ba(NO_3)_2$ c) $ZnSO_4$ d) $HgNO_3$

15. Which of the following is not a Lewis base?
a) NH_3 b) H_2O c) $AlCl_3$ d) None of these

16. Solubility of BaF_2 in a solution of $Ba(NO_3)_2$ will be represented by the concentration term
a) $[Ba^{2+}]$ b) $[F^-]$ c) $\frac{1}{2}[F^-]$ d) $2[NO_3^-]$

17. Which of the following is a buffer?
a) $NaOH + CH_3COOH$ b) $NaOH + Na_2SO_4$ c) $K_2SO_4 + H_2SO_4$ d) $NH_4OH + NaOH$

18. For the following three reactions I, II and III, equilibrium constants are given
I. $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g); K_1$
II. $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g);\ K_2$
III. $CH_4(g) + 2H_2O(g) \rightleftharpoons CO_2(g) + 4H_2(g);\ K_3$
Which of the following relations is correct?
a) $K_1\sqrt{K_2} = K_3$ b) $K_2K_3 = K_1$ c) $K_3 = K_1K_2$ d) $K_3K_2^3 = K_1^2$

19. 0.1 mole of $N_2O_4(g)$ was sealed in a tube under one atmospheric conditions at 25°C. Calculate the number of moles of $NO_2(g)$ present, if the equilibrium $N_2O_4(g) \rightleftharpoons 2NO_2(g) (K_p = 0.14)$ is reached after some time
a) 0.036 b) 36.00 c) 360.0 d) 3.600

20. A buffer solution is prepared by mixing 0.1 M ammonia and 1.0 M ammonium chloride. At 298 K, the pK_b of NH_4OH is 5.0.The pH of the buffer is
a) 10.0 b) 9.0 c) 6.0 d) 8.0

21. Which of the following molecules acts as a Lewis acid?
a) $(CH_3)_3N$ b) $(CH_3)_3B$ c) $(CH_3)_2O$ d) $(CH_3)_3P$

22. Which among the following is an electron deficient compound?
a) NF_3 b) PF_3 c) BF_3 d) AsF_3

23. Identify the correct order of acidic strength of CO_2, CuO, CaO, H_2O:
a) $CaO < CuO < H_2O < CO_2$
b) $H_2O < CuO < CaO < H_2O$
c) $CaO < H_2O < CuO < CO_2$
d) $H_2O < CO_2 < CaO < CuO$

24. Which of the following is a strong acid?
a) $HClO_4$ b) $HBrO_4$ c) HIO_4 d) HNO_3

25. According to Arrhenius concept the, strength of an acid depends on:
a) Hydrolysis
b) Concentration of acid
c) H^+ ions furnished by acid
d) Number of mole of base used for neutralization

26. $H_2 + I_2 \rightleftharpoons 2HI$
In the above equilibrium system, if the concentration of the reactants at 25°C is increased, the value of K_c will
a) Increase b) Decrease
c) Remains the same d) Depends on the nature of the reactants

27. 0.04 g of pure NaOH is dissolved in 10 litre of distilled water. The pH of the solution is:
a) 9 b) 10 c) 11 d) 12

28. What is the equilibrium expression for the reaction, $P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s)$?
a) $K_c = \frac{1}{[O_2]^5}$ b) $K_c = [O_2]^5$ c) $K_c = \frac{[P_4O_{10}]}{5[P_4][O_2]}$ d) $K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5}$

29. When 10^{-8} mole of HCl is dissolved in one litre of water, the pH of the solution will be:
a) 8 b) 7 c) Above 8 d) Below 7

30. A physician wishes to prepare a buffer solution at pH = 3.58 that efficiently resists a change in pH yet contains only small conc. of the buffering agents. Which one of the following weak acid together with its sodium salt would be best to use?
a) m-chloro benzoic acid (p$K_a = 3.98$)
b) p-chlorocinnamic acid (p$K_a = 4.41$)
c) 2,5-dihydroxy benzoic acid (p$K_a = 2.97$)
d) Acetoacetic acid (p$K_a = 3.58$)

31. The pH of 10^{-8}M HCl solution is
a) 8
b) More than 8
c) Between 6 and 7
d) Slightly more than 7

32. A certain buffer solution contains equal concentration of X^- and HX. The K_a for HX is 10. The pH of the buffer is:
a) 7
b) 8
c) 11
d) 14

33. 100 mL of 0.01 M solution of NaOH is diluted to 1 dm^3. What is the pH of the diluted solution?
a) 12
b) 11
c) 2
d) 3

34. Which of the following salt does not get hydrolysed in water?
a) $KClO_4$
b) NH_4Cl
c) CH_3COONa
d) None of these

35. A higher value for equilibrium constant, K shows that:
a) The reaction has gone to near completion towards right
b) The reaction has not yet started
c) The reaction has gone to near completion towards left
d) None of the above

36. Which one is least basic?
a) CH_3NH_2
b) NH_3
c) $C_2H_5NH_2$
d) $C_6H_5NH_2$

37. The aqueous solution of disodium hydrogen phosphate is:
a) Acidic
b) Neutral
c) Basic
d) None of these

38. 3.2 moles of hydrogen iodide were heated in a sealed bulb at 444°C till the equilibrium state was reached. Its degree of dissociation at this temperature was found to be 22%. The number of moles of hydrogen iodide present at equilibrium are
a) 1.876
b) 2.496
c) 3.235
d) 4.126

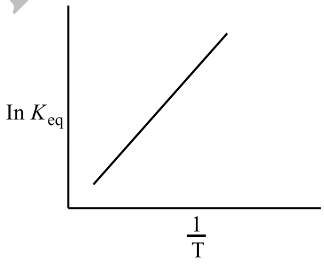
39. In the reactions, $PCl_5 \rightleftharpoons PCl_3 + Cl_2$, the amounts of PCl_5, PCl_3 and Cl_2 at equilibrium are 2 mole each and the total pressure is 3 am. The equilibrium constant K_p is :
a) 1.0 atm
b) 2.0 atm
c) 3.0 atm
d) 6.0 atm

40. Which of the following is correct for the reaction?

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

a) $K_p = K_c$
b) $K_p < K_c$
c) $K_p > K_c$
d) Pressure is required to predict the correlation

41. The graph relates ln K_{eq} $vs \frac{1}{T}$ for a reaction. The reaction must be :



a) Exothermic
b) Endothermic

c) ΔH is negligible

d) Highly spontaneous at ordinary temperature

42. 0.1 millimole of $CdSO_4$ are present in 10 mL acid solution of 0.08 N HCl. Now H_2S is passed to precipitate all the Cd^{2+} ions. The pH of the solution after filtering off precipitate, boiling of H_2S and making the solution 100 mL by adding H_2O is:

a) 2 b) 4 c) 6 d) 8

43. Calculate the pH of a solution in which hydrogen ion concentration is 0.005 g-equi/L?

a) 2.3 b) 2.8 c) 2.9 d) 2.6

44. In 1L saturated solution of AgCl $[K_{\mathrm{sp}}(\mathrm{AgCl})1.6\ 10^{10}]$, 0.1 mole of CuCl $[K_{\mathrm{sp}}(\mathrm{CuCl})1.0\ 10^{6}]$ is added. The resultant concentration of Ag in the solution is $1.6\ 10^{x}$. The value of $'x'$ is

a) 3 b) 5 c) 7 d) 9

45. Eight mole of a gas AB_3 attain equilibrium in a closed container of volume 1 dm^3 as, $2AB_3 \rightleftharpoons A_2(g) + 3B_2(g)$. If at equilibrium 2 mole of A_2 are present then, equilibrium constant is :

a) 72 mol^2L^{-2} b) 36 mol^2L^{-2} c) 3 mol^2L^{-2} d) 27 mol^2L^{-2}

46. Which of the following is most soluble in water?

a) $MnS(K_{sp} = 8 \times 10^{-37})$

b) $ZnS(K_{sp} = 7 \times 10^{-16})$

c) $Bi_2S_3(K_{sp} = 1 \times 10^{-70})$

d) $Ag_2S(K_{sp} = 6 \times 10^{-51})$

47. At a given temperature the K_c for the reaction, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is 2.4×10^{-3}. At the same temperature, the K_c for the reaction
$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ is :

a) 2.4×10^{-3} b) -2.4×10^{-3} c) 4.2×10^{-2} d) 4.8×10^{-2}

48. If the solubility of lithium sodium hexafluoroaluminate, $Li_3Na_3(AlF_6)_2$ is $'a'$mol/litre, its solubility product is equal to:

a) a^2

b) $12a^2$

c) $18a^3$

d) $2916a^8$

49. 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) $K_w = 14 \times K$

50. Degree of dissociation of 0.1 N CH_3COOH is (dissociation constant $= 1 \times 10^{-5}$)

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

51. If the solubility of $Ca(OH)_2$ is $\sqrt{3}$. The solubility product of $Ca(OH)_2$ is:

a) 3

b) 27

c) $\sqrt{3}$

d) $12\sqrt{3}$

52. pH of 0.1 M Na_2HPO_4 and 0.2 M NaH_2PO_4 solutions are respectively. pK_a for H_3PO_4 are 2.12, 7.21 and 12.0 for respective dissociation to $H_2PO_4^-$, HPO_4^{2-} and PO_4^{3-}.

a) 4.67, 9.61 b) 9.61, 4.67 c) 4.67, 5.61 d) 5.61, 4.67

53. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
In the reaction given above, the addition of small amount of an inert gs at constant pressure will shift the equilibrium towards which side?

a) LHS (Left hand side) b) RHS(Right hand side)

c) Neither side d) Either side

54. Which one is hard base?

a) Ag^+ b) Cr^{3+} c) I_2 d) F^-

55. Which species acts as an acid and also a conjugate base of another acid?
a) HSO_4^- b) CO_3^{2-} c) SO_4^{2-} d) H_3O^+

56. Predict the conditions for forward reaction on the basis of Le-Chatelier's principle for : $2SO_2(g) + O_2\ (g) \rightleftharpoons 2SO_3(g);\ \Delta H = -198$ kJ.
a) Lowering the temperature and increasing pressure
b) Any value of temperature and pressure
c) Lowering of temperature as well as pressure
d) Increasing temperature as well as pressure

57. The solubility of AgCl in water at 10°C is 6.2×10^{-6} mol/litre. The K_{sp} of AgCl is:
a) $[6.2 \times 10^{-6}]^{1/2}$ b) $6.2 \times (10^{-6})^2$ c) $(6.2)^2 \times 10^{-6}$ d) $[6.2 \times 10^{-6}]^2$

58. When pressure is applied to the equilibrium system ice r water. Which of the following phenomenon will happen?
a) More ice will be formed b) Water will evaporate
c) More water will be formed d) Equilibrium will not be formed

59. At constant temperature in one litre vessel, when the reaction,
$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$ is at equilibrium, the SO_2 concentration is 0.6 M, initial concentration of SO_3 is 1M. The equilibrium constant is :
a) 2.7 b) 1.36 c) 0.34 d) 0.675

60. When 20g of $CaCO_3$ were put into 10 litre flask and heated to 800°C, 35% of $CaCO_3$ remained unreacted at equilibrium. K_p for decomposition of $CaCO_3$ is :
a) 1.145 atm b) 0.145 atm c) 2.145 atm d) 3.145 atm

61. For the reaction equilibrium,
$2NOBr(g) \rightleftharpoons 2NO(g) + Br_2(g)$, if $P_{Br_2} = \frac{P}{9}$ at equilibrium and P is total pressure. The ratio K_p/P is equal to:
a) 1/9 b) 1/81 c) 1/27 d) 1/3

62. $K_{sp} = 1.2 \times 10^{-5}$ of M_2SO_4(M^+ is monovalent metal ion) at 298 K. The maximum concentration of M^+ ions that could be attained in a saturated solution of this solid at 298 K is:
a) $3.46 \times 10^{-3} M$ b) $7.0 \times 10^{-3} M$ c) $2.88 \times 10^{-2} M$ d) $14.4 \times 10^{-3} M$

63. Which of the following describes correct sequence for decreasing Lewis acid nature?
a) $BCl_3 > BF_3 > BBr_3$ b) $BBr_3 > BCl_3 > BF_3$ c) $BBr_3 > BF_3 > BCl_3$ d) $BF_3 > BCl_3 > BBr_3$

64. What should be the pH of solution to dissolve the $Cr(OH)_3$ precipitate?
[Given, $[Cr^{3+}] = 1.0$ mol/L , $K_{sp} = 6 \times 10^{-31}$)
a) 2.0 b) 3.0 c) 5.0 d) 4.0

65. Which one of the following salts on being dissolved in water gives pH>7 at 25°C?
a) KCN b) KNO_3 c) NH_4Cl d) NH_4CN

66. Aqueous solution of which salt has the lowest pH?
a) NaOH b) NH_4Cl c) Na_2CO_3 d) NaCl

67. In a gaseous reversible reaction,
$N_2 + O_2 \rightleftharpoons 2NO + \text{heat}$
If pressure is increased then the equilibrium constant would be
a) Unchanged
b) Increased
c) Decreased
d) Sometimes increased, sometimes decreased

68. Glycine is:
a) Arrhenius acid b) Lewis base c) Simplest amino acid d) All of these

69. On a given condition, the equilibrium concentration of HI, H_2 and $I_2$are 0.80, 0.10 and 0.10 mol/L. The equilibrium constant for the reaction, $H_2 + I_2 \rightleftharpoons 2HI$, will be

a) 8 b) 16 c) 32 d) 64

70. If pH of the solution is one, what weight of HCl present in one litre of solution?
a) 3.65 g b) 36.5 g c) 0.365 g d) 0.0365 g

71. The concentration of hydroxyl ion in a solution left after mixing 100 mL of 0.1 M $MgCl_2$ and 100 mL of 0.2 M NaOH $\left[K_{sp} \text{ of } Mg(OH_2) = 1.2 \times 10^{-11}\right]$ is:
a) 2.8×10^{-3} b) 2.8×10^{-2} c) 2.8×10^{-4} d) 2.8×10^{-5}

72. For a reaction and equilibrium which of the following is correct?
a) Concentration of reactant=concentration of product
b) Concentration of reactant is always greater than product
c) Rate of forward reaction=rate of backward reaction
d) $Q_c = k$

73. The correct order of increasing basic nature of the given conjugate bases is:
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) $RCO\overline{O} < \overline{N}H_2 < HC \equiv \overline{C} < \overline{R}$

74. What is the equilibrium expression for the reaction
$$P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s)\ ?$$
a) $K_c = \frac{[P_4O_{10}]}{[P_4][O_5]^5}$ b) $K_c = \frac{[P_4O_{10}]}{5[P_4][O_2]}$ c) $K_c = [O_2]^5$ d) $K_c = \frac{1}{[O_2]^5}$

75. A characteristic feature of reversible reaction is that :
a) They never proceed to completion
b) They proceed to completion
c) They are not complete unless the reactants are removed from the sphere of reaction mixture
d) None of the above

76. The concentration of CO_2 be in equilibrium with 2.5×10^{-2} mol litre^{-1} of CO at 100 °C for the reaction : $FeO(s) + CO(g) \rightleftharpoons Fe(s) + CO_2(g); K_c = 5.0$
a) 5 M b) 1.25 M c) 12.5 M d) 0.125 M

77. In the reaction, $H_2 + I_2 \rightleftharpoons 2HI$
In a 2 I flask 0.4 moles of each H_2 and I_2 are taken. At equilibrium 0.5 moles of HI are formed. What will be the value of equilibrium constant K_c?
a) 20.2 b) 25.4 c) 0.284 d) 11.1

78. 0.005 M acid solution has 5 pH. The percentage ionisation of acid is
a) 0.8% b) 0.6 % c) 0.4 % d) 0.2 %

79. A solution of pH 8 is … basic than a solution of pH 12.
a) Less b) More c) Equally d) None of these

80. Which statement is/are correct?
a) All Arrhenius acids are Bronsted acids
b) All Arrhenius bases are not Bronsted base
c) H^+ ion in solution exists as $H_9O_4^+$
d) All of the above

81. The concentration of fluroacetic acid (K_a of acid $= 2.6 \times 10^{-3}$) which is required to get $[H^+] = 1.50 \times 10^{-3} M$ is:
a) 0.865 M
b) $2.37 \times 10^{-3} M$
c) $2.37 \times 10^{-4} M$
d) 2.37×10^{-2} M

82. Which among the following is the strongest acid?
a) $H(ClO)O_2$ b) $H(ClO)O_3$ c) $H(ClO)O$ d) $H(ClO)$

83. Which one of the following is not an amphoteric substance?
a) HNO_3 b) HCO_3^- c) H_2O d) NH_3

84. For the chemical reaction $3X(g) + Y(g) \rightleftharpoons X_3Y(g)$, that amount of X_3Y at equilibrium is affected by
a) Temperature and pressure b) Temperature only
c) Pressure only d) Temperature, pressure and catalyst

85. K_p/K_c for the reaction,
$CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$is:
a) RT b) $1/\sqrt{RT}$ c) $\sqrt{RT}$ d) 1

86. Densities of diamond and graphite are 3.5 and 2.3 g/mL respectively. Increase of pressure on the equilibrium $C_{diamond} \rightleftharpoons C_{graphite}$:
a) Favours backward reaction
b) Favours forward reaction
c) Have no effect
d) Increases the reaction rate

87. The solubility product of $BaCl_2$ is 4×10^{-9}. Its solubility in mol/L is
a) 4×10^{-3} b) 4×10^{-9} c) 1×10^{-3} d) 1×10^{-9}

88. Addition of sodium acetate to 0.1 M acetic acid will cause
a) Increase in pH b) Decrease in pH
c) No change in pH d) Change in pH that cannot be predicted

89. The solubility in water of a sparingly soluble salt $A_2B$is 1.0×10^{-3}mol L^{-1}. Its solubility product will be
a) 4×10^{-9} b) 4×10^{9} c) 1×10^{9} d) 1×10^{-9}

90. $NaHCO_3$ and NaOH can not co-exist in a solution because of:
a) Common ion effect
b) Acid-base neutralisation
c) Le − Chatelier's principle
d) Redox change

91. Formation of $SO_3$from $SO_2$and O_2 is favoured by
a) Increase in pressure b) Decrease in pressure
c) Increase in temperature d) Decrease in temperature

92. A definite amount of solid NH_4HS is placed in a flask already containing NH_3 gas at certain temperature and 0.50 atm pressure. NH_4HS decomposes to give NH_3 and H_2S and total equilibrium pressure in flask is 0.84 atm. The equilibrium constant for the reaction is :
a) 0.30 b) 0.18 c) 0.17 d) 0.11

93. Hydroxyl ion concentration of 10^{-2}M HCl is
a) 1×10^{1}mol dm^{-3} b) 1×10^{-12} mol dm^{-3} c) 1×10^{-1} mol dm^{-3} d) 1×10^{-14} mol dm^{-3}

94. For a reaction in equilibrium :
a) There is no volume change
b) The reaction has stopped completely
c) The rate of forward reaction is equal to the rate of backward reaction
d) The forward reaction is faster than reverse reaction

95. A solution of $CuSO_4$ in water will:
a) Turn red litmus blue
b) Turn blue litmus red
c) Show no effect on litmus
d) Decolourize litmus

96. At constant temperature, the equilibrium constant (K_p) for the decomposition reaction $N_2O_4(g) \rightleftharpoons$

$2NO_2(g)$ is expressed by $K_p = \frac{(4x^2p)}{(1-x^2)}$

Where, $p=$ pressure, $x=$extent of decomposition. Which one of the following statements is true?

a) K_p increases with increase of p b) K_p remains constant with change in p and x
c) K_p increases with increase of x d) None of the above

97. The pH of a solution is 5.0. To this solution sufficient acid is added to decrease the pH to 2.0. The increase in hydrogen ion concentration is:
a) 1000 times b) 5/2 times c) 100 times d) 5 times

98. Which of the following is a Lewis acid?
a) $AlCl_3$ b) Cl^- c) CO d) C_2H_2

99. The solubility of AgCl is 1×10^{-5} mol/L. Its solubility in 0.1 molar sodium chloride solution is
a) 1×10^{-10} b) 1×10^{-5} c) 1×10^{-9} d) 1×10^{-4}

100. In which of the following reaction $K_p > K_c$?
a) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ b) $H_2 + I_2 \rightleftharpoons 2HI$ c) $2SO_3 \rightleftharpoons O_2 + 2SO_2$ d) $PCl_3 + Cl_2 \rightleftharpoons PCl_5$

101. K_{sp} for sodium chloride is 36 $\text{mol}^2/\text{litre}^2$. The solubility of sodium chloride is:
a) $\frac{1}{36}M$ b) $\frac{1}{6}M$ c) $6\ M$ d) $3600\ M$

102. Degree of dissociation of NH_4OH in water is 1.8×10^{-5}, then hydrolysis constant of NH_4Cl is
a) 1.8×10^{-5} b) 1.8×10^{-10} c) 5.55×10^{-5} d) 5.55×10^{-10}

103. What volume of 1.0 M sodium formate solution should be added to 50 mL of 0.05 M formic acid to produce a buffer solution of pH $= 4.0$ (pK_a of formic acid$= 3.80$)?
a) 39.0 mL b) 39.62 mL c) 40 mL d) 40.62 mL

104. An acid HA ionises as

$$HA \rightleftharpoons H^+ + A^-$$

The pH of 1.0 M solution is 5. Its dissociation constant would be
a) 1×10^{-10} b) .5 c) 5×10^{-8} d) 1×10^{-5}

105. Phosphorus pentachloride dissociates as follows, in a closed reaction vessel,

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

If total pressure at equilibrium of the reaction mixture is p and degree of dissociation of PCl_5 is x, the partial pressure of PCl_3 will be
a) $\left(\frac{x}{x+1}\right)p$ b) $\left(\frac{2x}{1-x}\right)p$ c) $\left(\frac{x}{x-1}\right)p$ d) $\left(\frac{x}{1-x}\right)p$

106. For the gaseous phase reaction, $2NO \rightleftharpoons N_2 + O_2$, $\Delta H^\circ = -43.5$ kcal mol^{-1}, which statement is correct for, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$?
a) K is independent of temperature
b) K increases as temperature decreases
c) K decreases as temperature decreases
d) K varies with addition of NO

107. Which would decreases the pH of 25 cm^3 of a 0.01 M solution of hydrochloric acid?
a) The addition of magnesium metal
b) The addition of 25$\text{cm}^3$0.02 M hydrochloric acid
c) The addition of 25 $\text{cm}^3$0.005 M hydrochloric acid
d) None of the above

108. Which is not a Lewis acid?
a) CCl_4 b) $SnCl_2$ c) $AlCl_3$ d) BF_3

109. Which is Lewis base?
a) HCl b) HNO_3 c) HF d) NH_3

110. Ammonia under a pressure of 15 atm at 27°C is heated to 347°C in a closed vessel in the presence of catalyst. Under the conditions, NH_3 is partially decomposed according to the equation, $2NH_3 \rightleftharpoons N_2 + 3H_2$. The vessel is such that the volume remains effectively constant whereas pressure increases to 50 atm.

Calculate the percentage of NH_3actually decomposed

a) 61.3% b) 63.5% c) 65.3% d) 66.6%

111. For the system; $3A + 2B \rightleftharpoons C$, the expression for equilibrium constant is

a) $\frac{[A]^3[B]^2}{[C]}$ b) $\frac{[C]}{[A]^3[B]^2}$ c) $\frac{[3A][2B]}{[C]}$ d) $\frac{[C]}{[3A][2B]}$

112. A monoprotic acid in a 0.1 M solution ionisesto 0.001%. Its ionisation constant is

a) 1×10^{-11} b) 1×10^{-3} c) 1×10^{-6} d) 1×10^{-8}

113. For the reaction, $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$, the principle pressure of CO_2 and CO are 2.0 and 4.0 atm respectively at equilibrium. The K_p for the reaction is

a) 2.0 b) 4.0 c) 8.0 d) 1.6

114. The vapour density of completely dissociated NH_4Cl would be:

a) Slightly less than half of that of ammonium chloride
b) Half of that of ammonium chloride
c) Double that of ammonium chloride
d) Determined by the amount of solid ammonium chloride used in the experiment

115. Mg^{2+} is … than Al^{3+}.

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

116. The equilibrium constant for the reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ is 4×10^{-4} at 2000 K. In presence of a catalyst the equilibrium is attained ten times faster. Therefore, the equilibrium constant, in present of the catalyst, at 2000 K is:

a) 40×10^{-4}
b) 4×10^{-4}
c) 4×10^{-3}
d) Difficult to compute without more data

117. The activation energies of forward and backward reaction: $A_2 + B_2 \rightleftharpoons 2AB$ are 180kJ mol^{-1} and 200 kJ mol^{-1} respectively. The presence of a catalyst lowers the activation energy of both (forward and backward) reactions by 100 kJ mol^{-1}. The enthalpy change of the reaction in the presence of catalyst will be (in kJ mol^{-1}):

a) -20
b) -300
c) $+120$
d) -280

118. How will increase of pressure affect the equation?

$$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$$

a) Shift in the forward direction b) Shift in the reverse direction
c) Increase in the yield of hydrogen d) No effect

119. If the pressure of N_2/H_2 mixture in a closed apparatus is 100 atm and 20% of the mixture then reacts, the pressure at the same temperature would be :

a) 100 b) 90 c) 85 d) 80

120. C_2H_5ONa acts as … in C_2H_5OH.

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

121. A solution of sodium borate has a pH of approximately:

a) > 7 b) < 7 c) $= 7$ d) Between 4 and 5

122. 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

a) 3 b) 8 c) 11 d) 14

123. Study the following table.

Buffer solution	Volume (in mL) of 1 M weak acid	Volume (in mL) of 0.1 M sodium

		salt of weak acid
I	4.0	4.0
II	4.0	40.0
III	40.0	4.0
IV	0.1	10.0

Which of the two sets of buffer solutions have least pH?

a) I and II b) I and III c) II and III d) II and IV

124. Which indicator works in the pH range 8-9.8?

a) Phenolphthalein b) Methyl orange c) Methyl red d) Litmus

125. 100 mL of 0.015 M HCl solution is mixed with 100 mL of 0.005 M HCl. What is the pH of the resultant solution?

a) 2.5 b) 1.5 c) 2 d) 1

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

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

127. The volume of water needed to dissolve 1 g of $BaSO_4$ ($K_{sp} = 1.1 \times 10^{-10}$) at 25°C is:

a) 820 litre
b) 410 litre
c) 205 litre
d) None of these

128. In a vessel containing SO_3, SO_2, and O_2 at equilibrium, some helium gas in introduced so that, the total pressure increase, while temperature and volume remain constant. According to Le-Chatelier's principle the dissociation of SO_3 :

a) Increases
b) Decreases
c) Remains unaltered
d) Changes unpredictably

129. Given the equilibrium system

$NH_4Cl(s) \rightleftharpoons NH_4^+(aq) + Cl^-(aq)$

($\Delta H = +3.5$ kcal/mol).

What change will shift the equilibrium to the right?

a) Decreasing the temperature
b) Increasing the temperature
c) Dissolving NaCl crystals in the equilibrium mixture
d) Dissolving NH_4NO_3 crystals in the equilibrium mixture

130. 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

a) 10^{-9} M b) 10^{-8} M c) 10^{-7} M d) 10^{-6} M

131. The solubility of $Pb(OH)_2$ in water is 6.7×10^{-6}M. Its solubility in a buffer solution of pH=8 would be

a) 1.2×10^{-2} b) 1.6×10^{-3} c) 1.6×10^{-2} d) 1.2×10^{-3}

132. In which of the following reactions is $K_p < K_c$?

a) $I_2(g) \rightleftharpoons 2I(g)$ b) $2BrCl(g) \rightleftharpoons Cl_2(g) + Br_2(g)$
c) $CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g)$ d) All of the above

133. Any precipitate is formed when

a) Solution becomes saturated
b) The value of ionic product is less than the value of solubility product
c) The value of ionic product is equal to the value of solubility product

d) The value of ionic product is greater than the value of solubility product

134. At 25°C, K_b for a base BOH is 1.0×10^{-12}. The $[OH^-]$ in $0.01M$ aqueous solution of base is:
a) $1.0 \times 10^{-6}\ M$ b) $1.0 \times 10^{-7}\ M$ c) $1.0 \times 10^{-5}\ M$ d) $2.0 \times 10^{-6}\ M$

135. The pH of a 10^{-9} M solution of HCl in water is
a) 8   b) -8 c) Between 7 and 8   d) Between 6 and 7

136. If pH of a saturated solution of $Ba(OH)_2$ is 12, the value of its K_{sp} is:
a) $4.0 \times 10^{-6}\ M^3$ b) $4.0 \times 10^{-7}\ M^3$ c) $5.0 \times 10^{-6}\ M^3$ d) $5.0 \times 10^{-7}\ M^3$

137. Liquid ammonia ionises to a slight extent. At -50°C, its self ionisation constant, $K_{NH_3} = [NH_4^+][NH_2^-] = 10^{-30}$. How many amide ions, are present per cm^3 of pure liquid ammonia? (Assume $N = 6.0 \times 10^{23}$)
a) 6×10^6 ions   b) 6×10^5 ions   c) 6×10^{-5} ions   d) 6×10^{-6} ions

138. 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
a) 5.0×10^{-5} b) 5.0×10^{15} c) 5.0×10^{-15} d) 0.2×10^5

139. Which is the strongest acid?
a) CH_3COOH b) $CH_2ClCOOH$ c) $CHCl_2COOH$ d) CCl_3COOH

140. A 0.01 M ammonia solution is 5% ionized. The concentration of $[OH^-]$ ion is:
a) 0.005 M b) 0.0001 M c) 0.0005 M d) 0.05 M

141. Nucleophiles are:
a) Lewis acids   b) Lewis bases   c) Bronsted acids   d) Bronsted bases

142. Theory of ionisation was given by
a) Rutherford   b) Graham   c) Faraday   d) Arrhenius

143. 0.01 mole of lime (CaO) was dissolved in 100 cm^3 of water. Assuming the base is completely ionised in the solution, the pH of the solution will be
a) 13.3   b) 8.5   c) 6   d) 8

144. 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) C and D

145. At 600°C, K_p for the following reaction is 1 atm.

$$X(g) \rightleftharpoons Y(g) + Z(g)$$

At equilibrium, 50% of X(g) is dissociated. The total pressure of the equilibrium system is p atm. What is the partial pressure (in atm) of X(g) at equilibrium?
a) 1   b) 4   c) 2   d) 0.5

146. Equilibrium constants K_1 and K_2 for the following equilibria are related as :
$NO(g) + \frac{1}{2} O_2(g) \rightleftharpoons NO_2(g); K_1$
$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g); K_2$
a) $K_2 = \frac{1}{K_1^2}$ b) $K_2 = \frac{1}{K_1}$ c) $K_2 = K_1^2$ d) $K_2 = \frac{K_1}{2}$

147. If K_1 and K_2 are equilibrium constants for reactions (I) and (II) respectively for,
$N_2 + O_2 \rightleftharpoons 2NO$ ... (i)
$\frac{1}{2}N_2 + \frac{1}{2}O_2 \rightleftharpoons NO$ ... (ii)
Then:
a) $K_2 = K_1$ b) $K_2 = \sqrt{K_1}$ c) $K_1 = 2K_2$ d) $K_1 = \frac{1}{2}K_2$

148. All reactions which have chemical disintegration are
a) Exothermic

b) Reversible
c) Reversible and exothermic
d) Reversible of irreversible and endothermic or exothermic

149. For which of the following sparingly soluble salt, the solubility (s) and solubility product (K_{sp}) are related by the expression $s = \left(K_{sp}/4\right)^{1/3}$?
a) $BaSO_4$ b) $Ca_3(PO_4)_2$ c) Hg_2Cl_2 d) Ag_3PO_4

150. For $PCl_5 \rightleftharpoons PCl_3 + Cl_2$, initial concentration of each reactant and product is 1 M. If $K_{eq} = 0.41$ then
a) More PCl_3 will form b) More Cl_2 will form c) More PCl_5 will form d) No change

151. The exothermic formation of ClF_3 is represented by the equation
$Cl_2(g) + 3F_2(g) \rightleftharpoons 2ClF_3(g)$;
$\Delta H = -329$ kJ
Which of the following will increase the quantity of ClF_3 in an equilibrium mixture of Cl_2, F_2 and ClF_3?
a) Adding F_2 b) Increasing the volume of the container
c) Removing Cl_2 d) Increasing the temperature

152. For which of the following reactions, does the equilibrium constant depend on the units of concentration?
a) $NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$
b) $Zn(s) + Cu^{2+}(aq) \rightleftharpoons Cu(s) + Zn^{2+}(aq)$
c) $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$
d) $C_2H_5OH(l) + CH_3COOH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$

153. If the solubility product of lead iodide (PbI_2) is 3.2×10^{-8}, its solubility will be:
a) $2 \times 10^{-3}\ M$ b) $4 \times 10^{-4}\ M$ c) $1.6 \times 10^{-5}\ M$ d) $1.8 \times 10^{-5}\ M$

154. At 30°C the solubility of Ag_2CO_3 ($K_{sp} = 8 \times 10^{-12}$) would be greatest in 1 L of
a) 0.05 M Na_2CO_3 b) 0.05 M $AgNO_3$ c) Pure water d) 0.05 M NH_3

155. The interfering radicals interfere in the test of usual inorganic analysis after II group analysis due to:
a) Their solubility in acid medium
b) Their solubility in alkaline medium
c) Their insoluble nature in alkaline medium
d) None of the above

156. The pK_b value of NH_3 is 5. Calculate the pH of the buffer solution, 1 L of which contains 0.01 M NH_4Cl and 0.10 M NH_4OH
a) 4 b) 6 c) 8 d) 10

157. The equilibrium constant K for the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ at room temperature 300 K is 2.85 and at 698 K 1.84×10^{-2}. Hence the reason that HI exists as a stable compound at room temperature is because:
a) It decomposes so slowly that equilibrium is not readily achieved
b) The HI bond has a large covalent contribution
c) The heat of reaction at room temperature is −5.31 kcal
d) It is uncatalytic reaction

158. A mixture of 0.3 mole of H_2 and 0.3 mole of I_2 is allowed to react in a 10 L evacuated flask at 500°C. The reaction is $H_2 + I_2 \rightleftharpoons 2HI$, the K is found to be 64. The amount of unreacted I_2 at equilibrium is
a) 0.03 mol b) 0.06 mol c) 0.09 mol d) 3.6 mol

159. In a solution of a weak electrolyte at infinite dilution we have:
a) Only cations and electrolyte in 10% dissociated
b) Only anions and electrolyte is 10% dissociated
c) Both cations and anions and electrolyte is 100% dissociated
d) Cations, anions and unionised electrolyte

160. In the reaction, $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, the equilibrium concentration of PCl_5 and PCl_3 are 0.4 and 0.2 mol/L respectively. If the value of K_c is 0.5 what is the concentration ofCl_2 in mol/L?

a) 0.5 b) 1.0 c) 1.5 d) 2.0

161. The reaction that proceeds in the forward direction is :

a) $SnCl_4 + Hg_2Cl_2 \rightarrow SnCl_2 + 2HgCl_2$

b) $NH_4Cl + NaOH \rightarrow H_2O + NH_3 + NaCl$

c) $Mn^{2+} + 2H_2O + Cl_2 \rightarrow MnO_2 + 4H^+ + 2Cl^-$

d) $S_4O_6^{2-} + 2I^- \rightarrow 2S_2O_3^{2-} + I_2$

162. Which is a Lewis base

$$I_2 + I^- \rightarrow I_3^- \text{ ?}$$

a) I_2 b) I_3^- c) I^- d) None of these

163. A solution contains 10 mL of 0.1 N NaOH and 10 mL of 0.05 N H_2SO_4, pH of this solution is

a) Less than 7 b) 7 c) Zero d) Greater than 7

164. The solubility of $PbCl_2$ in water is 0.01 M at 25°C. Its maximum concentration in 0.1 M NaCl will be:

a) $2 \times 10^{-3}\ M$ b) $1 \times 10^{-4}\ M$ c) $1.6 \times 10^{-2}\ M$ d) $4 \times 10^{-4}\ M$

165. HX is a weak acid ($K_a = 10^{-5}$). It forms a salt NaX (0.1 M on reacting with caustic soda. The degree of hydrolysis of NaX is

a) 0.01% b) 0.0001 % c) 0.1 % d) 0.5 %

166. Which species acts as stronger acid than formic acid in aqueous solution?

a) CH_3COOH b) H_2SO_4 c) NH_4^+ d) HPO_4^{2-}

167. In a reaction at equilibrium $'X'$ mole of the reactant A decompose to give 1 mole each of C and$D$. If the fraction of A decomposed at equilibrium is independent of initial concentration of A, then the value of $'X'$ is :

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

168. Starting with 1 mole of N_2O_4, if α is the degree of dissociation of N_2O_4 for the reaction, $N_2O_4 \rightleftharpoons 2NO_2$ then at equilibrium the total number of moles of N_2O_4 and NO_2 present is

a) 2 b) $(1-\alpha)$ c) $(1-\alpha)^2$ d) $(1+\alpha)$

169. A saturated solution of $Mg(OH)_2$ in water at 25°C contains 0.11 g $Mg(OH)_2$ per litre of solution. The solubility product of $Mg(OH)_2$ is:

a) $(0.11)^2$ b) $(0.11)^3$ c) $4 \times (0.11)^3$ d) $4 \times (0.11)^3/(58)^3$

170. For the reaction,

$$2NO_3(g) \rightleftharpoons 2NO(g) + O_2(g)$$

$$(K_c = 1.8 \times 10^{-6} \text{ at } 184°C)$$

$$(R = 0.00831\ kJ/(mol\ K))$$

When $K_p$and K_c are compared at 184°C, it is found that

a) Whether K_p is greater than less than or equal to $K_c$depends upon the total gas pressure

b) $K_p = K_c$

c) K_p is less than K_c

d) K_p is greater than K_c

171. Which is the best choice for weak base-strong acid titration?

a) Methyl red b) Litmus c) Phenol red d) Phenolphthalein

172. The value of the ionic product of water depends

a) On volume of water b) On temperature

c) Changes by adding acid or alkali d) Always remain constant

173. The formation of SO_3 takes place according to the following reaction, $2SO_2 + O_2 \rightleftharpoons 2SO_3, \Delta H = -45.2$ kcal. The formation of SO_3 is favoured by

a) Increase of volume b) Increase in pressure

c) Increase in temperature d) Removal of oxygen

174. Which one is strongest electrolyte in the following?

a) NaCl b) CH_3COOH c) NH_4OH d) $C_6H_{12}O_6$

175. For which of the following reactions, $K_p = K_c$?

a) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ b) $N_2 + O_2 \rightleftharpoons 2NO$ c) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ d) $2SO_3 \rightleftharpoons 2SO_2 + O_2$

176. The solubility of AgI in NaI solution is less than that in pure water because

a) AgI forms complex with NaI b) Of common ion effect

c) Solubility product of AgI is less d) The temperature of the solution decreases

177. The partial pressure of $CH_3OH(g)$, $CO(g)$ and $H_2(g)$ in equilibrium mixture for the reaction, $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$ are 2.0, 1.0 and 0.1 atm respectively at 427^{0}C. The value of K_p for the decomposition of CH_3OH to CO and H_2 is :

a) 10^2 atm b) 2×10^2 atm^{-1} c) 50 atm^2 d) 5×10^{-3} atm^2

178. What happens to pH of a solution when NH_4Cl crystal is added to a dilute solution of NH_4OH?

a) Decreases b) Increases c) Remains unaffected d) All of these

179. What mole of $Ca(OH)_2$ is dissolved in 250 mL aqueous solution to given a solution of pH 10.65, assuming full dissociation?

a) 0.47×10^{-4} b) 0.48×10^{-4} c) 0.56×10^{-4} d) 0.58×10^{-4}

180. The volume of the reaction vessel containing an equilibrium mixture in the reaction, $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$ is increased. When equilibrium is reestablished:

a) The amount of $SO_2(g)$ will decrease

b) The amount of $SO_2Cl_2(g)$ will increase

c) The amount of $Cl_2(g)$ will increase

d) The amount of Cl_2 (g) will remain unchanged

181. The acidic nature of zinc oxide is shown from the formation of salt:

a) $NaZnO_2$ b) Na_2ZnO_2 c) $Na_2Zn_2O_2$ d) None of these

182. Consider the following reaction equilibrium

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

Initially, 1 mole of N_2 and 3 moles of H_2 are take in a 2 L flask. At equilibrium state if, the number of moles of $N_2$is 0.6, what is the total number of moles of all gases present in the flask?

a) 0.8 b) 1.6 c) 3.2 d) 6.4

183. If 0.1 mole of I_2 is introduced into 1.0 litre flask at 1000 K, at equilibrium ($K_c = 10^{-6}$), which one is correct?

a) $[I_2(g)] > [I(g)]$ b) $[I_2(g)] < [I(g)]$ c) $[I_2(g)] = [I(g)]$ d) $[I_2(g)] = \frac{1}{2}[I(g)]$

184. The equilibrium constant K_c for $A(g) \rightleftharpoons B(g)$ is 1.1, Gas B will have molar concentration greater than 1 if :

a) $(A) = 0.91$ b) $(A) > 0.91$ c) $(A) > 1$ d) At all these

185. The equilibrium which remains unaffected by change in pressure of the reactants is

a) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ b) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

c) $2O_3(g) \rightleftharpoons 3O_2(g)$ d) $2NO_2 \rightleftharpoons N_2O_4(g)$

186. The pH value of 0.001 M aqueous solution of NaCl is

a) 7 b) 4 c) 11 d) unpredictable

187. The solution of AgCl is unsaturated if:

a) $[Ag^+][Cl^-] < K_{sp}$ b) $[Ag^+][Cl^-] > K_{sp}$ c) $[Ag^+][Cl^-] = K_{sp}$ d) None of these

188. A decimolar solution of ammonium hydroxide is ionised to the extent of 1.3%. If log 1.3. If $\log 1.3 = 0.11$, what is the pH of the solution?

a) 11.11 b) 9.11 c) 8.11 d) Unpredictable

189. The equivalent conductance of $\frac{M}{32}$ solution of a weak monobasic acid is 8.0 mhos cm^2 and at infinite dilution is 400 mhos cm^2. The dissociation constant of this acid is:

a) 1.25×10^{-4} b) 1.25×10^{-5} c) 1.25×10^{-6} d) 6.25×10^{-4}

190. Hydrolysis of oxide ion in water produces:

a) H^+ b) OH^- c) O_2 d) H_2O

191. A weak acid HX has the dissociation constant 1×10^{-5} M. It forms a salt NaX on reaction with alkali. The degree of hydrolysis of 0.1 M solution of NaX is
a) 0.0001% b) 0.01% c) 0.1% d) 0.15%

192. The species among the following which can act as an acid and a base is:
a) HSO_4^- b) SO_4^{2-} c) H_3O^+ d) Cl^-

193. For the reactions,
$A \rightleftharpoons B; \quad K_c = 2$
$B \rightleftharpoons C; \quad K_c = 4$
$C \rightleftharpoons D; \quad K_c = 6$
K_c for the reaction, $A \rightleftharpoons D$ is:
a) $(2 + 4 + 6)$ b) $(2 \times 4)/6$ c) $(4 \times 6)/2$ d) $2 \times 4 \times 6$

194. 0.365 g of HCl gas was passed through 100 cm^3 of 0.2 M NaOH solution. The pH of the resulting solution would be
a) 1 b) 5 c) 8 d) 13

195. The pH of a 0.0001 N solution of KOH will be
a) 4 b) 6 c) 10 d) 12

196. The equilibrium constant for a reaction is 1×10^{20} at 300 K. The standard Gibbs energy change for this reaction is :
a) − 115 kJ b) + 115kJ c) + 166 kJ d) − 116 kJ

197. The equilibrium constant for the reaction ; $P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s) is$:
a) $K_c = \frac{1}{[O_2]^5}$ b) $K_c = [O_2]^5$ c) $K_c = \frac{[P_4O_{10}]}{5[P_4][O_2]}$ d) $K_c = \frac{[P_4O_{10}]}{[P_4][O_2]^5}$

198. The correct relation for hydrolysis constant of NH_4CN is:
a) $\sqrt{\frac{K_w}{K_a}}$ b) $\frac{K_w}{K_a \times K_b}$ c) $\frac{\sqrt{K_H}}{c}$ d) $\frac{K_a}{K_b}$

199. The gaseous reaction,
$A + B \rightleftharpoons 2C + D + Q$ is most favoured at
a) Low temperature and high pressure b) High temperature and low high pressure
c) High temperature and low pressure d) Low temperature and low pressure

200. An aqueous solution of 0.1 M NH_4Cl will have a pH closer to:
a) 9.1 b) 8.1 c) 7.1 d) 5.1

201. If the concentration of OH^- ions is the reaction $Fe(OH)_3(s) \rightleftharpoons Fe^{3+}(aq) + 3OH^-(aq)$, is decreased by $\frac{1}{4}$ times, then equilibrium concentration of Fe^{3+} will increase by :
a) 16 times b) 64 times c) 4 times d) 8 times

202. $A(g) + 3B(g) \rightleftharpoons 4C(g)$.
Initially concentration of A is equal to that of B. The equilibrium concentrations of A and C are equal. K_c is
a) 0.08 b) 0.08 c) 8 d) 80

203. 18 mL of mixture of acetic acid and sodium acetate required 6 mL of 0.1 M NaOH for neutralization of the acid and 12 mL of 0.1 M HCl for reaction with salt, separately. If pK_a of the acid is 4.75, what is the pH of the mixture?
a) 5.05 b) 4.75 c) 4.5 d) 4.6

204. 50 mL of 0.1 M HCl and 50 mL of 0.2 M NaOH are mixed. The pH of the resulting solution is
a) 1.30 b) 4.2 c) 12.70 d) 11.70

205. K_c for the reaction : $[Ag(CN)_2]^- \rightleftharpoons Ag^+ + 2CN^-$, the equilibrium constant at 25°C is 4.0×10^{-19}, then the silver ion concentration in a solution which was originally 0.1 molar in KCN and 0.03 molar in $AgNO_3$ is :
a) 7.5×10^{18} b) 7.5×10^{-18} c) 7.5×10^{19} d) 7.5×10^{-19}

206. The pK_a for acid A is greater than pK_a for acid B. The strong acid is:

a) Acid A b) Acid B c) Are equally strong d) None of these

207. When 100 mL of 1 M NaOH solution is mixed with 10 mL of 10 M H_2SO_4, the resulting mixture will be
a) Acidic b) Alkaline c) $HClO_3$ d) H_3PO_3

208. The $[H_3O^+]$ in the rain water of pH $= 4.35$ is:
a) $4.5 \times 10^{-5}\ M$ b) $6.5 \times 10^{-5}\ M$ c) $9.5 \times 10^{-5}\ M$ d) $12.5 \times 10^{-5}\ M$

209. For which salt the pH of its solution does not change with dilution?
a) NH_4Cl b) CH_3COONH_4 c) CH_3COONa d) None of these

210. When hydrogen molecules decomposed into it's atoms which conditions gives maximum yield of H atom?
a) High temperature and low pressure b) Low temperature and high pressure
c) High temperature and high pressure d) Low temperature and low pressure

211. Which is not and acid salt?
a) NaH_2PO_2 b) NaH_2PO_3 c) NaH_2PO_4 d) $NaHSO_3$

212. Which is a Lewis base?
a) B_2H_6 b) $LiAlH_4$ c) AlH_3 d) NH_3

213. Final pressure is higher than initial pressure of a container filled with an ideal gas at constant temperature. What will be the value of equilibrium constant?
a) $K = 1.0$ b) $K = 10.0$ c) $K > 1.0$ d) $K < 1.0$

214. In which of the following cases, does not reaction go farthest to completion?
a) $K = 10^3$ b) $K = 10^{-2}$ c) $K = 10$ d) $K = 1$

215. For the reaction, $H_2(g) + I_2(g) \longrightarrow 2HI(g)$, the equilibrium constant K_p changes with
a) Total pressure b) Catalyst
c) The amount H_2 and I_2 d) Temperature

216. The equilibrium constant for the reaction,

$$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$$

At temperature T is 4×10^{-4}. The value of K_c for the reaction

$$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$$

at the same temperature is
a) 2.5×10^2 b) 50 c) 4×10^{-4} d) 0.02

217. The reaction, $2A_{(g)} + B_{(g)} \rightleftharpoons 3C_{(g)} + D_{(g)}$ is begun with the concentration of A and B both at an initial value of $1.00M$. When equilibrium is reached, the concentration of D is measured and found to be 0.25 M. The value for the equilibrium constant for this reaction is given by the expression :
a) $[(0.75)^3\ (0.25)] \div [(1.00)^2(1.00)]$
b) $[(0.75)^3\ (0.25)] \div [(0.50)^2(0.75)]$
c) $[(0.75)^3\ (0.25)] \div [(0.50)^2(0.25)]$
d) $[(0.75)^3\ (0.25)] \div [(0.75)^2(0.25)]$

218. In $HS^-, I^-, R-NH_2, NH_3$ order of proton accepting tendency will be:
a) $I^- > NH_3 > RNH_2 > HS^-$
b) $NH_3 > RNH_2 > HS^- > I^-$
c) $RNH_2 > NH_3 > HS^- > I^-$
d) $HS^- > RNH_2 > NH_3 > I^-$

219. Strong electrolytes are those which:
a) Dissolve readily in non-polar solvent
b) Conduct electricity in aqueous solution
c) Dissociate into ions at high concentration
d) None of the above

220. The pH of 0.1 N HCl solution is:
a) 1.0 b) 7.0 c) 14.0 d) 4.0

221. A solution of $FeCl_3$ in water acts as acidic due to:
a) Acidic impurities b) Ionisation c) Hydrolysis of Fe^{3+} d) Dissociation

222. The concept that an acid is a proton donor and a base is a proton acceptor was introduced by:
a) Arrhenius b) Bronsted-Lowry c) Lewis d) Faraday

223. Which is decreasing order of strength of bases?

$$\bar{O}H, \bar{N}H_2, HC \equiv C^- \text{ and } CH_3CH_2^-$$

a) $H_3CCH_2^- > NH_2^- > HC \equiv C^- > OH^-$ b) $HC \equiv C^- > CH_3CH_2^- > NH_2^- > OH^-$
c) $OH^- > NH_2^- > CH \equiv C^- > H_3CCH_2^-$ d) $NH_2^- > HC \equiv C^- > OH^- > H_3CCH_2^-$

224. The strength of an acid depends on its tendency to
a) Accept protons b) Donate protons c) Accept electrons d) Donate electrons

225. The following reactions are 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, then:
a) pH will decrease
b) Hydrogen ion concentration will diminish
c) H_2CO_3 concentration will be unaltered
d) The forward reaction will be promoted

226. The common ion effect is shown by which of the following sets of solutions?
a) $BaCl_2 + BaNO_3$ b) $NaCl + HCl$ c) $NH_4OH + NH_4Cl$ d) None of these

227. In the reaction, $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$, the equilibrium pressure is 12 atm. If 50% of CO_2 reacts, K_p for the change is :
a) 12 atm b) 16 atm c) 20 atm d) 6 atm

228. For a given solution $pH = 6.9$ at 60°C, where $K_w = 10^{-12}$. The solution is:
a) Acidic b) Basic c) Neutral d) Unpredictable

229. A quantity of PCl_5 was heated in a 10 litre vessel at 250°C to show $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$. At equilibrium the vessel contains 0.1 mole of PCl_5, 0.20 mole of PCl_3 and 0.20 mole of Cl_2. The equilibrium constant of the reaction is :
a) 0.02 b) 0.05 c) 0.04 d) 0.025

230. One mole of ethyl alcohol was treated with one mole of acetic acid at 25°C. 2/3 of the acid changes into ester at equilibrium. The equilibrium constant for the reaction will be:
a) 1 b) 2 c) 3 d) 4

231. 9.2 g of $N_2O_4(g)$ is taken in a closed 1 L vessel and heated till the following equilibrium is reached
$N_2O_4(g) \rightleftharpoons 2NO_2(g)$
At equilibrium, 50% $N_2O_4(g)$ is dissociated. What is the equilibrium constant (in $molL^{-1}$)? (Molecular weight of $N_2O_4 = 92$)
a) 0.1 b) 0.2 c) 0.3 d) 0.4

232. Assuming complete dissociation which of the following aqueous solutions will have the same pH value?
(i)100 mL of 0.01 M HCl
(ii)100 mL of 0.01 MH_2SO_4
(iii)50 mL of 0.01 M HCl
(iv)Mixture of 50 mL of 0.02 M H_2SO_4 and 50 mL of 0.02 M NaOH
a) (i), (ii) b) (i), (iii) c) (ii), (iv) d) (i), (iv)

233. At 3000 K, the equilibrium pressure of CO_2, CO and O_2 are 0.6, 0.4 and 0.2 atm respectively. K_p for the reaction $2CO_2 \rightleftharpoons 2CO + O_2$, is
a) 0.089 b) 0.098 c) 0.189 d) 0.198

234. The pK_a of weak acid H_A is 4.5. The pOH of an aqueous buffer solution of HA in which 50% of the acid is ionised:
a) 7.0 b) 4.5 c) 2.5 d) 9.5

235. An amphoteric buffer solution in which conc. of H^+ and HX is same. The value of K_a of HX is 10^{-8}, then pH of buffer solution is

a) 3 b) 8 c) 10 d) 14

236. In the reaction, $3A + 2B \rightarrow 2C$, the equilibrium constant K_c is given by

a) $\frac{[3A]\times[2B]}{[C]}$ b) $\frac{[A]^3\times[B]}{[C]}$ c) $\frac{[C]^2}{[A]^3\times[B]^2}$ d) $\frac{[C]}{[3A][2B]}$

237. Which reaction is not affected by change in pressure?

a) $\mathrm{H_2 + I_2 \rightleftharpoons 2HI}$ b) $\mathrm{N_2 + 3H_2 \rightleftharpoons 2NH_3}$

c) $\mathrm{PCl_5 \rightleftharpoons PCl_3 + Cl_2}$ d) $\mathrm{2C + O_2 \rightleftharpoons 2CO}$

238. Three reactions involving $\mathrm{H_2PO_4^-}$ are given below

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

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

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

In which of the above does $\mathrm{H_2PO_4^-}$ act as an acid?

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

239. pH for the solution of salt undergoing anionic hydrolysis (say $\mathrm{CH_3COONa}$) is given by:

a) $\mathrm{pH} = \frac{1}{2}[\mathrm{p}K_w + \mathrm{p}K_a + \log c]$

b) $\mathrm{pH} = \frac{1}{2}[\mathrm{p}K_w + \mathrm{p}K_a - \log c]$

c) $\mathrm{pH} = \frac{1}{2}[\mathrm{p}K_w + \mathrm{p}K_b - \log c]$

d) None of the above

240. For the reactions, $A + B + Q \rightleftharpoons C + D$, if the temperature is increased then concentration of the products will

a) Increase b) Decrease c) Remains the same d) Become zero

241. Under what conditions of temperature and pressure, the formation of atomic hydrogen from molecular hydrogen will be favoured most?

a) High temperature and high pressure b) High temperature and low pressure

c) Low temperature and low pressure d) Low temperature and high pressure

242. Mohr's salt is a:

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

243. pH of 0.05 M $\mathrm{Mg(OH)_2}$ is:

a) 13 b) 10 c) 1 d) Zero

244. In which of the following reactions, the concentration of product is higher than the concentration of reactant at equilibrium? (K = equilibrium constant)

a) $A \rightleftharpoons B; K = 0.001$ b) $M \rightleftharpoons N; K = 10$ c) $X \rightleftharpoons Y; K = 0.005$ d) $R \rightleftharpoons P; K = 0.01$

245. The values of dissociation constant of bases are given below. Which is the weakest base?

a) 1.8×10^{-5} b) 4.8×10^{-10} c) 7.2×10^{-11} d) 7.07×10^{-7}

246. The dissociation equilibrium of a gas $\mathrm{AB_2}$ can be represented as :

$$2AB_2(\mathrm{g}) \rightleftharpoons 2AB(\mathrm{g}) + B_2(\mathrm{g})$$

The degree of dissociation is $'x'$ and is small compared to 1. The expression relating the degree of dissociation (x) with equilibrium constant K_p and total pressure p is :

a) $(2K_p/P)^{1/3}$ b) $(2K_p/P)^{1/2}$ c) (K_p/P) d) $(2K_p/P)$

247. In which one of the following gaseous equilibria, K_p is less than K_c?

a) $\mathrm{N_2O_4 \rightleftharpoons 2NO_2}$ b) $\mathrm{2SO_2 + O_2 \rightleftharpoons 2SO_3}$ c) $\mathrm{2HI \rightleftharpoons H_2 + I_2}$ d) $\mathrm{N_2 + O_2 \rightleftharpoons 2NO}$

248. K_{sp} for $\mathrm{Cr(OH)_3}$ is 2.7×10^{-31} . What is its solubility in mol/L?

a) 1×10^{-8} b) 8×10^{-8} c) 1.1×10^{-8} d) 0.18×10^{-8}

249. $\mathrm{N_2O_4}$ is dissociated to 33% and 40% at total pressure P_1 and P_2 atm respectively. Then the ratio P_1/P_2 is:

a) 7/4 b) 7/3 c) 8/3 d) 8/5

250. In the reactions, $A + 2B \rightleftharpoons 2C$, if 2 moles of A, 3.0 moles of B and 2.0 moles of C are placed in a 2 L flask and the equilibrium concentration of C is 0.5 mol/L, the equilibrium constant (K_c) for the reactions is

a) 0.21 b) 0.50 c) 0.75 d) 0.025

251. The pH value of 1/1000 N KOH solution is

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

252. The pH of tears coming out of a person's eye is:

a) 7.4 b) 6.4 c) 7.0 d) 2.36

253. The solubility of CaF_2 is 2×10^{-4} mol/L. Its solubility product (K_{sp}) is

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

254. 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

a) 2.0×10^{-6}M b) 1.0×10^{-4}M c) 1.6×10^{-4}M d) 4.0×10^{-10}M

255. The solubility product of barium sulphate is 1.5×10^{-9} at 18°C. Its solubility in water at 18°C is

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

256. The strongest Bronsted base is

a) ClO_3^- b) ClO_2^- c) ClO_4^- d) ClO^-

257. The reaction quotient (Q) at equilibrium is:

a) $= 1$ b) $= K$ c) $> K$ d) $< K$

258. The concentration of oxalic acid is $'x'$mol L^{-1}. 40 mL. of this solution reacts with 16 mL of 0.05 M acidified $KMnO_4$. What is the pH of $'x'$ M oxolic acid solution?
(Assume that oxalic acid dissociates completely)

a) 1.3 b) 1.699 c) 1 d) 2

259. Metal ions like Ag^+, Cu^{2+} etc. act as

a) Bronsted acids b) Bronsted bases c) Lewis acids d) Lewis bases

260. 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

a) Unionised in the small intestine and in the stomach
b) Completely ionised in the small intestine and in the stomach
c) Ionised in the stomach and almost unionised in the small intestine
d) Ionised in the small intestine and almost unionised in the stomach

261. A solution is called saturated if:

a) Ionic concentration product < solubility product
b) Ionic concentration product > solubility product
c) Ionic concentration product ≥ solubility product
d) None of the above

262. The auto protonation constant of H_2O is:

a) 1×10^{-14} b) 3.23×10^{-18} c) 1.8×10^{-18} d) 3.23×10^{-20}

263. K_c for $m_1A + m_2B = n_1C + n_2D$ is given by:

a) $K_c = \dfrac{[A]^{m_1}[B]^{m_2}}{[C] \times [D]}$ b) $K_c = \dfrac{[A]^{n_1}[B]^{n_2}}{[C]^{m_1}[D]^{m_2}}$ c) $K_c = \dfrac{[C]^{n_1}[D]^{n_2}}{[A]^{m_1}[B]^{m_2}}$ d) $K_c = \dfrac{[C]^{m_1} \times [D]^{m_2}}{[A]^{n_1} \times [B]^{n_2}}$

264. The pH of millimolar HCl is

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

265. Partial pressure of A, B, C and D on the basis of gaseous system, $A + 2B \rightleftharpoons C + 3D$, are $A = 0.20, B = 0.10, C = 0.30$and $D = 0.50$ atm. The numerical value of equilibrium constant is

a) 3.75 b) 18.75 c) 17.85 d) 15.87

266. Which equilibrium can be described as Lewis acid-base reaction but not Bronsted acid-base reaction?

a) $H_2O + CH_3COOH \rightleftharpoons H_3O^+ + CH_3COO^-$
b) $2NH_3 + H_2SO_4 \rightleftharpoons 2NH_4^+ + SO_4^{2-}$
c) $NH_3 + CH_3COOH \rightleftharpoons NH_4^+ + CH_3COO^-$
d) $[Cu(H_2O)_4]^{2+} + 4NH_3 \rightleftharpoons [Cu(NH_3)_4]^{2+} + 4H_2O$

267. $SnCl_2$ and $HgCl_2$ cannot co-exist in a solution because of:

a) Common ion effect
b) Le – Chatelier's principle
c) Conc. of Cl^- increases to precipitate both
d) Redox change

268. The species which acts as a Lewis but not a Bronsted acid is
a) NH_2^- b) O^{2-} c) BF_3 d) OH^-

269. What is the best description of the change that occurs when $Na_2O(s)$ is dissolved in water?
a) Oxidation number of sodium decreases
b) Oxide ion accepts sharing in a pair of electrons
c) Oxide ion donates a pair of electrons
d) Oxidation number of oxygen increases

270. pH of 0.005 M calcium acetate is
(pK_a of $CH_3COOH = 4.74$)
a) 7.04 b) 9.37 c) 9.26 d) 8.2195

271. Relation between hydrolysis constant and dissociation constant are given. Which is the correct formula for $MgCl_2$?
a) $K_h = \frac{K_w}{K_a}$ b) $K_h = \frac{K_w}{K_b}$ c) $K_h = \frac{K_w}{K_a \times K_b}$ d) $K_w = \frac{K_h}{K_b}$

272. Theory's 'active mass' indicates that the rate of chemical reaction is directly proportional to the
a) Equilibrium constant b) Volume of apparatus
c) Properties of reactants d) Concentration of reactants

273. In which of the following reactions, the value of K_p will be equal to K_c?
a) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ b) $2NH_3 \rightleftharpoons N_2 + 3H_2$ c) $H_2 + I_2 \rightleftharpoons 2HI$ d) $2SO_2 + O_2 \rightleftharpoons 2SO_3$

274. In the hydrolysis of a salt of weak acid and weak base, the hydrolysis constant K_h is equal to
a) $\frac{K_w}{K_b}$ b) $\frac{K_w}{K_a}$ c) $\frac{K_w}{K_a . K_b}$ d) $K_a . K_b$

275. In which reaction ammonia acts as an acid?
a) $NH_3 + HCl \longrightarrow NH_4Cl$
b) $NH_3 + H^+ \longrightarrow NH_4^+$
c) $NH_3 + Na \longrightarrow NaNH_2 + \frac{1}{2}H_2$
d) NH_3 cannot act as an acid

276. The compounds A and B are mixed in equimolar proportion to form the products, $A + B \rightleftharpoons C + D$. At equilibrium, one third of A and B are consumed. The equilibrium constant for the reaction is
a) 0.5 b) 4.0 c) 2.5 d) 0.25

277. 40% of a mixture of 0.2 mole of N_2 and 0.6 mole of H_2 react to give NH_3 according to the equation, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at constant temperature and pressure. Then the ratio of the final volume to the initial volume of gases is :
a) 4 : 5 b) 5 : 4 c) 7 : 10 d) 8 : 5

278. An aqueous solution contains a substance which yields 4×10^{-3} mol litre^{-1} ion of H_3O^+. If $\log 2 = 0.3010$, the pH of the solution is:
a) 1.5 b) 2.398 c) 3.0 d) 3.4

279. For preparing a buffer solution of pH 6 by mixing sodium acetate and acetic acid, the ration of concentration of salt and acid ($K_a = 10^{-5}$) should be:
a) 1 : 10 b) 10 : 1 c) 100 : 1 d) 1 : 100

280. The concentration of hydrogen ion $[H^+]$ and pH in 10 M HCl is:
a) 10^1, zero b) $10^1, -1$ c) $10^2, 1$ d) $10^1, 1$

281. Solubility product of $Mg(OH)_2$ at ordinary temperature is 1.96×10^{-11}. pH of a saturated solution of $Mg(OH)_2$ will be

a) 10.53 b) 8.47 c) 6.94 d) 3.47

282. For the reaction $H_2 + I_2 \rightleftharpoons 2HI$:

a) $K_c = 2K_p$ b) $K_c > K_p$ c) $K_c = K_p$ d) $K_c < K_p$

283. When $CaCO_3$ is heated at a constant temperature in a closed container, the pressure due to CO_2 produced will:

a) Change with the amount of $CaCO_3$ taken

b) Change with the size of the container

c) Remain constant so long as temperature is constant

d) Remain constant even if temperature is changed

284. Four species are listed below

IV. HCO_3^-

V. H_3O^+

VI. HSO_4^-

VII. HSO_3F

Which one of the following is the correct sequence of their acid strength?

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

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

285. 1 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 observation is made?

[$K_{sp}Ag_2CrO_4$ 4 10^{12}]

[$K_{sp}AgCl$ 1 10^{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 precipitating simultaneously

286. Which is a basic salt?

a) PbS b) $PbCO_3$ c) $PbSO_4$ d) $2PbCO_3Pb(OH)_2$

287. A reversible reaction, $H_2 + Cl_2 \rightleftharpoons 2HCl$ is carried out in one litre flask. If the same reaction is carried out in two litre flask, the equilibrium constant will be:

a) Doubled b) Decreased c) Halved d) Same

288. In the system, $CaF_2(s) \rightleftharpoons Ca^{2+}(aq) + 2F^-(aq)$, increasing the concentration of Ca^{2+}ions 4 times will cause the equilibrium concentration of F^- ions to change to :

a) ¼ of the initial value

b) ½ of the initial value

c) 2 times of the initial value

d) None of the above

289. Hydrogen ion concentration in mol/L in a solution of pH = 5.4 will be

a) 3.98×10^8 b) 3.88×10^6 c) 3.68×10^{-6} d) 3.98×10^{-6}

290. The strongest conjugate base is

a) NO_3^- b) Cl^- c) SO_4^{2-} d) CH_3COO^-

291. In the reaction $I_2 + I^- = I_3^-$, the Lewis base is:

a) I_2 b) I^- c) I_3^- d) None of these

292. HI was heated in a sealed tube at 440°C till the equilibrium was reached, HI was found to be 22% decomposed. The equilibrium constant for dissociation is :

a) 0.282 b) 0.0796 c) 0.0199 d) 1.99

293. Which one is amphoteric oxide?

a) SO_2 b) B_2O_3 c) ZnO d) Na_2O

294. For which reaction K_p is less than K_c?

a) $N_2O_4 \rightleftharpoons 2NO_2$ b) $2HI \rightleftharpoons H_2 + I_2$ c) $2SO_2 + O_2 \rightleftharpoons 2SO_3$ d) $N_2 + O_2 \rightleftharpoons 2NO$

295. For the reactions, $H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(g)$ if the initial concentration of $[H_2] = [CO_2]$ and x mol/L of hydrogen is consumed at equilibrium, the correct expression of K_p is

a) $\frac{x^2}{(1-x)^2}$ b) $\frac{x^2}{(2+x)^2}$ c) $\frac{x^2}{1-x^3}$ d) $\frac{(1+x)^2}{(1-x)^2}$

296. In the given reaction,

$$2X(g) + Y(g) \rightleftharpoons 2Z(g) + 80 \text{ kcal},$$

Which combination of pressure and temperature will give the highest yield of Z at equilibrium?

a) 1000 atm and 200°C b) 500 atm and 500°C
c) 1000 atm and 100°C d) 500 atm and 100°C

297. Equimolar solutions of the following were prepared in water separately. Which one of the solutions will record the highest pH?

a) $BaCl_2$ b) $MgCl_2$ c) $CaCl_2$ d) $SrCl_2$

298. Which is not correct for Lewis acids?

a) They contain at least one vacant orbital
b) They have a tendency to accept electrons
c) The smaller ion has greater acidic strength
d) In case of ions, the strength of acid is inversely proportional to its charge

299. The vapour density of N_2O_4 at a certain temperature is 30. What is the percentage dissociation of N_2O_4 at this temperature?

a) 46.5% b) 36.2% c) 53.3% d) 64.2%

300. For which reaction $K_p \neq K_c$?

a) $2NO_2(g) \rightleftharpoons N_2(g) + O_2(g)$
b) $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$
c) $I_2(g) + H_2(g) \rightleftharpoons 2HI(g)$
d) $2C(s) + O_2(g) \rightarrow 2CO(g)$

301. A buffer mixture of acetic acid and potassium acetate has pH = 5.24. The ratio of $[CH_3COO^-]/[CH_3COOH]$ in this buffer is, ($pK_a = 4.74$):

a) 3 : 1 b) 1 : 3 c) 1 : 1 d) 1 : 2

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

a) 3.37 b) 4.37 c) 4.74 d) 0.474

303. If 1 M CH_3COONa is added to 1 M CH_3COOH:

a) pH of the solution increases
b) pH decreases
c) pH does not change
d) None of the above

304. 2.5 mL of $\frac{2}{5}$ M weak monoacidic base ($K_b = 1 \times 10^{-12}$ at 25°C) is titrated with $\frac{2}{15}$ M HCl in water at 25°C. The concentration of H^+ at equivalence point is ($K_w = 1 \times 10^{-14}$ at 25°C)

a) 3.7×10^{-13} M b) 3.2×10^{-7} M c) 3.2×10^{-2} M d) 2.7×10^{-2} M

305. Solubility product of a salt AB is 1×10^{-8} M^2 in a solution in which the concentration of A^+ ions is 10^{-3} M. The salt will precipitate when the concentration of B^- ions is kept

a) Between 10^{-8} to 10^{-7} M b) Between 10^{-7}M to 10^{-8} M
c) $> 10^{-5}$ M d) $< 10^{-8}$ M

306. For the gaseous reaction, $C_2H_4 + H_2 \rightleftharpoons C_2H_6, \Delta H = -130$ kJ mol^{-1} carried in a closed vessel, the equilibrium concentration of the C_2H_6 can definitely be increased by

a) Increasing temperature and decreasing pressure b) Decreasing temperature and increasing pressure

c) Increasing temperature and pressure both d) Decreasing temperature and pressure only

307. Chemical equilibrium is dynamic in nature because:
    a) The equilibrium is maintained rapidly
    b) The concentration of reactants and products become same at equilibrium
    c) The concentration of reactants and products decrease with time
    d) Both forward and backward reactions occur at all times with same speed

308. What happens to the yield on application of high pressure in the Haber's synthesis of ammonia?
    a) Increases b) Decreases c) Unaffected d) Reaction stops

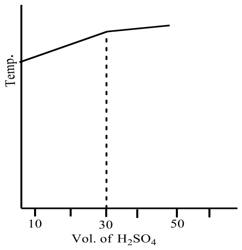
309. The buffering action of an acidic buffer is maximum when its pH is equal to
    a) 5 b) 7 c) 1 d) pK_a

310. HA is a weak acid. The pH of 0.1 M HA solution is 2. What is the degree of dissociation (α) of HA?
    a) 0.5 b) 0.2 c) 0.1 d) 0.301

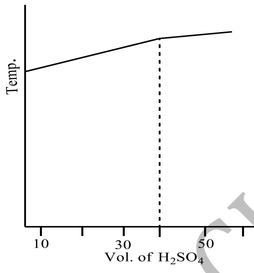
311. Which of the following is a wrong statement about equilibrium state?
    a) Rate of forward reaction= Rate of backward reaction
    b) Equilibrium is dynamic
    c) Catalysts increase value of equilibrium constant
    d) Free energy change is zero

312. In an experiment to determine the enthalpy of neutralization of sodium hydroxide with sulphuric acid, 50 cm^3 of 0.4 M sodium hydroxide were titrated thermometrically with 0.25 M sulphuric acid. Which of the following plots gives the correct representation?

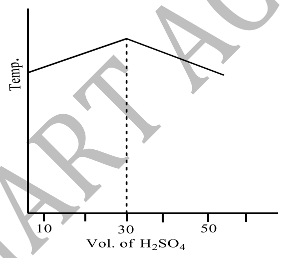
a)



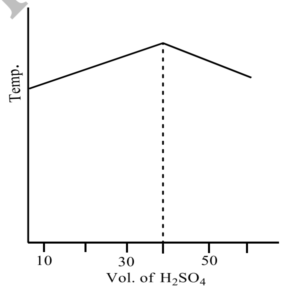
b)



c)



d)



313. H$^+$ ion produces common ion effect in the wet analysis of:
    a) Group I metals b) Group II metals c) Group III metals d) Group IV metals

314. 15 moles of H_2 and 5.2 moles of I_2 are mixed and allowed to attain equilibrium at 500°C. At equilibrium, the concentration of HI is found to be 10 moles. The equilibrium constant for the formation of HI is

a) 50 b) 15 c) 100 d) 25

315. $10^{-6}M$ HCl is diluted to 100 times. Its pH is:

a) 6.0 b) 8.0 c) 6.95 d) 9.5

316. For the reaction, $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$, the position of equilibrium can be shifted to the right by

a) Doubling the volume
b) Increasing the temperature
c) Addition of Cl_2 at constant volume
d) Addition of equimolar quantities ofPCl_3 and PCl_5

317. The pH of an aqueous solution containing $[H^+]$ concentration $=3.0 \times 10^{-3}$ M. The pH of the solution is

a) 2.523 b) 3.0 c) 2.471 d) None of these

318. The addition of which salt will decrease the H^+ concentration of HCN solution?

a) NH_4Cl b) $Al_2(SO_4)_3$ c) $AgNO_3$ d) NaCN

319. The pH of the solution obtained by mixing 10 mL of $10^{-1}N$ HCl and 10 mL of 10^{-1} N NaOH is:

a) 8 b) 2 c) 7 d) None of these

320. The solubility product of $PbCl_2$ is 2.3×10^{-32}. Its solubility will be

a) 1.78×10^{-11} g/L b) 2.95×10^{-9} g/L c) 3.42×10^{-9} g/L d) 4.95×10^{-9} g/L

321. A white salt is readily soluble in water and gives a colourless solution with a pH of about 9. The salt would be:

a) NH_4NO_3 b) CH_3COONa c) CH_3COONH_4 d) $CaCO_3$

322. The dissociation constant of NH_4OH is 1.8×10^{-5}. The hydrolysis constant of NH_4Cl would be:

a) 1.8×10^{-19} b) 1.8×10^{-5} c) 5.55×10^{-5} d) 5.55×10^{-10}

323. 50 mL of H_2O is added to 50 mL of 1×10^{-3} M barium hydroxide solution. What is the pH of the resulting solution?

a) 3.0 b) 3.3 c) 11.0 d) 11.7

324. The indicator used in titration of oxalic acid with caustic soda solution is

a) Methyl orange b) Methyl red c) Fluorescein d) Phenolphthalein

325. For $H_2 + I_2 \rightleftharpoons 2HI$, at equilibrium some I_2 is added. What happens to the equilibrium?

a) It is shifted to the right b) It gets shifted to the left c) It remains unchanged d) None of the above

326. Which of the following is a characteristic of a reversible reaction?

a) It can never proceed to completion
b) It can be influenced by a catalyst
c) Number of moles of reactants and products are equal
d) None of the above

327. An aqueous solution of hydrogen sulphide shows the equilibrium,

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

If dilute hydrochloric acid is added to an aqueous solution of hydrogen sulphide without any change in temperature, then:

a) The equilibrium constant will change
b) The concentration of HS^- will increase
c) The concentration of undissociated hydrogen sulphide will decrease
d) The concentration of HS^- will decreases

328. Le-Chatelier′s principle is not applicable to:

a) Homogeneous reactions
b) Heterogeneous reactions
c) Homogeneous or heterogeneous systems in equilibrium

d) Systems not in equilibrium

329. If pK_a values of four acids are given below at 25°C, the strongest acid is

a) 2.0 b) 2.5 c) 3.0 d) 4.0

330. Weakest base among the following is:

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

331. A solution of pH 9.0 is one thousand times as basic as a solution of pH:

a) 6 b) 7 c) 4 d) 10

332. Aprotic solvent is:

a) CCl_4 b) C_6H_6 c) SO_2 d) All of these

333. The hydroxide with highest solubility product is:

a) $Al(OH)_3$ b) $Co(OH)_2$ c) $Cr(OH)_3$ d) $Fe(OH)_3$

334. In the absence of formation of complex ions by the addition of a common ion, the solubility of a given salt is:

a) Increased

b) Decreased

c) Unaffected

d) First increased and then decreased

335. The pH of 0.1 M NaHS is, K_{a_1} and K_{a_2} for H_2S are 1.3×10^{-7} and 7.1×10^{-15} respectively:

a) 10.52 b) 9.52 c) 12.52 d) 13.52

336. $A + B \rightleftharpoons C + D$

Initially moles of A and B are equal. At equilibrium, moles of C are three times that of A. the equilibrium constant of the reaction will be

a) 1 b) 3 c) 4 d) 9

337. The strongest acid among the following is:

a) $ClO_3(OH)$

b) $ClO_2(OH)$

c) $SO(OH_2)$

d) $SO_2(OH)_2$

338. The equilibrium constant in a reversible reaction at a given temperature

a) Does not depend on the initial concentrations

b) Depends on the initial concentrations of the reactants

c) Depends on the concentration of the products at equilibrium

d) It is not characteristic of the reaction

339. For the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ at 720 K, the value of equilibrium constant is 50, when equilibrium concentration of both H_2 and I_2 is 0.5 M. K_p under the same conditions will be :

a) 0.02 b) 0.2 c) 50 d) 50 RT

340. If 340 g of a mixture of N_2 and H_2 in the correct ratio gave a 20% yield of NH_3. The mass produced would be :

a) 16 g b) 17 g c) 20 g d) 68 g

341. The conjugate acid of CO_3^{2-} is:

a) H_2O b) H_2CO_3 c) OH^- d) HCO_3^-

342. Calculate the partial pressure of carbon monoxide from the following datas

$$CaCO_3C \xrightarrow{\Delta} CaO(g) + CO_2 \uparrow K_p = 8 \times 10^{-2}$$

$$O_2(g) + C(s) \rightarrow 2CO(g), \quad K_p = 2$$

a) 0.2 b) 0.4 c) 1.6 d) 4

343. In aqueous solution, the ionisation constants for carbonic acid are,

$$K_1 = 4.2 \times 10^{-7} \quad \text{and} \quad K_2 = 4.8 \times 10^{-11}$$

Select the correct statement for a saturated 0.034 M solution of the carbonic acid.

a) The concentration of CO_3^{2-} is 0.034 M
b) The concentration of CO_3^{2-} is greater than that of HCO_3^-
c) The concentration of H^+ and HCO_3^- are approximately equal
d) The concentration of H^+ is double that of CO_3^{2-}

344. 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 the ratio of the concentration of the conjugate acid (HIn) and base (In^-) forms of the indicator given by the expression
a) $\log\frac{[In^-]}{[HIn]} = pK_{In} - pH$
b) $\log\frac{[HIn]}{[In^-]} = pK_{In} - pH$
c) $\log\frac{[HIn]}{[In^-]} = PH - pK_{In}$
d) $\log\frac{[In^-]}{[HIn]} = pH - pK_{In}$

345. The number of mole of hydroxide $[OH^-]$ ion in 0.3 litre of 0.005 M solution of $Ba(OH)_2$ is:
a) 0.0075
b) 0.0015
c) 0.0030
d) 0.0050

346. 4.5 moles each of hydrogen and iodine heated in a sealed 10 L vessel. At equilibrium 3 moles of HI were found. The equilibrium constant for $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is
a) 1
b) 5
c) 10
d) 0.5

347. The degree of hydrolysis in hydrolytic equilibrium $A^- + H_2O \rightleftharpoons HA + OH^-$ at salt concentration of 0.001 M is $(K_a = 1 \times 10^{-5})$
a) 1×10^{-3}
b) 1×10^{-4}
c) 5×10^{-4}
d) 1×10^{-6}

348. For a hypothetical equilibrium:
$4A + 5B \rightleftharpoons 4x + 6y$; the equilibrium constant K_c has the unit:
a) $mol^2 litre^{-2}$
b) litre mol^{-1}
c) $litre^2 mol^{-2}$
d) mol $litre^{-1}$

349. Salting out action of soap is based on:
a) Complex ion formation
b) Common ion effect
c) Solubility product
d) Acid-base neutralization

350. The equilibrium constant for the reaction,
$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$ is 5×10^{-2} atm. The equilibrium constant of the reaction $2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$ would be
a) 100 atm
b) 200 atm
c) 4×10^2 atm
d) 6.25×10^4 atm

351. Which can be explained as applications of Le-Chatelier′s principle?
a) Transport of oxygen by haemoglobin in blood
b) Removal of CO_2 from tissues by blood
c) Tooth decay due to use of sweet substances
d) All of the above

352. Which equilibrium in gaseous phase would be unaffected by an increase in pressure?
a) $N_2O_4 \rightleftharpoons 2NO_2$
b) $N_2 + O_2 \rightleftharpoons 2NO$
c) $N_2 + 3H_2 \rightleftharpoons 2NH_3$
d) $CO + \frac{1}{2} O_2 \rightleftharpoons CO_2$

353. The aqueous solution of $AlCl_3$ is acidic due to the hydrolysis of
a) Aluminum ion
b) Chloride ion
c) Both aluminium and chloride ion
d) None of the above

354. The percentage error in $[H^+]$ made by neglecting the ionisation of water in $1.0 \times 10^{-6} M$ NaOH is:
a) 1%
b) 2%
c) 3%
d) 4%

355. The colour of $CuCr_2O_7$ solution in water is green because:
a) Cu^{2+} ions is green
b) $Cr_2O_7^{2-}$ ion is green
c) Both the ions are green
d) Cu^{2+} ion is blue and $Cr_2O_7^{2-}$ ion is yellow

356. Ammonium carbonate decomposes as

$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$

For the reaction, $K_p = 2.9 \times 10^{-5}$ atm^{-3}. If we start with 1 mole of the compound, the total pressure at equilibrium would be

a) 0.0766 atm b) 0.0582 atm c) 0.388 atm d) 0.0194 atm

357. Ionic product of water increases if

a) Pressure is reduced b) H^+ is added
c) OH^- is added d) Temperature increase

358. In which of the following reactions, increases in the volume at constant temperature do not affect the number of moles at equilibrium?

a) $2NH_3 \rightleftharpoons N_2 + 3H_2$ b) $C(s) + \frac{1}{2}O_2(g) \rightarrow CO(g)$
c) $H_2(g) + O_2(g) \rightarrow H_2O_2(g)$ d) None of the above

359. Which one of the following is least likely to act as a Lewis base?

a) I^+ b) I c) SCl_2 d) PCl_3

360. An aqueous solution of ammonium acetate is:

a) Faintly acidic b) Fair acidic c) Faintly alkaline d) Almost neutral

361. The strongest Lewis base in the following is

a) CH_3^- b) F^- c) NH_2^- d) OH^-

362. For anionic hydrolysis, pH is given by

a) $pH = \frac{1}{2}pK_w - \frac{1}{2}pK_b - \frac{1}{2}\log C$ b) $pH = \frac{1}{2}pK_w + \frac{1}{2}pK_a - \frac{1}{2}pK_b$
c) $pH = \frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}\log C$ d) $pH = -\frac{1}{2}(pK_w - pK_a - pK_b)$

363. Which of the following is a conjugated acid-base pair?

a) HCl, NaOH b) NH_4Cl, NH_4OH c) H_2SO_4, HSO_4^- d) KCN, HCN

364. In the hydrolytic 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}

365. The equilibrium constant (K_c) for the reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ at room temperature T is 4×10^{-4}. The value of K_c for $NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$ at the same T is :

a) 0.02 b) 50 c) 4×10^{-4} d) 2.5×10^{-2}

366. For the reaction,

$CuSO_4 \cdot 5H_2O(s) \rightleftharpoons CuSO_4 \cdot 3H_2O(s) + 2H_2O(v)$ which one is correct representation?

a) $K_p = (P_{H_2O})^2$ b) $K_c = [H_2O]^2$ c) $K_p = K_c(RT)^2$ d) All of these

367. 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

368. K_C for $A + B \rightleftharpoons C + D$ is 10 at 25°C. If a container contains 1, 2, 3 and 4 mole per litre of A, B, C *and* D respectively at 25°C, the reaction shall:

a) Proceed from left to right
b) Proceed from right to left
c) Be at equilibrium
d) None of the above

369. The compound whose 0.1 M solution is basic is

a) Ammonium acetate b) Ammonium chloride
c) Ammonium sulphate d) Sodium acetate

370. Isoelectric point is defined as the pH at which:
a) An amino acid becomes acidic
b) An amino acid becomes basic
c) Zwitter ion has positive charge
d) Zwitter ion has zero charge

371. The equilibrium constant of a reaction is 300. If the volume of reaction flask is tripled, the equilibrium constant is
a) 300 b) 600 c) 900 d) 100

372. The oxoacid of SO_2 is:
a) H_2SO_3 b) H_2SO_4 c) $H_2S_2O_8$ d) None of these

373. The solubility of CaF_2 in pure water is 2.3×10^{-6} mol dm^{-3}. Its solubility product will be
a) 4.8×10^{-18} b) 48.66×10^{-18} c) 4.9×10^{-11} d) 48.66×10^{-15}

374. pH value of which one of the following is not equal to one?
a) 0.1 M HNO_3
b) 0.05 M H_2SO_4
c) 0.1 M CH_3COOH
d) 50 cm^3 of 0.4 M HCl + 50 cm^3 of 0.2 M NaOH

375. 50 mL of 2 N acetic mixed with 10 mL of 1N sodium acetate solution will have an approximate pH of ($K_a = 10^{-5}$):
a) 4 b) 5 c) 6 d) 7

376. The solubility of AgCl in 0.2 M NaCl is
(K_{sp} of AgCl $= 1.8 \times 10^{-10}$)
a) 1.8×10^{-11} M b) 9×10^{-10} M c) 6.5×10^{-12} M d) 5.6×10^{-11} M

377. The dissociation of water at 25°C is 1.9×10^{-7} percent and the density of water is 1.0 g/cm^3. The ionisation constant of water is:
a) 3.42×10^{-6} b) 3.42×10^{-8} c) 1.00×10^{-14} d) 2.00×10^{-16}

378. $N_2 + 3H_2 \rightleftharpoons 2NH_3 +$ heat. What is the effect of the increase of temperature on the equilibrium of the reaction?
a) Equilibrium is shifted to the left
b) Equilibrium is shifted to the right
c) Equilibrium is unaltered
d) Reaction rate does not change

379. The expression for the solubility product of Ag_2CO_3 will be
a) $K_{sp}\quad s^2$ b) $K_{sp}\quad 4s^3$ c) $K_{sp}\quad 27s^4$ d) $K_{sp}\quad s$

380. The solubility of AgCl in 0.2 M NaCl solution is
[K_{sp} of AgCl $\quad 1.2 \quad 10^{10}$]
a) $6.0 \quad 10^{10}$ M b) 0.2 M c) $1.2 \quad 10^{10}$ M d) $0.2 \quad 10^{10}$ M

381. Which of the following will not function as a buffer solution?
(i) NaCl and NaOH
(ii) NaOH and NH_4OH
(iii) CH_3COONH_4 and HCl
(iv) Borax and boric acid
a) (i), (ii), (iii) b) (ii), (iii), (iv) c) (i), (iii), (iv) d) (i), (ii), (iii), (iv)

382. K_{SP} of salts AB, AB_2 and A_3B are 4.0×10^{-8}, 3.2×10^{-14} and 2.7×10^{-15} respectively at temperature T. The solubility order of these salts in water at temperature T (in mol $litre^{-1}$) is:
a) $AB > AB_2 > A_3B$ b) $A_3B > AB_2 > AB$ c) $AB_2 > A_3B > AB$ d) $AB > A_3B > AB_2$

383. Which does not act as Bronsted acid?
a) NH_4^+ b) CH_3COO^- c) HCO_3^- d) HSO_3^-

384. Which of the following solutions will have pH=9 at 298 K?
a) 1×10^{-9} M HCl solution
b) 1×10^{-5} M NaOH solution
c) 1×10^{-9} M KOH solution
d) Both (a) and (b)

385. Acidosis is diagnosed when blood pH:

a) Falls below 7.35 b) Rises above 7.45 c) Both (a) and (b) d) None of these

386. Which statement is false? (Assume complete dissociation in each case)
a) If 2.0 L of a solution of H_2SO_4 contains 0.1 mole, then pH of the solution is 2
b) The concentration of OH^- in 0.005 M HNO_3 is 2.0×10^{-12} mol/L
c) The pH of 0.01 M KOH is 12
d) In a 0.001 M solution of NaOH the concentration of $H^+$is 10^{-3} mol/L

387. 10 mL of a solution contains 0.1 M $NH_4Cl + 0.01$ M NH_4OH. Which addition would not change the pH of the solution?
a) Adding 1 mL water
b) Adding 5 mL of 0.1 M NH_4Cl
c) Adding 5 mL of 0.1 M NH_4OH
d) Adding10 mL of 0.1 M NH_4Cl

388. Arrhenius theory of acid-base is not valid for:
a) Aqueous solution
b) In presence of water
c) Non-aqueous solution
d) None of these

389. The solubility in water of a sparingly soluble salt AB_2 is 1×10^{-5} mol L^{-1}. Its solubility product number will be
a) 4×10^{-15} b) 4×10^{-10} c) 1×10^{-15} d) 1×10^{-10}

390. The equilibrium constant (K_p) for the reaction, $PCl_5(g) \rightarrow PCl_3(g) + Cl_2(g)$ is 16. If the volume of the container is reduced to one half its original volume, the value of K_p for the reaction at the same temperature will be
a) 8 b) 16 c) 32 d) 64

391. The indicators used in the titration of iodine against sodium thiosulphate is
a) Starch b) $K_3Fe(CN)_6$ c) K_2CrO_4 d) Potassium

392. For the reaction,
$2HI(g) \rightleftharpoons H_2(g) + I_2(g) - Q$ kJ , the equilibrium constant depends upon
a) Temperature b) Pressure c) Catalyst d) Volume

393. In the dissociation of $2HI \rightleftharpoons H_2 + I_2$, the degree of dissociation will be influenced by the:
a) Addition of inert gas at constant volume
b) Addition of inert gas at constant pressure
c) Increase of temperature
d) Increase of pressure

394. If pressure increases then its effect on given equilibrium
$2NO(g) \rightleftharpoons N_2(g) + O_2(g)$ is shift in
a) Forward direction b) Backward direction
c) No effect d) None of these

395. Which one of the molecular hydride acts as Lewis acid?
a) NH_3 b) H_2O c) B_2H_6 d) CH_4

396. For the reversible reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$at 500°C, the value of K_p is 1.44×10^{-5} when partial pressure is measured in atmospheres. The corresponding value of K_c with concentration in mol L^{-1}, is
a) $\frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$ b) $\frac{1.44 \times 10^{-5}}{(0.082 \times 773)^{2}}$ c) $\frac{1.44 \times 10^{-5}}{(8.314 \times 773)^{-2}}$ d) $\frac{1.44 \times 10^{-5}}{(0.082 \times 500)^{-2}}$

397. The compound that does not act as Lewis acid, is:
a) $AlCl_3$ b) BF_3 c) NH_3 d) $FeCl_3$

398. For the following reaction in gaseous phase

$CO(g) + \frac{1}{2}O_2(g) \longrightarrow CO_2(g)$ K_p/K_c is

a) $(RT)^{1/2}$ b) $(RT)^{-1/2}$ c) (RT) d) $(RT)^{-1}$

399. For the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the equilibrium constants expressed in terms of concentrations K_c and in terms of partial pressure K_p, are related as

a) $K_p = K_c(RT)^2$ b) $K_p = K_c(RT)^{-2}$ c) $K_p = K_c$ d) $K_c = K_p(RT)$

400. In the titration of Na_2CO_3 and HCl, the indicator used is

a) Methyl orange b) Methylene blue c) Phenolphthalein d) Litmus

401. $HSO_4^- + OH^- \rightarrow SO_4^{2-} + H_2O$

Which is correct about conjugate acid base pair?

a) HSO_4^- is conjugate acid of base SO_4^{2-} b) HSO_4^- is conjugate base of base SO_4^{2-}

c) SO_4^{2-} is conjugate acid of acid HSO_4^- d) None of the above

402. In the reaction, $A_2(g) + 4B_2(g) \rightleftharpoons 2AB_4(g), \Delta H < 0$, the formation of AB_4 will be favoured at

a) Low temperature, high pressure b) High temperature, low pressure

c) Low temperature, low pressure d) High temperature, high pressure

403. On applying pressure to the equilibrium,

ice $\rightleftharpoons$ water

Which phenomenon will happen?

a) More ice will be formed

b) More water will be formed

c) Equilibrium will not be disturbed

d) Water will evaporate

404. A saturated solution of Ag_2SO_4 is 2.5×10^{-2} M. The value of its solubility product is

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

405. Aqueous solutions of two acids having same concentrations of common ion (H^+) are called:

a) Isohydric solutions b) Isotonic solutions c) Isomeric solutions d) Hypotonic solutions

406. The hydrolysis constant of a salt of weak acid and weak base is inversely proportional to

a) Ionic product of water

b) Dissociation constant of both weak acid and weak base

c) Dissociation constant of weak acid

d) Dissociation constant of weak base

407. If in the reaction $N_2O_4 \rightleftharpoons 2NO_2$, x is that part of N_2O_4 which dissociates, then the number of molecules at equilibrium will be

a) 1 b) 3 c) $1 + x$ d) $(1 + x)^2$

408. 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 ionised is

a) 4.5 b) 2.5 c) 9.5 d) 7.0

409. Number of H^+ ions present in 10 mL of a solution of pH = 3 is:

a) 10^{13} b) 6.02×10^{18} c) 6.02×10^{13} d) 6.02×10^{10}

410. The pH of gastric juice is normally:

a) Greater than 1.5 and less than 1.2

b) Less than 1.5

c) Greater than 1 and less than 3

d) Less than 1 and greater than zero

411. With reference to protonic acids, the correct statement is:

a) PH_3 is more basic than NH_3

b) PH_3 is less basic than NH_3

c) PH_3 is amphoteric while NH_3 is basic

d) None of the above

412. In a 500 mL flask, the degree of dissociation of PCl_5 at equilibrium is 40% and the initial amount is 5 moles. The value of equilibrium constant in mol L^{-1} for the decomposition of PCl_5 is

a) 2.33 b) 2.66 c) 5.32 d) 4.66

413. The unit of ionic product of water (K_w) is:

a) $mol^{-1}litre^{-1}$ b) $mol^{-1}litre^{-2}$ c) $mol^{-2}litre^{-1}$ d) $mol^{2}litre^{-2}$

414. In a reversible reaction two substance are in equilibrium. If the concentration each one is doubled, the equilibrium constant will be

a) Reduced to one fourth of its original value b) Reduced to half of its original value
c) Constant d) Doubled

415. Le-Chatelier principle is applicable only to a

a) System in equilibrium b) System not in equilibrium
c) Homogeneous reaction d) Heterogeneous reaction

416. The dissociation constant of a substituted benzoic acid at 25°C is 1.0×10^{-4}. The pH of 0.01 M solution of its sodium salt is

a) 3 b) 7 c) 8 d) 6

417. A mixture of sodium oxide and calcium oxide are dissolved in water and saturated with excess carbon dioxide gas. The resulting solution is ….. .It contains

a) Basic; NaOH and $Ca(OH)_2$ b) Neutral; Na_2CO_3 and $CaCO_3$
c) Basic; Na_2CO_3 and $CaCO_3$ d) Acidic; NaOH and $CaCO_3$

418. Conjugate acid of HF_2^- is

a) H^+ b) HF c) F_2^- d) H_2F_2

419. Consider the reaction, $CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$. One mole each of CH_3COOH and C_2H_5OH are heated in the presence of little concentrated H_2SO_4. On equilibrium:

a) 1 mole of ethyl acetate is formed
b) 2 mole of ethyl acetate are formed
c) 1/2 mole of ethyl acetate is formed
d) 2/3 mole of ethyl acetate is formed

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

a) 10^{-6} b) 10^{-7} c) 10^{-8} d) 10^{-9}

421. The pH of a 0.001 M NaOH will be

a) 3 b) 2 c) 11 d) 12

422. In lime kiln, the reversible reaction. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ proceeds to completion because :

a) Of high temperature
b) CO_2 escapes out
c) CaO is removed
d) Of low temperature

423. Solid $Ba(NO_3)_2$ is gradually dissolved in a 1.0×10^{-4} M Na_2CO_3 solution. At what concentration of Ba^{2+} will a precipitate begin to form?
(K_{sp} for $BaCO_3 = 5.1 \times 10^{-9}$)

a) 4.1×10^{-5} M b) 5.1×10^{-5} M c) 8.1×10^{-8} M d) 8.1×10^{-7} M

424. The solubility of AgCl is 0.0015 g/litre. The solubility product of AgCl will be:

a) 2×10^{-10} b) 1.1×10^{-10} c) 3.1×10^{-10} d) 4.1×10^{-10}

425. Although CO is neutral but it shows acidic nature on reaction with high P and T:

a) $Ca(OH)_2$ b) NaOH c) $Mg(OH)_2$ d) LiOH

426. The acidic character order for given oxy-acids of halogens is:

a) HOCl > HOBr > HOI b) HOI > HOBr > HOCl c) HOBr > HOCl > HOI d) HOI > HOCl > HOBr

427. The stronger Bronsted base is:

a) ClO^- b) ClO_2^- c) ClO_3^- d) ClO_4^-

428. The indicator used in the titration of sodium carbonate with sulphuric acid is
a) Potassium ferrocyanide
b) Potassium ferricyanide
c) Methyl orange
d) Phenolphthalein

429. A cylinder fitted with a movable piston contains liquid water in equilibrium with water vapour at 25^0C. Which operation result in a decrease in the equilibrium vapour pressure?
a) Moving the piston downward a short distance
b) Removing a small amount of vapour
c) Removing a small amount of the liquid water
d) Dissolving salt in the water

430. If acetic acid is mixed with sodium acetate then H^+ ion concentration will
a) Increase b) Decrease c) Remain unchanged d) pH decrease

431. The reverse process of neutralization is:
a) Hydrolysis b) Decomposition c) Dehydration d) Synthesis

432. The hydrogen ion concentration of a $10^{-8}\ M$ HCl aqueous solution at 298 K ($K_w = 10^{-14}$) is:
a) $9.525 \times 10^{-8}\ M$
b) $1.0 \times 10^{-8}\ M$
c) $1.0 \times 10^{-6}\ M$
d) $1.0525 \times 10^{-7}\ M$

433. The number of ions formed when cuprammonium sulphate dissolves in water is:
a) One b) Two c) Four d) Zero

434. A reversible chemical reaction have two reactants in equilibrium. If the concentrations of the reactants are doubled then the equilibrium constant will
a) Be halved b) Also be doubled c) Remains the same d) None of these

435. According to Arrhenius concept, base is a substance that:
a) Gives a pair of protons
b) Donates a proton
c) Accepts an electron pair
d) Gives OH^- ions in aqueous solution

436. What is the effect of increasing pressure on the dissociation of PCl_5 according to the equation?

$$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$$

a) Dissociation decreases b) Dissociation increases
c) Dissociation does not change d) None of the above

437. Which is Lewis acid?
a) BF_3 b) NF_3 c) Cl^- d) H_2O

438. Which one of the following substances has the highest proton affinity?
a) H_2O b) H_2S c) NH_3 d) CH_3COOH

439. The solubility product of a salt AB_2 is 4×10^{-9} at 373 K. The solubility of AB_2 in boiling water will be:
a) $4 \times 10^{-3} M$ b) $4 \times 10^{-4} M$ c) $1 \times 10^{-10} M$ d) $1 \times 10^{-3} M$

440. Which pair will show common ion effect?
a) $BaCl_2 + Ba(NO_3)_2$ b) $NaCl + HCl$ c) $NH_4OH + NH_4Cl$ d) $AgCN + KCN$

441. In the case of gaseous homogeneous reaction, the concentrations of the reactants may be given by:
a) $\frac{PV}{RT}$ b) $\frac{P}{RT}$ c) $\frac{n}{V}RT$ d) $\frac{RT}{P}$

442. 0.5 M ammonium benzoate is hydrolysed to 0.25 percent. Hence, its hydrolysis constant is
a) 2.5×10^{-5} b) 1.25×10^{-5} c) 3.125×10^{-6} d) 6.25×10^{-6}

443. The K_{sp} of $PbCO_3$ and $MgCO_3$ are 1.5×10^{-15} and 1×10^{-15} respectively at 298 K. The concentration of Pb^{2+} ions in a saturated solution containing $MgCO_3$ and $PbCO_3$ is:

a) $1.5 \times 10^{-4}\ M$ b) $3 \times 10^{-8}\ M$ c) $2 \times 10^{-8}\ M$ d) $2.5 \times 10^{-8}\ M$

444. The $[H^+]$ ion concentration in 0.001 M acetic acid is 1.34×10^{-4}g ion/litre. The $[H^+]$ ion concentration of 0.164g of CH_3COONa is added to a litre of 0.001 M CH_3COOH will be:

a) 9×10^{-6} b) 18×10^{-6} c) 4.5×10^{-6} d) 5×10^{-6}

445. pH scale was introduced by

a) Arrhenius b) Sorensen c) Lewis d) Lowry

446. 28 g N_2 and 6 g H_2 were mixed. At equilibrium 17g NH_3 was formed. The weight of N_2 and H_2 of equilibrium are respectively :

a) 11 g, zero b) 1 g, 3 g c) 14 g, 3 g d) 11 g, 3 g

447. An equilibrium mixture of the reaction, $2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$ has 0.5 mole H_2S, 0.10 mole H_2 and 0.4 mole S_2 in 1 L vessel. The value of equilibrium constant (K) in mol L^{-1}, is

a) 0.004 b) 0.008 c) 0.016 d) 0.032

448. 1 mole of $N_2O_4(g)$ at 300 K is kept in a closed container under 1 atm. It is heated to 600 K when 20% by mass of $N_2O_4(g)$ decomposes to $NO_2(g)$. The resultant pressure is

a) 1.2 atm b) 2.4 atm c) 2.0 atm d) 1.0 atm

449. Equivalent amounts of H_2 and I_2 are heated in a closed vessel till equilibrium is obtained. If 80% of the hydrogen can be converted to H, the K_c at this temperature is

a) 64 b) 16 c) 0.25 d) 4

450. 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?

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

451. The vapour density of undecomposed N_2O_4 is 46. When heated, vapour density decreases to 24.5 due to its dissociation to NO_2. The per cent dissociation of N_2O_4 at the final temperature is :

a) 87 b) 60 c) 40 d) 70

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

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

453. For the reaction
$CO(g) + 0.5O_2(g) \rightarrow CO_2(g)$ K_p/K_c is equal to

a) $\sqrt{RT}$ b) $\frac{1}{\sqrt{RT}}$ c) 1 d) RT^2

454. Central metal ion in a complex or a cation acts as:

a) Lewis base b) Lewis acid c) Bronsted acid d) Arrhenius acid

455. The degree of dissociation of CH_3COOH is influenced by:

a) HCl b) CH_3COONa c) NH_4OH d) Either of these

456. Solubility of $Ca(OH)_2$ is a s mol L^{-1}. The solubility product (K_{sp}) under the same condition is

a) $4s^3$ b) $3s^4$ c) $4s^2$ d) s^3

457. Which one of the following substances has the highest proton affinity?

a) H_2O b) H_2S c) NH_3 d) PH_3

458. Which of the following is not a conjugate acid base pair?

a) HPO_3^{2-}, PO_3^{3-} b) $H_2PO_4^-, HPO_4^{2-}$ c) $H_3PO_4, H_2PO_4^-$ d) $H_2PO_4^-, PO_3^{3-}$

459. In an equilibrium reaction, if $\Delta G° = 0$ the equilibrium constant, K should be equal to:

a) 0 b) 1 c) 2 d) 10

460. The gastric juice in our stomach contains enough hydrochloride acid to make the hydrogen ion concentration about 0.01 mol/litre. The pH of the gastric juice is:

a) 0.01 b) 1 c) 2 d) 14

461. At 550 K, the K_c for the following reaction is 10^4 $mol^{-1}L$

$$X(g) + Y(g) \rightleftharpoons Z(g)$$

At equilibrium, it was observed that

$$[X] = \frac{1}{2}[Y] = \frac{1}{2}[Z]$$

What is the value of $[Z]$(in mol L^{-1}) at equilibrium?

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

462. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K_p is

a) 1.8 atm b) 3 atm c) 0.3 atm d) 0.18 atm

463. Ammonium carbonate decomposes as

$$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$$

For the reaction, $K_p = 2.9 \times 10^{-5}$ atm^3. If we start with 1 mole of the compound, the total pressure at equilibrium would be

a) 0.766 atm b) 0.0582 atm c) 0.0388 atm d) 0.0194 atm

464. The pK_a of a weak acid, HA, is 4.80. The pK_b of a weak base, BOH is 4.78. The pH of an aqueous solution of the corresponding salt, BA, will be

a) 9.58 b) 4.79 c) 7.01 d) 9.22

465. The species among the following , which can act as an acid and a base is

a) HSO_4^- b) SO_4^{2-} c) H_3O^+ d) Cl^-

466. A monoprotic weak acid (HA) is ionised 5% in 0.1 M aqueous solution. What is the equilibrium constant for its ionisation?

$$HA(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + A^-(aq)$$

a) 2.63×10^{4} b) 2.63×10^{3} c) 2.63×10^{-4} d) 2.63×10^{-3}

467. Strongest acid is

a) C_2H_6 b) CH_3OH c) $HC \equiv HC$ d) C_6H_6

468. Which of the following will have maximum pH?

a) $\frac{M}{10}$ HCl b) $\frac{M}{100}$ HCl c) $\frac{M}{10}$ NaOH d) $\frac{M}{100}$ NaOH

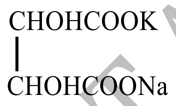
469. The pH of 1.0 M aqueous solution of a weak acid HA is 6.0. Its dissociation constant is:

a) 10^{-6} b) 10^{-12} c) 1.0 d) 6.0

470. In which of the following, the reaction proceeds towards completion?

a) $K = 1$ b) $K = 10$ c) $K = 10^2$ d) $K = 10^3$

471. The mixed salt among the following is:

a) 
$\begin{array}{l} CHOHCOOK \\ | \\ CHOHCOONa \end{array}$
b) $NaKSO_4$ c) $CaOCl_2$ d) All of these

472. What volume of M/10 NaOH added in 50 mL, M/10 acetic acid solution to get a buffer solution having highest buffer capacity?

a) 50 mL b) 25 mL c) 10 mL d) 40 mL

473. The pH value of an acid is 5 and its concentration is 1 M. What is the value of K_a for the acid?

a) 10^{-7} b) 10^{-5} c) 10^{-10} d) 10^{-8}

474. The pH of a neutral water sample is 6.5. Then the temperature of water

a) is 25°C b) is more than 25°C

c) is less than 25°C d) can be more or less than 25°C

475. The formation of phosgene is represented as, $CO + Cl_2 \rightleftharpoons COCl_2$. The reaction is carried out in 500 mL flask. At equilibrium 0.3 mole of phosgene, 0.1 mole of CO and 0.1 mole of Cl_2 are present. The equilibrium constant of the reaction is:

a) 30 b) 15 c) 5 d) 3

476. In qualitative analysis, in order to detect second group basic redical, H_2S gas is passed in the

presence of dilute HCl to

a) Increase the dissociation of H_2S
b) Decrease the dissociation of salt solution
c) Decrease the dissociation of H_2S
d) Increase the dissociation of salt solution

477. For two acids $A$and $pK_a = 1.2$, and 2.8 respectively in value then which is true?

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

478. The weakest base among the following is:

a) H^-
b) CH_3^-
c) CH_3O^-
d) Cl^-

479. The hydrogen ion concentration in mol/litre of a solution of $pH = 0$ is:

a) Zero
b) 10^{-7}
c) 1 M
d) None of these

480. For which reaction is $K_p = K_c$?

a) $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$
b) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
c) $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$
d) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

481. For the reaction,

$H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(g)$, if the initial concentration of $[H_2] = [CO_2]$and x mol/L of hydrogen is consumed at equilibrium, the correct expression of K_p is

a) $\frac{x^2}{(1-x)^2}$
b) $\frac{(1+x)^2}{(1-x)^2}$
c) $\frac{x^2}{(2+x)^2}$
d) $\frac{x^2}{1-x^2}$

482. $K_{sp} = [A]^3[B]^2$ for the salt where A and B are the cation and anion as the case may be stand true for:

a) $Ca_3(PO_4)_2$
b) As_2S_3
c) Bi_2S_3
d) All are correct

483. The dissociation constant for acetic acid and HCN at 25°C are 1.5×10^{-3} and 4.5×10^{-10} respectively. the equilibrium constant for the equilibrium,

$CN^- + CH_3COOH \rightleftharpoons HCN + CH_3COO^-$ would be:

a) 3.0×10^4
b) 3.0×10^5
c) 3.0×10^{-5}
d) 3.0×10^{-4}

484. The pH of the solution

5 mL $\frac{M}{5}$ HCl + 10 mL of $\frac{M}{10}$ NaOH is

a) 5
b) 3
c) 7
d) 8

485. In the reaction, $AlCl_3 + Cl^- \longrightarrow [AlCl_4]^-$, $AlCl_3$ acts as:

a) Salt
b) Lewis base
c) Lewis acid
d) Bronsted acid

486. A weak acid HX has dissociation constant 10^{-5}. The pH of 0.1 M solution of this acid will be

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

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

a) 9.30
b) 7.30
c) 10.30
d) 8.30

488. 30 cc of $\frac{M}{3}$ HCl, 20 cc of $\frac{M}{2}$ HNO_3 and 40 cc of $\frac{M}{4}$ NaOH solutions are mixed and the volume was made up to 1 dm^3. The pH of the resulting solution is

a) 8
b) 2
c) 1
d) 3

489. A solution contains 10 mL 0.1 N NaOH and 10 mL 0.05 N NH_2SO_4, pH of this solution is

a) Less than 7
b) 7
c) Zero
d) Greater than 7

490. A reversible chemical reaction is having two reactants, in equilibrium. If the concentration of the reactants are doubled then the equilibrium constant will

a) Bo doubled
b) Become one fourth
c) Be halved
d) Remain the same

491. Conjugate bade of $H_2PO_4^-$ is

a) H_3PO_4
b) P_2O_5
c) PO_4^{3-}
d) HPO_4^{2-}

492. The equilibrium constant for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ is K then the equilibrium constant for the equilibrium,

$NH_3 \rightleftharpoons \frac{1}{2}N_2 + \frac{3}{2}H_2$ is

a) $\frac{1}{K}$ b) $\sqrt{K}$ c) $\frac{1}{K^2}$ d) $\frac{1}{\sqrt{K}}$

493. An acid type indicator HIn differs in colour from its conjugate base (In^-). The human eye is sensitive to colour differences only when the ratio $[In^-]/[HIn]$ is greater than 10 or smaller than 0.1. What should be the minimum change in the pH of the solution to observe a complete colour change ($K_a = 1.0 \times 10^{-5}$)?

a) 4 b) 2 c) 6 d) 1

494. Which is an example of Lewis acid?

a) HCl b) H_2SO_4 c) SO_2 d) HNO_3

495. A student wants to prepare a saturated solution of Ag^+ ion. He has got three samples AgCl$(K_{sp} = 10^{-10})$, AgBr$(K_{sp} = 10^{-13})$ and $Ag_2CrO_4(K_{sp} = 10^{-12})$. Which of the above compound will be used by him using minimum weight to prepare the saturated solution?

a) AgCl b) AgBr c) Ag_2CrO_4 d) All of these

496. Acetic acid and propionic acid have K_a values 1.75×10^{-5} and 1.3×10^{-5} respectively at a certain temperature. An equimolar solution of a mixture of the two acids is partially neutralized by NaOH. How is the ratio of the contents of acetate and propionate ions related to the K_a values and the molarity?

a) $\left(\frac{\alpha}{1-\alpha}\right) = \frac{1.75}{1.3} \times \left(\frac{\beta}{1-\beta}\right)$, 0 where α and β are ionised fractions of the acids

b) The ratio is unrelated to the K_a values

c) The ratio is unrelated to the molarity

d) The ratio is unrelated to the pH of the solution

497. The equivalent conductance of 0.1 N acetic acid is 5 $cm^2 ohm^{-1} eq.^{-1}$ at 298 K while λ_∞ is 390 $cm^2 ohm^{-1} eq.^{-1}$. The degree of dissociation of 0.1 N acetic acid will be:

a) 0.0013 b) 0.013 c) 0.13 d) 0.5

498. Raising the temperature of a reversible chemical reaction :

a) Favours the forward rate only

b) Favours the backward rate only

c) Favours both the forward and backward rates as the case may be

d) Favours neither the forward nor backward rates

499. Zn salt is mixed with $(NH_4)_2S$ of molarity 0.021 M. The amount of Zn^{2+} remains unprecipitated in 12 mL of this solution (K_{sp} of ZnS $= 4.51 \times 10^{-24}$) which is:

a) 1.677×10^{-22}g b) 1.767×10^{-22}g c) 2.01×10^{-23}g d) None of these

500. Pure ammonia is placed in a vessel at temperature where its dissociation constant (α) is appreciable. At equilibrium,

a) K_p does not change significantly with pressure

b) α does not change with pressure

c) Concentration of NH_3 does not change with pressure

d) Concentration of H_2 is less than that of N_2

501. A chemical reaction $A \rightleftharpoons B$ is said to be at equilibrium when:

a) Complete conversion of A to B has taken place

b) Conversion of A to B is only 50% complete

c) Only 10% conversion of A to B has taken place

d) The rate of transformation of A and B is just equal to the rate of transformation of B to A in the system

502. As the temperature increases, the pH of a KOH solution

a) Will decrease

b) Will increase

c) Remains constant

d) Depends upon the concentration of KOH solution

503. Tribasic acid furnishes…type of anions.
a) 2 b) 1 c) 3 d) 4

504. Which of the following pairs constitutes buffer?
a) HNO_3 and NH_4NO_3 b) HCl and KCl c) HNO_2 and $NaNO_2$ d) NaOH and NaCl

505. What will be the pH and % α respectively for the salt BA of 0.1 M concentration? Given, K_a for H$A = 10^{-6}$ and K_b for BOH $= 10^{-6}$
a) 7, 10% b) 5, 10% c) 5, 0.1% d) 7, 1%

506. The indicator used in titrating oxalic acid with caustic soda solution is:
a) Methyl orange b) Methyl red c) Fluorescein d) Phenolphthalein

507. The pH of a 0.02 M solution of hydrochloric acid is:
a) 2.0 b) 1.7 c) 0.3 d) 2.2

508. For the reaction, $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$, at a given temperature, the equilibrium amount of $CO_2(g)$ can be increased by
a) Increasing the amount of CO(g)
b) Decreasing the volume of the container
c) Adding a suitable catalyst
d) Adding an inert gas

509. $Ag^+ + NH_3 \rightleftharpoons [Ag(NH_3)]^+;\ K_1 = 3.5 \times 10^{-3}$
$[Ag(NH_3)]^+ + NH_3 \rightleftharpoons [Ag(NH_3)_2]^+;$
$K_2 = 1.7 \times 10^{-3}$
Then the formation constant of $[Ag(NH_3)_2]^+$ is
a) 6.08×10^{-6} b) 6.08×10^{6} c) 6.08×10^{-9} d) None of these

510. 1 mL of 0.1 N HCl is added to 999 mL solution of NaCl. The pH of the resulting solution will be:
a) 7 b) 4 c) 2 d) 1

511. The role of catalyst in reversible reaction is :
a) To increase the rate of forward reaction
b) Decrease the rate after equilibrium
c) Allow equilibrium to be achieved quickly
d) None of the above

512. Which one is correct representation for,
$2SO_3 \rightleftharpoons 2SO_2 + O_2$?
a) $K_p = \dfrac{(p_{SO_2})^2 (p_{O_2})}{(p_{SO_3})^2}$
b) $K_c = \dfrac{[SO_2]^2[O_2]}{[SO_3]^2}$
c) $K_p = \dfrac{(\text{mole of } SO_2)^2 \times (\text{mole of } O_2)}{(\text{mole of } SO_3)^2} \times \left[\dfrac{P}{\text{total mole at equilibrium}}\right]$
d) All of the above

513. The solubility of $Ca_3(PO_4)_2$ in water is y moles/litre. Its solubility product is
a) $6\,y^4$ b) $36\,y^4$ c) $64\,y^5$ d) $108\,y^5$

514. For the reaction $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, the equilibrium constant is K_1, the equilibrium constant is K_2, for the reaction $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$. What is K. for the reaction $NO_2(g) \rightleftharpoons 1/2N_2\ (g) + O_2(g)$?
a) $\dfrac{1}{(K_1K_2)}$ b) $\dfrac{1}{(2K_1K_2)}$ c) $\dfrac{1}{(4K_1K_2)}$ d) $\left(\dfrac{1}{(K_1K_2)}\right)^{1/2}$

515. The equilibrium constant for the reaction $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$ at temperature $T$is 4×10^{-4}. The value of K_c for the reaction $NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$ at the same temperature is
a) 25 b) 50 c) 75 d) 100

516. If the value of K_c for an equilibrium reaction is 10^{-4}, then the reaction is in
a) Backward direction
b) Forward direction
c) Equilibrium
d) Reaction is not possible

517. 5 moles of X are mixed with 3 moles of Y. At equilibrium for the reaction, $X + Y \rightleftharpoons Z$, 2 moles of Z are formed. The equilibrium constant for the reaction will be

a) $\frac{2}{3}$ b) $\frac{1}{2}$ c) $\frac{3}{2}$ d) $\frac{1}{4}$

518. If in the reaction : $N_2O_4 \rightleftharpoons 2NO_2$, α is degree of dissociation of N_2O_4, then the number of molecules at equilibrium will be:

a) 3 b) 1 c) $(1-\alpha)^2$ d) $(1+\alpha)$

519. The hydroxide having the lowest value of K_{sp} at 25°C is:

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

520. The effect of increasing the pressure on the equilibrium $2A + 3B \rightleftharpoons 3A + 2B$ is

a) Forward reaction is favoured b) Backward reaction is favoured

c) No effect d) None of the above

521. Conjugate base of hydrazoic acid is:

a) HN_3^- b) N_3^- c) N^{3-} d) N_2^-

522. A reaction is, $A + B \rightarrow C + D$. Initially we start with equal concentrations of $A$and B. At equilibrium, we find the moles of C are two times of A. What is the equilibrium constant of the reaction?

a) 2 b) 4 c) $\frac{1}{2}$ d) $\frac{1}{4}$

523. Which of the following is the strongest conjugate base?

a) Cl^- b) CH_3COO^- c) SO_4^{2-} d) NO_2^-

524. Consider the following equilibrium in a closed container

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

At a fixed temperature, the volume of the reaction container is halved. For this change which of the following statement holds true regarding the equilibrium constant (K_p) and degree of dissociation (α) ?

a) Neither K_p nor α changes b) Both K_p and α changes

c) K_p changes but α does not d) K_p does not change but α changes

525. If K_a for a weak acid is 10^{-5}. pK_b value of its conjugate base is:

a) 5 b) 6 c) 7 d) 9

526. According to law of mass action, for the reaction

$2A + B \rightarrow$ Products

a) Rate $= k[A][B]$ b) Rate $= k[A]^2[B]$ c) Rate $= k[A][B]^2$ d) Rate $= k[A]^{1/2}[B]$

527. The equilibrium constant for the reaction, $2X(g) + Y(g) \rightleftharpoons 2Z(g)$ is 2.25 litre mol^{-1}. What would be the concentration of Y at equilibrium with 2.0 mole of X and 3.0 mole of Z in one litre vessel?

a) 1.0 M b) 2.25 M c) 2.0 M d) 4.0 M

528. $A(g) + B(g) \rightleftharpoons AB(g)$ is a reversible reaction. At equilibrium 0.4 mole of AB is formed when each A and B are taken one mole. How much of A changes into AB?

a) 20% b) 40% c) 60% d) 4%

529. A solute undergoes complex formation with ions of sparingly soluble salt, the solubility of salt:

a) Increases b) Decreases c) Is unaffected d) Either of these

530. The pH of the solution containing 0.1 N NaOH and 0.1N NH_4OH is:

a) 1 b) 7 c) 2 d) 13

531. Which buffer solution comprising of the following has its pH value greater than 7?

a) $CH_3COOH + CH_3COONa$ b) $HCOOH + HCOOK$

c) CH_3COONH_4 d) $NH_4OH + NH_4Cl$

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

a) BF_3 b) Cl^- c) CO d) None of these

533. If solubility of calcium hydroxide is $\sqrt{3}$, then its solubility product will be

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

534. Pure water is kept in a vessel and it remains exposed to atmospheric CO_2 which is absorbed. Then the pH will be:
a) Greater than 7
b) Less than 7
c) 7
d) Depends on ionic product of water

535. The decomposition of N_2O_4 to NO_2 is carried out at 280 K in chloroform. When equilibrium has been established, 0.2 mole of N_2O_4 and 2×10^{-3} mole ofNO_2 are present in 2 L solution. The equilibrium constant for reaction $N_2O_4 \rightleftharpoons 2NO_2$ is
a) 1×10^{-2}
b) 1×10^{-3}
c) 1×10^{-4}
d) 1×10^{-5}

536. The most favourable condition for the manufacture of NH_3 is
a) high temperature and high pressure
b) low temperature and low pressure
c) high temperature and low pressure
d) low temperature and high pressure

537. The value of K_p for the following reaction $2H_2S(g) \rightleftharpoons 2H_2(g) + S_2(g)$, is 1.2×10^{-2} at 106.5°C. The value of K_c for this reaction is
a) $= 1.2 \times 10^{-2}$
b) $< 1.2 \times 10^{-2}$
c) $> 1.2 \times 10^{-2}$
d) None of these

538. In hydrolysis of a salt of weak acid and strong base $A^- + H_2O \rightleftharpoons HA + OH^-$, 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) $\frac{K_w}{K_a \times K_b}$

539. The pH of $7 \times 10^{-8} M$ CH_3COOH is:
a) 8.1
b) 7.9
c) 7.1
d) 6.85

540. Water acts as an acid in presence of:
a) NH_3
b) H_2SO_4
c) C_6H_6
d) HCl

541. Which statement is/are correct?
a) All Bronsted bases are also Lewis bases
b) All Bronsted acids are not Lewis acids
c) All cations are acids and all anions are bases
d) All of the above

542. Three moles of PCl_5, three moles of PCl_3 and two moles of Cl_2 are taken in a closed vessel. If at equilibrium the vessel has 1.5 moles of PCl_5, the number of moles of PCl_3 present in it is
a) 5
b) 3
c) 6
d) 4.5

543. Ice and water are in equilibrium at 273 K, which of the following statements is correct?
a) $G_{(\text{ice})} > G_{(H_2O)}$
b) $G_{(\text{ice})} < G_{(H_2O)}$
c) $G_{(\text{ice})} = G_{(H_2O)} = 0$
d) $G_{(\text{ice})} = G_{(H_2O)} \neq 0$

544. For an equilibrium reaction involving gases, the forward reaction is 1st order while the reverse reaction is 2nd order. The units of K_P for the forward equilibrium is:
a) atm
b) atm^2
c) atm^{-1}
d) atm^{-2}

545. A buffer solution has equal volumes of 0.2 M NH_4OH and 0.02 M NH_4Cl. The pK_b of the base is 5. The pH is
a) 10
b) 9
c) 4
d) 7

546. Which of the following will supress the ionisation of acetic acid is aqueous solution?
a) NaCl
b) HCl
c) KCl
d) Unpredictable

547. The Henderson's equation used to calculate the pOH of basic buffer is:
a) $\text{pOH} = pK_b + \log\frac{[\text{Conjugate acid}]}{[\text{Base}]}$
b) $\text{pOH} = pK_b - \log\frac{[\text{Conjugate acid}]}{[\text{Base}]}$
c) $\text{pOH} = pK_b + \log\frac{[\text{Base}]}{[\text{Conjugate acid}]}$

d) $\mathrm{pOH} = \mathrm{p}K_b - \log\frac{[\text{Base}]}{[\text{Conjugate acid}]}$

548. Which of the following is the weakest acid?
a) HCl b) HF c) H_2SO_4 d) HNO_3

549. How many gram of NaOH must be present in one litre of the solution to give it a pH $= 12$?
a) 0.20 g litre^{-1} b) 0.4 g litre^{-1} c) 4.0 g litre^{-1} d) 0.10 g litre^{-1}

550. Approximate pH of 0.10 M aqueous H_2S solution having K_1 and K_2 for H_2S at 25°C 10^{-7} and 10^{-13} respectively, is:
a) 4 b) 5 c) 9 d) 8

551. An aqueous solution whose pH is zero will be called as
a) Acidic b) Basic c) Neutral d) Amphoteric

552. The concentration of KI and KCl in a 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?
$(K_{\text{sp}}\ \text{AgCl} = 10^{-10}, K_{\text{sp}}\ \text{AgI} = 10^{-16})$
a) AgI will be precipitated b) AgCl will be precipitated
c) There will be no precipitate d) Both AgCl and AgI will be precipitated

553. The equilibrium reaction that is not influenced by volume change at constant temperature is
a) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ b) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
c) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ d) $2NO(g) + O_2 \rightleftharpoons 2NO_2(g)$

554. Group IA metals react violently with water to produce … nature in solution.
a) Acidic b) Basic c) Amphoteric d) Neutral

555. $A + B = C + D$. If initially the concentration of A and B are both equal but at equilibrium, concentration of D will be twice of that of A, then what will be the equilibrium constant of reaction?
a) $\frac{4}{9}$ b) $\frac{9}{4}$ c) $\frac{1}{9}$ d) 4

556. The phenomenon of interaction of anions and cations furnished by a electrolyte with the H^+ and OH^- ions of water to produce acidic nature or alkalinity is known as hydrolysis. In hydrolysis:
a) The pH may either increase or decrease
b) All the salts (except those made up with strong acid and base) undergo hydrolysis
c) The variation of pH depends upon the nature of salts as well as on the temperature
d) All of the above

557. $A_2(g) + B_2(g) \rightleftharpoons 2AB(g), \Delta H = -\text{ve}$
The reaction
a) Remains unaffected by pressure b) Occurs at 1000 atm pressure
c) Occurs at high temperature d) Occurs at high pressure and high temperature

558. 20 mL of 0.5 N HCl and 35 mL of 0.1 N NaOH are mixed. The resulting solution will
a) Be neutral b) Be basic
c) Turn phenolphthalein solution pink d) Turn methyl orange red

559. 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?
a) FeS b) MgS c) HgS d) ZnS

560. Ostwald's dilution law is applicable for
a) Weak electrolyte b) Strong electrolyte
c) Both weak and strong electrolyte d) Non-electrolyte

561. The equilibrium $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ shows that K_p is 24.63 times the value of K_c at a particular

temperature T. Then T(in K) is:

a) 200 b) 100 c) 300 d) 400

562. At 90°C, pure water has $[H^+] = 10^{-6}$ M, if 100 mL of 0.2 M HCl is added to 200 mL of 0.1 M KOH at 90°C then pH of the resulting solution will be

a) 7 b) 8 c) 4 d) 6

563. In a reaction, the rate of reactions is proportional to its active mass. This statement is known as

a) Law of mass-action b) Le-Chatelier principle

c) Faraday law of electrolysis d) Law of constant proportion

564. The values of K_{p_1} and K_{p_2} for the reactions

$X \rightleftharpoons Y + Z$ ..(1)

and $A \rightleftharpoons 2B$ ..(2)

are in the ration 9 : 1. If degree of dissociation of X and A be equal, then total pressure at equilibrium (1) and (2) are in the ratio :

a) 1 : 9 b) 36 : 1 c) 1 : 1 d) 3 : 1

565. Which of the following is not a characteristic property of chemical equilibrium?

a) Rate of forward reaction is equal to rate of backward reaction at equilibrium

b) After reaching the chemical equilibrium, the concentrations of reactants and products remain unchanged with time

c) For $A(g) \rightleftharpoons B(g), K_c$ is 10^{-2}. If this reaction is carried out in the presence of catalyst, the value of K_c decreases

d) After reaching the equilibrium, both forward and backward reactions continue to take place

566. Which molecule is an electron donor?

a) NH_3 b) BF_3 c) PF_5 d) AsF_5

567. The correct expression for the solubility product of $Ca_3(PO_4)_2$ is

a) $108\ s^5$ b) $27\ s^5$ c) $16\ s^4$ d) $81\ s^4$

568. pH of solution can be expressed as

a) $-\log_e[H^+]$ b) $-\log_{10}[H^+]$ c) $\log_e[H^+]$ d) $\log_{10}[H^+]$

569. Which aqueous solution will have pH less than 7?

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

570. If the salts M_2X, QY_2 and PZ_3 have the same solubilities, K_{sp} values are related as:

a) $K_{sp}(M_2X) = K_{sp}(QY_2) < K_{sp}(PZ_3)$

b) $K_{sp}(M_2X) > K_{sp}(QY_2) = K_{sp}(PZ_3)$

c) $K_{sp}(M_2X) = K_{sp}(QY_2) = K_{sp}(PZ_3)$

d) $K_{sp}(M_2X) > K_{sp}(QY_2) > K_{sp}(PZ_3)$

571. The pH values of 0.1 M solution of HCl, CH_3COOH, NH_4Cl and CH_3COONa will have the order

a) $HCl < CH_3COOH < NH_4Cl < CH_3COONa$ b) $CH_3COONa < NH_4Cl < CH_3COOH < HCl$

c) $NH_4Cl < CH_3COONa < CH_3COOH < HCl$ d) All will have same of pH value

572. When rain is accompanied by a thunderstorm the collected rain water will have a pH value:

a) Uninfluenced by occurrence of thunderstorm

b) Depending on the amount of dust in air

c) Slightly lower than that of rain water without thunderstorm

d) Slightly higher than that when the thunderstorm is not there

573. Ammonia gas dissolves in water to form NH_4OH. In this reaction water acts as

a) A conjugate base b) A non-polar solvent c) An acid d) A base

574. pH scale was introduced by

a) Arrhenius b) Sorensen c) Lewis d) Lowry

575. Given : $[Ag(NH_3)_2]^+ \rightleftharpoons Ag(NH_3)^+ + NH_3; \quad K_1^0 = 1.4 \times 10^{-4}$

$Ag(NH_3)^+ \rightleftharpoons Ag^+ + NH_3; \quad K_2^0 = 4.3 \times 10^{-4}$

The instability constant of the complex $Ag\ (NH_3)_2^+$ is equal to :

a) 7.14×10^3
b) 2.33×10^3
c) 6.02×10^{-8}
d) 1.66×10^7

576. An aqueous solution contains Ni^{2+}, Co^{2+} and Pb^{2+} ions at equal concentrations. The solubility product of NiS, PbS and CoS in water at 25°C are 1.4×10^{-24}, 3.4×10^{-28} and 3×10^{-26}, respectively. Indicate which of these ions will be precipitated first and last when sulphide concentration is progressively increased from zero?
a) NiS and PbS
b) NiS and CoS
c) CoS and NiS
d) PbS and NiS

577. 10^{-6} M NaOH is diluted 100 times. The pH of the diluted base is
a) Between 7 and 8
b) Between 5 and 6
c) Between 6 and 7
d) Between 10 and 11

578. An acid with molecular formula $C_7H_6O_3$ forms three types of sodium salts, *i.e.*, $C_7H_5O_3Na$, $C_7H_4O_3Na_2$ and $C_7H_3O_3Na_3$. The basicity of the acid is:
a) One
b) Two
c) Three
d) Four

579. If the concentration of CrO_4^{2-} ion in a saturated solution of silver chromate be $2 \times 10^{-4}\ M$, solubility product of silver chromate will be:
a) 4×10^{-8}
b) 8×10^{-12}
c) 32×10^{-12}
d) 6×10^{-12}

580. What would be the effect on addition of $CaCO_3$ on the equilibrium of $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ in a closed container:
a) conc. of CO_2 increases
b) conc. of CO_2 decreases
c) Remains unaffected
d) Cannot be predicted

581. In a chemical equilibrium, the rate constant of the backward reaction is 7.5×10^{-4} and the equilibrium constant is 1.5. So, the rate constant of the forward reaction is
a) 1.125×10^{-3}
b) 2.225×10^{-3}
c) 3.335×10^{-5}
d) 1.125×10^{-1}

582. 0.1 *M* acetic acid solution is titrated against 0.1 *M* NaOH solution. What would be the difference in pH between 1/4 and 3/4 stages of neutralization of acid?
a) $2 \log 3/4$
b) $2 \log 1/4$
c) $\log 1/3$
d) $2 \log 3$

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

584. The values of dissociation constant of some acids (at 25°C) are given below. The strongest acid in water is:
a) 1.4×10^{-2}
b) 1.6×10^{-4}
c) 4.4×10^{-10}
d) 4.3×10^{-7}

585. In a mixture of acetic acid and sodium acetate the ratio of concentration of the salt to the acid is increased ten times. Then, the pH of the solution
a) Increases by one
b) Decreases by one
c) Decreases ten fold
d) Increased ten fold

586. Which of the following salts is most soluble?
a) $Bi_2S_3(K_{sp} = 1 \times 10^{-17})$
b) $MnS(K_{sp} = 7 \times 10^{-16})$
c) $CuS(K_{sp} = 8 \times 10^{-37})$
d) $Ag_2S(K_{sp} = 6 \times 10^{-51})$

587. van't Hoff's equation giving the effect of temperature on chemical equilibrium is represented as:
a) $\frac{d \text{ In } F}{dT} = \frac{\Delta H}{RT^2}$
b) $\frac{d \text{ In } K_p}{dT} = \frac{\Delta H T^2}{R}$
c) $\frac{d \text{ In } K_p}{dT} = \frac{\Delta H}{RT^2}$
d) $\frac{d \text{ In } K_p}{dT} = \frac{RT^2}{\Delta H}$

588. Hydrogen and oxygen were heated together in a closed vessel. The equilibrium constant is found to decrease after 2000°C. Which is responsible for this?
a) Backward reaction predominates
b) Forward reaction predominates
c) Both forward and backward reactions have same rate
d) It is a property of the system, hence no reason for lower value

589. The dissociation constant of HCN is 1.3×10^{-9}. The value of hydrolysis constant of KCN will be:
a) 1.3×10^{-9} b) 10^{-14} c) 7.7×10^{-5} d) 0.77×10^{-5}

590. 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 L of 0.05 M solution of silver nitrate to start the precipitation of AgBr is
a) 1.2 10^{10} g b) 1.2 10^{9} g c) 6.2 10^{5} g d) 5.0 10^{8} g

591. In the thermal decomposition of potassium chlorate given as $2KClO_3 \rightarrow 2KCl + 3O_2$, law of mass action
a) Can be applied
b) Cannot be applied
c) Can be applied at low temperature
d) Can be applied at high temperature and pressure

592. The solubility product of a sparingly soluble salt AB at room temperature is 1.21×10^{-6}. Its molar solubility is
a) 1.21×10^{-6} b) 1.21×10^{-3} c) 1.1×10^{-4} d) 1.1×10^{-3}

593. What is the correct representation for the solubility product of SnS_2?
a) $[Sn^{2+}][S^{2-}]^2$ b) $[Sn^{4+}][S^{2-}]^2$ c) $[Sn^{2+}][2S^{2-}]$ d) $[Sn^{4+}][2S^{2-}]^2$

594. Which of the following pK_a values, represent the strongest acid?
a) 10^{-4} b) 10^{-8} c) 10^{-5} d) 10^{-2}

595. An electrolyte
a) Gives complex ions in solution b) Dissolves in water to give ions
c) Is ionised in the solid state d) Generates ions on passing electric current

596. The strongest base among the following is:
a) CH_3^- b) F^- c) NH_2^- d) OH^-

597. Given the reaction between 2 gases represented by A_2 and B_2 to give the compound $AB_{(g)}$.

$$A_{2(g)} + B_{2(g)} \rightleftharpoons 2AB_{(g)}$$

At equilibrium, the concentration
of $A_2 = 3.0 \times 10^{-3}$ M
of $B_2 = 4.2 \times 10^{-3}$ M
of $AB = 2.8 \times 10^{-3}$ M
If the reaction takes place in a sealed vessel at 527°C, then the value of K_c will be :
a) 2.0 b) 1.9 c) 0.62 d) 4.5

598. For the reaction, $A + B \rightleftharpoons C + D$, the initial concentration of A and B are equal, but the equilibrium concentration of C is twice that of equilibrium concentration of$A$. The equilibrium constant is :
a) 4 b) 9 c) 1/4 d) 1/9

599. For the reaction,
$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ the position of equilibrium can be shifted to the right by
a) Doubling the volume
b) Increasing the temperature
c) Addition of equimolar quantities of PCl_3 and PCl_5
d) Addition of Cl_2 at constant volume

600. The solubility of AgCl $\left(K_{sp} = 1.2 \times 10^{-10}\right)$ in a 0.10 M NaCl solution is:
a) 0.1 M b) $1.2 \times 10^{-6} M$ c) $1.2 \times 10^{-9} M$ d) $1.2 \times 10^{-10} M$

601. The following equilibrium exists in aqueous solution $CH_3COOH \rightleftharpoons H^+ + CH_3COO^-$. If dilute HCl is added to this solution:
a) The equilibrium constant will increase
b) The equilibrium constant will decrease
c) Acetate ion concentration will increase
d) Acetate ion concentration will decrease

602. What is the solubility product of CaF_2, if its saturated solution contains 0.017 g of CaF_2 per litre?

a) 1.44×10^{-4} b) 4.14×10^{-11} c) 4.14×10^{-18} d) 41.4×10^{-24}

603. Which of the following will occur if a 0.1 M solution of weak acid is diluted to 0.01 M at constant temperature?
a) pH will increase
b) K_a will decrease
c) $[H^+]$ will decrease to 0.01 M
d) % ionisation will increase

604. Passing H_2S gas into a mixture of Mn^2, Ni^2, Cu^2 and Hg^2 ions in an acidified aqueous solution precipitates
a) CuS and HgS b) MnS and CuS c) MnS and NiS d) NiS and HgS

605. The pH of an aqueous solution of CH_3COONa of concentration C(M) is given by
a) $7 - \frac{1}{2}pK_a - \frac{1}{2}\log C$
b) $\frac{1}{2}pK_w + \frac{1}{2}pK_b + \frac{1}{2}\log C$
c) $\frac{1}{2}pK_w - \frac{1}{2}pK_b - \frac{1}{2}\log C$
d) $\frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}\log C$

606. The concentration of $[H^+]$ and concentration of $[OH^-]$ of a 0.1 M aqueous solution of 2% ionised weak acid is:
[ionic product of water $= 1 \times 10^{-14}$]
a) 0.02×10^{-3} M and 5×10^{-11} M
b) 1×10^{-3} M and 3×10^{-11} M
c) 2×10^{-3} M and 5×10^{-12} M
d) 3×10^{-2} M and 4×10^{-13} M

607. For a weak acid pK_a is 4.8. What will be the ratio of concentration of acid and salt in pH 5.8 solution?
a) 10 b) 3 c) 9 d) 0.1

608. Two system PCl_5 (g) $\rightleftharpoons$ PCl_3(g) + Cl_2(g) and $COCl_2$(g) $\rightleftharpoons$ CO(g) + Cl_2(g)are simultaneously in equilibrium in a vessel at constant volume. If some CO is introduced into the vessel then at the new equilibrium the concentration of :
a) PCl_5 is greater
b) PCl_3 remains unchanged
c) PCl_5 is less
d) Cl_2 is greater

609. The solubility product of Ag_2CrO_4 in water at 298 K is 3.2×10^{-11}. What will be the concentration of CrO_4^{2-} ions in the saturated solution of Ag_2CrO_4?
a) 2×10^{-4} M b) 5.7×10^{-5} M c) 5.7×10^{-6} M d) 3.2×10^{-11} M

610. Sulphide ions in alkaline solution react with solid sulphur to form polyvalent sulphide ions. The equilibrium constant for the formation of S_2^{2-} and S_3^{2-} from S and S^{2-} ions are 1.7 and 5.3 respectively. Equilibrium constant for the formation of S_3^{2-} from S_2^{2-} and S is:
a) 1.33 b) 3.11 c) 4.21 d) 1.63

611. The pH of water is 7 at 25°C. If water is heated to 50°C, which of the following should be true?
a) pH will decrease
b) pH will increase
c) pH will remain seven
d) $[H^+]$ will increase but $[OH^-]$ will decrease

612. The conjugate acid of NH_2^- is
a) N_2H_4 b) NH_4^+ c) NH_2OH d) NH_3

613. pH of a solution of the mixture of 0.1 N HCl and 0.1 N CH_3COOH is:
a) 1 b) 2 c) 1.7 d) None of these

614. A buffer solution is prepared by mixing 10 mL of 1.0 M acetic and 20 mL of 0.5 M sodium acetate and then diluted to 100 mL with distilled water. If the pK_a of CH_3COOH is 4.76, what is the pH of the buffer solution prepared?
a) 5.21 b) 4.76 c) 4.34 d) 5.21

615. $CH_3COOH(l) + C_2H_5OH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$
In the above reaction, one mole of each of acetic acid and alcohol are heated in the presence of little conc.H_2SO_4. On equilibrium being attained
a) 1 mole of ethyl acetate is formed
b) 2 mole of ethyl acetate is formed
c) $\frac{2}{3}$mole of ethyl acetate is formed
d) $\frac{1}{2}$ mole of ethyl acetate is formed

616. When the pH of a solution is 2, the hydrogen ion concentration is:
a) 1×10^{-14} M
b) 1×10^{-2} M
c) 1×10^{-7} M
d) 1×10^{-12} M

617. On adding A to the reaction at equilibrium, $AB(s) \rightleftharpoons A(g) + B(g)$, the new equilibrium concentration of A becomes double, the equilibrium concentration of B would become :
a) 1/2 of its original value
b) 1/4 of its original value
c) 1/8 of its original value
d) Twice of its original value

618. The change in pressure will not affect the equilibrium constant for
a) $N_2 + 3H_2 \rightleftharpoons 2NH_3$
b) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$
c) $H_2 + I_2 \rightleftharpoons 2HI$
d) All of these

619. Equilibrium concentration of HI, I_2 and H_2 is 0.7, 0.1 and 0.1M respectively. The equilibrium constant for the reaction, $I_2 + H_2 \rightleftharpoons 2HI$ is :
a) 0.36
b) 36
c) 49
d) 0.49

620. The dissociation constant of acetic acid K_a is 1.74×10^{-5} at 298 K. The pH of a solution of 0.1 M acetic acid is
a) 2.88
b) 3.6
c) 4.0
d) 1.0

621. What is the effect of increasing pressure on the dissociation of PCl_5 according to the equation
$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g) - x$ cal?
a) Dissociation decreases
b) Dissociation increases
c) Dissociation does not change
d) None of the above

622. The ionic product of water at 60°C is 9.61×10^{-14}. The pH of water at 60°C is:
a) 6.51
b) 6.70
c) 9.61
d) 7.0

623. For the reaction equilibrium, $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, the concentration of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and 1.2×10^{-2} mol/L respectively. The value of K_c for the reaction is
a) 3×10^{-3}mol/L
b) 3.3×10^{-3}mol/L
c) 3×10^{-1}mol/L
d) 3.3×10^{-1}mol/L

624. If first dissociation of $X(OH)_3$ is 100% where as second dissociation is 50% and third dissociation is negligible then the pH of 4×10^{-3} M $X(OH)_3$ is
a) 7.5
b) 9.54
c) 11.78
d) 13.25

625. The equilibrium constant for the reaction, $3C_2H_2 \rightleftharpoons C_6H_6$ *is* 4.0 at T K. If the equilibrium concentration of C_2H_2 is 0.5 mol/litre, the concentration of C_6H_6 is :
a) 0.5 M
b) 1.5 M
c) 5 x 10^{-2} M
d) 0.25 M

626. For the reaction, $CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(l)$,
$\Delta_r H$ = - 170.8 kJ mol^{-1}
Which of the following statements is not true?
a) Addition of CH_4(g) or O_2 (g) at equilibrium will cause a shift to the right
b) The reaction is exothermic
c) At equilibrium, the concentrations of CO_2 (g) and $H_2O(l)$ are not equal
d) The equilibrium constant for the reaction is given by $K_p = \frac{[CO_2]}{[CH_4][O_2]}$

627. The law of mass action was enunciated by
a) Graham
b) Bodestein
c) Rutherford
d) Guldberg and Waage

628. The correct statement about buffer solution is:
a) It contains a weak acid and its conjugate base
b) It contains a weak base and its conjugate acid
c) It shows little change in pH on adding small amount of an acid or base

d) All of the above

629. Which reaction has $\Delta n = 2$?

a) $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$

b) $3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$

c) $NH_4Cl(g) \rightleftharpoons NH_3(g) + HCl(g)$

d) $CuSO_4 \cdot 5H_2O(s) \rightleftharpoons CuSO_4 \cdot 3H_2O(s) + 2H_2O(g)$

630. In the reaction, $N_2O_4 \rightleftharpoons 2NO_2, \alpha$ is that part of N_2O_4 which dissociates, then the number of moles at equilibrium will be

a) 1 b) 3 c) $(1+\alpha)$ d) $(1-\alpha)^2$

631. Decreasing acid strengths of HI, HBr, HCl and HF is:

a) $HF > HCl > HBr > HI$

b) $HI > HBr > HCl > HF$

c) $HI > HCl > HBr > HF$

d) $HI > HF > HCl > HBr$

632. A monoprotic acid in 0.1 M solution has $K_a = 1.0 \times 10^{-5}$. The degree of dissociation acid is:

a) 1.0% b) 99.9% c) 0.1% d) 99%

633. In what manner will increase of pressure affect the following equation?

$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2O(g)$

a) Shift in the reverse direction b) Shift in the forward direction

c) Increase in the yield of hydrogen d) No effect

634. Which one of the following pair shows buffer's solution?

a) $NaCl + NaOH$ b) $CH_3COONa + CH_3COOH$

c) $CH_3COOH + CH_3COONH_4$ d) $H_2SO_4 + CuSO_4$

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

a) 8.73 b) 9.08 c) 9.43 d) 11.72

636. The degree of ionisation of a compound depends

a) Size of solute molecules b) Nature of solute molecules

c) Nature of vessel used d) Quantity of electricity passed

637. Amongst the following, the total number of compounds whose aqueous solution turns red litmus paper blue is

KCN K_2SO_4 $(NH_4)_2C_2O_4$ NaCl

$Zn(NO_3)_2$ $FeCl_3$ K_2CO_3 NH_4NO_3

LiCN

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

638. The aqueous solution of a salt is alkaline. This shows that salt is made from:

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

639. Which of the following solutions cannot act as a buffer?

a) $NaH_2PO_4 + H_3PO_4$ b) $CH_3COOH + CH_3COONa$

c) $HCl + NH_4Cl$ d) $H_3PO_4 + Na_2HPO_4$

640. The relation for calculating pH of a solution containing weak acid and its salt is:

a) $pH = pK_a + \log\frac{[\text{Conjugate base}]}{[\text{Acid}]}$

b) $pH = pK_a - \log\frac{[\text{Conjugate base}]}{[\text{Acid}]}$

c) $\text{pH} = \text{p}K_a + \log \frac{[\text{Conjugate base}]}{[\text{Salt}]}$

d) $\text{pOH} = \text{p}K_a - \log \frac{[\text{Acid}]}{[\text{Conjugate base}]}$

641. The pH of a 0.01 M solution of acetic acid having degree of dissociation 12.5% is:
a) 4.509 b) 3.723 c) 2.903 d) 5.623

642. Which one is more acidic in aqueous solution?
a) $NiCl_2$ b) $FeCl_3$ c) $AlCl_3$ d) $BeCl_2$

643. In any chemical reaction, equilibrium is supposed to be establish when
a) Mutual opposite reactions undergo
b) Velocity of mutual reactions become equal
c) Concentration of reactants and resulting products are equal
d) The temperature of mutual opposite reactions become equal

644. Of the following which change will shift the reaction towards the product?
$I_2(g) \rightleftharpoons 2I(g), \Delta H°_r(298\text{ K}) = +150\text{ kJ}$
a) Increase in temperature b) Increase in total pressure
c) Increase in concentration of I d) Decrease in concentration of I_2

645. Electrophiles are:
a) Lewis acids b) Lewis bases c) Bronsted acids d) Bronsted bases

646. Buffer solutions have constant acidity and alkalinity because:
a) They have large excess of H^+ or OH^- ions
b) They have fixed value of pH
c) These give unionised acid or base on reaction with added acid or alkali
d) Acids and alkalies in these solutions are shielded from attack by other ions

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

648. When different types of salts have nearly same solubility product constant K_{sp} but less than one the most soluble salt is that:
a) Which produces maximum number of ions
b) Which produces minimum number of ions
c) Which produces more charge on ion
d) None of the above

649. In a flask, colourless N_2O_4 is in equilibrium with brown coloured NO_2. At equilibrium, when the flask is heated at 100°C the brown colour deepens and on cooling it becomes less coloured. The change in enthalpy ΔH, for the system is :
a) Negative b) Positive c) Zero d) Undefined

650. 56 g of nitrogen and 8 g of hydrogen gas heated in a closed vessel. At equilibrium, 34 g of ammonia are present. The equilibrium number of moles of nitrogen, hydrogen and ammonia are, respectively
a) 1, 1, 2 b) 1, 2, 2 c) 2, 1, 1 d) 2, 2, 1

651. Calculate pOH of 0.001 M NH_4OH, when it is 1 % dissociated in the solution
a) 5 b) 2.96 c) 9.04 d) 11.4

652. On addition of an inert gas at constant volume to the reaction, $N_2 + 3H_2 \rightleftharpoons 2NH_3$ at equilibrium:
a) The reaction halts
b) Forward reaction is favoured
c) The reaction remains unaffected
d) Backward reaction is favoured

653. The reaction quotient (Q) for the reaction is given by:

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3; \quad Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

The reaction will proceed from right to left if:
a) $Q = 0$ b) $Q = K_c$ c) $Q < K_c$ d) $Q > K_c$

654. Sulphuric acid is a dibasic acid. Hence, it forms:
a) Acidic salt
b) Basic and acidic salt
c) Acidic and normal salt
d) Double salt

655. Solubility of AgCl at 20°C is 1.435×10^{-3} g/L . The solubility product of AgCl is
a) 1×10^{-5} b) 1×10^{-10} c) 1.435×10^{-5} d) 108×10^{-3}

656. Le-Chatelier′s principle is not applicable to:
a) $Fe(s) + S(s) \rightleftharpoons FeS(s)$
b) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
c) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
d) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

657. 4 moles each of SO_2 and O_2 gases are allowed to react to form SO_3 in a closed vessel. At equilibrium 25% of O_2 is used up. The total number of moles of all the gases at equilibrium is
a) 6.5 b) 7.0 c) 8.0 d) 2.0

658. The pH of a 0.005 M aqueous solution of sulphuric acid is approximately:
a) 0.005 b) 2 c) 1 d) 0.01

659. When ammonium chloride is added to ammonia solution, the pH of the resulting solution will be
a) Increased b) Seven c) Decreased d) Unchanged

660. The pH at which an acid indicator with $K_a = 1 \times 10^{-5}$ changes colour when the indicator concentration is 1×10^{-3} M, is:
a) 4 b) 5 c) 6 d) 3

661. The equilibrium, $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ shifts forward if:
a) A catalyst is used
b) An absorbent is used to remove SO_3 as soon as it is formed
c) Small amounts of reactants are used
d) None of the above

662. 56 g of nitrogen and 8 g of hydrogen gas are heated in a closed vessel. At equilibrium 34 g of ammonia are present. The equilibrium number of moles of nitrogen, hydrogen and ammonia are respectively
a) 1, 2, 2 b) 2, 2, 1 c) 1, 1, 2 d) 2, 1, 2

663. A white substance having alkaline nature in solution is
a) $NaNO_3$ b) NH_4Cl c) Na_2CO_3 d) Fe_2O_3

664. Which of the following is not a buffer solution?
a) 100 mL 0.1 M CH_3COOH + 50 mL 0.1 M CH_3COONa
b) 100 mL 0.1 M CH_3COOH + 50 mL 0.1 M NaOH
c) 50 mL 0.1 M CH_3COOH + 100 mL 0.1 M NaOH
d) 100 mL 0.1 M NH_4OH + 50 mL 0.1 M HCl

665. For the reaction, $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$, the partial pressure of CO_2 and CO are 4 and 8 atm respectively, K_p for the reaction is :
a) 16 atm b) 2 atm c) 5 atm d) 4 atm

666. For the reaction, $H_2 + I_2 \rightleftharpoons 2HI$, the equilibrium concetratio of H_2, I_2 and HI are 8.0, 3.0 and 28.0 mol/L respectively. The equilibrium constant of the reaction is
a) 32.66 b) 34.33 c) 22.44 d) 11.22

667. The solubility product of $Ag_2CrO_4$is 32×10^{-12}. What is the concentration of CrO_4^- ions in that solution?
a) 2×10^{-4}M b) 16×10^{-4}M c) 8×10^{-4}M d) 8×10^{-8}M

668. The equilibrium constant for the reaction,

$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$ is 2×10^{-6} at 185°C.
Then the equilibrium constant for the reaction,
$4NO(g) + 2O_2(g) \rightleftharpoons 4NO_2(g)$ at the same temperature would be
a) 2.5×10^{-5} b) 4×10^{-12} c) 2.5×10^{11} d) 2×10^{6}

669. At 25°C, the solubility product of $Mg(OH)_2$ is $1.0 \quad 10^{11}$. At which pH, will Mg^2 ions start precipitating in the form of $Mg(OH)_2$ from a solution of 0.001 M Mg^2 ions?
a) 9 b) 10 c) 11 d) 8

670. Precipitation just takes place when the product of concentration of ions:
a) Equals their solubility product
b) Exceeds their solubility product
c) Is less than their solubility product
d) Is negligible

671. The suitable indicator for the titration of strong acid and weak base is
a) Methyl orange b) Methyl red c) Phenol red d) Phenolphthalein

672. Tetramine copper (II) sulphate is an example of:
a) Simple salt b) Double salt c) Complex salt d) Normal salt

673. The self ionisation constant for pure formic acid, $K = [HCOOH_2^+][HCOO^-]$ has been estimated as 10^{-6} at 1.22 g/cm^3. The percentage of formic acid molecules in pure formic acid converted to formate ion is:
a) 0.002% b) 0.004% c) 0.006% d) 0.008%

674. The pH of blood is maintained by CO_2 and H_2CO_3 in the body and chemical constituents of blood. This phenomenon is called:
a) Colloidal b) Buffer action c) Acidity d) Salt balance

675. Weak electrolytes are only partly dissociated in solutions. The extent to which they are dissociated in a given solution is known as the 'Degree of dissociation'. Which of the following statements for this degree of dissociation in aqueous solution is true?
a) It is inversely proportional to the square root of initial concentration of the electrolyte
b) It is directly proportional to the initial concentration of the electrolyte
c) It is independent of the initial concentration of the electrolyte
d) It depends on the equilibrium concentration of the electrolyte

676. At a certain temperature, the dissociation constants of formic acid and acetic acid are 1.8×10^{-4} and 1.8×10^{-5} respectively. The concentration of acetic acid solution in which the hydrogen ion has the same concentration as in 0.001 M formic acid solution is equal to
a) 0.01 M b) 0.001 M c) 0.1 M d) 0.0001 M

677. Partial pressure of O_2 in the reaction
$2Ag_2O(s) \rightleftharpoons 4Ag(s) + O_2(g)$ is
a) K_p b) $\sqrt{K_p}$ c) $3\sqrt{K_p}$ d) $2K_p$

678. 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
a) 4.0×10^{-10} M b) 1.6×10^{-4} M c) 1.0×10^{-4} M d) 2.0×10^{-6} M

679. In a lime kiln, to get higher yield of CO_2, the measure that can be taken is
a) To remove CaO b) To add more $CaCO_3$
c) To maintain high temperature d) To pump out CO_2

680. Which of the following is a Bronsted acid as well as Bronsted base:
a) Na_2CO_3 b) H_2O c) NH_3 d) BF_3

681. The rate constant for forward reaction and backward reaction of hydrolysis of ester are 1.1×10^{-2} and 1.5×10^{-3} per minute respectively. Equilibrium constant for the reaction is
$CH_3COOC_2H_5 + H_2O \rightleftharpoons CH_3COOH + C_2H_5OH$
a) 33.7 b) 7.33 c) 5.33 d) 33.3

682. Which acid is involved in digestion process?

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

683. For $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$, the observed pressure for reaction mixture in equilibrium is 1.12 atm at 106°C. The value of K_p for the reaction is :

a) 3.136 atm^2 b) 0.3136 atm^2 c) 31.36 atm^2 d) 6.98 atm^2

684. A solution of NaCl in contact with atmosphere has a pH of about:

a) 3.2 b) 5.4 c) 7.0 d) 14

685. Amines behave as

a) Lewis acid b) Lewis base c) Aprotic acid d) Neutral compound

686. The two Bronsted bases in the reaction are

$HC_2O_4^- + PO_4^{3-} \longrightarrow HPO_4^{2-} + C_2O_4^{2-}$:

a) $HC_2O_4^-$ and PO_4^{2-} b) HPO_4^{3-} and $C_2O_4^{3-}$ c) PO_4^{3-} and $C_2O_4^{2-}$ d) $HC_2O_4^-$ and HPO_4^{2-}

687. 1 M NaCl and 1 M HCl are present in an aqueous solution. The solution is

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

688. The use of methyl orange as an indicator in the volumetric determination of the equivalent weight of a weak acid would lead to:

a) A low value for the equivalent weight

b) A high value for the equivalent weight

c) No error in the value

d) Improved accuracy

689. 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) $H_3O^+ > HF > H_2O > NH_4^+ > OH^-$

690. Which of the following is a Lewis base?

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

691. An aqueous solution of sodium carbonate is alkaline because sodium carbonate is a salt of

a) Weak acid and weak base b) Strong acid and weak base

c) Weak acid and strong base d) Strong acid and strong base

692. Which of the following is least likely to behave as Lewis acid?

a) OH^- b) H_2O c) NH_3 d) BF_3

693. Which statement is false in case of equilibrium state?

a) There is no apparent change in properties with time

b) It is dynamic in nature

c) It can be attained from either side of the reaction

d) It can be attained from the side of the reactants only

694. The active mass of 45 g of KCl in a 3 L flask would be

a) 0.20 b) 2.0 c) 3 d) 4

695. 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?

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

696. 9.2g N_2O_4 is heated in a 1L vessel till equilibrium state is established

$$N_2O_4(g) \rightleftharpoons 2NO_2(g)$$

In equilibrium state 50% N_2O_4 was dissociated, Equilibrium constant will be (mol. wt. of $N_2O_4 = 92$)

a) 0.1 b) 0.4 c) 0.3 d) 0.2

697. At 3000 K, the equilibrium partial pressure of CO_2, CO and O_2 are 0.6, 0.4 and 0.2 atm respectively. K_p for the reaction, $2CO_2 \rightleftharpoons 2CO + O_2$ is

a) 0.088 b) 0.0533 c) 0.133 d) 0.177

698. Aqueous solution of sodium cyanide is
a) Acidic b) Amphoteric c) Basic d) Neutral

699. A mixture of N_2 and H_2 in the mole ratio 1:3 is allowed to attain equilibrium when 50% of mixture has reacted. If P is the equilibrium pressure, then partial pressure of NH_3 formed is:
a) $P/6$ b) $P/2$ c) $P/3$ d) $P/4$

700. CH_3COOH is weaker acid than H_2SO_4. It is due to
a) More ionisation b) Less ionisation c) Covalent bond d) Electrovalent bond

701. Equal volume 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?
a) 3.7×10^{-4} M b) 3.7×10^{-3} M c) 1.11×10^{-3} M d) 1.11×10^{-4} M

702. The ionisation of strong electrolytes in acetic acid, compared to in water, is
a) Weak, low b) Strong, more
c) Medium, the same d) No ionisation, 100%

703. A saturated solution of CaF_2 is 2×10^{-4} mol/L. Its solubility product constant is
a) 2.6×10^{-9} b) 4×10^{-8} c) 4×10^{-12} d) 3.2×10^{-11}

704. The vapour density of PCl_5 is 104.16, but when heated at 230°C. Its vapour density is reduced to 62. The percentage of dissociation of PCl_5 at this temperature will be
a) 6.8% b) 68% c) 46% d) 64%

705. Which is not amphoteric?
a) HSO_4^- b) HCO_3^- c) $H_2PO_4^-$ d) $HCOO^-$

706. An amount of solid NH_4HS is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm pressure. Ammonium hydrogen sulphide decomposes to yield NH_3 and H_2S gases in the flask. When the decomposition reaction reaches equilibrium the total pressure in the flask rises to 0.84 atm? The equilibrium constant for NH_4HS decomposition at this temperature is
a) 0.11 b) 0.17 c) 0.18 d) 0.30

707. The correct order of acetic strength is:
a) $Cl_2O_7 > SO_2 > P_4O_{10}$
b) $CO_2 > N_2O_5 > SO_3$
c) $Na_2O > MgO > Al_2O_3$
d) $K_2O > CaO > MgO$

708. The equilibrium constant K_p for the reaction,
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is
a) More than one b) Less than one c) Equal to K_c d) Zero

709. Which of the following is least soluble?
a) $MnS(K_{sp} = 7 \times 10^{-16})$
b) $FeS(K_{sp} = 7 \times 10^{-19})$
c) $PtS(K_{sp} = 8 \times 10^{-73})$
d) $NiS(K_{sp} = 3 \times 10^{-12})$

710. The best explanation for the solubility of MnS in dil. HCl is that:
a) Solubility product of $MnCl_2$ is less than that of MnS
b) Concentration of Mn^{2+} is lowered by the formation of complex ions with chloride ions
c) Concentration of sulphide ions is lowered by oxidation to free sulphur
d) Concentration of sulphide ions is lowered by formation of the weak acid H_2S

711. If the pOH of a solution is 6.0, then pH is:
a) 6 b) 8 c) 10 d) 14

712. If the pH of a solution is 2, its normality will be:
a) 2 N b) 0.5 N c) 0.01 N d) None of these

713. The pH of solution, whose hydrogen ion concentration is one mole per litre, will be:
a) 1.0 b) 0.1 c) Zero d) 1.5

714. Consider the reaction equilibrium
$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g), \Delta H° = -198$ kJ
On the basis of Le-Chatelier's principle, the condition favourable for the forward reaction is
a) Lowering of temperature as well as pressure
b) Lowering the temperature and increasing the pressure
c) Increasing the temperature and pressure
d) Any value of temperature and pressure

715. NH_4Cl is acidic because
a) On hydrolysis NH_4Cl gives weak base NH_4OH and strong acid HCl
b) Nitrogen donates a pair of electrons
c) It is a salt of weak acid and strong base
d) On hydrolysis NH_4Cl gives strong base and weak acid

716. In a buffer solution consisting of a weak acid and its conjugate base, the ratio of concentration of conjugate base to acid is increased tenfold; then the pH of the solution will:
a) Increase by one b) Increase tenfold c) Decrease by one d) Decrease tenfold

717. The solubility in water of a sparingly soluble salt AB_2 is 1.0×10^{-5} mol/litre. Its solubility product is:
a) 1×10^{-15} b) 1×10^{-10} c) 4×10^{-15} d) 4×10^{-10}

718. If ClO_3^- is chlorate ion, then $HClO_3$ is:
a) Hydrochloride acid b) Chlorous acid c) Chloric acid d) Chlorate acid

719. Which of the following is not a Lewis base?
a) H_2O b) Ag^+ c) NH_3 d) OH^-

720. For a system in equilibrium, $\Delta G = 0$, under conditions of constant
a) Temperature and pressure b) Energy and volume
c) Temperature and volume d) Pressure and volume

721. In 100 mL of an aqueous HCl of pH 1.0, 900 mL of distilled water is added, the pH of the resultant solution becomes:
a) 1.0 b) 2.0 c) 4.0 d) 7.0

722. 20 mL of a 0.1 N HCl is mixed with 20 mL of a 0.1 N KOH solution. The pH of the solution would be:
a) Zero b) 7 c) 2 d) 9

723. In a system : $A(s) \rightleftharpoons 2B(g) + 3C(g)$. If the concentration of C at equilibrium is increased by a factor 2, it will cause the equilibrium concentration of B to change to:
a) Two times of its original value
b) One half of its original value
c) $2\sqrt{2}$ times of its original value
d) $\frac{1}{2\sqrt{2}}$ times of its original value

724. The Bronsted acid which gives the weakest conjugate base is:
a) HF b) H_2S c) H_2O d) HCl

725. How much sodium acetate should be added to 0.1 M solution of CH_3COOH to give a solution of pH = 5.5 (p$K_a$of CH_3COOH = 4.5)?
a) 0.1 M b) 0.01 M c) 1.0 M d) 10.0 M

726. Which solution has pH equal to 10?
a) 10^{-4} M KOH b) 10^{-10} M KOH c) 10^{-10} M HCl d) 10^{-4} M HCl

727. A saturated solution prepared by dissolved $CaF_2(s)$ in water, has $[Ca^{2+}] = 3.3 \times 10^{-4}$ M. What is the $K_{sp}$of CaF_2?
a) 1.44×10^{-10} b) 2.24×10^{-8} c) 1.58×10^{-8} d) 1.67×10^{-8}

728. When 1.0 mL of dil. HCl acid is added to 100 mL of a buffer solution of pH 4.0, the pH of the solution:
a) Becomes 7 b) Does not change c) Becomes 2 d) Becomes 10

729. The pH of blood is:

a) Less than 6
b) Greater than 7 and less than 8
c) Greater than 8 and less than 9
d) Greater than 10

730. The unit of equilibrium constant, K for the reaction, $A + B \rightleftharpoons C$, would be

a) mol L^{-1} b) mol L c) L mol^{-1} d) Dimensionless

731. Which statement is correct?

a) An acid and its conjugate base react to form salt and water
b) The acid H_2O is its own conjugate base
c) The conjugate base of a weak acid is a strong base
d) The conjugate base of a strong acid is strong base

732. From separate solutions of four sodium salts NaW, NaX, NaY and NaZ had pH 7.0, 9.0, 10.0 and 11.0 respectively. When each solution was 0.1 M, the strongest acid is:

a) HW
b) HX
c) HY
d) HZ

733. Which information can be obtained from Le-Chatelier's principle?

a) Shift in equilibrium position on changing P, T and concentration
b) Dissociation constant of a weak acid
c) Energy change in a reaction
d) Equilibrium constant of a chemical reaction

734. The solubility product of Hg_2I_2 is equal to:

a) $[Hg_2^{2+}][I^-]$ b) $[Hg^{2+}][I^-]$ c) $[Hg_2^{2+}][I^-]^2$ d) $[Hg^{2+}]^2[I^-]^2$

735. The pH of a solution formed by mixing 40 mL of 0.10 M HCl and 10 mL of 0.45 M NaOH is:

a) 5 b) 8 c) 12 d) 10

736. The correct relationship between K_c and K_p in gaseous equilibrium is :

a) $K_c = K_p\,(RT)^{\Delta n}$
b) $K_p = K_c\,(RT)^{\Delta n}$
c) $\frac{K_c}{RT} = (K_p)^{\Delta n}$
d) $\frac{K_P}{RT} = (K_c)^{\Delta n}$

737. In a mixture of CH_3COOH and CH_3COONa, the ratio of salt to acid concentration is increased by ten folds. The pH of the solution will increase by:

a) Zero b) 1 c) 2 d) 3

738. NaOH(aq), HCl(aq)andNaCl(aq) concentration of each is 10^{-3} M. Their pH will be respectively

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

739. At 25°C, the equilibrium K_1, K_2 and K_3 of three reactions are :

$N_2 + 3H_2 \rightleftharpoons 2NH_3; K_1$

$N_2 + O_2 \rightleftharpoons 2NO; K_2$

$H_2 + \frac{1}{2}O_2 \rightleftharpoons H_2O; K_3$

The equilibrium constants for the oxidation of NH_3 by oxygen to give NO is :

a) K_3^2/K_1 b) $K_2^2K_3/K_1$ c) K_1K_2/K_3 d) $K_2K_3^3/K_1$

740. Which of the following is the strongest base?

a) $C_2H_5^-$ b) $C_2H_5COO^-$ c) $C_2H_5O^-$ d) H_2PO_4

741. The equilibrium constant, K for the reaction

$2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

At room temperature is 2.85 and that at 698 K, it is 1.4×10^{-2}. This implies that

a) HI is resonance stabilised b) HI is exothermic compound

c) HI is stable at room temperature d) HI is less stable than H_2 and I_2

742. If the solubility product of $BaSO_4$ is 1.5×10^{-10} in water. Its solubility, in moles per litre, is
a) 1.5×10^{-9} b) 3.9×10^{-5} c) 7.5×10^{-5} d) 1.5×10^{-5}

743. Soda water has a pH value:
a) Less than 7 b) More than 7 c) 7 d) Greater than 14

744. According to Le-Chatelier's principle, if heat is given to solid-liquid system, then
a) Quantity of solid will reduce b) Quantity of liquid will reduce
c) Temperature will increase d) Temperature will decrease

745. The salt that does not hydrolyse, is:
a) $SnCl_2$ b) $FeCl_3$ c) $SnCl_4$ d) $CaCl_2$

746. An acid-base indicator has $K_a = 3.0 \times 10^{-5}$. The acid form of the indicator is red and the basic form is blue. The $[H^+]$ required to change the indicator from 75% red to 75% blue is:
a) $8 \times 10^{-5}\ M$ b) $9 \times 10^{-5} M$ c) $1 \times 10^{-5} M$ d) $3 \times 10^{-4} M$

747. When ammonium chloride is added to a solution of ammonium hydroxide,
a) Dissociation of NH_4OH increases b) Concentration of OH^- increases
c) Concentration of NH_4^+ and OH^- increases d) Concentration of NH_4^+ decreases

748. The pH of an aqueous solution having hydroxide ion concentration as 1×10^{-5} is
a) 5 b) 9 c) 4.5 d) 11

749. In the manufacture of NH_3 by Haber's process, the condition which would give maximum yield is
$N_2 + 3H_2 \rightleftharpoons 2NH_3 + Q$ kcal
a) Low temperature and high pressure
b) Low temperature, low pressure and low concentration of H_2
c) High temperature, low pressure and low concentration
d) High temperature, high pressure and high concentration

750. In water, the acid $HClO_4$, HCl, H_2SO_4 and HNO_3 exhibit the same strength as they are completely ionised in water (a base). This is called … of the solvent water.
a) Strength b) Capacity c) Buffer effect d) Levelling effect

751. Which of the following solutions will have pH close to 1.0?
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

752. For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$; $\Delta H = -93.6\ \text{kJ mol}^{-1}$, the concentration of NH_3 at equilibrium can be increased by
(I) lowering the temperature
(II)low pressure
(III)excess of N_2
(IV)excess of H_2
a) (II) and (IV) are correct b) (II) only is correct
c) (I), (II) and (III) are correct d) (III) and (IV) are correct

753. Some salts although containing two different metallic elements give test for only one of them in solution. Such salts are:
a) Double salts b) Normal salts c) Complex salts d) None of these

754. Which statement is correct?
a) NH_4OH is a strong base
b) CH_3COONa given acidic solution in water
c) CH_3COOH is a weak acid
d) NH_4Cl gives alkaline solution in water

755. Which one of the following species acts as both Bronsted acid and base?
a) $H_2PO_2^-$ b) HPO_3^{2-} c) HPO_4^{2-} d) All of these

756. Which one is the strongest base?

a) OH^- b) RO^- c) NH_2^- d) R^-

757. To a mixture of acetic acid and sodium acetate a further amount of sodium acetate is added. The pH of the mixture:

a) Increases b) Decreases c) Remains unchanged d) Not predictable

758. Ionisation constant of CH_3COOH is 1.7×10^{-5} and $[H^+]$ ions is 3.4×10^{-4}. Then, initial concentration of CH_3COOH molecules is

a) 6.8×10^{-3} b) 2.5×10^{-4} c) 3.5×10^{-3} d) 4.5×10^{-3}

759. 0.023 g of sodium metal is reached with 100 cm^3 of water. The pH of the resulting solution is

a) 10 b) 11 c) 9 d) 12

760. For the reaction, $N_2 + 3H_2 \rightleftharpoons 2NH_3$ in a vessel, after the addition of equal number of mole of N_2 and H_2, equilibrium state is formed. Which of the following is correct?

a) $[H_2] = [N_2]$ b) $[H_2] < [N_2]$ c) $[H_2] > [N_2]$ d) $[H_2] > [NH_3]$

761. 1.1 mole of A are mixed with 2.2 mole of B and the mixture is then kept in one litre flask till the equilibrium is attained $A + 2B \rightleftharpoons 2C + D$. At the equilibrium 0.2 mole of C are formed. The equilibrium constant of the reaction is :

a) 0.001 b) 0.002 c) 0.003 d) 0.004

762. 50% neutralization of a solution of formic acid ($K_a = 2 \times 10^{-4}$) with NaOH would result in a solution having a hydrogen ion concentration of:

a) 2×10^{-4} b) 3.7 c) 2.7 d) 1.85

763. pH of K_2S solution is:

a) > 7 b) < 7 c) 7 d) Zero

764. If pressure is applied to the following equilibrium, Liquid $\rightleftharpoons$ Vapour. The boiling point of the liquid:

a) Will decrease b) Will increase c) May not change d) Will not change

765. The extent of ionisation increases

a) With the increase in concentration b) On addition of excess water to the solution
c) On decreasing the temperature of solution d) On stirring the solution vigorously

766. Which one of the following salts will produce an alkaline solution while dissolving in water?

a) NH_4Cl b) Na_2CO_3 c) $NaNO_3$ d) Na_2SO_4

767. Which addition would not change the pH of 10 mL of dilute hydrochloric acid?

a) 20 mL of the same dilute hydrochloric acid
b) 5 mL of pure water
c) 20 mL of pure water
d) 10 mL of concentrated hydrochloric acid

768. Which does not contribute significantly to acid rains?

a) SO_3 b) NO_2 c) CO_2 d) CO

769. Given that the equilibrium constant for the reaction

$$2SO_{2(g)} + O_{2(g)} \rightleftharpoons 2SO_{3(g)}$$

has a value of 278 at a particular temperature. What is the value of the equilibrium constant for the following reaction at the same temperature?

$$SO_{3(g)} \rightleftharpoons SO_{2(g)} + \frac{1}{2}O_{2(g)}$$

a) 1.8×10^{-3} b) 3.6×10^{-3} c) 6.0×10^{-2} d) 1.3×10^{-5}

770. The equilibrium constant for the reaction, $HONO + CN^- \longrightarrow HCN + ONO^-$ is 1×10^{-14}. The magnitude of the equilibrium constant suggests that:

a) CN^- is stronger base than ONO^-
b) HCN is stronger acid than HONO
c) ONO^- is the conjugate base of HONO
d) The conjugate acid of CN^- is HCN

771. A buffer solution contains 0.1 mole of sodium acetate dissolved in 1000 cm^3 of 0.1 M acetic acid.

To the above buffer solution, 0.1 mole of sodium acetate is further added and dissolved. The pH of the resulting buffer is

a) pK_a b) $pK_a + 2$ c) $pK_a - \log 2$ d) $pK_a + \log 2$

772. Some chemists at ISRO wished to prepare a saturated solution of a silver compound and they wanted it to have the highest concentration of silver ion possible. Which of the following compounds, would they use?

$K_{sp}(\mathrm{AgCl}) = 1.8 \times 10^{-10}$

$K_{sp}(\mathrm{AgBr}) = 5.0 \times 10^{-13}$

$K_{sp}(\mathrm{Ag_2CrO_4}) = 2.4 \times 10^{-12}$

a) AgCl b) AgBr c) Ag_2CrO_4 d) None of these

773. Ostwald's dilution law is applicable in the case of the solution of:

a) CH_3COOH b) NaCl c) NaOH d) H_2SO_4

774. H_2S is passed into one dm^3 of a solution containing 0.1 mole of Zn^3 and 0.01 mole of Cu^2 till the sulphide ion concentration reaches 8.1 10^{10} moles. Which one of the following statements is true?

[K_{sp} of Zn and CuS are 3 10^{22} and 8 10^{36} respectively]

a) Only ZnS precipitates b) Both CuS and ZnS precipita c) Only CuS precipitates d) No precipitation occurs

775. The degree of dissociation of 0.1 M HCN solution is 0.01% its ionisation constant would be

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

776. Solubility of a gas in liquid increases on:

a) Addition of a catalyst
b) Increasing the pressure
c) Decreasing the pressure
d) Increasing the temperature

777. In chemical reaction, $A \rightleftharpoons B$, the system will be known in equilibrium when

a) 50% of A changes to B
b) A completely changes to B
c) Only 10% of A changes to B
d) The rate of change of A to B and B to A on both the sides are same

778. For a polyprotic acid say H_3PO_4, its three dissociation constant K_1, K_2 and K_3 are in the order:

a) $K_1 < K_2 < K_3$ b) $K_1 > K_2 > K_3$ c) $K_1 = K_2 = K_3$ d) $K_1 = K_2 > K_3$

779. The reaction, $A + 2B \rightleftharpoons 2C + D$ was studied using an initial concentration of B which was 1.5 times that of A. But the equilibrium concentration of A and C were found to be equal. Then the K_c for the equilibrium is :

a) 4 b) 8 c) 6 d) 0.32

780. 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) $K_{sp} = [Al^{3+}]^2[SO_4^{2-}]^2$

781. If the dissociation constant of an acid HA is 1×10^{-5}, the pH of a 0.1 M solution of the acid HA will be approximately:

a) 3 b) 5 c) 1 d) 6

782. Calculate the pOH of a solution at 25°C that contains 1×10^{-10} M of hydronium ions *i.e.*, H_3^+O:

a) 4 b) 9 c) 1 d) 7

783. When a strong acid-strong base or their salt are dissolved in water, they are completely ionised. If a strong acid is added to a strong base, H^+ ions from the former combines with OH^- ions of the latter forming water. The formation of each water molecule liberates a certain quantity of energy and the reaction is exothermic. The heat liberated when one mole of water is formed by combining hydrochloric acid and sodium hydroxide is 13.7 kcal. The heat liberated when one mole of water is formed by combining

sulphuric acid and sodium hydroxide is:

a) 34 kcal b) 13.7 kcal c) 8.5 kcal d) 25.5 kcal

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

a) 2 mL b) 4 mL c) 8.2 mL d) 6.4 mL

785. The equilibrium constants for the reactions are:

$$H_3PO_4 \xrightleftharpoons{K_1} H^+ + H_2PO_4^- ; \quad K_1$$

$$H_2PO_4^- \xrightleftharpoons{K_2} H^+ + H_2PO_4^{2-} ; \quad K_2$$

$$HPO_4^{2-} \xrightleftharpoons{K_3} H^+ + PO_4^{3-} ; \quad K_3$$

The equilibrium constant for

$H_3PO_4 \rightleftharpoons 3H^+ + PO_4^{3-}$ will be:

a) K_1/K_2K_3 b) $K_1 \times K_2 \times K_3$ c) K_2/K_1K_3 d) $K_1 + K_2 + K_3$

786. Four moles of PCl_5 are heated in a closed 4 dm^3 container to reach equilibrium at 400 K. at equilibrium 50% of PCl_5 is dissociated. What is the value of K_c for the dissociation of PCl_5 into PCl_3 and Cl_2 at 400 K?

a) 0.50 b) 1.00 c) 1.15 d) 0.05

787. Favourable conditions for manufacture of ammonia by the reaction.

$N_2 + 3H_2 \rightleftharpoons 2NH_3$; $\Delta H = -21.9$ kcal are:

a) Low temperature, low pressure and catalyst

b) Low temperature, high pressure and catalyst

c) High temperature, low pressure and catalyst

d) High temperature, high pressure and catalyst

788. If K_{sp} of Ag_2S is 10^{-17}, the solubility of Ag_2S in 0.1 M solution of Na_2S will be

a) 10^{-8} b) 5×10^{-9} c) 10^{-15} d) 10^{-16}

789. 5 moles of $SO_2$and 5 moles of O_2 are allowed to react to forms SO_3 in a closed vessel. At the equilibrium stage 60% of SO_2 is used up. The total number of moles of SO_2, O_2 and SO_3 in the vessel now is

a) 8.5 b) 9.5 c) 10 d) 10.5

790. How many gram of CaC_2O_4 will dissolve in one litre of saturated solution? K_{sp} of CaC_2O_4 is $2.5 \times 10^{-9} M^{-2}$ and its molecular weight is 128:

a) 0.0064 g b) 0.0128 g c) 0.0032 g d) 0.0640 g

791. In the iodometric estimation in laboratory which process is involved?

a) $Cr_2O_7^{2-} + H^+ + I^- \longrightarrow 2Cr^{5+} + I_2$
$I_2 + S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + I^-$

b) $MnO_4^- + H^+ + I^- \longrightarrow Mn^{2+} + I_2$
$I_2 + S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + I_2$

c) $MnO_4^- + OH^- + I^- \longrightarrow MnO_2 + I_2$
$I_2 + S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + I^-$

d) $Cr_2O_7^{2-} + OH^- + I^- \longrightarrow 2Cr^{3+} + I_2$
$I_2 + S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + I^-$

792. Equilibrium constant K_1 and K_2 for the following equilibria

$NO(g) + \frac{1}{2}O_2 \xrightleftharpoons{K_1} NO_2(g)$

and, $2NO_2(g) \xrightleftharpoons{K_2} 2NO(g) + O_2(g)$ are related as

a) $K_1 = \frac{1}{K_2}$ b) $K_2 = \frac{1}{K_1}$ c) $K_2 = \frac{1}{K_1^2}$ d) $K_1 = \frac{1}{K_2^2}$

793. A sample of $Na_2CO_3 \cdot H_2O$ weighing 0.62 g is added to 100 mL of 0.1 N $(NH_4)_2SO_4$ solution. What will be the resulting solution?

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

794. For which one of the following reactions $K_p = K_c$?

a) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ b) $N_2 + O_2 \rightleftharpoons 2NO$ c) $N_2 + 3H_2 \rightleftharpoons 2NH_3$ d) $2SO_3 \rightleftharpoons 2SO_2 + O_2$

795. K_{sp} of AgCl at 18°C is 1.8×10^{-10}. If Ag^+ of sodium is 4×10^{-3} mol/litre the Cl^- that must exceed before AgCl is precipitated would be:
a) 4.5×10^{-8} mol/litre
b) 7.2×10^{-13} mol/litre
c) 4.0×10^{-3} mol/litre
d) 4.5×10^{-7} mol/litre

796. The equilibrium constant (K_p) for the decomposition of gaseous H_2O

$$H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)$$

is related to degree of dissociation (α) at a total pressure p is given by
a) $K_p = \frac{\alpha^3 p^{1/2}}{(1+\alpha)(2+\alpha)^{1/2}}$ b) $K_p = \frac{\alpha^3 p^{3/2}}{(1-\alpha)(2+\alpha)^{1/2}}$ c) $K_p = \frac{\alpha^{3/2} p^2}{(1-\alpha)(2+\alpha)^{1/2}}$ d) $K_p = \frac{\alpha^{3/2} p^{1/2}}{(1-\alpha)(2+\alpha)^{1/2}}$

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

798. pH of 1 M NH_3 aqueous solution is
$(K_b = 1.8 \times 10^{-5})$
a) 11.13 b) 12.5 c) 13.42 d) 11.55

799. K_a for formic acid and acetic acid are 2.1×10^{-4} and 1.1×10^{-5} respectively. The relative strength of acids is:
a) 2 : 1 b) 2.3 : 1 c) 1 : 2.1 d) 4.36 : 1

800. Would gaseous HCl be considered as an Arrhenius acid?
a) Yes b) Nor
c) Not known d) Gaseous HCl does not exist

801. According to Le-Chatelier's principle, the addition of temperature to the following reaction

$$CO_2(g) + 2H_2O(g) \rightarrow CH_4(g) + 2O_2(g)$$

will cause it to the right. This reaction is, therefore
a) Exothermic b) Unimolecular c) Endothermic d) Spontaneous

802. The degree of dissociation of $PCl_5(\alpha)$ obeying the equilibrium,
$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, is approximately related to the pressure at equilibrium by:
a) $\alpha \propto P$ b) $\alpha \propto \frac{1}{\sqrt{P}}$ c) $\alpha \propto \frac{1}{P^2}$ d) $\alpha \propto \frac{1}{P^4}$

803. Solubility product of MX_2 at 298 K is 4×10^{-12}. At this temperature concentration of M^{2+} ion in mol per litre is:
a) $2 \times 10^{-6} M$ b) $1 \times 10^{-4} M$ c) $1.6 \times 10^{-4} M$ d) $4 \times 10^{-6} M$

804. A reaction attains equilibrium when the Gibbs energy change accompanying the reaction is:
a) Positive and large b) Zero c) Negative and large d) Negative and small

805. $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$
In the above reaction, if the pressure at equilibrium and at 300 K is 100 atm then what will be the equilibrium constant K_p?
a) 2500 atm^2 b) 50 atm^2 c) 100 atm^2 d) 200 atm^2

806. The solubility product of a sparingly salt AX_2 is 3.2×10^{-11}. Its solubility (in mol/L) is
a) 5.6×10^{-6} b) 3.1×10^{-4} c) 2×10^{-4} d) 4×10^{-4}

807. If the solubility product of $AgBrO_3$ and Ag_2SO_4 are 2×10^{-5} and 5.5×10^{-5} respectively, the relationship between the solubilities of these can be correctly represented as:
a) $sAgBrO_3 > sAg_2SO_4$ b) $sAgBrO_3 < sAg_2SO_4$ c) $sAgBrO_3 = sAg_2SO_4$ d) $sAgBrO_3 \equiv sAg_2SO_4$

808. The conjugate acid of HPO_4^{2-} is:
a) $H_2PO_4^-$ b) PO_4^{3-} c) H_3PO_4 d) H_3PO_3

809. The colour of an electrolyte solution depends on:

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

810. The resultant pH of a solution on mixing 200 mL of an aqueous solution of HCl (pH $= 2.0$) is mixed with 300 mL of an aqueous solution of NaOH (pH $= 12.0$) is:
a) 11.0310 b) 11.3010 c) 10.000 d) None of these

811. If ΔG^0 for the reaction given below is 1.7 kJ; the equilibrium constant of the reaction, $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ at 25°C is :
a) 24.0 b) 3.9 c) 2.0 d) 0.5

812. In a reaction, $A + B \rightleftharpoons C + D$, the concentrations of A, B, C and D (in mol/L) are 0.5, 0.8, 0.4 and 1.0 respectively. The equilibrium constant is
a) 0.1 b) 1.0 c) 0.5 d) 5.0

813. The solvent which is neither proton donor nor proton acceptor is called:
a) Amphoteric b) Neutral c) Aprotic d) Protonic

814. The equilibrium constant of a reaction is 20.0. At equilibrium, the rate constant of forward reaction is 10.0. The rate constant for backward reaction is :
a) 0.5 b) 2.0 c) 10.0 d) 200.0

815. For the reversible reaction,
$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ at 500°C, the value of K_p is 1.44×10^{-5}. When partial pressure is measured in atmospheres. The corresponding value of K_c with concentration in mol L^{-1} is
a) $1.44 \times 10^{-5}/(0.082 \times 773)^{-3}$ b) $1.44 \times 10^{-5}/(0.082 \times 500)^{-2}$
c) $1.44 \times 10^{-5}/(8.314 \times 773)^{2}$ d) $1.44 \times 10^{-5}/(0.082 \times 773)^{-2}$

816. The pH of the solution produced when an aqueous solution of strong acid pH 5 is mixed with equal volume of an aqueous solution of strong acid of pH 3 is:
a) 3.3 b) 3.5 c) 4.5 d) 4.0

817. Given, $HF + H_2O \xrightarrow{K_a} H_3O^+ + F^-$,
$F^- + H_2O \xrightarrow{K_b} HF + OH^-$
Which relation is correct?
a) $K_b = K_w$ b) $K_b = \frac{1}{K_w}$ c) $K_a \times K_b = K_w$ d) $\frac{K_a}{K_b} = K_w$

818. The pH of a solution is 4. The hydrogen ion concentration of the solution in mol/L is
a) 9.5 b) 10^{-4} c) 10^{4} d) 10^{-2}

819. Which one of the following statements is not true?
a) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}
b) pH + pOH = 14 for all aqueous solutions
c) The pH of 1×10^{-8} M HCl is 8
d) 96,500 C of electricity when passed through a $CuSO_4$ solution deposits 1 g equivalent of copper at the cathode

820. The correct representation for the solubility product constant of Ag_2CrO_4 is:
a) $[Ag^+]^2[CrO_4^{2-}]$ b) $[Ag^+][CrO_4^{2-}]$ c) $[2Ag^+][CrO_4^{2-}]$ d) $[2Ag^+]^2[CrO_4^{2-}]$

821. For a reversible reaction, the rate constant for the forward reaction is 2.38×10^{-4} and for the backward reaction is 8.15×10^{-5}. The K_c for the reaction is :
a) 0.342 b) 2.92 c) 0.292 d) 3.42

822. The pH of a soft drink is 3.82. Its H^+ ion concentration will be:
a) 1.96×10^{-2} mol/litre b) 1.96×10^{-3} mol/litre c) 1.5×10^{-4} mol/litre d) 1.96×10^{-1} mol/litre

823. The decreasing order of strength of the bases,
$OH^-, NH_2^-, H—C \equiv C^-$ and $CH_3—CH_2^-$, is:
a) $CH_3—CH_2^- > NH_2^- > H—C \equiv C^- > OH^-$

b) $H—C \equiv C^- > CH_3—CH_2^- > NH_2^- > OH^-$
c) $OH^- > NH_2^- > H—C \equiv C^- > CH_3—CH_2^-$
d) $NH_2^- > H—C \equiv C^- > OH^- > CH_3—CH_2^-$

824. The metallic sulphide not precipitated if H_2S gas is passed through an aqueous solution containing cuprous chloride, bismuth chloride, mercuric chloride and sodium chloride is:
a) CuS b) Bi_2SO_3 c) HgS d) Na_2S

825. pH of 1×10^{-8} M nitric acid solution will be
a) 6 b) 6.96 c) 7.96 d) 8

826. Indicate the correct answer out of the following for the reaction,
$NH_4Cl + H_2O \rightleftharpoons NH_4OH + HCl$
a) The reaction is retarded by the addition of KOH
b) The reaction is favoured by the addition of NH_4OH
c) The reaction is retarded by the addition of hydrogen ion
d) None of the above

827. The salt of strong acid and weak base ($FeCl_2$) is
a) Acidic b) Basic c) Neutral d) None of these

828. For the following reaction in gaseous phase
$$CO + \frac{1}{2}O_2 \longrightarrow CO_2$$
K_c/K_p is
a) $(RT)^{1/2}$
b) $(RT)^{-1/2}$
c) (RT)
d) $(RT)^{-1}$

829. For a reaction if $K_p > K_c$ the forward reaction is favoured by
a) Low pressure b) High pressure c) High temperature d) Low temperature

830. What will be the pH value of 0.05M $Ba(OH)_2$ solution?
a) 12 b) 13 c) 1 d) 12.96

831. pH of a saturated solution of $Ba(OH)_2$ is 12. The value of solubility product (K_{sp}) of $Ba(OH)_2$ is:
a) 4.0×10^{-6} b) 5.0×10^{-6} c) 3.3×10^{-7} d) 5.0×10^{-7}

832. The conjugate base of H_2SO_4 is
a) SO_4^{2-} b) HSO_4^- c) HSO_4^+ d) H_3SO_4

833. For the reaction, $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$, the value of K_c at 250°C is 26. The value of K_p at this temperature will be
a) 0.41 b) 0.51 c) 0.61 d) 0.71

834. The pH of a 10^{-10} M NaOH solution is nearest to
a) 10 b) 7 c) 4 d) -10

835. Which can act as buffer?
a) $NH_4Cl + NH_4OH$
b) $CH_3COOH + CH_3COONa$
c) 40 mL of 0.1 M NaCN + 20 mL of 0.1 M HCl
d) All of the above

836. The pH indicators are
a) Salts of strong acids and strong bases b) Salts of weak acid and weak bases
c) Either weak acids or weak bases d) Either strong acid or strong bases

837. Phenolphthalein is a:
a) Weak acid b) Weak base c) Strong acid d) Strong base

838. The solubility product of Hg_2I_2 is equal to
a) $[Hg_2^{2}\ ][I\ ]$ b) $[Hg^{2}\ ][I\ ]$ c) $[Hg_2^{2}\ ][I\ ]^2$ d) $[Hg^{2}\ ][I\ ]^2$

839. The rate at which a substance reacts depends on its

a) Atomic weight b) Atomic number c) Molecular weight d) Active mass

840. The compound HCl behaves as … in the reaction,

$HCl + HF \longrightarrow H_2^+Cl + F^-$

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

841. At temperature T, a compound AB_2 (g) dissociated according to the reaction $2AB_2$ (g) $\rightleftharpoons 2AB(g) + B_2(g)$ with a degree of dissociation x, which is small compared with unity. The expression for K_p, in terms of x and the total pressure P, is:

a) $\frac{Px^3}{2}$ b) $\frac{Px^2}{3}$ c) $\frac{Px^3}{3}$ d) $\frac{Px^2}{2}$

842. Which of the following is not a Lewis acid?

a) BF_3 b) $AlCl_3$ c) SO_2 d) H_2O

843. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionization constant, K_a of this aid is:

a) 1×10^{-3} b) 1×10^{-5} c) 1×10^{-7} d) 3×10^{-1}

844. For the precipitation of IInd group cations only the solution is made acidic so that:

a) The sulphide ion concentration may increase

b) The sulphide ion concentration may decrease

c) The H^+ ion concentration may increase

d) The cations concentration may increase

845. Let the solubility of an aqueous solution of $Mg(OH)_2$ be X then its K_{sp} is

a) $4x^3$ b) $108x^5$ c) $27x^4$ d) $9x$

846. In the equilibrium,$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$, the partial pressure of SO_2, O_2 and SO_3 are 0.662, 0.101 and 0.331 atm respectively. What should be the partial pressure of oxygen so that the equilibrium concentration of SO_2 and SO_3 are equal?

a) 0.4 atm b) 1.0 atm c) 0.8 atm d) 0.25 atm

847. In the following reaction,

$AgCl + KI \rightleftharpoons KCl + AgI$

as KI is added, the equilibrium is shifted towards right giving more AgI precipitate. because

a) Both AgCl and AgI are sparingly soluble

b) The K_{sp} of AgI is lower than K_{sp} of AgCl

c) The K_{sp} of AgI is higher than K_{sp} of AgCl

d) Both AgCl and AgI have same solubility product

848. Which of the following is a Lewis base?

a) NaOH b) NH_3 c) BCl_3 d) All of these

849. The ionisation constant of NH_4^+ in water is 5.6×10^{-10} at 25°C. The rate constant for the reaction of NH_4^+ and OH^- to form NH_3 and H_2O at 25°C is 3.4×10^{10} L mol^{-1}s^{-1}. The rate constant for proton transfer from water to NH_3 is:

a) 6.07×10^5 s^{-1} b) 6.07×10^{-10} s^{-1} c) 6.07×10^{-5} s^{-1} d) 6.07×10^{10} s^{-1}

850. K_{sp} for AgCl in water at 25°C is 1.8×10^{-10}. If 10^{-5} mol of Ag^+ ions are added to this solution. K_{sp} will be:

a) 1.8×10^{-16} b) 1.8×10^{-10} c) 1.8×10^{-5} d) None of these

851. The reaction which proceeds in the forward direction is :

a) $Fe_2O_3 + 6HCl = 2FeCl_3 + 3H_2O$

b) $SnCl_4 + Hg_2Cl_2 = SnCl_2 + 2HgCl_2$

c) $NH_3 + H_2O + NaCl = NH_4Cl + NaOH$

d) $2CuI + I_2 + 4K^+ = 2Cu^{2+} + 3KI$

852. The chemical equilibrium of a reversible reaction is not influenced by

a) Pressure b) Catalyst

c) Concentration of the reactants d) Temperature

853. A 0.01 M ammonia solution is 5 % ionised, its pH will be
a) 11.80 b) 10.69 c) 7.22 d) 12.24

854. For the decomposition reaction
$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$
The $K_p = 2.9 \times 10^{-5} atm^3$. The total pressure of gases at equilibrium when 1 mole of $NH_2COONH_4(g)$ was taken to start with would be
a) 0.0766 atm b) 0.0582 atm c) 0.0388 atm d) 0.0194 atm

855. 3 moles of A and 4 moles of B are mixed together and allowed to come into equilibrium according to the following reaction.
$$3A(g) + 4B(g) \rightleftharpoons 2C(g) + 3D(g)$$
When equilibrium is reached, there is 1 mole of C.
The equilibrium extent of the reaction is
a) $\frac{1}{4}$ b) $\frac{1}{3}$ c) $\frac{1}{2}$ d) 1

856. For the reaction, $C_2H_4 + H_2 \rightleftharpoons C_2H_6$
The correct relation is
a) $K_p = K_c$ b) $K_p = K_c[RT]$ c) $K_p = K_c[RT]^{-2}$ d) $K_p = K_c[RT]^{-1}$

857. Which solution will have pH closer to 1.0?
a) 100 mL of $(M/10)$ HCl + 100 mL of $(M/10)$ NaOH
b) 55 mL of $(M/10)$ HCl + 45 mL of $(M/10)$ NaOH
c) 10 mL of $(M/10)$ HCl + 90 mL of $(M/10)$ NaOH
d) 75 mL of $(M/5)$ HCl + 25 mL of $(M/5)$ NaOH

858. Which of the following is a Lewis acid?
a) Cl^- b) H_3O^+ c) PF_3 d) C_2H_5OH

859. A buffer solution can be prepared from a mixture of
(i)sodium acetate and acetic acid in water
(ii) sodium acetate and hydrochloric acid in water
(iii) ammonia and ammonium chloride in water
(iv) ammonia and sodium hydroxide in water
a) (i), (ii) b) (ii), (iii) c) (iii), (iv) d) (i), (iii)

860. An equilibrium mixture of the reaction, $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$ contains 0.120 mole of NO_2, 0.080 mole of NO and 0.640 mole of O_2 in a 4 litre flask at constant temperature. The value of K_c for the reaction at this temperature is:
a) 14 b) 24 c) 7 d) 28

861. For the reaction,
$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, the value of K_c at 800°C is 0.1. When the equilibrium concentration of both the reactants is 0.5 mole, what is the value of K_p at the same temperature?
a) 0.5 b) 0.1 c) 0.01 d) 0.025

862. The equilibrium,
$P_4(s) + 6Cl_2(g) \rightleftharpoons 4PCl_3(g)$ attained by mixing equal moles of P_4 and Cl_2 in a evacuated vessel. Then, at equilibrium,
a) $[Cl_2] > [PCl_3]$ b) $[Cl_2] > [P_4]$ c) $[P_4] > [Cl_2]$ d) $[PCl_3] > [P_4]$

863. The yield of product in the reaction $A_2(g) + 2B(g) \rightleftharpoons C(g) + Q$ kJ would be high at
a) High temperature and high pressure b) High temperature and low pressure
c) Low temperature and high pressure d) Low temperature and low pressure

864. According to law of mass action, rate of a chemical reaction is proportional to
a) Molar concentration of reactants b) Concentration of reactants
c) Concentration of products d) Molar concentration of products

865. If NaOH is added to a solution of acetic acid:

a) H^+ ions increases b) pH decreases c) $[C_2H_3O_2]^-$ increases d) $[HC_2H_3O_2]$ increases

866. What is the effect of having the pressure by doubling the volume on the following system at 500°C?

$$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$$

a) Shift to reactant side b) Shift to product formation

c) Liquefaction of HI d) No effect

867. The solubility product (K_{sp}) of the following compounds are given at 25°C

Compound	K_{sp}
AgCl	$1.1\ \ 10^{10}$
AgI	$1.0\ \ 10^{16}$
$PbCrO_4$	$4.0\ \ 10^{14}$
Ag_2CO_3	$8.0\ \ 10^{12}$

The most soluble and least soluble compounds are

a) AgCl and $PbCrO_4$ b) AgI and Ag_2CO_3 c) AgCl and Ag_2CO_3 d) Ag_2CO_3 and AgI

868. The pH of 10^{-10} M NaOH solution is nearest to

a) -4 b) -10 c) 4 d) 7

869. The conjugate base of $H_2PO_4^-$ is

a) H_3PO_4 b) P_2O_5 c) PO_4^{3-} d) HPO_4^{2-}

870. The ionization constant of ammonium hydroxide is 1.77×10^{-5} at 298 K. Hydrolysis constant of ammonium chloride is:

a) 5.65×10^{-12} b) 5.65×10^{-10} c) 6.50×10^{-12} d) 5.65×10^{-13}

871. 1 M solution of an acid has a pH of 5. Which of the following is the most reasonable explanation for this acid?

a) The acid is too dilute

b) It is a strong acid

c) It reacts with water to produce a high concentration of hydronium ions

d) It is a weak acid

872. The solubility product K_{sp}, of a sparingly soluble salt $AgIO_3$ is 1.0×10^{-8} at a given temperature. What is the mass of $AgIO_3$ (mol. Mass = 283) contained in 100 mL solution at this temperature is:

a) 1.0×10^{-4}g b) 28.3×10^{-2}g c) 2.83×10^{-3}g d) 1.0×10^{-7}g

873. The pH of a buffer solution containing equal molal concentration of a weak base and its chloride (K_b for weak base $= 2 \times 10^{-5}$) is

a) 5 b) 9 c) 4.7 d) 9.3

874. In qualitative analysis, in III group NH_4Cl is added before NH_4OH because

a) To increase the concentration of NH_4^+ ions b) To increase the concentration of Cl^- ions

c) To reduce the concentration of OH^- ions d) To increase the concentration of OH^- ions

875. The K_{sp} for $Cr(OH)_3$ is $1.6\ \ 10^{30}$. The molar solubility of this compound in water is

a) $\sqrt[2]{1.6\ \ 10^{30}}$ b) $\sqrt[4]{1.6\ \ 10^{30}}$ c) $\sqrt[4]{1.6\ \ 10^{30}/27}$ d) $1.6\ \ 10^{30}/27$

876. ΔG^0 for the reaction $X + Y \rightleftharpoons Z$ is -4.606 kcal. The equilibrium constant for the reaction at 227°C is :

a) 100 b) 10 c) 2 d) 0.01

877. For the reaction, $2A(g) \rightleftharpoons 3C(g) + D(s)$, the value of K_c will be equal to

a) $K_p(RT)$ b) K_p/RT c) $= K_p$ d) None of these

878. Reaction between barium chloride and sodium sulphate goes to completion because:

a) Barium sulphate is almost insoluble

b) The reaction is reversible

c) The solubility of barium chloride decreases

d) None of the above

879. Which of the following cannot act as a Lewis of Bronsted acid?
a) BF_3 b) $AlCl_3$ c) $SnCl_4$ d) CCl_4

880. Consider the reaction,

$$NO_2 \rightleftharpoons \frac{1}{2}N_2 + O_2, K_1; N_2O_4 \rightleftharpoons 2NO_2, K_2$$

Give the equilibrium constant for the formation of N_2O_4 from N_2 and O_2.
a) $\frac{1}{K_1^2} + \frac{1}{K_2}$ b) $\frac{1}{K_1K_2}$ c) $\sqrt{\frac{1}{K_1K_2}}$ d) $\frac{K_2}{K_1}$

881. A weak monobasic acid is 1% ionised in 0.1 M solution at 25°C. The percentage of ionisation in its 0.025 M solution is
a) 1 b) 2 c) 3 d) 4

882. In $K_p = K_c[RT]^{\Delta n}, \Delta n$ may have:
a) +ve values
b) −ve values
c) Integer of fractional values
d) Either of the above

883. The conjugate acid of H^- ion is:
a) H_3O^+ b) H_2 c) OH^- d) H_2O

884. The addition of HCl does not suppresses the ionisation of:
a) Acetic acid b) Benzoic acid c) H_2S d) H_2SO_4

885. A colourless solution liberates CO_2 gas when added to a metal bicarbonate. The solution is:
a) Basic b) Acidic c) Amphoteric d) Neutral

886. Which one of the following statement is not true?
a) The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}
b) pH + pOH = 14 for all aqueous solutions
c) The pH of 1×10^{-8} M HCl is 8
d) 96500 C of electricity when passed through a $CuSO_4$ solution deposit 1 g equivalent of copper at the cathode

887. Two moles of PCl_5 is heated in a closed vessel of 2 L capacity. When the equilibrium is attained 40% of it has been found to be dissociated. What is the K_c in mol/dm^3?
a) 0.532 b) 0.266 c) 0.133 d) 0.174

888. A liquid is in equilibrium with its vapour at it's boiling point. On the average, the molecules in two phases have equal
a) Inter-molecular forces b) Potential energy
c) Kinetic energy d) Total energy

889. At equilibrium, the amount of HI in a 3 litre vessel was 12.8 g. Its equilibrium concentration is :
a) 4.267 *M* b) 0.033 *M* c) 0.1 *M* d) 0.2 *M*

890. Which one of the following salts give an acidic solution in water?
a) CH_3COONa b) NH_4Cl c) NaCl d) CH_3COONH_4

891. For which reaction does the equilibrium constant depend on the units of concentration?
a) $NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$
b) $Zn(s) + Cu^{2+}(aq) \rightleftharpoons Cu(s) + Zn^{2+}(aq)$
c) $C_2H_5OH(l) + CH_3COOH(l) \rightleftharpoons CH_3COOC_2H_5(l) + H_2O(l)$
d) $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$

892. The solubility product of As_2S_3 is 2.8×10^{-72}. What is the solubility of As_2S_3?
a) 1.92×10^{-15} mol/L b) 1.72×10^{-15} mol/L
c) 2.3×10^{-16} mol/L d) 1.65×10^{-36} mol/L

893. When CO_2 dissolves in water, the following equilibrium is established, $CO_2 + 2H_2O \rightleftharpoons H_3O^+ + HCO_3^-$, for which the equilibrium constant is 3.8×10^{-7} and pH = 6.0. The ratio of $[HCO_3^-]/[CO_2]$ is :

a) 3.8×10^{-18} b) 3.8 c) 0.38 d) 13.8

894. The blood buffers are most often involved in stabilizing the pH in presence of metabolically produced:

a) Acids b) Bases c) Salts d) None of these

895. If concentration of N_2, H_2 and NH_3 are 1, 2 and 3 respectively, their concentrations at equilibrium will be:
$N_2 + 3H_2 \rightleftharpoons 2NH_3$

a) $(1-x)$ $(2-3x)$ 2b) $(1-x/3)$ $(2-x)$ 2xc) $(1-x)$ $(2-x)$ (3d) $(1-x)$ $(2-3x)$ (

896. For the reaction, $N_2 + 3H_2 \rightleftharpoons 2NH_3$ at 500⁰C, the value of K_p is 1.44×10^{-5}. What will be the value of K_p at low pressure where the gases are behaving almost ideally?

a) 1.44×10^{-5} b) $(0.082 \times 773)^2 \times 1.44 \times 10^{-5}$ c) $1.44 \times 10^{-5} \times (0.082 \times 500)^2$ d) $1.44 \times 10^{-5} \times (0.082 \times 773)^3$

897. The range of pH in which methyl orange works as indicator:

a) 3-4 b) 10-12 c) 8-10 d) 6-8

898. For the reaction : $CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g), K_p/K_c$ is:

a) RT b) $(RT)^{-1}$ c) $(RT)^{-1/2}$ d) $(RT)^{1/2}$

899. K_{sp} of CuS, Ag_2S and HgS are $10^{-31}, 10^{-44}$ and 10^{-54} respectively. Select the correct order for their solubility in water:

a) $Ag_2S > HgS > CuS$ b) $HgS > CuS > Ag_2S$ c) $HgS > Ag_2S > CuS$ d) $Ag_2S > CuS > HgS$

900. pH of a 0.0001 M HCl solution is

a) 4.0 b) 2.0 c) 6.0 d) 7.0

901. The pH of 0.1 M HCl is approximately 1. The approximate pH of 0.05 M H_2SO_4 is:

a) 0.05 b) 0.5 c) 1 d) 2

902. Phenolphthalein shows … in acid medium.

a) Red colour b) Yellow colour c) Pink colour d) No colour

903. The $[OH^-]$ in 100 mL of 0.015 M HCl $(aq.)$ is:

a) $5 \times 10^{-12}\ M$ b) $3 \times 10^{-10}\ M$ c) $6.7 \times 10^{-13}\ M$ d) $2.0 \times 10^{-9}\ M$

904. For an equilibrium reaction if the value of $K_c >> 1$, then the reaction favoured more towards

a) Backward b) Forward
c) Equilibrium will be obtained d) Reaction will stop

905. K_c for $A + B \rightleftharpoons 3C$ is 20 at 25°C. If a 2 litre vessel contains 1,2 and 4 mole of A, B and C respectively, the reaction at 25°C shall :

a) Proceed from left to right
b) Proceed from right to left
c) Be at equilibrium
d) Not occur

906. Solution prepared by dissolving equal number of mole of HOCl($K_a = 3.2 \times 10^{-8}$) and NaOCl is a buffer of pH:

a) 8.0 b) 3.2 c) 7.5 d) 4.8

907. An increase in the temperature of an equilibrium system:

a) Favours the exothermic reaction
b) Favours the endothermic reaction
c) Favours both the exothermic and endothermic reactions
d) Favours neither the exothermic nor endothermic reactions

908. Which of these is a Lewis acid?

a) $AlCl_3$ b) NCl_3 c) HCl d) ROR

909. The pH of a solution is 4. The hydrogen ion concentration of the solution if pH is to be increased to 5 is:

a) Halved

b) Doubled
c) Decreased by 10 times
d) Decreased to half of its original value of concentration

910. The oxo-acid of anhydride P_2O_5 is:
a) H_3PO_4 b) $H_4P_2O_7$ c) HPO_3 d) All of these

911. 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 temprature is 1.0×10^{-8} , what is the mass of $AgIO_3$ contained in 100 mL of its saturated solution?
a) 28.3×10^{-2} g b) 2.83×10^{-3} g c) 1.0×10^{-7} g d) 1.0×10^{-4} g

912. H_3BO_3 is:
a) Monobasic and weak Lewis acid b) Monobasic and weak Bronsted acid c) Monobasic and strong Lewis acid d) Tribasic and weak Bronsted acid

913. All Lewis acids are not necessarily:
a) Proton donor b) Bronsted acids c) Arrhenius acids d) All of these

914. In the reaction,
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$. Which of the following is correct?
a) $K_p = K_c$ b) $K_p > K_c$ c) $K_p < K_c$ d) $K_p \geq K_c$

915. Which of the following is most soluble in water?
a) Bi_2S_3 $(K_{sp} = 10^{-70})$ b) $MnS(K_{sp} = 7 \times 10^{-16})$ c) $CuS(K_{sp} = 8 \times 10^{-37})$ d) $Ag_2S(K_{sp} = 6 \times 10^{-51})$.

916. The equilibrium constant for the reaction

$$SO_3(g) \rightleftharpoons SO_2(g) + \frac{1}{2}O_2(g)$$

is $K_c = 4.9 \times 10^{-2}$. The value of K_c for the reaction
$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ will be
a) 416 b) 2.40×10^{-3} c) 9.8×10^{-2} d) 4.9×10^{-2}

917. pK_a or a weak acid is defined as
a) $\log\ K_a$ b) $\frac{1}{\log K_a}$ c) $\log \frac{1}{K_a}$ d) $-\log \frac{1}{K_a}$

918. In the equilibrium, $AB \rightleftharpoons A + B$, if the equilibrium concentration of A is doubled, the equilibrium concentration of B would become
a) Half b) Twice c) $\frac{1}{4}$th d) $\frac{1}{8}$th

919. Two moles of PCl_5 were heated in a closed vessel of 2 L. At equilibrium 40% of PCl_5 is dissociated into PCl_3 and Cl_2. The value of equilibrium constant is
a) 0.53 b) 0.267 c) 2.63 d) 5.3

920. When NaOH is dissolved in water, heat is evolved. If the temperature is raised, the solubility of NaOH:
a) Increases
b) Decreases
c) Remains the same
d) Cannot be predicted

921. In which of the following equilibrium, change in volume of the system does not alter the number of moles?
a) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$
b) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$
c) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
d) $SOCl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$

922. Conjugate base of HSO_4^- is
a) SO_4^{2-} b) H_2SO_4 c) $H_3SO_4^+$ d) None of these

923. Which favours the backward reaction in a chemical equilibrium?

a) Increasing the concentration of one of the reactants
b) Removal of at least one of the products at regular intervals
c) Increasing the concentration of one or more of the products
d) None of the above

924. A weak acid $HX(K_a = 1 \times 10^{-5})$ on reaction with NaOH gives NaX. For 0.1 M aqueous solution of NaX, the % hydrolysis is:
a) 0.001%   b) 0.01%   c) 0.15%   d) 1%

925. For the reaction: $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$; $K_c = 1.8 \times 10^{-6}$ at 184°C and $R = 0.083$ litre atm $K^{-1} mol^{-1}$. When K_p and K_c are compared at 184°C, it is found that :
a) $K_p > K_c$ b) $K_p < K_c$ c) $K_p = K_c$ d) $K_p \gtreqless K_c$

926. Mg(OH)Cl is an example of:
a) Acidic salt   b) Basic salt   c) Neutral salt   d) Amphoteric salt

927. The degree of dissociation of a weak acid is 1.34% at 0.1 M concentration. Its dissociation constant is:
a) 8×10^{-6} b) 1.79×10^{-5} c) 0.182×10^{-5} d) 8×10^{-5}

928. In the reaction $HCl + H_2O \rightleftharpoons H_3O^+ + Cl^-$
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

929. Slope and intercepts of the plots log $_{10}K$ vs $\frac{1}{T}$ are given respectively by :
a) $-\frac{\Delta H^\circ}{R}, \frac{\Delta S^\circ}{R}$ b) $\frac{-\Delta H^\circ}{2.303R}, \frac{\Delta S^\circ}{2.303}$ c) $\frac{-\Delta H^\circ}{2.303R}, \frac{\Delta S^\circ}{2.303R}$ d) $\frac{\Delta H^\circ}{2.303}, \frac{-\Delta S^\circ}{2.303R}$

930. On adding 0.1 M solution each of $[Ag^+]$, $[Ba^{2+}]$, $[Ca^{2+}]$ in a Na_2SO_4 solution, species first precipitated is
$\left[K_{sp}\ BaSO_4 = 10^{-11}, K_{sp}\ CaSO_4 = 10^{-6}, K_{sp}\ AgSO_4 = 10^{-5}\right]$
a) Ag_2SO_4 b) $BaSO_4$ c) $CaSO_4$ d) All of these

931. K for the synthesis of HI is 50. K for the dissociation of HI is
a) 0.2   b) 0.02   c) 0.4   d) 0.04

932. Which of the following factors will favour the reverse reaction in a chemical equilibrium?
a) Increase in the concentration of one of the reactants
b) Increase in the concentration of one or more products
c) Removal of at least one of the product at regular time intervals
d) None of the above

933. The anhydride of HNO_3 is:
a) P_2O_5 b) N_2O_3 c) NO   d) N_2O_5

934. According to Le-Chatelier principle, adding heat a solid and liquid in equilibrium will cause the
a) Amount of solid to decrease   b) Amount of liquid to decrease
c) Temperature to rise   d) Temperature to fall

935. What is the conjugate base of OH^-?
a) O^{2-} b) O^- c) H_2O d) O_2

936. The solubility of $Al(OH)_3$ is 's' mol per litre, the solubility product of $Al(OH)_3$ is:
a) s^3 b) $27s^4$ c) s^2 d) $4s^2$

937. The pH of 0.1 M solution of the following salts increases in the order
a) $NaCl < NH_4Cl < NaCN < HCl$ b) $HCl < NH_4Cl < NaCl < NaCN$
c) $NaCN < NH_4Cl < NaCl < HCl$ d) $HCl < NaCl < NaCN < NH_4Cl$

938. For the Haber's process for the formation of NH_3 at 298 K is :

$$N_2 + 3H_2 \rightleftharpoons 2NH_3;\ \Delta H = -460 \text{ kJ}$$

Which of the following is correct?
a) The condition for equilibrium is $G_{N_2} + 3G_{H_2} = 2G_{NH_3}$, where G is Gibbs energy per mole of gaseous species measured at that partial pressure

b) On addition N_2, the equilibrium will shift to forward direction because according to II law of thermodynamics the entropy must decrease in the direction of spontaneous reaction.
c) The catalyst will increase the rate of forward reaction by 2 times and that of backward reaction by 1.5 times
d) Name of the above

939. Consider the reversible reaction,
$HCN(aq) \rightleftharpoons H^+(aq) + CN^-(aq)$
At equilibrium, the addition of $CN^-(aq)$ would:
a) Reduce $HCN(aq)$ concentration
b) Decrease the $H^+(aq)$ ion concentration
c) Increase the equilibrium constant
d) Decrease the equilibrium constant

940. The solubility product of iron (III) hydroxide is 1.6×10^{-39}. If X is the solubility of iron (III) hydroxide, which one of the following expression can be used to calculate X?
a) $K_{sp} = X^4$ b) $K_{sp} = 9X^4$ c) $K_{sp} = 27X^3$ d) $K_{sp} = 27X^4$

941. Baking soda is a/an:
a) Basic salt b) Double salt c) Complex salt d) Acidic salt

942. An aqueous solution of sodium carbonate has a pH greater than 7 because
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

943. The pH of a solution obtained by mixing 10 mL of 0.1 M HCl and 40 mL of 0.2 M H_2SO_4 is:
a) 1.4865 b) 0.4865 c) 0.4685 d) 3

944. Just before a reversible reaction attains equilibrium it is found that:
a) The velocity of both forward reaction and backward reaction is also increasing
b) The velocity of the forward reaction is decreasing and that of backward reaction in increasing
c) The velocity of both forward and backward reactions is decreasing
d) All of the above

945. How many mole of HCl are required to prepare one litre of buffer solution (containing NaCN + HCl) of pH 8.5 using 0.01 g formula weight of NaCN ($K_{\mathrm{HCN}} = 4.1 \times 10^{-10}$)?
a) 8.85×10^{-3} b) 8.75×10^{-2} c) 8.85×10^{-4} d) 8.85×10^{-2}

946. For the reaction $A + B \rightleftharpoons 3C$ at 25°C, a 3 litre vessel contains 1, 2, 4 mole of A, B and C respectively. If K_c for the reaction is 10, the reaction will proceed in :
a) Forward direction b) Backward direction c) In either direction d) In equilibrium

947. What is the pH of a $1M CH_3COONa$ solution? K_a of acetic acid $= 1.8 \times 10^{-5}, K_w = 10^{-14} \mathrm{mol^2 litre^{-2}}$:
a) 2.4 b) 3.6 c) 4.8 d) 9.4

948. Formaldehyde polymerizes to form glucose according to the reaction,
$$6\ HCHO \rightleftharpoons C_6H_{12}O_6$$
The theoretically computed equilibrium constant for this reaction is found to be 6×10^{22}. If 1 M solution of glucose dissociates according to the above equilibrium, the concentration of formaldehyde in the solution will be
a) 1.6×10^{-2} M b) 1.6×10^{-4} M c) 1.6×10^{-6} M d) 1.6×10^{-8} M

949. The polyprotic acid is:
a) HCl
b) $HClO_4$
c) H_3PO_4
d) HNO_3

950. The solubility of Sb_2S_3 in water is 1.0×10^{-5} mol/L at 298 K. What will be its solubility product?

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

951. The pH of $1/1000\ N$ KOH solution is:

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

952. Which acts both as Lowry Bronsted acid and base?

a) OH^- b) Na_2CO_3 c) NH_3 d) HSO_4^-

953. By applying law of mass action, the equilibrium constant, K for the reaction

$$HA + H_2O \rightleftharpoons H_3O^+ + A^-\text{, is given as}$$

a) $K = \frac{[HA][H_2O]}{[H_3O^+][A^-]}$ b) $K = \frac{[H_3O^+][A^-]}{[HA][H_2O]}$ c) $K = \frac{[H_3O^+][H_2O]}{[A^-][HA]}$ d) $K = \frac{[HA][A^-]}{[H_2O][H_3O^+]}$

954. The Haber's process for the manufacture of ammonia is usually carried out at about 500°C. If a temperature of about 250°C was used instead of 500°C:

a) Ammonia would not be formed at all

b) The percentage of ammonia in the equilibrium mixture would be too low

c) A catalyst would be of no use at all at this temperature

d) The rate of formation of ammonia would be too slow

955. The equilibrium constant for, $H_2(g) + CO_2(g) \rightleftharpoons H_2O(g) + CO(g)$ *is* 1.80 *at* 1000^0C. If 1.0 mole of H_2 and 1.0 mole of CO_2 are placed in one litre flask, the final equilibrium concentration of CO at 1000°C will be:

a) 0.573 M b) 0.385 M c) 5.73 M d) 0.295 M

956. For a reaction $H_2 + I_2 \rightleftharpoons 2HI$ at 721 K, the value of equilibrium constant is 50. If 0.5 moles each of H_2 and I_2 is added to the system the value of equilibrium constant will be

a) 40 b) 60 c) 50 d) 30

957. Among BMe_3, BF_3, BCl_3 and B_2H_6 which one will be the best Lewis acid?

a) BCl_3 b) BMe_3 c) B_2H_6 d) BF_3

958. Potassium ferrocyanide is a

a) Mixed salt b) Normal salt c) Complex salt d) Double salt

959. The pH of pure water at 25°C and 35°C are 7 and 6 respectively. The heat of formation of water from H^+ and OH^- is:

a) 84.55 kcal mol^{-1}

b) −84.55 kcal mol^{-1}

c) 74.55 kcal mol^{-1}

d) −74.55 kcal mol^{-1}

960. The pH of solution A, B, C, D are 9.5, 2.5, 3.5 and 5.5 respectively. The most acidic solution is:

a) A b) B c) C d) D

961. According to Debye-Hückel theory of strong electrolytes, increase in conductivity on dilution is due to:

a) Increase in number of ions

b) Increase in the mobility of ions

c) Decrease in the number of ions

d) Decrease in the mobility of ions

962. If K_1 and K_2 are the respective equilibrium constants for the two reactions,

$XeF_6(g) + H_2O(g) \rightleftharpoons XeOF_4(g) + 2HF(g)$

$XeO_4(g) + XeF_6(g) \rightleftharpoons XeOF_4(g) + XeO_3F_2(g)$

The equilibrium constant for the reaction,

$XeO_4(g) + 2HF(g) \rightleftharpoons XeO_3F_2(g) + H_2O(g)$ is:

a) K_1K_2 b) K_1/K_2^2 c) K_2/K_1 d) K_1/K_2

963. The solubility of a saturated solution of calcium fluoride is 2×10^{-4} moles per litre. Its solubility product is:

a) 32×10^{-10} b) 32×10^{-8} c) 32×10^{-14} d) 32×10^{-12}

964. The equilibrium constant $Br_2 \rightleftharpoons 2Br$ at 500 K and 700 K are 10^{-10} and 10^{-5} respectively. The reaction is:

a) Endothermic b) Exothermic c) Fast d) Slow

965. For the homogenous reaction,

$$4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$$

the equilibrium constant K_c has the units

a) conc.$^{+10}$ b) conc.$^{+1}$ c) conc.$^{-1}$ d) It is dimensionless

966. 1 mole of H_2 and 2 moles of I_2 are taken initially in a 2 L vessel. The number of moles of H_2 at equilibrium is 0.2. Then, the number of moles of $I_2$and HI at equilibrium are

a) 1.2, 1.6 b) 1.8, 1.0 c) 0.4, 2.4 d) 0.8, 2.0

967. If the ionic product of water (K_w)is 1.96×10^{-14} at 35°C, what is its value at 10°C ?

a) 1.96×10^{-14} b) 3.92×10^{-14} c) 2.95×10^{-15} d) 1.96×10^{-13}

968. 0.1 mole of CH_3NH_2 ($K_b = 5 \times 10^{-4}$) is mixed with 0.08 mole of HCl diluted to 1 L. What will be the H^+ concentration in the solution?

a) 8×10^{-2} M b) 8×10^{-11} M c) 1.6×10^{-11} M d) 8×10^{-5} M

969. The conjugate base of H_3BO_3 is:

a) $B(OH)_4^-$ b) $H_2BO_3^-$ c) HBO_3^{2-} d) $H_4BO_3^+$

970. For the reaction, $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$ the value of K_p/K_c is equal to :

a) 1.0 b) RT c) $\sqrt{RT}$ d) $\frac{1}{RT}$

971. One mole of nitrogen is mixed with 3 mole of hydrogen in a closed 3 litre vessel. 20% of nitrogen is converted into NH_3. Then K_c for the $\frac{1}{2}N_2 + \frac{3}{2}H_2 \rightleftharpoons NH_3$ is:

a) 0.36 litre mol^{-1} b) 0.46 litre mol^{-1} c) 0.5 litre mol^{-1} d) 0.2 litre mol^{-1}

972. Which is a reversible reaction?

a) $H_2 + I_2 \rightarrow 2HI$

b) $H_2SO_4 + Ba(OH)_2 \rightarrow BaSO_4\downarrow + 2H_2O$

c) $NaCl + AgNO_3 \rightarrow NaNO_3 + AgCl\downarrow$

d) $2KClO_3 \rightarrow 2KCl + 3O_2\uparrow$

973. $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$

The equilibrium constant of the above reaction is 6.4 at 300 K. If 0.25 mole each of H_2 and I_2 are added to the system, the equilibrium constant will be

a) 6.4 b) 0.8 c) 3.2 d) 1.6

974. Would gaseous HCl be considered as an Arrhenius acid?

a) Yes b) No

c) Not known d) Gaseous HCl does not exsit

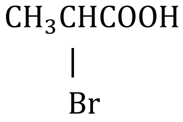
975. Buffer solution is prepared by mixing

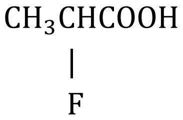
a) Strong acid + its salt of strong base b) Weak acid + its salt of weak base

c) Strong acid + its salt of weak base d) Weak acid + its salt of strong base

976. Which of the following acids will have lowest value of pK_a?

a) CH_3CH_2COOH

b) 
$CH_3\underset{\overset{|}{Br}}{C}HCOOH$

c) 
$CH_3\underset{\overset{|}{F}}{C}HCOOH$

d) FCH_2CH_2COOH

977. 2 moles of PCl_5 were heated in a closed vessel of 2 L capacity. At equilibrium 40% of PCl_5 is dissociated into $PCl_3$and Cl_2. The value of equilibrium constant is

a) 0.266 b) 0.366 c) 2.66 d) 3.66

978. pK_a of a weak acid is defined as

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

979. For a reaction equilibrium, $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, the concentrations of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and 1.2×10^{-2} mol/L respectively. The value of K_c for the reaction is
a) 3×10^{-3} mol/L b) 3.3×10^{-3} mol/L c) 3×10^{-1} mol/L d) 3.3×10^{-1} mol/L

980. If α is the degree of ionisation, C the concentration of a weak electrolyte and K_a the acid ionisation constant then the correct relationship between α, C and K_a is
a) $\alpha^2 = \sqrt{\frac{K_a}{C}}$ b) $\alpha^2 = \sqrt{\frac{C}{K_a}}$ c) $\alpha = \sqrt{\frac{K_a}{C}}$ d) $\alpha = \sqrt{\frac{C}{K_a}}$

981. Which of the following behaves as Lewis acid and not as Bronsted acid?
a) HCl b) H_2SO_4 c) HSO_3^- d) SO_3

982. If little heat is added to ice $\rightleftharpoons$ liquid equilibrium in a sealed container, then:
a) Pressure will rise b) Temperature will rise c) Temperature will fall d) No change in P and T

983. An aqueous solution in which the H^+ ion concentration is greater than 10^{-7} M is said to be
a) Acidic b) Alkaline c) Neutral d) None of these

984. The conjugate base of H_2SO_4 in the following reaction is:
$H_2SO_4 + H_2O \rightleftharpoons H_3O^+ + HSO_4^-$
a) H_2O b) HSO_4^- c) H_3O^+ d) SO_4^{2-}

985. For the reaction, $H_2 + I_2 \rightleftharpoons 2HI$, the equilibrium concentration of H_2, I_2 and HI are 8.0, 3.0 and 28.0 mol/L respectively. The equilibrium constant is
a) 28.34 b) 32.66 c) 34.78 d) 38.88

986. HClO is a weak acid. The concentrations 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) $5 \times 10^{-7}\ M$ c) $6 \times 10^{-7}\ M$ d) $7 \times 10^{-4}\ M$

987. At a certain temperature, $2HI \rightleftharpoons H_2 + I_2$ only 50% HI is dissociated at equilibrium. The equilibrium constant is :
a) 1.0 b) 3.0 c) 0.5 d) 0.25

988. Aqueous solution of CH_3COOH contains:
a) CH_3COOH, H^+ b) $CH_3COO^-, H_3O^+, CH_3CO$c) CH_3COO^-, H_3O^+, H^+ d) CH_3COOH, CH_3COO^-, H^+

989. In the manufacture of ammonia by Haber's process,
$N_2(g) + 3H_2 \rightleftharpoons 2NH_3(g) + 92.3$ kJ
Which of the following condition is unfavourable?
a) Increasing the temperature
b) Increasing the pressure
c) Reducing the temperature
d) Removing ammonia as it is formed

990. If $CuSO_4.5H_2O(s) \rightleftharpoons CuSO_4.3H_2O(s) + 2H_2O(v)$ $K_p = 1.086 \text{ x } 10^{-4}$ atm^2 at 25°C. The efflorescent nature of $CuSO_4.5H_2O$ can be noticed when vapour pressure of H_2O in atmosphere is :
a) > 7.92 mm b) < 7.92 mm c) ≷ 7.92 mm d) None of these

991. Conjugate acid-base pair differs by a/an:
a) Electron b) Electron pair c) Proton d) Neutron

992. The hydrogen ion concentration in a solution of weak acid of dissociation constant K_a and concentration c is nearly equal to:
a) $\sqrt{\frac{K_a}{c}}$ b) $\frac{c}{K_a}$ c) $K_a c$ d) $\sqrt{K_a c}$

993. For the liquefaction of gas, the favourable conditions are:
a) Low T and high P
b) Low T and low P
c) Low T and high P and a catalyst

d) Low T and catalyst

994. 0.5 M ammonium benzoate is hydrolysed to 0.25 percent, hence, its hydrolysis constant is

a) 2.5×10^{-5}
b) 1.5×10^{-4}
c) 3.125×10^{-6}
d) 6.25×10^{-6}

995. For the equilibrium, $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$, which of the following expression is correct?

a) $K_p = [CaO][CO_2]/[CaCO_3]$
b) $K_p = (p_{CaO} + p_{CO_2})/P_{CaCO_3}$
c) $K_p = p_{CO_2}$
d) $K_p = (p_{CaO} + p_{CO_2}/p_{CaCO_3})$

996. When $NaNO_3$ is heated in a closed vessel, O_2 is liberated and $NaNO_2$ is left behind. At equilibrium,

(i) Addition of $NaNO_3$ favours forward reaction
(ii) Addition of $NaNO_2$ favours backward reaction
(iii) Increasing pressure favours reverse reaction
(iv) Increasing temperature favours forward reaction

Correct option is

a) (i), (ii), (iii)
b) (ii), (iii), (iv)
c) (i), (iii), (iv)
d) (i), (ii) (iii), (iv)

997. Given pH of a solution A is 3 and it is mixed with another solution B having pH 2. After mixing are resultant pH of the solution will be

a) 3.2
b) 1.9
c) 3.4
d) 3.5

998. To neutralise completely 20 mL of 0.1 M aqueous solution of phosphorus acid H_3PO_3, the volume of 0.1 M KOH solution required is:

a) 60 mL
b) 20 mL
c) 40 mL
d) 10 mL

999. The relation between equilibrium constant K_p and K_c is

a) $K_p = K_c(RT)^{\Delta n_g}$
b) $K_c = K_p(RT)^{\Delta n_g}$
c) $K_p = \left(\frac{K_c}{RT}\right)^{\Delta n_g}$
d) $K_p - K_c = (RT)^{\Delta n_g}$

1000. On mixing equal volumes of two buffer solutions of pH value 3 and 5, the pH of the resultant solution will be

a) 3.3
b) 4.0
c) 4.7
d) 5.3

ACTIVE SITE TUTORIALS

Date : 23-07-2019
Time : 16:40:00
Marks : 4000

TEST ID: 137
CHEMISTRY

7.EQUILIBRIUM

: ANSWER KEY :

1)	**d**	**2)**	**a**	**3)**	**a**	**4)**	**a**	**165)**	**a**	**166)**	**b**	**167)**	**c**	**168)**	**d**
5)	**c**	**6)**	**b**	**7)**	**a**	**8)**	**d**	**169)**	**d**	**170)**	**d**	**171)**	**a**	**172)**	**b**
9)	**d**	**10)**	**d**	**11)**	**b**	**12)**	**a**	**173)**	**b**	**174)**	**a**	**175)**	**b**	**176)**	**b**
13)	**c**	**14)**	**d**	**15)**	**c**	**16)**	**c**	**177)**	**d**	**178)**	**a**	**179)**	**c**	**180)**	**c**
17)	**a**	**18)**	**c**	**19)**	**a**	**20)**	**d**	**181)**	**b**	**182)**	**c**	**183)**	**a**	**184)**	**d**
21)	**b**	**22)**	**c**	**23)**	**a**	**24)**	**a**	**185)**	**a**	**186)**	**a**	**187)**	**a**	**188)**	**a**
25)	**c**	**26)**	**c**	**27)**	**b**	**28)**	**a**	**189)**	**b**	**190)**	**b**	**191)**	**b**	**192)**	**a**
29)	**d**	**30)**	**d**	**31)**	**c**	**32)**	**b**	**193)**	**d**	**194)**	**d**	**195)**	**c**	**196)**	**a**
33)	**b**	**34)**	**a**	**35)**	**a**	**36)**	**d**	**197)**	**a**	**198)**	**b**	**199)**	**d**	**200)**	**d**
37)	**c**	**38)**	**b**	**39)**	**a**	**40)**	**b**	**201)**	**b**	**202)**	**c**	**203)**	**a**	**204)**	**c**
41)	**a**	**42)**	**a**	**43)**	**a**	**44)**	**c**	**205)**	**b**	**206)**	**b**	**207)**	**a**	**208)**	**a**
45)	**d**	**46)**	**b**	**47)**	**c**	**48)**	**d**	**209)**	**b**	**210)**	**a**	**211)**	**a**	**212)**	**d**
49)	**b**	**50)**	**d**	**51)**	**d**	**52)**	**a**	**213)**	**d**	**214)**	**b**	**215)**	**d**	**216)**	**b**
53)	**a**	**54)**	**d**	**55)**	**a**	**56)**	**a**	**217)**	**b**	**218)**	**c**	**219)**	**b**	**220)**	**a**
57)	**d**	**58)**	**c**	**59)**	**d**	**60)**	**a**	**221)**	**c**	**222)**	**b**	**223)**	**a**	**224)**	**b**
61)	**b**	**62)**	**c**	**63)**	**b**	**64)**	**c**	**225)**	**b**	**226)**	**c**	**227)**	**b**	**228)**	**b**
65)	**a**	**66)**	**b**	**67)**	**a**	**68)**	**d**	**229)**	**c**	**230)**	**d**	**231)**	**b**	**232)**	**d**
69)	**d**	**70)**	**a**	**71)**	**d**	**72)**	**c**	**233)**	**a**	**234)**	**d**	**235)**	**b**	**236)**	**c**
73)	**a**	**74)**	**d**	**75)**	**a**	**76)**	**d**	**237)**	**a**	**238)**	**a**	**239)**	**a**	**240)**	**a**
77)	**d**	**78)**	**d**	**79)**	**a**	**80)**	**d**	**241)**	**b**	**242)**	**d**	**243)**	**a**	**244)**	**b**
81)	**b**	**82)**	**b**	**83)**	**a**	**84)**	**a**	**245)**	**c**	**246)**	**a**	**247)**	**b**	**248)**	**a**
85)	**b**	**86)**	**c**	**87)**	**c**	**88)**	**a**	**249)**	**d**	**250)**	**a**	**251)**	**d**	**252)**	**a**
89)	**a**	**90)**	**b**	**91)**	**a**	**92)**	**d**	**253)**	**d**	**254)**	**b**	**255)**	**d**	**256)**	**d**
93)	**b**	**94)**	**c**	**95)**	**b**	**96)**	**b**	**257)**	**b**	**258)**	**a**	**259)**	**c**	**260)**	**d**
97)	**a**	**98)**	**a**	**99)**	**c**	**100)**	**c**	**261)**	**c**	**262)**	**b**	**263)**	**c**	**264)**	**b**
101)	**c**	**102)**	**d**	**103)**	**b**	**104)**	**a**	**265)**	**b**	**266)**	**d**	**267)**	**d**	**268)**	**c**
105)	**a**	**106)**	**c**	**107)**	**b**	**108)**	**a**	**269)**	**c**	**270)**	**d**	**271)**	**b**	**272)**	**d**
109)	**d**	**110)**	**a**	**111)**	**b**	**112)**	**a**	**273)**	**c**	**274)**	**c**	**275)**	**c**	**276)**	**c**
113)	**c**	**114)**	**b**	**115)**	**c**	**116)**	**b**	**277)**	**a**	**278)**	**b**	**279)**	**b**	**280)**	**a**
117)	**a**	**118)**	**b**	**119)**	**b**	**120)**	**c**	**281)**	**a**	**282)**	**c**	**283)**	**c**	**284)**	**c**
121)	**a**	**122)**	**b**	**123)**	**b**	**124)**	**a**	**285)**	**c**	**286)**	**d**	**287)**	**d**	**288)**	**b**
125)	**c**	**126)**	**d**	**127)**	**b**	**128)**	**c**	**289)**	**d**	**290)**	**d**	**291)**	**b**	**292)**	**c**
129)	**b**	**130)**	**c**	**131)**	**d**	**132)**	**c**	**293)**	**c**	**294)**	**c**	**295)**	**a**	**296)**	**c**
133)	**d**	**134)**	**a**	**135)**	**d**	**136)**	**d**	**297)**	**a**	**298)**	**d**	**299)**	**c**	**300)**	**d**
137)	**b**	**138)**	**c**	**139)**	**d**	**140)**	**c**	**301)**	**a**	**302)**	**a**	**303)**	**a**	**304)**	**d**
141)	**b**	**142)**	**d**	**143)**	**a**	**144)**	**c**	**305)**	**c**	**306)**	**b**	**307)**	**d**	**308)**	**a**
145)	**a**	**146)**	**a**	**147)**	**b**	**148)**	**d**	**309)**	**d**	**310)**	**c**	**311)**	**c**	**312)**	**d**
149)	**c**	**150)**	**c**	**151)**	**a**	**152)**	**c**	**313)**	**b**	**314)**	**a**	**315)**	**c**	**316)**	**c**
153)	**a**	**154)**	**d**	**155)**	**c**	**156)**	**d**	**317)**	**a**	**318)**	**d**	**319)**	**c**	**320)**	**d**
157)	**c**	**158)**	**b**	**159)**	**c**	**160)**	**b**	**321)**	**b**	**322)**	**d**	**323)**	**c**	**324)**	**d**
161)	**b**	**162)**	**c**	**163)**	**d**	**164)**	**d**	**325)**	**a**	**326)**	**a**	**327)**	**d**	**328)**	**d**

329)	a	330)	c	331)	a	332)	d	533)	d	534)	b	535)	d	536)	d
333)	b	334)	b	335)	a	336)	d	537)	b	538)	a	539)	d	540)	a
337)	a	338)	a	339)	c	340)	d	541)	d	542)	d	543)	d	544)	a
341)	d	342)	b	343)	c	344)	d	545)	a	546)	b	547)	a	548)	b
345)	c	346)	a	347)	a	348)	d	549)	b	550)	a	551)	a	552)	a
349)	c	350)	c	351)	d	352)	b	553)	a	554)	b	555)	d	556)	d
353)	a	354)	a	355)	d	356)	b	557)	a	558)	c	559)	c	560)	a
357)	d	358)	d	359)	a	360)	d	561)	c	562)	d	563)	a	564)	b
361)	a	362)	c	363)	c	364)	a	565)	c	566)	a	567)	a	568)	b
365)	b	366)	d	367)	c	368)	a	569)	d	570)	a	571)	a	572)	c
369)	d	370)	d	371)	a	372)	a	573)	c	574)	b	575)	c	576)	d
373)	b	374)	c	375)	a	376)	b	577)	b	578)	c	579)	c	580)	c
377)	d	378)	a	379)	b	380)	a	581)	a	582)	d	583)	c	584)	a
381)	a	382)	d	383)	b	384)	b	585)	a	586)	a	587)	c	588)	d
385)	a	386)	d	387)	a	388)	c	589)	d	590)	b	591)	b	592)	d
389)	a	390)	b	391)	a	392)	a	593)	b	594)	b	595)	b	596)	a
393)	c	394)	c	395)	c	396)	a	597)	c	598)	a	599)	d	600)	c
397)	c	398)	b	399)	c	400)	a	601)	d	602)	b	603)	d	604)	a
401)	a	402)	a	403)	b	404)	a	605)	d	606)	c	607)	d	608)	c
405)	a	406)	b	407)	c	408)	c	609)	a	610)	b	611)	a	612)	d
409)	b	410)	c	411)	b	412)	b	613)	a	614)	b	615)	c	616)	b
413)	d	414)	c	415)	a	416)	c	617)	a	618)	d	619)	c	620)	a
417)	c	418)	d	419)	d	420)	c	621)	a	622)	a	623)	a	624)	c
421)	c	422)	b	423)	b	424)	b	625)	a	626)	d	627)	d	628)	d
425)	b	426)	a	427)	a	428)	c	629)	d	630)	c	631)	b	632)	a
429)	d	430)	b	431)	a	432)	d	633)	a	634)	b	635)	c	636)	b
433)	b	434)	c	435)	d	436)	a	637)	c	638)	d	639)	c	640)	a
437)	a	438)	c	439)	d	440)	c	641)	c	642)	c	643)	b	644)	a
441)	b	442)	c	443)	b	444)	a	645)	a	646)	c	647)	c	648)	a
445)	b	446)	c	447)	c	448)	b	649)	b	650)	a	651)	a	652)	c
449)	a	450)	b	451)	a	452)	c	653)	d	654)	c	655)	b	656)	a
453)	b	454)	b	455)	d	456)	a	657)	a	658)	b	659)	c	660)	b
457)	c	458)	d	459)	b	460)	c	661)	b	662)	c	663)	c	664)	c
461)	a	462)	a	463)	b	464)	c	665)	a	666)	a	667)	a	668)	c
465)	a	466)	c	467)	b	468)	c	669)	b	670)	a	671)	a	672)	c
469)	b	470)	d	471)	d	472)	b	673)	b	674)	b	675)	a	676)	a
473)	c	474)	b	475)	b	476)	c	677)	a	678)	c	679)	d	680)	b
477)	b	478)	d	479)	c	480)	c	681)	b	682)	b	683)	b	684)	c
481)	a	482)	d	483)	a	484)	c	685)	b	686)	c	687)	a	688)	a
485)	c	486)	b	487)	a	488)	b	689)	c	690)	b	691)	c	692)	d
489)	b	490)	d	491)	d	492)	d	693)	d	694)	a	695)	b	696)	d
493)	b	494)	c	495)	b	496)	a	697)	a	698)	c	699)	c	700)	b
497)	b	498)	c	499)	a	500)	d	701)	a	702)	a	703)	d	704)	b
501)	d	502)	b	503)	c	504)	c	705)	d	706)	a	707)	a	708)	c
505)	a	506)	d	507)	b	508)	a	709)	c	710)	d	711)	b	712)	d
509)	a	510)	b	511)	c	512)	d	713)	c	714)	b	715)	a	716)	a
513)	d	514)	d	515)	b	516)	a	717)	c	718)	c	719)	b	720)	a
517)	a	518)	d	519)	d	520)	c	721)	b	722)	b	723)	d	724)	d
521)	b	522)	b	523)	b	524)	d	725)	c	726)	a	727)	a	728)	b
525)	d	526)	b	527)	a	528)	b	729)	b	730)	c	731)	c	732)	a
529)	a	530)	d	531)	d	532)	b	733)	a	734)	c	735)	c	736)	b

737)	b	738)	b	739)	d	740)	a
741)	d	742)	b	743)	a	744)	a
745)	d	746)	c	747)	b	748)	b
749)	a	750)	d	751)	d	752)	c
753)	c	754)	c	755)	c	756)	d
757)	a	758)	a	759)	d	760)	b
761)	a	762)	a	763)	a	764)	b
765)	b	766)	b	767)	a	768)	d
769)	c	770)	b	771)	d	772)	c
773)	a	774)	b	775)	d	776)	b
777)	d	778)	b	779)	d	780)	b
781)	a	782)	a	783)	b	784)	a
785)	b	786)	a	787)	b	788)	b
789)	a	790)	a	791)	b	792)	c
793)	a	794)	b	795)	a	796)	d
797)	a	798)	a	799)	d	800)	b
801)	c	802)	b	803)	b	804)	b
805)	a	806)	c	807)	b	808)	a
809)	c	810)	b	811)	d	812)	b
813)	c	814)	a	815)	d	816)	a
817)	c	818)	b	819)	c	820)	a
821)	b	822)	c	823)	a	824)	d
825)	b	826)	c	827)	a	828)	a
829)	a	830)	b	831)	d	832)	b
833)	c	834)	a	835)	d	836)	c
837)	a	838)	c	839)	d	840)	d
841)	a	842)	d	843)	b	844)	b
845)	a	846)	a	847)	b	848)	b
849)	a	850)	b	851)	a	852)	b
853)	b	854)	b	855)	c	856)	d
857)	d	858)	b	859)	d	860)	a
861)	b	862)	c	863)	c	864)	a
865)	c	866)	d	867)	d	868)	d
869)	d	870)	b	871)	d	872)	b

873)	d	874)	c	875)	c	876)	a
877)	b	878)	a	879)	d	880)	a
881)	b	882)	d	883)	b	884)	d
885)	b	886)	c	887)	b	888)	c
889)	b	890)	b	891)	d	892)	a
893)	c	894)	a	895)	d	896)	a
897)	a	898)	c	899)	d	900)	a
901)	c	902)	d	903)	c	904)	b
905)	a	906)	b	907)	b	908)	a
909)	c	910)	d	911)	b	912)	a
913)	d	914)	a	915)	b	916)	a
917)	c	918)	a	919)	b	920)	a
921)	a	922)	a	923)	c	924)	b
925)	a	926)	b	927)	b	928)	b
929)	c	930)	b	931)	b	932)	b
933)	d	934)	a	935)	a	936)	b
937)	b	938)	a	939)	b	940)	d
941)	d	942)	b	943)	c	944)	b
945)	a	946)	b	947)	d	948)	b
949)	c	950)	a	951)	d	952)	d
953)	b	954)	d	955)	a	956)	c
957)	a	958)	c	959)	b	960)	b
961)	b	962)	c	963)	d	964)	a
965)	b	966)	a	967)	c	968)	b
969)	a	970)	d	971)	a	972)	a
973)	a	974)	b	975)	d	976)	a
977)	a	978)	c	979)	a	980)	c
981)	d	982)	d	983)	a	984)	b
985)	b	986)	a	987)	d	988)	b
989)	a	990)	b	991)	c	992)	d
993)	a	994)	c	995)	c	996)	d
997)	b	998)	c	999)	a	1000)	a

ACTIVE SITE TUTORIALS

Date : 23-07-2019
Time : 16:40:00
Marks : 4000

TEST ID: 137
CHEMISTRY

7.EQUILIBRIUM

: HINTS AND SOLUTIONS :

1 **(d)**

$$\begin{array}{ccccccc} HC_2H_3O_2 & + & NaOH & \longrightarrow & C_2H_3O_2Na & + & H_2O \\ 1 & & 0.5 & & 0 & & 0 \\ 0.5 & & 0 & & 0.5 & & 0.5 \end{array}$$

The solution contains weak acid + its conjugate base

0.5 Mol 0.5 Mol

and thus, acts as buffer.

2 **(a)**

Aqueous solution of 1M NaCl and 1M HCl is not a buffer but pH<7.

3 **(a)**

Reaction is exothermic and volume is decreasing from left to right, so for higher production of SO_3, there should be low temperature and high pressure

4 **(a)**

The acid is called strong acid when it ionise up to great extent

i.e., if its K_a value is large.

We know that $pK_a = \log \frac{1}{K_a}$

5 **(c)**

$$[OH^-] = \sqrt{K_b \times C}$$
$$= \sqrt{1 \times 10^{-5} \times 10^{-1}}$$
$$= \sqrt{10^{-6}} = 10^{-3}$$
$$K_w = [H^+][OH^-]$$
$$10^{-14} = [H^+][10^{-3}]$$
$$[H^+] = 10^{-11}$$
Hence, $pH = -\log H^+$
$$= -\log(1 \times 10^{-11}) = 11$$

6 **(b)**

$$H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$$

We know that,

$$K_p = K_c.(RT)^{\Delta n_g}$$

Δn_g = no. of moles of gaseous products – no. of moles of gaseous reactants

=2-2=0

$$K_p = K_c.(RT)^0$$
$$K_p = K_c$$

7 **(a)**

$NaH_2PO_4 + H_3PO_4; NaH_2PO_4 + Na_2HPO_4; Na_2HPO_4 + Na_3PO_4$.

9 **(d)**

pH of a solution $\propto [OH^-]$ $\frac{M}{4}$ $Ca(OH)_2$ solution will give highest concentration of $[OH^-]$.

Hence, it has highest pH.

10 **(d)**

Salt	Solubility product	Solubility
MX	$S_1^2 = 4.0 \times 10^{-8}$	$S_1 = 2 \times 10^{-4}$
MX_2	$4S_2^3 = 3.2 \times 10^{-14}$	$S_2 = 2 \times 10^{-5}$
M_3X	$27S_3^4 = 2.7 \times 10^{-15}$	$S_3 = 1 \times 10^{-4}$

Thus, solubility order= $MX > M_3X > MX_2$

11 **(b)**

Basic strength $\propto$ dissociation constant of base (K_b).

So, smaller the value of K_b weaker will be the base.

The weakest base will have smallest value of K_b.

$\because$ $C_6H_5NH_2$ (aniline) has smallest value of K_b.

$\therefore$ It is weakest base.

12 **(a)**

$$\alpha = \frac{\text{number of mole dissociated}}{\text{total mole present}}$$
$$= \frac{10^{-7}}{1000/18} = 1.8 \times 10^{-9} = 1.8 \times 10^{-7}\%$$

Total mole of H_2O in 1 litre $= \frac{1000}{18}$

13 **(c)**

A precipitate is formed when the ionic product exceeds the solubility product.

i.e., $[A^+][B^-] > K_{sp}$

14 **(d)**
$2HgNO_3 + 2HCl \longrightarrow Hg_2Cl_2 + 2HNO_3$;
Hg_2Cl_2 in insoluble in water.

15 **(c)**
Lewis bases are electrons rich compounds.
(i) $\overset{\bullet\bullet}{N}H_3$ and $H_2\overset{\bullet\bullet}{\underset{\bullet\bullet}{O}}$ are Lewis bases because they have lone pair of electron.
(ii)$AlCl_3$ is Lewis acid because it can accept electrons.

16 **(c)**
$Ba(NO_3)_2$givesNO_3^-, Ba^{2+} ions, hence Ba^{2+} ion increases. To keep K_{sp} constant, $[F^-]$ decreases. Thus, it is represented as $\frac{1}{2}[F^-]$

18 **(c)**
As equation 'III' is obtained on adding equation 'I' and equation 'II', so $K_3 = K_1.K_2$.

19 **(a)**
$N_2O_4 \rightleftharpoons \quad 2NO_2$
0.1 $\quad$ 0 $\quad$ initialy
$(0.1 - \alpha) \quad 2\alpha$ at equilibrium
$\frac{0.1-\alpha}{0.1+\alpha}p \quad \frac{2\alpha}{0.1+\alpha}p$ atp_i

$$K_p = \frac{[NO_2]^2}{[N_2O_4]}$$

$$0.14 = \left(\frac{2\alpha \times p}{0.1+\alpha}\right)^2 \times \left(\frac{0.1+\alpha}{0.1-\alpha}\right)p$$

$$= \frac{4\alpha^2}{(0.1+\alpha)(0.1-\alpha)}p$$

$$= \frac{4\alpha}{0.01-\alpha^2} \times 1$$

or $\alpha = 0.018$
Thus, $[NO_2] = 2 \times 0.018 = 0.036$ mol

20 **(d)**
From Henderson equation

$$pOH = pK_b + \log\frac{[salt]}{[base]}$$

$pH + pOH = 14$

$$pOH = 5.0 + \log\frac{[1.0]}{[0.1]} = 5 + \log 10 = 5 + 1$$

$pOH = 6$
$pH + pOH = 14$
$pH + 6 = 14$
$pH = 14 - 6 = 8$

21 **(b)**
It has sextet of electron and can accept lone pair of electron.

22 **(c)**
BF_3 is electron deficient compound because B has six electrons in outermost orbit. It has incomplete octet. So, it is an electron deficient molecule.

23 **(a)**
Metal oxides are basic, non-metal oxides are acidic. CaO is more basic than CuO. Water (H_2O) is amphoteric.

24 **(a)**
The acidic character of oxy-acids decreases down the group and increases along the period. Also higher ox.no. of non-metal in oxy-acid shows more acidic nature.

25 **(c)**
Follow Arrhenius concept.

27 **(b)**

$$N_{NaOH} = \frac{0.04}{40 \times 10} = 10^{-4}N$$

$\therefore$ $pOH = 4$
$\therefore$ $pH = 10$

28 **(a)**
$P_4(s) + 5O_2(g) \rightleftharpoons P_4O_{10}(s)$

$$K_c = \frac{[P_4O_{10}(s)]}{[P_4(s)][O_2(g)]^5}$$

We know that concentration of a solid component is always taken as unity

$$K_c = \frac{1}{[O_2]^5}$$

29 **(d)**
$[HCl] = 10^{-8}$ M, Being very dilute $pH < 7$.
New concentration of,

$$HCl = \frac{10^{-6}}{100} = 10^{-8}\ M$$

$\therefore [H^+] = 10^{-18} + 10^{-7}$
$= 1.1 \times 10^{-7}$ M
$\therefore$ $pH \approx 7$

30 **(d)**
A buffer solution is more effective in the pH range of $pK_a \pm 1$.

31 **(c)**
From H_2O, $[H^+] = 1 \times 10^{-7}M$
From $HCl[H^+] = 1 \times 10^{-8}M$
Total $\quad [H^+] = (1 \times 10^{-7} + 1 \times 10^{-8})M$
$= (1 \times 10^{-7} + 0.1 \times 10^{-7})M$
$= 1.1 \times 10^{-7}M$
$pH = -\log(1.1 \times 10^{-7}) = 6.9586$

32 **(b)**

$$pH = -\log K_a + \log\frac{[Conjugate\ base]}{[Acid]}$$

33 **(b)**
100 mL of 0.01 M NaOH solution is diluted to 1 dm^3 (*i.e.*, 10 times diluted hence, the

resultant solution will be 0.001 M)

$$[\mathrm{OH^-}] = 0.001 = 10^{-3}$$

$$[\mathrm{H^+}] = \frac{10^{-14}}{[\mathrm{OH^-}]} = \frac{10^{-14}}{10^{-3}} = 10^{-11}$$

$$\mathrm{pH} = -\log[\mathrm{H^+}]$$

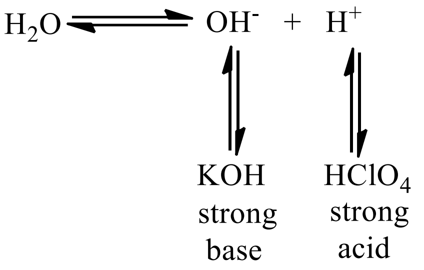
$$= -\log[10^{-11}]$$

$$\mathrm{pH}=11$$

34 **(a)**

Only salts of (weak acid+ strong base) and (strong acid + weak base) get hydrolysed ($i.e.$, show alkalinity or acidity in water). $KClO_4$ a salt of strong acid and strong base, therefore, it does not get hydrolysed in water.

$$\mathrm{KClO_4} \rightleftharpoons \mathrm{K^+} \quad + \quad \mathrm{ClO_4^-}$$



35 **(a)**

Higher is the value of K_c or K_p more is feasibility for reaction to show forward reaction.

36 **(d)**

A +ve inductive effect of C_6H_5 intensifies +ve charge on N atom and thus, availability of co-ordination for electron pair decreases; The basic character order is

$C_2H_5NH_2 > CH_3NH_2 > NH_3 > C_6H_5 - NH_2$

37 **(c)**

Na_2HPO_4 on hydrolysis of HPO_4^{2-} ion produces free OH^- ion in solution.

38 **(b)**

$2HI \rightleftharpoons H_2 + I_2$

3.2 0 0 initially

$3.2 - x$ x x at equilibrium

$x = 22\%$ of 3.2

$= \frac{22 \times 3.2}{100}$

$= 0.704$

Hence, number of moles of HI present at equilibrium

$= 3.2 - x$

$= 3.2 - 0.704$

$= 2.496$

39 **(a)**

$$K_p = \frac{{}^{n}\mathrm{Cl_2} \times {}^{n}\mathrm{PCl_3}}{{}^{n}\mathrm{PCl_5}} \times \left[\frac{p}{\sum n}\right]^1$$

$$= 2 \times \frac{2}{2} \times \left[\frac{3}{6}\right]^1$$

$= 1$ atm

40 **(b)**

$$\mathrm{N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)}$$

$$\Delta n = n_p - n_r$$

$$= 2 - 4$$

$$= -2$$

$\therefore$ $K_p = K_c(RT)^{-2}$

or $K_p = \frac{K_c}{(RT)^2}$

$$K_p < K_c$$

41 **(a)**

$$In\frac{K_2}{K_1} = \frac{\Delta H}{R}\left[\frac{T_2 - T_1}{T_1 T_2}\right]$$

K increase with $\frac{1}{T}$ or decreases with T it is decided by ΔH.

Here, K decrease with T. Thus, $\Delta H = -$ve.

42 **(a)**

	$CdSO_4 +$	HCl	$+ H_2S \longrightarrow$	$CdS +$	H_2SO_4
Millimole added	0.1	10×0.08 =0.8			
Millimole after reaction		0.8		0.1	0.1

$\therefore$ Millimole of H^+ left $= \underset{\text{(from HCl)}}{0.8} + \underset{(\text{from } H_2SO_4)}{0.1 \times 2} = 1.0$

Total volume $= 100$ mL

$\therefore$ $[\mathrm{H^+}] = \frac{1}{100} = 10^{-2}M$

$\therefore$ $\mathrm{pH} = 2$

43 **(a)**

$$\mathrm{pH} = -\log[\mathrm{H^+}] = -\log[0.005]$$

$$= -\log[5 \times 10^{-3}] = 2.3$$

44 **(c)**

It is a case of simultaneous solubility of salts with a common ion. Here solubility product of CuCl is much greater than that of AgCl, it can be assumed that Cl^- in solution comes mainly from CuCl.

$\Rightarrow$ $[\mathrm{Cl^-}] = \sqrt{K_{\mathrm{sp}}(\mathrm{CuCl})} = 10^{-3}$ M

Now for AgCl : $K_{\mathrm{sp}} = 1.6 \times 10^{-10}$

$$= [\mathrm{Ag^+}][\mathrm{Cl^-}]$$

$$= [\mathrm{Ag^+}] \times 10^{-3}$$

$\Rightarrow$ $[\mathrm{Ag^+}] = 1.6 \times 10^{-7}$

45 **(d)**

	$2AB_3(\mathrm{g}) \rightleftharpoons$	$A_2(\mathrm{g}) +$	$3B_2(\mathrm{g})$
t = 0	8	0	0
At.eqilibrium:	$(8-a)$	$a/2$	$\frac{3a}{2}$

Thus, $K_c = \frac{[A_2][B_2]^3}{[AB_3]^2}$; Also, $\frac{a}{2} = 2$ $\therefore a = 4$

$\therefore [AB_3] = \frac{4}{1}$; $[A_2] = \frac{2}{1}$; $[B_2] = \frac{6}{1}$

Thus, $K_c = \dfrac{2 \times 6^3}{4^2} = 27\ \text{mol}^2\text{L}^{-2}$

46 **(b)**

Find solubility for each separately by $s^2 = K_{sp}$ for MnS and ZnS, $108s^5 = K_{sp}$ for Bi_2S_3 and $4\,s^3 = K_{sp}$ for Ag_2S.

47 **(c)**

$$K_{c_1} = \frac{1}{K_{c_2}} = \frac{1}{2.4 \times 10^{-3}} = 4.2 \times 10^2$$

48 **(d)**

$Li_3Na_3(AlF_6)_2 = 3Li^+ + 3Na^+ + 2AlF_6^{3-}$

$\therefore \quad K_{sp} = (3a)^3(3a)^3(2a^2) = 2916a^8.$

49 **(b)**

Dissociation constant

$H_2O \rightleftharpoons H^+ + OH^-: [H^+] = OH^- = 1 \times 10^{-7}$ M

And $[H_2O]$=1 g/mL = 1000 gL^{-1}

$= \frac{1000}{18}$ mol L^{-1} = 55.56 M

$$K = \frac{[H^+][OH^-]}{H_2O} = \frac{10^{-14}}{55.6}$$

$$K_w = 1 \times 10^{-14}$$

So, $K_w = 55.6 \times K$

50 **(d)**

$K_a = C\alpha^2$ and $\alpha = \sqrt{\frac{K_a}{C}}$

$$\alpha = \sqrt{\frac{10^{-5}}{10^{-1}}} = 10^{-2}$$

51 **(d)**

$K_{sp} = 4s^3 = 4 \times \left(\sqrt{3}\right)^3 = 12\sqrt{3}.$

52 **(a)**

$\text{pH} = \frac{1}{2}\left[pK_{a_1} + pK_{a_2}\right]$ and $\text{pH} = \frac{1}{2}\left[pK_{a_2} + pK_{a_3}\right]$.

53 **(a)**

In the given equilibrium reaction, if inert gas is added at constant pressure, it will result in increased volume. Due to which, the equilibrium will shift towards the left hand side (LHS) *i.e.*, reaction goes in back direction.

54 **(d)**

Hard base is that anion which is small and difficult to polarise.

55 **(a)**

HSO_4^- is an acid and conjugate base of H_2SO_4.

56 **(a)**

An increase in temperature favours endothermic reaction whereas an increase in pressure favours the reaction showing decrease in mole or volume.

57 **(d)**

K_{sp} for AgCl $= s^2$.

58 **(c)**

According to Le-Chatelier's principle when a system at equilibrium is subjected to change in pressure, temperature or concentration then the equilibrium is disturbed and shifts in a direction where the effect of change is annuled.

Ice ⇌ water

When pressure is increased in this system, the melting point of ice is decreased *i.e.*, more ice melts and more water is formed.

59 **(d)**

$\because \quad 2SO_3 \quad \rightleftharpoons \quad 2SO_2 + O_2$

$\quad (1 - 0.6) \qquad 0.6 \quad 0.3$

$$K_c = \frac{[SO_2]^2[O_2]}{[SO_3]^2} = \frac{0.6 \times 0.6 \times 0.3}{0.4 \times 0.4} = 0.675$$

60 **(a)**

	$CaCO_3(s) \rightleftharpoons$	$CaO(s) +$	$CO_2(g)$
Mole before dissociation	$\frac{20}{100}$	0	0
Mole after dissociation	$\left[\frac{20}{100} \times \frac{35}{100}\right]$	$\left[\frac{20}{100} \times \frac{65}{100}\right]$	$\left[\frac{20}{100} \times \frac{65}{100}\right]$

$\therefore$ Mole of CO_2 formed $= \frac{20 \times 65}{10^4} = 1.3 \times 10^{-1}$

$\because \quad PV = nRT$

$$p_{CO_2} = \frac{1.3 \times 10^{-1}}{10} \times 0.0821 \times 1073$$
$$= 1.145 \text{ atm}$$

Now, $K_p = p_{CO_2} = 1.145$ atm

61 **(b)**

$2NOBr(g) \rightleftharpoons 2NO + Br_2$

$\quad \frac{6P}{9} \qquad\quad \frac{2P}{9} \quad \frac{P}{9}$

Total pressure $= \frac{6P}{9} + \frac{2P}{9} + \frac{P}{9} = \text{P}$

$$K_P = \frac{(P_{NO})^2(P_{Br_2})}{(P_{NOBr})^2} = \frac{(2P/9)^2\,(P/9)}{\left(\frac{6P}{9}\right)^2} = \frac{P}{81}$$

62 **(c)**

$K_{sp} = 4s^3$

or $\quad s = \left[\dfrac{1.2 \times 10^{-5}}{4}\right]^{1/3} = 1.44 \times 10^{-2}$

$\therefore \quad [M^+] = 1.44 \times 10^{-2} \times 2$

$\qquad = 2.88 \times 10^{-2} M.$

63 **(b)**

Due to back bonding (BF_3 shows maximum tendency due to small size of F).

64 **(c)**

$Cr(OH)_3 \rightleftharpoons Cr^{3+} + 3OH^-$

For precipitate to be dissolved,

$$K_{sp} \le [Cr^{3+}][OH^-]^3$$

or $6 \times 10^{-31} \leq [0.1][\mathrm{OH^-}]^3$

$\therefore \quad [\mathrm{OH^-}] \geq 1.79 \times 10^{-10}$

So, $[\mathrm{H^+}] \leq \frac{10^{-14}}{1.79\times10^{-10}} \leq 5.59 \times 10^{-5}$

$\mathrm{pH} \geq -\log(5.59 \times 10^{-5})$ or $\mathrm{pH} \geq 4.253$

65 **(a)**

KCN is a salt of weak acid and strong base hence, on being dissolved in water gives basic solution *i.e.*, pH > 7 at 25°C .

66 **(b)**

$\mathrm{NH_4Cl}$ is acidic due to hydrolysis of $\mathrm{NH_4^+}$;
$\mathrm{NH_4^+ + H_2O \rightleftharpoons NH_4OH + H^+}$; pH < 7.

67 **(a)**

When the number of moles of gaseous reactants and products is same, then equilibrium is not affected by pressure and hence, the equilibrium constant is unaffected.

68 **(d)**

Glycine, the simplest amino acid ($\mathrm{CH_2NH_2COOH}$) has the tendency to donate $\mathrm{H^+}$ by $-\mathrm{COOH}$ gp. and the tendency to donate lone pair by N-atom of $-\mathrm{NH_2}$ gp. and also exists as **Zwitter ion.**

$\mathrm{H_2NCH_2 \cdot COOH \rightleftharpoons H_3N^+CH_2COO^-}$

69 **(d)**

$\mathrm{H_2 + I_2 \rightleftharpoons 2HI}$

$[\mathrm{HI}] = 0.80, [\mathrm{H_2}] = 0.10, [\mathrm{I_2}] = 0.10$

$$K_c = \frac{[\mathrm{HI}]^2}{[\mathrm{H_2}][\mathrm{I_2}]} = \frac{0.80 \times 0.80}{0.10 \times 0.10} = 64$$

70 **(a)**

$[\mathrm{H^+}] = 10^{-1}\ M$

$\therefore \quad \frac{w}{36.5} = 10^{-1}$

or $\quad w = 36.5 \times 10^{-1} = 3.65\ \mathrm{g}$

71 **(d)**

	$\mathrm{MgCl_2}$	$+ \mathrm{2NaOH} \longrightarrow$	$\mathrm{Mg(OH)_2} +$
mM before reaction	10	20	0
mM after reaction	0	0	10

Thus, 10 m mole of $\mathrm{Mg(OH)_2}$ are formed. The product of $[\mathrm{Mg^{2+}}][\mathrm{OH^-}]^2$ is therefore $\left[\frac{10}{200}\right] \times \left[\frac{20}{200}\right]^2 = 5 \times 10^{-4}$ which is more than K_{sp} of $\mathrm{Mg(OH)_2}$. Now, solubility (s) of $\mathrm{Mg(OH)_2}$ can be derived by $K_{sp} = 4s^3$

72 **(c)**

At chemical equilibrium, rate of forward reaction is equal to the rate of backward reaction.

73 **(a)**

Acidic nature is

$R\mathrm{COOH > CH \equiv CH > NH_3} > R\mathrm{H}$

Stronger is acid, weaker is its conjugate base.

74 **(d)**

In the expression for equilibrium constant (K_p or K_c) species in solid state are not written (*i.e.*, their molar concentrations are taken as 1)

$$\mathrm{P_4}(s) + \mathrm{5O_2(g)} \rightleftharpoons \mathrm{P_4O_{10}}(s)$$

Thus, $\quad K_c = \frac{1}{[\mathrm{O_2}]^5}$

75 **(a)**

Reversible reaction always attains equilibrium and never go for completion.

76 **(d)**

$$K_c = \frac{[\mathrm{CO_2}]}{[\mathrm{CO}]}$$

$$\therefore 5 = \frac{[\mathrm{CO_2}]}{2.5 \times 10^{-2}}$$

$\therefore [\mathrm{CO_2}] = 0.125\ M$

77 **(d)**

	$\mathrm{H_2}$	$+ \mathrm{I_2}$	$\rightleftharpoons \mathrm{2HI}$
Initial	0.4	0.4	0
At equilibrium	0.4-0.25 =0.15	0.4-0.25 =0.15	0.05

$$K_c = \frac{[\mathrm{HI}]^2}{[\mathrm{H_2}][\mathrm{I_2}]}$$

$$= \frac{\left(\frac{0.50}{2}\right)^2}{\left(\frac{0.15}{2}\right)\left(\frac{0.15}{2}\right)} = \frac{0.5\times0.5}{0.15\times0.15} = 11.11$$

78 **(d)**

We know that,

$$[\mathrm{H^+}] = 10^{-\mathrm{pH}} = 10^{-5}$$

$$\alpha = \frac{\text{actual concentration}}{\text{molar concentration}}$$

$$= \frac{10^{-5}}{0.005} = 0.2 \times 10^{-2}$$

$\therefore$ Percentage ionisation $= 0.2 \times 10^{-2} \times 100$

$= 0.2\%$

79 **(a)**

More is pH, more basic is solution.

80 **(d)**

Both Arrhenius and Bronsted bases are source of

H^+ Arrhenius base (OH^- furnish) may not be capable of accepting proton (*i.e.*, Bronsted based). H^+ exists as $H_9^+O_4$.

81 **(b)**

$$\begin{array}{lccc} & CH_2FCOOH = & CH_2FCOO^- + & H^+ \\ \text{Mole before dissociation} & 1 & 0 & 0 \\ \text{Mole after dissociation} & (1-\alpha) & \alpha & \alpha \end{array}$$

Given, $[H^+] = c\alpha = 1.5 \times 10^{-3}$ mol litre^{-1}

$$\because \quad K_a = \frac{(c\alpha)(c\alpha)}{c(1-\alpha)} = \frac{c\alpha^2}{(1-\alpha)}$$

$$2.6 \times 10^{-3} = \frac{1.5 \times 10^{-3} \times \alpha}{(1-\alpha)}$$

$$\therefore \quad \alpha = 0.634$$

Now, $c\alpha = 1.50 \times 10^{-3}$

$$\therefore \quad c = \frac{1.50 \times 10^{-3}}{0.634} = 2.37 \times 10^{-3} M$$

Note: Since K_a is of the order of $10^{-3}M$ and thus, it is not advisable to use $K_a = c\alpha^2$. Because $(1-\alpha)$ is not equal to 1 since α is not small.

82 **(b)**

For oxoacids of the same element, the acidic strength increases with increase in the oxidation number of the element

$$\overset{+1}{HClO} < \overset{+3}{HClO_2} < \overset{+5}{HClO_3} < \overset{+7}{HClO_4}$$

83 **(a)**

HNO_3 (nitric acid) is generally not an amphoteric substance. It is a strong acid (proton-donating) though sometimes, in presence of stronger acid, it also acts as a base (*e.g.*, in nitration of atomic compounds, it acts as a base and accept proton from H_2SO_4). However HCO_3^-, H_2O and NH_3 frequently act both as an acid as well as a base (*i.e.*, amphoteric in nature).

85 **(b)**

$K_p = K_c\ (RT)^{-1/2}$

$\because \Delta n = -1/2$

86 **(c)**

Le-Chatelier's principle is not valid for solid-solid equilibrium.

87 **(c)**

$BaCl_2 \longrightarrow Ba^{2+} + 2Cl^-$

Let the solubility of $BaCl_2$ is x mol/L

$$\therefore \quad K_{sp} = [Ba^{2+}][Cl^-]^2$$
$$= (x) \times (2x)^2$$
$$= x \times 4x^2 = 4x^3$$

or solubility of $BaCl_2$ =

$$\frac{(\text{solubility product of } BaCl_2)^{1/3}}{4}$$

$$= \frac{(4 \times 10^{-9})^{1/3}}{4}$$

$$= 10^{-3}\ \text{mol/L}$$

88 **(a)**

Addition of sodium acetate in acetic acid solution, due to common ion NH_4^+ the ionisation of acetic acid is supressed so concentration of $[H^+]$ decreases. Hence, pH of solution increases.

89 **(a)**

$AB_2 \rightleftharpoons A^+ + \quad 2B^-$

$1 \times 10^{-3} \quad 2 \times 10^{-3}$

$K_{sp} = [1 \times 10^{-3}][2 \times 10^{-3}]^2 = 4 \times 10^{-9}$

90 **(b)**

$$\underset{\text{Acid salt}}{NaHCO_3} + \underset{\text{Base}}{NaOH} \longrightarrow Na_2CO_3 + H_2O.$$

91 **(a)**

$$\underbrace{2SO_2\,(g) + O_2(g)}_{3\ \text{mol}} \rightleftharpoons \underbrace{2SO_3\,(g)}_{2\ \text{mol}}$$

Formation of

SO_3 (sulphur trioxide)from $SO_2$and O_2 is accompanied by decrease in volume. So, increase in pressure favours SO_3 formation (also due to Le-Chatelier's principle).

92 **(d)**

$$\begin{array}{lccc} & NH_4HS(s) \rightleftharpoons & NH_3(g) + & H_2S(g) \\ \text{at} & t = 0 & 0.5 & 0 \\ at & t{=}eq. & 0.5{+}P & P \end{array}$$

$P_T \quad = 0.5 + P + \ P = 0.84$

$\therefore P = 0.17$ atm

$K_p = P_{NH_3} \times P_{H_2S} = (0.5 + 0.17) \times 0.17$

$\quad = 0.11$ atm

93 **(b)**

$[H^+][OH^-] = 10^{-14}$

$[10^{-2}][OH^-] = 10^{-14}$

$[OH^-] = \frac{10^{-14}}{10^{-2}}$

$= 10^{-12}$ mol dm^{-3}

94 **(c)**

It is condition for chemical equilibrium.

95 **(b)**

Solution of $CuSO_4$ is acidic due to hydrolysis of Cu^{2+} ion.

97 **(a)**

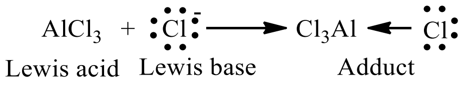
$[H^+]_I = 10^{-5}$

$[H^+]_{II} = 10^{-2}$

Thus, increase in $[H^+] = \frac{10^{-2}}{10^{-5}} = 1000$ times.

98 **(a)**

According to Lewis acid is any species (molecule, radial or ion) that can accept an electron pair to form a coordinate covalent bond. Thus, acid is an electron deficient species *e.g.*, $BF_3, AlCl_3, SO_3$ and all cations etc.



Or $AlCl_4^-$

99 **(c)**

K_{sp} of AgCl = (solubility of AgCl)^2

$= (1 \times 10^{-5})^2 = 1 \times 10^{-10}$

Suppose its solubility in 0.1 M

NaCl is x mol/L

$$AgCl \rightleftharpoons \underset{x}{Ag^+} + \underset{x}{Cl^-}$$

$$NaCl \rightleftharpoons \underset{0.1\text{ M}}{Na^+} + \underset{0.1\text{ M}}{Cl^-}$$

$[Cl^-] = (x + 0.1)$ M

K_{sp} of AgCl $= [Ag^+][Cl^-]$

$= x \times (x + 0.1)$

$1 \times 10^{-10} = x^2 + 0.1x$

Higher power of x are neglecated

$1 \times 10^{-10} = 0.1x$

$x = 1 \times 10^{-9}$ M

100 **(c)**

For reaction, $2SO_3 \rightleftharpoons O_2 + 2SO_2$

Here, $\Delta n_g = 3 - 2 = 1$, *ie*, +ve, thus, K_p is more than K_c $[\because K_p = K_c(RT)^{\Delta n_g}]$

101 **(c)**

$s = \sqrt{K_{sp}} = \sqrt{36} = 6M.$

102 **(d)**

$K_h = \frac{K_w}{K_b}$

where K_w =ionic product of water $= 1 \times 10^{-14}$

K_b =degree of dissociation of $NH_4OH = 1.8 \times 10^{-5}$

$K_h = \frac{1 \times 10^{-14}}{1.8 \times 10^{-5}}$

$= 0.555 \times 10^{-9}$

$= 5.55 \times 10^{-10}$

103 **(b)**

Let V mL of 0.1 M HCOONa be mixed to 50 mL of 0.05 M HCOOH.

$\left[\because [\ ] = \frac{\text{Total millimole}}{\text{Total volume}}\right]$

$\therefore$ In mixture $[HCOONa] = \frac{0.1 \times V}{(V + 50)}$

$\therefore [HCOOH] = \frac{50 \times 0.05}{V + 50}$

$\because pH = -\log K_a + \log \frac{[\text{Conjugate base}]}{[\text{Acid}]}$

$\therefore 4.0 = 3.80 + \log \frac{(0.1 \times V)(V + 50)}{2.5/(V + 50)}$

$\therefore V = 39.62$ mL.

104 **(a)**

HA (a weak acid) ionises as

$$\begin{array}{ccc} HA & \rightleftharpoons H^+ & + \ A^- \\ 1 & 0 & 0 \\ (1 - 10^{-5}) & 10^{-5} & 10^{-5} \end{array}$$

$[A^-] = [H^+] = 10^{-pH} = 10^{-5}$M

$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{10^{-5} \times 10^{-5}}{(1 - 10^{-5})} = \frac{10^{-10}}{1}$

$(\therefore 1 >>> 10^{-5})$

$= 1 \times 10^{-10}$ M

105 **(a)**

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

$(1 - x) \qquad x \qquad x$

Total number of moles at equilibrium

$= (1 - x) + x + x$

$= 1 + x$

$p_{PCl_3} = \left(\frac{x}{1+x}\right) \times p$

106 **(c)**

$2.303 \log \frac{K_2}{K_1} = \frac{\Delta H}{R} \frac{[T_2 - T_1]}{T_1 T_2}$,

ΔH = +ve for the reaction,

$N_2 + O_2 \rightleftharpoons 2NO$.

107 **(b)**

Now $[H^+] = \frac{25 \times 0.01 + 25 \times 0.02}{50}$

$= \frac{0.75}{50} = 0.015\ M$

and thus, pH will decrease, as $[H^+]$ increases.

108 **(a)**

Carbon cannot expand its octet.

109 **(d)**

N of NH_3 possesses lone pair of electron available for donation.

110 **(a)**

$$2NH_3 \rightleftharpoons N_2 + 3H_2$$

Initial moles $\quad a \quad 0 \quad 0$

At equilibrium$(a-2x) \quad x \quad 3x$

Initial pressure of NH_3 of 'a'mole $=$ 15 atm at 27°C. The pressure of 'a' mole of NH_3 $=$ p atm at 347°C

$\therefore \dfrac{15}{300} = \dfrac{p}{620}$

$\therefore p = 31$ atm

At constant volume and at 347°C,

mole $\propto$ pressure

$a \propto 31$ (before equilibrium)

$\therefore (a-2x) \propto 50$ (after equilibrium)

$\therefore \dfrac{(a-2x)}{a} = \dfrac{50}{31}$

$\therefore x = \dfrac{19}{62}a$

$\therefore$ % of NH_3 decomposed $= \frac{2x}{a} \times 100$

$= \dfrac{2 \times 19a}{62 \times a} \times 100$

$= 61.33\%$

111 **(b)**

Equilibrium constant for the reaction,

$3A + 2B \rightleftharpoons C$, is

$K = \dfrac{[C]}{[A]^3[B]^2}$

112 **(a)**

$HA \rightleftharpoons H^+ + A^-$

$K = C\alpha^2$

$= 0.1 \times (10^{-5})^2$

$= 0.1 \times 10^{-10}$ or 1×10^{-11}

113 **(c)**

$K_p = \dfrac{p_{CO}^2}{p_{CO_2}} = \dfrac{4 \times 4}{2} = 8$

114 **(b)**

$\frac{\text{normal.mol.wt.}}{\text{exp.mol.wt.}} = 1 + \alpha$

For, $NH_4Cl \rightleftharpoons NH_3 + HCl$;

$\because \alpha = 1$

$\therefore$ Exp. Mol.wt. $= \frac{\text{normal.mol.wt.}}{2}$

115 **(c)**

$Al(OH)_3$ is weak base than $Mg(OH)_2$. Hydroxides of I and II group metals are strong base, stronger is base, weaker is its conjugate acid.

116 **(b)**

K_p and K_c values do not change with catalyst.

117 **(a)**

$\Delta H = E_{a_{(f)}} - E_{a_{(b)}} = 180 - 200$

$= -20$ kJ mol^{-1} (in absence of catalyst)

$\therefore \ \Delta H = E_{a_{(f)}} - E_{a_{(b)}}$

$= [180 - 100] - [200 - 100]$

$= -20$ kJ mol^{-1} (in presence of catalyst)

Catalyst's have no influence on ΔH

118 **(b)**

$C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$; Here, $\Delta n > 1$

Hence, decrease of pressure shifts the equilibrium in forward direction and increase of pressure shift the equilibrium in backward (reverse) direction.

119 **(b)**

20% mixture reacts to form 10% NH_3 ;

Thus, 80% mixture and 10% NH_3 left or total pressure left = 90 atm, since 100% mixture has 100 atm.

120 **(c)**

$C_2H_5O^-$ is conjugate strong base of C_2H_5OH.

121 **(a)**

Borate ions are hydrolysed to develop alkaline nature in solution.

123 **(b)**

For a buffer solution, pH is given by Henderson equation.

$$pH = pK_a + \log\frac{[\text{salt}]}{[\text{acid}]}$$

hence, pH is least when concentration of acid is higher than that of salt.

124 **(a)**

Phenolphthalein is good indicator in the range of pH 8 to 9.8.

125 **(c)**

$N = \frac{N_1V_1 + N_2V_2}{V_1 + V_2}$

($\because$ for HCl $N = M$)

$= \frac{0.015 \times 100 + 0.005 \times 100}{100 + 100}$

$= \frac{1.5 + 1.5}{200} = \frac{1}{100} = 10^{-2}$

Resulting solution is acidic in nature.

Then, $[H^+] = 10^{-2}$

$pH = -\log[H^+]$

$= \log\frac{1}{[H^+]} = \log\frac{1}{10^{-2}}$

$= 2 \log\ 10$

$$= 2$$

126 **(d)**

$K_{sp} = [A^{3+}]^2[X^{2-}]^3 = (2y)^2(3y)^3 = 108\,y^5$

127 **(b)**

Solubility of $BaSO_4 = \sqrt{K_{sp}}$

$$= \sqrt{1.1 \times 10^{-10}}$$

$$= 1.05 \times 10^{-5}\,M$$

∴ wt. of $BaSO_4 = 1.05 \times 10^{-5} \times 233$

or $w_{BaSO_4} = 244.37 \times 10^{-5}$ g/litre

∴ Volume of water needed to dissolve 1 g.

$BaSO_4$ is equal to $\frac{1}{244.37 \times 10^{-5}} = 410$ litre.

128 **(c)**

Addition of inert gas at constant volume does not influence the equilibrium concentration.

129 **(b)**

$H_4Cl(s) \rightleftharpoons NH_4^+(aq) + Cl^-(aq); \quad \Delta H = +3.5\text{ kcal/mol}$

This is the endothermic reaction hence, increasing the temperature will shift the equilibrium to the right.

130 **(c)**

K_{sp} of $BaSO_4 = 1.5 \times 10^{-9}$: $[Ba^{2+}] = 0.01$ M

$$[SO_4^{2-}] = \frac{1.5 \times 10^{-9}}{0.01} = 1.5 \times 10^{-7}$$

131 **(d)**

$Pb(OH)_2 \rightleftharpoons Pb^{2+} + 2OH^-$

$$K_{sp} = [Pb^{2+}][OH^-]^2 = S \times (2S)^2$$

$$K_{sp} = 4s^3 = 4 \times (6.7 \times 10^{-6})^3$$

$$= 1.20 \times 10^{-15}$$

In a solution with pH=8

$$[H^+] = 10^{-8}$$

and $[OH^-] = 10^{-6}$

$$1.20 \times 10^{-15} = [Pb^{2+}][10^{-6}]^2$$

$$[Pb^{2+}] = \frac{1.2 \times 10^{-15}}{[10^{-6}]^2}$$

$$= 1.2 \times 10^{-3}\text{M}$$

132 **(c)**

$I_2(g) \rightleftharpoons 2I(g)$

$$\Delta n = n_p - n_r$$

$$= 2 - 1 = 1$$

$$K_p = K_c(RT)$$

$2BrCl(g) \rightleftharpoons Cl_2(g) + Br_2(g)$

$$\Delta n = 0$$

$$K_p = K_c(RT)^0$$

$$K_p = K_c$$

$CO(g) + 3H_2(g) \rightleftharpoons CH_4(g) + H_2O(g)$

$$\Delta n = 2 - 4 = -2$$

$$K_p = K_c(RT)^{-2}$$

$$K_p < K_c$$

133 **(d)**

When the value of ionic product is greater than the solubility product, precipitation takes place

134 **(a)**

$$\underset{(1-\alpha)}{BOH} \rightleftharpoons \underset{c\,\alpha}{B^+} + \underset{c\alpha}{OH^-}$$

$$K_b = \frac{[B^+][OH^-]}{BOH} = [OH^-]^2$$

∴ $[OH^-] = 1.0 \times 10^{-6} M.$

135 **(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^{-9} M

136 **(d)**

pH = 12

∴ pOH = 2

or $[OH^-] = 10^{-2}$; ∴ $[Ba^{2+}] = \frac{10^{-2}}{2}$

$K_{sp}Ba(OH)_2 = [Ba^{2+}][OH^-]^2 = \frac{10^{-2}}{2} \times (10^{-2})^2$

$$= 5 \times 10^{-7} M^3.$$

137 **(b)**

$2NH_3 \rightleftharpoons NH_4^+ + NH_2^-$ (self ionisation)

and $K = [NH_4^+][NH_2^-]$

∴ $[NH_4^+] = [NH_2^-]$

∴ $[NH_2^-] = \sqrt{K} = \sqrt{10^{-30}} = 10^{-15} M$

Number of amide ions in $10^3 cm^3 = 10^{-15} \times 6 \times 10^{23}$

∴ Number of amide ions in one $cm^3 = \frac{10^{-15} \times 6 \times 10^{23}}{10^3}$

$$= 6 \times 10^5 \text{ ions}$$

138 **(c)**

$K = k_1 \times k_2$

$= 1.8 \times 10^{-5} \times 5.0 \times 10^{-10}$

$= 5 \times 10^{-15}$

139 **(d)**

Trichloroacetic acid is almost of same strength as HCl due to inductive effect of Cl-atoms.

140 **(c)**

$[OH^-] = c \cdot \alpha = 0.01 \times \frac{5}{100} \times 5 \times 10^{-5}.$

141 **(b)**

Nucleophiles are electron rich species and donate electron pair.

143 **(a)**

$[Ca(OH)_2] = 0.01$ mol/100 cc $= 0.1$ mol L^{-1}

Assuming complete ionisation,

$[OH^-] = 0.2$ M, $[H^+] = \frac{10^{-14}}{0.2} = 5 \times 10^{-14}$

$\text{pH} = -\log[\text{H}^+]$
$= -\log(5 \times 10^{-14})$
$= 14 - 0.669 = 13.3$

144 **(c)**

A solution with reverse acidity or basically is known as buffer solution. It is of two types :

(I)Acidic buffer solution : A mixture of weak acid and its salt with strong base

e.g., $CH_3COOH + CH_3COONa$

(II)Basic buffer solution : A mixture of a weak base and its salt with strong acid.

e.g., $NH_4OH + NH_4Cl$

145 **(a)**

$X(\text{g}) \rightleftharpoons$
$Y(\text{g})$ $Z(\text{g})$

Initial 1 0
0
At equilibrium 0.5 0.5
0.5
Partial pressure $\frac{0.5}{1.5}p$ $\frac{0.5}{1.5}p$
$\frac{0.5}{1.5}p$

$\because$ K_p $\frac{p_Y \cdot p_Z}{p_x}$

1 $\frac{\frac{p}{3}\ \frac{p}{3}}{\frac{p}{3}}$

p 3 atm

Partial pressure of X $\frac{p}{3}$ $\frac{3}{3}$ 1 atm.

146 **(a)**

$K_1 = \frac{[NO_2]}{[NO][O_2]}$ and $K_2 = \frac{[NO]^2[O_2]}{[NO_2]^2}$

$\therefore \quad K_2 = \frac{1}{K_1^2}$

147 **(b)**

$$K_1 = \frac{[NO]^2}{[N_2][O_2]};$$

$$K_2 = \frac{[NO]}{[N_2]^{1/2}\,[O_2]^{1/2}};$$

$\therefore K_1 = K_2^2.$

149 **(c)**

$Hg_2Cl_2 \rightleftharpoons Hg_2^{2+} + 2Cl^-$
$\qquad\qquad s \qquad 2s$

$$K_{\text{sp}} = [Hg_2^{2+}][Cl^-]^2$$
$$K_{\text{sp}} = (s)(2s)^2$$
$$K_{\text{sp}} = 4s^3$$
$$s = \left(\frac{K_{\text{sp}}}{4}\right)^{1/3}$$

150 **(c)**

$K_c = \frac{[\text{product}]}{[\text{reactant}]}$

$0.41 = \frac{[\text{product}]}{[\text{reactant}]}$

$\Rightarrow \quad [\text{product}] = 0.41 \times [\text{reactant}]$
$\Rightarrow \quad [\text{product}] < [\text{reactant}]$

Therefore, reaction proceeds in backward direction, *i.e.*, more PCl_5 will be formed.

151 **(a)**

Reaction is exothermic. By Le-Chatelier's principle, a reaction is spontaneous in forward side (in the direction of formation of more ClF_3) if F_2 is added, temperature is lowered and ClF_3 is removed.

152 **(c)**

$\Delta ng = 1$ for this change, so the equilibrium constant depends on the units of concentration

153 **(a)**

$K_{sp} = 4s^3$
$\therefore \quad 4s^3 = 3.2 \times 10^{-8}$
$\therefore \quad s = 2 \times 10^{-3} M$

154 **(d)**

$Ag_2CO_3 \rightleftharpoons 2Ag^+ + CO_3^{2-}$

Due to the common ion effect, the solubility decreases, so the solubility of Ag_2CO_3 would be greatest 1 L of 0.05 M NH_3 due to the absence of common ion either Ag^+or CO_3^{2-}. Ag^+form complex with NH_3.

$$Ag^+ + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+$$

155 **(c)**

The interferring radicals are $PO_4^{3-}, BO_3^{3-}, C_2O_4^{2-}$ and F^- give insoluble matter in alkaline medium.

156 **(d)**

$\text{pOH} = K_b + \log\frac{[\text{salt}]}{[\text{base}]}$

given, $\text{p}K_b = 5, [\text{Base}] = 0.10$ M,
$[\text{salt}] = 0.01$ M

$\therefore \qquad \text{pOH} = 5 + \log\frac{0.01}{0.10} = 4$
$\qquad \text{pH} + \text{pOH} = 14$
$\therefore \qquad \text{pH} = 14 - 4 = 10$

157 **(c)**

$2.303 \log\frac{K_2}{K_1} = \frac{\Delta H}{R}\frac{[T_2 - T_1]}{T_1T_2}$; find ΔH.

158 **(b)**

$$K_c = \frac{[HI]^2}{[H_2][I_2]}$$

$$\therefore 64 = \frac{x^2}{0.03 \times 0.03}$$

$\therefore x^2 = 64 \times 9 \times 10^{-4}$

or, $x = 8 \times 3 \times 10^{-2}$

x is the amount of HI

At equilibrium, amount of I_2 will be

$0.30 - 0.24 = 0.06$

159 **(c)**

Weak electrolytes are completely ionised at infinite dilution.

160 **(b)**

$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{0.2 \times x}{0.4} = 0.5$$

$\therefore\ x = 1$

161 **(b)**

Rest all occur in backward direction.

162 **(c)**

Electron donors are Lewis base.

In the reaction $I_2 + I^- \rightarrow I_3^-, I^-$ donates a pair of electron and I_2 accepts it to form I_3^-.

$\therefore$ 1^- is Lewis base.

163 **(d)**

Number of milliequivalents of

$$NaOH = 10 \times 0.1 = 1$$

Number of milliequivalents of

$$H_2SO_4 = 10 \times 0.05 = 0.5$$

Milliequivalent of H_2SO_4 will neutralise NaOH so, that (1-0.5)=0.5 millieq. Of NaOH is left unneutralised.

Hence, pH of the resulting solution will be greater than seven (pH>7).

164 **(d)**

$K_{sp}PbCl_2 = 4s^3 = 4 \times (0.01)^3 = 4 \times 10^{-6}$

In NaCl solution for $PbCl_2$;

$$K_{sp} = [pb^{2+}][Cl^-]^2$$

or $4 \times 10^{-6} = [pb^{2+}][0.1]^2$

$\therefore\quad [Pb^{2+}] = 4 \times 10^{-4} M.$

165 **(a)**

$aX + H_2O \rightleftharpoons NaOH + HX$

In it HX is weak acid, so NaX is a salt of weak acid and strong base.

$\therefore$ Hydrolysis constant of NaX

$$K_h = \frac{K_w}{K_a} = \frac{1\times10^{-14}}{10^{-5}} = 1 \times 10^{-9}$$

For this type of salt

$$K_h = \frac{h^2}{V} = Ch^2$$

h = degree of hydrolysis

$\therefore\quad 1 \times 10^{-9} = 0.1 \times h^2$

or $\quad h^2 = \frac{1\times10^{-9}}{0.1} = 1 \times 10^{-8}$

$h = 1 \times 10^{-4}$

$\therefore$ % of degree of hydrolysis on NaX salt

$= 1 \times 10^{-4} \times 100 = 1 \times 10^{-2} = 0.01\%$

166 **(b)**

H_2SO_4 is almost completely ionised in aqueous solution.

167 **(c)**

$$\begin{array}{cccc} XA & \rightleftharpoons C & + & D \\ 0 & 0 & & 0 \\ a(1-\alpha) & \frac{a\alpha}{x} & & \frac{a\alpha}{x} \end{array}$$

$$\because\ K = \frac{[C][D]}{[A]^X} = \left[\frac{a^2\alpha^2}{x^2V^2}\right] \Big/ \left[\frac{a(1-\alpha)}{V}\right]^X$$

$$= \frac{\alpha^2.a^{2-x}}{x^2(1-\alpha)^X.V^{2-X}}$$

If α is independent of a, then $2 - X$ =0

Or X=2

168 **(d)**

$N_2O_4 \rightleftharpoons 2NO_2$

$(1-\alpha)\quad 2\alpha$

Total number of moles = $1 - \alpha + 2\alpha = 1 + \alpha$

169 **(d)**

$$K_{sp} = 4s^3$$

Also, $\quad s = \frac{0.11}{58}$ mol litre^{-1}

$\therefore\quad K_{sp} = 4 \times \left(\frac{0.11}{58}\right)^3$

170 **(d)**

$2NO_3(g) \rightleftharpoons 2NO(g) + O_2(g)$

$K_c = 1.8 \times 10^{-6}$ at 184°C(= 457K)

$R = 0.00831$ kJ mol^{-1}K^{-1}

$K_p = K_c(RT)^{\Delta n_g}$

Where,

Δn_g = (gaseous products – gaseous reactants)

=3-2=1

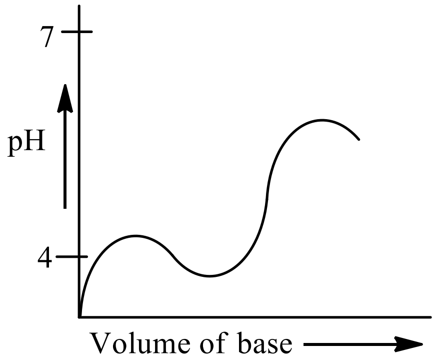
$\therefore K_p = 1.8 \times 10^{-6} \times 0.00831 \times 457$

$= 6.836 \times 10^{-6} > 1.8 \times 10^{-6}$

Thus, $K_p > K_c$

171 **(a)**

pH curve of strong acid with weak base is vertical over the pH range of 4 to 7.



The indicator that shows colour change

within this range is suitable. Methyl red (pH range 4.4 to 6.5) is suitable indicator for titration of weak base *vs* strong acid.

172 **(b)**

The value of the ionic product of water depends on temperature.

173 **(b)**

In this reaction, ΔH is negative, so reaction moves forward by decrease in temperature while value of $\Delta n_g = 2 - 3 = -1$, *ie*, negative, so the reaction moves in forward direction by increase in pressure

175 **(b)**

$K_p = K_c(RT)^{\Delta n}$

For the reaction,

$N_2 + O_2 \rightleftharpoons 2NO$

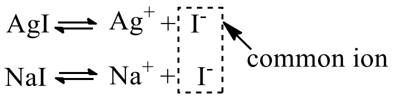
$\Delta n = 2 - 2 = 0$

$\therefore \quad K_p = K_c(RT)^0$

$K_p = K_c$

176 **(b)**

Solubility is decreased due to common ion effect



177 **(d)**

$$K_p = \frac{p_{CH_3OH}}{P_{CO} \times p_{H_2}^2} = \frac{2}{1 \times (0.1)^2} = 200$$

K_p for reverse reaction is

$$= \frac{1}{K_p} = \frac{1}{200} = 5 \times 10^{-3} \text{ atm}^2$$

178 **(a)**

Due to common ion effect, dissociation of NH_4OH decreases and thus, pOH increases or pH decreases.

179 **(c)**

$pOH = 14 - pH = 14 - 10.65 = 3.35$

$pOH = -\log[OH^-]$

$-3.35 = \log[OH^-]$

$\therefore [OH^-] = 4.447 \times 10^{-4}$ M

$Ca(OH)_2 = Ca^{2+} + 2OH^-$

4.447×10^{-4} M

$\frac{[OH^-]}{2} = [Ca(OH)_2] = 2.2235 \times 10^{-4}$ M

Hence, in 250 mL, moles of

$$Ca(OH)_2 = \frac{2.2235 \times 10^{-4} \times 250}{1000}$$

$= 0.56 \times 10^{-4}$

180 **(c)**

An increase in volume for the equilibrium having,

$$K_c = \frac{[SO_2][Cl_2]}{[SO_2Cl_2]} = \frac{[\text{mole of } SO_2][\text{mole of } Cl_2]}{[\text{mole of } SO_2Cl_2] \times \text{volume}}$$

Will increase the mole of Cl_2 or SO_2 to maintain K_c values constant.

181 **(b)**

$\underset{\text{Acid}}{ZnO} + \underset{\text{Base}}{2NaOH} \longrightarrow \underset{\text{Salt}}{Na_2ZnO2_2} + H_2.$

182 **(c)**

$N_2(g) \quad +$

$3H_2(g) \quad \rightleftharpoons 2NH_3(g)$

(Initially) 1 mole 3 mole

0 moles(2L)

(At equilibrium) 0.6 or $(3 - 3x)$

$2x$ moles

$(1 - x)$ moles moles

Number of moles of $N_2 = 0.6 = 1 - x$

$\therefore \quad x = 1 - 0.6 = 0.4$

So, $\quad 3 - 3x = 3 - 3 \times 0.4 = 1.8,$

and $\quad 2x = 2 \times 0.4 = 0.8$

Therefore, the total number of moles at equilibrium.

$= (1 - x) + (3 - 3x) + 2x$

$= 0.6 + 1.8 + 0.8$

$= 3.2$ mol

183 **(a)**

$I_2 \rightleftharpoons 2I^-$;

Find x, using $K_c = 10^{-6} = \frac{4x^2}{(1-x)}$, find x and notice $2x < (1 - x)$.

184 **(d)**

$K_c = \frac{[B]}{[A]} = 1.1$

185 **(a)**

In the reaction, $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, the number of moles of reactants and products are equal, thus it remain unaffected by change in pressure

186 **(a)**

Aqueous solution of NaCl is neutral. So, its pH value is 7.

187 **(a)**

If saturated solution $[Ag^+][Cl^-] = K_{sp}$ if the product of ionic concentration is lower than K_{sp}, solution is unsaturated.

188 **(a)**

$NH_4OH \rightleftharpoons NH_4^+ + OH^-$

At $t = 00.1 \quad M \qquad 0 \qquad 0$

At equilibrium $\left(0.1 - \frac{1.3 \times 0.1}{100} \text{M}\right)$ 0.0013 M(0.0013 M)

$= 0.1\text{ M}$

$= [\text{OH}^-] = 0.0013\text{ M} = 13 \times 10^{-4}\text{ M}$

$\text{pOH} = -\log[\text{OH}^-] = -\log(13 \times 10^{-4}) = 2.89$

$\text{pH} = 14 - 2.89 = 11.11$

189 **(b)**

$$\alpha = \frac{\Lambda_v}{\Lambda_\infty} = \frac{8}{400} = 0.02$$

Now $K_a = c\alpha^2 = \frac{1}{32} \times (0.02)^2$

$= 1.25 \times 10^{-5}$.

190 **(b)**

$O^{2-} + H_2O \longrightarrow 2OH^-$.

191 **(b)**

$X^- + H_2O \rightleftharpoons HX + OH^-$

$K_h = \frac{10^{-14}}{10^{-5}}$ so, $h = \sqrt{\frac{K_h}{C}} = \sqrt{\frac{10^{-9}}{10^{-1}}} = 10^{-4}$

$= 100 \times 10^{-4} = 10^{-2}$

So, degree of hydrolysis is 0.01%

192 **(a)**

The species which can accept as well as donate H^+ can act both as an acid and a base

$HSO_4^- + H^+ \rightleftharpoons H_2SO_4$

base

$HSO_4^- \rightleftharpoons SO_4^{2-} + H^+$

acid

193 **(d)**

$2 = \frac{[B]}{[A]}; 4 = \frac{[C]}{[B]}$ and $6 = \frac{[D]}{[C]}$

Thus, on multiplying

$2 \times 4 \times 6 = \frac{[D]}{[A]}$, i.e., K_c for the reaction.

194 **(d)**

Moles of HCl $= \frac{0.365}{36.5} = 0.01$

Moles of NaOH in 100 cm^3 of 0.2 M NaOH

$$0.2 = \frac{n \times 1000}{100} = 0.02$$

Moles of NaOH left=0.02−0.01=0.01

Moles of NaOH per litre

$\frac{0.01 \times 1000}{100} = 0.1$

$[H^+] = \frac{10^{-14}}{0.1} = 10^{-13}$; $(K_w = [H^+].[OH^-])$

$\text{pH} = -\log[H^+] = -\log[10^{-13}]$

$\text{pH} = 13$

195 **(c)**

$[\text{OH}^-] = 0.0001\text{N}, \text{pOH} = 4$

$\text{pH} + \text{pOH} = 14$

$\text{pH} = 14 - \text{pOH} = 14 - 4 = 10$

196 **(a)**

$\Delta G^0 = -2.303RT \log K_p$

$= -2.303 \times 8.314 \times 300 \log 10^{20}$

$= -114.88\text{ kJ}$

197 **(a)**

$K_c = \frac{1}{[O_2]^5}$; note that the expression does not involve the concentration terms of solid species.

198 **(b)**

NH_4CN Is a salt of weak acid and weak base and thus, for it,

$$K_H = \frac{K_w}{K_a \times K_b}$$

199 **(d)**

The forward reaction is exothermic and an increase in volume is taking place, Hence, according to Le-Chatelier's principle, forward reaction will be favoured by low temperature and low pressure.

200 **(d)**

NH_4Cl on hydrolysis gives acidic nature.

201 **(b)**

$K_c = [\text{Fe}^{3+}][\text{OH}^-]^3$

If $[\text{OH}^-] = \frac{1}{4} \times [\text{OH}^-]_{\text{initial}}$, than $[\text{Fe}^{3+}] = 64\,[\text{Fe}^{3+}]_{\text{initial}}$ to have K_c constant

202 **(c)**

$A(g) \quad + 3B(g) \rightleftharpoons 4C(g)$

1 1 0 Initial concentration

$(1 - x)$ $(1 - 3x)$ $4x$ Final concentration

(at equilibrium)

According to question, $1 - x = 4x$

$\therefore \quad x = \frac{1}{5}$

For above reaction,

$$K_c = \frac{[C]^4}{[A][B]^3} = \frac{(4x)^4}{(1-x)(1-3x)^3}$$

$$K_c = \frac{\left(4 \times \frac{1}{5}\right)^4}{\left(1 - \frac{1}{5}\right)\left(1 - 3 \times \frac{1}{5}\right)^3} = 8.0$$

203 **(a)**

m Mole of acid $= 6 \times 0.1 = 0.6$

m Mole of salt $= 12 \times 0.1 = 1.2$

$\therefore \text{pH} = 4.75 + \log\frac{1.2}{0.6} = 4.75 + 0.3010 = 5.05.$

204 **(c)**

50 mL of 0.1 M HCl $= \frac{0.1 \times 50}{1000} = 5 \times 10^{-3}$

50 mL of 0.2 M NaOH $= \frac{0.2 \times 50}{1000} = 10 \times 10^{-3}$

Hence, after neutralisation NaOH is left

$= 10 \times 10^{-3} - 5 \times 10^{-3}$

$= 5 \times 10^{-3}$

Total volume= 100 cc

The concentration of NaOH

$$= \frac{5 \times 10^{-3} \times 1000}{100} = 0.05\ \text{M}$$

$$[\text{OH}^-] = 0.05\ \text{M} = 5 \times 10^{-2}\text{M}$$

$$\text{pOH} = -\log\ [\text{OH}^-]$$

$$= -\log\ [5 \times 10^{-2}]$$

$$= 1.3010$$

$\text{pH} + \text{pOH} = 14$

$\text{pH} = 14 - 1.3010 = 12.699$

205 **(b)**

$$\begin{array}{ccccccccc} 2\text{KCN} & + & \text{AgNO}_3 & \rightarrow & \text{Ag(CN)}_2^- & + & \text{KNO}_3 & + & \text{K}^+ \\ \underset{(0.1-0.06)}{0.1} & & \underset{0}{0.03} & & \underset{0.03}{0} & & \underset{0.03}{0} & & \underset{0.03}{0} \end{array}$$

$\therefore \quad [\text{Ag(CN)}_2^-] = 0.03$

$$\begin{array}{llllll} \text{Now,} & \text{Ag(CN)}_2^- & \rightleftharpoons & \text{Ag}^+ & + & 2\text{CN}^- \\ & \underset{(0.03-a)}{0.03} & & \underset{a}{0} & & \underset{(0.04+a)}{0.04}\ \text{(left from KCN)} \end{array}$$

K_c is small $\therefore 0.03 - a \approx 0.03$ and $0.04 + a \approx 0.04$

$\therefore K_c = 4 \times 10^{-19} = \frac{(0.04)^2 \times a}{0.03}$; $\therefore a = 7.5 \text{ x } 10^{-18}$

206 **(b)**

Higher $\text{p}K_a (-\log K_a)$ means lower K_a for acid.

207 **(a)**

$N_{\text{NaOH}} = 1 \times 1 = 1\ \text{N}$

$N_{\text{H}_2\text{SO}_4} = 2 \times 10 = 20\ \text{N}$

Millieq. of NaOH $= 1 \times 100 = 100$

Millieq. of $\text{H}_2\text{SO}_4 = 20 \times 10 = 200$

Thus, Millieq. of acid are left and therefore pH < 7. So, the resulting mixture will be acidic

208 **(a)**

$\text{pH} = 4.35$

$\therefore \quad 4.35 = -\log[\text{H}^+]$

or $[\text{H}^+] =$ antilog of (-4.35)

$= 4.5 \times 10^{-5} M$

209 **(b)**

pH of salts of weak acid and weak base is derived by the relation : $[\text{H}^+] = \sqrt{K_H} = \sqrt{\frac{K_w}{K_a \cdot K_b}}$

210 **(a)**

$$\underset{\substack{\text{hydrogen} \\ \text{molecule}}}{\text{H}_2} \xrightarrow[2000°\text{C}]{\text{Electric arc}} \underset{\substack{\text{atomic} \\ \text{hydrogen}}}{2\text{H}} \ -104.5\ \text{kcal}$$

The reaction is endothermic. For endothermic reaction increase in temperature shift the equilibrium in forward direction. To proceed forward the pressure must be low because for the above reaction, increase of pressure will favoured backward reaction. So, for maximum yield the conditions are high temperature and low pressure.

211 **(a)**

H_3PO_2 is monobasic acid and thus, it forms only one normal salt.

212 **(d)**

According to Lewis, "A base is a species which can donate an electron pair." In NH_3, $\ddot{\text{N}}$ has one lone pair. Thus, $\ddot{\text{N}}\text{H}_3$is a Lewis base.

213 **(d)**

$K < 1.0$

214 **(b)**

Higher is the value of K, more is the probability for a reaction to go for completion.

215 **(d)**

$\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$

The equilibrium constant (K_p) changes with the change in temperature.

Note : Variation of equilibrium constant with temperature can be express as:

$$\log \frac{K_2}{K_1} = \frac{\Delta H}{2.303R}\left[\frac{T_2 - T_1}{T_1 . T_2}\right]$$

216 **(b)**

$\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO(g)}$

$$K_c = \frac{[\text{NO}]^2}{[\text{N}_2][\text{O}_2]} = 4 \times 10^{-4}$$

$$\text{NO} \rightleftharpoons \frac{1}{2}\text{N}_2(\text{g}) + \frac{1}{2}\text{O}_2(\text{g})$$

$$K_c' = \frac{[\text{N}_2]^{1/2}[\text{O}_2]^{1/2}}{[\text{NO}]}$$

$$= \sqrt{\frac{1}{K_c}} = \sqrt{\frac{1}{4 \times 10^{-4}}} = 50$$

217 **(b)**

$$\begin{array}{lccccccc} & 2A_{(\text{g})} & + & B_{(\text{g})} & \rightleftharpoons & 3C_{(\text{g})} & + & D_{(\text{g})} \\ \underset{\text{At.Eq.}}{\text{Initial}} & \underset{0.5}{1.0} & & \underset{0.75}{1.0} & & \underset{0.75}{0} & & \underset{0.25}{0} \end{array}$$

$$K_c = \frac{(0.25) \times (0.75)^3}{(0.5)^2 \times 0.75}$$

218 **(c)**

$R\text{NH}_2$ is stronger base than NH_3. Also HI is strong acid and thus, I^- is weak base.

219 **(b)**

Due to ionisation in water.

220 **(a)**

$[\text{H}^+] = 10^{-1}$

$\therefore \text{pH} = 1$

221 **(c)**

$\text{Fe}^{3+} + 3\text{H}_2\text{O} \longrightarrow \text{Fe(OH)}_3 + 3\text{H}^+$.

222 **(b)**

This is Bronsted-Lowry concept of acid base.

223 **(a)**

The conjugate acids of $\overline{\text{O}}\text{H}, \overline{\text{N}}\text{H}_2, \text{HC} \equiv$

C^- and $CH_3CH_2^-$ are

$H_2O, NH_3, HC = CH$ and $CH_3 - CH_3$ respectively. Their acidic strength is as

$HOH > HC \equiv CH > NH_3 > CH_3CH_3$

A strong acid has a weak conjugate base, hence the decreasing order of basic strength is

$CH_3CH_2^- > NH_2^- > HC \equiv C^- > OH^-$

225 **(b)**

On removal of CO_2 (one of the reaction), reaction will proceed in backward direction.

226 **(c)**

Common ion effect includes two necessary points; one presence of common ion and the other a weak electrolyte.

227 **(b)**

$$C(s) + CO_2 \rightleftharpoons 2CO(g)$$

Gaseous mole before dissociation - 1 0

Gaseous mole after - $\left(1 - \frac{50}{100}\right)\left(\frac{2 \times 50}{100}\right)$

dissociation

1. 0.5 1

$\therefore$ Total mole $= 1.5$ and $\Delta n = 1$

Total pressure given at equilibrium $= 12$ atm

$$K_p = \frac{(n_{CO})^2}{(n_{CO_2})} \times \left[\frac{P}{\sum n}\right]^{\Delta n} = \frac{(1)^2}{0.5} \times \left(\frac{12}{1.5}\right)^1$$

$$K_p = \frac{12}{1.5 \times 0.5} = 16 \text{ atm}$$

228 **(b)**

If $K_w = 10^{-12}$, then $[H^+]$ for neutral scale $= 10^{-6}$ or pH $= 6$; thus, pH 6.9 refers for alkaline nature.

229 **(c)**

$$K_c = \frac{[Cl_2][PCl_3]}{[PCl_5]} = \frac{\frac{0.2}{10} \times \frac{0.2}{10}}{\frac{0.1}{10}} = 0.04$$

230 **(d)**

$$\underset{(1-2/3)}{\overset{1}{CH_3COOH}} + \underset{(1-2/3)}{\overset{1}{C_2H_5OH}} \rightleftharpoons \underset{2/3}{\overset{0}{CH_3COOC_2H_5}} + \underset{2/3}{\overset{0}{H_2O}}$$

$$\therefore K_c = \frac{\frac{2}{3} \times \frac{2}{3}}{\frac{1}{3} \times \frac{1}{3}} = 4$$

231 **(b)**

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} = \frac{4 \times (0.05)^2}{0.05} = 4 \times 0.05 = \mathbf{0.2}$$

232 **(d)**

Millieq. of 0.01 M HCl $= \frac{0.01 \times 100}{1000} = 1 \times 10^{-3}$

$\therefore$ pH $= 3$

Millieq. of 0.02 M $H_2SO_4 = \frac{0.04 \times 50}{1000} = 2 \times 10^{-3}$

Millieq. of 0.02 M NaOH $= \frac{0.02 \times 50}{1000} = 1 \times 10^{-3}$

Left $[H^+] = 2 \times 10^{-3} - 1 \times 10^{-3}$; $\therefore$ pH $= 3$

233 **(a)**

$$K_p = \frac{p_{CO}^2 p_{O_2}}{p_{CO_2}^2} = \frac{[0.4]^2 \times [0.2]}{(0.6)^2} = 0.0888$$

234 **(d)**

$$\text{pH} = 4.5 + \log \frac{[\text{Conjugate base}]}{[\text{Acid}]}$$

$\because$ [Salt] = [Acid], since $[A^-] = [H_A]$

$\therefore$ pH $= 4.5$ $\therefore$ pOH $= 9.5$

235 **(b)**

We know that,

$$\text{pH} = \text{p}K_a + \log \frac{[\text{salt}]}{[\text{acid}]}$$

or $\text{pH} = -\log 10^{-8} + \log \frac{1}{1}$

($\because$ [salt] = [acid])

or pH $= 8$

236 **(c)**

$3A + 2B \rightarrow 2C$

$$K_c = \frac{\text{concentration of products}}{\text{concnetration of reactants}} = \frac{[C]^2}{[A]^3 \times [B]^2}$$

238 **(a)**

Only in reaction (ii) $H_2PO_4^-$, gives H^+ to H_2O, thus behaves as an acid.

239 **(a)**

$$CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-$$

$$\therefore \quad [OH^-] = c \cdot h = c\sqrt{\frac{K_H}{c}} = \sqrt{K_H \cdot c} = \sqrt{\frac{K_w}{K_a} \cdot c}$$

or $\quad -\log OH = -\frac{1}{2}[\log K_w + \log c - \log K_a]$

or $\quad \text{pOH} = \frac{1}{2}[\text{p}K_w - \log c - \text{p}K_a]$

Now, pH + pOH = pK_w

$\therefore \quad \text{pH} = \frac{1}{2}[\text{p}K_w + \log c + \text{p}K_a]$.

240 **(a)**

$$\underbrace{A + B}_{2} + Q \rightleftharpoons \underbrace{C + D}_{2}$$

The reaction is endothermic so, on increase temperature concentration of product will increase

242 **(d)**

It is $FeSO_4 \cdot (NH_4)_2SO_4 \cdot 10H_2O$.

243 **(a)**

$[OH^-] = 2 \times 0.05 = 0.1$

$\therefore$ pOH $= 1$ and pH $= 13$.

244 **(b)**

For a reaction, $K_c = \frac{[\text{product}]}{[\text{reactant}]}$

Hence,

if $K_c > 1$, then [Product]>[Reactant]

245 **(c)**

For base BOH

$$B\text{OH} \rightleftharpoons B^+ + \text{OH}^-$$

Dissociation constant $K_b = \frac{[B^+][\text{OH}^-]}{[B\text{OH}]}$

∴ Higher the value of K_b, more will be dissociation of base and stronger will be base and *vice-versa.*

∴ Weakest base among given choices is having $K_b = 7.2 \times 10^{-11}$.

246 **(a)**

$2AB_2(\text{g}) \rightleftharpoons 2AB(\text{g}) + B_2(\text{g})$

$\underset{1-x}{1} \qquad \underset{x}{0} \qquad \underset{x/2}{0}$

$$\therefore \quad K_p = \frac{x^2.x}{2(1-x)^2}.\left[\frac{P}{1+\frac{x}{2}}\right]^1 = \frac{x^3.P}{2}$$

$$\left(1 - x \ \approx 1 \text{ and } 1 + \frac{x}{2} \approx 1, \text{since } x \ll 1\right)$$

Or $\quad P = \frac{3\sqrt{2K_p}}{P}$

247 **(b)**

$K_p = K_c(RT)^{\Delta ng}$

$\Delta ng = -1$ (For the reaction, $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$).

Thus, for this reaction, K_p is less than K_c

248 **(a)**

$\text{Cr(OH)}_3 \rightleftharpoons \text{Cr}^{3+} + 3\text{OH}^-$

$\qquad (s) \qquad (3s)$

$$K_{\text{sp}} = s \times (3s)^3$$

$$= 27s^4$$

$$2.7 \times 10^{-31} = 27s^4$$

$$\therefore \quad s = \sqrt[4]{\frac{K_{\text{sp}}}{27}} = \sqrt[4]{\frac{2.7\times10^{-31}}{27}}$$

$$= \sqrt[4]{10^{-32}}$$

$$= 10^{-8} \text{ mol/L}$$

249 **(d)**

$\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$

$\underset{1-\alpha}{1} \qquad \underset{2\alpha}{0}$

$$K_p = \frac{\left(n_{\text{NO}_2}\right)^2}{n_{\text{N}_2\text{O}_4}} \times \left[\frac{P}{\Sigma n}\right]^1$$

For 33% dissociation: $K_p = \frac{(2 \times 0.33)^2}{0.67} \times \left[\frac{P}{1.33}\right]$

For 40% dissociation: $K_p = \frac{(2 \times 0.40)^2}{0.60} \times \left[\frac{P}{1.40}\right]$

$\therefore \frac{P_1}{P_2} = 1.56 \approx 1.60 = \frac{8}{5}$

250 **(a)**

$A + 2B \ \rightleftharpoons \ 2C$

2 3 2 initial moles

$(2-0.5)(3-0.5)(2\times0.5)$ at equilibrium

Molar concentration of $A = \frac{1.5}{2}$

Molar concentration of $B = \frac{2.5}{2}$

Molar concentration of $C = \frac{1}{2}$

$$K = \frac{[C]^2}{[A][B]^2} = \frac{1\times1\times2\times2\times2\times2}{2\times2\times1.5\times2.5\times2.5}$$

$$= \frac{2}{1.5\times2.5\times2.5} = 0.21$$

251 **(d)**

In $\frac{\text{N}}{1000}$ KOH solution, $[\text{OH}^-] = 10^{-3}$ M

$$\text{pOH} = -\log[\text{OH}^-] = -\log[10^{-3}]$$

$$= +3\log 10 = 3$$

$$\text{pH} + \text{pOH} = 14$$

$$\text{pH} = 14 - \text{pOH}$$

$$= 14 - 3$$

$$= 11$$

252 **(a)**

Tears are alkaline in nature.

254 **(b)**

$MX_2 = M^{2+} + 2X^-$

$s \qquad 2s$

$K_{\text{sp}} = (2s)^2(s) = 4s^3$

$$\Rightarrow s = \sqrt[3]{\frac{K_{\text{sp}}}{4}} = \sqrt[3]{\frac{4\times10^{-12}}{4}} = 1.0\times10^{-4}\text{M}$$

255 **(d)**

Let solubility of BaSO_4 = mol L^{-1}

$$\text{BaSO}_4 \rightleftharpoons \text{Ba}^{2+} + \text{SO}_4^{2-}$$

$$x \qquad x \qquad x$$

∴ Ions at equilibrium

$$K_{\text{sp}} = [\text{Ba}^{2+}][\text{SO}_4^{2-}]$$

$$= x \times x$$

$$x^2$$

Given, $K_{\text{sp}} = 1.5 \times 10^{-9}$

$$(1.5 \times 10^{-9}) = x^2$$

or $\quad \sqrt{1.5\times10^{-9}} = x$

$$x = 3.9 \times 10^{-5} \text{ mol/L}$$

256 **(d)**

Strongest Bronsted base is that which has weakest conjugate acid.

Base	Conjugate acid (base + H^+)
ClO^-	$HClO$
ClO_2^-	$HClO_2$
ClO_3^-	$HClO_3$
ClO_4^-	$HClO_4$

∵ HClO is weak conjugate acid.

∵ ClO^- is strongest Bronsted base.

257 **(b)**

At equilibrium $Q = K_c$ (or $Q = K_p$)

258 **(a)**

Oxalic acid $= x$ mol/L

Oxalic acid $KMnO_4$

$$M_1V_1 = M_2V_2$$

$$40 \text{ mL} \times x = 16 \text{ mL} \times 0.05$$

$$x = \frac{16\times0.05}{40} = \frac{1}{50}$$

$$x = \frac{1}{50}\text{ M}$$

Now, convert molarity into normality

$N \times$ eq. wt $=$ M $\times$ mol. wt. of oxalic acid

$$N \times 45 = \frac{1}{50} \times 90$$

$$N = \frac{1}{25}$$

This normality represents the hydrogen ion concentration.

So, $[H^+] = \frac{1}{25}$

$$pH = \log\frac{1}{[H^+]}$$

$$= \log 25 = 1.3$$

259 **(c)**

Simple cations such as Ag^+, Cu^{2+}, Fe^{3+} etc. can accept pairs of electrons and hence are Lewis acids.

260 **(d)**

Aspirin is a weak acid. Due to common ion effect, it is unionised in acid medium but completely ionised in alkaline medium

261 **(c)**

For a saturated solution product of ionic concentrations $\geq K_{sp}$.

262 **(b)**

$H_2O + H_2O = H_3O^+ + OH^-$

$$K_{\text{S.I}} = \frac{K_w}{[H_2O]^2} = \frac{10^{-14}}{(55.6)^2} = 3.23 \times 10^{-18}$$

263 **(c)**

Follow the method to write K_c or K_p values. It is the ratio of concentrations of products with suitable powers to concentration of reactants e.g.,

$3A(g) + 2B(g) \rightleftharpoons 4C\,(g) + 5D(g)$

$$K_c = \frac{[C]^4[D]^5}{[A]^3[B]^2}$$

$$K_p = \frac{[P_C]^4.[P_D]^5}{[P_A]^3.[P_B]^2}$$

264 **(b)**

(i)Millimolar$=10^{-3}$M

(ii)$pH = -\log[H^+]$

$pH = -\log(10^{-3}) = 3.$

265 **(b)**

$A + 2B \rightleftharpoons C + 3D$

$$K_c = \frac{p_C p_D{}^3}{p_A p_B{}^2} = \frac{0.30 \times (0.50)^3}{0.20 \times (0.10)^2}$$

$= 18.75$

266 **(d)**

It involves gain and loss of electron pair (Lewis concept).

267 **(d)**

$SnCl_2 + 2HgCl_2 \longrightarrow SnCl_4 + \underset{\text{(white ppt.)}}{Hg_2Cl_2}$

$SnCl_2 + Hg_2Cl_2 \longrightarrow SnCl_4 + \underset{\text{(Grey ppt.)}}{Hg_2}$

268 **(c)**

BF_3 can accept a pair of electrons, but it cannot give H^+ ions in the aqueous solution, hence BF_3 acts as Lewis acid but not as a Bronsted acid

269 **(c)**

$Na_2O + H_2O \rightarrow 2NaOH$

↑ ↑

Oxidation number of Na +1

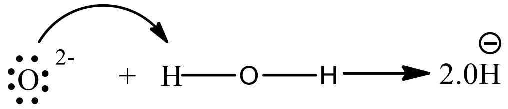
+1

Oxygen -2 -2

-2

No change in oxidation number, so (a) and (d) are not true.

(b) is also not true.



Oxide ion donates a pair of electrons, thus changes to OH^-

270 **(d)**

$$pH = \frac{1}{2}pK_w + \frac{1}{2}\log C + \frac{1}{2}pK_a$$

$$= \frac{14}{2} + \frac{1}{2}\log(5 \times 10^{-3}) + \frac{1}{2} \times 4.74$$

$$= 7 + \frac{1}{2}[0.6990 - 3] + 2.3$$

$$pH = 8.2195$$

271 **(b)**

For a salt of weak base and strong acid like $MgCl_2$ the relation is as

$$K_h = \frac{K_w}{K_b}$$

272 **(d)**

Theory of active mass indicates that the rate of chemical reaction is directly proportional to the concentration of reactants

273 **(c)**

If $n_P = n_R$, then $K_p = K_c$

where, n_p = number of moles of products

n_R = number of moles of reactants

274 **(c)**

$$K_h = \frac{K_w}{K_a \times K_b}$$

275 **(c)**

N— H bond behaves as an acid.

276 **(c)**

$$A \quad + \quad B \quad \rightleftharpoons \quad C \quad + \quad D$$

Initial $\quad x$ mol $\quad x$ mol

At equilibrium $x - \frac{x}{3} = \frac{2x}{3} \quad \frac{2x}{3} \quad \frac{x}{3} \quad \frac{x}{3}$

Hence,

$$K_c = \frac{[C][D]}{[A][B]} = \frac{\left(\frac{x}{3V}\right)\left(\frac{x}{3V}\right)}{\left(\frac{2x}{3V}\right)\left(\frac{2x}{3V}\right)} = \frac{1}{4} = 0.25$$

277 **(a)**

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

Initially at eq. $\quad \underset{(0.2-a)}{0.2} \quad \underset{(0.6-3a)}{0.6} \quad \underset{2a}{0}$

Total mixture is 0.8; 40% of it reacts, i.e., $\frac{0.8 \times 40}{100}$ reacts to give $\frac{0.8 \times 40}{100} \times \frac{1}{2}$ mole of NH_3

or NH_3 formed is 0.16 mole

Or $\quad 2a = 0.16$

$\therefore \quad a = 0.08$

$\therefore$ initial mole = 0.8

Final mole = (0.2 – 0.08) + (0.6 – 0.24) + 0.16

= 0.12 + 0.36 + 0.16 = 0.64

$\therefore$ Ratio of final to initial mole $= \frac{0.64}{0.8} = 0.8 = \frac{4}{5}$

278 **(b)**

$[H^+] = 4 \times 10^{-3}\ M$

$\therefore \text{pH} = -\log 4 \times 10^{-3} = 2.398.$

279 **(b)**

$$\text{pH} = \text{p}K_a + \log \frac{[\text{Salt}]}{[\text{Acid}]}$$

$= 5 + \log \frac{10}{1}$ if $\frac{[\text{Salt}]}{[\text{Acid}]} = 10 : 1$, Then,

pH = 6.

280 **(a)**

10 M HCl will give $[H^+] = 10^1$; pH of such solution = 0.

281 **(a)**

$$\underset{}{Mg(OH)_2} \rightleftharpoons \underset{s}{Mg^{2+}} + \underset{2s}{2OH^-}$$

$$K_{sp} Mg(OH)_2 = [Mg^{2+}][OH^-]^2$$

$\Rightarrow \quad K_{sp}\ Mg(OH)_2 = 4S^3$

$1.96 \times 10^{-11} = 4S^3$

or $\quad S = \left[\frac{1.96 \times 10^{-11}}{4}\right]^{1/3}$

or $\quad S = (4.9 \times 10^{-12})^{1/3}$

$\therefore \quad S = 1.96 \times 10^{-4}$

So, concentration of $[OH^-] = 2S$

$\therefore \quad [OH^-] = 3.38 \times 10^{-4}$

$\Rightarrow \quad \text{pOH} = -\log[OH^-]$

$= -\log[3.38 \times 10^{-4}]$

pOH = 3.471

pH = 14 − pOH

= 14 − 3.471

$\therefore \quad$ pH=10.529

282 **(c)**

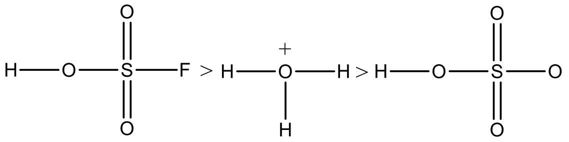
$K_p = K_c\ (RT)^{\Delta n}$;

283 **(c)**

K_c is characteristic constant for a given reaction at a temperature ; $K_p = P_{CO_2}$.

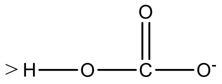
284 **(c)**

Acidity order



$$H-O-\overset{O}{\underset{O}{S}}-F > H-\overset{+}{\underset{H}{O}}-H > H-O-\overset{O}{\underset{O}{S}}-O$$

(Conjugate anion decreases acidity)



$$> H-O-\overset{O}{C}-O^-$$

285 **(c)**

For precipitation,

ionic product > solubility product (K_{sp})

For, Ag_2CrO_4

ionic product = $[Ag^+]^2[CrO_4^-]$

$= (10^{-4})^2(10^{-5}) = 10^{-13}$

K_{sp} of $Ag_2CrO_4 = 4 \times 10^{-12}$

Here, K_{sp} > IP

This, no precipitate is obtained.

For AgCl, ionic product = $[Ag^+][Cl^-]$ =

$[10^{-4}][10^{-5}]$

$$= 10^{-9}$$

$$K_{sp}(\text{AgCl}) = 1 \times 10^{-10}$$

Here, $\text{IP} > K_{sp}$

So, precipitate will form.

Thus, silver chloride gets precipitated first.

286 **(d)**

It is basic lead carbonate.

287 **(d)**

K_p or K_c are characteristic constants for a given reaction.

288 **(b)**

$K_c = [\text{Ca}^{2+}][\text{F}^-]^2$;

If $[\text{Ca}^{2+}] = 4 \times [\text{Ca}^{2+}]$;

To have K_c constant $[\text{F}^-]$ should be $\frac{[\text{F}^-]}{2}$.

290 **(d)**

Strong conjugate base has a weak conjugate acid. Weakest conjugate acid is CH_3COOH.

291 **(b)**

I^- is electron pair donor.

292 **(c)**

$2HI \rightleftharpoons H_2 + I_2$;

$$K_c = \frac{\alpha^2}{4(1-\alpha)^2}$$

Where α is degree of dissociation,

Also, $\alpha = \frac{22}{100}$

$\therefore K_c = 0.0199$

293 **(c)**

ZnO reacts with acid and alkalies both.

294 **(c)**

$\Delta n = -1$ and $K_p = K_c \text{ x } (RT)^{\Delta n}$

295 **(a)**

$H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(l)$

Initial conc. 1 1 0 0

At equilibrium $(1-x)(1-x)$ x x

$$K_p = \frac{p_{CO} \cdot p_{H_2O}}{p_{H_2} \cdot p_{CO_2}} = \frac{x \cdot x}{(1-x)(1-x)} = \frac{x^2}{(1-x)^2}$$

296 **(c)**

In this equation, volume is decreasing and the reaction is exothermic. So, for the highest yield of *Z*, pressure should be high and temperature should be low.

297 **(a)**

The pH of salt $BaCl_2 = 7$ whereas $SrCl_2$ and $CaCl_2 \simeq 7$ and $MgCl_2 < 7$.

298 **(d)**

Lewis definition suggests that an acid must be capable of accepting lone pair in its vacant orbital. Smaller ion shows more attraction towards lone pair of electron.

299 **(c)**

Degree of dissociation, $\alpha = \frac{D-d}{d}$

$$= \frac{46-30}{30}$$

$= 0.533$ or 53.3%

300 **(d)**

$\Delta n = 0$ then, $K_p = K_c$

For $(d) \Delta n = 1$

301 **(a)**

$$\text{pH} = \text{p}K_a + \log \frac{[\text{Conjugate base}]}{[\text{Acid}]}$$

or $5.24 = 4.74 + \log \frac{[\text{Conjugate base}]}{[\text{Acid}]}$

$\therefore \frac{[\text{Conjugate base}]}{[\text{base}]} = 3.$

302 **(a)**

$[H^+] = C\alpha = \sqrt{K_a . C}$

$$\text{pH} = -\log(K_a . C)^{1/2}$$

$$= \frac{1}{2}[-\log K_a - \log C]$$

$$= \frac{1}{2}[4.74 - \log 10^{-2}]$$

$$= \frac{1}{2}[4.74 + 2] = 3.37$$

303 **(a)**

$1M$ solution of CH_3COONa on addition to acid shows a decrease in dissociation of acid due to common ion effect.

304 **(d)**

Weak monoacidic base *e.g.*, BOH is neutralised as follows

$$BOH + HCl \rightarrow BCl + H_2O$$

At equivalence point all BOH gets converted into salt and remember! The concentration of H^+ (or pH of solution) is due to hydrolysis of resultant salt (BCl, cationic, hydrolysis here)

$$\begin{array}{cccc} B^+ & + H_2O \rightleftharpoons BOH & + & H^+ \\ C(1-h) & Ch & & Ch \end{array}$$

Volume of HCl used up

$$V_a = \frac{N_b V_b}{N_a} = \frac{2.5 \times 2 \times 15}{2 \times 5} = 7.5 \text{ mL}$$

Concentration of salt

$$[\text{BCl}] = \frac{\text{conc.of base}}{\text{total volume}} = \frac{2 \times 2.5}{5(7.5+2.5)} = \frac{1}{10} = 0.1$$

$$K_h = \frac{Ch^2}{1-h} = \frac{K_w}{K_b}$$

(h should be estimated whether that can be neglected or not)

on calculating h=0.27 (significant, not negligible)

$[H^+] = Ch = 0.1 \times 0.27 = 2.7 \times 10^{-2} M$

305 **(c)**

A salt is precipitated only when the product of ionic concentration is more than its solubility product.

$$K_{sp} = 1 \times 10^{-8}$$
$$[A^+] = 10^{-3}\ M$$
$$[B^-] = \frac{1\times10^{-8}}{10^{-3}} = 10^{-5}\ M$$

So, AB will be more precipitated only when the concentration of $[B^-]$ is more than 10^{-5} M.

306 **(b)**

According to Le-Chatelier's principle exothermic reactions are favourable at low pressure. The reaction in which number of moles decreases are favourable at high pressure or low volume.

$C_2H_4 + H_2 \rightleftharpoons C_2H_6, \Delta H = -130\ kJ\ mol^{-1}$

∵ The reaction is exothermic and number of moles of reactants are decreasing.

∵ The reaction rate is increased by decreasing temperature and increasing pressure.

307 **(d)**

The reaction does not cease up but goes in both directions with same speed.

308 **(a)**

Haber's process of synthesis of ammonia

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$

$$N_2 + 3H_2 \xrightleftharpoons[750\ K,\ 2000\ atm]{Fe,\ Mo} 2NH_3$$

Since, the number of molecules of gaseous products are less than the number of molecules of gaseous reactants, thus according to Le-Chatelier's principle, high pressure favours the forward reaction *i.e.*, more ammonia will be obtained.

309 **(d)**

Buffer capacity of an acidic buffer is maximum when the ratio of HA to A^- is unity.

Since, pH of acidic buffer $= pK_a + \log\frac{[A^-]}{[HA]}$

For maximum buffer capacity, $[A^-] = [HA]$

$\therefore \quad pH = pK_a$

310 **(c)**

$\therefore \quad pH = 2$

$\therefore \quad [H^+] = 10^{-2}$

$[H^+] = N.\alpha$

$10^{-2} = 0.1 \times \alpha$

$\alpha = \frac{10^{-2}}{0.1}$

$\alpha = 0.1$

311 **(c)**

Since, catalyst increases the rate of forward reaction as well as the rate of backward reaction, it does not affect the equilibrium constant.

312 **(d)**

Meq. of H_2SO_4 needed for 20 Meq. of NaOH = 20

Thus, volume of H_2SO_4 needed $= V_{mL}$

or $\quad V \times 0.25 \times 2 = 20$

$\therefore \quad V = 40\ mL$

Also, temperature increases during neutralization and then decreases after neutralization on further addition of acid.

313 **(b)**

The dissociation of H_2S decreases in presence of acid (or H^+ a common ion furnished by an acid).

314 **(a)**

$H_2 \quad + \quad I_2 \quad \rightleftharpoons \quad 2HI$

15 $\quad$ 5.2 $\quad$ 0

(15-5) $\quad$ (5.2-5) $\quad$ 10

Equilibrium constant

$$(K_c) = \frac{[HI]^2}{[H_2][I_2]} = \frac{10\times10}{10\times0.2} = 50$$

315 **(c)**

New concentration of,

$$HCl = \frac{10^{-6}}{100} = 10^{-8}\ M$$

$\therefore \quad [H^+] = 10^{-18} + 10^{-7}$

$= 1.1 \times 10^{-7}\ M$

$\therefore \quad pH \approx 7$

317 **(a)**

$pH = -\log[H^+]$

$= -\log(3 \times 10^{-3})$

$= 3 - \log 3$

$= 3 - 0.4771$

$= 2.5229$

318 **(d)**

The dissociation of HCN will decrease in presence of NaCN due to common ion effect.

319 **(c)**

Meq. of HCl $= 10 \times 10^{-1} = 1$

Meq. of NaOH $= 10 \times 10^{-1} = 1$

Thus, both are neutralized and 1 Meq. Of NaCl (a salt of strong acid and strong base) which does not hydrolyse and thus, pH = 7.

320 **(d)**

$PbCl_2 \rightleftharpoons Pb^{2+} + 2I^-$

s mol/L $\quad s \quad 2s$

Hence, $K_{sp} = [Pb^{2+}][I^-]^2$

$= (s)(2s)^2$

$= 4s^3$

$\therefore \quad s = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{2.3\times10^{-32}}{10}}$

$= 1.78 \times 10^{-11}$mol/L

$= 1.78 \times 10^{-11} \times 278$ g/L

$= 4.95 \times 10^{-9}$ g/L

321 **(b)**

Hydrolysis of CH_3COO^- give alkaline solution.

322 **(d)**

For hydrolysis of NH_4^+;

$$K_H = \frac{K_w}{K_p} = \frac{10^{-14}}{1.8 \times 10^{-5}} = 5.5 \times 10^{-10}$$

323 **(c)**

In water, barium hydroxide is hydrolysed as followers

$Ba(OH)_2 \rightleftharpoons Ba^{2+} + 2OH^-$

Conc. Of $Ba^{2+} = 1 \times 10^{-3}$M

Conc. of $[OH^-] = 2 \times 1 \times 10^{-3}$M

$= 2 \times 10^{-3}$M

$pOH = -\log[OH^-]$

$= -\log(2 \times 10^{-3})$

$= 2.69$

$pH + pOH = 14$

$pH = 14 - pOH$

$= 14 - 2.69$

$= 11.3$

≈ 11.0

324 **(d)**

In the titrationof weak acid with strong base, phenolphthalein is used

326 **(a)**

In a reversible reaction some amount of the reactants remains unconverted into products and it never go for completion

327 **(d)**

K_a for $H_2S = \frac{[H^+][HS^-]}{[H_2S]}$;

An increase in $[H^+]$ will show a decrease in $[HS^-]$ to maintain constant K_a value.

328 **(d)**

Le-Chatelier proposed a principle to explain the effect of P, T and C on systems in equilibrium.

329 **(a)**

$pK_a = -\log K_a$

Higher the value of pK_a, weaker is the acid. Among given choices 2.0, 2.5, 3.0 and 4.0 the value 2.0 is lowest so this acid is strongest.

330 **(c)**

Alkali and alkaline earth metal hydroxides are strong base.

331 **(a)**

$pH = 9 \therefore [H^+] = 10^{-9}$

$pH = 6 \therefore [H^+] = 10^{-6}$

332 **(d)**

Aprotic solvents are those from which hydrogen ion or OH^- cannot be derived.

333 **(b)**

$Co(OH)_2$ is not precipitated in III gp. or it more soluble and thus, has high K_{sp}.

334 **(b)**

$[A^+][B^-] > K_{sp}$.

335 **(a)**

$$pH = \frac{1}{2}[pK_{a_1} + pK_{a_2}] = \frac{1}{2}[14.15 + 6.89] = 10.52$$

336 **(d)**

$A \quad + \quad B \quad \rightleftharpoons \quad C \quad + \quad D$

1 $\quad$ 1 $\quad$ 0 $\quad$ 0 Initially

$(1-3x)$ $(1-3x)$ $\quad 3x \quad 3x$ At equilibrium (given)

At equilibrium, the remaining moles of A is x, because $3x$ moles of C are produced.

$\Rightarrow \quad 1 - 3x = x$

$\therefore \quad x = \frac{1}{4}$

Equilibrium constant,

$$K_c = \frac{[C][D]}{[A][B]} = \frac{3x.3x}{(1-3x)^2}$$

On putting the value of x, we get,

$$K_c = \frac{9\times\frac{1}{16}}{1+\frac{9}{16}-\frac{6}{4}} = \frac{9}{1} = 9$$

337 **(a)**

The acidic character of $HClO_4$ is maximum. The order is

$HClO_4 > HClO_3 > H_2SO_4 > H_2SO_3$.

339 **(c)**

K_p is independent of initial concentration.

340 **(d)**

20% yield of NH_3 and thus, 20% of 340 g is

$$= \frac{20 \times 340}{100} = 68 \text{ g}$$

341 **(d)**

$CO_3^{2-} + H^+ \longrightarrow HCO_3^-$(acid).

342 **(b)**

2. $CaCO_3(s) \overset{\Delta}{\rightarrow} CaO(g)(s) + CO_2(g)\uparrow$

$K_p = 8 \times 10^{-2}$

$$K_p = \frac{p_{CaO(s)} \times p_{CO_2(g)}}{p_{CaCO_3(s)}}$$

(Heterogenous equilibrium)

$K_p = p_{CO_2}$

$p_{CO_2} = 8 \times 10^{-2}$

3. $CO_2(g) + C(s) \rightarrow 2CO(g), \quad K_p = 2$

$$K_p = \frac{p^2_{CO(g)}}{p_{CO_2} \times p_{C(s)}}$$

(Heterogenous equilibrium)

$K_p = \frac{p^2_{CO}}{p_{CO_2}}$

$2 = \frac{p^2_{CO}}{8 \times 10^{-2}}$

$p^2_{CO} = 2 \times 8 \times 10^{-2}$

$p_{CO} = 0.4$ atm

343 **(c)**

$H_2CO_3 \rightleftharpoons H^+ + HCO_3^-; \quad K_1 = 4.2 \times 10^{-7}$

$HCO_3^- \rightleftharpoons H^+ + CO_3^{2-}; \quad K_2 = 4.8 \times 10^{-11}$

$K_1 >> K_2$

$\therefore \quad [H^+] = [HCO_3^-]$

$$K_2 = \frac{[H^+][CO_3^{2-}]}{[HCO_3^-]}$$

So, $[CO_3^{2-}] = K_2 = 4.8 \times 10^{-1}$

344 **(d)**

Acid indicators are generally weak acid. The dissociation of indicator HIn takes place as follows

$HIn \rightleftharpoons H^+ + In^-$

$$K_{In} = \frac{[H^+][In^-]}{[HIn]}$$

or $\quad [H^+] = K_{In}\frac{[HIn]}{[In^-]}$

$$pH = -\log[H^+]$$
$$= -\log\left(K_{In}\frac{[HIn]}{[In^-]}\right)$$
$$= -\log K_{In} + \log\frac{[In^-]}{[HIn]}$$
$$= pK_{In} + \log\frac{[In^-]}{[HIn]}$$

or $\log\frac{[In^-]}{[HIn]} = pH - pK_{In}$

345 **(c)**

Mole $OH^- = M \times V_{\text{in litre}}$

$\therefore$ No of $OH^- = 0.3 \times 0.005 \times 2 = 0.0030.$

346 **(a)**

	$H_2 +$	$I_2 \rightleftharpoons$	$2HI$
Initial concentration	4.5	4.5	0
	$(4.5 - x)$	$(4.5 - x)$	$2x$

From equation, $2x = 3$

$\therefore x = \frac{3}{2} = 1.5$

So, concentration at equilibrium

$[H_2] = 4.5 - 1.5 = 3$

$[I_2] = 4.5 - 1.5 = 3$

$[HI] = 3$

$$\therefore K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{3 \times 3}{3 \times 3} = 1$$

347 **(a)**

Given, $K_w = 10^{-14}, K_a = 10^{-5}$

Concentration of salt = 0.001 M

$\therefore \quad K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{10^{-5}} = 10^{-9}$

According to equation

$A^- + H_2O \rightleftharpoons HA + OH^-$

Let degree of hydrolysis$=h$

$\therefore \quad 0.001(1-h)(0.001 \times h)(0.001 \times h)$

$\therefore \quad K_h = \frac{[HA][OH^-]}{[A^-]} = \frac{(0.001 \times h)(0.001 \times h)}{0.001(1-h)}$

or $\quad 10^{-9} = (0.001h)^2 \quad [\because 0.001(1-h) = 1]$

or $\quad 10^{-6} = h^2$

$\therefore \quad 10^{-3} = h$

348 **(d)**

Unit of $K_c = [\ \ ]^{\Delta n}. \Delta n = +1.$

349 **(c)**

To precipitate soap from its saturated solution on addition of salt is called salting out action of soap.

$RCOONa \rightleftharpoons RCOO^- + Na^+$

$K_{sp} = [RCOO^-][Na^+]$

In presence of NaCl, $[Na^+]$ increases and thus, the product of $[Na^+][RCOO^-]$ exceeds in K_{sp} to show precipitation of soap.

350 **(c)**

$SO_2 + \frac{1}{2}O_2 \rightleftharpoons SO_3$

$$K_1 = \frac{[SO_3]}{[SO_2][O_2]^{1/2}}$$

...(i)

$2SO_3 \rightleftharpoons 2SO_2 + O_2$

$$K_2 = \frac{[SO_2]^2[O_2]}{[SO_3]^2}$$

...(ii)

From Eqs. (i) and (ii)

$$K_2 = \frac{1}{K_1^2}$$
$$= \frac{1}{(5 \times 10^{-2})^2} = \frac{1}{25 \times 10^{-4}}$$
$$= \frac{100 \times 10^2}{25}$$
$$= 4 \times 10^2 \text{atm}$$

351 **(d)**

(i) The haemoglobin of RBC combines with oxygen in lungs following the equilibrium,

$$H_b\ (s) + O_2\ (g) \rightleftharpoons H_bO_2(s)$$

When these are at lungs, the partial pressure of O_2 being appreciable to show forward reaction, however, when they pass to tissues, the partial pressure of O_2 decreases to favour backward reaction releasing O_2.

(ii) Removal of CO_2 from blood is based on the equilibrium,

$$CO_2\ (g) + H_2O(l) \rightleftharpoons H^+(aq) + HCO_3^-(aq)$$

In tissues CO_2 gets dissolved in H_2O due to high pressure whereas in lungs, the CO_2 is released out because of low pressure of CO_2.

(iii) Tooth enamel substance (hydroxyapatite) $Ca_5(PO_4)_3OH$ shows the following equilibrium,

$$Ca_5(PO_4)_3OH \xrightleftharpoons[\text{Remineralization}]{\text{Demineralization}} 5Ca^{2+}(aq) + 3PO_4^{3-}(aq) + OH^-(aq)$$

The use of sweet material or fermentation produces H^+, which combines with OH^- to favour demineralization of enamel causing tooth decay.

352 **(b)**

Pressure has no effect on equilibrium if $\Delta n = 0$

353 **(a)**

Aqueous solution of $AlCl_3$ is acidic due to the hydrolysis of aluminium ion

$$AlCl_3 \xrightarrow{\text{Hydrolysis}} Al(OH)_3 + H^+$$

354 **(a)**

$H^+ = 1.0 \times 10^{-8} = 10 \times 10^{-9}$

Also, if ionisation is not neglected

$$H_2O \rightleftharpoons \underset{10^{-8}+a}{H^+} + \underset{a}{OH^-}$$

$a \times (10^{-8} + a) = 10^{-14}$

$\therefore \qquad a = 9.9 \times 10^{-9}$

$$\therefore \qquad \% \text{ emr} = \frac{10 \times 10^{-9} - 9.9 \times 10^{-9}}{10 \times 10^{-9}}$$
$$= 1\%.$$

355 **(d)**

Thus, a solution of blue and yellow ions appears green.

356 **(b)**

$NH_2COONH_4(g) \rightleftharpoons 2NH_3(g) + CO_2(g)$

At eq. if partial pressure of $CO_2 = p$

Then that of $NH_3 = 2p$

$K_p = p_{NH_3}^2 \times p_{CO_2} = (2p)^2 \times p = 4p^3$

$= 2.9 \times 10^{-5}$ or $p^3 = 0.725 \times 10^{-5}$

or $p = 1.935 \times 10^{-2}$

Hence, total pressure $= p = 5.81 \times 10^{-2} =$ 0.0581 atm

357 **(d)**

K_w increases with increase in temperature

358 **(d)**

In all the given reactions, equilibrium is affected by the increase in volume at constant temperature

359 **(a)**

Lewis bases are electron pair donor. I^+ is electron deficient, hence do not act as Lewis base.

360 **(d)**

CH_3COONH_4 is a salt of weak acid and weak base and

$$\underset{CH_3COOH}{K_{\text{acid}}} \approx \underset{NH_4OH}{K_{\text{base}}}$$

361 **(a)**

CH_4 has almost no acidic nature and thus, CH_3^- is the strongest base

363 **(c)**

$H_2SO_4 \rightleftharpoons H^+ + HSO_4^-$

364 **(a)**

$$h = \sqrt{\left[\frac{K_h}{c}\right]} = \sqrt{\left[\frac{K_w}{K_a \cdot c}\right]}$$

$$= \sqrt{\left[\frac{10^{-14}}{10^{-5} \times 0.001}\right]} = 10^{-3}$$

365 **(b)**

$$K_{c_1} = \frac{[NO]^2}{[N_2][O_2]} = 4 \times 10^{-4}$$

$$K_{c_2} = \frac{[N_2]^{1/2}[O_2]^{1/2}}{[NO]}$$

$$\therefore K_{C_2} = \sqrt{\frac{1}{K_{C_1}}} = \sqrt{\frac{1}{4 \times 10^{-4}}} = 50$$

366 **(d)**

$K_p = \left(P_{H_2O}\right)^2$ and $K_c = [H_2O]^2$; the solid species are not used in writing K_c or K_p

367 **(c)**

H_2SO_4 is strong acid having pH < 7. $NaNO_2$ on hydrolysis gives alkaline solution of pH > 7. NaCl is neutral and H_2S is weak acid.

368 **(a)**

$A + B \rightleftharpoons C + D$;

$$Q = \frac{[C][D]}{[A][B]} = \frac{3 \times 4}{1 \times 2} = 6$$

But $K_c = 10$;

Thus, to increase the value of Q to K_c, forward reaction should occur.

369 **(d)**

(A)$CH_3COONH_4 + H_2O \longrightarrow CH_3COOH + NH_4OH$

Ammonium acetate

Although both (CH_3COOH and NH_4OH) of them are weak still CH_3COOH is slightly more acidic.

$\therefore$ Solution is acidic in nature.

(B)$NH_4Cl \quad + H_2O \quad \longrightarrow NH_4OH \quad + HCl$

ammonium chloride weak base strong acid

$\therefore$ Solution is acidic in nature.

(C) $(NH_4)_2SO_4 \quad + H_2O \longrightarrow 2NH_4OH \quad + H_2SO_4$

ammonium sulphate weak base strong base

$\therefore$ Solution is acidic in nature.

(D)$CH_3COONa \quad + H_2O \quad \longrightarrow CH_3COOH \quad + NaOH$

sodium acetate weak acid strong base

$\therefore$ Solution is basic in nature.

370 **(d)**

Isoelectric point is the condition when Zwitter ions or sol particles do not move under the influence of electric field, *i.e.*, they lose their charge.

371 **(a)**

The value of equilibrium constant is independent of volume of container.

$\therefore$ Value of equilibrium constant will remain same (300) if volume of reaction flask is tripled.

372 **(a)**

S has +4 ox.no. in H_2SO_3 and SO_2 both.

373 **(b)**

$$\underset{s}{CaF_2} \rightleftharpoons Ca^{2+} + \underset{2s}{2F^-}$$

$$K_{sp} = s(2s)^2 = 4s^3$$

$$K_{sp} = 4(2.3 \times 10^{-6})^3$$

$$= 48.668 \times 10^{-18} \text{ (mol dm}^{-3})^3$$

374 **(c)**

Among the given, pH of 0.1M CH_3COOH is not equal to one as CH_3COOH is a weak acid, thus does not ionise completely.

375 **(a)**

Meq. of acetic acid $= 50 \times 2 = 100$

Meq. of $CH_3COONa = 10 \times 1 = 10$

$$\text{pH} = -\log K_a + \log \frac{[\text{Conjugate base}]}{[\text{Acid}]}$$

or $\quad \text{pH} = -\log 10^{-5} + \log \frac{10}{100} = 4$

376 **(b)**

Let the solubility of AgCl is S

$$AgCl = Ag^+ + Cl^-$$

$$s \qquad s$$

$[Cl^-]$ from NaCl=0.2

Concentration of $Cl^- = S + 0.2$

$$K_{sp} = S(S + 0.2)$$

$$1.8 \times 10^{-10} = S^2 + 0.2S$$

(S is very small as AgCl is sparingly soluble in water, thus $S^2 <<< 1$)

$$1.8 \times 10^{-10} = 0.2S$$

$$S = \frac{1.8\times10^{-10}}{0.2}$$

$$= 9.0 \times 10^{-10}\text{ M}$$

377 **(d)**

$\alpha = 1.9 \times 10^{-9}; c = \frac{1000}{18}$

$$K = \frac{[\text{H}^+][\text{OH}^-]}{[\text{H}_2\text{O}]} = c\alpha^2$$

$$= 1.9 \times 10^{-9} \times 1.9 \times 10^{-9} \times \frac{1000}{18}$$

$$= 2.0 \times 10^{-16}$$

378 **(a)**

$\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3 + \text{heat}$

It is an exothermic reaction, so high temperature favours backward reaction. Hence, equilibrium is shifted towards the left.

379 **(b)**

$$\underset{s}{\text{Ag}_2\text{CO}_3(s)} \rightleftharpoons \underset{2s}{2\text{Ag}^+} + \underset{s}{\text{CO}_3^{2-}}$$

$$K_{\text{sp}} = [\text{Ag}^+]^2[\text{CO}_3^{2-}] = (2s)^2.s$$

$\therefore \quad K_{\text{sp}} = 4s^3$

380 **(a)**

Given, concentration of NaCl $= 0.2$ M

$$K_{\text{sp}}(\text{AgCl}) = 1.20 \times 10^{-10}$$

Let the solubility of AgCl in NaCl $= x$

$$\underset{x}{\text{AgCl}} \rightarrow \underset{x}{\text{Ag}^+} + \underset{x}{\text{Cl}^-}$$

Solubility $\underset{0.2}{\text{NaCl}} \rightarrow \underset{0.2}{\text{Na}^+} + \underset{0.2}{\text{Cl}^-}$

$\therefore \quad [\text{Ag}^+] = x$ and $[\text{Cl}^-] = (x + 0.2)$

$\therefore \quad K_{\text{sp}}(\text{AgCl}) = [\text{Ag}^+][\text{Cl}^-]$

$$= x(x + 0.2)$$

$$= x^2 + 0.2x$$

$\therefore \quad K_{\text{sp}} = 0.2x (x^2 \ll 1)$

or $\quad 1.2 \times 10^{-10} = 0.2x$

$\therefore \quad x = 6 \times 10^{-10}$

381 **(a)**

Because buffer solutions are mixture of weak acid or weak base and their salt

382 **(d)**

Let solubility be S_1, S_2, S_3 for AB, AB_2 and A_3B respectively.

$\therefore \quad S_1 = \sqrt{K_{\text{Sp}}} = \sqrt{4 \times 10^{-8}} = 2 \times 10^{-4}\ M$

$$S_2 = \sqrt[3]{\frac{K_{\text{Sp}}}{4}} = \sqrt[3]{\frac{3.2 \times 10^{-14}}{4}} = 2 \times 10^{-5}\ M$$

$$S_3 = \sqrt[4]{\frac{K_{\text{Sp}}}{27}} = \sqrt[4]{\frac{2.7 \times 10^{-15}}{27}} = 1 \times 10^{-4}\ M$$

383 **(b)**

It is Bronsted base and can accept H^+ only.

384 **(b)**

(a)pH of 10^{-9} M HCl will be < 7

(b)pOH of 10^{-5}M NaOH

$= -\log[\text{OH}^-]$

$= -\log[1 \times 10^{-5}] = 5$

$\text{pH} + \text{pOH} = 14$

$\text{pH} = 14 - 5 = 9$

(c)pH of 10^{-9}M KOH will be slightly greater than 7.

385 **(a)**

The loss in pH of blood is called acidosis.

386 **(d)**

In 0.001 M NaOH,

$[\text{OH}^-] = 0.001 = 10^{-3}$

$\therefore \quad [\text{H}^+] = \frac{10^{-14}}{[\text{OH}^-]} = \frac{10^{-14}}{10^{-3}} = 10^{-11}$

387 **(a)**

Both NH_4Cl and NH_4OH are diluted to same extent;

$$\text{pOH} = -\log K_b + \log\frac{[\text{Conjugate base}]}{[\text{Base}]}$$

388 **(c)**

According to Arrhenius concept-Acids are the substances which furnish H^+ ions in water and a base is a substance which furnishes OH^- ions in water.

389 **(a)**

$$AB_2 \rightleftharpoons \underset{s}{A^{2+}} + \underset{2s}{2B^-}$$

$$K_{sp} = [A^{2+}][B^-]^2$$

$$= (S)(2S)^2 = 4S^3$$

$$= 4(1 \times 10^{-5})^3$$

$$= 4 \times 10^{-15}$$

390 **(b)**

$pV = nRT$

Volume become $\frac{1}{2}V$ then pressure become $2p$,

So, $2p \times \frac{1}{2}V = pV = nRT$

Hence, there is no effect on K_p

391 **(a)**

Starch is used as an indicator in the titration of iodine against sodium thiosulphate

392 **(a)**

$2HI(g) \rightleftharpoons H_2(g) + I_2(g); -Q\text{kJ}$

n_g No. of moles of gaseous products – No. of moles of gaseous reactants

$2-2 \quad 0$

As the number of moles of products and reactants are equal, so equilibrium constant is not affected by any change in pressure and volume. Catalyst also does not affect the equilibrium constant. It is an endothermic reaction, hence equilibrium constant depends only upon the temperature.

393 **(c)**

An increase in temperature will change K_c. Addition of inert gas has no effect in $\Delta n = 0$. Also increase in pressure has no effect if $\Delta n = 0$.

394 **(c)**

According to Le-Chatelier principle the reactions in which number of moles of reactants is equal to number of moles of products, is not effected by change in pressure.

$$2NO(g) \rightleftharpoons N_2(g) + O_2(g)$$

Moles of reactants =2

Moles of products = 2

∵ There is no change in number of moles of reactants and products.

∵The reaction is not effected by change in pressure.

395 **(c)**

B_2H_6 is electron deficient and thus electron pair acceptor or Lewis acid.

396 **(a)**

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

$\underbrace{1 \quad 3}_{4} \qquad 2$

$\Delta n_g = 2 - 4 = -2$

$K_p = K_c(RT)^{\Delta n_g}$

$\therefore K_p = K_c(RT)^{-2}$

$\therefore K_c = \dfrac{K_p}{(RT)^{-2}} = \dfrac{1.44 \times 10^{-5}}{(0.082 \times 773)^{-2}}$

397 **(c)**

NH_3 is Lewis base.

398 **(b)**

$K_p \quad K_c(RT)^{n_g}$

Where, n_g No. of moles of gaseous products – No. of moles of gaseous reactants

$$CO(g) \qquad \tfrac{1}{2}O_2(g) \qquad CO_2(g)$$

$n_g \qquad 1 - 1.5 \quad -\frac{1}{2}$

∵ $\quad K_p \quad K_c(RT)^{n_g}$

$K_p \quad K_c(RT)^{-1/2}$

$\frac{K_p}{K_c} \quad (RT)^{-1/2}$

399 **(c)**

For the reaction.

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

$$K_p = K_c(RT)^{\Delta n}$$

$$\Delta n = 2 - 2 = 0$$

so, $\qquad K_p = K_c$

(where, $K_p$and K_c are equilibrium constants in terms of partial pressures and concentrations.)

400 **(a)**

pH of the solution at the equivalence point is on the acidic side due to dissolution of CO_2 formed. A slight excess of strong acid lowers pH to 3.5 when methyl orange produces red colour.

401 **(a)**

The residual part of the acid after removal of a proton from the molecule of an acid, is called its conjugate base. Thus, conjugate base=Acid−H^+ and a base after accepting a proton gets converted into its conjugate acid. Thus, HSO_4^- is conjugate acid of base SO_4^{2-}.

403 **(b)**

Volume of ice>volume of water and thus, increase in pressure favours forward reaction showing decrease in volume.

404 **(a)**

$Ag_2SO_4 \rightarrow 2Ag^+ + SO_4^{2-}$

Ag_2SO_4 is a 2: 1 type electrolyte *i.e.*, it gives two Ag^+ ions and one SO_4^{2-}ion on ionisation.

Given, $s = 2.5 \times 10^{-2}$ M

Hence, its $K_{sp} = 4s^3$

(where, $\quad s$ = molar solubility)

$$K_{sp} = 4(2.5 \times 10^{-2})^3$$

$$= 4 \times 15.63 \times 10^{-6}$$

$$= 62.5 \times 10^{-6}$$

405 **(a)**

Isohydric solutions of two acids contains same $[H^+]$ ion in them.

406 **(b)**

$K_h = \frac{K_w}{K_a \times K_b}$

From this, it is clear that hydrolysis constant of a salt of weak and weak base is inversely proportional to dissociation constant of both weak acid and weak base.

407 **(c)**

$N_2O_4 \rightleftharpoons 2NO_2$

1 0 Before dissociation

$1 - x$ $2x$ After dissociation

Total number of moles at equilibrium

$$= 1 - x + 2x = 1 + x$$

408 **(c)**

From the aqueous buffered solution of HA, 50% HA is ionised

$$[HA] = [A^-]$$

Buffer solution of weak acid HA ⟶ acidic buffer

$$\mathrm{pH} = \mathrm{p}K_a + \log\frac{[A^+]}{[HA]}$$

or $\mathrm{pH} = \mathrm{p}K_a = 4.5$

$$\mathrm{pOH} = \mathrm{p}K_w - \mathrm{pH}$$

$$\mathrm{pOH} = 14 - 4.5 = 9.5$$

409 **(b)**

Meq. of $H^+ = 10^{-3} \times 10 = 10^{-2}$

$\therefore$ No. of $H^+ = \dfrac{10^{-2} \times 6.02 \times 10^{23}}{1000} = 6.02 \times 10^{18}$

410 **(c)**

pH of gastric juice is in between 1 and 3.

411 **(b)**

The basic character of hydrides decreases down the group.

412 **(b)**

PCl_5 $\rightleftharpoons$ PCl_3 + Cl_2 Initial moles

5 0 0

5(1-) 5 5 Moles at equilibrium

$\frac{5(1-)}{0.5}$ $\frac{5}{0.5}$ $\frac{5}{0.5}$ Conc. At equilibrium

40%

0.4

K_c $\frac{[PCl_3][Cl_2]}{[PCl_5]}$

$$\frac{\frac{5 \quad 0.4}{0.5} \quad \frac{5 \quad 0.4}{0.5}}{\frac{5 \quad 0.6}{0.5}} \qquad \frac{16}{6}$$

2.66 mol/L

413 **(d)**

$K_w = [H^+][OH^-]$.

414 **(c)**

The equilibrium constant does not depend on concentration, when reversible reaction at equilibrium hence, equilibrium constant will be constant.

416 **(c)**

The hydrolysis reaction of conjugate base of acid is

$$A^-(aq) + H_2O \longrightarrow HO^- + HA$$

$$K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{10^{-4}} = 10^{-10}$$

Since, degree of hydrolysis is negligible;

$$[OH^-] = \sqrt{K_h C} = 10^{-6}. p[OH] = 6$$

and pH=14-6=8

417 **(c)**

$Na_2O + CaO + H_2O + CO_2 \rightarrow Na_2CO_3 + CaCO_3$

Solution is basic. It can be proved as

$$CO_3^{2-} + 2H_2O \rightarrow H_2CO_3 + 2OH^-$$

418 **(d)**

When a base accepts a proton, then an acid is formed. This acid is known as conjugated acid of that base. For example :

$$\underset{\text{base}}{NH_3} + H^+ \rightleftharpoons \underset{\text{conjugated acid}}{NH_4^+}$$

The conjugated acid of HF_2^- is H_2F_2.

$$\underset{\text{base}}{HF_2^-} + H^+ \rightleftharpoons \underset{\text{conjugated acid}}{H_2F_2}$$

419 **(d)**

2/3 rd of alcohol and acid react to form ester at equilibrium.

420 **(c)**

For hydrolysis of

$B^+; K_H = \dfrac{K_w}{K_b} = \dfrac{10^{-14}}{10^{-6}} = 10^{-8}$

421 **(c)**

0.001 M of NaOH means $[OH^-] = 0.001$

$= 10^{-3}\mathrm{M} \Rightarrow \mathrm{pOH} = 3$

$\mathrm{pH} + \mathrm{pOH} = 14 \Rightarrow \mathrm{pH} = 14 - 3 = 11$

422 **(b)**

Removal of product always favours forward reaction.

423 **(b)**

$$K_{\mathrm{sp}}[\mathrm{BaCO_3}] = [\mathrm{Ba^{2+}}][\mathrm{CO_3^{2-}}]$$

$$[\mathrm{Ba^{2+}}] = \frac{K_{\mathrm{sp}}}{[\mathrm{CO_3^{2-}}]} = \frac{5.1\times10^{-9}}{1\times10^{-4}}$$

$$[\mathrm{Ba^{2+}}] = 5.1\times10^{-5}\ \mathrm{M}$$

424 **(b)**

$K_{sp} = s^2 = \left(\frac{0.0015}{143.5}\right)^2 = 1.1\times10^{-10}$.

425 **(b)**

$\underset{\text{Acid}}{\mathrm{CO}} + \underset{\text{Base}}{\mathrm{NaOH}} \xrightarrow{P,T} \underset{\text{Salt}}{\mathrm{HCOONa}}$.

426 **(a)**

The acidic character has been explained in term of electronegativity of halogens.

427 **(a)**

Higher is the ox. no. of central atom in oxy-acid, *e*.g., acid ($\mathrm{HClO_4}$), more is its acidic nature and weaker is its conjugate base, (*e*.g., $\mathrm{ClO_4^-}$).

428 **(c)**

Methyl orange is used for strong acid titration; Alkali may be weak or strong.

429 **(d)**

Addition of salt always lowers the vapour pressure. Also, vapour pressure of a liquid is its characteristic pressure and depends only on temperature.

430 **(b)**

$\mathrm{CH_3COOH \rightleftharpoons CH_3COO^- + H^+}$

On adding $\mathrm{CH_3COONa}$, $[\mathrm{H^+}]$ decreases

431 **(a)**

Neutralization is exothermic whereas hydrolysis is endothermic.

432 **(d)**

$\mathrm{HCl} \longrightarrow \underset{10^{-8}}{\mathrm{H^+}} + \mathrm{Cl^-}$

$\mathrm{H_2O} \rightleftharpoons \underset{10^{-8}+a}{\mathrm{H^+}} + \underset{a}{\mathrm{OH^-}}$ The dissociation of $\mathrm{H_2O}$ is suppressed due to common ion effect

$\therefore \quad K_w = [\mathrm{H^+}][\mathrm{OH^-}]$

or $10^{-14} = (10^{-8} + a)\times a$

$\therefore \quad a = 0.95\times10^{-7}$

$\therefore \quad [\mathrm{H^+}] = 10^{-8} + 0.95\times10^{-7} = 1.05\times10^{-7}M$.

433 **(b)**

$\mathrm{Cu(NH_3)_4SO_4 \rightleftharpoons Cu(NH_3)_4^{2+} + SO_4^{2-}}$.

434 **(c)**

K_c is a characteristic constant for the given reaction

435 **(d)**

According to Arrhenius concept-Acids are the substances which furnish $\mathrm{H^+}$ ions in water and a base is a substance which furnishes $\mathrm{OH^-}$ ions in water.

436 **(a)**

According to Le-chatelier principle the reactions in which number of moles are increasing in forward reaction are favoured at low pressure or high volume.

$$\mathrm{PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)}$$

∵ Number of moles are increasing in the forward reaction in above reaction.

∵ Reaction is favoured at low pressure.

∵ At high pressure, rate of dissociation of $\mathrm{PCl_5}$ decreases.

437 **(a)**

Electron acceptors are Lewis acids. They are electron deficient compounds. $\mathrm{BF_3}$ is Lewis acid because B has only 6 electrons in its valence shell and it can accept electrons. $\mathrm{NF_3}$, $\mathrm{Cl^-}$ and $\mathrm{H_2O}$ have lone pair of electrons. Thus, they are electron donors and Lewis bases.

438 **(c)**

Stronger the base, higher the tendency to accept protons. Among the given, $\mathrm{CH_3COOH}$ and $\mathrm{H_2S}$ both are acids, thus have very low tendency to accept a proton. Between $\mathrm{NH_3}$ and $\mathrm{H_2O}$, $\mathrm{NH_3}$ is a stronger base (due to less electronegativity of N as compared to O) and hence, it has the highest tendency to accept a proton among the given. Moreover, the conjugate base formed by it also stable one

$\mathrm{NH_3 + H^+ \rightarrow NH_4^+}$

(stable)

439 **(d)**

$K_{sp} = 4s^3$

$\therefore \quad s^3 = \dfrac{4\times10^{-9}}{4} = 10^{-9}$

$\therefore \quad s = 10^{-3}M$

441 **(b)**

$PV = nRT \ \therefore \frac{n}{V} = \frac{P}{RT}$

442 **(c)**

$K_h = Ch^2$

$= 0.5\times\left(\dfrac{0.25}{100}\right)^2$

$= 3.125\times10^{-6}$

443 **(b)**

$\mathrm{PbCO_3} \rightleftharpoons \underset{s}{\mathrm{Pb^{2+}}} + \underset{x+y}{\mathrm{CO_3^{2-}}}$

$\mathrm{MgCO_3} \rightleftharpoons \underset{y}{\mathrm{Mg^{2+}}} + \underset{x+y}{\mathrm{CO_3^{2-}}}$

(Since both are present in same solutes)

∴ $\frac{K_{sp}\ \mathrm{PbCO_3}}{K_{sp}\ \mathrm{MgCO_3}} = \frac{x}{y}$

∴ $\frac{x}{y} = \frac{1.5\times10^{-15}}{1\times10^{-15}}$

or $x = 1.5\,y$

Now, $x(x+y) = 1.5\times10^{-15}$

or $1.5\,y(1.5\,y+y) = 1.5\times10^{-15}$

or $y = \left[\frac{1.5\times10^{-15}}{3.75}\right]^{1/2}$

$= 2\times10^{-8}$

∴ $x = 1.5\times2\times10^{-8}$

$= 3.0\times10^{-8}\ M.$

444 **(a)**

$[\mathrm{H^+}] = c\alpha = 1.34\times10^{-4}$

∴ $\alpha = 1.34\times10^{-1}$

∴ $K_c = c\alpha^2 = 1.8\times10^{-5}$

$\mathrm{pH} = -\log 1.8\times10^{-5} + \log\frac{0.164/82}{0.001}$

$= +4.7447 + 0.3010 = 5.0457$

∴ $[\mathrm{H^+}] = 9\times10^{-6}$.

445 **(b)**

Sorensen in 1909 gave pH scale to indicate the strength of the hydrogen ion concentration expressed in g/L. Here p stands for potenz meaning strength.

446 **(c)**

$$\begin{array}{llll} \mathrm{N_2} & +\,3\mathrm{H_2} & \rightleftharpoons\ 2\mathrm{NH_3} & \\ \frac{28}{28}=1 & \frac{6}{2}=3 & 0 & \text{mole before reaction} \\ 1-\frac{1}{2} & 3-\frac{3}{2} & \frac{17}{17}=1 & \text{mole after reaction} \end{array}$$

∴ Mole of $\mathrm{N_2} = \frac{1}{2}$

∴ wt. of $\mathrm{N_2} = 14\mathrm{g}$

Mole of $\mathrm{H_2} = \frac{3}{2}$

∴ wt. of $\mathrm{H_2} = \frac{3}{2}\times2 = 3\mathrm{g}$

447 **(c)**

$$K_c = \frac{[\mathrm{H_2}]^2[\mathrm{S_2}]}{[\mathrm{H_2S}]^2} = \frac{[0.10]^2[0.4]}{[0.5]^2} = 0.016$$

448 **(b)**

$$\begin{array}{lcc} & \mathrm{N_2O_4} \rightleftharpoons & 2\mathrm{NO_2} \\ \text{Initial} & 1\ \text{mol} & 0 \\ \text{At eqm} & 1\text{-}0.20 & 0.40\ \text{mol} \end{array}$$

$$pV = nRT$$

$$1\times V = 1\times R\times300$$

…(i)

$$p\times V = 1.2\times R\times600$$

…(ii)

On dividing (ii) by (i)

$$p = 2.4\ \text{atm}$$

449 **(a)**

$$\begin{array}{lccc} \mathrm{H_2} & +\ \mathrm{I_2} & \rightleftharpoons & 2\mathrm{HI} \\ 1 & 1 & & 0 \\ (1\text{-}0.8) & (1\text{-}0.8) & & 2\times0.8 \\ =0.2 & =0.2 & & =1.6 \end{array}$$

$$K_c = \frac{[\mathrm{HI}]^2}{[\mathrm{H_2}][\mathrm{I_2}]}$$

$$= \frac{1.6\times1.6}{0.2\times0.2}$$

$$K_c = 64$$

450 **(b)**

According to common ion effect, dissociation of weak electrolyte is further suppressed in presence of strong electrolyte having common ion.

∴ AgCl is weak electrolyte and NaCl is strong electrolyte having common anion.

∴ Solubility as well as concentration of $\mathrm{Ag^+}$ and $\mathrm{Cl^-}$ will decrease.

451 **(a)**

$\frac{\text{normal mol.wt.}}{\text{exp.mol.wt.}} = 1+\ \alpha$; (Mol. wt $= 2\ \times$ VD)

$$\frac{92}{49} = 1+\alpha$$

∴ $\alpha = 0.87$

452 **(c)**

A precipitation of AgCl is formed when equal volumes of 10^{-5} M $\mathrm{AgNO_3}$ and 10^{-4}M HCl are mixed, because ionic product will be 10^{-9} which is greater than $K_{\mathrm{sp}}(10^{-10})$. For the precipitation of an electrolyte, it is necessary that the ionic product must exceed its solubility product.

453 **(b)**

$\mathrm{CO(g)} + 0.5\mathrm{O_2(g)} \rightarrow \mathrm{CO_2(g)}$

$\Delta n_g = n_p - n_r = 1 - 1.5 = -0.5$

$$K_p = K_c(RT)^{\Delta n} = K_c(RT)^{-0.5}$$

$$\frac{K_p}{K_c} = \frac{1}{\sqrt{RT}}$$

454 **(b)**

Metal cation possesses the tendency to accept electron pair from ligands.

455 **(d)**

Any acid or salt having an ion common (due to common ion effect) or any base (due to acid-base reaction) will influence degree of dissociation of weak acid.

456 **(a)**

$Ca(OH)_2 \rightleftharpoons Ca^{2+} + 2OH^-$

$$K_{sp} = [Ca^{2+}][OH^-]^2$$

$$= (s)(2s)^2 = 4s^3$$

457 **(c)**

Proton affinity means affinity for proton *i.e.*, basicity. In NH_3 nitrogen has pair of electron to donate as well as higher tendency to donate due to lower electronegativity. In PH_3, P is not suitable as that has large size.

458 **(d)**

$Acid_1 + Base_2 \rightleftharpoons Acid_2 + Base_1$

$HPO_3^{2-} + H_2O \rightleftharpoons H_3O^+ + PO_3^{3-}$

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

$H_3PO_4 + H_2O \rightleftharpoons H_3O^+ + H_2PO_4^-$

459 **(b)**

$\Delta G^0 = -RT \text{ In } K_p$ if $\Delta G^\circ = 0$; In $K_p = 0$ or $K_p = 1$

460 **(c)**

$[H^+] = 10^{-2}\ M$

$\therefore$ pH = 2.

461 **(a)**

$X(g) + Y(g) \rightleftharpoons Z(g)$

$$K_c = \frac{[Z]}{[X][Y]} \quad \text{or} \quad 10^4 = \frac{[Z]}{[X][Y]}$$

$$\therefore \quad [Z] = 10^4[X][Y]$$

$$= 10^4 \times \frac{1}{2}[Z][Z]$$

(Given, $[X] = \frac{1}{2}[Y] = \frac{1}{2}[Z]$)

$\therefore \quad [Z] = 2 \times 10^{-4}$ mol L^{-1}

462 **(a)**

$CO_2(g) + C(s) \rightleftharpoons 2CO(g)$

Initial : 0.5 atm

At equili : $(0.5 - p)$ $2p$ atm

This is a case of heterogeneous equilibrium. $C(s)$ being solid is not considered

Total pressure of CO_2 and CO gases.

$$p_{CO_2} + p_{CO} = p_{total}$$

$$0.5 - p + 2p = 0.8$$

$$p = 0.3 \text{ atm}$$

$$\therefore \quad p_{CO_2} = 0.5 - 0.3 = 0.2 \text{ atm}$$

$$p_{CO} = 2p = 0.6 \text{ atm}$$

$$K_p = \frac{p^2_{CO}}{p_{CO_2}} = \frac{0.6 \times 0.6}{0.2}$$

$$= 1.8 \text{ atm}$$

463 **(b)**

$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$

At equilibrium if partial pressure of CO_2 p then that of NH_3 $2p$

$$K_p \quad p^2_{NH_3} \quad p_{CO_2} \quad (2p)^2 \quad p \quad 4p^3$$

$$2.9 \quad 10^{-5} \quad 4p^3$$

$$p^3 \quad 0.725 \quad 10^{-5}$$

or p^3 7.25 10^{-6} or p 1.935 10^{-2}

hence, total pressure p $3p$

5.81 10^{-2} 0.0581 atm.

464 **(c)**

For salt of weak acid and weak base

$$pH = \frac{1}{2}[\log K_a + \log K_w - \log K_b]$$

$$= \frac{1}{2}pK_a + \frac{1}{2}pK_w - \frac{1}{2}pK_b$$

$$= \frac{1}{2} \times 4.80 + 7 - \frac{1}{2} \times 4.78$$

$$= 7.01$$

465 **(a)**

The species which can accept as well as donate H^+ can act both as an acid and a base.

$$\underset{\text{base}}{HSO_4^-} + H^+ \rightleftharpoons H_2SO_4$$

$$\underset{\text{acid}}{HSO_4^-} \rightleftharpoons SO_4^{2-} + H^+$$

466 **(c)**

$$HA(aq) + H_2O(l) \rightleftharpoons H_3O^+(aq) + A^-(aq)$$

Initial	0.1 M	0	0
Change	$-\frac{0.1 \times 5}{100}$	$+\frac{0.1 \times 5}{100}$	$+\frac{0.1 \times 5}{100}$
Equi conc.	0.095	0.005	0.005

$$K_c = \frac{[H_3O^+][A^-]}{[HA]} = \frac{0.005 \times 0.005}{0.095}$$

$$= 2.63 \times 10^{-4}$$

467 **(b)**

Acetylene is more acidic than both ethane and benzene but methyl alcohol is slightly more acidic ($pK_a < 25$) than acetylene.

468 **(c)**

$pH = -\log[H^+]$

pH=14−pOH

Calculate pH of all the solution to find which will have maximum pH.

(A)M/10 HCl

$$\therefore \quad [H^+] = 10^{-1}$$

$$pH = -\log[H^+]$$

$$= -\log[10^{-1}]$$

$$= 1$$

(B)M/100 HCl

$$\therefore \quad [H^+] = 10^{-2}$$

$$pH = -\log[H^+]$$

$$= -\log[10^{-2}]$$
$$= 2$$

(C)M/10 NaOH

$$\therefore \quad [\mathrm{OH}^-] = 10^{-1}$$
$$\mathrm{pH} = 14 - \mathrm{pOH}$$
$$= 14[-\log 10^{-1}]$$
$$= 14 - 1$$
$$= 13$$

(D)M/100 NaOH

$$\therefore \quad [\mathrm{OH}^-] = 10^{-2}$$
$$\mathrm{pH} = 14 - \mathrm{pOH}$$
$$= 14 - [\log 10^{-2}]$$
$$= 14 - 2 = 12$$

∴ M/100 NaOH solution has highest pH.

469 **(b)**

$[H^+] = 10^{-6}$ or $c\alpha = 10^{-6}$; also, $c = 1.0\ M \ \therefore \alpha = 10^{-6}$

$K_a = c\alpha^2 = 10^{-6} \times 10^{-6} = 10^{-12}$

470 **(d)**

Those reactions which have high value of K, proceeds towards completion

471 **(d)**

A mixed salt is one which furnishes two types of cations or anions.

472 **(b)**

Buffer capacity of a buffer solution is maximum when the concentration of the weak acid and its salt or weak base and its salt are equal, *i.e.*, for highest buffer capacity $\mathrm{pH} = \mathrm{p}K_a$

For this [salt] = [acid]

Thus, 25 mL.

473 **(c)**

By using $\mathrm{pH} = -\log\sqrt{K_a . C}$

$$5 = -\log\sqrt{K_a \times 1} = -\frac{1}{2}\log K_a$$
$$\log K_a = -10$$
$$K_a = 10^{-10}$$

Hence, dissociation constant $(K_a) = 10^{-10}$.

474 **(b)**

pH varies inversely with temperature. Thus, if the pH of neutral water is 6.5, the temperature of water is more than 25°C.

475 **(b)**

$$[\mathrm{CO}] = \frac{0.1}{0.5}$$
$$[\mathrm{Cl_2}] = \frac{0.1}{0.5}$$
$$[\mathrm{COCl_2}] = \frac{0.3}{0.5}$$
$$\therefore \ K_c = \frac{0.3/0.5}{\frac{0.1}{0.5} \times \frac{0.1}{0.5}} = 15$$

476 **(c)**

In qualitative analysis, in order to detect IInd group radicals, H_2S gas is passed in the presence of dilute HCl to decrease the dissociation of H_2S by common-ion effect so that less S^{2-}ions are obtained and only IInd group radical could precipitate.

477 **(b)**

The value of $\mathrm{p}K_a$ for strong acid is less

478 **(d)**

HCl a mineral acid is strong acid and thus, Cl^- is weak base.

479 **(c)**

$[H^+] = 10^0 = 1\ M$

480 **(c)**

$\Delta n = 0$ and thus, $K_p = K_c$.

481 **(a)**

$$\mathrm{H_2(g) + CO_2(g) \rightleftharpoons CO(g) + H_2O(g)}$$

	$H_2(g)$	$CO_2(g)$	$CO(g)$	$H_2O(g)$
Initial conc.	1	1	0	0
At equilibrium	$(1-x)$	$(1-x)$	x	x

$$\therefore \quad K_p = \frac{p_{\mathrm{CO}} \cdot p_{\mathrm{H_2O}}}{p_{\mathrm{H_2}} \cdot p_{\mathrm{CO_2}}}$$
$$= \frac{x . x}{(1-x)(1-x)} = \frac{x^2}{(1-x)^2}$$

482 **(d)**

For each case $K_{sp} = [A^{2+}]^3[B^{3-}]^2$.

483 **(a)**

$\mathrm{CH_3COOH \rightleftharpoons CH_3COO^- + H^+}$

$$K_{a_1} = 1.5 \times 10^{-5}$$
$$= \frac{[\mathrm{CH_3COO^-}][\mathrm{H^+}]}{[\mathrm{CH_3COOH}]} \quad \ldots \text{(i)}$$

$\mathrm{HCN \rightleftharpoons H^+ + CN^-}$

$$K_{a_2} = 4.5 \times 10^{-10}$$
$$= \frac{[\mathrm{H^+}][\mathrm{CN^-}]}{[\mathrm{HCN}]} \quad \ldots \text{(ii)}$$

By (i)/(ii)

$$K = \frac{K_{a_1}}{K_{a_2}} = \frac{[\mathrm{HCN}][\mathrm{CH_3COO^-}]}{[\mathrm{CN^-}][\mathrm{CH_3COOH}]} = \frac{1.5 \times 10^{-5}}{4.5 \times 10^{-10}}$$
$$= 3 \times 10^4$$

484 **(c)**

Given, vol. of HCl = 5 mL, molarity = M/5

Vol. of NaOH = 10 mL, molarity = M/10

Mulliequivalents of HCl $= 5 \times \frac{1}{5} = 1$

Mulliequivalents of NaOH $= 10 \times \frac{1}{10} = 1$

$HCl + NaOH \rightarrow NaCl + H_2O$

∵ Mulliequivalents of HCl = Mulliequivalents of NaOH

∴ Solution is neutral and pH=7.

485 **(c)**

$AlCl_3$ accepts electron pair.

486 **(b)**

$$[H^+] = \sqrt{K_a \times C}$$
$$= \sqrt{10^{-5} \times 0.1}$$
$$= \sqrt{10^{-6}} = 10^{-3}$$
$$\text{pH} = -\log[H^+] = -\log 10^{-3} = 3$$

487 **(a)**

$$\text{pH} = \text{p}K_a + \log\frac{[\text{KCN}]}{[\text{HCN}]} = 9.3 + \log\frac{2.5}{2.5} = 9.30$$

488 **(b)**

Total milliequivalent of H^+

$$= 30 \times \frac{1}{3} + 20 \times \frac{1}{2} = 20$$

Total milliequivalent of OH^-

$$= 40 \times \frac{1}{4} = 10$$

Milliequivalent of H^+ left

= 20-10=10

∴ $[H^+] = \frac{10}{1000}$ g ions/dm^3 $= 10^{-2}$

∴ pH=2

489 **(b)**

Given, for NaOH, $V = 10$ mL, $N = 0.1$ N

For H_2SO_4, $V = 10$ mL, $N = 0.05$ N

Miliequivalents of NaOH $= 10 \times 0.1 = 1$

Miliequivalents of $H_2SO_4 = 10 \times 0.05 = 0.5$

$H_2SO_4 + 2NaOH \rightarrow Na_2SO_4 + H_2O$

1 equivalent 2 equivalent

∵ 0.5 equivalent of H_2SO_4 will react with 1 equivalent of NaOH

∴ The pH of solution = 7 (neutral)

491 **(d)**

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

acid conjugated base

$H_2PO_4^-$ gives HPO_4^{2-} (conjugated base) in aqueous solution. It acts as proton donor.

492 **(d)**

K_1 for, $N_2 + 3H_2 \rightleftharpoons 2NH_3$

K_2 for, $NH_3 \rightleftharpoons \frac{1}{2}N_2 + \frac{3}{2}H_2$

$$\therefore K_1 \times K_2 = \frac{[NH_3]^2}{[N_2][H_2]^3} \times \frac{[N_2]^{1/2}[H_2]^{3/2}}{[NH_3]}$$

or, $K_1 \times K_2 = \frac{1}{K_2}$

$$\therefore K_2 = \frac{1}{\sqrt{K_1}}$$

493 **(b)**

The two conditions when colour of indicator will be visible are derived by

$$\text{pH} = \text{pK}_a + \log\frac{[\text{In}^-]}{[\text{HIn}]}$$

(i) pH $= 5 + \log 10 = 6$

(ii) pH $= 5 + \log 0.1 = 4$

Thus, minimum change in pH = 2.

495 **(b)**

(s) or mole of AgCl needed $= \sqrt{K_{sp}} = 10^{-5}$

(s) or mole of AgBr needed $= \sqrt{K_{sp}} = 3.16 \times 10^{-7}$

(s) or mole of Ag_2CrO_4 needed $= \sqrt[3]{\frac{K_{sp}}{4}} = 0.62 \times 10^{-4}$

∴ Weight of AgCl $= 10^{-5} \times 143.5 = 1.435 \times 10^{-3}$ g

∴ Weight of AgBr $= 3.16 \times 10^{-7} \times 188 = 5.94 \times 10^{-5}$g

∴ Weight of $Ag_2CrO_4 = 6.2 \times 10^{-5} \times 332 = 2.058 \times 10^{-2}$g

496 **(a)**

In a given mixture, the ionisation of two acids can be written as: Let α, β be degree of ionisation at same concentration.

$$\underset{1-\alpha}{CH_3COOH} \rightleftharpoons \underset{\alpha}{CH_3COO^-} + \underset{\alpha+\beta}{H^+}$$
$$\underset{1-\beta}{C_2H_5COOH} \rightleftharpoons \underset{\beta}{C_2H_5COO^-} + \underset{\alpha+\beta}{H^+}$$

$$\therefore \quad K_{AA} = \frac{[\alpha][\alpha+\beta]\cdot c}{[1-\alpha]}$$
$$K_{PA} = \frac{[\beta][\alpha+\beta]\cdot c}{[1-\beta]}$$
$$\therefore \quad \frac{K_{AA}}{K_{PA}} = \frac{\alpha}{1-\alpha} \times \frac{(1-\beta)}{\beta}$$
$$\text{or} \quad \frac{\alpha}{1-\alpha} = \frac{1.75}{1.3} \times \left[\frac{\beta}{1-\beta}\right]$$

497 **(b)**

$$\alpha = \frac{\lambda_u}{\lambda_\infty} = \frac{5}{390} = 0.013$$

498 **(c)**

Follow Le-Chatelier's principle.

499 **(a)**

$[(NH_4)_2S] = 0.021\ M$

∴ $[S^{2-}] = 0.021\ M$

$\because$ At equilibrium $[Zn^{2+}][S^{2-}] = K_{sp}$ of ZnS

$$\therefore \quad [Zn^{2+}] = \frac{4.51 \times 10^{-24}}{0.021} = 2.15 \times 10^{-22}\ M$$

$\therefore$ $[Zn^{2+}]$ left in solution $= 2.15 \times 10^{-22} \times$ 65 g/litre

$$= \frac{2.15 \times 10^{-22} \times 65 \times 12}{1000}\ \text{g/12 mL}$$

$$= 1.677 \times 10^{-22}\ \text{g/12 mL.}$$

500 **(d)**

K_p is a constant and does not change with pressure

501 **(d)**

A chemical equilibrium is the state when concentration of reactants and products do not change with time. It is attained when rate of forward reaction becomes equal to rate of backward reaction.

503 **(c)**

H_3PO_4 furnishes $H_2PO_4^-, HPO_4^{2-}$ and PO_4^{3-} anions.

504 **(c)**

The mixture containing a weak acid (HNO_2) and its conjugate base (NO_2^-) acts as acidic buffer.

505 **(a)**

$$\because \text{pH} = \frac{1}{2}\text{p}K_w + \frac{1}{2}\text{p}K_a - \frac{1}{2}\text{p}K_b$$

$$= \frac{1}{2} \times 14 + \frac{1}{2} \times 6 - \frac{1}{2} \times 6$$

pH = 7

$$\alpha = \sqrt{\frac{K_w}{K_a \times K_b}} = \sqrt{\frac{10^{-14}}{10^{-6} \times 10^{-6}}} = \sqrt{10^{-2}}$$

$= 10^{-1} = 0.1$or 10%

506 **(d)**

Phenolphthalein is used for strong alkali titrations; Acid may be weak or strong.

507 **(b)**

$$[H^+] = 2 \times 10^{-2}$$

$\therefore$ pH $= -\log 2 \times 10^{-2}$

i.e., in between 1 and 2.

509 **(a)**

(i)$Ag^+ + NH_3 \rightleftharpoons [Ag(NH_3)]^+$;

$K_1 = 3.5 \times 10^{-3}$

(ii)$[Ag(NH_3)]^+ + NH_3 \rightarrow [Ag(NH_3)_2]^+$;

$K_2 = 1.7 \times 10^{-3}$

On the basis of above reaction,

$$K_1 = \frac{[Ag(NH_3)]^+}{[Ag^+][NH_3]} \quad \text{...(i)}$$

$$K_2 = \frac{[Ag(NH_3)_2]^+}{[Ag(NH_3)]^+[NH_3]} \quad \text{...(ii)}$$

For the formation of $[Ag(NH_3)_2]^+$

$$Ag^+ + 2NH_3 \rightleftharpoons [Ag(NH_3)_2]^+$$

Formation constant (K)

$$= \frac{[Ag(NH_3)_2]^+}{[Ag^+][NH_3]^2} \quad \text{...(iii)}$$

From Eqs. (i) and (ii)

$$K = K_1 \times K_2$$

$$= 3.5 \times 10^{-3} \times 1.7 \times 10^{-3}$$

$$= 5.95 \times 10^{-6} \approx 6.08 \times 10^{-6}$$

510 **(b)**

$0.1 \times 1 = N \times 1000$

$\therefore$ N dilute acid $= 10^{-4}$

or $[H^+] = 10^{-4}$ and so ph = 4.

511 **(c)**

Catalyst provides a new pathway to attain equilibrium earlier.

512 **(d)**

Follow law of mass action equations.

513 **(d)**

$$Ca_3(PO_4)_2(s) \rightleftharpoons \underset{3y}{3Ca^{2+}(aq)} + \underset{2y}{2PO_4^{3-}(aq)}$$

$$K_{sp} = [Ca^{2+}]^3.[PO_4^{3-}]^2$$

$$= (3y)^3.(2y)^2$$

$$= 27y^3 \times 4y^2$$

$$= 108y^5$$

514 **(d)**

$N_2 + O_2 \rightleftharpoons 2NO; \qquad K_1$

$$= \frac{[NO]^2}{[N_2][O_2]} \quad \text{... (1)}$$

$2NO + O_2 \rightleftharpoons 2NO_2; \qquad K_2$

$$= \frac{[NO_2]^2}{[NO]^2[O_2]} \quad \text{... (2)}$$

$NO_2 \rightarrow \frac{1}{2}N_2 + O_2; \rightleftharpoons \qquad K_3$

$$= \frac{[N_2]^{1/2}\ [O_2]}{[NO_2]} \quad \text{... (3)}$$

By observation $\qquad K_3 = \frac{\sqrt{1}}{K_1K_2}$

515 **(b)**

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

$$K_c = \frac{[NO]^2}{[N_2][O_2]} = 4 \times 10^{-4}$$

$$NO(g) \rightleftharpoons \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g)$$

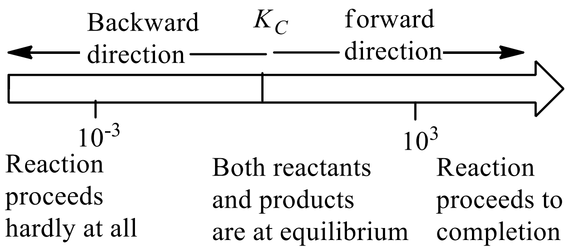
$$K_c' = \frac{[N_2]^{\frac{1}{2}}[O_2]^{\frac{1}{2}}}{[NO]}$$

$$= \frac{1}{\sqrt{K_c}} = \frac{1}{\sqrt{4 \times 10^{-4}}}$$

$$= \frac{1}{2 \times 10^{-2}} = \frac{100}{2} = 50$$

516 **(a)**

From the value of K_c, the direction of the reaction may be predicated as follows :



Since, for given reaction $K_c = 10^{-4}$ therefore, the reaction proceeds in backward direction.

517 **(a)**

$$X + Y \rightleftharpoons Z$$

Initial conc., 5 3 0

At equilibrium $(5-2)(3-2)$ 2

Equilibrium constant $(K_c) = \frac{[Z]}{[X][Y]}$

$= \frac{2}{3 \times 1} = \frac{2}{3}$

518 **(d)**

$$\underset{1-\alpha}{\overset{1}{N_2O_4}} \rightleftharpoons \underset{2\alpha}{\overset{0}{2NO_2}}$$

$\therefore$ Total mole at equilibrium

$= 1 - \alpha + 2\alpha = 1 + \alpha$

519 **(d)**

The solubility order of alkaline earth metal hydroxides is

$Ba(OH)_2 > Ca(OH)_2 > Mg(OH)_2 > Be(OH)_2$.

521 **(b)**

$N_3H \xrightarrow{-H^+} N_3^-$.

522 **(b)**

$A + B \rightleftharpoons C + D$

a a $2a$ $2a$ at equilibrium

$\therefore K_c = \frac{[C][D]}{[A][B]}$

$= \frac{2a \times 2a}{a \times a} = 4$

523 **(b)**

CH_3COO^-,because it is the conjugate base of weak acid

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

524 **(d)**

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

Given, volume is halved

$\therefore$ Pressure is doubled

$\therefore$ Equilibrium will shift backeard and degree of dissociation (α) will decreases.

K_p is constant at constant temperature.

525 **(d)**

$pK_a = 5$; Also, $pK_a + pK_b = 14$

$\therefore pK_b = 9$.

527 **(a)**

$$K_c = \frac{[Z]^2}{[X]^2[Y]} = \frac{(3)^2}{(2)^2(Y)} = 2.25, \therefore [Y] = 1M$$

528 **(b)**

$$\underset{(1-x)}{\overset{1}{A}} + \underset{(1-x)}{\overset{1}{B}} \rightleftharpoons \underset{x}{\overset{0}{AB}};$$

Given, $x = 0.4$

$\therefore$ Percentage of A changing to $AB = \frac{0.4 \times 100}{1}$

$= 40\%$

529 **(a)**

$\underset{\text{ion}}{I^-} + \underset{\text{solute}}{I_2} \longrightarrow I_3^-$; It is therefore I_2 is more soluble in KI.

530 **(d)**

If strong base is present in a solution, then pH is calculated from its concentration.

$\therefore$ $[OH^-] = 10^{-1}$ or $pOH = 1$

$\therefore$ $pH = 13$.

531 **(d)**

$NH_4OH + NH_4Cl$ is an example of basic buffer. Its pH value is greater than 7.

533 **(d)**

$$Ca(OH)_2 \rightleftharpoons \underset{s}{Ca^{2+}} + \underset{2s}{2OH^-}$$

$K_{sp} = [S][2S]^2$ (where S=solubility)

$K_{sp} = 4S^3$

$K_{sp} = 4.(\sqrt{3})^3$

$= 12\sqrt{3}$

534 **(b)**

CO_2 is acidic oxide which on dissolution in water develops acidic nature.

535 **(d)**

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} = \frac{\left[2 \times \frac{10^{-3}}{2}\right]^2}{\left[\frac{0.2}{2}\right]}$$

$= \frac{10^{-6}}{10^{-1}} = 10^{-5}$

536 **(d)**

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3$; $\Delta H = -92.38 \text{ kJ mol}^{-1}$

Forward reaction, the volume decreases and it is exothermic reaction. According to Le-Chatelier principle, such reactions are favoured at low temperature and high pressure.

537 **(b)**

$K_p = K_c(RT)^{\Delta n_g}$

Here, $\Delta ng = 1$

Thus, K_c will be less than K_p

539 **(d)**

Acetic acid is weak acid and only pH in given range is 6.85 for acids.

540 **(a)**

NH_3 is proton acceptor and thus, H_2O behaves as proton donor.

541 **(d)**

Bronsted bases are proton acceptor and each Lewis base contains one or more electron pair and thus, accept proton. On the other hand, Bronsted acids are proton donor and may or may not be capable of accepting lone pair of electron, *e.g.*, H_2SO_4 is Bronsted acid not Lewis acid; BF_3 is Lewis acid but not Bronsted acid. Also each cation is acid and each anion is base.

542 **(d)**

$PCl_5 \quad \rightleftharpoons \quad PCl_3 \quad + \quad Cl_2$

3 mol   3 mol   2 mol initially

(3-x) mol   (3 x)mol   (2 x)mol at equilibrium

$\because \quad 3 - x \quad 1.5$

$x \quad 1.5$

Number of moles of PCl_3 3 x

3 1.5 4.5

543 **(d)**

At equilibrium, $\Delta G = 0$,

$ie, G_{\text{ice}} = G_{H_2O} \neq 0$

544 **(a)**

$$K = \frac{K_f}{K_b} = \frac{[P_{\text{product}}]^2}{[P_{\text{reaction}}]^1}$$

$K =$ atm.

545 **(a)**

$$pOH = pK_b + \log\frac{[\text{salt}]}{[\text{base}]}$$

(Henderson's equation)

$$= 5 + \log\frac{0.02}{0.2} = 5 + \log\frac{1}{10}$$

$$= 5 + (-1) = 4$$

pH=$14 - pOH = 14 - 4 = 10$

546 **(b)**

HCl provides common H^+ ions to CH_3COOH

$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$

547 **(a)**

This is Henderson equation for basic buffer mixtures.

548 **(b)**

Higher the tendency to give H^+ ion (*i.e.*, to undergo ionisation), stronger will be the acid or *vice-versa.*

HF has poor tendency to give H^+ ion, hence it is the weakest acid among the given.

The order of acidity of given acids is

$$H_2SO_4 > HNO_3 > HCl > HF.$$

549 **(b)**

$[H^+] = 10^{-12}$

$[OH^-] = 10^{-2}$

$\frac{w}{40} = 10^{-2}$

or $\quad w = 0.4$ g litre^{-1}

550 **(a)**

pH of 0.1 M H_2S solution can be derived as:

$H_2S = H^+ + HS^-; K_a = 10^{-7}$

$\therefore \quad [H^+] = c \cdot \alpha = \sqrt{K.c} = \sqrt{10^{-7} \times 0.1} = 10^{-4}$

$\therefore \quad pH = 4$

551 **(a)**

pH=0 means $[H^+] = 10^\circ = 1$ M. hence, solution is strongly acidic.

552 **(a)**

The saturated solution of AgI means that

$$[Ag^+][I^-] = K_{sp}\ AgI$$

Hence, in this solution, if a mixture of KI + KCl is added, then the concentration of $[I^-]$ ions will increase quite a bit in the solution. Hence, now the ionic product of AgI will be more than its solubility product and therefore, AgI will precipitate out.

553 **(a)**

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

Here, $\quad \Delta n = 2 - 2 = 0$

Hence, this equilibrium reaction is not influenced by volume change at constant temperature.

554 **(b)**

$2Na + 2H_2O \longrightarrow 2NaOH + H_2$.

555 **(d)**

$A + B = C + D$

$x \quad x \quad 0 \quad 0$ At initial

$2x \quad 2x$ At equilibrium

$$K_c = \frac{[C][D]}{[A][B]} = \frac{2x \times 2x}{x \times x} = 4$$

556 **(d)**

These are characteristics of salt hydrolysis.

558 **(c)**

(i)20 mL of 0.5 N HCl

0.5N⇒ 1000 mL of 0.5 mol of HCl

HCl present in 20 mL=$\frac{20 \times 0.5}{1000} = 1.0 \times 10^{-2}$

(ii)35mL of 0.1 N NaOH

0.1 N⇒ 1000 mL of 0.1 mol of NaOH

$\Rightarrow$ NaOH present in 35 mol $= \frac{3.5\times0.1}{1000}$

$= 0.35 \times 10^{-2}$

Total volume = 20+35=55 mL

$\Rightarrow$ Resulting mole in solution,

$(1.0 - 0.35)10^{-2} = 0.65 \times 10^{-2}$ mol HCl

$$\mathrm{HCl} = \mathrm{H^+} + \mathrm{Cl^-}$$

$$[\mathrm{HCl}] = [\mathrm{H^+}] + [\mathrm{Cl^-}]$$

55 mL contains 0.65×10^{-2} mole of $\mathrm{H^+}$ ions

$$1000\text{ mL} = \frac{0.65\times10^{-2}\times10^3}{55} = \frac{6.5}{55}$$

$$\mathrm{pH} = -\log[\mathrm{H^+}] = -\log(6.5/55)$$

$$= \log 55 - \log 6.5 = 0.92$$

Due to acidic nature of solution the colour of phenolphthalein becomes pink.

559 **(c)**

On the basis of precipitation concept an electrolyte will be precipitated firstly whose ionic product is exceeded to its solubility product. In similar ionic conc. of cations, an electrolyte is precipitated firstly for which K_{sp} is lower. In these electrolytes

MnS, FeS, ZnS and HgS, HgS is precipitated firstly.

560 **(a)**

Ostwald's dilution law is applicable for weak electrolyte

561 **(c)**

$$\frac{K_p}{K_c} = (RT)^{\Delta n}$$

$24.63 = (0.0821 \text{ x } T)^1$

$\therefore T = 300K$

562 **(d)**

20 M eq. of HCl reacts completely with 20 Meq. Of KOH. Hence, the final solution is neutral. Thus, at 90°C, pH = 6

564 **(b)**

$$K_{P_1} = \frac{n_Y.n_Z}{n_X}\left[\frac{P_1}{\sum n_1}\right]^1 \quad K_{P_2} - \frac{(n_B)^2}{n_A} \times \left[\frac{P_2}{\sum n_2}\right]^1$$

$$\begin{array}{lccccccc} \text{For} & X & \rightleftharpoons & Y & + & Z & \text{for } A & \rightleftharpoons 2B \\ & \underset{1-\alpha}{1} & & \underset{\alpha}{0} & & \underset{\alpha}{0} & \underset{1-\alpha}{1} & \underset{2\alpha}{0} \end{array}$$

$$\therefore \frac{K_{P_1}}{K_{P_2}} = \frac{P_1}{P_2} \times \frac{n_Y.n_Z}{n_X} \times \frac{(n_A)}{(n_B)^2} \times \left[\frac{\sum n_2}{\sum n_1}\right]$$

$$9 = \frac{P_1}{P_2} \times \frac{\alpha.\alpha}{1-\alpha} \times \frac{(1-\alpha)}{(2\alpha)^2} \times \frac{(1+\alpha)}{(1+\alpha)}$$

$$\therefore \frac{P_1}{P_2} = 4 \times 9 = 36$$

565 **(c)**

There will be no effect on equilibrium constant (K_c) in presence of catalyst. So, statement (c) is wrong.

566 **(a)**

$\mathrm{NH_3}$ (ammonia) possess an unshared electron pair on N-atom hence, it can donate electron pair. Such species are called Lewis bases. $\mathrm{BF_3}$ acts as Lewis acid.

567 **(a)**

$$\underset{5\text{ mol/L}}{\mathrm{Ca_3(PO_4)_2}} = \underset{3s}{3\mathrm{Ca^{2+}}} + \underset{2s}{2\mathrm{PO_4^{3-}}}$$

$$\therefore \quad K_{\mathrm{sp}} = [\mathrm{Ca^{2+}}]^3[\mathrm{PO_4^{3-}}]^2$$

$$= (3s)^3(2s)^2$$

$$K_{\mathrm{sp}} = 108s^5$$

569 **(d)**

$\mathrm{Fe^{3+}}$ ions are hydrolysed to develop acidic nature in solution.

570 **(a)**

K_{sp} of $M_2X = 4s^3$

K_{sp} of $QY_2 = 4s^3$

K_{sp} of $PZ_3 = 27s^4$

571 **(a)**

Strong acids have low pH value while strong bases have high pH value. Hence, the order of pH is

$\mathrm{HCl} \quad < \quad C\mathrm{H_3COOH} \ < \ N\mathrm{H_4Cl} \quad < \quad C\mathrm{H_3COONa}$

strong weak (salt of weak base

(salt of weak acid

Acid acid and strong acid)

and strong base)

572 **(c)**

Thunderstorm produces acidic oxides of N, S which produce acidic rain on dissolution in water.

573 **(c)**

$$\mathrm{H_2O} + \mathrm{NH_3} \rightleftharpoons \mathrm{NH_4^+} + \mathrm{OH^-}$$

In this reaction, $\mathrm{H_2O}$ acts as an acid because it donates a proton

575 **(c)**

K°for

$$[\mathrm{Ag(NH_3)_2}]^+ \rightleftharpoons \mathrm{Ag^+} + 2\mathrm{NH_3}$$

$$K^\circ = \frac{[\mathrm{Ag^+}][\mathrm{NH_3}]^2}{[\mathrm{Ag(NH_3)_2}]^+}$$

Also, $K_1^0 = 1.4 \times 10^{-4} = \frac{[\mathrm{Ag(NH_3)}]^+[\mathrm{NH_3}]}{[\mathrm{Ag(NH_3)_2}]^{+2}}$

and $K_2^0 = 4.3 \times 10^{-4} = \frac{[\mathrm{Ag}^+][\mathrm{NH}_3]}{[\mathrm{Ag(NH}_3)]^+}$

$\therefore \quad K^0 = K_1^0 \times K_2^0 = 1.4 \times 10^{-4} \times 4.3 \times 10^{-4}$

$= 6.02 \times 10^{-8}$

576 **(d)**

For precipitation, ionic product > solubility product

$\therefore$ The metal sulphide with lowest K_{sp}(PbS) will precipitate out first because its inonic product will exceed its K_{sp}first and the metal sulphide with highest K_{sp}(NiS) will precipitate out at last.

577 **(b)**

$[\mathrm{OH}^-]$in the diluted base $= \frac{10^{-6}}{10^2} = 10^{-8}$

Total $[\mathrm{OH}^-] = 10^{-8} + [\mathrm{OH}^-]$ of water

$= (10^{-8} + 10^{-7})\mathrm{M}$

$= 10^{-8}(1 + 10)\mathrm{M}$

$= 11 \times 10^{-8}$ M

$\mathrm{pOH} = -\log 11 \times 10^{-8}$

$= -\log 11 + 8 \log 10$

$= 6.9586$

$\mathrm{pH} = 14 - 6.9586$

$= 7.0414$

578 **(c)**

The molecule shows three H-atoms are replaceable, *i.e.*, basicity of acid.

579 **(c)**

K_{sp} of $\mathrm{Ag_2CrO_4} = [\mathrm{Ag}^+]^2[\mathrm{CrO}_4^{2-}]$

Also, if $\mathrm{CrO}_4^{2-} = 2 \times 10^{-4}$

Then $\mathrm{Ag}^+ = 2 \times 2 \times 10^{-4}$

$\therefore \quad K_{sp} = (4 \times 10^{-4})^2(2 \times 10^{-4})$

$= 32 \times 10^{-12}$.

580 **(c)**

$K_p = P_{\mathrm{CO}_2}$

581 **(a)**

$K_c = \dfrac{k_f}{k_b}$

$\therefore k_f = K_c \times k_b = 1.5 \times 7.5 \times 10^{-4}$

$= 1.125 \times 10^{-3}$

582 **(d)**

$\underset{\frac{0.3}{4}}{\mathrm{CH_3COOH}} + \underset{-}{\mathrm{NaOH}} \longrightarrow \underset{\frac{0.1}{4}\text{(14 neutralization)}}{\mathrm{CH_3COONH_4}} + \mathrm{H_2O}$

$\therefore \mathrm{pH}_1 = \mathrm{p}K_a + \log \dfrac{1}{3}$

$\underset{\frac{0.1}{4}}{\mathrm{CH_3COOH}} + \mathrm{NaOH} \longrightarrow \underset{\frac{0.3}{4}}{\mathrm{CH_3COONH_4}} + \mathrm{H_2O}$

$\therefore \mathrm{pH}_2 = \mathrm{p}K_a + \log 3$

$\therefore \mathrm{pH}_1 \sim \mathrm{pH}_2 = \log \dfrac{1}{3} \sim \log 3 = 2 \log 3$

583 **(c)**

The weak electrolyte A_xB_y dissociates as follows

$A_xB_y \rightleftharpoons xA^{y+} + yB^{x-}$

C 0 0

$C(1-\alpha) \quad xC_\alpha \quad yC_\alpha$

Where, α= degree of dissociation

C = concentration

$K_{\mathrm{eq}} = \frac{[A^{y+}]^x[B^{x-}]^y}{[A_xB_y]}$

$= \frac{[xC\alpha]^x[yC\alpha]^y}{C(1-\alpha)}$

$= \frac{x^x.C^x\alpha^x.y^y.C^y.a^y}{C}$

$[\because 1-\alpha \approx 1]$

$= x^x.y^y.\alpha^{x+y}.C^{x+y-1}$

$a^{x+y} = \frac{K_{\mathrm{eq}}}{x^x.y^y.C^{x+y-1}}$

$\alpha = \left(\frac{K_{\mathrm{eq}}}{x^x.y^y.C^{x+y-1}}\right)^{\left(\frac{1}{x+y}\right)}$

584 **(a)**

−do −

585 **(a)**

Mixture of acetic and sodium acetate is an acidic buffer. Hence, from Henderson equation,

$\mathrm{pH} = \mathrm{p}K_a + \log \frac{[\mathrm{salt}]}{[\mathrm{acid}]}$

On increasing [salt] ten times of that of [acid], the pH will increase by one.

586 **(a)**

$\mathrm{Bi_2S_3} \rightleftharpoons \underset{2s}{2\mathrm{Bi}^{3+}} + \underset{3s}{3\mathrm{S}^{2-}}$

$K_{\mathrm{sp}} = (2s)^2(3s)^3 = 108s^5$

$108s^5 = 1 \times 10^{-17}$

$s = \left(\frac{1 \times 10^{-17}}{108}\right)^{1/5} = 1.56 \times 10^{-4}$

$\mathrm{MnS} \rightleftharpoons \underset{s}{\mathrm{Mn}^{2+}} + \underset{s}{\mathrm{S}^{2-}}$

$K_{\mathrm{sp}} = s^2$

$s = \sqrt{K_{\mathrm{sp}}} = \sqrt{7 \times 10^{-16}}$

$= 2.64 \times 10^{-8}$

$\mathrm{CuS} \rightleftharpoons \underset{s}{\mathrm{Cu}^{2+}} + \underset{s}{\mathrm{S}^{2-}}$

$K_{\mathrm{sp}} = s^2$

$8 \times 10^{-37} = s^2$

$s = \sqrt{8 \times 10^{-37}} = 0.89 \times 10^{-18}$

$\mathrm{Ag_2S} \rightleftharpoons \underset{2s}{2\mathrm{Ag}^+} + \underset{s}{\mathrm{S}^{2-}}$

$$K_{\mathrm{sp}} = 4s^3 \text{or } 4s^3 = 6 \times 10^{-51}$$

$$s = \sqrt[3]{\frac{6\times10^{-51}}{4}}$$

$$= \sqrt[3]{1.5 \times 10^{-51}} = 1.14 \times 10^{-17}$$

The solubility of Bi_2S_3 is maximum. Hence, it is the most soluble.

587 **(c)**

The variation of equilibrium constant with temperature is given by van't Hoff isochore as:

$\frac{d}{dt}$ In $K_c = \frac{\Delta H}{RT^2}$

588 **(d)**

It is the characteristic of reaction.

589 **(d)**

$$K_h = \frac{K_w}{K_a} = \frac{10^{-14}}{1.3 \times 10^{-9}} = 7.7 \times 10^{-6}$$

590 **(b)**

$$K_{\mathrm{sp}} = [\mathrm{Ag}^+][\mathrm{Br}^-] = 5.0 \times 10^{-13}$$

$$[\mathrm{Ag}^+] = 0.05\ \mathrm{M}$$

$$[\mathrm{Br}^-] = \frac{5.0\times10^{-13}}{0.05} = 1 \times 10^{-11}\ \mathrm{M}$$

Moles of KBr $= 1 \times 10^{-11} \times 1 = 1 \times 10^{-11}$

Weight of KBr $= 1 \times 10^{-11} \times 120 = 1.2 \times 10^{-9}$g

591 **(b)**

Thermal decomposition of potassium chlorate is irreversible. So, law of mass action cannot be applied on this reaction

592 **(d)**

AB is binary electrolyte,

$$s = \sqrt{K_{\mathrm{sp}}} = \sqrt{1.21 \times 10^{-6}} = 1.1 \times 10^{-3}\ \mathrm{M}$$

593 **(b)**

$SnS_2 = Sn^{4+} + 2S^{2-}$.

594 **(b)**

$pK_a = -\log K_a$

Where, K_a = ionisation constant of weak acid. Smaller the value of pK_a, stronger will be the acid. So, $pK_a = 10^{-8}$ is strongest acid.

596 **(a)**

CH_4 has almost no acidic nature and thus, CH_3^- is strongest base.

597 **(c)**

$$K_c = \frac{[AB]^2}{[A_2][B_2]}$$

$$K_c = \frac{(2.8\ \times\ 10^{-3})^2}{3\ \times\ 10^{-3}\ \times\ 4.2\ \times\ 10^{-3}} = 0.62$$

598 **(a)**

$$\begin{array}{ccccccc} A & + & B & \rightleftharpoons & C & + & D \\ a & & a & & 0 & & 0 \\ (a-x) & & (a-x) & & x & & x \end{array}$$

Given , $x = 2(a-x)$or $x = \frac{2a}{3}$

$$K_c = \frac{x^2}{(a-x)^2} = \frac{(2a/3)^2}{(a-2a/3)^2} = 4$$

599 **(d)**

$PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$

According to Le-Chatelier's principle, on increasing volume of a reactant, the reaction proceeds in forward direction. Hence, on addition of Cl_2 to above reaction, the equilibrium will shift to the right.

600 **(c)**

K_{sp} AgCl $= 1.2 \times 10^{-10} = [\mathrm{Ag}^+][\mathrm{Cl}^-] = [s][s + 0.1]$ where, s is solubility of AgCl

$\therefore \quad K_{sp} = s \times 0.1 = 1.2 \times 10^{-10}$

$\therefore \quad s = 1.2 \times 10^{-9} M$

601 **(d)**

Dissociation weak acid decreases in presence of common ion.

602 **(b)**

$K_{sp} = 4s^3$

Also, $s = \frac{0.017}{78} M$

$$\therefore K_{sp} = 4 \times \left(\frac{0.017}{78}\right)^3 = 4.14 \times 10^{-11}$$

603 **(d)**

For weak acid,

$$\alpha = \sqrt{\frac{K_a}{C}}$$

As $'C'$ decreases, α increases therefore, percentage ionisation will increase

604 **(a)**

In acidic medium, H_2S is very feebly ionised giving very small concentration of sulphide ion for precipitation. Therefore, the most insoluble salts CuS and HgS are precipitated only.

605 **(d)**

In case of hydrolysis of salt of weak acid and strong base, the pH is given by

$$\frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}\log C$$

606 **(c)**

$$[\mathrm{H}^+] = c\alpha = 0.1 \times \frac{2}{100} = 2 \times 10^{-3} M$$

Also, $[\mathrm{H}^+] \times [\mathrm{OH}^-] = 10^{-14}$.

607 **(d)**

$$\because \quad \mathrm{pH} = pK_a + \log\frac{[\mathrm{salt}]}{[\mathrm{acid}]}$$

or $\quad 5.8 = 4.8 + \log\frac{[\text{salt}]}{[\text{acid}]}$

or $\quad \log\frac{[\text{salt}]}{[\text{acid}]} = 1.0$

$\frac{[\text{salt}]}{[\text{acid}]} = \text{anti} - \log 1.0 = 10$

∴ $\quad \frac{[\text{acid}]}{[\text{salt}]} = \frac{1}{10} = 0.1$

608 **(c)**

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g); K_p = \frac{p_{PCl_3} \text{ x } p_{Cl_2}}{p_{PCl_5}}$

$COCl_2\ (g) \rightleftharpoons CO(g) + Cl_2(g); K_p = \frac{p_{CO} \text{ x } p_{Cl_2}}{p_{COCl_2}}$

If CO is introduced, the dissociation of $COCl_2$ will decrease and p_{Cl_2} will decrease. This will favour dissociation of p_{Cl_5}, because both reactions are attained in same vessel.

609 **(a)**

For saturated solution of Ag_2CrO_4, if solubility is 's' mol L^{-1}. Then

$$\underset{s}{Ag_2CrO_4} \rightleftharpoons \underset{2s}{2Ag^+(aq)} + \underset{s}{CrO_4^{2-}(aq)}$$

$$K_{sp} = (2s)^2(s) = 4s^3$$

$$K_{sp} = 3.2 \times 10^{-11} \text{ (given)}$$

∴ $\quad 3.2 \times 10^{-11} = 4s^3$

$$s^3 = \frac{3.2\times10^{-11}}{4} = 8 \times 10^{-12}$$

∴ $\quad s = \sqrt{8 \times 10^{-12}} = 2 \times 10^{-4}$ M

610 **(b)**

Given , $S(s) + S^{2-} \rightleftharpoons S_2^{2-} \qquad K_{c_1} = 1.7$

$2S(s) + S^{2-} \rightleftharpoons S_3^{2-} \qquad K_{c_2} = 5.3$

∴ $K_{c_1} = \frac{[S_2^{2-}]}{[S^{2-}]} = 1.7$ ..(i)

$K_{c_2} = \frac{[S_3^{2-}]}{[S^{2-}]} = 5.3$ ..(ii)

Now for, $S_2^{2-}(s) + S(s) \rightleftharpoons S_3^{2-}$

$K_c = \frac{[S_3^{2-}]}{[S_2^{2-}]}$

∴ By Eqs. (ii) and (i), $\frac{K_{c_2}}{K_{c_1}} = \frac{[S_3^{2-}]}{[S_2^{2-}]} = K_c$

∴ $K_c = 3.11$

611 **(a)**

pH will decrease as K_w will increase and $[H^+]$ will increase but $[H^+] = [OH^-]$ and thus, solution will be neutral or we can say scale of pH will change.

612 **(d)**

The conjugate acid of NH_2^- is NH_3.

$$\underset{\text{base}}{NH_2^-} + H^+ \rightleftharpoons \underset{\text{conjugate acid}}{NH_3}$$

613 **(a)**

If strong acid is present in a solution, then pH is calculated from its concentration,

∴ $[OH^-] = 10^{-1}$ or pH = 1.

614 **(b)**

$pH = pK_a + \log\frac{[\text{Conjugate base}]}{[\text{Acid}]}$

$[\text{Conjugate base}] = \frac{20 \times 0.5}{30}; [\text{Acid}] = \frac{10 \times 1}{30}$

∴ $pH = 4.76 + \log\frac{1}{1} = 4.76$

615 **(c)**

In the presence of little H_2SO_4 (as catalyst) about 2/3 mole of each of CH_3COOH and C_2H_5OH to form $\frac{2}{3}$ mole of the product at equilibrium

616 **(b)**

pH = 2

∴ $[H^+] = 10^{-pH} = 10^{-2}M$

617 **(a)**

$K_c = \frac{[A][B]}{[AB]}$;

If $[A] = 2 \times [A]$;

To have K_c constant $[B]$ should be $[B] \times \frac{1}{2}$

618 **(d)**

The change in pressure will not affect the equilibrium constant. Equilibrium constant changes with change in temperature.

619 **(c)**

$K_c = \frac{[HI]^2}{[H_2][I_2]} = \frac{0.7 \times 0.7}{0.1 \times 0.1} = 49$

620 **(a)**

For 0.1 M acetic acid, or $C = 0.1$ mol L^{-1}

$K_a = 1.74 \times 10^{-5}$

pH=?

According to Ostwald dilution formula,

$$[H^+] = \sqrt{K_a \times C}$$

$$= \sqrt{1.7 \times 10^{-5} \times 0.1}$$

$$= \sqrt{0.017 \times 10^{-4}}$$

$$pH = -\log_{10}[H^+]$$

$$= -\log_{10}\sqrt{0.017 \times 10^{-4}}$$

pH=2.88

621 **(a)**

$PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

For this reaction, $\Delta n_g = 2 - 1 = 1$

Value of Δn_g is positive, so the dissociation of PCl_5 increases by decrease in pressure and by increase in pressure, the dissociation of PCl_5 decreases

622 **(a)**

$pH = -\log[H^+]$ and $[H^+] = \sqrt{9.61 \times 10^{-14}}$

∴ pH = 6.51

624 **(c)**

First dissociation

$X(\mathrm{OH})_3 \rightarrow X(\mathrm{OH})_2^+ + \mathrm{OH}^-$

Second dissociation

$X(\mathrm{OH})_2^+ \rightarrow X(\mathrm{OH})^{2+} + \mathrm{OH}^-$

Total $[\mathrm{OH}^-] = 4 \times 10^{-3} + 2 \times 10^{-3}$

$= 6 \times 10^{-3}$

$\mathrm{pOH} = 3 - \log 6$

$= 3 - 0.78 = 2.22$

$\mathrm{pH} = 14 - 2.22 = 11.78$

625 **(a)**

$K_c = \dfrac{[\mathrm{C_6H_6}]}{[\mathrm{C_2H_2}]}$

Or $4 = \frac{[\mathrm{C_6H_6}]}{(0.5)^3}$;

$\therefore [\mathrm{C_6H_6}] = 0.5\, M$

626 **(d)**

K_p of the reaction is : $K_p = \frac{P'_{\mathrm{CO_2}}}{(P'_{\mathrm{CH_4}})(P'_{\mathrm{O_2}})}$.

628 **(d)**

Buffer is $\underset{\text{Acid}}{\mathrm{CH_3COOH}} + \underset{\text{Conjugate base}}{\mathrm{CHCOO^-}}$ and has pH fixed.

629 **(d)**

Δn = Mole of product – Mole of reactant; count only gaseous phase reactants.

630 **(c)**

$\mathrm{N_2O_4} \rightleftharpoons 2\mathrm{NO_2}$

1 0 initially

$(1-\alpha)$ 2α at equilibrium

Total moles at equilibrium $= (1-\alpha) + 2\alpha$

$= 1 + \alpha$

631 **(b)**

Larger is bond length, more is acidic nature.

632 **(a)**

$K_a = c\alpha^2$ or $1.0 \times 10^{-5} = 0.1 \times \alpha^2$

$\therefore \alpha = 10^{-2}$ or 1%

633 **(a)**

By Le-Chatelier principle

$n_p > n_r$ (gaseous)

So, reaction shift in the backward direction

634 **(b)**

The buffer solutions are those solutions which resists the change in its pH value on addition of small amount of a base or an acid. $\mathrm{CH_3COOH}$ and $\mathrm{CH_3COONa}$ solution is buffer solution because it is a solution of weak acid and its salt with strong base.

635 **(c)**

$$\mathrm{pOH} = \mathrm{p}K_b + \log\frac{[\text{Conjugate acid}]}{[\text{base}]}$$

$$= -\log 1.8 \times 10^{-5} + \log\frac{0.2}{0.3}$$

$$= -\log 1.8 \times 10^{-5} + \log 0.66$$

$$= 4.744 - 0.176 = 4.567$$

$\therefore$ pH $= 14 - 4.567 = 9.423$.

637 **(c)**

The aqueous solution of KCN, $\mathrm{K_2CO_3}$ and LiCN turn red litmus blue because of alkaline nature.

The anionic hydrolysis turns the solution alkaline.

638 **(d)**

e.g., $\mathrm{CH_3COONa}$;

$\mathrm{CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-}$.

640 **(a)**

This is Henderson equation for acidic buffer mixtures.

641 **(c)**

$[\mathrm{H^+}] = c.\alpha = 0.01 \times \dfrac{12.5}{100}$

$= 1.25 \times 10^{-3}$

$\therefore$ Thus, pH $= -\log 1.25 \times 10^{-3}$

i.e., in between 2 and 3.

642 **(c)**

$\mathrm{AlCl_3}$ on hydrolysis gives weak base and strong acid.

643 **(b)**

When rate of forward reaction is equal to the rate of backward reaction then equilibrium is supposed to be established

644 **(a)**

ΔH is positive, so it will shift toward the product by increasing temperature

645 **(a)**

Electrophiles are electron deficient compounds and accept pair of electron.

646 **(c)**

Consider a buffer of $\mathrm{CH_3COOH + CH_3COONa}$

Addition of Acid : $H^+ + CH_3COO^- \longrightarrow \underset{\text{Weak acid}}{CH_3COOH}$

Addition of alkali :

$OH^- + CH_3COOH \longrightarrow \underset{\text{(Weak electrolyte)}}{H_2O} + CH_3COO^-$

Thus addition of acid or alkali does not cause any change in pH.

647 **(c)**

For the precipitation of an electrolyte, it is necessary that the ionic product must exceed its solubility product

648 **(a)**

For different salts such as AB, AB_2, AB_3 … etc.

$K_{sp} = s^2, 4s^3, 27s^4$ … respectively. If K_{sp} is same for different salts, then s is more for the salt in which is more number of ions.

649 **(b)**

An increase in temperature favours forward reaction, if $\Delta H =$ +ve,

$N_2O_4 \rightleftharpoons 2NO_2$; $\Delta H = +\text{ve}$

650 **(a)**

$N_2 + \quad 3H_2 \rightleftharpoons 2NH_3$

56 g 8 g 0 g

(= 2 mol)(= 4 mol) (0 mol) initially

$(2-1)(4-3)$ 34 g at equilibrium

= 1 = 1 (= 2 mol)

According to Eq.(1) 2 moles of ammonia are present a produce 2 moles of NH_3, we need 1 mole of N_2 and 3 of H_2, hence $2-1=1$ mole of N_2 and $4-3=1$ mole are present at equilibrium in vessel

651 **(a)**

$[OH^-]$in NH_4OH solution $= C\alpha$

$$= 0.001 \times \frac{1}{100} = 1 \times 10^{-5}$$

$$pOH = -\log[OH^-]$$

$$pOH = -\log[1 \times 10^{-5}]$$

$$pOH = 5$$

652 **(c)**

Addition of inert gas at constant volume condition to an equilibrium has no effect.

653 **(d)**

$Q > K_c$ thus, Q must decrease so that $[NH_3]$ may decrease to have backward reaction.

654 **(c)**

$NaHSO_4$ (acidic salt) and Na_2SO_4 normal salt.

655 **(b)**

$AgCl \rightleftharpoons Ag^+ + Cl^-$

$$K_{sp} = [Ag^+][Cl^-]$$

$$K_{sp} = S^2$$

(S=solubility in mol/L)

$$S = \frac{1.435 \times 10^{-3}\ \text{g/L}}{143.5} = 1 \times 10^{-10}\ \text{mol/L}$$

656 **(a)**

Le-Chatelier's principle is not applicable to solid-solid heterogeneous equilibrium.

657 **(a)**

$2SO_2 \quad + \quad O_2 \quad \rightleftharpoons \quad 2SO_3$

Initially 4 4 0.

At equili. 4(1-0.25) 4(1-0.25) 0.25 × 2

Total number of moles at equilibrium

$4(1-0.25)$ $4(1-0.25)$ 0.5

$4-1$ $4-1$ 0.5 6.5

658 **(b)**

$0.005\ M\ H_2SO_4 = 2 \times 0.005\ N\ H_2SO_4$

$= 0.01\ N\ H_2SO_4$;

Thus, $[H^+] = 10^{-2}M$

$\therefore$ pH = 2.

659 **(c)**

Due to common ion effect, rate of ionisation of NH_4OH decreases, so power $[OH^-]$ is obtained. Hence, pH value decrease.

660 **(b)**

For indicator dissociation equilibrium; being an acid

$\underset{\text{Colour } A}{HIn} \rightleftharpoons H^+ + \underset{\text{Colour } B}{In^-}$

$$K_{In} = \frac{[H^+][In^-]}{[HIn]}$$

The mid point of the colour range of an indicator HIn is the point at which $[In^-] = [HIn]$.

$\therefore \quad K_{In} = [H^+] = 1 \times 10^{-5}$

$\therefore \quad [H^+] = 1 \times 10^{-5}$

or pH = 5.

661 **(b)**

Follow Le-Chatelier's principle

662 **(c)**

$N_2 \quad + 3H_2 \rightleftharpoons 2NH_3$

Initial $\frac{56}{28} = 2$ $\frac{8}{2} = 4$

At $(2-x)$ (4-3x) $2x = \frac{34}{17} = 2$

moles

equilibrium mole mole

Hence, $x = 1$ mole

Hence, number of moles of N_2 at equilibrium

=2-1=1 mole

Number of moles of H_2 at equilibrium

=4-3=1 mole

Number of moles of NH_3 at equilibrium=2 moles

663 **(c)**

Na_2CO_3, on hydrolysis gives alkaline solution as the solution contains strong base and weak acid.

$$\underset{\text{White}}{Na_2CO_3} \xrightarrow{2H_2O} \underset{\text{strong base}}{2NaOH} + \underset{\text{weak acid}}{H_2CO_3}$$

664 **(c)**

Acidic buffer is a mixture of weak acid and its salt with strong base. Similarly, basic buffer is a mixture of weak base and its salt with strong acid. Hence, 50 mL 0.1 M CH_3COOH + 100 mL 0.1 M NaOH does not constitute a buffer solution because in this case millimoles of acid are less than that of strong base, which after reaction with strong base gives salt. Now, the solution contains only strong base and salt but no weak acid. Hence, no buffer is formed.

665 **(a)**

$$K_p = \frac{(p_{CO})^2}{(p_{CO_2})} = \frac{8 \times 8}{4} = 16 \text{ atm.}$$

667 **(a)**

$Ag_2CrO_4 \rightarrow 2Ag^+ + CrO_4^{2-}$

$s \qquad 2s \qquad s$

$K_{sp} = (2s)^2 s = 4s^3$

$$s = \left(\frac{K_{sp}}{4}\right)^{1/3} = \left(\frac{32 \times 10^{-12}}{4}\right)^{1/3} = 2 \times 10^{-4} \text{M}$$

668 **(c)**

$2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$

$$K = \frac{[NO]^2[O_2]}{[NO_2]^2} = 2 \times 10^{-6}$$

$4NO(g) + O_2(g) \rightleftharpoons 4NO_2(g)$

$$K' = \frac{[NO_2]^4}{[NO]^4[O_2]^2}$$

$$= \frac{1}{(K)^2} = \frac{1}{(2 \times 10^{-6})^2}$$

Equilibrium constant $K' = 0.25 \times 10^{12}$

$= 2.5 \times 10^{11}$

669 **(b)**

$Mg(OH)_2 \rightleftharpoons Mg^{2+} + 2OH^-$

$K_{sp} = [Mg^{2+}][OH^-]^2$

$$[OH^-] = \sqrt{\frac{K_{sp}}{[Mg^{2+}]}}$$

$$[OH^-] = \sqrt{\frac{1.0 \times 10^{-11}}{0.001}} = 10^{-4}$$

pOH=4 and pH=10

670 **(a)**

Precipitation just starts when the product of ionic concentration is equal to K_{sp}.

$[Ag^+][Cl^-] = K_{sp\text{AgCl}}$. This is the limiting case at which precipitation just starts or no precipitation up to this limit.

671 **(a)**

Such solutions are acidic and methyl orange act on acidic pH

672 **(c)**

$[Cu(NH_3)_4]SO_4 \longrightarrow [Cu(NH_3)_4]^{2+} + SO_4^{2-}$; The complex ion is not ionised.

673 **(b)**

Given density of formic acid = 1.22 g/cm^3

∴ Weight of formic acid in 1 litre solution = 1.22×10^3 g

Thus, $[HCOOH] = \frac{1.22 \times 10^3}{46} = 26.5\,M$

Since in case of auto ionisation $[HCOOH_2^+] = [HCOO^-]$

and $[HCOO^-][HCOOH_2^+] = 10^{-6}$

∴ $\qquad [HCOO^-] = 10^{-3}$

Now % dissociation of HCOOH

$$= \frac{[HCOO^-] \times 100}{[HCOOH]} = \frac{10^{-3}}{26.5} \times 100 = 0.004\%$$

674 **(b)**

A buffer of H_2CO_3 and HCO_3^- is formed.

675 **(a)**

$c\alpha^2 = K_a \quad \therefore \alpha = \sqrt{\left[\frac{K_a}{c}\right]}$ or $\alpha = \frac{1}{\sqrt{c}}$.

676 **(a)**

$[H^+] = K_a.C$

Given, $[H^+]_{HCOOH} = [H^+]_{CH_3COOH}$

$K_a.C = K'_a C'$

$\Rightarrow \quad 1.8 \times 10^{-4} \times 0.001 = 1.8 \times 10^{-5} \times C'$

$\therefore \quad C' = 0.01\text{M}$

677 **(a)**

$2Ag_2O(s) \rightleftharpoons 4Ag(s) + O_2(g)$

$K_p = p_{O_2}$

(∵ Ag and Ag_2O are solids)

678 **(c)**

$MX_2 \rightleftharpoons M^{2+} + 2X^-$

$s \qquad 2s$

$K_{sp} = [M^{2+}][X^-]^2$

If solubility be s then

$$K_{sp} = (s)(2s)^2 = 4s^3$$
$$4s^3 = 4 \times 10^{-12}$$
$$\therefore \quad s = 1 \times 10^{-4}\ \text{M}$$
$$\therefore \quad M^{2+} = s = 1 \times 10^{-4}\text{M}$$

679 **(d)**

$CaCO(s) \rightleftharpoons CaO(s) + CO_2(g)$

The equilibrium constant for this reaction is given by $K = [CO_2]$(as $CaCO_3$ and CaO are solid).

Hence, to get more CO_2, we need to pump out continuously the CO_2 gas.

680 **(b)**

H_2O can accept H^+ or donate H^- .

681 **(b)**

$k_f = 1.1 \times 10^{-2}, k_b = 1.5 \times 10^{-3}$

$$K_c = \frac{k_f}{k_b} = \frac{1.1 \times 10^{-2}}{1.5 \times 10^{-3}} = 7.33$$

682 **(b)**

HCl is metabolically produced in human body.

683 **(b)**

$$\underset{\text{Pressure at equilibrium}}{NH_4HS(s)} \rightleftharpoons \underset{P}{NH_3(g)} + \underset{P}{H_2S(g)}$$

$\therefore$ Total pressure at equilibrium $= 2P = 1.12$ atm

$$P = 1.12/2\ \text{atm}$$

$\because K_p = P'_{NH_3}$ x P'_{H_2S}

$$\therefore K_p = \frac{1.12}{2} \times \frac{1.12}{2} = 0.3136\ \text{atm}^2$$

684 **(c)**

NaCl does not hydrolyse.

685 **(b)**

The substance which can donate a pair of electrons is called Lewis base.

Amines contain lone pair of electron on nitrogen atom, so behave as Lewis base.

686 **(c)**

Both possess the tendency to accept proton.

687 **(a)**

It is an acidic solution with pH < 7 as NaCl solution is neutral but HCl is a strong acid

688 **(a)**

Methyl orange will give colour only when more of weak acid is used, *i.e.*, more milli equivalents are added. Thus, $\frac{w}{E} \times 1000 =$ Meq. Thus, E will be lower if Meq. are more.

689 **(c)**

Among the given species, correct order of increasing acidic, strength is

$$OH^- < H_2O < NH_4^+ < HF < H_3O^+$$

OH^- is a basic (i.e., it tends to gain a proton) and hence is least acidic. H_2O is neutral species. $H_3O^+$is most acidic as it readily lose proton.

690 **(b)**

Presence of lone pair of electron and they donate two electron pairs

691 **(c)**

$Na_2CO_3 + 2H_2O \rightleftharpoons 2NaOH + H_2CO_3$. It is a salt of strong base and weak acid, so it is basic

692 **(d)**

BF_3 has incomplete octet and will act as Lewis acid NH_3 has lone pair of electron available for donation and thus Lewis base.

693 **(d)**

These are the characteristics of a reaction in equilibrium.

695 **(b)**

$AgCl \rightarrow Ag^+ + Cl^-$

$X \qquad X$

After NaCl is added $\qquad X \qquad X + 1 \times 10^{-4}$

That is why Ag^+ will be less

696 **(d)**

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

Molar concentration of

$[N_2O_4] = \frac{9.2}{92} = 0.1$ mol/L

In equilibrium state,

(When it 50% dissociates)

$$[N_2O_4] = 0.05\ \text{M}$$
$$[NO_2] = 0.1\ \text{M}$$
$$\because \quad K_c = \frac{[NO_2]^2}{[N_2O_4]}$$
$$\therefore \quad K_c = \frac{0.1 \times 0.1}{0.05}$$
$$= 0.2$$

697 **(a)**

$$2CO_2 \rightleftharpoons 2CO \quad + \quad O_2$$

At equili. $\quad$ 0.6 atm $\quad$ 0.4 atm $\quad$ 0.2 atm

$$\therefore \quad K_p = \frac{p_{CO}^2 \times p_{O_2}}{p_{CO_2}^2}$$
$$= \frac{(0.4)^2(0.2)}{(0.6)^2} = 0.088$$

698 **(c)**

Aqueous solution of NaCN is basic because it is a salt of strong base and weak acid

699 **(c)**

$$N_2 + 3H_2 \rightleftharpoons 2NH_3$$
$$\underset{1-x}{1} \qquad \underset{3-3x}{3} \qquad \underset{2x}{0}$$

$\therefore$ 50% mixture reacts

$$\therefore\ 1-x+3-3x=\frac{4}{2}=2$$
$$x=0.5$$
$$\therefore P_{NH_3}^1=P_T\ \times\ mf \text{ of } \mathrm{NH_3}$$
$$=\frac{P\ \times\ 2\ \times\ 0.5}{(4-0.5\ \times\ 2)}=\frac{P}{3}$$

700 **(b)**

The CH_3COOH is weaker acid than H_2SO_4. The reason is that CH_3COOH is weakly ionised in comparison with H_2SO_4.

701 **(a)**

The problem is valid only if strong acids are mixed. After mixing equal volumes of three acids, total volume = 3 V

$\therefore$ $[H^+]$ after mixing

$$=\frac{10^{-3}\times V}{3V}+\frac{10^{-4}\times V}{3V}+\frac{10^{-5}\times V}{3V}$$
$$=\frac{1.11\times10^{-3}}{3}=3.7\times10^{-4}$$

702 **(a)**

The ionisation of strong electrolytes in acetic acid, compared to water, is weak and low because acetic acid is a non-polar solvent.

703 **(d)**

Solubility of $CaF_2 =\ 2\times10^{-4}$ mol/L

Each mole of CaF_2 dissolving in H_2O gives one mole of Ca^{2+} and two moles of F^- ions.

$$\begin{array}{llll} CaF_2 \rightleftharpoons & Ca^{2+} & + & 2F^- \\ & 2\times10^{-4}\,\mathrm{M} & & 2\times2\times10^{-4}\,\mathrm{M} \end{array}$$
$$K_{sp}=[Ca^{2+}][F^-]^2$$
$$=[2\times10^{-4}][2\times2\times10^{-4}]^2$$
$$K_{sp}=3.2\times10^{11}$$

704 **(b)**

$$\alpha=\frac{D-d}{d}=\frac{104.16-62}{62}$$
$= 0.68 = 68\%$

705 **(d)**

$HCOO^-$ is base having conjugate acid HCOOH (a monobasic acid).

706 **(a)**

$$\begin{array}{llll} & NH_4HS(s) \rightleftharpoons & NH_3(g) + & H_2S(g) \\ \text{Initially} & 1 & 0.5 & 0 \\ \text{At equilibrium} & (1-x) & (0.5+x) & x \end{array}$$

Total pressure at equilibrium

$$=p_{NH_3}+p_{H_2S}$$
$$=0.5+x+x=0.84$$
$$\therefore\qquad x=0.17\text{ atm}$$
$$\therefore\quad p_{NH_3}=0.50+0.17=0.67\text{ atm}$$
$$p_{H_2S}=0.17\text{ atm}$$
$$\therefore\quad K_p=p_{NH_3}.p_{H_2S}$$
$$=0.67\times0.17=0.114\text{ atm}$$

707 **(a)**

The acidic character of non-metallic oxides increases along the period.

708 **(c)**

$H_2(g)+I_2(g)\rightleftharpoons 2HI(g)$

We know that, $K_p=K_c(RT)^{\Delta n_g}$

Here, $\Delta n_g=2-2=0$

$$\therefore\qquad K_p=K_c(RT)^0=K_c$$

709 **(c)**

Lower is K_{sp}, lower is solubility of salt.

710 **(d)**

$MnS+2HCl\longrightarrow MnCl_2+H_2S$;

The dissociation of H_2S (formed) is suppressed due to the presence of HCl.

711 **(b)**

pH + pOH = 14

712 **(d)**

The problem does not have suggests about the nature of acid, *i.e.*, weak or strong. The normality will be 10^{-2} for strong acid. If weak acid, normality can be obtained only if K_a is known.

713 **(c)**

$[H^+]=1$

$\therefore \text{pH}=-\log 1=0.$

714 **(b)**

It is an exothermic reaction, hence low temperature and increasing pressure will favour forward reaction

715 **(a)**

NH_4Cl is acidic because it is a salt of weak base NH_4OH and a strong acid HCl. Thus, on hydrolysis, it gives strong acid HCl and weak base NH_4OH.

$$NH_4Cl+H_2O\rightarrow NH_4OH+HCl$$

716 **(a)**

$$\text{pH}=-\log K_a+\log\frac{[\text{C. B}]}{[\text{Acid}]};\ \therefore \text{pH}$$
$$=\text{p}K_a\left[\frac{[\text{C. B}]}{[\text{Acid}]}=1\right]$$

Find pH by $\frac{[\text{C. B}]}{[\text{Acid}]}=10, i.e., \text{pH}=\text{p}K_a+1$

717 **(c)**

For $AB_2: K_{sp}=4s^3=4\times(1.0\times10^{-5})^3=4\times10^{-15}$.

718 **(c)**

$HClO_3$ is called chloride acid.

719 **(b)**

Ag^+ is not a Lewis base as it has no lone pair of electron.

721 **(b)**

$100 \times 10^{-1} = 1000 \times N$

$\therefore \quad N_{HCl} = 10^{-2} \;\; \therefore \text{pH} = 2.$

722 **(b)**

Meq. of $HCl = 20 \times 0.1 = 2$

Meq. of $KOH = 20 \times 0.1 = 2$

Both are neutralized to give 2 Meq. of KCl (a salt of strong acid + strong base) and thus, does not hydrolyse and shows pH = 7.

723 **(d)**

For $A(s) \rightleftharpoons 2B(\text{g}) + 3C(\text{g})$

$\therefore K_c = [C]^3[B]^2$; if $[C]$ becomes twice,

Then let conc. of B becomes B', then

$$K_c = [2C]^3\,[B']^2$$

Or $\quad [C]^3.[B\,]^2 = [2C]^3.[B']^2$

$\therefore \quad \frac{[B']}{[B]} = \frac{1}{8} = \frac{1}{2\sqrt{2}}$

724 **(d)**

The acidic character is $HCl > HF > H_2S > H_2O$ and thus, basic character of conjugate base will be $Cl^- < F^- < HS^- < OH^-$.

725 **(c)**

We know that,

$$\text{pH} = \text{p}K_a + \log\frac{[\text{salt}]}{[\text{acid}]}$$

$$5.5 = 4.5 + \log\frac{[\text{salt}]}{[0.1]}$$

$[\text{salt}] = 1.0$ M

727 **(a)**

$CaF_2(s) \rightleftharpoons Ca^{2+}(aq) + 2F^-(aq)$

$[F^-] = 2[Ca^{2+}]$

$= 2 \times 3.3 \times 10^{-4}$

$= 6.6 \times 10^{-4}$ M

$K_{sp} = [Ca^{2+}][F^-]^2$

$= (3.3 \times 10^{-4})(6.6 \times 10^{-4})^2$

$= 1.44 \times 10^{-10}$

728 **(b)**

Buffer solutions do not change their pH on addition of small amount of acid or base.

729 **(b)**

Blood is alkaline having pH between 7.0 to 7.4.

730 **(c)**

$A + B \rightleftharpoons C$

$$K = \frac{[C]}{[A][B]}$$

$$= \frac{\text{mol L}^{-1}}{\text{mol L}^{-1} \times \text{mol L}^{-1}} = (\text{mol L}^{-1})^{-1} = \text{mol}^{-1}\text{L}$$

731 **(c)**

Stronger is acid, weaker is its conjugate base and *vice-versa*.

732 **(a)**

The salt hydrolysis in each case occurs except NaW because its pH = 7. Thus, HW is strongest acid. More is the pH of salt solution, weaker is its acid part.

733 **(a)**

Follow Le-Chatelier's principle.

734 **(c)**

Hg exist as Hg_2^{2+} and not as Hg^+. Thus $K_{sp} = [Hg_2^{2+}][I^-]^2$.

735 **(c)**

Meq. of $HCl = 40 \times 0.1 = 4$

Meq. of $NaOH = 10 \times 0.45 = 4.5$

$\therefore$ Meq. of NaOH left = 0.5

Now, $[OH^+] = \frac{0.5}{50} = 10^{-2}$

$\therefore \quad \text{pOH} = 2$ and $\text{pH} = 12$

736 **(b)**

$K_p = K_c \text{ x } (RT)^{\Delta n}$.

Where Δn= mole of products – mole of reactants.

737 **(b)**

$\text{pH} = \text{pK}_a + \log\frac{[\text{Salt}]}{[\text{Acid}]}$ if $\frac{[\text{Salt}]}{[\text{Acid}]}$ increases by 10 times $\text{pH} = \text{pK}_a + 1$.

738 **(b)**

$NaOH = [OH^-] = 10^{-3}$

$[H^+][OH^-] = 10^{-14}$

$[H^+] = 10^{-11}$

$\text{pH} = -\log[H^+]$

$= -\log[10^{-11}] = 11$

$HCl(aq) = [H^+] = 10^{-3}$

$\text{pH} = -\log[10^{-3}] = 3$

$NaCl(aq)$ =Neutral; $[H^+] = [OH^-] = 10^{-7}$

ie, pH = 7

739 **(d)**

$$K_1 = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$K_2 = \frac{[NO]^2}{[N_2][O_2]}$$

$$K_3 = \frac{[H_2O]}{[H_2][O_2]^{1/2}}$$

$\therefore$ For $NH_3 + \frac{5}{2}O_2 \rightarrow 2NO + 3H_2O$

$$K = \frac{[NO]^2[H_2O]^3}{[NH_3]^2[O_2]^{5/2}} = \frac{K_2K_3^3}{K_1}$$

741 **(d)**

Decrease of K with rise of temperature means that the forward reaction is exothermic. As the given reaction is exothermic, energy of HI is greater or stability is less than $H_2$and I_2

742 **(b)**

$BaSO_4 \rightleftharpoons Ba^{2+} + SO_4^{2-}$

Solubility product $= s \times s$

$15 \times 10^{-10} = s^2 : s = \sqrt{15 \times 10^{-10}} : s$

$= 3.9 \times 10^{-5}$

743 **(a)**

CO_2 is present in soda water bottle which increases H^+ in solution,

$H_2O + CO_2 \longrightarrow H_2CO_3 \rightleftharpoons H^+ + HCO_3^-$.

744 **(a)**

On increasing temperature, equilibrium will shift in forward direction due to decrease in intermolecular forces of solid

745 **(d)**

$CaCl_2$ is a salt of strong acid and strong base.

746 **(c)**

$$K_a = \frac{[H^+][In^-]}{[HIn]}$$

$$\text{or } 3 \times 10^{-5} = \frac{[H^+] \times 75}{25}$$

$$\therefore \quad [H^+] = 1 \times 10^{-5} M$$

748 **(b)**

$[OH^-] = 1 \times 10^{-5}$

$$pOH = -\log[OH^-]$$
$$= -\log[1 \times 10^{-5}]$$
$$pOH = 5$$
$$pH + pOH = 14$$
$$pH = 14 - pOH$$
$$= 14 - 5$$
$$pH = 9$$

750 **(d)**

It is definition of Levelling effect.

751 **(d)**

$$N = \frac{75 \times \frac{1}{5} - 25 \times \frac{1}{5}}{100} = 15 - 5 = \frac{10}{100} = 0.1$$

$pH = -\log[H^+] = -\log[0.1] = 1$

752 **(c)**

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g);$

$\Delta H = -93.6 \text{ kJ mol}^{-1}$

This reaction is exothermic therefore the concentration of NH_3 can be increased by lowering the temperature, high pressure $(\Delta n < 0)$ excess N_2 and H_2.

753 **(c)**

e.g., $K_4Fe(CN)_6$ does not give test for Fe^{3+} ions.

754 **(c)**

CH_3COONa in water gives alkaline solution due to hydrolysis of acetate ions. NH_4Cl gives acidic solution due to hydrolysis of NH_4^+ ions. Also NH_4OH is a weak base due to less dissociation.

755 **(c)**

$HPO_4^{2-} + H_2O \rightleftharpoons H_2PO_4^{2-} + OH^-$

$HPO_4^{2-} + H_2O \rightleftharpoons PO_4^{3-} + H_3O^+$

$H_2PO_2^-$ is a conjugate base of H_3PO_2 (a monobasic acid) and does not give H^+, HPO_3^{2-} is a conjugate base of $H_2PO_3^-$ and does not ionise further, since H_3PO_3 is a dibasic acid.

756 **(d)**

Alkanes are not acidic and thus, R^- is strongest base.

757 **(a)**

$$pH = -\log K_a + \log \frac{[\text{Conjugate base}]}{[\text{Acid}]}$$

758 **(a)**

$[H^+] = \sqrt{K_a \cdot C}$

Where, C =initial concentration of the weak acid

$$C = \frac{[H^+]^2}{K_a}$$

$$= \frac{(3.4 \times 10^{-4})^2}{1.7 \times 10^{-5}}$$

$C = 6.8 \times 10^{-3}$ M

759 **(d)**

$$\underset{2\text{ mol}}{2Na} + \underset{2\text{ mol}}{2H_2O} \rightarrow \underset{2\text{ mol}}{2NaOH} + H_2$$

Given, $\frac{0.023}{23}$ mol $\frac{100}{22400}$ mol

$= 1 \times 10^{-3}$mol $= 4.46 \times 10^{-3}$ mol

Thus, Na is the limiting reagent and decide the amount of NaOH formed.

$\because$ 1 mole Na give NaOH = 1 mol

$\therefore$ 1×10^{-3}mole Na will give NaOH

$= 1 \times 10^{-3}$ mol

Concentration of

$$[OH^-] = \frac{1 \times 10^{-3} \times 1000}{100} = 1 \times 10^{-2}$$

$$pOH = -\log[OH^-]$$
$$= -\log(1 \times 10^{-2})$$
$$= 2$$
$$pH = 14 - 2 = 12$$

760 **(b)**

1 mole of N_2 reacts with 3 mole of H_2 thus, for

$$\underset{\underset{(a-x)}{a}}{N_2} + \underset{\underset{(a-3x)}{a}}{3H_2} \rightleftharpoons \underset{2x}{2NH_3}; (a-x) > (a-3x)$$

761 **(a)**

$$A + 2B \rightleftharpoons 2C + D$$

$$\begin{matrix} \text{a} & \text{b} & \text{o} & \text{o} \\ (a-x) & (b-2x) & 2x & x \end{matrix}$$

Given, $2x = 0.2$, Also, a=1.1

$x = 0.1 \; b = 2.2$

$$\therefore K_c = \frac{2\,x^2}{(a-x)(b-2x)}$$

$$= \frac{(2 \times 0.1)^2 \times 0.1}{(1.1-0.1)(2.2-0.2)^2} = 0.001$$

762 **(a)**

$$\text{pH} = \text{p}K_a + \log\frac{[\text{Conjugate base}]}{[\text{Acid}]}$$

$\text{pH} = \text{p}K_a + \log 1$ ($\because$ 50% neutralization)

$\therefore \quad \log \text{H}^+ = -\log 2 \times 10^{-4}$

or $\quad \text{H}^+ = 2 \times 10^{-4}$

763 **(a)**

K_2S shows alakaline nature due to hydrolysis of S^{2-} ions,

$S^{2-} + H_2O \rightleftharpoons HS^- + OH^-$.

764 **(b)**

B.pt. increases with increase in pressure.

766 **(b)**

Na_2CO_3 salt gives strong base and weak acid on dissolving in water. Hence, it produces an alkaline solution.

$$Na_2CO_3 + H_2O \rightarrow \underset{\text{Strong base}}{NaOH} + \underset{\text{Weak acid}}{H_2CO_3}$$

767 **(a)**

Addition of some concentration HCl does not change pH.

768 **(d)**

CO is neutral.

769 **(c)**

$2SO_2 + O_2 \rightleftharpoons 2SO_3$; $K = 278$

$SO_3 \rightleftharpoons SO_2 + \frac{1}{2}O_2$; $K' = \frac{1}{\sqrt{K}}$

$K' = \frac{1}{\sqrt{K}} = \frac{1}{\sqrt{278}} = 6 \times 10^{-2}$

770 **(b)**

The reaction shows lower $K_{eq.}$ value in forward direction, *i.e.*, more $K_{eq.}$ in backward direction or HCN decomposes salt of HNO_2.

771 **(d)**

Initially $[CH_3COONa] = 0.1$ mol

$[CH_3COOH] = 0.1$ mol

when 0.1 mol CH_3COONa is added.

$[CH_3COONa] = 0.1 + 0.1 = 0.2$ mol

$$\text{pH} = \text{p}K_a + \log\frac{[\text{salt}]}{[\text{acid}]}$$

$$= \text{p}K_a + \log\frac{0.2}{0.1}$$

$$= \text{p}K_a + \log 2$$

772 **(c)**

For binary salts (like AgCl, AgBr).

$$s = \sqrt{K_{\text{sp}}}$$

$\therefore$ Solubility of AgCl $= \sqrt{1.8 \times 10^{-10}}$

$= 1.35 \times 10^{-7}$ mol/L

Solubility of AgBr $= \sqrt{5.0 \times 10^{-13}}$

$= 7.1 \times 10^{-7}$ mol/L

For, $Ag_2CrO_4, K_{\text{sp}} = 4s^3$

$\therefore$ Solubility of Ag_2CrO_4

$$= \sqrt[3]{\frac{K_{\text{sp}}}{4}}$$

$$= \sqrt[3]{\frac{2.4 \times 10^{-12}}{4}}$$

$$= \sqrt[3]{600 \times 10^{-15}}$$

$$= 8.44 \times 10^{-5} \text{ mol/L}$$

As Ag_2CrO_4 has maximum solubility, it will give maximum Ag^+ ions in solution. Hence, it will be used.

773 **(a)**

Ostwald's dilution law is valid only for weak electrolytes.

774 **(b)**

$[Zn^{2+}][S^{2-}] = 10^{-1} \times 8.1 \times 10^{-19} = 8.1 \times 10^{-20} > K_{\text{sp}}$of ZnS (3×10^{-22})

$[Cu^{2+}][S^{2-}] = 10^{-2} \times 8.1 \times 10^{-19} = 8.1 \times 10^{-21} > K_{\text{sp}}$of CuS (8×10^{-36})

776 **(b)**

Gas + Liquid $\rightleftharpoons$ Solution. An increase in P will favour forward reaction.

778 **(b)**

$K_{a_1} > K_{a_2}$.

779 **(d)**

$$\begin{matrix} A & + & 2B & \rightleftharpoons & 2C & + & D \\ \text{a} & & \frac{3}{2}a & & \overset{0}{x} & & \overset{0}{x} \\ (a-x) & & \left(\frac{3}{2}a-2x\right) & & & & \end{matrix}$$

Given, $a - x = 2x$

$\therefore x = a/3$

Now, $K_c = \frac{[C]^2[D]}{[A][B]^2} = \frac{\left(\frac{2a}{3}\right)^2 \times \frac{a}{3}}{\left(a-\frac{a}{3}\right)\left(\frac{3a}{2}-\frac{2a}{3}\right)^2} = 0.32$

780 **(b)**

$Al_2(SO_4)_3 \rightleftharpoons 2Al^{3+} + 3SO_4^{2-}$

$K_{\text{sp}} = [Al^{3+}]^2[SO_4^{2-}]^3$

781 **(a)**

$[H^+]$ from weak acid,

$$= c\cdot\alpha = c\sqrt{\frac{K_a}{c}} = \sqrt{K_a c} = \sqrt{10^{-5}\times 0.1}$$

$$= 10^{-3}$$

$\therefore \quad pH = 3$

782 **(a)**

$[H^+] = 10^{-10}M$

$\therefore \quad pH = 10$

$\therefore \quad pOH = 4$

783 **(b)**

$H^+ + OH^- \longrightarrow H_2O$

$\Delta H = -13.7$ kcal.

784 **(a)**

$$pH = -\log(5\times10^{-10}) + \log\left[\frac{5\times V}{V+10}\Big/\frac{10\times 2}{V+10}\right]$$

$$9 = -\log(5\times10^{-10}) + \log\frac{V}{4}$$

On solving, $V = 2$ mL

785 **(b)**

$$K_1 = \frac{[H^+][H_2PO_4^-]}{[H_3PO_4]}; K_2 = \frac{[H^+][HPO_4^{2-}]}{[H_2PO_4^-]}$$

$K_3 = \frac{[H^+][PO_4^{3-}]}{[HPO_4^{2-}]}$ Multiplying these three

$$K_1 \times K_2 \times K_3 = \frac{[H^+]^3[PO_4^{3-}]}{[H_3PO_4]}$$

786 **(a)**

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$

Initial conc. $\quad \frac{4}{4} \quad 0 \quad 0$

Equili. conc. $\quad \frac{2}{4} \quad \frac{2}{4} \quad \frac{2}{4}$

$$K = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$= \frac{2\times2\times4}{4\times4\times2} = \frac{1}{2} = 0.5$$

787 **(b)**

Follow Le-Chatelier's principle.

788 **(b)**

Let the solubility of Ag_2S is s.

$$\underset{s}{Ag_2S} \rightleftharpoons \underset{2s}{2Ag^+} + \underset{s}{S^{2-}}$$

Na_2S, being a strong electrolyte, dissociates completely and provides

$[S^{2-}]$=0.1 M

$\therefore \quad [Ag^+] = s$

$[S^{2-}] = (s + 0.1)$ M

$K_{sp} = [Ag^+]^2[S^{2-}]$

$= (2s)^2(s + 0.1)$

$= 4s^3 + 0.4s^2$

$\Rightarrow \quad 10^{-17} = 0.4s^2$

[$\because$ Higher powers are neglected.]

$\therefore \quad s = 5\times10^{-9}$ mol L^{-1}

789 **(a)**

$$SO_2 + \frac{1}{2}O_2 \rightleftharpoons SO_3$$

5 mol $\quad$ 5 mol $\quad$ 0 $\quad$ initially

$(5-x)\left(5-\frac{1}{2}x\right)\ x \quad$ at equilibrium

$$x = \frac{60}{100}\times 5 = 3$$

Total number of moles $= (5-x) + \left(5-\frac{1}{2}x\right) + x$

$$= (5-3) + \left(5-\frac{1}{2}\times3\right) + 3$$

$= 8.5$

790 **(a)**

$s = \sqrt{K_{sp}} = (2.5\times10^{-9})^{1/2}$

$= 5\times10^{-5}$ mol litre^{-1}

$\therefore \frac{w}{128} = 5\times10^{-5}$

$\therefore w = 6.4\times10^{-3}$g.

791 **(b)**

In the iodometric estimation in laboratory, this process is involved

$MnO_4^- + H^+ + I^- \longrightarrow Mn^{2+} + I_2$

$I_2 + S_2O_3^{2-} \longrightarrow S_4O_6^{2-} + I^-$

792 **(c)**

$K_1 = \frac{[NO_2]}{[NO][O_2]^{1/2}} \quad$ ...(i)

$K_2 = \frac{[NO]^2[O_2]}{[NO_2]^2} \quad$ ...(ii)

$$\therefore \frac{1}{K_2} = \frac{[NO_2]^2}{[NO]^2[O_2]}$$

or, $\frac{1}{\sqrt{K_2}} = \frac{[NO_2]}{[NO][O_2]^{1/2}} \quad$ ...(iii)

From Eqs.(i) and (iii),

$$K_1 = \frac{1}{\sqrt{K_2}}$$

$$\therefore K_2 = \frac{1}{K_1^2}$$

793 **(a)**

g equivalent of $(NH_4)_2SO_4 = \frac{100}{1000}\times\frac{1}{10}\times 66 = 0.66$

g equivalent of$Na_2CO_3\cdot H_2O = \frac{0.62}{62} = 0.01$

left $(NH_4)_2SO_4$ is $0.66 - 0.01 = 0.65$

$(NH_4)_2SO_4$ is a salt of strong acid and weak base

794 **(b)**

$K_p = K_c(RT)^{\Delta n}$

$K_p = K_c$ only when $(RT)^{\Delta n} = 0$

(a)$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$\Delta n = n_p - n_R$

$= 2-1$

$= 1$

$\therefore \quad \Delta K_p \neq K_c$

(b) $N_2 + O_2 \rightleftharpoons 2NO$

$\Delta n = 2 - 2$

$= 0$

$\therefore \quad K_p = K_c$

(c) $N_2 + 3H_2 \rightleftharpoons 2NH_3$

$\Delta n = 2 - 4$

$= -2$

$\therefore \quad \Delta K_p \neq K_c$

(d) $2SO_3 \rightleftharpoons 2SO_2 + O_2$

$\Delta n = 3 - 2 = 1$

$\therefore \quad \Delta K_p \neq K_c$

795 **(a)**

$K_{sp} = 1.8 \times 10^{-10} = 4 \times 10^{-3} \times [Cl^-]$

$[Cl^-] = 4.5 \times 10^{-8}$ mol litre^{-1} .

796 **(d)**

$H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)$

1 0 0 Initial

$(1 - \alpha)$ α $\alpha/2$ At equilibrium

Total moles $= (1 - \alpha) + \alpha + \frac{\alpha}{2} = 1 + \frac{\alpha}{2}$

Partial pressure of $H_2O = p\left(\frac{1-\alpha}{1+\frac{\alpha}{2}}\right)$

Partial pressure of $H_2 = p\left(\frac{\alpha}{1+\frac{\alpha}{2}}\right)$

Partial pressure of $O_2 = p\left(\frac{\alpha}{2+\alpha}\right)$

$$K_p = \frac{pH_2 . pO_2^{1/2}}{pH_2O}$$

$$K_p = \frac{\alpha^{3/2} p^{1/2}}{(1-\alpha)(2+\alpha)^{1/2}}$$

797 **(a)**

For weak electrolytes, according to Ostwald's dilution law

$\alpha = \sqrt{KV}$

Here, $\alpha = 0.01\% = 0.0001 = 1 \times 10^{-4}$

$V = \frac{1}{C} = \frac{1}{1.0} = 1L$

$\therefore \quad K_a = \frac{\alpha^2}{V} = \frac{(1 \times 10^{-4})^2}{1} = 1 \times 10^{-8}$

798 **(a)**

Given, $K_b = 1.8 \times 10^{-5}$, $[NH_3] = 0.1$ M

$NH_3 + H_2O \rightleftharpoons NH_4^+ + OH^-$

Let concentration of $[NH_4^+] = [OH^-] = x$

$$K_b = \frac{[NH_4^+][OH^-]}{[NH_3]}$$

$$= \frac{x \times x}{0.1}$$

or $\quad 1.8 \times 10^{-5} = \frac{x^2}{0.1}$

or $\quad x^2 = 1.8 \times 10^{-6}$

$\therefore \quad x = 1.35 \times 10^{-3}$

$\therefore \quad [OH^-] = 1.35 \times 10^{-3}$

$pOH = -\log[OH^-]$

$= -\log(1.35 \times 10^{-3})$

$= 2.87$

$pH = 14 - pOH = 14 - 2.87 = 11.13$

799 **(d)**

$\because$ Relative strength of weak acids $= \sqrt{\left(\frac{K_{a_1}}{K_{a_2}} \times \frac{c_1}{c_2}\right)}$

Assume c_1 and c_2 are same (Although not given)

$\therefore$ Relative strength $= \sqrt{\left(\frac{K_{a_1}}{K_{a_2}}\right)} = \sqrt{\left(\frac{2.1 \times 10^{-4}}{1.1 \times 10^{-5}}\right)}$

Relative strength for HCOOH to $CH_3COOH =$ 4.36 : 1 .

800 **(b)**

According to Arrhenius concepts acids are those substances which give proton in aqueous solution.

$\therefore$ Gaseous HCl is not an Arrhenius acid.

801 **(c)**

$CO_2(g) + 2H_2O(g) \rightarrow CH_4(g) + 2O_2(g)$

According to Le-Chatelier's principle, addition of temperature shifts a endothermic reaction towards right. The addition of temperature to the above reaction will cause it to right, hence it is an endothermic reaction. ($\Delta H = +$ve).

802 **(b)**

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

1 0 0

$1-\alpha$ α α

$\therefore K_p = \frac{\alpha^2}{(1-\alpha)}\left[\frac{P}{1+\alpha}\right] = \frac{\alpha^2 P}{1-\alpha^2}$

Or $\alpha = \sqrt{\frac{K_p}{P}}$ if $1 - \alpha^2 = 1$

803 **(b)**

$K_{sp} = 4s^3$ or $s = \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{4 \times 10^{-12}}{4}} = 10^{-4}$

804 **(b)**

$\Delta G = 0$ at equilibrium

805 **(a)**

$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$

1 0 0

$p \qquad\qquad p$ At equilibrium

Given,

$$p + p = 100 \text{ atm}$$
$$2p = 100 \text{ atm}$$
$$p = 50 \text{ atm}$$
$$K_p = p_{\mathrm{NH_3}}.p_{\mathrm{H_2S}}$$
$$= 50 \times 50 = 2500 \text{atm}^2$$

806 **(c)**

AX_2 is ionised as follows

$$\underset{S \text{ mol L}^{-1}}{AX_2} \rightleftharpoons \underset{S}{A^{2+}} + \underset{2S}{2X^-}$$

Solubility product of AX_2

$$(K_{\mathrm{sp}}) = [A^{2+}][X^-]^2 = S \times (2S)^2 = 4S^3$$

$\therefore$ K_{sp} of $AX_2 = 3.2 \times 10^{-11}$

$\therefore$ $3.2 \times 10^{-11} = 4S^3$

$S^3 = 0.8 \times 10^{-11} = 8 \times 10^{-11}$

Solubility $= 2 \times 10^{-4}$ mol/L

807 **(b)**

$$s \text{ of } \mathrm{Ag_2SO_4} = \left[\frac{K_{sp}}{4}\right]^{1/3}$$
$$= \left[\frac{5.5 \times 10^{-5}}{4}\right]^{1/3}$$
$$= 2.39 \times 10^{-2}\, M$$
$$s \text{ of } \mathrm{AgBrO_3} = \sqrt{K_{sp}} = (2 \times 10^{-5})^{1/2}$$
$$= 4.4 \times 10^{-3}\, M.$$

808 **(a)**

Base + $\mathrm{H^+} \longrightarrow$ Conjugate acid.

809 **(c)**

e.g., $\mathrm{CuSO_4}$ is blue because $\mathrm{Cu^{2+}}$ ions are blue; $\mathrm{CuCr_2O_7}$ is green because $\mathrm{Cu^{2+}}$ is blue and $\mathrm{Cr_2O_7^{2-}}$ is orange yellow.

810 **(b)**

pH of HCl = 2 $\therefore$ [HCl] $= 10^{-2}M$

pH of NaOH = 12 $\therefore$ [NaOH] $= 10^{-2}M$

$$\begin{array}{lccccccc} & \mathrm{HCl} & + & \mathrm{NaOH} & \longrightarrow & \mathrm{NaCl} & + & \mathrm{H_2O} \\ \text{Meq.before reaction} & 200\times10^{-2} = 2 & & 300\times10^{-2} = 3 & & 0 & & 0 \\ \text{Meq.after reaction} & 0 & & 1 & & 2 & & 2 \end{array}$$

$\therefore$ $[\mathrm{OH^-}]$ left from NaOH $= \frac{1}{500} = 2 \times 10^{-3}M$

$\therefore$ pOH $= -\log \mathrm{OH^-} = -\log 2 \times 10^{-3}$

$\therefore$ pOH = 2.6989

$\therefore$ pH = 11.3010

811 **(d)**

$\Delta G^0 = -2.303\, RT \log K_p$;

$1.7 = -2.303 \times 8.314 \times 10^{-3} \times 298 \log K_p$

$\therefore K_p = 0.5$

813 **(c)**

Aprotic solvents are those from which hydrogen ion or $\mathrm{OH^-}$ cannot be derived.

814 **(a)**

$$K_c = \frac{k_f}{k_b}$$
$$\therefore \quad 20 = \frac{10}{K_b}$$
$$\therefore \quad k_b = \frac{1}{2} = 0.5$$

815 **(d)**

For the reversible reaction,

$\mathrm{N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)}$

$$\Delta n_g = 2 - (1 + 3)$$
$$= 2 - 4 = -2$$
$$R = 0.0821 \text{ L atm K}^{-1}\text{mol}^{-1}$$
$$T = 500 + 273 = 773 \text{ K}$$
$$K_p = K_c(RT)^{\Delta n_g}$$
$$K_p = K_c \times (RT)^{-2}$$

or $\qquad K_c = \frac{K_p}{(RT)^{-2}}$

$$= \frac{1.44\times10^{-5}}{(0.082\times773)^{-2}}$$

or $\qquad 1.44 \times 10^{-5}/(0.082 \times 773)^{-2}$

816 **(a)**

$$[\mathrm{H^+}] = \frac{10^{-5} \times V + 10^{-3} \times V}{2V}$$
$$= \frac{1.01 \times 10^{-3}}{2}$$

$\therefore$ pH = 3.2967

817 **(c)**

$$K_a = \frac{[\mathrm{H_3O^+}][\mathrm{F^-}]}{[\mathrm{HF}][\mathrm{H_2O}]}$$

and $\quad K_b = \frac{[\mathrm{HF}][\mathrm{OH^-}]}{[\mathrm{F^-}][\mathrm{H_2O}]}$

$\therefore K_a \times K_b = [\mathrm{H_3O^+}][\mathrm{OH^-}] = K_w.$

818 **(b)**

$[\mathrm{H^+}] = 10^{-\mathrm{pH}} = 10^{-4}$ M

819 **(c)**

Because pH = 8 shows basic nature but HCl is a strong acid

820 **(a)**

$[\mathrm{Ag^+}]^2[\mathrm{CrO_4^2}] = K_{\mathrm{sp}}$ or $K_{\mathrm{sp}} = (2S)^2 \times S = 4S^3$.

821 **(b)**

$$K_c = \frac{K_f}{K_b} = \frac{2.38 \times 10^{-4}}{8.15 \times 10^{-5}} = 2.92$$

822 **(c)**

pH $= 3.82 = -\log[\mathrm{H^+}]$

$\therefore \quad [\mathrm{H^+}] = 1.5 \times 10^{-4}M.$

823 **(a)**

$\mathrm{CH_3{-}CH_3}$ is neutral or least acidic and thus, its conjugate base should be strongest.

824 **(d)**

K_{sp} of Na_2S is very high.

826 **(c)**

An increase H^+ favours the backward reaction.

828 **(a)**

$K_p = K_c(RT)^{\Delta n_g}$

$\Delta n_g = 1 - 1.5 = -0.5$

$K_p = K_c(RT)^{-1/2} = \frac{K_c}{(RT)^{1/2}}$

$\therefore \quad \frac{K_c}{K_p} = (RT)^{1/2}$

829 **(a)**

For the reaction, we know that

$$K_p = K_c(RT)^{\Delta n_g}$$

where, Δn_g = Number of gaseous moles of product – Number of gaseous moles of reactant

Hence, if $K_p > K_c$, then Δn must be positive. It means that there is a decrease in volume of reaction, hence low pressure will favour the forward reaction.

830 **(b)**

0.05 M $Ba(OH)_2$ solution

$$\cong 2 \times 0.05 \text{ N } Ba(OH)_2$$
$$\cong 0.10 \text{ N } Ba(OH)_2$$

$\therefore \quad pOH = -\log[OH^-]$

$= -\log(0.10) = 1$

$pH = 14 - pOH$

$= 14 - 1 = 13$

831 **(d)**

$pH = 12 \;\therefore pOH = 2$

$\therefore \quad [OH^-] = 10^{-2}$

Now $\quad Ba(OH)_2 = Ba^{2+} + 2OH^-$

$\therefore \quad K_{sp} = [Ba^{2+}][OH^-]^2$

$= \left[\frac{10^{-2}}{2}\right][10^{-2}]^2 \quad \because [Ba^{2+}]$

$= \frac{1}{2} \times [OH^-]$

$= 5 \times 10^{-7}$.

832 **(b)**

HSO_4^- is the conjugate base of H_2SO_4.

$$\underset{\text{acid}}{HSO_4^-} \rightleftharpoons \underset{\text{conjugate base}}{HSO_4^-} + H^+$$

833 **(c)**

$K_p = K_c(RT)^{\Delta ng}$

Here, $\Delta n_g = -1$ and $K_c = 26$

$R = 0.0812, T = 250 + 273 = 523$ K

$K_p = 26 \times (0.0812 \times 523)^{-1} = 0.605 = 0.61$

835 **(d)**

NaCN (4 millimole) and HCl (2 millimole) on reaction give 2 millimole of HCN and 2 millimole of NaCN are left which acts as buffer.

837 **(a)**

Phenolphthalein furnishes H^+ and phenolphthalein anion is solution.

838 **(c)**

$Hg_2I_2 \rightleftharpoons Hg_2^{2+} + 2I^-$

$K_{sp} = [Hg_2^{2+}][I^-]^2$

839 **(d)**

According to law of mass action, at a given temperature the rate of reaction at a particular instant is proportional to the product of active masses of the reactants at that instant raised to powers which are numerically equal to the numbers of their respective molecules.

840 **(d)**

HCl is accepting proton in HF medium and acts as weak base .

841 **(a)**

$$\underset{\substack{1 \\ 1-x}}{2AB_2(g)} \rightleftharpoons \underset{\substack{0 \\ x}}{2AB(g)} + \underset{\substack{0 \\ \frac{x}{2}}}{B_2(g)}$$

$\therefore \quad K_p = \frac{x^2 .x}{2(1-x)^2}\left[\frac{P}{1+\frac{x}{2}}\right]^1$

x being small $\therefore 1 - x \approx 1$ *and* $1 + \frac{x}{2} \approx 1$

$\therefore \quad K_p = \frac{x^3.P}{2}$

842 **(d)**

According to Lewis, electron deficient species are called acids while bases are the substances which have unshared pair of electron and can donate the electron pair to the formation of coordinate bond. Hence, $H_2\ddot{O}$**:** is a Lewis base while BF_3, $AlCl_3$ and SO_2 are Lewis acids.

843 **(b)**

0.1 M weak acid (HQ) has pH = 3

$\therefore [H^+] = C\alpha = 10^{-3}$

$\therefore \quad \alpha = 10^{-2} \qquad (\because C = 10^{-1})$

Now for weak acid,

$K_a = C\alpha^2 = C\alpha \cdot \alpha = 10^{-3} \times 10^{-2} = 10^{-5}$

844 **(b)**

So that only II group radicals are precipitated, otherwise III group also get precipitated.

845 **(a)**

$Mg(OH)_2 \rightleftharpoons Mg^{2+} + 2OH^-$

$(x)(2x)^2$

$K_{sp} = 4x^3$

846 **(a)**

$$K_p = \frac{(p_{SO_3})^2}{(p_{SO_2})^2(p_{O_2})} = \frac{(0.331)^2}{(0.662)^2(0.101)} = 2.5$$

Now, $K_p = \frac{(p_{SO_3})2}{(p_{SO_2})^2 P_{O_2}}$;

If $p_{SO_3} = p_{SO_2}$

Then, $p_{O_2} = \frac{1}{K_p} = \frac{1}{2.5} = 0.4$ atm

847 **(b)**

The salt with lower solubility product (AgI) will precipitate first from the solution by adding KI.

848 **(b)**

The species which can donate a lone pair of electron, are called Lewis base *e.g.*, NH_3, H_2O, Cl^- etc.

849 **(a)**

$$NH_3 + H_2O \xrightleftharpoons{K_f} NH_4^+ + OH^- ; K_b = 3.4 \text{ x } 10^{10}$$

$$NH_4^+ + H_2O \xrightleftharpoons{K_b} NH_4OH + H^+ ; K_a = 5.6 \text{ x } 10^{10}$$

$$K_{\text{base }NH_3} = \frac{K_f}{K_b} = \frac{K_w}{K_{\text{acid }NH_4^+}} (\because K_{acid} \times K_{base} = K_w)$$

or $\frac{K_f}{3.4 \times 10^{10}} = \frac{10^{-14}}{5.6 \times 10^{-10}}$

or $K_f = 6.07 \times 10^5 s^{-1}$.

850 **(b)**

K_{Sp} is characteristic constant for given electrolyte.

851 **(a)**

It is an acid-base reaction;

Rest all occurs in reverse direction.

852 **(b)**

Catalyst affect both the forward and backward reactions upto same extent, hence it, overall does not affect the equilibrium state. However, it brings equilibrium state quickly.

853 **(b)**

Given, aqueous solution of

NH_3 (weak base) $C = 0.01$ M

$\alpha = 5\% = \frac{5}{100}$

$[OH^-] = C\alpha = 0.01 \times \frac{5}{100} = 5 \times 10^{-4}$

$pOH = -\log[OH^-]$

$= \log(5 \times 10^{-4})$

$= 4 \log 10 - \log 5$

$= 4 - 0.6989$

$= 3.3010$

$\therefore$ pH $= 14 - $ pOH $= 14 - 3.3010 = 10.6990$

854 **(b)**

$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$

1 2 4

If p is the total pressure at equilibrium

$$K_p = \frac{[NH_3]^2[CO_2]}{[NH_2COONH_4]}$$

$$2.9 \times 10^{-5} = \frac{\left(\frac{2p}{3}\right)^2 \times \frac{p}{3}}{1}$$

$$2.9 \times 10^{-5} = \frac{4 \times p^3}{27}$$

$$\Rightarrow p^3 = \frac{27 \times 2.9 \times 10^{-5}}{4}$$

$= 1.9575$

$p = \sqrt[3]{1.9575} = 0.058$

855 **(c)**

$3A + 4B \rightleftharpoons 2C + 3D$

$\Rightarrow K_1 = \frac{[C]^2[D]^3}{[A]^3[B]^4}$ ...(i)

When moles of $C = 1$, the equation becomes

$\frac{3}{2}A + 2B \rightleftharpoons C + \frac{3}{2}D$

$\Rightarrow K_2 = \frac{[C][D]^{3/2}}{[A]^{3/2}[B]^2}$ ...(ii)

On comparing Eq.(i) with Eq.(ii), we get

$K_2^2 = K_1$ or $K_2 = (K_1)^{1/2}$

Hence, equilibrium extent $= \frac{1}{2}$

856 **(d)**

$C_2H_2 + H_2 \rightleftharpoons C_2H_6$

$K_p = K_c(RT)^{\Delta n}$

$\Delta n = 1 - 2 = -1$

$K_p = K_c(RT)^{-1}$

857 **(d)**

Meq. of HCl $= 75 \times \frac{1}{5} = 15$

Meq. of NaOH $= 25 \times \frac{1}{5} = 5$

$\therefore$ Meq. of HCl left $= 15 - 5 = 10$

Now [HCl]left $= \frac{10}{100} = 10^{-1}$

$\therefore$ pH $= 1$

858 **(b)**

A Lewis acid is a substance, which can accept a pair of electrons, *e.g.*, H_3O^+.

860 **(a)**

$$K_c = \frac{[NO_2]^2}{[NO]^2[O_2]} = \frac{[0.120/4]^2}{\left(\frac{0.080}{4}\right)^2\left(\frac{0.64}{4}\right)} = 14.06$$

861 **(b)**

$N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

$K_c = 0.1, K_p = K_c(RT)^{\Delta n}$

Δn =Number of gaseous product – Number of gaseous reactants

$\Delta n = 2 - 2 = 0$

$\Delta n = 0$

$\therefore\ K_p = K_c = 0.1$

862 **(c)**

For the reaction,

$$P_4(s) + 6Cl_2(g) \rightleftharpoons 4PCl_3(g)$$

At t=0 $\quad 1 \quad 1 \quad 0$

At eq. $\quad (1-x) \quad (1-6x) \quad 4x$

As $\quad (1-x) > (1-6x)$

Hence, at equilibrium $\quad [P_4] > [Cl_2]$

865 **(c)**

Dissociation of acetic acid increases as,

$CH_3COOH + NaOH \longrightarrow CH_3COONa + H_2O$

866 **(d)**

The reaction in which number of moles of reactants= number of moles of products are not effected by change in pressure or volume.

$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

$\therefore$ Number of moles of reactant = number of moles of products

2=2

$\therefore$ This reaction is not effected by change in pressure or volume.

867 **(d)**

$$AgCl \rightleftharpoons \underset{s}{Ag^+} + \underset{s}{Cl^-}$$

$K_{sp} = [Ag^+][Cl^-] = s^2$

$s = \sqrt{K_{sp}} = 1.1 \times 10^{-10} = 10^{-5}$

Similarly s for AgI is 10^{-8},

s for $PbCrO_4$is 2 $\times 10^{-7}$and s for $Ag_2CO_3$is 1.26 $\times 10^{-4}$.

Most soluble $-$ Ag_2CO_3, least soluble AgI

868 **(d)**

Given, concentration of NaOH $= 10^{-10}$M

$$\underset{10^{-10}}{NaOH} \rightarrow \underset{10^{-10}}{Na^+} + \underset{10^{-10}}{OH^-}$$

$\therefore$ $[OH^-]$from NaOH $= 10^{-10}$

$\therefore \quad$ Total $[OH^-] = 10^{-7} + 10^{-10}$

$= 10^{-7}(1 + 0.001)$

$= 10^{-7}\left(\frac{1001}{1000}\right)$

$= 10^{-10} \times 1001$

$pOH = -\log[OH^-]$

$= -\log(1001 \times 10^{-10})$

$= -3.004 + 10$

$= 6.9996$

$\because \quad pH + pOH = 14$

$\therefore \quad pH = 14 - 6.9996$

=7.0004=7

870 **(b)**

$$K_H = \frac{K_w}{K_b} = \frac{10^{-14}}{1.77 \times 10^{-5}} = 5.65 \times 10^{-10}$$

871 **(d)**

$1M$ solution of strong acid must have pH = 1. Since, pH = 5 which is possible only when acid is weak $[H^+] = c \cdot \alpha$.

872 **(b)**

$K_{sp} = s^2$

$\therefore s = 1.0 \times 10^{-4} m/l$

$= 1.0 \times 10^{-4} \times 283 \times \frac{100}{1000}$ mL

$= 28.3 \times 10^{-2}$ g/100mL

873 **(d)**

For basic buffer,

$$pOH = pK_b + \log\frac{[salt]}{[base]}$$

Given, $\quad$ [salt]=[base]=1

$K_b = 2 \times 10^{-5}$

$\therefore \quad pOH = pK_b = -\log(2 \times 10^{-5})$

$= 5 - \log 2$

$= 5 - 0.30 = 4.70$

$pH = 14 - pOH$

$= 14 - 4.70 = 9.30$

874 **(c)**

NH_4Cl being a strong electrolyte, dissociates as

$NH_4Cl \rightarrow NH_4^+ + Cl^-$

and NH_4OH as,

$$\underset{\text{weak electrolyte}}{NH_4OH} \rightleftharpoons \underset{\text{common ion}}{NH_4^+} + OH^-$$

Due to the presence of common ion, the degree of dissociation of NH_4OH decreases. Thus, less OH^- ions are produced which are sufficient only for the precipitation of hydroxides if III group radicals and not of higher group radicals.

875 **(c)**

Let molar solubility of $Cr(OH)_3 = s$ mol L^{-1}

$$Cr(OH)_3(s) \rightleftharpoons \underset{s}{Cr^{3+}(aq)} + \underset{3s}{3OH^-(aq)}$$

$$K_{sp} = 1.6 \times 10^{-30} = [Cr^{3+}][OH^-]^3$$

$$= (s)(3s)^3 = 27s^4$$

$$\therefore \quad s^4 = \frac{1.6\times10^{-30}}{27}$$

$$\therefore \quad s = \sqrt[4]{\frac{1.6\times10^{-30}}{27}}$$

876 **(a)**

$\Delta G^0 = -2.303\, RT \log K$

$-4.606 \times 10^3 = -2.303 \times 2 \times 500 \log K$

$\therefore\ K = 100$

877 **(b)**

$2A(g) \rightleftharpoons 3C(g) + D(s)$

For this reaction, $\Delta n_g = 3 - 2 = 1$

$\therefore\ K_p = K_c(RT)^1$

or $K_c = \frac{K_p}{RT}$

878 **(a)**

$BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 \downarrow + 2NaCl$

879 **(d)**

CCl_4 is not a Lewis or Bronsted acid as it does not contain H^+ and has complete ocetet

880 **(a)**

Given, $NO_2 \rightleftharpoons \frac{1}{2}N_2 + O_2$, K_1 ...(i)

$N_2O_4 \rightleftharpoons 2NO_2$, K_2 ...(ii)

Required reaction

$N_2 + 2O_2 \rightleftharpoons N_2O_4$, K ...(iii)

By squaring Eq. (i) we get,

$2NO_2 \rightleftharpoons N_2 + 2O_2$, K_1^2 ...(iv)

Now, Eq (iii) is obtained by inverting Eq. (ii) and Eq. (iv) and by adding them as.

$N_2 + 2O_2 \rightleftharpoons 2NO_2$, $\frac{1}{K_1^2}$

$2NO_2 \rightleftharpoons N_2O_4$, $\frac{1}{K_2}$

$N_2 + 2O_2 \rightleftharpoons N_2O_4$, $\frac{1}{K_1^2} + \frac{1}{K_2}$

881 **(b)**

$C_1\alpha_1^2 = C_2\alpha_2^2$

$0.1 \times 1^2 = 0.025 \times \alpha_2^2$

$\alpha_2^2 = 4$

$\alpha = 2$

882 **(d)**

Δn may be zero, positive or negative integers or fractional depending upon nature of reaction.

Δn = No. of mole of products – No. of mole of reactants.

883 **(b)**

$$\underset{\text{Base}}{H^-} + H^+ \longrightarrow \underset{\text{Conjugate acid}}{H_2}$$

884 **(d)**

Common ion effect is noticed only for weak electrolyte dissociation H_2SO_4 is strong electrolyte.

885 **(b)**

Acids liberate CO_2 from bicarbonates.

886 **(c)**

1×10^{-8} M HCl solution H_2O is also present there which also undergoes self ionisation.

$$H_2O \rightleftharpoons \underset{10^{-7}\text{ M at }25°C}{H^+} + OH^-$$

If it is taken simply even without common ion effect, higher concentration must be considered which is 10^{-7}M but H^+ from HCl decreases self ionisation which further decreases self ionisation, hence $[H^+]$from H_2O.

Hence, net concentration must be smaller than 10^{-7} M.

887 **(b)**

Number of moles of PCl_5 dissociated at equilibrium

$= 2 \times 40/100 = 0.8$

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

(Initial)2 0 0

(At equilibrium) (2-0.8) mol 0.8 mol 0.8 mol

$[PCl_5] = \frac{1.2}{2} = 0.6\ ML^{-1}$

$[PCl_3] = [Cl_2] = \frac{0.8}{2} = 0.4\ ML^{-1}$

$\therefore\ K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]} = \frac{0.4\times0.4}{0.6}$

$= 0.267\ mol/dm^3$

888 **(c)**

In liquid ⇌ vapour, equilibrium the rate at which molecules escape from the liquid surface to gaseous phase equals to rate at which molecules in the gas phase strike the surface and becomes the part of liquid. Hence, the molecules in the two phases have equal kinetic energy.

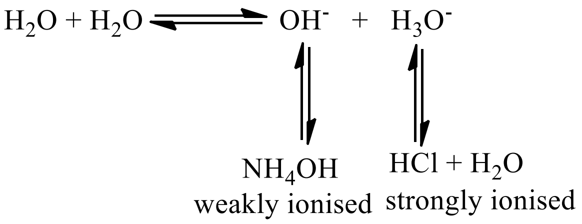
889 **(b)**

$$[\text{HI}] = \frac{12.8}{128 \times 3} = 0.033M$$

890 **(b)**

NH_4Cl salt gives an acidic solution in water

$$NH_4Cl \rightleftharpoons NH_4^+ \quad + Cl^-$$



891 **(d)**

Δn= 1 for this change; Unit of $K_p = (\text{atm})^{\Delta n}$;

Unit of $K_c = (\text{mol litre}^{-1})^{\Delta n}$

892 **(a)**

$As_2S_3 \rightleftharpoons 2As^{3+} + 3S^{2-}$

5 mol/L $\quad 2s \quad 3s$

$$K_{sp} = [As^{3+}]^2[S^{2-}]^3$$
$$= (2s)^2(3s)^3$$
$$= 108s^5$$
$$\therefore \quad s = \sqrt[5]{\frac{K_{sp}}{108}} \text{ or } \left(\frac{K_{sp}}{108}\right)^{\frac{1}{5}}$$
$$= \sqrt[5]{\frac{2.8\times10^{-72}}{108}}$$
$$= \sqrt[5]{25.93\times10^{-75}}$$
$$= 1.92\times10^{-15} \text{ mol/L}$$

893 **(c)**

$K_p = \frac{[HCO_3^-][H_3O^+]}{[CO_2]}$;

Given, $K_p = 3.8 \times 10^{-7}$

and $[H_3O^+] = 10^{-6}$

$\therefore \quad \frac{[HCO_3^-]}{[CO_2]} = \frac{3.8\times10^{-7}}{10^{-6}} = 3.8 \times 10^{-1}$

894 **(a)**

Blood buffer controls the pH change by acidic components present metabolically.

895 **(d)**

$N_2 + 3H_2 \rightleftharpoons 2NH_3$

1 2 3 : Before reaction

(1- x) (2-3x) (3+2x) : After reaction

x mole of N_2will react with $3x$ mole of H_2 to give $2x$ mole of NH_3. Notice the stoichiometry of change.

896 **(a)**

K_p is independent of pressure.

897 **(a)**

Methyl orange is good indicator in the range of pH 3 to 4. Actually working range of good indicator can be derived as,

$MeOH \rightleftharpoons Me^+ + OH^-$

$K_b = \frac{[Me^+][OH^-]}{[MeOH]}$; Taking logarithm

$\log K_b = \log\frac{[Me^+]}{[MeOH]} + \log OH^-$

or $pK_b = \log\frac{[MeOH]}{[Me^+]} + \log pOH$

The indicator is more effective when

$\frac{[MeOH]}{[Me^+]}$ or $\frac{[Me^+]}{[MeOH]} = 1$

Thus, $pOH = pK_b$; Thus, working range is pOH ± 1.

898 **(c)**

$$\Delta n = 1 - 1 - \frac{1}{2} = -\frac{1}{2}$$

$\therefore \quad K_p = K_c(RT)^{-1/2}$

899 **(d)**

Find solubility by $4s^3 = K_{sp}$ for Ag_2S and $s^2 = K_{sp}$ for CuS and HgS.

900 **(a)**

$pH = -\log[H^+]$

$[H^+] = 0.0001 = 1\times10^{-4}$

$pH = -\log\ [1\times10^{-4}] = 4$

901 **(c)**

$N\ H_2SO_4 = 0.05\times2 = 0.1$

$\therefore \quad [H^+] = 0.1$ and $pH = 1$.

902 **(d)**

Phenolphthalein exists as HPh, *i.e.*, undissociated molecule in acid medium and thus, shown no colour.

903 **(c)**

$[H^+] = 1.5\times10^{-2}$

$\therefore [OH^-] = \frac{10^{-14}}{1.5\times10^{-2}} = 6.7\times10^{-13}M.$

904 **(b)**

$K_c = \frac{[\text{product}]}{[\text{reactant}]}$

if $K_c >> 1$

$\Rightarrow$ [product]>>[reactant]

$\Rightarrow$ Reaction favoured more towards forward.

905 **(a)**

$$Q = \frac{[C]^3}{[A][B]} = \frac{(4/2)^3}{(1/2)(2/2)} = 16;$$

Given, $K_c = 20$;

Thus, to have $Q = K_c$;

The concentration of C must increase, i.e., reaction should proceed from left to right

906 **(b)**

$pH = pK_a$ if [Conjugate base] = [Acid].

907 **(b)**

An increase in temperature favours endothermic reaction.

908 **(a)**

Lewis acids are those species which can accept a lone pair of electron.

$BF_3, AlCl_3, SnCl_4, FeCl_3$ etc. are Lewis acids.

NCl_3 and ROR are Lewis bases. HCl is acid according to the concept of Arrhenius and Bronsted-Lowry.

909 **(c)**

$\mathrm{pH} = 4 \ \therefore [H^+]_{\mathrm{I}} = 10^{-4}$

$\mathrm{pH} = 5 \ \therefore [H^+]_{\mathrm{II}} = 10^{-5} \ \therefore [H^+]_{\mathrm{II}} = [H^+]_{\mathrm{I}} \times 10^{-1}.$

910 **(d)**

Each acid has P of +5 oxidation state as in P_2O_5.

911 **(b)**

$AgIO_3(s) \rightleftharpoons Ag^+(aq) + IO_3^-(aq)$

Let solubility of $AgIO_3$ be S

$$K_{sp} = [Ag^+][IO_3^-]$$

$1.0 \times 10^{-8} = S^2$ or $S = 1 \times 10^{-4}$ mol/L

In 1000 mL of mol of $AgIO_3$ dissolved $= 1 \times 10^{-4}$ mol

In 100 mL of mol of $AgIO_3$ dissolved $= 1 \times 10^{-5}$ mol

Mass of $AgIO_3$ in 100 mL $= 1 \times 10^{-5} \times 283$

$= 2.83 \times 10^{-3}$

912 **(a)**

H_3BO_3 accepts OH^- ions to act as weak monobasic Lewis acid.

$H_3BO_3 + H_2O \longrightarrow B(OH)_4^- + H^+; K_a = 10^{-9}$

913 **(d)**

e.g., BCl_3 is a Lewis acid as it accepts lone pair of electron but not Lowry-Bronsted acid as it cannot furnish H_3O^+ in solution.

914 **(a)**

For equation $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the value of

$$\Delta n = 2 - (1 + 1) = 0$$

Hence, by using formulae $K_p = K_c(RT)^{\Delta n}$

$$K_p = K_c(RT)^0$$

$$K_p = K_c$$

915 **(b)**

$$\text{Solubility} = \sqrt[5]{\frac{K_{sp}}{108}} = \sqrt[5]{\frac{10^{-70}}{108}} = 9.8 \times 10^{-13}$$

$$= \sqrt{7 \times 10^{-16}} = 2.64 \times 10^{-8}$$

$$= \sqrt{K_{sp}} = \sqrt{8 \times 10^{-37}} = 8.94 \times 10^{-19}$$

$$= \sqrt[3]{\frac{K_{sp}}{4}} = \sqrt[3]{\frac{6 \times 10^{-51}}{4}} = 1.1 \times 10^{-17}$$

916 **(a)**

Equilibrium constant for the reaction,

$$SO_2(g) + \tfrac{1}{2}O_2 \rightleftharpoons SO_3(g)$$

$$K_c = \frac{1}{4.9\times10^{-2}}$$

and for $2SO_2 + O_2 \rightleftharpoons 2SO_3(g)$

$$K_c = \left(\frac{1}{4.9\times10^{-2}}\right)^2$$

$$= \frac{10^4}{(4.9)^2} = 416.49$$

917 **(c)**

$pK_a = -\log K_a = \log \frac{1}{K_a}$

918 **(a)**

$AB \rightleftharpoons A + B$

$K = \dfrac{[A][B]}{[AB]}$

If concentration of A is doubled, the equilibrium concentration of B becomes half

919 **(b)**

Degree of dissociation=0.4

$PCl_5 \quad \rightleftharpoons PCl_3 + Cl_2$

$a(1-x) \quad ax \quad ax$

$$a = 2, x = 0.4, V = 2$$

$$[PCl_5] = \frac{2(1-0.4)}{2} = 0.6 \text{ mol/L}$$

$$[PCl_3] = \frac{2\times0.4}{2} = 0.4 \text{ mol/L}$$

$$[Cl_2] = \frac{2\times0.4}{2} = 0.4 \text{ mol/L}$$

$$\therefore \quad K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

$$= \frac{0.4\times0.4}{0.6} = 0.267$$

920 **(a)**

An increase in temperature favours endothermic reaction, however, in case of NaOH it is an exception and solubility of NaOH increase in temperature.

921 **(a)**

$\Delta n = 0$

922 **(a)**

$HSO_4^- \to H^+ + SO_4^{2-}$

923 **(c)**

An increase in the concentration of products always brings in backward reaction.

924 **(b)**

For NaX

$\underset{1-h}{X^-} + H_2O \rightleftharpoons \underset{h}{HX} + \underset{h}{OH^-}$

$$\therefore h = \sqrt{\frac{K_H}{c}} = \sqrt{\frac{K_w}{K_a \cdot c}} = \sqrt{\frac{10^{-14}}{10^{-5} \times 0.1}}$$

$$= \sqrt{10^{-8}} = 10^{-4}$$

$$\therefore \% \, h = 10^{-4} \times 100 = 10^{-2} = 0.01$$

925 **(a)**

$\Delta n = 2 + 1 - 2 = +1 \quad \therefore K_p = K_c(RT)^1$

$\therefore \; K_p > K_c$

926 **(b)**

A basic salt has one or more replaceable OH in it.

927 **(b)**

$K_a = C\alpha^2 = 0.1 \times (1.34 \times 10^{-2})^2 = 1.79 \times 10^{-5}$.

928 **(b)**

HCl is a strong acid and its conjugate base is a very weak base Cl^-

929 **(c)**

$2.303 \log_{10} K = -\frac{\Delta G^\circ}{RT}$

$2.303 \log_{10} K = \frac{-\Delta H^\circ}{RT} + \frac{\Delta S^\circ}{R}$

930 **(b)**

The compound which is having least solubility will be precipitated first.

$BaSO_4$: Given, $K_{sp} = 10^{-11}$

Let the solubility=x mol/L

$BaSO_4 \rightarrow \underset{x}{Ba^2} + \underset{x}{SO_4^{2-}}$

$\therefore \quad K_{sp} = [Ba^{2+}][SO_4^{2-}]$

or $\quad K_{sp} = x \times x$

$\therefore \quad K_{sp} = x^2$

or $\quad x = \sqrt{K_{sp}}$

$= \sqrt{10^{-11}}$

$= 3.16 \times 10^{-6}$ mol/L

$CaSO_3$: Given, $K_{sp} = 10^{-6}$

Let the solubility=x mol/L

$CaSO_4 \rightarrow [Ca^{2+}][SO_4^{2-}]$

$\therefore \quad K_{sp} = [Ca^{2+}][So_4^{2-}]$

or $\quad K_{sp} = x \times x$

$\therefore \quad K_{sp} = x^2$

or $\quad x = \sqrt{K_{sp}}$

$= \sqrt{10^{-6}}$

$= 1 \times 10^{-3}$ mol/L

$AgSO_4$: Given, $K_{sp} = 10^{-5}$

Let the solubility=x mol/L

$$Ag_2SO_4 \rightarrow \underset{2x}{2Ag^+} + \underset{x}{SO_4^{2-}}$$

$\therefore \quad K_{sp} = [Ag^+]^2[SO_4^{2-}]$

or $\quad = (2x)^2(x)$

or $\quad K_{sp} = 4x^3$

or $\quad x = \frac{\sqrt[3]{K_{sp}}}{4}$

$= \frac{\sqrt{10^{-5}}}{4}$

$= 10^{-2}$ mol/L

$\because BaSO_4$ has least solubility.

$\therefore$ It will precipitated first.

931 **(b)**

K_{C_1} for $H_2 + I_2 \rightleftharpoons 2HI$ is 50

K_{C_2} for $2HI \rightleftharpoons H_2 + I_2$

$K_{C_1} = \frac{[HI]^2}{[H_2][I_2]} \quad$ ...(i)

$K_{C_2} = \frac{[H_2][I_2]}{[HI]^2} \quad$ ...(ii)

On reversing Eq.(i)

$\frac{1}{K_{C_1}} = \frac{[H_2][I_2]}{[HI]^2} \quad$ ...(iii)

From Eqs. (ii) and (iii)

$K_{C_2} + \frac{1}{K_{C_1}} = \frac{1}{50} = 0.02$

932 **(b)**

A reaction which is in equilibrium, will shift in reverse or backward direction when we increase the concentration of one or more products (from Le-Chatelier'sprinciple)

933 **(d)**

N_2O_5 and HNO_3 both have ox.no. of N = +5.

934 **(a)**

Fusion of solid is an endothermic process, so addition of heat is favoured for the forward reaction (solid to melt), the amount of solid become decrease.

935 **(a)**

Conjugate base is formed by loss of H^+.

$$OH^- \rightarrow O^{2-} + H^+$$

Conjugate base

O^{2-} is the conjugate base of OH^-.

936 **(b)**

$Al(OH)_3 \rightleftharpoons \underset{s}{Al^{3+}} + \underset{3s}{3OH^-}$

$\therefore K_{sp} = [Al^{3+}][OH^-]^3 = s \times (3s)^3 = 27s^4$

937 **(b)**

HCl is strong acid. In its 0.1 M solution, $[H^+] = 0.1$ M and hence, pH = 1 $NH_4Cl(aq)$ hydrolysis in solution and give acidic solution which is less than 0.1 M HCl. NaCl is not hydrolysed in aqueous solutions. Its pH=7. NaCN undergoes hydrolysis in solution to give alkaline solution. So, the pH increases in the order

$$\mathrm{HCl} < \mathrm{NH_4Cl} < \mathrm{NaCl} < NaCN$$

938 **(a)**

$\Delta G = 0$; at equilibrium

939 **(b)**

$K_a = \frac{[\mathrm{H^+}]\,[\mathrm{CN^-}]}{[\mathrm{HCN}]}$;

An increase in $[\mathrm{CN^-}]$ will decrease $[\mathrm{H^+}]$ to maintain K_a constant.

940 **(d)**

The solubility product (K_{sp}) of a sparingly soluble salt at a given temperature may be defined as the product of the molar concentrations of its ions each raised to the power equal to its number of ions present in the equation representing the dissociation of one molecule of the salt.

$$\underset{}{\mathrm{Fe(OH)_3}} \rightleftharpoons \underset{X}{\mathrm{Fe^{3+}}} + \underset{3X}{3\mathrm{OH^-}}$$

$$K_{\mathrm{sp}} = [\mathrm{Fe^{3+}}][\mathrm{OH^-}]^3$$

$$\therefore \quad K_{\mathrm{sp}} = X(3X)^3 = 27X^4$$

941 **(d)**

Baking soda ($\mathrm{NaHCO_3}$) has one replaceable H.

942 **(b)**

$\mathrm{Na_2CO_3 + H_2O \rightarrow 2NaOH + H_2CO_3}$

$\because$ NaOH is strong base.

$\therefore$ It will be more ionised and number of $\mathrm{Na^+}$ and $\mathrm{OH^-}$ ions will be more.

$\because$ $\mathrm{H_2CO_3}$ is weak acid .

$\therefore$ It will be less ionised and number of $\mathrm{H^+}$ and $\mathrm{CO_3^{2-}}$ will be less.

$\therefore$ The solution will have more hydroxide ions than carbonate ions.

943 **(c)**

Milli equivalent of $\mathrm{H^+}$ from HCl $= 10 \times 0.1 = 1$

Milli equivalent of $\mathrm{H^+}$ from $\mathrm{H_2SO_4} = 40 \times 0.2 \times 2 = 16$

Total Meq. of $\mathrm{H^+}$ in solution $= 1 + 16 = 17$

$\therefore [\mathrm{H^+}] = \frac{17}{50} = 3.4 \times 10^{-1} \quad \left(\because [\mathrm{H^+}] = \frac{\mathrm{Meq.}}{V_{\mathrm{in\ mL}}}\right)$

$\therefore$ $\mathrm{pH} = -\log[\mathrm{H^+}] = -\log 0.34$

$\mathrm{pH} = 0.4685.$

944 **(b)**

Before attaining the equilibrium, the rate of forward reaction decreases due to decrease in concentration of reactant with time and the rate of backward reaction increases due to increase in concentration of products with time.

945 **(a)**

NaCN + HCl is not a buffer but if HCl is in less amount then, it gives a buffer as it produces HCN.

$$\begin{array}{lcccc} & \mathrm{NaCN} + & \mathrm{HCl} \longrightarrow & \mathrm{NaCl} + & \mathrm{HCN} \\ \text{Mole added} & 0.01 & a & 0 & 0 \\ \text{Mole after reaction} & (0.01-\alpha) & 0 & \alpha & \alpha \end{array}$$

This is buffer of HCN + NaCN.

Let a mole of HCl be used for this purpose

$$\therefore \ \mathrm{pH} = -\log K_a + \log \frac{0.01 - a}{a}$$

$$8.5 = -\log 4.1 \times 10^{-10} + \log \frac{0.01 - a}{a}$$

$\therefore \quad a = 8.85 \times 10^{-3}$ mole of HCl.

946 **(b)**

Quotient $Q = \frac{[C]^3}{[A][B]} = \frac{4^3 \times 3 \times 3}{3^3 \times 1 \times 2} = 10.66$

$\left[[C] = \frac{4}{3}; [A] = \frac{1}{3}; [B] = \frac{2}{3}\right]$

Since, $K_c = 10$, Thus, Q must decrease to attain value of K_c and therefore, $[C]$ must decrease or $[A]$ or $[B]$ must increase, i.e., backward direction.

947 **(d)**

$\mathrm{CH_3COO^- + H_2O \rightleftharpoons CH_3COOH + OH^-}$

$$\therefore [\mathrm{OH^-}] = c \cdot h = c\sqrt{\left[\frac{K_h}{c}\right]}$$

$$= \sqrt{\left[\frac{K_w}{K_a} \cdot c\right]}$$

$$= \sqrt{\frac{10^{-14} \times 1}{1.8 \times 10^{-5}}} = 2.35 \times 10^{-5}$$

$\therefore$ $\mathrm{pOH} = 4.6289$

$\therefore$ $\mathrm{pH} = 9.3710$

948 **(b)**

A very high value of K for the given equilibrium shows that dissociation of glucose to form HCHO is very-very small. Hence, at equilibrium, we can take,

$[\mathrm{C_6H_{12}O_6}] = 1\ \mathrm{M}$

$K = \frac{[\mathrm{C_6H_{12}O_6}]}{[\mathrm{HCHO}]^6}, \qquad i.e., 6 \times 10^{22} = \frac{1}{[\mathrm{HCHO}]^6}$

or $[\mathrm{HCHO}] = \left(\frac{1}{6 \times 10^{22}}\right)^{1/6} = 1.6 \times 10^{-4}\ \mathrm{M}$

949 **(c)**

Polyprotic acids furnishes more than one $\mathrm{H^+}$ ion in solution.

950 **(a)**

$\mathrm{Sb_2S_3 \rightleftharpoons 2Sb^{3+} + 3S^{2-}}$

s mol/L $\quad 2s \quad 3s$

Solubility product $(K_{\mathrm{sp}}) = [\mathrm{Sb^{3+}}]^2[\mathrm{S^{2-}}]^3$

$= (2s)^2(3s)^3 =$

$108s^5$

$= 108 \times$

$(1.0 \times 10^{-5})^5 = 108 \times 10^{-25}$

951 **(d)**

$10^{-3}N$ KOH will give $[OH^-] = 10^{-3}$

$\therefore$ pOH = 3

Also, pH + pOH = 14

$\therefore$ pH = 11.

952 **(d)**

HSO_4^- can accept a proton (forms H_2SO_4) or can donate a proton (forms SO_4^{2-}).

953 **(b)**

$HA + H_2O \rightleftharpoons H_3O^+ + A^-$

$$K = \frac{[H_3O^+][A^-]}{[HA][H_2O]}$$

954 **(d)**

The minimum temperature at which the combination of N_2 and H_2 occurs at measurable rate is 500°C in Haber's process. No doubt if temperature is raised up, above 500°C, it will favour backward reaction, because the reaction is exothermic.

955 **(a)**

$$CO_2 + H_2 \rightleftharpoons H_2O + CO$$

$$\underset{(1-x)}{1} \quad \underset{(1-x)}{1} \quad \underset{x}{0} \quad \underset{x}{0}$$

$$\therefore K_c = \frac{x^2}{(1-x)^2}$$

Or $\frac{x}{1-x} = \sqrt{K_c} = \sqrt{1.8}$;

$\therefore \frac{x}{1-x} = 1.34$,

$\therefore x = 0.573\ M$.

956 **(c)**

The equilibrium constant does not change when concentration of reactant is changed as the concentration of product also get changed accordingly.

957 **(a)**

(i)BF_3 and BCl_3 are better Lewis acid than BMe_3 and B_2H_6 due to $-I$-effect of Cl and F.

(ii)Between BCl_3 and BF_3, BCl_3 is better Lewis acid due to lesser extent of $p\pi - p\pi$ back bonding in it.

958 **(c)**

Potassium ferrocyanide is a complex salt because in it ferrocyanide $[Fe(CN)_6]^{4-}$ is the complex ion. It does not give test for ferric and cyanide ions.

959 **(b)**

At 25°C; $[H^+] = 10^{-7}$ $\therefore K_{w_1} = 10^{-14}$

At 35°C; $[H^+] = 10^{-6}$ $\therefore K_{w_2} = 10^{-12}$

$$\because \quad 2.303 \log \frac{K_{w_2}}{K_{w_1}} = \frac{\Delta H}{R}\left[\frac{T_2 - T_1}{T_1 \times T_2}\right]$$

$$2.303 \log \frac{10^{-12}}{10^{-14}} = \frac{\Delta H}{2}\left[\frac{10}{298 \times 308}\right]$$

$$\therefore \quad \Delta H = 84551.4 \text{ cal/mol}$$

$$= 84.551 \text{ kcal/mol}$$

Thus, $H_2O = H^+ + OH^-; \Delta H =$ 84.551 kcal/mol

$\therefore$ $H^+ + OH^- = H_2O; \Delta H =$ −84.551 kcal/mol.

960 **(b)**

Lesser is the pH, more is acidic nature.

961 **(b)**

Strong electrolyte are 100% ionised in solution state and thus number of ions present in solution becomes constant at normal dilution. On further increasing dilution, the mobility of ion increase due to relaxation and electrophoretic effect.

962 **(c)**

$K_1 = \frac{[XeOF_4][HF]^2}{[XeF_6][H_2O]}$ ..

(i)

$K_2 = \frac{[XeOF_4][XeO_3F_2]}{[XeO_4][XeF_6]}$ ..

(ii)

By Eq.(ii)/(i) we have $\frac{K_2}{K_1} = \frac{[XeO_3F_2][H_2O]}{[XeO_4][HF]^2} = K_c$

963 **(d)**

K_{sp} of $CaF_2 = 4s^3 = 4 \times (2 \times 10^{-4})^3 = 32 \times 10^{-12}$.

964 **(a)**

$2.303 \log \frac{K_{p2}}{K_{p1}} = \frac{\Delta H}{R} \frac{[T_2 - T_1]}{T_1 T_2}$

Thus, if $K_{P2} > K_{P1}$; $T_2 > T_1$, then ΔH = +ve

965 **(b)**

$4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$

$$K_c = \frac{[NO]^2[H_2O]^6}{[NH_3]^4[O_2]^5}$$

Hence, units of $K_c = \text{Conc}^{+1}$.

966 **(a)**

	H_2	I_2	$\rightleftharpoons$	2HI
Initially	1 mol	2 mol		2 mol
At equili	0.2 mol	2-0.8		2 0.8
		1.2 mol		1.6 mol

Amount of H_2(and hence I_2) consumed

1 − 0.2 0.8

967 **(c)**

Ionic product ∝ temperature

So, if the temperature is decreased, the value of ionic product will definitely be less than before.

968 **(b)**

CH_3NH_2 (base) on reaction with HCl (acid) to give a salt of weak base and strong acid as $CH_3NH_3^+Cl^-$

$$CH_3NH_2 + HCl \rightarrow CH_3NH_3^+Cl^-$$

At=0 0.1 mol 0.8 mol 0.08 mol

After reaction (0.1-0.08)
=0.02 mol

So, it acts as basic buffer solution due to presence of base and salt in solution of 1 L.

$$pOH = -\log_{10} K_b + \log_{10}\frac{[salt]}{[base]}$$

$$pOH = -\log_{10} K_b + \log_{10}\frac{[CH_3NH_3^+Cl^-]}{[CH_3NH_2]}$$

$$= -\log_{10} 5 \times 10^{-4} + \log_{10}\frac{[0.08]}{[0.02]}$$

$$= -\log_{10} 5 + 4\log_{10} 10 + \log_{10}\frac{[0.08]}{[0.02]}$$

$$= -0.699 + 4 + 0.602 = 3.903$$

$$pH = 14 - pOH$$

$$= 14 - 3.903$$

$$= 10.097 = -\log_{10}[H^+]$$

$\therefore$ $[H^+] = 8.0 \times 10^{-11}$

969 **(a)**

H_3BO_3 accepts OH^- to form its conjugate base $B(OH)_4^-$,

$H_3BO_3 + H_2O \rightleftharpoons B(OH)_4^- + H^+$

970 **(d)**

$\Delta n = 1 - 2 = -1$

$\therefore$ $K_p = K_c\,(RT)^{\Delta n}$

$K_p = K_c(RT)^{-1}$

971 **(a)**

$\frac{1}{2}\,N_2 + \frac{3}{2}\,H_2 \rightleftharpoons NH_3$

$\left(1 - \frac{20}{100}\right)\left(3 - \frac{3\times 20}{100}\right)\left(\frac{20\times 2}{100}\right)$ mole at eq.

$$K_c = \frac{[NH_3]}{[N_2]^{1/2}[H_2]^{3/2}} = \frac{[20 \times 2/(100 \times 3)]}{\left[\frac{80}{100\times 3}\right]^{1/2}\left[\frac{240}{100\times 3}\right]^{3/2}}$$

$$= 0.36\ L\ mol^{-1}$$

972 **(a)**

An irreversible reaction is one in which either of the product is separated out as solid or escapes out as gas.

973 **(a)**

The value of equilibrium constant remains constant for a given reaction of constant temperature.

974 **(b)**

Gaseous HCl does not give H^+ but liquid HCl givesH^+ in aqueous solution, therefore gaseous HClis not an Arrhenius acid due to covalent bonding in gaseous condition

975 **(d)**

Buffer solution consists of weak acid and its salt with strong base. And a basic buffer solution is a mixture of weak base and its salt with strong acid.

976 **(a)**

$pK_a \propto \frac{1}{K_a}$

Stronger the acid, higher the K_a value and lower the pK_a value.

The order of acidity of given acids is as

$$\underset{\underset{F}{|}}{CH_3CHCOOH} > \underset{\underset{Br}{|}}{CH_3CHCOOH} > FCH_2CH_2COOH > CH_3CH_2COOH$$

Since, CH_3CH_2COOH is the weakest acid among the given, its pK_a value will be highest.

977 **(a)**

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

0 0 0 initially

$\frac{2\times 60}{100}$ $\frac{2\times 40}{100}$ $\frac{2\times 40}{100}$ at equilibrium

Volume of container = 2L

$$K_c = \frac{\frac{2\times 40}{100\times 2} \times \frac{2\times 40}{100\times 2}}{\frac{2\times 60}{100\times 2}} = 0.266$$

979 **(a)**

According to law of mass action

$$K_c = \frac{[NO_2]^2}{[N_2O_4]} = \frac{\left[1.2\times 10^{-2}\right]^2}{4.8\times 10^{-2}} = 0.3 \times 10^{-2} = 3 \times 10^{-3}\ mol/L$$

981 **(d)**

Lewis acid have a tendency to accept electrons while Bronsted acids have a tendency to donate proton.

(A)HCl $\rightarrow H^+ + Cl^-$
Bronsted acid

(B)H_2SO_4 $\rightarrow H^+ + HSO_4^-$
Bronsted acid

(C)HSO_3^- $\rightarrow H^+ + SO_3^{2-}$
Bronsted acid

(D)

$$\underset{\text{Lewis acid}}{SO_3} + :\ddot{\underset{\cdot\cdot}{O}}:^{2-} \longrightarrow SO_4^{2-}$$

982 **(d)**
Heat will be used to melt ice.

983 **(a)**
In an acidic solution $[\mathrm{H}^+] > 10^{-7}$
pH is less than 7.
In an alkaline solution $[\mathrm{H}^+] < 10^{-7}$, pH is greater than 7.

984 **(b)**
$\mathrm{H_2SO_4(acid)} \xrightarrow{-\mathrm{H}^+} \mathrm{HSO_4^-}$(Conjugate base).

985 **(b)**
Given, $[\mathrm{H_2}] = 8.0$ mol/L
$[\mathrm{I_2}] = 3.0$ mol/L
$[\mathrm{HI}] = 28$ mol/L
$K = ?$
$\mathrm{H_2 + I_2 \rightleftharpoons 2HI}$

$$\therefore \quad K = \frac{[\mathrm{HI}]^2}{[\mathrm{H_2}][\mathrm{I_2}]} = \frac{(28)^2}{(8)\times(3)} = \frac{28\times 28}{24} = 32.66$$

986 **(a)**

$$[\mathrm{H}^+] = c\alpha = c\sqrt{\left[\frac{K_a}{c}\right]} = \sqrt{K_a c} = \sqrt{5\times 10^{-8}\times 0.1} = 7.07\times 10^{-5}\,M$$

987 **(d)**

$$K_c = \frac{x^2}{4(1-x)^2};$$

If, $x = 0.5$;

$$K_c = \frac{0.5\times 0.5}{4\times(0.5)^2} = \frac{1}{4} = 0.25$$

988 **(b)**
$\mathrm{CH_3COOH}$ is weak acid and thus, partially ionised,
$\mathrm{CH_3COOH + H_2O \rightleftharpoons H_3O^+ + CH_3COO^-}$.

989 **(a)**
$\mathrm{N_2(g) + 3H_2(g) \rightleftharpoons 3NH_3(g)} + 92.3$ kJ
According to Le-Chatelier's principle, the favourable conditions for the reaction are
1.Low temperature (as the reaction is exothermic)

2.High pressure (volume is decreasing)

3.Constant removal of ammonia gas as it is formed.

990 **(b)**
An efflorescent salt is one that loses $\mathrm{H_2O}$ to atmosphere. For the reaction,
$\mathrm{CuSO_4.5H_2O}(s) \rightleftharpoons \mathrm{CuSO_4.3H_2O}(s) + 2\mathrm{H_2O}(v)$

$$K_p = \left(P'_{\mathrm{H_2O}}\right)^2 = 1.086\times 10^{-4}$$

$P'_{\mathrm{H_2O}} = 1.042\times 10^{-2}$ atm $= 7.92$ mm
$\because$ If $P'_{\mathrm{H_2O}}$ AT 25°C < 7.92 mm only then, reaction will proceed in forward direction.

991 **(c)**
Acid $\xrightarrow{-\mathrm{H}^+}$ conjugate base;
Base $\xrightarrow{+\mathrm{H}^+}$ conjugate acid.

992 **(d)**

$$[\mathrm{H}^+] = c\cdot\alpha = c\sqrt{\left[\frac{K_a}{c}\right]} = \sqrt{K_a c}$$

993 **(a)**
Gas $\rightleftharpoons$ Liquid; $\Delta H = -$ve;
Apply Le-Chatelier's principle

994 **(c)**

$$h = \sqrt{\frac{K_h}{C}}$$

where, K_h = hydrolysis constant =?
h = degree of hydrolysis = 0.25% = 0.25/100
C = concentration = 0.5 M

$$\therefore \quad \frac{0.25}{100} = \sqrt{\frac{K_h}{0.5}}$$

or

$$\left(\frac{0.25}{100}\right)^2 = \frac{K_h}{0.5}$$

$$\therefore \quad K_h = \frac{0.25\times 0.25\times 0.5}{100\times 100} = 3.125\times 10^{-6}$$

995 **(c)**
Only $\mathrm{CO_2}$ is gas at equilibrium and K_p, K_c formula does not involve solid state.

996 **(d)**
$\mathrm{2NaNO_3 \rightleftharpoons 2NaNO_2 + O_2}$
According to Le-Chatelier principle, low pressure, high temperature and addition of $\mathrm{NaNO_3}$favour forward reaction

997 **(b)**
pH of the solution $A = 3$
$[\mathrm{H}^+]_A = 10^{-3}$ M
pH of the solution $B = 2$
$[\mathrm{H}^+]_B = 10^{-2}$ M
$[\mathrm{H}^+] = 10^{-3} + 10^{-2} = 11\times 10^{-3}$
$\mathrm{pH} = -\log(11\times 10^{-3}) = 3 - \log 11$
$= 3 - 1.04 = 1.9$

998 **(c)**
Meq. of KOH = Meq. of $\mathrm{H_3PO_3}$
$0.1\times v = 20\times 0.1\times 2$ ($\mathrm{H_3PO_3}$ is dibasic)
$\therefore \quad v = 40$ mL

100 **(a)**

0 $[\mathrm{H^+}]$for the solution of pH 3$= 1 \times 10^{-3}$
$[\mathrm{H^+}]$for the solution of pH 5$= 1 \times 10^{-5}$
Let V volumes of both the solutions are added, then concentration of $\mathrm{H^+}$ in final mixture

$$= \frac{1\times10^{-3}\times V + 1\times10^{-5}\times V}{V+V}$$

$$= \frac{V(1\times10^{-3}+1\times10^{-5})}{2V}$$

$$= \frac{1.01\times10^{-3}}{2}$$

$$= 5.05 \times 10^{-4}$$

pH of resultant solution $= -\log[\mathrm{H^+}]$

$$= -\log(5.05 \times 10^{-4})$$

$$= 3.29$$

$$\approx 3.3$$

EQUILIBRIUM

CHEMISTRY

Assertion - Reasoning Type

This section contain(s) 0 questions numbered 1 to 0. Each question contains STATEMENT 1(Assertion) and STATEMENT 2(Reason). Each question has the 4 choices (a), (b), (c) and (d) out of which **ONLY ONE** is correct.

a) Statement 1 is True, Statement 2 is True; Statement 2 **is** correct explanation for Statement 1

b) Statement 1 is True, Statement 2 is True; Statement 2 **is not** correct explanation for Statement 1

c) Statement 1 is True, Statement 2 is False

d) Statement 1 is False, Statement 2 is True

1

Statement 1: On cooling in a freezing mixture, colour of the mixture turns to pink from deep blue for a reaction.$\mathrm{CO(H_2O)_6^{2+}(aq) + 4Cl^-(aq) \rightleftharpoons COCl_4^{2-}(aq) + 6H_2O(I)}$

Statement 2: Reaction is endothermic, so on cooling the reaction moves to backward direction.

2

Statement 1: The pH of a buffer solution containing equal moles of acetic acid and sodium acetate is 4.8 (pK_a of acetic acid is 4.8)

Statement 2: The ionic product of water at 25°C is 10^{-14} mol^2 L^{-2}. The correct answer is

3

Statement 1: Buffer system of carbonic acid and sodium bicarbonate is used for the precipitation of hydroxides of third group elements

Statement 2: It maintains the pH to a constant value, about 7.4

4

Statement 1: Catalyst affects the final state of the equilibrium.

Statement 2: It enables the system to attain a new equilibrium state by complexing with the reagents.

5

Statement 1: Addition of neon to $\mathrm{PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)}$ equilibrium at constant volume does not affect this equilibrium

Statement 2: Active masses of reactants and products do not change when volume remains constant

6

Statement 1: The value of K gives us a relative idea about the extent to which a reaction proceeds

Statement 2: The value of K is independent of the stochiometry of reactants and products at the point of equilibrium

7

Statement 1: The reaction, $2NO(g) + O_2(g) \rightleftharpoons 2NO_2(g)$ is favoured in the forward direction with increase of pressure

Statement 2: The reaction is exothermic

8

Statement 1: The aqueous solution of CH_3COONa is alkaline in nature.

Statement 2: Acetate ion undergoes anionic hydrolysis.

9

Statement 1: NaCl solution can be purified by passage of hydrogen chloride through brine.

Statement 2: This type of purification is based on Le- Chatelier principle .

10

Statement 1: Solubility of $BaSO_4$ in 0.1 M Na_2SO_4 is 10^{-9} M, hence its K_{sp} is 10^{-18}

Statement 2: Because for $BaSO_4, K_{sp} = S^2$

11

Statement 1: Dry HCl shall not act as an acid

Statement 2: For the acidic or basic properties, the presence of water is absolutely necessary

12

Statement 1: Increase of temperature favour the formation of NH_3 by Haber's process

Statement 2: Increase of pressure and addition of catalyst favour the formation of NH_3

13

Statement 1: For the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ Unit of K_c $L^2 mol^{-2}$

Statement 2: For the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$Equilibrium constant $K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$

14

Statement 1: Methyl orange is used as indicator in Na_2CO_3 titrating against HCl solution

Statement 2: The pH range of methyl orange is 3.1 to 4.5

15

Statement 1: Effect of temperature on K_c and K_p depends on enthalpy change.

Statement 2: Increase in temperature shifts the equilibrium in exothermic direction and decrease in temperature shifts the equilibrium position in endothermic direction.

16

Statement 1: For gaseous reaction when $\Delta n = 0, K_P = K_c$, Δn=change n the number fo gas moles.

Statement 2: For gaseous reaction $K_p = K_c (RT)\Delta n$

17

Statement 1: Ice ⇌ Water, if pressure is applied water will evaporate

Statement 2: Increase of pressure pushes the equilibrium towards the side in which umber of gaseous mole decrease

18

Statement 1: A solution of$FeCl_3$in water produce brown precipitate on standing

Statement 2: Hydrolysis of $FeCl_3$ takes place in water

19

Statement 1: Addition of an inert gas to the equilibrium mixture has no effects on the states of equilibrium at constant volume or at constant pressure.

Statement 2: The addition of inert gas at constant volume will not alter the concentration of the reactants as well as products of a reaction mixture.

20

Statement 1: On opening a sealed soda bottle dissolved CO_2 escapes

Statement 2: Gas escapes to reach the new equilibrium condition of lower pressure.

EQUILIBRIUM

CHEMISTRY

: ANSWER KEY :

1)	a	2)	b	3)	d	4)	d
5)	a	6)	c	7)	b	8)	a
9)	c	10)	d	11)	a	12)	d
13)	a	14)	a	15)	c	16)	a
17)	d	18)	a	19)	a	20)	a

EQUILIBRIUM

CHEMISTRY

: HINTS AND SOLUTIONS :

1 **(a)**
$CO(H_2O)_6^{2+}$ (pink) while $CoCl_4^{2-}$ (blue); so on cooling because of Le-Chatelier's principle the reaction tries to overcome the effect the temperature.

2 **(b)**
Both Assertion and Reason are true statement but Reason is not the correct explanation of Assertion. pH of a buffer solution is given by Henderson-Haselbalch equation.

$$pH = pK_a + \log\frac{[salt]}{[acid]}$$

$$\therefore \quad pH = pK_a \text{ (when [salt]=[acid])}$$

3 **(d)**
In biological systems buffer system of carbonic acid and sodium bicarbonate is found in our blood. It maintains the pH of blood to a constant value of about 7.4

5 **(a)**
The state of equilibrium is not affected by the addition of noble gases, at constant volume

6 **(c)**
The value of K depends on the stoichiometry of reactants and products at the point of equilibrium. For example if the reaction is multiplied by 2, the equilibrium constant is squared

7 **(b)**
According to Le-Chatelier's principle with increase of pressure, equilibrium shifts in that direction in which lesser number of gaseous moles are produced

8 **(a)**

$$CH_3COONa + H_2O \rightarrow CH_3COOH + NaOH$$

The above process takes place in following steps

$$\underset{\text{in aqueous solution}}{CH_3COONa \xrightleftharpoons{\text{Ionisation}}} \underset{\text{Strong base}}{CH_3COO^- + Na^+}$$

$$CH_3COO^- + H_2O \longrightarrow CH_3COOH + OH^-$$

Acetate ion undergoes anionic hydrolysis and the resulting solution is slightly basic due to excess of OH^- ions. Hence, both Assertion and Reason are true and Reason is the correct explanation of Assertion.

9 **(c)**
This is based on common ion effect

$NaCl \rightleftharpoons Na^+ + Cl^-$

$HCl \leftrightharpoons H^+ + Cl^-$

Concentration of Cl^- ions increases due to ionization of HCl which increases the ionic product$[Na^+][Cl^-]$. This results in the precipitation of pure NaCl.

10 **(d)**
$BaSO_4(s) \rightleftharpoons Ba^{2+} + SO_4^{2-}$

$s \qquad s + 0.1$

$K_{sp} = (s)(s + 0.1)$

$s < 10^{-9}$

11 **(a)**
HCl is regarded as an acid only when dissolved in water and not in any other solvent

12 **(d)**
$N_2 + 3H_2 \rightleftharpoons 2NH_3 + \text{Heat}$

This reaction is favoured by decrease of temperature, increase of pressure, addition of catalyst and promoter

13 **(a)**

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3}$$

$$K_c = \frac{mol^2 \times L \times L^3}{L^2 \times mol \times mol^3}$$

$$= L^2\ mol^{-2}$$

14 **(a)**
The pH of the solution at the neutralisation point region is about 3.5 to 7 and methyl orange gives

its colour change between pH 3.1 to 4.4

15 **(c)**
According to Le-chateliers principle endothermic reaction favours increase in in temperature . However exothermic reaction favour decrease in temperature.

16 **(a)**
According to formula $K_P = K_C(RT)^{\Delta n}$

$\Delta n = 0$

$K_P = K_c(RT)^0$

$K_P = K_C$

17 **(d)**
Increase in pressure favours melting of ice into water because at higher pressure melting point of ice is lowered

18 **(a)**
Aqueous solution of $FeCl_3$ on standing produce brown ppt. Due to hydrolysis, it produces ppt of $Fe(OH)_3$ which is of brown colour. Hence, both are correct and reason is a correct explanation

19 **(a)**
If volume is not constant the addition of inert gas affect the equilibrium constant. Both at constant volume, the addition of inert gas has no effect on the state of equilibrium.

20 **(a)**
According to Henry's law, "the mass of gas dissolved in a given mass of a solvent at any temperature is directly proportional to the pressure of the gas above the solvent."