CHEMISTRY

BOOKS - CHHAYA CHEMISTRY (BENGALI ENGLISH)

EQUILIBRIUM

NUMERICAL EXAMPLES

1. At a particular temperature, the values of rate constant of forward and backward reactions are $1.5 \times 10^{-2} L \cdot mol^{-1} \cdot s^{-1}$ and $1.8 \times 10^{-3} L \cdot mol^{-1} \cdot s^{-1}$ respectively for the reaction $A + B \Leftrightarrow C + D$. Determine the equilibrium constnt of the reaction at that temperature.

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2. At a particular temperature, the equilibrium constant of the reaction $2A + B \Leftrightarrow 2C$ is $8.0 \times 10^4 L \cdot mol^{-1}$. If the rate constant of the reverse reaction be $1.24 L \cdot mol^{-1} \cdot s^{-1}$, then find the value of rate constant of the forward reaction at that temperature.

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3. For the reaction $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g), K_p = 3 \times 10^{24}$ at $25\,^{\circ}C$. Find the value of K_c.

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4. AT 1500K, $K_c = 2.6 \times 10^{-9}$ for the reaction $2BrF_5(g) \Leftrightarrow Br_2(g) + 5F_2(g)$. Determine K_p of the reaction at that temperature.

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5. Find the temperature at which the numerical values of K_p and K_c will be equal to each other for the reaction, $\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \Leftrightarrow NH_3(g)$.

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6. At $400^\circ C, H_2(g)$ and $I_2(g)$ are allowed to react in a closed vessel of 5 L capacity to produce H(g). At equilibrium, the mixture in the flask is found to consist of 0.6 mol $H_2(g), 0.6$ mol $I_2(g)$ annd 3.5 mol $HI(g)$. Determine the value of K_c of the reaction.

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7. At a particular temperature, CO(g) reacts with $Cl_2(g)$ in a closed container to produce $COCl_2(g)$. In the equilibrium mixture, partial pressures of CO(g), $Cl_2(g)$ and $COCl_2(g)$ are found to be 0.12, 1.2 and 0.58 atm respectively. Find the value of K_p of the reaction, $CO(g) + Cl_2(g) \Leftrightarrow COCl_2(g)$.

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8. In a closed vessel of 1 dm^3 capacity, 1 mol $N_2(g)$ and 2 mol $H_2(g)$ interact to produce 0.8 mol $NH_3(g)$ in the equilibrium mixture. What is the concentration of $H_2(g)$ in the equilibrium mixture?

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9. At $20^\circ C, 0.258 mol \ A(g)$ and 0.592 mol B(g) are mixed in a closed vessel of 5L capacity to conduct the following reaction: $A(g) + 2B(g) \Leftrightarrow C(g)$. If 0.035 mol C(g) remains in the equilibrium mixture, then determine the partial pressure of each constituent at equilibrium.

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10. 2 mol of HI were heated in a sealed tube at $440^\circ C$ until the equilibrium was reched. HI was found to be 22% dissociated. Calculate the equilibrium constant for the reaction $2HI(g) \Leftrightarrow H_2(g) + I_2(g)$.

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11. 1 mol $PCl_2(g)$ is heated in a closed container of 2 litre capacity. If at equilibrium, the quantity of $PCl_5(g)$ be 0.2 mol then calculate the value of equilibrium constant for the given reaction,

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$.

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12. The following reaction is carried out at a particular temperature in a closed vessel of definite volume: $CO_2(g) + H_2(g) \Leftrightarrow CO(g) + H_2O(g)$. Initially, partial pressures of $CO_2(g)$ and $H_2(g)$ are 2 atm and 1 atm respectively and that of $CO_2(g)$ at equilibrium is 1.4 atm. calculate equilibrium constant of the reaction.

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13. $B(g) + C(g) \Leftrightarrow A(g)$. At constant temperature, mixture of 1 mol A(g), 2 mol B(g) and 3 mol C(g) are left to stand in a closed vessel of 1 L capacity. The equilibrium mixture is found to contain B(g) of 0.175 molar concentrations $\left(mol \cdot L^{-1}\right)$. Find the value of equilibrium constant at that temperature.

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14. At 550 K, the value of equilibrium constant $\left(K_c\right)$ is 0.08 for the given reaction: $PCl_5 \Leftrightarrow PCl_3(g) + Cl_2(g)$ occurring in a closed container. If the equilibrium concentration of $PCl_5(g)$ and $Cl_2(g)$ are 0.75 and 0.32 $mol \cdot L^{-1}$ respectively, then find the concentration of $PCl_3(g)$.

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15. At a given temperature, K_p is 0.36 for the reaction, $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ occurring in a closed vessel. If at equilibrium, the partial pressures of $SO_2(g)$&$O_2(g)$ be 0.15 atm & 0.8 atm respectively, then calculate the partial pressure of $SO_3(g)$.

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16. For the reaction, $A_2(g) + B_2(g) \Leftrightarrow 2AB(g)$, the value of equilibrium constant is 50 at $100^\circ C$. If a flask of 1L capacity contianing 1 mol A_2 is connected with another flask of 2 L capacity containing 2 mol B_2, then calculate the number of moles of AB at equilibrium.

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17. At a particular temperature, the value of K_p is 100 for the reaction, $2NO(g) \Leftrightarrow N_2(g) + O_2(g)$ occurring in a closed container. If the iniital pressure of $NO(g)$ be 25 atm then calculate the partial pressures of NO, N_2 and O_2 at equilibrium.

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18. For the reaction $A(g) + 2B(g) \Leftrightarrow 2D(g), \Delta G^0 = 2.\,kJ \cdot mol^{-1}$ at 500K. What is the value of K_p for the reaction $\frac{1}{2}A(g) + B(g) \Leftrightarrow D(g)$ at that temperature?

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19. Find the value of ΔG^0 and K_c for the following reaction at 298K. $NO(g) + \frac{1}{2}O_2(g) \Leftrightarrow NO_2(g)$

Given: standard free energy of formation $\left(\Delta G_f^0\right)$ of NO_2 and NO are 52.0 and 87.0 $kJ \cdot mol^{-1}$ respectively.

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20. At 298K, for attainment of equilibrium of the reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$, 5 mol of each of the constituents is taken. Due to this, total pressure of the mixture turns 20 atm. If $\Delta G_f^0\left(N_2O_4\right) = 100kJ \cdot mol^{-1}$ and $\Delta G_f^0\left(NO_2\right) = 50K\left(J \cdot mol^{-1}\right)$ then- (1)

Give the value of ΔG of the reaction? (2) In which direction will the reaction proceed more to attain equilibrium?

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21. At $986^{\circ}C$, 3 mol of $H_2O(g)$ and 1 mol of CO(g) react with each other according to the reaction, $CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$. At equilibrium, the total pressure of the reaction mixture is found to be 2.0 atm. If $K_c = 0.63$ (at $986^{\circ}C$), then at equilibrium find (1) the number of moles of $H_2(g)$, (2) the partial pressure of each of the gases.

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22. For the reaction, $N_2O_4(g) \Leftrightarrow 2NO_2(g)$ occurring in a closed vessel at 300K, the partial pressures of $N_2O_4(g)$ and $NO_2(g)$ at equilibrium are 0.28 atm and 1.1 atm respectively. What will be the partial pressures of these gases if the volume of the reaction system is doubled keeping the temperature constnt ?

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23. $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g), K_p = 1.8$. At $250\,^{\circ}C$ if 50% of PCl_5 dissociates at equilibrium then what should be the pressure of the reaction-system?

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24. At a particular temperature and 0.50 atm pressure, $NH_3(g)$ and some amount of solid NH_4HS are present in a closed container. Solid NH_4HS dissociates to give $NH_3(g)$ and $H_2S(g)$. At equilibrium, the total pressure of the reaction-mixture is found to be 0.84 atm. find the value of equilibrium constant of this reaction at that temperature.

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25. At $25\,^{\circ}C$ temperature, the molar concentrations of NH_3, NH_4^+ and OH^- at equilibrium are $9.6 \times 10^{-3}(M), 4.0 \times 10^{-4}(M)$ and

$4.0 \times 10^{-4}(M)$ respectively. Determine the ionisation constant of NH_3 at that temperature.

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26. A 0.1 (M) solution of acetic acid is 1.34% ionised at 25°. Calculate the ionisation constant of the acid.

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27. In a 0.01 (M) acetic acid solution, degree of ionisation of acetic acid is 4.2%. Determine the concentration of H_3O^+ ions in that solution.

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28. The value of ionisation constant of pyridine $\left(C_5H_5N\right)$ at $25^{\circ}C$ is 1.6×10^{-9}. What is the concentration of OH^- ions in a 0.1 (M) aqueous solution of pyridine at that temperature ?

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29. At $25^{\circ}C$, the value of ionisation constant of a weak monobasic acid, HA is 1.6×10^{-4}. What is the degree of ionisation of HA in its 0.1(M) aqueous solution?

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30. Ionisation constant of ammonia is 1.8×10^{-5} at $25^{\circ}C$. Calculate the degree of ionisation of ammonia in its $0.1(M)$ aqueous solution at that temperature.

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31. Determine the pH of the following solutions:

(1) 0.01(N) HCl (2) 0.05 (M) H_2SO_4

(3) 0.001(N) H_2SO_4.

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32. Determine the pH of the following solutions:

(1) 0.1 (N) NaOH (2) 0.005(M) $Ca(OH)_2$

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33. Calculate the concentrations of H_3O^+ and OH^- ions in the solution with the following pH values at $25^\circ C$

(1) pH=5.0

(2) pH=12.

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34. Calculate the amount of Ca$(OH)_2$ required to be dissolved to prepare 250 mL aqueous solution of pH=12.

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35. Determine the pH of the following solutions at $25^{\circ}C$,

(1) $10^{-7}(M)HCl$

(2) $10^{-8}(M)NaOH.$

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36. Calculate the pH of 0.1 (N) acetic acid solution. Given: K_a (acetic acid) $= 1.8 \times 10^{-5}$

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37. The concentration of an aqueous solution of a weak monobasic acid is 1(M) and its degree of ionisation is 1.32%. Determine the pH of the solution.

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38. Determine the pH of an aqueous solution of ammonia if the concentration of the solution is 3(M). K_b(ammonia) $= 1.8 \times 10^{-5}$.

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39. pH of 0.05(M) aqueous solution of diethylamine is 12. calculate the ionisation constant and degree of ionisationn of the amine.

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40. At $25^\circ C$ pH of 0.01 (M) propionic acid solution is 3.4. determine the degree of ionisation and ionisation constnt of propionic acid at $25^\circ C$.

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41. What will be the pH of the solution obtained when 50cc of 0.1(M) $Ca(OH)_2$ solution is diluted to 500cc by ading water into it?

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42. 20 mL 3(N) HCl solution is mixed with 15 mL 4(N)NaOH solution. What will be the pH of the resulting solution?

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43. 25 mL (M/10) HCl solution is mixed with 50 mL 2/25(M)KOH solution. What will be the pH of the resulting solution?

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44. 200 mL HCl solution is mixed with 300 mL NaOH solution. What will be the pH of the mixed solution if pH values of HCl and NaOH solutions are 2 and 12 respectively?

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45. Determine the pH of a buffer solution consisting of 0.01(M) CH_3COOH and $0.03(M)$ CH_3COONa. Given: $K_a\left(CH_3COOH\right) = 1.8 \times 10^{-5}$.

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46. Find the pH of ann ammonia-ammonium chloride buffer solution in which $\left[NH_3\right] = 0.2(M)$ and $\left[NH_4^+\right] = 0.3(M)$. Given $K_b\left(NH_3\right) = 1.76 \times 10^{-5}$.

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47. 0.15 mol of pyridinium chloride is added to 500 mL 0.2 (M) pyridine solution. Determine the pH of the solution. Given: K_b(pyridine) $= 1.5 \times 10^{-9}$ and assume that volume of the solution does not change due to the addition of pyridinium chloride.

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48. What will be the pH of the solution obtained by mixing 50 mL 0.1(N) CH_3COOH with 25 mL 0.1(N) NaOH solution? Given: $pK_a(CH_3COOH) = 4.74$.

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49. 100 mL of a buffer solution (pH=9.5) is to be prepared using 0.3(M) NH_3 and 0.1(M) HCl solution. What are the volumes (in mL) of NH_3 and HCl required to prepare this buffer solution? Given: $pK_b(NH_3) = 4.74$.

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50. pH of human blood is maintained by the balance in concentrations of $H_2CO_3\&NaHCO_3$. What volume of 5(M) $NaHCO_3$ solution is to be added to 10 mL of a blood sample containing 2(M) H_2CO_3 in order to maintain the pH at 7.4 ? $[K_a(H_2CO_3) = 7.8 \times 10^{-7}]$

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51. In a buffer solution, total concentration of NH_3 and NH_4Cl is 0.6 (M). If the pH of the buffer be 9.0 then, find the amount of NH_3 and NH_4Cl required to prepare 1L of that buffer. Given: $pK_b(NH_3) = 4.74$

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52. Find the amount of $(NH_4)_2SO_4$ required to be added to 500 mL 0.2 (M) NH_3 to prepare a buffer solution of $pH = 9.35$. [Given: $K_b(NH_3) = 1.78 \times 10^{-5}$].

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53. In a buffer solution consisting of CH_3COOH and CH_3COONa, concentration of each of the constituents is 0.1(M). If 1 mL 10(M) HCl is added to 1L of this buffer, then what will be the change in pH of the buffer ? Given: $pK_a(CH_3COOH) = 4.74$.

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54. At a certain temperature, solubility of CaF_2 in its saturated aqueous solution is $2 \times 10^{-4} mol \cdot L^{-1}$. What is its solubility produced at that temperature?

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55. At $25^{\circ} C$ concentration of AgCl in its saturated aqueous solution is 0.00287$g \cdot L^{-1}$. Find its solublity product at that temperature. [Ag=108, Cl=35.5].

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56. If the molar concentration of Cl^{-} ions in saturated aqueous solution of $PbCl_2$ is $3.2 \times 10^{-2} mol \quad L^{-1}$ at a certain temperature, then find the solubility product of $PbCl_2$ at that temperature.

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57. Calculate the solublity of $SrSO_4$ in water in $mol \cdot L^{-1}$ at $25^\circ C$. (Solublity product of $SrSO_4$ at $25^\circ C = 7.6 \times 10^{-7} mol^2 \cdot L^{-2}$]

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58. At $25^\circ C$, solublity product of CaF_2 is 4×10^{-11}. Determine the solubility of CaF_2 in its saturated solution and also the molar concentrations of the constituent ions.

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59. If the solubility product of $Mn(OH)_2$ be 1.9×10^{-13} at $25^\circ C$, then what is the pOH of a saturated aqueous solution of $Mn(OH)_2$ at that temperature?

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60. At what concentration of PO_4^{3-} ions in 0.1(M) aqueous solution of $AgNO_3$, will Ag_3PO_4 start to precipitate?Given: $K_{sp}\left(Ag_3PO_4\right) = 1.3 \times 10^{-20}$.

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61. At $25^{\circ} C$, equal volumes of 0.04 (M) $CaCl_2$ and $0.01(M)Na_2SO_4$ solution are mixed. Will $CaSO_4$ be precipitated in the resulting solution? $K_{sp}\left(CaSO_4\right) = 2.4 \times 10^{-5}\left(25^{\circ} C\right)$.

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62. Justify whether any precipitate will appear or not if 10 mL 0.01 (M) calcium chloride solution is mixed with 5 mL 0.1(M) potassium chromate solution. Given: $K_{sp}\left(CaCrO_4\right) = 2.3 \times 10^{-2}$.

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63. At what value of pH of 0.1 (M) aqueous $FeCl_3$ solution, will $Fe(OH)_3$ start to precipitate? Given: Solublity product of $Fe(OH)_3 = 2.0 \times 10^{-39}$.

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WARM UP EXERCISE

1. Equilibria involving physical and chemical changes are dynamic in nature-why?

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2. State Henry's law regarding the solublity of a gas in a liquid.

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3. When a liquid vaporises in a closed container, an equilibrium establishes between the liquid and its vapour. Will this equilibrlium be established if the liquid is vaporised in an open container? Given reason for your answer.

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4. Give molecular interpretation of the dynamic nature of liquid-vapour equilibrium.

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5. Give examples of two systems involving solid-vapour equilibrium.

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6. What is the reason for fizzing out of CO_2 gas when a soda water bottle is opened?

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7. The equilibrium established in the dissolution of a solid in a liquid or a gas in a liquid is dynamic in nature. Explain.

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8. What are irreversible & reversible reactions? Given examples.

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9. Mention the characteristics of a reversible reaction.

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10. Will the same result be obtained if $CaCO_3$ is heated in an open vessel and in a closed container separately? Explain.

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11. The reaction $Fe_2O_3(s) + 3CO(g) \rightarrow 2Fe(s) + 3CO_2(g)$ is carried out separately in a closed vassel and in an open vesel in which case do you expect a higher yield of $CO_2(g)$?

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12. If a reversible reaction is carried out in a closed vessel, the reactant(s) is/are never used up completely. Explain the reaction with nan example.

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13. Will three be any difference in the amount of products if the reaction between steam and red hot iron is carried out separately in a closed and in an open vessel?

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14. What are the characteristics of chemical equilibrium?

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15. What do you mean by chemical equilibrium?

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16. What is the effect of catalyst on chemical equilibrium?

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17. How will you establish the dynamic nature of a chemical equilibrium?

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18. The reaction, $A + B \Leftrightarrow C$ is at equilibrium at a certain temperature. Can the yield of product be increased by using catalyst?

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19. The following reaction is carried out in a closed vessel at a fixed temperature $A(g) \Leftrightarrow 2B(g)$. The concentrations of A(g) and B(g) in course of the reaction are as follows:

(i) When does the reaction attain equilibrium?

(ii) What are the equilibrium concentrations of A and B?

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20. The same equilibrium will be attained irrespective of whether a reversible reaction is started from the reactants or products. Explain.

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21. At a given temperature, for the reaction $A \Leftrightarrow B$, the rate constant $\left(k_f\right)$ of the forward reaction is greater than that of the backward reaction

(k_b). Is the value of equilibrium constant (K) for this reaction greater than, less than or equal to 1?

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22. Write the expressions of K_c and K_p for the reaction: $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$.

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23. Write the expressions of K_c and K_p for the reaction: $2BrF_5(g) \Leftrightarrow Br_2(g) + 5F_2(g)$

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24. Write the expressions of K_c and K_p for the reaction:$3O_2(g) \Leftrightarrow 2O_3(g)$.

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25. Write the expressions of K_c and K_p for the reaction: $4HCl(g) + O_2(g) \Leftrightarrow 2Cl_2(g) + 2H_2O(g)$.

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26. Write the expressions of K_c and K_p for the reaction: $P_4(g) + 3O_2(g) \Leftrightarrow P_4O_6(s)$

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27. Write the expressions of K_c and K_p for the reaction: $CO(g) + 2H_2(g) \Leftrightarrow CH_3OH(l)$.

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28. Write the expression of K_c for the reactions: $2Ag^+(aq) + Cu(s) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$.

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29. Write the expression of K_c for the reactions: $NH_4NO_3(s) \Leftrightarrow N_2O(g) + 2H_2O(g)$

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30. Write the expression of K_c for the reactions: $Au^+(aq) + 2CN^-(aq) \Leftrightarrow \left[Au(CN)_2\right]^-(aq)$.

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31. Write the expression of K_c for the reactions: $3Cu(s) + 2NO_3^-(aq) + 8H^+(aq) \Leftrightarrow 3Cu^{2+}(aq) + 2NO(g) + 4H_2O(l)$

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32. Write the expression of K_c for the reactions: $Cl_2(g) + 2Br^-(aq) \Leftrightarrow Br_2(l) + 2Cl^-(aq)$.

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33. Establish the relation between K_p and K_c for the following reactions: $aA + bB \Leftrightarrow lL + mM$ [where the terms have their usual significance].

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34. What will be the relation between K_p and K_c for the given equilibrium ? $CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$.

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35. Give two examples of chemical reactions for each of the cases: $K_p > K_c$

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36. Give two examples of chemical reactions for each of the cases: $K_p < K_c$

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37. Give two examples of chemical reactions for each of the cases: $K_p = K_c$

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38. "In any reversible reaction, the equilibrium constant for the forward reaction in the reciprocal of the equilibrium constant of the backward reaction"-explain.

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39. Find the relation betweenn $K_p \& K_c$ for the given reactions:

$NH_3(g) + HCl(g) \Leftrightarrow NH_4Cl(s)$

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40. Find the relation betweenn $K_p \& K_c$ for the given reactions:

$C(s) + CO_2(g) + 2Cl_2(g) \Leftrightarrow 2COCl_2(g)$

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41. Find the relation betweenn $K_p \& K_c$ for the given reactions:

$\frac{1}{2}N_2(g) + O_2(g) \Leftrightarrow NO_2(g)$

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42. Find the relation betweenn $K_p \& K_c$ for the given reactions:

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

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43. Find the relation betweenn $K_p \& K_c$ for the given reactions:

$Fe(s) + H_2O(g) \Leftrightarrow FeO(s) + H_2(g)$

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44. Find the relation betweenn $K_p \& K_c$ for the given reactions:

$CH_4(g) + H_2O(l) \Leftrightarrow CO(g) + 3H_2(g)$

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45. Find the relation betweenn $K_p \& K_c$ for the given reactions:

$CO(g) + 2H_2(g) \Leftrightarrow CH_3OH(l)$.

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46. Given an example of a reaction for which $K_p = K_c = K_a$.

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47. At $200^{\circ} C$, the equilibrium $N_2O_4(g) \Leftrightarrow 2NO_2(g) isa\chi eved \in thefollow \in gtwopathways : (i) 0.1 mol$ N_(2)O_(4)$isheated \in aclosedvasselof 1 Lvolume. (ii) amixtureof 0.05 mol$ N_(2)O_(4)(g) and $0.05 mol$NO_(2)(g)$isheatedat$200^(@)C $\in aclosedvesselof 1 Lvolume. \in thesetwocases, willtheequilibriumconcentrations$ N_(2)O_(4)(g) and NO_(2)(g)` and the values of equilibrium constants be the same?

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48. At a constant temperature, the equilibrium constant of the reaction $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ is K and that of the reaction $\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \Leftrightarrow NH_3(g)$ is $\sqrt{K}$. Explain this difference of K values in spite of the fact that the reactants and products in both the reactions are same.

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49. For the reaction $2H_2(g) + O_2(g) \Leftrightarrow 2H_2O(g)$ - $K_p = K_c(RT)^x$. Find the value of x.

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50. If the value of equilibrium constant of the reaction $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ be K, then what will be the values of equilibrium constant of the reaction :

$4SO_2(g) + 2O_2(g) \Leftrightarrow 4SO_3(g)$

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51. If the value of equilibrium constant of the reaction $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ be K, then what will be the values of equilibrium constant of the reaction :

$2SO_3(g) \Leftrightarrow 2SO_2(g) + O_2(g)$

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52. If the value of equilibrium constant of the reaction $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ be K, then what will be the values of equilibrium constant of the reaction :

$SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g)$

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53. If the value of equilibrium constant of the reaction $2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ be K, then what will be the values of equilibrium constant of the reaction :

$SO_3(g) \Leftrightarrow SO_2(g) + \frac{1}{2}O_2(g)$.

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54. At a particular temperature, the following reaction is carried out with 1 mol of A(g) and 1 mol of B(g) in a closed vessel: $A(g) + 4B(g) \Leftrightarrow 4B_4(g)$.

Will the equilibrium concentration of $AB_4(g)$ be higher thn that of A(g)?

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55. A few reactions and their equilbirium constant are given. Find the equilibrium constant of the reaction, $A \Leftrightarrow 3B + E$.

$A \Leftrightarrow B + C, K_c = 2$

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56. A few reactions and their equilbirium constant are given. Find the equilibrium constant of the reaction, $A \Leftrightarrow 3B + E$.

$C \Leftrightarrow B + D, K_c = 3$

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57. A few reactions and their equilbirium constant are given. Find the equilibrium constant of the reaction, $A \Leftrightarrow 3B + E$.

$D \Leftrightarrow B + E, K_c = 4$.

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58. If the value sof K_c for the reactions, $A + 2B \Leftrightarrow C$ and $C \Leftrightarrow 2D$ are 2 and 4, respectively, then what will be the value of K_c for the reaction, $2D \Leftrightarrow A + 2B$?

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59. What does the sign of ΔG of a reaction at a given pressure annd temperature indicate about the feasibility of the reaction?

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60. What does it imply about the direction of a reactions, if the value of reaction quotient (Q) at any instant of the reaction at a constant temperature is smaller than or larger than or equal to the equilibrium constant (K) of the reaction at the temperature?

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61. For the reaction $A + B \Leftrightarrow C + D$, the equilibrium constant is K. what would be the value of the reaction quotient (Q), when the reaction just starts annd when it reaches equilibrium?

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62. We know, $\Delta G^0 = -RT\ln K_c$ and $\Delta G^0 = -RT\ln K_p$. Therefore in case of a reaction occurring in gaseous phase at a given temperature, ΔG^0 is the same evenn if the values of K_p and K_c are different. Is the statement true? Given reasons.

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63. The values of equilibrium constant (K) of a reaction at $25^{\circ}C$ and $50^{\circ}C$ are 2×10^{-4} and 2×10^{-2} respectively. Is the reaction an exothermic or an endothermic reaction?

Watch Video Solution

64. Consider the reaction, $aX_2(g) + bY_2(g) \Leftrightarrow cXY(g) +$ heat and answer the following questions:

Find the relation among a,b and c.

Watch Video Solution

65. Consider the reaction, $aX_2(g) + bY_2(g) \Leftrightarrow cXY(g) +$ heat and answer the following questions:

State whether the equilibrium will be shifted towards right or left if temperature is increased.

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66. State Le Chatelier's principle.

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67. Explain the effect of (a) pressure and (b) continuous removal of HI at constant temperature on the position of equilibrium of the following reaction: $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$.

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68. What will be the effect of catalyst on the position of a chemical equilibrium?

Watch Video Solution

69. For the following endothermic reactions: $PCl_5 \Leftrightarrow PCl_3(g) + Cl_2(g)$ (a) At constant temperature, what will be the effect of pressure? (b) At constant volume, what will be the effect of addition of chlorine gas and nitrogen gas on the position of equilibrium?

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70. Consider the following reaction:

$2A(g) + B_2(g) \Leftrightarrow 2AB(g), \Delta H < 0$. How can the yield of AB(g) be increased?

Watch Video Solution

71. $2BrF_5(g) \Leftrightarrow Br_2(g) + 5F_2(g)$, At constant temperature, how the increase in pressure will afffect the following at equilibrium-

Equilibrium constant.

Watch Video Solution

72. $2BrF_5(g) \Leftrightarrow Br_2(g) + 5F_2(g)$, At constant temperature, how the increase in pressure will afffect the following at equilibrium-

Position of the equilibrium and yield of product?

Watch Video Solution

73. Consider the reaction, $A(g) + 2B(g) \Leftrightarrow 2D(g) + 3E(g) +$ heat and state how the following changes at equilibrium will affect the yield of the product. D(g)-

temperature is increased.

Watch Video Solution

74. Consider the reaction, $A(g) + 2B(g) \Leftrightarrow 2D(g) + 3E(g) +$ heat and state how the following changes at equilibrium will affect the yield of the product. D(g)-

pressure is increased at constant temperature.

Watch Video Solution

75. Consider the reaction, $A(g) + 2B(g) \Leftrightarrow 2D(g) + 3E(g) +$ heat and state how the following changes at equilibrium will affect the yield of the product. D(g)-

Some amount of E(g) is removed from the reaction system at constant temperature and volume.

Watch Video Solution

76. Consider the reaction, $A(g) + 2B(g) \Leftrightarrow 2D(g) + 3E(g) +$ heat and state how the following changes at equilibrium will affect the yield of the product. D(g)-

some amount of D(g) is added to the reaction system, keeping temperature and volume constant.

Watch Video Solution

77. Consider the following reaction: What will be the effect on the following if temperature is increased? (a) equilibrium constant (b) position of equilibrium (c) yiled of products.

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g), \Delta H > 0$

Watch Video Solution

78. Consider the following reaction: What will be the effect on the following if temperature is increased? (a) equilibrium constant (b) position of equilibrium (c) yiled of products.

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g), \Delta H < 0.$

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79. For this reactions, predict the effect on the following if pressure is increased at equilibrium-(a) position of equilibrium, (b) yield of the products.

$H_2(g) + I_2(g) \Leftrightarrow 2HI(g),$

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80. For this reactions, predict the effect on the following if pressure is increased at equilibrium-(a) position of equilibrium, (b) yield of the products.

$2CO(g) + O_2(g) \Leftrightarrow 2CO_2(g)$.

Watch Video Solution

81. For this reactions, predict the effect on the following if pressure is increased at equilibrium-(a) position of equilibrium, (b) yield of the products.

$C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g)$.

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82. At constant temperature, in a closed vessel the following equilibrium establishes during decomposition of $NH_4Cl(s): NH_4Cl(s) \rightarrow NH_3(g) + HCl(g)$. If pressure of the equilibrium mixture=P and value of equilibrium constant = K_p, then show that $P = 2\sqrt{K_p}$.

Watch Video Solution

83. Write the conjugate bases of the following acids and give reason: $HN_3, CH_3OH, \left[Al\left(H_2O\right)_6\right]^{3+}, NH_4^+, HPO_4^{2-}, H_2O_2, OH^-$.

Watch Video Solution

84. Write the conjugate acids of the following bases and give reason: $OH^-, H_2PO_4^-, O^{2-}, HS^-, SO_3^{2-}, H_2O, HCO_3^-, NH_2^-, NH_3, H^-, C_6H_5NH_2, S_2O_8^{2-}$, C

.

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85. Which of the following is the strongest Bronsted base? $ClO^-, ClO_2^-, ClO_3^-, ClO_4^-$.

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86. Identify the Lewis acids and Lewis bases in the reaction below:

$H^{+} + OH^{-} \rightarrow H_2O$

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87. Identify the Lewis acids and Lewis bases in the reaction below:

$Co^{3+} + 6NH_3 \Leftrightarrow \left[Co\left(NH_3\right)_6\right]^{3+}.$

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88. Identify the Lewis acids and Lewis bases in the reaction below:

$BF_3 + \ddot{N}H_3 \rightarrow \left[H_3N \rightarrow BF_3\right]$

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89. Identify the Lewis acids and Lewis bases in the reaction below:

$CO_2 + OH^- \rightarrow HCO_3^-$

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90. Identify the Lewis acids and Lewis bases in the reaction below:

$AlF_3 + 3F^- \rightarrow AlF_6^{3-}$.

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91. All Lewis bases are in fact Bronsted bases-Explain.

Watch Video Solution

92. Each of HCO_3^- and HPO_4^{2-} can act both as Bronsted acid and base-why? Write the formula of conjugate base and conjugate acid in each case.

Watch Video Solution

93. State and exaplain Ostwald's dilution law.

Watch Video Solution

94. Of the two solutions of acetic acid with concentrations 0.1(N) and 0.01 (N), in which one does acetic acid have higher degree of dissociation?

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95. Write down the limitations of Ostwald's dilution law.

Watch Video Solution

96. At a certain temperature, the ionisation constannt of three weak acids HA, HB and HC are 4.0×10^{-5}, 5.2×10^{-4} and 8.6×10^{-3}, respectively. If the molar concentrations of their solutions are the same, then arrange them in order of their increasing strength.

Watch Video Solution

97. A weak tribasic acid, H_3A, in its aquous solution ionises in the following step:

If the ionisation constants of the steps are K_1, K_2 and K_3 respectively, then determine the overall ionisation constant of H_3A.

$H_3A(aq) + H_2O(l) \Leftrightarrow H_3O^+(aq) + H_2A^-(aq)$

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98. A weak tribasic acid, H_3A, in its aquous solution ionises in the following step:

If the ionisation constants of the steps are K_1, K_2 and K_3 respectively, then determine the overall ionisation constant of H_3A.

$H_2A^-(aq) + H_2O(l) \Leftrightarrow H_3O^+(aq) + HA^{2-}(aq).$

Watch Video Solution

99. A weak tribasic acid, H_3A, in its aquous solution ionises in the following step:

If the ionisation constants of the steps are K_1, K_2 and K_3 respectively, then determine the overall ionisation constant of H_3A.

$HA^{2-}(aq) + H_2O(l) \Leftrightarrow H_3O^+(aq) + A^{3-}(aq)$.

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100. At a certain temperature, the ratio of ionisation constants of weak acids HA and HB is 100:1. if the molarity of the solution of HA is the samme as that of HB and the degrees of ionisation of HA and HB in their respective solutions are α_1 and α_2 respectively, then show that $\alpha_1 = 10\alpha_2$.

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101. Are the ionisation constant and ionic product of water the same? Explain.

Watch Video Solution

102. Find $\left[OH^{-}\right]$ in pure water if $\left[H_3O^{+}\right]$ in it is x $mol \cdot L^{-1}$. Also, find the relation between x and K_w.

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103. Why is the ionic product of water at $50\,^{\circ}C$ greater than that at $25\,^{\circ}C$?

Watch Video Solution

104. Why does the concentration of OH^{-} ions in pure water increase with rise in temperature ? Does this increase make pure water alkaline ?

Explain.

Watch Video Solution

105. At $25^{\circ}C$ what is the concentration of H_3O^+ ions in an aqueous solution in which the concentration of OH^- ions is $2 \times 10^{-5}(M)$?

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106. What is common ion effect? Give example. What is buffer action?

Watch Video Solution

107. Discus the effect of addition of dilute HCl and CH_3COONa solution separately to a dilute aqueous acetic acid solution.

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108. By what factor will the concentration of H_3O^+ ions in an aqueous solution in incrased or decreased if its pH is increased by one unit ?

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109. The pH of solution A is twice that of solution B. if the concentrations of H_3O^+ ions in A and B are x (M) and y (M), respectively, then what is the relation between x and y?

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110. Establish the relation betweenn pH, pOH and pK_w in case of pure water or any aqueous solution.

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111. In cae of pure water or any aqueous solution, show that pH+pOH=14. comment on whether this value will be greater than or less than 14 at $0^\circ C$ and $100^\circ C$.

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112. The values off pH for pure water at $0^\circ C$ and $25^\circ C$ are x and y respectively. Is x greater than or less than y?

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113. $pK_w = 12.26$ at $100^\circ C$. What is the range of pH-scale at this temperature? What will be the pH of a neutral solution at this temperature ?

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114. Between 0.1(M) and 0.01(M) acetic acid solutions which one will have a higher pH, and why?

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115. pH of $10^{-8}(M)$ HCl is 8-is it true? Give reasons.

Watch Video Solution

116. The concentration of H_3O^+ ions in solution A is 1000 times than that in solution B. what is the difference between the values of pH of these two solutions?

Watch Video Solution

117. Derive an equation of determine pH of an aqueous NH_3 solution at a certain temperature.

Watch Video Solution

118. Explain with equation why an aqueous of $FeCl_3$ is acidic.

Watch Video Solution

119. An aqueous solution of $\left(NH_4\right)_2SO_4$ is acidic. Explain.

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120. What colour change does a blue or red litmus paper exhibit when it is put separately in each of the following aqueous solutions ?

CH_3COONa.

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121. What colour change does a blue or red litmus paper exhibit when it is put separately in each of the following aqueous solutions ?

CH_3COONH_4.

Watch Video Solution

122. What colour change does a blue or red litmus paper exhibit when it is put separately in each of the following aqueous solutions ?

NH_4Cl.

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123. Why is an aqueous solution of $NaNO_3$ neutral?

Watch Video Solution

124. CH_3COONH_4 undergoes hydrolysis, although its aqueous solution is neutral. Explain with reason

Watch Video Solution

125. Why is aq. Solution of ammonium formate slightly acidic ?

Watch Video Solution

126. Arrange the followin aqueous solutions in order of their increasing pH values: Na_2CO_3, CH_3COONH_4, $CuSO_4$.

Watch Video Solution

127. Give an example of a salt solution whose pH is independent of salt concentration.

Watch Video Solution

128. Which of the givensalts will undego cationic or anionic or both cationic and anionicc hydrolysis?

$NH_4F, NaCN, AlCl_3, Na_2CO_3, NH_4Cl.$

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129. Show that in an aqueous solution for a conjugate acid-base pair, $K_a \times K_b = K_w$.

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130. Show that, at $25^{\circ}C$ for a conjugate acid-base pair, $pK_a + pK_b = pK_w$ (or, 14).

Watch Video Solution

131. What is buffer solutio? Give one example of acidic buffer. In which case of acidic buffer pH = pKa.

Watch Video Solution

132. What are buffer solutions? Give one example for each of the buffer- acid, basic buffer solution.

Watch Video Solution

133. What are buffer solutions? Give one example for each of the buffer- a buffer solution obtained by mixing aquueous solutions of two salts derived from a polybasic acid.

Watch Video Solution

134. Describe the mechanism of acction of an acidic buffer an a basic buffer.

Watch Video Solution

135. What is buffer capacity? Whenn does the buffer capacity of a buffer solution consisting of a weak acid and its salt become maximum?

Watch Video Solution

136. Write the Henderson's equation for determining the pH of acidic and basic buffer solutions.

Watch Video Solution

137. Which of the following are buffer solutions? Give reason.

100 mL 0.1 (M) $NH_3 + 50 mL . 0.1 (M) HCl$

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138. Which of the following are buffer solutions? Give reason.

100 mL 0.1 (M) $CH_3COOH + 50 mL 0.2 (M) NaOH$

Watch Video Solution

139. Which of the following are buffer solutions? Give reason.

100 mL $0.1 (M) CH_3COOH + 100 mL 0.15 (M) NaOH$

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140. Which of the following are buffer solutions? Give reason.

100 mL 0.1 $(M) CH_3COONa + 25 mL 0.1 (M) HCl$

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141. Which of the following are buffer solutions? Give reason.

50 mL $0.2(M)NH_4Cl + 50mL0.1(M)NaOH.$

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142. You are supplied with HCOOH $\left(pK_a = 3.74\right), CH_3COOH\left(pK_a = 4.74\right)$ and $NaOH$ solutions. To prepare a buffer solution of pH=3.8, which acid will you select? Give reason.

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143. pH of a buffer solution composed of NH_3 and NH_4Cl is 9.26. will there be any change in pH if 100 mL of distilled water is added to 100 mL of this buffer solution?

Watch Video Solution

144. The buffer capacity of a buffer solution consisting of a weak acid, HA and its salt, NaA becomes maximum when its pH is 5.0. at this pH, what is the relation between the molar concentration of HA and NaA? Also find the value of pK_a of HA.

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145. What are the factors that influence the pH of an acidic or a basic buffer at a particular temperature?

Watch Video Solution

146. A,B and C are three buffer solutions, each of which composed of a weak acid and its salt. For increasing the pH by 0.02 units, it is found that 1.0, 1.4 and 1.2 millimol of NaOH are required for A,B and C, respectively. Arrange the solutions in the increasinng order of their buffer capacity.

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147. Of the two bottles, one contains HCl solution and the other a buffer solution. Each of the bottles is labelled as pH=5. how can you identify the solutions?

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148. Derive the relation between the solublity produce $\left(K_{sp}\right)$ and the solublity (S) of a sparingly soluble salt of the type, M_xA_y at a given temperature.

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149. At a given temperature, if the solublity product and the solublity of a sparingly soluble salt M_2X_3 be K_{sp} and S.

respectively, then prove that $S = \left(\frac{K_{sp}}{108}\right)^{1/(5)}$.

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150. At a certain temperature, K_{sp} of $AgCl$ in water is 1.8×10^{-10}. What will be its K_{sp} is a 0.1 M solution of $AgNO_3$ at some temperature.

View Text Solution

151. The principle of solublity product is also applicable in case of highly soluble ionic compounds-explain with the help of a suitable example.

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152. Two strong electrolytes AB and CD react with each other, forming a sparingly soluble salt AD. The solution of x(M) AB is mixed with an equal volume of the solution off y(M) CD. If the solubility product of AD be z, then what will be the value of xy (in terms of z) when AD starts precipitating?

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153. The solubility products of silver bromide, silver cyanide, silver chromate annd silver chloride are $7.7 \times 10^{-13}, 2.2 \times 10^{-12}, 9 \times 10^{-12} a \cap d 1.56 \times 10^{-10}$, respectively. If a dilute solution of silver nitrate is added drop by drop by drop to a solution containing equal concentrations of potassium bromide, potassium cyanide, potassium chromate and potassium chloride, then which silver salt will precipitate first and which one at last?

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QUESTION ANSWER ZONE FOR BOARD EXAMINATION (very short answer type)

1. To find out the equilibrium constant (K) of a reaction, it is compulsory to mention the balanced equation of the reaction-why?

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2. For what kind of solids, 'solid ⇔ vapour' equilibrium is achived is achieved easily?

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3. At a fixed temperature, a liquid is in equilibrium with its vapours in a closed vessel. Which measurable quantity for the liquid gets fixed at equilibrium?

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4. The equilibrium established in the evaporation of a liquid at a given temperature is due to the same rate of two processes. What are these two processes?

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5. In a soda-water bottle, CO_2 gas remains dissolved in water under high pressure, write down the equilibrium established in this case.

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6. At $0^\circ C$ and 1 at pressure, why is the equilibrium established between water and ice regarded as dynamic in nature?

Watch Video Solution

7. Find out K_p/K_c for the reactio $CO(g) + \frac{1}{2}O_2(g) \Leftrightarrow CO_2(g)$.

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8. For the reaction, $2NH_3(g) \Leftrightarrow N_2(g) + 3H_2(g)$ the units of K_p will be

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9. The values of equilibrium constant (K) of a reaction at $25^{\circ} C \& 50^{\circ} C$ are $2 \times 10^{-4} \& 2 \times 10^{-2}$, respectively. Is the reaction exothermic or endothermic?

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10. For a gaseous reaction, $K_p > K_c$. What will be the effect on equilibrium if pressure is increased at constant temperature? Will it affect the yields of the products?

Watch Video Solution

11. In case of thermal decomposition of $H_2(g)$ to $H(g)$, which conditions of pressure and temperature will be favourable for an increase in the yield of H(g)?

Watch Video Solution

12. In case of the reaction $A_2(g) + 4B_2(g) \Leftrightarrow 2AB_4(g)$, the change in enthalpy (ΔH) is negative. Mention the conditions of pressure and temperature at which the yield of the product, $AB_4(g)$ will decrease.

Watch Video Solution

13. How will equilibrium of the reaction, $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ be affected if the volume of the reaction syste at equilibrium is doubled keeping the temperature constant?

Watch Video Solution

14. Each of HS^- and NH_3 can act as both Bronsted acid and Bronsted base-why? Write the formula of conjugate base and conjugate acid in each case.

Watch Video Solution

15. In the reaction $I_2 + I^- \rightarrow I_3^-$, which one acts as a Lewis base?

Watch Video Solution

16. The pK_a values of the three weak acids HA, HB and HC are 4.74, 3.75 and 4.20, respectively. Arrange them in order their of increasing acid strengths.

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17. X and Y are two aqueous solutions of acid HA with concentrations 0.1 M & 0.01M, respectively. In which solution will the degree of ionisation of HA be higher?

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18. Which one of the following two acids will have a higher concentration of H_3O^+ ions in their 0.1(M) aqueous solution- (1) HCl and (2) CH_3COOH?

Watch Video Solution

19. Show that $\left[OH^-\right] > \sqrt{K_w}$ in an alkaline solution.

Watch Video Solution

20. Will the concentration of H_3O^+ ions in pure water at $0^\circ C$ be more than or less than that at $4^\circ C$?

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21. At a certain temperature, what is the value for the sum of pH annd pOH for an aqueous solution? What will be its value at $25^\circ C$?

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22. Show that in pure water, $pH = pOH = \frac{1}{2}pK_w$.

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23. An acid bottle is labelled 'pH=5'. Is this acid a weak acid?

Watch Video Solution

24. At a certain temperature, K_w of pure water $= 10^{-12}$ what will be the pH-range and pH of the neutral solution at that temperature?

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25. pH of an aqueous 0.1(M) CH_3COOH solution is 2.87. state whether pH of the solution will decrease or increase if CH_3COONa is added to this solution.

Watch Video Solution

26. At $25^{\circ}C$, the ionisation constant $\left(K_a\right)$ of weak acid HA is 10^{-6}. What will the value of ionisationn constant $\left(K_b\right)$ of its conjugate base $\left(A^{-}\right)$ be at that temperature ?

Watch Video Solution

27. Which of the following mixtures will act as buffer solution(s)?

(1) 50 mL 0.1(M) $NH_3 + 100mL \quad 0.025(M)HCl$

(2) 100mL 0.05(M) $CH_3COOH + 50mL0.1(M)NaOH.$

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28. Here are a few salts. Whose aqueous solution(s) at $25^{\circ}C$ has (have) a pH greater than 7, less than 7 or equal to?

$\left(NH_4\right)_2SO_4, CH_3COONH_4, K_2CO_3, NaNO_3$

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29. A liquid is in equilibrium with its vapour as its boiling point. On average which property of the molecules is equal in two phases?

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30. According to Le Chatelier's principle, what is the effect of adding heat to a solid and liquid in equilibrium?

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QUESTION ANSWER ZONE FOR BOARD EXAMINATION SHORT ANSWER TYPE

1. The unit of equilibrium constant of the reaction, $A + 3B \Leftrightarrow nC$ is $L^2 \cdot mol^{-2}$. What is the value of n

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2. Find out the value of K_p/K_c for the reaction $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$, at 298K, consider the unit of concentration is $mol \cdot L^{-1}$ and the unit of pressure is atm.

Watch Video Solution

3. Mention two ways by which the equilibrium of the given reaction can be shifted to the right.

$$CH_3COOH(l) + C_2H_5OH(l) \overset{H^+}{\Leftrightarrow} CH_3COOC_2H_5(l) + H_2O(l)$$

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4. When steam is passed over red hot iron, H_2 gas is produced. In this reaction, the yield of $H_2(g)$ is found to increase when the partial pressure of steam is increased. Explain.

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5. Why does not the equilibrium constant expression for a reaction involving pure solids or liquid contain the concentrations terms of the solid or liquids?

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6. Find out the equilibrium constant for the reaction, $XeO_4(g) + 2HF(g) \Leftrightarrow XeO_3F_2(g) + H_2O(g)$ consider K_1 as the equilibrium constant for the reaction, $XeF_6(g) + H_2O(g) \Leftrightarrow XeOF_4(g) + 2HF(g)$ and K_2 as the equilibrium constant for the reaction, $XeO_4(g) + XeF_6(g) \Leftrightarrow XeOF_4(g) + XeO_3F_2(g)$.

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7. How will the following reaction equilibrium be affected if the volume of each reaction system is increased at constant temperature?

(1) $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$

(2) $C(s) + \frac{1}{2}O_2(g) \Leftrightarrow CO(g)$

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8. The equilibrium of any reversible reaction may be shifted to the left or right by changing the conditions. Will this change cause any alteration in the value of equilibrium constant?

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9. Constant temperature, the following reaction is at equilibrium in a closed container:

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

At constant pressure, if the amount of the solid carbon is reduced to half at equilibrium, then what will be the change in the concentration of CO(g)?

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10. At constant temperature, if the pressure is changed at equilibrium of a gaseous reaction, then will the values of K_p, K_c and K_x change?

Watch Video Solution

11. How can the yield of the product be increased by changing the volume of the reaction system in the given reactions at constant temperature?

(1) $C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g)$

(2) $2H_2(g) + O_2(g) \Leftrightarrow 2H_2O(l)$

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12. Mention two factors for which the yields of the products in the given reaction increases.

$CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$ - heat.

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13. At a particular temperature, for the reaction, $aA + bB \Leftrightarrow dC + cD$, equilibrium constant is K. Find out the equilibrium constants for the following reactions at the same temperature.

(1) $maA + mbB \Leftrightarrow mdC + mcD$

(2) $\frac{1}{m}aA + \frac{1}{m}bB \Leftrightarrow \frac{1}{m}dC + \frac{1}{m}cD$

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14. What would the effect on the yield of products be if temperature of the following reaction systems is changed at equilibrium ?

(1) $N_2(g) + O_2(g) \Leftrightarrow 2NO(g), \Delta H > 0$

(2) $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g), \Delta H < 0$

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15. Identify Lewis acids and Lewis bases in the following reactions and give reactions: (1) $SiF_4 + 2F^- \rightarrow SiF_6^{2-}$

(2) $RMgX + 2\left(C_2H_5\right)_2\ddot{O}: \rightarrow RMg\left[O\left(C_2H_5\right)_2\right]_2X$

(3) $Ag^{+} + 2\ddot{N}H_3 \rightarrow \left[Ag\left(NH_3\right)_2\right]^{+}$

(4) $\ddot{N}H_3 + H^{+} \rightarrow \overset{+}{N}H_4.$

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16. State the nature of aqueous solutions containing the following ions with reason: NH_4^{+}, F^{-}, Cl^{-}.

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17. The solubility of zinc phosphate in S $mol \cdot L^{-1}$. Derive the mathematic expression of the solublity product of the compound .

Watch Video Solution

18. At a certain temperature, the ionisation of two weak acids, HA and HB are K_{a_1} and K_{a_2}, respectively. If $K_{a_1} > K_{a_2}$ and the concentration of the

aqueous solutions of both the acids be 0.1(M), then which solution will have a higher pH?

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19. What will be the change in concentrations of H_3O^+ & OH^- and the ionic product of water $\left(K_w\right)$ if NaOH is added to pure water at a certain temperature?

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20. 20 mL of 0.15(M) HCl solution is mixed with 50 mL of 0.1(M) CH_3COONa solution. State whether the mixed solution will act as a buffer or not.

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21. The pH of a buffer solution remains almost unchanged even after dilute- explain.

Watch Video Solution

22. Consider the salts given below. For which salt(s) will the pH of the aqueous solution (s) be independent of the concentration of the salt? CH_3NH_3Cl, $(NH_4)_3PO_4$, KCN and $(NH_4)_2CO_3$.

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23. When H_2S gas is passed through an acidified solution of Cu^{2+} and Zn^{2+}, only CuS is precipitated-why?

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24. Zinc sulphide is not precipitated from an acidic solution of zinc salt by passing H_2S. Why?

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25. What will happen when a solution of potassium chloride is added to a saturated solution of lead chloride? Give reason.

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26. Why does not $MgSO_4$ form any precipitate when it reacts with NH_3 in presence of NH_4Cl?

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27. Why is the aqueous solution of $Cu(NO_3)_2$ acidic?

Watch Video Solution

28. In spite of being a neutral salt, the aqueous solution of Na_2CO_3 is alkline-why?

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29. (1) HPO_4^{2-} can act both as a Bronsted base and as a Bronsted acid. Write the equation of equilibrium established by HPO_4^{2-} as an acid and a base in aqueous solution. Also write the expressions of $K_a \& K_b$ in two cases.

(2) What are the conjugate acid and base of HS^-?

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30. Will the pH of pure water at $20^\circ C$ be lower or higher than that at $50^\circ C$?

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31. An aqueous solution of sodium bisulphate is acidic, whereas an aqueous solution of sodium bicarbonate is basic-explain.

Watch Video Solution

32. Both Cus and ZnS are precipitated if H_2S gas is passed through an alkaline solution of Cu^{2+} and Zn^{2+}. Explain.

Watch Video Solution

33. $Ag^+ + NH_3 \Leftrightarrow \left[Ag\left(NH_3\right)\right]^+, K_1 = 3.5 \times 10^3$

$\left[Ag\left(NH_3\right)\right]^+ + NH_3 \Leftrightarrow \left[Ag\left(NH_3\right)_2\right]^+, K_2 = 1.7 \times 10^3$

Calculate the formation constant of $\left[Ag\left(NH_3\right)_2\right]^+$.

Watch Video Solution

34. Write the correct order of increasing acid strength among $HCO_3^-, H_3O^-, HSO_4^-, HSO_3F$.

Watch Video Solution

35. The first and second dissociation constants of an acid H_2A are 1×10^{-5} and 5×10^{-10} respectively. Calculate the value of overall dissociation constant.

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36. α - D-glucose $\Leftrightarrow \beta$ - D glucose, equilibrium constant for this is 1.8. calculate the percentage of α - D glucose at equilibrium.

Watch Video Solution

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

Watch Video Solution

38. 2.5 mL of $\frac{2}{5}M$ weak monoacidic base $\left(K_b = 1 \times 10^{-12}$ at $25^\circ C\right)$ is titrated with $\frac{2}{15}$M HCl in water at $25^\circ C$. Calculate the concentration of H^+ at equilibrium point. $\left(k_w = 1 \times 10^{-14}\right)$

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QUESTION ANSWER ZONE FOR BOARD EXAMINATION LONG ANSWER TYPE

1. State the law of chemical equilibrium and explain it.

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2. Find out the value of equilibrium constant, for the reaction, $2NH_3(g) + \frac{5}{2}O_2(g) \Leftrightarrow 2NO(g) + 3H_2O(g)$.

Consider K_1, K_2 and K_3 as the respective equilibrium constants of the given three reaction:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g) \ldots$ (1)

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g) \ldots$ (2)

$H_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow H_2O(g) \ldots$ (3)

Watch Video Solution

3. When 1 mole of ethyl alcohol and 1 mole of acetic acid arc heated in a closed vessel even for adong time 1 mole of ester and 1 mole of water are never produced. Explain why?

Watch Video Solution

4. $CO(g) + 2H_2(g) \Leftrightarrow CH_3OH(g)$, for this reversible reaction at equilibrium Keeping temperature constant what will happen if (i) the volume of the container is halved (ii) the partial pressure of H_2 is halved (iii) He gas is introduced at constant temperature and pressure.

Watch Video Solution

5. The following equilibrium is established during thermal dissociation of $H_2O(g)$ in a closed vessel:

$H_2O(g) \Leftrightarrow H_2(g) + \frac{1}{2}O_2(g)$

If the total pressure of the system be P, then find out the relation between equilibrium constant $\left(K_p\right)$ and the degree of dissociation of $H_2O(g)$.

Watch Video Solution

6. The equilibrium established during thermal dissociation of $PCl_5(g)$ in a closed vessel is as follows:

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

If the degree of dissociation of $PCl_5(g)$ at equilibrium be 'x', then show that (1) 'x' is inversely proportional to the square root of the total pressure of reaction mixture at equilibrium and (2) 'x' increases with increase in volume of the system.

Watch Video Solution

7. Explain the effect of addition of inert gas to the following systems at equilibrium at constant pressure and temperature- (1) $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$

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

(3) $C(s) + O_2(g) \Leftrightarrow CO_2(g)$.

Watch Video Solution

8. The given reaction is carried out in a closed vessel: $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g), \Delta H^0 > 0$. What would be the effect of the following changes on the equilibrium of the reaction if (1) solid $CaCO_3$ is added to the reaction system, (2) some amount of CaO is removed from the reaction system, (3) $CO_2(g)$ is introduced into the reaction system at constant volume and temperature.,

(4) temperature is increased, and (5) volume of the reaction vessel is reduced at constant temperature.

Watch Video Solution

9. The concentration of each of the aqueous solutions of NaCl, NH_4Cl, $NaCn$ and HCl is 0.1(M). Arrange these solutions in the increasing order of their pH.

Watch Video Solution

10. Derive the mathematical form of degree of ionisation of acetic acid in its dilute aqueous solution at a given temperature.

Watch Video Solution

11. Explain the buffer action of the mixed aqueous soluton of Na_2CO_3 and $NaHCO_3$.

Watch Video Solution

12. Arrange the following sparingly soluble ionic compounds in the increasing order of molar solubilities.

(1) $MX : K_{sp} = 8.1 \times 10^{-17}$

(2) $AX_2, K_{sp} = 4 \times 10^{-9}$

(3) $PX_3, K_{sp} = 2.7 \times 10^{-19}$.

Watch Video Solution

13. The equilibrium constant K_{p_1} and K_{p_2} for the reaction $X \Leftrightarrow 2Y$ and $Z \Leftrightarrow P + Q$, respectively are in the ratio of 1:9. if the degree of dissociation of X and Z be equal, find the ratio of total pressure at these equilibriam.

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SOLVED WBCHSE SCANNER

1. Ammonium chloride dissolves in water with absorption of heat. The solubility of ammonium chloride increases with ____in temperature.

Watch Video Solution

2. Consider the givenr reaction:

$A_2(g) + B_2(g) \Leftrightarrow 2AB(g), \Delta H < 0$

How can the yield of AB(g) be increased?

Watch Video Solution

3. $A_2(g) + B_2(g) \Leftrightarrow 2AB(g),$ equilibrium constant of the given reaction at $100\ ^\circ C$ is 50. A 1 L flask containing 1 mol of A_2 is connected to a 2L flask containing 2mol of B_2. Calculate theno. Of moles of AB at $100^\circ C$ at equilibrium.

Watch Video Solution

4. Fill in the blank: AgCl gets precipitated when the product of the concentrations of its ions exceed its____.

Watch Video Solution

5. 50 ml 0.1 N CH_3COOH solution is mixed with 25 ml 0.1 N NaOH solution. What is the pH of the final solution? Given : pK_a of CH_3COOH = 4.74

Watch Video Solution

6. What is common ion effect? Cite an example.

Watch Video Solution

7. Calculate the solubility of $SrSO_4$ in water in $mol \cdot L^{-1}$ at $25\,^\circ C$ (solubility product of $SrSO_4$ at $25\,^\circ C = 7.6 \times 10^{-7} mol^2 \cdot L^{-2}$).

Watch Video Solution

8. Indicate the correct answer: for the reaction $SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g)$, if $K_p = K_c(RT)^x$, then x is -

A. -1

B. $-\frac{1}{2}$

C. $+\frac{1}{2}$

D. 1

Watch Video Solution

9. $I_2(g) \Leftrightarrow 2I(g)$, Discuss the effect of the following changes on equilibrium of the mentioned endothermic reaction: (i) temperature is increased. (ii) pressure is increased at constant temperature.

Watch Video Solution

10. The dissociation equilibrium of AB_2 gas is,

$2AB_2(g) \Leftrightarrow 2AB(g) + B_2(g)$

The degree of dissociation of $AB_2(g)$ is x and $x < < 1$. Establish the relation among the degree of dissociation (x), equilibrium constant $\left(K_p\right)$ and total pressure (P).

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11. Fill in the blanks: Addition of silver nitrate solution to saturated solution of AgCl produces turbidity. This is due to ___effect.

Watch Video Solution

12. Indicate the correct answer: pH of $10^{-10}(M)$ aqueous solution of HCl is approximately-

A. 14

B. 10

C. 7

D. 1

Watch Video Solution

13. An aqueous solution of chloroacetic acid of strength 0.2 $mol \cdot L^{-1}$ has pH 1.7. calculate the degree of dissociation of the acid.

Watch Video Solution

14. Calculate the amount of NaOH in gram present in 1L NaOH solution of pH=12.

Watch Video Solution

15. In the reaction, $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$, the value of equilibrium constant $\left(K_P\right)$ changes with change in ____.

Watch Video Solution

16. The equilibrium constant of the following equilibria

$SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g)$

$2SO_3(g) \Leftrightarrow 2SO_2(g) + O_2(g)$ are given by K_1 and K_2 respectively. Find the relation between K_1 and K_2.

Watch Video Solution

17. What will be the effect of addition of an inert gas in the following equilibrium at constant temperature and volume? $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$.

Watch Video Solution

18. For the relation, $H_2(g) + CO_2(g) \Leftrightarrow H_2O(g) + CO(g)$ show the equilibrium yield of the products is independent of pressure at constant temperature.

Watch Video Solution

19. Fill in the blanks: For a ____electrolyte the degree of dissociation increases as its ____decreases.

Watch Video Solution

20. Choose the correct answer:

At $40^{\circ} C$ the ionic product of water being 2.92×10^{-14}, its pH is-

A. < 7.0

B. > 7.0

C. 7.0

D. 14.0

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21. AgCl is dissolved separately in pure water and in 0.025(M) NaCl solution. Find the ratio of concentrations of Ag^{+} ion in pure water and in the NaCl solution. The solubility product of AgCl is 1.75×10^{-10}.

Watch Video Solution

22. Give example of an acidic and an alkaline buffer solution. Explain the buffer action of any one of the solutions.

Watch Video Solution

23. The equilibrium constant $\left(K_P\right)$ of a gaseous reaction is-

A. dependent on the total pressure

B. dependent on the pressure

C. dependent on the concentration of the reactants

D. dependent on the presence of an inert gas

Watch Video Solution

24. Consider the equilibrium:

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ + heat. Apply the i.e., chatelier's principle to explain the effect of pressure, temperature and addition of inert gas at constant volume on the equilibrium yield of NH_3.

Watch Video Solution

25. What is buffer solution? Give one example.

Watch Video Solution

26. At 318K and 2 atm total pressure the degree of dissociation (α) is 28% at the equilibrium condition for the reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$. Calculate $K_p \& K_c$.

Watch Video Solution

27. Calculate the pH of 0.1(M) NH_4OH at $25^\circ C$. The dissociation constant of NH_4OH at $25^\circ C$ is 1.76×10^{-5}.

Watch Video Solution

28. The pH of aqueous solution of NH_4Cl is ____than 7 and the pH of aqueous solution of Na_2CO_3 is _____ than 7.

Watch Video Solution

29. Ionic product of water____ with increase in temperature and therefore pH of water___with increase in temperature.

Watch Video Solution

30. The solubility of a sparingly soluble A_2B salt at a given temperature being x(M), its solubility product is-

A. x^3

B. $2x^2$

C. $4x^3$

D. $2x^3$

Watch Video Solution

31. What is buffer solutio? Give one example of acidic buffer. In which case of acidic buffer pH = pKa.

Watch Video Solution

32. 1.37g of a mixture of Na_2CO_3 and $NaHCO_3$ was dissolved in water. The solution was titrated with 0.5(M) HCl solution first with phenolphthalein followed by methyl orange indicator. The first and second titrations required 10 mL and 30mL of acid solution respectively. calculate the amounts (in g) of Na_2CO_3 and $NaHCO_3$ present in the mixture.

Watch Video Solution

33. For the reversible reaction $A + 2B \Leftrightarrow C +$ heat, the forward reaction will proceed at-

A. low temperature and low pressure

B. low pressure

C. high pressure and low pressure

D. high pressure and high temperature

Watch Video Solution

34. $4NH_3(g) + 5O_2(g) \Leftrightarrow 4NO(g) + 6H_2O(g)$. Write the K_p and K_c values for the above reaction and also make a relation between them.

Watch Video Solution

35. What is meant by solubility product?

Watch Video Solution

36. pH of $0.2 mol \cdot L^{-1}$ chloroacetic acid is 1.7. find out the degree of dissociation of this chloroacetic acid.

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37. At 1000K temperature CO_2 has a pressure of 0.5 atm in a closed container. On adding some amount of graphite inside the container, some amount of CO_2 is converted to CO. at equilibrium the pressure becomes 0.8 atm. Find out the value of K_p.

Watch Video Solution

38. What amount of CH_3COONa is to be added to one litre of $0.1(M)CH_3COOH$ solution so that the pH becomes 4.0? $\left[K_a = 1.8 \times 10^{-3}\right]$

.

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39. What is meant by common ion effect?

Watch Video Solution

40. $PCl_5 \Leftrightarrow PCl_3(g) + Cl_2(g)$. For this reaction at the chemical equilibrium condition which of the following is correct-

A. $K_p = K_c$

B. $K_c = K_p \times RT$

C. $K_p = K_c \times RT$

D. $K_p = \frac{1}{K_c}$

Watch Video Solution

41. (i) State law of mass action.

(ii) For the reaction $N_2 + 3H_2 \Leftrightarrow 2NH_3$ equilibrium constant is K_1 and that of for the reaction $NH_3 \Leftrightarrow \frac{1}{2}N_2 + \frac{3}{2}H_2$ is K_2. Then calculate the relation between K_1 and K_2.

(iii) Calculate the pH of 0.01 (M) CH_3COOH at $25\,^{\circ}C$. $\left(K_a \text{ of } CH_3COOH = 1.75 \times 10^{-5}\right)$.

Watch Video Solution

42. What is buffer solutio? Give one example of acidic buffer. In which case of acidic buffer pH = pKa.

Watch Video Solution

43. In which of the following cases chemical reaction goes to complete in high extent-

A. $K = 10^6$

B. $K = 10^{-6}$

C. $K = 10^{-8}$

D. $K = 1$

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44. What is the pH of $10^{-7}(M)HCl$ solution-

A. 7

B. 6.79

C. 6.12

D. 7.1

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45. $N_2 + 3H_2 \Leftrightarrow 2NH_3$. Total pressure of the system is P and mole-fraction of NH_3 is x. express K_p of the reaction with respect to x and P, where value of x is very small.

Watch Video Solution

46. (i) Aqueous solution of borax basic? Explain.

(ii) Calculate the pH of 0.05(M) H_2SO_4 solution?

(iii) What is the formula of the conjugate base of $\left[Al\left(H_2O\right)_6\right]^{3+}$?

Watch Video Solution

47. The relation betweenn K_p and K_c for the following reaction-

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$

A. $K_p = K_c$

B. $K_p = K_c(RT)^{-1}$

C. $K_p = K_c(RT)$

D. $K_p = K_c(RT)^2$

Watch Video Solution

48. State the law of mass action.

Watch Video Solution

49. What is buffer solution? Give example of an acidic buffer solution.

Watch Video Solution

50. If the concentration of ammonia of ammonium chloride in a buffer solution of ammonia-ammonium chloride are 0.2M and 0.3M respectively, determine the pH of the solution. [Given $K_b\left(NH_3\right) = 1.76 \times 10^{-5}$]

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51. Determine the pH of 0.1 M acetic acid solution. (pK_a of acetic acid=4.75). Is there any OH^- present in this solution of acetic acid? Answer with reason.

Watch Video Solution

52. Why does rate of dissociation of H_2S solution decrease in the presence of HCl?

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SOLVED NCERT EXERCISE

1. A liquid is in equilibrium with its vapour in a sealed container at a fixed temperature. The volume of the container is suddenly increased.

(1) What is the initial effect of the change on vapour pressure?

(2) How do rates of evaporation & condensation change initially?

(3) What happens when equilibrium is restored finally and what will be the final vapour pressure?

Watch Video Solution

2. What is K_c for the following equilibrium when the equilibrium concentration of each substance is: $\left[SO_2\right] = 0.60(M), \left[O_2\right] = 0.82(M)$ and $\left[SO_3\right] = 1.90(M)$?

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$.

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3. At a certain temperature & total pressure of $10^5 Pa$, iodine vapour contians 40% by volume 1 atoms, $I_2(g) \Leftrightarrow 2I(g)$. Calculate K_p for the equilibrium.

Watch Video Solution

4. Write the expression for the equilibrium constant, K_c for each of the following reactions: $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$.

Watch Video Solution

5. Write the expression for the equilibrium constant, K_c for each of the following reactions: $2Cu\left(NO_3\right)_2(s) \Leftrightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$

Watch Video Solution

6. Write the expression for the equilibrium constant, K_c for each of the following reactions:

$CH_3COOC_2H_5(aq) + H_2O(l) \Leftrightarrow CH_3COOH(aq) + C_2H_5OH(aq)$

Watch Video Solution

7. Write the expression for the equilibrium constant, K_c for each of the following reactions: $Fe^{3+}(aq) + 3OH^-(aq) \Leftrightarrow Fe(OH)_3(s)$

Watch Video Solution

8. Write the expression for the equilibrium constant, K_c for each of the following reactions: $I_2(s) + 5F_2 \Leftrightarrow 2IF_5$

View Text Solution

9. Find out the value of K_c for each of of the following equilibria from the value of K_p:

$2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g), K_p = 1.8 \times 10^{-2}$ at 500K

Watch Video Solution

10. Find out the value of K_c for each of of the following equilibria from the value of K_p:

$CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g), K_p = 167$ at 1073 K.

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11. For the following equilibrium, $K_c = 6.3 \times 10^{14}$ at 1000 K: $NO(g) + O_3(g) \Leftrightarrow NO_2(g) + O_2(g)$. Both The forward and reverse reactions in the equilibrium are elementary bimolecular reactions. What is K_c for the reverse reaction ?

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12. Explain why pure liquids and solids can be ignored while writing the equilibrium constant expression

Watch Video Solution

13. Reaction between N_2 and O_2 takes place as follows: $2N_2(g) + O_2(g) \Leftrightarrow 2N_2O(g)$. If a mixture of 0.482 mol of N_2 and 0.933 mol of O_2 is placed in a 10 L reaction vessel and allowed to form N_2O at a temperature for which $K_c = 2.0 \times 10^{-37}$, determine the composition of equilibrium mixture.

Watch Video Solution

14. Nitric oxide reacts with Br_2 and gives nitrosyl bromide as per reaction gives below:

$2NO(g) + Br_2(g) \Leftrightarrow 2NOBr(g)$

When 0.087 mol of NO and 0.0437 mol of Br_2 are mixed in a closed container at constant pressure, 0.0518 mol of NOBr is obtained at equilibrium. calculate equilibrium amount of NO and Br_2.

Watch Video Solution

15. At 450K, $K_p = 2.0 \times 10^{10}$/bar for the given reaction at equilibrium, $2SO_2(g) + O_2 \Leftrightarrow 2SO_3(g)$. What is K_c at this temperature.

Watch Video Solution

16. A sample of HI(g) is placed in flask at a pressure of 0.2 atm. At equilibrium the partial pressure of HI(g) is 0.04 atm. What is K_p for the given equilibrium?

$2HI(g) \Leftrightarrow H_2(g) + I_2(g)$.

Watch Video Solution

17. A mixture of 1.57 mol of N_2, 1.92 mol of H_2 & 8.13 mol of NH_3 is introduced into a 20 L reaction vessel at 500 K. at this temperature, the equilibrium constant, K_c for the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NO_3(g)$ is 1.7×10^2. is the reaction mixture at equilibrium ? if not, what is the direction of the net reaction?

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18. The equilibrium constant expression for a gas reaction is, $K_c = \frac{[NH_3]^4[O_2]^5}{[NO]^4[H_2O]^6}$. Write the balanced chemical equation corresponding to this expression.

Watch Video Solution

19. One mole of H_2O and one mole of CO are taken in 10 L vessel and heated to 725 K. at equilibrium 40% of water (by mass) reacts with CO according to the equation $H_2O(g) + CO(g) \Leftrightarrow H_2(g) + CO_2(g)$.

Calculate the equilibrium constant for the reaction.

Watch Video Solution

20. At 700K, equilibrium constant for the reaction: $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$ is 54.8. if 0.5 $mol \cdot L^{-1}$ of HI(g) is present at equilibrium at 700 K, what are the concentrations of $H_2(g)$ and $I_2(g)$ assuming that we initially started with HI(g) and allowed it to reach equilibrium at 700 K ?

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21. What is the equilibrium concentration of each of the substances in the equilibrium when the initial concentration of ICl was 0.78(M)?

$2ICl(g) \Leftrightarrow I_2(g) + Cl_2(g), K_c = 0.14.$

Watch Video Solution

22. $K_p = 0.04$ atm at 899 K for the equilibrium shown below. What is the equilibrium concentration of C_2H_6 when it is placed in a flask at 4.0 atm pressure and allowed to come to equilibrium?

$C_2H_6(g) \Leftrightarrow C_2H_4(g) + H_2(g)$.

Watch Video Solution

23. Ethyl acetate is formed by the reaction between ethanol and acetic acid and the equilibrium is represented as: $CH_3COOH(l) + C_2H_5OH(l) \Leftrightarrow CH_3COOC_2H_5(l) + H_2O(l)$

(1) Write the concentration ration (reaction, quotient), Q_c, for this reaction (note: Water is not in excess and is not a solvent in this reaction).

(2) At 293K, if one starts with 1.00 mol of acetic acid and 0.18 mol of ethanol, there is 0.171 mol of ethyl acetate in the final equilibrium mixture. calculate the equilibrium constant.

(3) Starting with 0.5 mol of ethanol and 1.0 mol of acetic acid and maintaining it at 293K, 0.214 mol of ethyl acetate is found after sometime. has equilibrium been reached?

Watch Video Solution

24. A sample of pure PCl_5 was introduced into an evacuated vessel at 473 K. after equilibrium was attained, concentration of PCl_5 was found to be $0.5 \times 10^{-1} mol \cdot L^{-1}$, if value of K_c is 8.3×10^{-3}, what are the concentration of PCl_3 and Cl_2 at equilibrium?

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25. One of the reaction that takes place in producing steel from iron ore is the reduction of iron (II) oxide by carbon monoxide to give iron metal and CO_2. $FeO(s) + CO(g) \Leftrightarrow Fe(s) + CO_2(g), K_p = 0.265 atm$ at 1050K. What are the equilibrium partial pressures of CO and CO_2 at 1050K if the initial partial pressures are: $p_{CO} = 1.4 atm \& p_{CO_2} = 0.80$ atm?

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26. Equilibrium constant, K_c for the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$ at 500K is 0.061. at a particular time, the analysis shows that composition of the reaction mixture is 3.0 $mol \cdot L^{-1}$ N_2, $2.0 mol \cdot L^{-1}$ H_2 and $0.5 mol \cdot L^{-1} NH_3$. is the reaction at equilibrium? If not in which direction does the reaction tend to proceed to reach equilibrium ?

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27. Bromine monochloride, BrCl decomposes into bromine and chlorine and reaches the equilibrium: 500K. If initially pure BrCl is present at a concentration of $3.3 \times 10^{-3} mol \cdot L^{-1}$, what is its molar concentration in the mixture at equilibrium?

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28. At 1127 K & 1 atm, a gaseous mixture of CO and CO_2 in equilibrium with solid carbon has 90.55% CO by mass $C(s) + CO_2(g) \Leftrightarrow 2CO(g)$. Calculate K_C for this reaction at the above temperature.

Watch Video Solution

29. Calculate (1) ΔG^0 and (2) The equilibrium constant for the formation of NO_2 from NO and O_2 at 298K.

$NO(g) + 1/2O_2(g) \Leftrightarrow NO_2(g)$

where $\Delta_f\Delta G^0\left(NO_2\right) = 52.0kJ/mol,$

$\Delta_fG^0(NO) = 87.0kJ/mol, \Delta_fG^0\left(O_2\right) = 0kJ/mol$

Watch Video Solution

30. Does the number of moles of reaction products increase, decrease of remain same when each of the following equilibria is subjected to a decrease in pressure by increasing the volume?

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

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31. Does the number of moles of reaction products increase, decrease of remain same when each of the following equilibria is subjected to a decrease in pressure by increasing the volume?

$CaO(s) + CO_2(g) \Leftrightarrow CaCO_3(s)$

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32. Does the number of moles of reaction products increase, decrease of remain same when each of the following equilibria is subjected to a decrease in pressure by increasing the volume?

$3Fe(s) + 4H_2O(g) \Leftrightarrow Fe_3O_4(s) + 4H_2(g)$.

Watch Video Solution

33. Which of the following reactions will get affected by increasing the pressure? Also, mention whether change will cause the reaction to go into forward or backward direction.

(1) $COCl_2(g) \Leftrightarrow CO(g) + Cl_2(g)$

(2) $CH_4(g) + 2S_2(g) \Leftrightarrow CS_2(g) + 2H_2S(g)$

(3) $CO_2(g) + C(s) \Leftrightarrow 2CO(g)$

(4) $2H_2(g) + CO(g) \Leftrightarrow CH_3OH(g)$

(5) $CaCO_3(s) \Leftrightarrow CaO(s) + CO_2(g)$

(6) $4NH_3(g) + 5O_2(g) \Leftrightarrow 4NO(g) + 6H_2O(g)$.

Watch Video Solution

34. The equilibrium constant for the followingg reaction is 1.6×10^5 at 1024K, $H_2(g) + Br_2(g) \Leftrightarrow 2HBr(g)$. Find the equilibrium pressure of all gases if 10.0 bar of HBr is intoroduced into a sealed container at 1024K.

Watch Video Solution

35. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per following

$CH_4(g) + H_2O(g) \Leftrightarrow CO(g) + 3H_2(g)$

Write an expression for K_p for the above reaction.

Watch Video Solution

36. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per following

$CH_4(g) + H_2O(g) \Leftrightarrow CO(g) + 3H_2(g)$

How will the values of K_p and composition of equilibrium mixture be affected by

(i) Increasing the pressure (ii) Incresing the temperature (iii) using a catalyst ?

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37. Describe the effect of:

Addition of H_2.

Watch Video Solution

38. Describe the effect of:

Addition of CH_3OH.

Watch Video Solution

39. Describe the effect of:

Removal of CO.

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40. Describe the effect of:

removal of CH_3OH on the equilibrium of: $2H_2(g) + CO(g) \Leftrightarrow CH_3OH(g)$.

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41. At 473K, equilibrium constant K_c for decomposition of PCl_5 is $8.3x10^{-3}$. If decomposition is depicted as, $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$,

$\Delta H_r^0 = 124.0 kJ \cdot mol^{-1}$

Write an expression for the reaction.

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42. At 473K, equilibrium constant K_c for decomposition of PCl_5 is $8.3x10^{-3}$. If decomposition is depicted as, $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$,

$\Delta H_r^0 = 124.0 kJ \cdot mol^{-1}$

What is the value of K_c for the reverse reaction at the same temperature?

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43. At 473K, equilibrium constant K_c for decomposition of PCl_5 is $8.3x10^{-3}$. If decomposition is depicted as, $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$,

$\Delta H_r^0 = 124.0 kJ \cdot mol^{-1}$

What would be the effect on K_c if (i) more PCl_5 is added (ii) presure is increased (iii) the temperature is increased?

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44. Dihydrogen gas used in Haber's process is produced by reacting methane from natural gas with high temperature steam. The first stage of two stage reaction involves the formation of CO and H_2. In second stage, CO formed in first stage is reacted with more steam in water gas shift reaction.

$CO(g) + H_2O(g) \Leftrightarrow CO_2(g) + H_2(g)$

If a reaction vessel at $400\,^{\circ}C$ is charged with an equimolar mixture of CO and steam such that $p_{CO} = p_{H_2O} = 4.0$ bar, what will be the partial pressure of H_2 at equilibrium? $K_p = 10.1$ at $400\,^{\circ}C$.

View Text Solution

45. Predict which of the following reaction will have appreciable concentration of reactants and products:

$Cl_2(g) \Leftrightarrow 2Cl(g), K_c = 5 \times 10^{-39}$

Watch Video Solution

46. Predict which of the following reaction will have appreciable concentration of reactants and products:

$Cl_2(g) + 2NO(g) \Leftrightarrow 2NOCl(g), K_c = 3.7 \times 10^8$

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47. Predict which of the following reaction will have appreciable concentration of reactants and products:

$Cl_2(g) + 2NO_2(g) \Leftrightarrow 2NO_2Cl(g), K_c = 1.8.$

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48. The value of K_c for the reaction $3O_2(g) \Leftrightarrow 2O_3(g)$ is 2.0×10^{-50} at $25\ ^\circ C$. If the equilibrium concentration of O_2 in air at $25\ ^\circ C$ is 1.6×10^{-2}, what is the concentration of O_3 ?

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49. The reaction $CO(g) + 3H_2(g) \Leftrightarrow CH_4(g) + H_2O(g)$ is at equilibrium at 1300K in a 1L flask. It also contains 0.30 mol of CO, 0.10 mol of H_2 and 0.02 mol of H_2O and an unknown amount of CH_4 in the flask. Determine the concentration on CH_4 in the mixture. the equilibrium constant, K_c for the reaction at the given temperature is 3.90.

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50. What is meant by the conjugate acid-base pair? Find the conjugate acid/base for the following species: $HNO_2, CN^-, HClO_4, F^-, OH^-, CO_3^{2-}$, and S^{2-}.

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51. Which of the following are Lewis acids? H_2O, BF_3, H^+ and NH_4^+

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52. What will be the conjugate bases for the Bronsted acids: HF, H_2SO_4 and HCO_3^- ?

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53. Write the conjugate acids for the following Bronsted bases: NH_2^-, NH_3 and $HCOO^-$.

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54. The species: H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Bronsted acids and bases. For each case give the corresponding conjugate acid and base.

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55. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid/base: (1) OH^-

(2) F^-

(3) H^+

(4) BCl_3.

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56. The concentration of hydrogen ion in a sample of soft drink is $3.8 \times 10^{-3}(M)$, what is its pH?

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57. The pH of a sample of vinegar is 3.76. calculate the concentration of hydrogen ion in it.

Watch Video Solution

58. The ionisation constant of HF< HCOOH and HCN at 298K are 6.8×10^{-4}, 1.8×10^{-4} and 4.8×10^{-9} respectively. Calculate the ionisation constant of the corresponding conjugate base.

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59. The ionisation constant of phenol is 1.0×10^{-10}. What is the concentration of phenolate ion in 0.05(M) phenol solution ? What will be its degree of ionisation if the solution is also 0.01(M) in sodium phenolate?

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60. The first ionisation constant of H_2S is 9.1×10^{-8}. Calculate the concentration of HS^- ion in its 0.1(M) solution. How this concentration be affected if the solution is 0.1(M) in HCl also? If the second dissociation constant of H_2S is 1.2×10^{-13}, calculate the concentration of S^{2-} under both conditions.

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61. The ionisation constant of acetic acid is `1.74xx10^(-5). Calculate the degree of dissociation of acetic acid in its 0.05 (M) solution. Calculate the concentration of acetate ion in the solution and its pH.

Watch Video Solution

62. It has been found that pH of a 0.01 (M) solution of an organic acid is 4.15. calculate the concentration of anion, ionisation constant of the acid and its pK_a.

Watch Video Solution

63. Assuming complete dissociation, calculate the pH of the following solutions: 0.003 (M) HCl

Watch Video Solution

64. Assuming complete dissociation, calculate the pH of the following solutions: 0.005 (M) NaOH

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65. Calculate the pH of 0.002(M) HBr solution

Watch Video Solution

66. 0.002(M) KOH

Watch Video Solution

67. Calculate the pH of the following solution:

2g of TIOH dissolved in water to give 2 litre of solution.

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68. Calculate the pH of the following solution:

0.3 g of $Ca(OH)_2$ dissolved in water to give 500 mL of solution.

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69. Calculate the pH of the following solution:

0.3g of NaOH dissolved in water to give 200 mL of solution.

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70. Calculate the pH of the following solution:

1mL of 13.6 (M) HCl is diluted with water to give 1 litre of solution.

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71. The degree of ionisation of a 0.1(M) bromoacetic acid solution is 0.132.

calculate the pH of the solution and the pK_a of bromoacetic acid.

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72. The pH of 0.005(M) codeine $\left(C_{18}H_{21}NO_3\right)$ solution is 9.95. calculate its ionisation constant and pK_b.

Watch Video Solution

73. What is the pH of 0.001 (M) aniline solution? The ionisation constant of aniline can be taken from standard table. Calculate the degree of ionisation of aniline in the solution. Also calculate the ionisation constant of the conjugate acid of aniline.

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74. Calculate the degree of ionisation of 0.05(M) acetic acid if its pK_avalue is 4.74. How is the degree of dissociation affected when its solution also contain (1) 0.01(M) in HCl

(2) 0.1(M) in HCl?

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75. The ionisation constant of dimethylamine is 5.4×10^{-4}. Calculate its degree of ionisation in its 0.02(M) solution. What percentage of dimethylamine is ionised if the solution is also 0.1 (M) in NaOH?

Watch Video Solution

76. Calculate the hydrogen ion concentration in the folowing biological fluids whose pH are given below:

Human muscle-fluid, 6.83.

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77. Calculate the hydrogen ion concentration in the folowing biological fluids whose pH are given below:

Human stomach fluid, 1.2.

Watch Video Solution

Watch Video Solution

78. Calculate the hydrogen ion concentration in the folowing biological fluids whose pH are given below:

Human blood, 7.38.

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79. Calculate the hydrogen ion concentration in the folowing biological fluids whose pH are given below:

Human saliva, 6.4.

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80. The pH of milk, black coffe, tomato juice, lemon juice and egg white are 6.8, 5.0, 4.2, 2.2 and 7.8 respectively. Calculate corresponding hydrogen ion concentration in each.

Watch Video Solution

81. 0.561g KOH is dissolved in water to give 200 mL of solution at 298K. Calculate the concentrations of K^{+}, H^{+} and OH^{-} ions. What is its pH?

Watch Video Solution

82. The solubility of $Sr(OH)_2$ at 298K is 19.23 g/L of solution. Calculate the concentrations of stronium and hydroxyl ions and the pH of the solution.

Watch Video Solution

83. The ionisation constant of propanoic acid is 1.32×10^{-5}. Calculate the degree of ionisation of the acid in its 0.05(M) solution and also its pH. What will be its degree of ionisation if the solution is 0.01(M) in HCl also?

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84. The pH of 0.1M solution of cyanic acid (HCNO) is 2.34. calculate the ionisation constant of the acid and its degree of ionisation in the solution.

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85. The ionisation constant of nitrous acid is 4.5×10^{-4}. Calculate the pH of 0.04M sodium nitrite solution and also its degree of hydrolysis.

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86. A 0.02 M solution of pyridinium hydrochloride has pH=3.44. calculate the ionisation constant of pyridine.

Watch Video Solution

87. Predict if the solutions of the following salts are neutral, acidic or basic: NaCl, KBr, NaCN, NH_4NO_3, $NaNO_2$ and KF.

Watch Video Solution

88. The ionisation constant of chloroacetic acid is 1.35×10^{-3}. What will be the pH of 0.1 M acid and its 0.1 M sodium salt solution?

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89. Ionic product of water at 310K is 2.7×10^{-14}. What is the pH of neutral water at this temperature?

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90. Calculate the pH of the resultant mixtures: (1) 10 mL of 0.2M $Ca(OH)_2 + 25mL$ of 0.1 M HCl

(2) 10 mL of 0.01M $H_2SO_4 + 10mL$ of 0.01M $Ca(OH)_2$.

(3) 10 mL of 0.1M $H_2SO_4 + 10mL$ of 0.1M KOH.

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91. Determine the solubilities of silver chromate, barium chromate, ferric hydroxide, lead chloride and mercurous iodide at 298K from their solubility product constant given in the standard table. Determine also the molarities of individual ions. Silver chromate, 1.1×10 −12 Barium chromate, 1.2×10 −10 Ferric hydroxide, 1.0×10 −38 Lead dichloride, 1.6×10 −5 Mercurous iodide, 4.5×10 −29

Watch Video Solution

92. The solubility product constant of Ag_2CrO_4 and $AgBr$ are 1.1×10^{-12} and 5.0×10^{-13} respectively. Calculate the ratio of the molarities of their saturated solutions.

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93. Equal volumes of 0.002M solutions of sodium iodate and cupric perchlorate are mixed together. Will it lead to precipitation of copper iodate? (for cupric iodate, $K_{sp} = 7.4 \times 10^{-8}$).

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94. The ionisation constant of benzoic acid is 6.46×10^{-5} and K_{sp} for silver benzoate $\left(C_6H_5COOAg\right)$ is 2.5×10^{-13}. How many times is silver benzoate more soluble in a buffer of pH 3.19 compared to its solubility in pure water?

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95. What is the maximum concentration of equimolar solutions of $FeSO_4$ and Na_2S so that when mixed in equal volumes, there is no precipitation of iron sulphide? (For iron sulphide, $K_{sp} = 6.3 \times 10^{-18}$).

Watch Video Solution

96. What is the minimum volume of water requires to dissolve 1g of calcium sulphate at 298K ? (For calcium sulphate, K_{sp} is 9.1×10^{-6}).

Watch Video Solution

97. The concentration of sulphide ion in 0.1M HCl solution saturated with hydrogen sulphide is $1.0 \times 10^{-19} M$. If 10 mL of this is added to 5 mL of 0.04 M solution of the following: $FeSO_4$, $MnCl_2$, $ZnCl_2$ and $CdCl_2$ in which of these solutions precipitation will take place?

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HIGHER ORDER THINKING SKILL (HOTS) QUESTIONS

1. In case of a gaseous reaction, the different between the heat change at constant volume and the heat change at constant pressure is 2RT. Find out the ratio of K_p to K_c of that reaction.

Watch Video Solution

2. "All chemical reaction are reversible"-Is the statement true? Given reason for your answer.

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3. The following reaction is at equilibrium at a particular temperature: $AB(g) \Leftrightarrow A(g) + B(g)$. Show that when the compound AB gets 50% dissociated, then the total pressure of the system becomes three times the numerical value of K_P.

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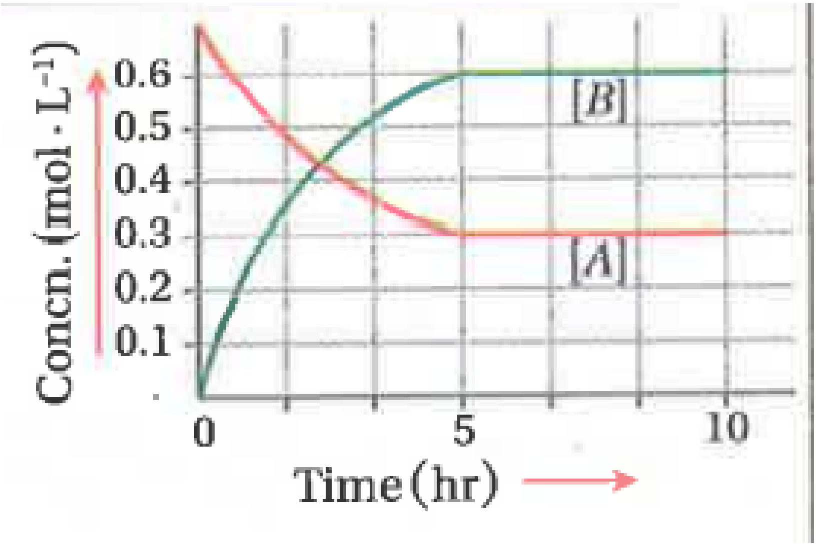
4. The given graph indicates the change in concentrations of A and B of a reversible reaction, $A \Leftrightarrow nB$ at constant temperature. If the value of equilibrium constant of the reaction is 1.2 at that temperature, then find



the value of n.

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5. Under a particular reaction condition if the value of the reaction-quotient (Q) is 1, then find out the change in the value of free energy (ΔG).

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6. We know, $\Delta G^0 = -RT\ln K_c$ and $\Delta G^0 = -RT\ln K_p$. State whether the value of ΔG^0 will be same or not provided the numerical values of both K_p and K_c are different.

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7. At $25^\circ C$, the value of equilibrium (K_c) for the reaction, $A(s) + 4B(g) \Leftrightarrow 2C(l) + 3D(g)$ is 16. if the reaction is initiated with 0.2 mol of each of the component taken in a closed vessel of 1 L volume, then in which direction the reaction will occur at a higher rate to attain the equilibrium?

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8. In which type of gaseous reactions, the ratio of K_p to K_c (i.e., K_p/K_c) is influenced by temperature? In which type of gaseous reactions, this ratio remains unaffected by temperature?

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Watch Video Solution

9. "When NH_4SCN (colourless) is added to dilute solution of $FeCl_3$ (light yellow), the colour o the solution becomes deep red but on addition of NH_4Cl solution (colourless) the red colour faded." Why?

Watch Video Solution

10. Sodium salts of three monobasic acids, HA, HB and HC are HaA, NaB and NaC, respectively. The concentration of each of the aqueous solution of the aqueous solution of these salts is 0.1(M) and the pH of their solutions are 7,9 and 10, respectively. Among HA, HB and HC, which is (are) strong acid(s)?

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11. $Mg(OH)_2$ is sparingly soluble in water but highly soluble in aqueous NH_4Cl solution-explain.

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12. The pH of two aqueous solutions of HCl and NaOH are 2 and 12, respectively. If 200 mL HCl solution is mixed with 300 mL NaOH solution, then what will be the pH of the mixed solution?

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13. You are asked to prepare a 100 mL buffer solution of pH=5.0. for this purpose, you are supplied with acetic acid $\left(pK_a = 4.74\right)$, benzoic acid $\left(pK_a = 4.20\right)$, formic acid $\left(pK_a = 3.75\right)$ and their sodium salts. Which one of the acids will you use to prepare the most effective buffer?

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14. If 50mL 0.1(M) NaOH solution is added to 20 mL 0.25(M) CH_3COOH solution, then what will be the pH of mixed solution? $\left[pK_a\left(CH_3COOH\right) = 4.74\right]$.

Watch Video Solution

15. Determine the pH of an aqueous 1.0(M) CH_3COOH solution. If 1L of this acid solution is diluted with distilled water, then calculate the volume of the dilute solution for a two-fold increase in the pH of the solution? $\left[K_a\left(CH_3COOH\right) = 1.8 \times 10^{-5}\right]$.

Watch Video Solution

16. pK_a values of three weak acids HA, HB and HC are 4.74, 3.35 and 5.24 respectively. The concentration of aqueous solutions of each of the three acids is 0.01 (M). Arrange them in order of increasing pH values.

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17. Show that, degree of dissociation of a weak monobasic acid, $\alpha = \frac{1}{1 + 10^{\left(pK_a - pH\right)}}$, where, K_a is the dissociation constant of the weak acid at experimental temperature.

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ENTRANCE QUESTIONS BANK

1. 2g of metal carbonate is neutralised completely by 100mL of 0.1(N) HCl. The equilvalent weight of metal carbonate is-

A. 50

B. 100

C. 150

D. 200

Watch Video Solution

2. If the equilibrium constants of the following equilibrium $SO_2 + \frac{1}{2}O_2 \Leftrightarrow SO_3$ and $2SO_3 \Leftrightarrow 2SO_2 + O_2$ are given by K_1 and K_2 respectively, then which of the following relations is correct-

A. $K_2 = \left(\frac{1}{K_1}\right)^2$

B. $K_1 = \left(\frac{1}{K_2}\right)^3$

C. $K_2 = \left(\frac{1}{K_1}\right)^2$

D. $K_2 = \left(\left(K_1\right)^2\right.$.

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3. 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. $\frac{1}{2}pK_w + \frac{1}{2}pK_a + \frac{1}{2}\log C$

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4. The solubility of $Ca_3(PO_4)_2$ in water is y mol/L. its solubility product is:

A. $6y^4$

B. $36y^4$

C. $64y^5$

D. $108y^5$

Answer: D

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5. 20 mL 0.1 (N) acetic acid is mixed with 10 mL 0.1(N) NaOH solution. pH of the resulting solution is (pK_a of acetic acid is 4.74)-

A. 3.74

B. 4.74

C. 5.74

D. 6.74

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6. The weight of oxalic acid that will be required to prepare a 100 mL (N/20) solution is-

A. $\frac{126}{100}g$

B. $\frac{63}{40}g$

C. $\frac{63}{20}g$

D. $\frac{126}{20}g$

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

A. 4.9

B. 5.0

C. 7.0

D. 10.0

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8. In a reversible chemical reaction at equilibrium, if the concentration of any one of the reactants is doubled then the equilibrium constant will-

A. also be doubled

B. be halved

C. remain the same

D. become one-fourth

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9. 1×10^{-3} mol of HCl is added to a buffer solution made up of 0.01 (M) acetic acid and 0.01(M) sodium acetate. The final pH of the buffer will be (pK_a of acetic acid is 4.75 at $25\,^\circ C$)-

A. 4.60

B. 4.66

C. 4.75

D. 4.8

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10. Number of hydrogen ions present in 10 million part of $1.33 cm^3$ of pure water at $25^\circ C$ is-

A. 6.023 million

B. 60 million

C. 80.1 million

D. 80.23 million

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11. At $25^\circ C$, pH of a 10^{-8}(M) aqueous KOH solution will be-

A. 6

B. 7.02

C. 8.02

D. 9.02

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12. At $25^{\circ}C$, the solubility product of a salt of MX_2 type is 3.2×10^{-8} in water. The solubility (in mol/L) of MX_2 in water at the same temperature will be

A. 1.2×10^{-3}

B. 2×10^{-3}

C. 3.2×10^{-3}

D. 1.75×10^{-3}

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13. The standard Gibbs free energy $\left(\triangle G^{\circ}\right)$ at 25° C for the dissociations of N_2O_4(g) to NO_2(g) is (given : equilibrium constant $= 0.15, R = 8.314J \cdot K^{-1}mol^{-1}$

A. 1.1 KJ

B. 4.7 KJ

C. 8.1 KJ

D. 38.2KJ

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14. pH of a solution of $10^{-4}(M)KOH$ is

A. 4

B. 11

C. 10.5

D. 10

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15. The ratio of volumes of 0.1(N) CH_3COOH to 0.1(N) CH_3COONa required to prepare a buffer solution of pH 5.74 is (given : pK_a of CH_3COOH is 4.74_-

A. $10:1$

B. $5:1$

C. $1:5$

D. $1:10$

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16. For the reaction $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ at 300K, the value of $\Delta G°$ is - 690.9R. The equilibrium constant value for the reaction at that temperature is (R is gas constant)

A. $10 atm^{-1}$

B. 10atm

C. 10

D. 1

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17. In which of the following mixed aqueous solutions $pH = kea$ at equilibrium-

A. (I) is correct

B. (II) is correct

C. (III) is correct

D. both (I) and (II) are correct

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18. The molar solubility (in mol L^{-1}) of a sparingly soluble salt MX_4 is 's' the corresponding solubility products is K_{sp} 's' in terms of K_{sp} is given by the reaction-

A. $S = \left(\frac{K_{sp}}{128}\right)^{1/4}$

B. $S = \left(\frac{K_{sp}}{256}\right)^{1/5}$

C. $S = \left(256K_{sp}\right)^{1/5}$

D. $S = \left(128K_{sp}\right)^{1/4}$

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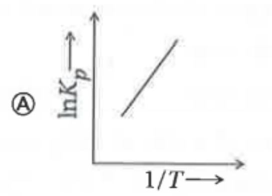
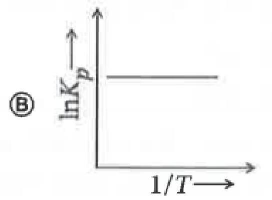
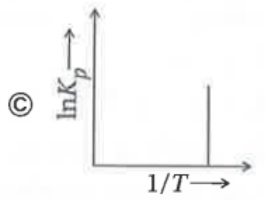
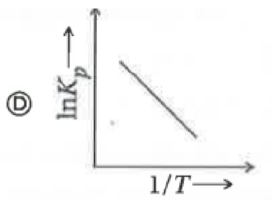
19. Which of the following plots represents an exothermic reaction-

A. 

B. 

C. 

D. 

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20. Of the following compounds, which one is the strongest acid in an aqueous solution-

A. $HClO_3$

B. $HClO_2$

C. HOCl

D. HOBr

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21. Dissolving NaCN in demonized water will result in a solution having

A. pH>7

B. pH=7

C. pOH=7

D. pH<7

Watch Video Solution

22. Equilibrium constants for the following reactions at 1200 K are given :

$2H_2O(g) \Leftrightarrow 2H_2(g) + O_2(g): K_1 = 6.4 \times 10^{-8}$

$2CO(g) \Leftrightarrow 2CO(g) + O_2(g): K_2 = 1.6 \times 10^{-6}$

The equilibrium constant for the reaction $H_2(g) + CO_2(g) \Leftrightarrow CO(g) + H_2O(g)$ at 1200K will be-

A. 0.05

B. 20

C. 0.2

D. 5

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23. Your are supplied with 500 mL each of 2(N) HCl and 5(N) HCl. What is the maximum volume of 3(M) HCl that you can prepare using only these two solution-

A. 250mL

B. 500mL

C. 750mL

D. 1000mL

Watch Video Solution

24. The following euilibrium constants are given:

`N_2+3H_2 `H_2+1/2O^2 The equilibrium constant for the oxidation of 2 mol of NH_3 to give NO is-

A. $K_1 \times \frac{K_2}{K_3}$

B. $K_2 \times \frac{K_3^3}{K_1}$

C. $K_2 \times \frac{K_3^2}{K_1}$

D. $K_2^2 \times \frac{K_3}{K_1}$

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25. A vessel at 1000K 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 0.8atm. The value of K is

A. 3 atm

B. 0.3 atm

C. 0.18 atm

D. 1.8 atm

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

A. 2.5×10^2

B. 4×10^{-4}

C. 50

D. 0.02

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27. The pH of a 0.1 molar solution of the acid HQ is 3. The value of the ionisation constant K_a of this acid is

A. 1×10^{-3}

B. 1×10^{-5}

C. 1×10^{-7}

D. 3×10

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28. How many litres of water mutt be added to 1 litre of of an aqueous solution of HCl with a pH of 1 to create an aqueous solution with pH of 2

A. 9.0L

B. 0.9L

C. 0.1L

D. 2.0L

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29. The molarity of a solution obtained by mixing 750 mL of 0.5(M) HCl with 250 mL of 2(M) HCl will be

A. 0.975(M)

B. 1.00(M)

C. 0.875(M)

D. 1.75(M)

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30. For the reaction `SO_2(g)+1/2O_2(g)

A. 1

B. -1

C. $-\frac{1}{2}$

D. $\frac{1}{2}$

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31. The following reaction is performed at 298K

$2NO(g) + O_2(g) \Leftrightarrow 2NO_2(g)$

Standard free energy of formation of NO(g) is $86.6 kJ. mol^{-1}$ at 298K. What is the standard free energy of formation of $NO_2(g)$ at 298K $\left(K_p = 1.6 \times 10^{12}\right)$

A. $8660 - \dfrac{In\left(1.6 \times 10^{12}\right)}{R(209)}$

B. $0.5\left[2 \times 86600 - R(298)In\left(1.6 \times 10^{12}\right)\right]$

C. $R(298)In\left(1.6 \times 10^{12}\right) - 86600$

D. $86600 + R(298)In\left(1.6 \times 10^{12}\right)$

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32. The standard Gibbs energy change at 300K for the reaction `2A⇋B+C is 2494.2 J. At a given time, the composition of the reaction mixture is [A] = 2 1 , [B] = 2 and [C] = 2 1 . The reaction proceeds in the : [R=8.314J/K/mol,e=2.718]

A. forward direction because Q>K_c`

B. reverse direction because Q>K_c

C. forward direction because Q

D. reverse direction because Q

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33. The equilibrium constant at 298 K for a reaction, `A+B⇌C+D is 100. If the initial concentration of all the four species were 1 M each, then equilibrium concentration of D (in mol L −1) will be:

A. 0.182

B. 0.818

C. 1.818

D. 1.182

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34. pK_a of a weak acid (HA) and pK_b of a weak base (BOH) are 3.2 and 3.4, respectively. The pH of their salt (AB) solution-

A. 7

B. 1

C. 7.2

D. 6.9

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35. Which of the following salts is most basic in aqueous solution-

A. CH_3COOK

B. $FeCl_3$

C. $Pb\left(CH_3COO\right)_3$

D. $Al(CN)_2$

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36. An alkali is titrated against an acid with methyl orange as indicator. Which of the following is a correct combination-

A. Base-Weak, Acid-Strong, End point- Colourless to pink

B. Base-Strong, Acid-Strong, End point-Pinkish red to yellow

C. Base-Weak , Acid-Strong, End point-Yellow to pinkish red

D. Base-Strong, Acid-Strong, End point-Pink to colourless

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37. An aqueous solution an unknown concentration of Ba^{2+} When 50mL of a 1 (M) solution of Na_SO_4 is added $BaSO_4$ just begins to precipitate. The final volume is 500mL. The solubility product of $BsSO_4$ is 1×10^{10} What is the original concentration of Ba^{2+}

A. $5 \times 10^{-9}(M)$

B. $2 \times 10^{-19}(M)$

C. $1.1 \times 10^{-9}(M)$

D. $1.0 \times 10^{-10}(M)$

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38. An aqueous solution contains 0.10 (M) H_2S and 0.20 (M) HCl. If the equilibrium constants for the formation of HS^- from H_2S is 1.0×10^{-7}

and that of S^{2-} from HS^{-} ions is 1.2×10^{13}, then the concentration of S^{2-} ions in aqueous solution is-

A. 5×10^{-8}

B. 3×10^{-20}

C. 6×10^{-21}

D. 5×10^{-19}

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39. Which of the following lines correctly show the temperature dependence of equilibrium constant, K, for an exothermic reaction-

A. A and B

B. B and C

C. C and D

D. A and D

View Text Solution

40. For the reaction, $N_2(g) + O_2(g) \Leftrightarrow 2No(g)$ equilibrium constant is K_1. The equilibrium constant is K_2 for the reaction. $2NO(g) + O_2(g) \Leftrightarrow 2NO_2(g)$. What is K for the reaction, $NO_2(g) \Leftrightarrow \frac{1}{2}N_2(g) + O_2(g)$-

A. $\frac{1}{2K_1K_2}$

B. $\frac{1}{4K_1K_2}$

C. $\left[\frac{1}{K_1K_2}\right]^{1/2}$

D. $\frac{1}{K_1K_2}$

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41. Given the reaction between 2 gases represented by A_2 and B_2 to give the compound $AB(g)$ is $A_2(g) + B_2(g) \Leftrightarrow 2AB(g)$. At equilibrium, concentration of $A_2 = 3.0 \times 10^{-3}(M)$. If the reaction takes place in a sealed vessel at $527\,^{\circ}C$, then value of K_c will be-

A. 1.9

B. 0.62

C. 4.5

D. 2

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42. Given that the equilibrium constant for the reaction

`2SO_2(g)+O_2(g) `SO_3(g)

A. 3.6×10^{-3}

B. 6.0×10^{-2}

C. 1.3×10^{-5}

D. 1.8×10^{-3}

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43. 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). The equilibrium constant K_b for NH_3 equals 1.8×10^{-5}. What is the pH of this solution-

A. 8.73

B. 9.08

C. 9.43

D. 11.72

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44. Equimolar solutions of the following substances were prepared separately. Which one of these will record the highest pH value-

A. LiCl

B. $BaCl_2$

C. $BeCl_2$

D. $AlCl_3$

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45. 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}

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46. 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 alkalis in these solutions are shielded from attack by other ions.

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47. $KMnO_4$ can be prepared from K_2MnO_4 as per the reaction

`3MnO_4^(2-)+2H_2O

A. SO_2

B. CO_2

C. KOH

D. HCl

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48. For a given exothermic reaction, K_P and $K_p^{'}$ are the equilibrium constants at temperature T_1 and $T_2\left(T_2 > T_1\right)$ respectively. Assuming the heat of reaction is constant in temperature range between T_1 and T_2 , it is readily observed that

A. $K_p > K_p^{'}$

B. $K_p < K_p^{'}$

C. $K_p = K_p^{'}$

D. $K_p = \frac{1}{K_p}$

Watch Video Solution

49. For the reaction, $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$+heat the equilibrium shifts in forward direction-

A. By increasing the concentration of $NH_3(g)$

B. By increasing pressure and decreasing temperature

C. by decreasing the concentration of $N_2(g)$ and $H_2(g)$

D. By decreasing the pressure

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50. Using the Gibbs energy change $G^\circ = +63.3kJ$ for the given reaction: $Ag_2CO_3(s) \Leftrightarrow 2Ag^+(aq) + CO_3^{2-}$(aq), the K_{sp} of Ag_2CO_3(s) in water at $25^\circ C$ is $\left(R = 8.314J \cdot K^{-1}. mol^{-1}\right)$

A. 3.2×10^{-26}

B. 2.9×10^{-3}

C. 8.12×10^{-12}

D. 7.9×10^{-12}

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51. What is the pH of resulting solution when equal volumes of 0.1(M) NaOH and 0.01(M) HCl are mixed-

A. 12.65

B. 2

C. 7

D. 1.04

Watch Video Solution

52. Which one of the following pairs of solution is not an acidic buffer?

A. $HClO_4$ and $NaClO_4$

B. CH_3COOH and CH_3COONa

C. H_2CO_3 and Na_2CO_3

D. H_3PO_4 and Na_3PO_4

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53. If equilibrium constant for `N_2(g)+O_2(g)

A. $K^{1/2}$

B. $\frac{1}{2}K$

C. K

D. K^2

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54. MY and NY_3, two nearly insoluble salts have the same -K_{sp} values of 6.4×10^{13} at room temperature. Which statement would be true in regard to MY and NY_3

A. The salts of My and NY_3 are more soluble in 0.5 (M) KY than in pure water

B. the addition to the salt of KY to solutions of MY and NY_3 will have no effect on their solubilities

C. The molar solubilities of MY and NY_3 in water are identical

D. The molar solubility of MY in water is less than that of NY_3

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55. The percentage of pyridine $\left(C_5H_5N\right)$ that forms pyridinium ion $\left(C_5H_5N^+H\right)$ in a 0.10(M) aqueous pyridine solution $\left(K_b\right)$ for $C_5H_5N = 107 \times 10^9\big)$ is

A. $0.0060\ \%$

B. $0.013\ \%$

C. 0.0077

D. 0.016

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56. The solubility of AgCl(s) with solubility product 1.6×10^{-10} in 0.1 (M) NaCl solution would be-

A. 1.26×10^{-5} (M)

B. 1.6×10^{-9}(M)

C. 1.6×10^{-11} (M)

D. zero

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57. A 20 litre container at 400 K contains CO_2(g) at pressure 0.4 atm and an excess of SrO (neglect the volume of solid SrO). the volume of the container is now decreased by moving the movable piston fitted in the container. The maximum volume of the container, when pressure of CO_2 attains its maximum value, will be-

(Given that: `SrCO_3(s) K_p=1.6 atm

A. 10 litre

B. 4 litre

C. 2 litre

D. 5 litre

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58. Which one of the following statements is not correct

A. The value of equilibrium constant is changed in the presence of a catalyst in the reaction at equilibrium

B. enzymes catayse mainly biochemical reactions

C. Coenzymes increase the catalytic acitivity of enzyme

D. Catalyst does not initiate any reaction

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59. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is $2.2 \times 10^{-4} mol. L^{-1}$. Solubility product of $AG_2C_2O_4$ is

A. 2.66×10^{-12}

B. 4.5×10^{-11}

C. 5.3×10^{-12}

D. 2.42×10^{-8}

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60. The equilibrium constants of the following are:

`N_2+3H_2 `N_2+O_2 `H_2+1/2O_2 The equilibrium constant (K) of the reaction:

`2NH_3+5/3O_2overset(K)

A. $\dfrac{K_2K_3^3}{K_1}$

B. $\dfrac{K_2K_3}{K_1}$

C. $\dfrac{K_2^3K_3}{K_1}$

D. $\dfrac{K_1K_3^3}{K_1}$

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61. Which one of the following conditions will favour maximum formation of product in the reaction

$A_2(g) + B_2(g) \Leftrightarrow X_2(g), \ \triangle_r \triangle H = x' kJ$-

A. low temperature and low pressure

B. low temperature and low pressure

C. high temperature and high pressure

D. high temperature and low pressure

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62. The solubility of $BaSO_4$ in water is $2.42 \times 10^{-3} g \cdot L^{-1}$ at 298K. The value of its solubility product $\left(K_{sp}\right)$ will be

(Given molar mass of $BaSO_4 = 233 g \cdot mol^{-1}\Big)$

A. $1.08 \times 10^{-10} mol^2 \cdot L^{-2}$

B. $1.08 \times 10^{-12} mol^2 \cdot L^{-2}$

C. $1.08 \times 10^{-14} mol^2 \cdot L^{-2}$

D. $1.08 \times 10^{-8} mol^2 \cdot L^{-2}$

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63. Following the solutions were prepared by mixing different volumes of NaOH and HCl of different concentration-pH of which one of them will be equal to 1?

A. $60mL. \frac{M}{10}HCl + 40mL. \frac{M}{10}NaOH$

B. $55mL. \frac{M}{10}HCl + 45mL. \frac{M}{10}NaOH$

C. $75mL. \frac{M}{5}HCl + 25mL. \frac{M}{10}NaOH$

D. $100mL. \frac{M}{10}HCl + 100mL. \frac{M}{10}NaOH$

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64. 25 mL, 0.2 M $Ca(OH)_2$ is neutralised by 10 mL of 1 M HCl. then pH of resulting solution is-

A. 1.37

B. 9

C. 12

D. 7

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65. Which of the following is not a characteristic of equilibrium-

A. rate is equal in both directions

B. measurable quantities are constant at equilibrium

C. equilibrium occurs in reversible condition

D. equilibrium occurs only in open vessel at constant temperature.

Answer: D

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66. K_{sp} of $CaSO_4 \cdot 5H_2O$ is 9×10^{-6}, find the volume for 1g of $CaSO_4$ (M.mass=136)

A. 2.45 litre

B. 5.1 litre

C. 4.52 litre

D. 3.2 litre

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67. At $60\ ^\circ C$ and 1 atm, N_2O_4 is 50% dissociated into NO_2 then K_p is -

A. 1.33atm

B. 2atm

C. 2.67atm

D. 3atm

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68. $\frac{K_p}{K_c}$ for following reaction will be-

$$CO(g) + \frac{1}{2}O_2(g) \rightarrow CO_2(g)$$

A. RT

B. $\frac{1}{RT}$

C. $\frac{1}{\sqrt{RT}}$

D. $\frac{RT}{2}$

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69. Which has the highest pH-

A. CH_3COOK

B. Na_2CO_3

C. NH_4Cl

D. $NaNO_3$

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70. Which is correct?

A. $\triangle T = 0$

B. $\triangle S = 0$

C. $\triangle H = 0$

D. $\triangle G^0 = 0$

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71. What will be the solubility product of AX_3-

A. $27S^4$

B. $4S^2$

C. $36S^4$

D. $9S^3$

Answer: A

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72. The equilibrium constant for the reaction , $\frac{1}{2}H_2(g) + \frac{1}{2}I_2(g) \rightarrow HI(g)$ is K_c

then find equilibrium constant for $2HI(g) \rightarrow H_2(g) + I_2(g)$

A. $1/K_c$

B. $1/\left(K_c\right)^2$

C. $2/K_c$

D. $2/\left(K_c\right)^2$

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73. K_p for the reaction $A \to B$ is 4. If initially only A is present then what will be the partial pressure of B after equilibrium-

A. 1.2

B. 0.8

C. 0.6

D. 1

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74. K_a for HCN is 5×10^{-10} at $25\,^{\circ}C$. For maintaining a constant pH=9, the volume of 5M KCN solution required to be added to 10mL of 2M HCN solution is-

A. 4mL

B. 2.5 mL

C. 2mL

D. 6.4 mL

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75. Which of the following pairs of substances cannot exist together in solution

A. $Na_2CO_3 + NaOH$

B. $NaHCO_3 + Na_2CO_3$

C. $NaHCO_3 + NaOH$

D. $NaOH + NaCl$

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76. For the reaction , $H_2 + I_2 \Leftrightarrow 2HI$, K=47.6. If the initial number of moles of each reactant and product is 1mol then at equilibrium

A. $\left[I_2\right] = \left[H_2\right], \left[I_2\right] > [HI]$

B. $\left[I_2\right] = \left[H_2\right], \left[I_2\right] < [HI]$

C. $\left[I_2\right] = \left[H_2\right], \left[I_2\right] = [HI]$

D. $\left[I_2\right] > \left[H_2\right], \left[I_2\right] = [HI]$

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77. Calculate ionisation constant for pyridinium hydrogen Chloride. (given that H^+ ion concentration is 3.6×10^{-4} M and its concentration is 0.02 M)-

A. 6.48×10^{-2}

B. 6×10^{-6}

C. 1.5×10^{-9}

D. 12×10^{-8}

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78. For the reaction. $H_2 + I_2 \Leftrightarrow 2HI, K = 47.6$. If the initial number of moles of each reactant product is 1 mol then at equilibrium-

A. [I2]=[H2],[I2]>[HI]

B. [I2]=[H2],[I2]<[HI]

C. [I2]<[H2],[I2]=[HI]

D. [I2]>[H2],[I2]=[HI]

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79. If for the reaction $2ICl \rightarrow I_2 + Cl_2, K_c = 0.14$ and initial concentration of ICl is 0.6 M then equilibriurn concentration of $I2$ is

A. 0.37 M

B. 0.128M

C. 0.228M

D. 0.748M

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80. When 50 mL 0.1 NH_3 is mixed with 10mL of 0.1 M HCl when what is the pH of resultant solution? $\left(pK_b = 4.75\right)$-

A. 9.25

B. 10

C. 9.85

D. 4.15

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81. When $CH_3COOH_3 + HCl$ is titrated with NaOH then at neutral point the colour of phenolphthalein becomes colourless from pink due to-

A. Formation of CH_3OH

B. formation of CH_3COOH which acts as a weak acid

C. phenolphthalein vaporises

D. presence of HCl

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SINGLE CORRECT TYPE (MCQ HOTSPOT)

1. Some reactions, their equilibrium constants are as follows:

$CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g), K_1$

$CH_4(g) + H_2O \rightarrow CO(g) + 3H_2(g), K_2$

$CH_4(g) + 2H_2O(g) \rightarrow CO_2(g) + 4H_2(g), K_2$

The relation among K_1, K_2 and K_3 is

A. $K_3 \times K_2^3 = K_1^2$

B. $K_1\sqrt{K_2} = K_3$

C. $K_2 \times K_3 = K_1$

D. $K_3 = K_1 \times K_2$

Answer: D

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2. At a given temperature, the reaction, $A(g) \Leftrightarrow 2N(g)$, is in equilibrium in a closed flask. At the same temperature, the reaction $c(g) \Leftrightarrow D(g) + E(g)$ is in equilibrium in an another closed flask. Values of equilibrium constants of these two reactions are K_{p1} and K_{p2} respectively and the total pressures of the equilibrium mixtures are P_1 and P_2 respectively. If $K_{p1} : K_{p2} = 1 : 4$ and $P_1 : P_2 = 1 : 4$ then the ratio of degree of dissociation of A(g) and C(g) are (assume the degrees of dissociation of both are very small compared to 1)-

A. 0.15

B. 0.5

C. 1

D. 1.5

Answer: B

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3. At given temperature the reaction $A_2(g) + B_2(g) \Leftrightarrow 2AB(g)$ was started with 0.4 mol of $A_2(g)$ and 0.6 mol of $B_2(g)$ in a flask of volume 2 L. When the reaction achieved equilibrium, it was found that the reaction mixture contained 0.5 mol of AB. The equilibrium constant $\left(K_c\right)$ for the reaction is-

A. 8.3

B. 4.76

C. 10.27

D. 6.49

Answer: B

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4. At a given temperature, if degree of dissociation of N_2O_4 in the following reaction $N_2O_4(g) \Leftrightarrow 2NO_2(g)$ be a, and total pressure of the equilibrium mixture be P, then it can be shown that equilibrium constant for the reaction, $K_P = a^2P$ (assuming a is very small compared to 1). Which of the following comments is true for this relation

A. K_p increases as P increases

B. K_p increases as P increases

C. value of K_p does not depend on P but depends on $\propto$

D. the value of K_p depends neither on P nor on $\propto$

Answer: D

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5. For the reactions. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), N_2(g) + O_2 \Leftrightarrow 2NO(g)$ & $H_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow H_2O(g)$ if the equilibrium constant are K_1, K_2 and K_3

respectively, then the equilibrium constant for the reaction

$4NH_3(g) + 5O_2(g) \Leftrightarrow 4NO(g) + 6H_2O(g)$ is

A. $\frac{K_2K_3^2}{K_1}$

B. $\frac{K_2^2K_3^2}{K_1}$

C. $\frac{K_1^3K_2^2}{K_3}$

D. $\frac{K_2^2K_3^6}{K_1^2}$

Answer: D

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6. For a hypothetical reaction, K_c = 0.9 and K_p = 538. Which of the following equations can represent the reaction properly at 25° C

A. $A(g) < \Rightarrow 2C(s) + D(g)$

B. $B(g) < \Rightarrow C(l) + D(l)$

C. $A(l) + 2B(g) < \Rightarrow 2C(g)$

D. $A(g) + B(s) < \Rightarrow 3C(g)$

Answer: D

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7. When a mixture containing N_2 and H_2 in the molar ratio 1 : 3 is heated in presence of a catalyst in a closed vessel the following equilibrium is established:

`N_2(g)+3H_2(g) equilibrium, if the mole fraction of $NH_3$ is 0.6 and the total pressure of the equiHbrium mixture is 10 atm then $K_P$ for the reaction `2NH_3(g)

A. $1.33 atm^{-2}$

B. $0.75 atm^2$

C. $1.333 atm^2$

D. $0.75 atm^{-2}$

Answer: A

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8. The reaction $A(g) + 4B(g) \Leftrightarrow 2C(g) + 3D(g)$ is carried out in a closed vessel of volume 2L by taking 3 mol of A(g) and 4 mol of B(g). At equilibrium, if the amount of C(g) be 1 mol. then K_c for the reaction is-

A. 0.056

B. 0.038

C. 0.084

D. 1.24

Answer: C

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9. The total pressure at equilibrium of the reaction, $XY(g) \Leftrightarrow X(g) + Y(g)$ is P . If the equilibrium constant for the reaction is K_p and $K_p = \frac{P}{8}$, then the percent dissociation of XY is

A. 0.3049

B. 0.3333

C. 0.419

D. 0.1926

Answer: B

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10. At 500K, for the reaction, $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$ the equilibrium constant, KP = 0.52. In a closed container, these three gases are mixed together. If the partial pressure of each of these gases be 1 atm, then in the reaction system-

A. The number of moles of PCl_5 will increase

B. the number of moles of PCl_3 will increase

C. the reaction will attain equilibrium when 50% of the the reaction gets completed

D. the reaction will attain equilibrium when 75% of the reaction gets completed

Answer: A

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11. For the reaction : $A(g) + B(g) \Leftrightarrow C(g) + D(g)$, two moles of each A and B were taken into a flask which of following relation between the concentration terms is true when the system attains equilibrium

A. [A]=[B]

B. [A] $<$ [B]

C. [B]=[C]

D. [A] > [B]

Answer: B

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12. The reaction $2A(g) + B(g) \rightarrow C(s), \triangle H < 0$ is in equilibrium in a closed vessel. Which of the following changes at equilibrium will increase the yield of C (s)-

A. temperature is increased

B. at constant volume and temperature, some amount of B(g) is added to the reaction system

C. at constant volume and temperature, some amount of C(s) is removed from the reaction system

D. pressure is decreased at constant temperature

Answer: B

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13. At 300K the reaction $A(g) + B(g) \Leftrightarrow C(s)$ is in equilibrium in a closed, vessel. At the beginning of the reaction, the partial pressures of A and B gases are 0.2 and 0.3 atrn respectively and total pressure of the equilibrium mixture is 0.3 atm. K_c, for the reaction is-

A. $6.06 \times 10^4 L^2 Mol^{-2}$

B. $2.59 \times 10^3 L^2 Mol^{-2}$

C. $3.03 \times 10^4 L^2 Mol^{-2}$

D. $8.2 \times 10^{-2} L^2 Mol^{-2}$

Answer: C

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14. At 300K for the reaction `AB_3(g) $K_p = 1.66$. At the same temperature, $\triangle G^0$ for the reaction, `AB_2(g)+B_2(g)

A. +2.19 kJ

B. -2.52kJ

C. +3.85kJ

D. -3.26kJ

Answer: B

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15. At a given temperature, when a reversible reaction is carried out in absence of catalyst, the ratio of the rate constants for the forward and reverse reactions is found to be 8.0. At the same temperature, if the reaction is carried out in presence of catalyst, then the ratio will be

A. gt8.0

B. lt8.0

C. 8

D. lt8.0

Answer: C

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16. At a given temperature, a closed vessel contains NH_3 gas and solid NH_4HS. The pressure of NH_3 gas in the vessel is 0.50 atm. On dissociation, NH_4HS produces NH_3 and H_2S gases. The total pressure in the flask at equilibrium is 0.84 atm. The equilibrium constant for the dissociation reaction (KP) of NH_4HS is-

A. $0.30 atm^2$

B. $0.16 atm^{-2}$

C. $0.11 atm^2$

D. $0.22 atm^{-2}$

Answer: C

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17. N_2O_4 is dissociated to 33% and 40% at total pressures P_1 and P_2 atm respectively. Hence, the ratio of P_1 to P_2 is

A. $\frac{7}{3}$

B. $\frac{8}{3}$

C. $\frac{8}{5}$

D. $\frac{7}{4}$

Answer: C

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18. The reaction $A(g) + 2B \Leftrightarrow 2C(g) + D(g)$ was studied using an initial concentration of B which was 1.5 times that of A. The equilibrium concentration of A and C were found to be equal. So, K_c for the equilibrium is-

A. 4

B. 0.32

C. 2.73

D. 8.17

Answer: B

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19. The equilibrium constant K_{p1} and k_{p2} for the reactions $x \Leftrightarrow 2y$ and $z \Leftrightarrow p + q$ respectively are in the ratio of 1 : 9 . If the degree of dissociation of X and z be equal then the ratio of total pressure at these equilibrium is-

A. $1:36$

B. $1:1$

C. $1:3$

D. $1:9$

Answer: A

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20. If the equilibrium constant for mutarotation $\propto$ -0-glucose $.\beta$-D-glucose is 1.8. Then the percentage of the a -form in the equilibrium mixture is-

A. 64.5

B. 35.7

C. 53.7

D. 44.8

Answer: B

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21. The reaction , $C(s)+CO_2(g) \Leftrightarrow 2CO(g)$ is at equilibrium in a closed vessel under a given set of conditions. If the degree of dissociation of CO_2 at equilibrium is α and the total pressure of the equilibrium mixture and the value of equilibrium constant are P and K_p respectively, then α

A. $\dfrac{K_p}{\sqrt{2P}}$

B. $\dfrac{1}{2}\sqrt{\dfrac{K_p}{P}}$

C. $\dfrac{\sqrt{K_p}}{P}$

D. $\sqrt{\dfrac{P}{K_p}}$

Answer: B

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22. At a given temperature, the equilibrium constant K_c for the reaction, $A+B \rightarrow C$ is 10. At the same temperature the reaction is allowed to occur in a closed vessel of volume 1L. At a particular moment of time during the reaction, if the amount of A, B and C in the reaction system are 0.1,0.4 and 0.3 mol respectively then-

A. the reaction is in equilibrium at that moment

B. the reaction will occur to a greater extent towards left to attain equilibrium

C. the reaction will occur to a greater extent towards right to attain equilibrium

D. reaction will occur to greater extent towards left for achieving equilibrium and concentrations of reactants and products will be the same at new equilibrium

Answer: C

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23. A mixture containing N_2 and H_2 in a mole ratio 1 : 3 is allowed to attain equilibrium when 50% of the mixture has reacted. If P is the pressure at equilibrium, then the partial pressure of NH_3 formed is

A. P/3

B. P/2

C. P/9

D. P/5

Answer: A

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24. If the concentration of OH^- ions in the reaction `Fe(OH)_3(s)

A. 64 times

B. 4 times

C. 8 times

D. 16 times

Answer: A

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25. The equilibrium constant $\left(K_P\right)$ for the decomposition of gaseous H_2O, $H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$, is related to degree of dissociation ($\propto$) at a total pressure (P) as-

A. $K_p = \frac{\propto^3 p^{1/2}}{(1+\propto)(2+\propto)^{1/2}}$

B. $K_p = \frac{\propto^3 p^{3/2}}{(1+\propto)(2+\propto)^{1/2}}$

C. $K_p = \frac{\propto^3 p^{2/2}}{(1+\propto)(2+\propto)^{1/2}}$

D. $K_p = \frac{\propto^{3/2} p^{1/2}}{(1-\propto)(2+\propto)^{1/2}}$

Answer: D

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26. 2 mol of $PCl_5(g)$ is heated at a given temperature in a closed vessel of volume 2L. As a result, $PCl_5(g)$ dissociates and forms $PCl_3(g)$ and $Cl_2(g)$.

When the dissociation reaction reaches equilibrium, it is found that 50% of $PCl_5(g)$ has dissociated. K_c for the reaction is

A. 0.15

B. 0.3

C. 0.25

D. 0.5

Answer: D

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27. At a given temperature, the reaction, `SO_2Cl_2(g)

A. The concentration of SO_2(g) will increase

B. the concentration of SO_2Cl_2(g) will increase

C. the concentration of $SO_2(g)$, $Cl_2(g)$, $SO_2Cl_2(g)$ will remain the same

D. the value of equibrium constant will decrease

Answer: C

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28. The reaction $C(s) + CO_2(g) \Leftrightarrow 2CO_2(g)$ is in a state of equilibrium in a closed vessel at a constant temperature. The equilibrium of the reaction will shift towards left and get re-established if at constant temperature and volume some amount of-

A. C(s) is removed from the reaction system

B. CO_2 (g) is added to the reaction system

C. $CO_2(g)$ is removed form the reaction system

D. CO(g) is removed from the reaction system

Answer: C

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29. The pair of compound which cannot exist together in solution is-

A. $NaHCO_3$ and NaOH

B. Na_2CO_3 and $NaHCO_3$

C. Na_2CO_3 and NaOH

D. $NaHCO_3$ and NaCl

Answer: A

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30. Equimolar solutions of the following were prepared in water separately. Which of the solutions will have the highest pH-

A. $SnCl_2$

B. $BaCl_2$

C. $MgCl_2$

D. $CaCl_2$

Answer: B

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31. A student wants to prepare a saturated solution of Ag^+ ion

He has got only three samples of Ag-AgCl

$\left(K_{sp} = 1.8 \times 10^{-18}\right)$, AgBr $\left(K_{sp} = 5 \times 10^{-13}\right)$ and $Ag_2CrO_4\left(K_{sp} = 2.4 \times 10^{-12}\right)$. Which compound should he take to obtain maximum $\left[Ag^+\right]$

A. AgCl

B. AgBr

C. Ag_2CrO_4

D. none of these

Answer: C

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32. Correct relationship between pH of isomolar solutions of sodium oxide (pH_1), sodium sulphide (pH_2) , sodium selenide (pH_3) and sodium telluride (pH_4) is-

A. $pH_1 > pH_2 > pH_3 > pH_4$

B. $pH_1 < pH_2 < pH_3 < pH_4$

C. $pH_1 < pH_2 < pH_3 < pH_4$

D. $pH_1 > pH_2 = pH_3 > pH_4$

Answer: A

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33. Solubility product constant (K_{sp}) of salts of type MX MX_2 & M_3X at temperature TK are 4.0×10^{-8},3.2×10^{-14} & 2.7×10^{-15} respectively. Solubility $(moldm^{-3})$ of the salts at temperature T are in the order-

A. $MX > MX_2 > M_3X$

B. $M_3X > MX_2 > MX$

C. $MX_2 > M_2X > MX$

D. $MX > M_3X > MX_2$

Answer: D

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34. If the solubilities of AgCl in H_2O,0.01(M) $CaCl_2$,0.01(M) NaCl and 0.05(M) $AgNO_3$ are S_1, S_2, S_3 and S_4 respectively, then-

A. $AS_1 > S_2 > S_3 > S_4$

B. $S_1 > S_2 = S_3 > S_4$

C. $S_1 > S_3 > S_2 > S_4$

D. $S_4 > S_2 > S_3 > S_1$

Answer: C

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35. The degree of hydrolysis of a salt of weak acid and weak base in its 0.01(M) solution is found to be 50%. If the molarity of the solution is 0.2(M), the percentage hydrolysis of the salt should be

A. 1

B. 0.5

C. 0.25

D. 0.1

Answer: B

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36. 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. 5.010^{-5}

B. 5.0×10^{15}

C. 5.0×10^{-15}

D. 0.2×10^{5}

Answer: C

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37. If three salts P_2X, QY_2 and RZ_3 have the same solubilities in water then the correct relation among their K_{sp}` values is-

A. $K_{sp}(P_2X) = K_{sp}(QY_2) < K_{sp}(RZ_3)$

B. $K_{sp}(P_2X) > K_{sp}(QY_2) = K_{sp}(RZ_3)$

C. $K_{sp}(P_2X) = K_{sp}(QY_2) = K_{sp}(RZ_3)$

D. $K_{sp}(P_2X) > K_{sp}(QY_2) > K_{sp}(RZ_3)$

Answer: A

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38. The pH of the solution obtained by mixing 20mL of 0.01 (M) $Ca(OH)_2$ and 30mL of 0.1 (M) HCl solution is-

A. 0.32

B. 9.85

C. 11.3

D. 4.74

Answer: C

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39. The pH of an aqueous solution of HCl is 3.0 and that of an aqueous solution of NaOH is 12. The pH of the solution obtained by mixing 100mL of NaOH solution with 500ml of HCI solution is-

A. 6.71

B. 10.92

C. 12.05

D. 3.08

Answer: B

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40. At $25^\circ C$, the pH of 0.1 (M) aqueous solution of NH_3 is 11.13. At the same temperature, the pH of a solution containing 0.1 (M) of NH_4Cl and 0.01 (M) of NH_3 is

A. 4.74

B. 6.25

C. 8.26

D. 9.34

Answer: C

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41. 800mL 0.l(M) HCl solution is mixed with 200mL 0.5(M) CH_3NH_2 solution. In the resulting solution , concentration of H_3O^+ ions is $\left[K_b\left(CH_3NH_2\right) = 5 \times 10^{-4}\right]$ is

A. $3 \times 10^{-5}(M)$

B. $1.25 \times 10^{-4}(M)$

C. $8 \times 10^{-11}(M)$

D. $7.2 \times 10^{-10}(M)$

Answer: C

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42. A solution of a weak acid (Ka = 10^{-5}) has a molarity of (M/5). lOmL of this solution is neutralised completely with a NaOH solution of molarity (M/20). At the neutralisation point, concentration of H_3O^+ ions $\left(mol \cdot L^{-1}\right)$ is-

A. 4.39×10^{-5}

B. 1.25×10^{-6}

C. 7.02×10^{-6}

D. 1.58×10^{-9}

Answer: D

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43. At $25\,°$, K_{sp} for $PbCl_2$ is 1.6×10^{-5} in water. At the same temperature, the amount of $PbCl_2$ (molar mass = 278.19 $g \cdot mol^{-1}$) that remains in dissolved state in 100mL of a saturated solution of $PbCl_2$ is-

A. 0.28g

B. 0.44g

C. 0.17g

D. 0.35g

Answer: B

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44. At $25\,^{\circ}$C, the solubility product for $Cd(OH)_2$ in water is 1.2×10^{-14}. What would be the pH of an aqueous solution of 0.01(M) Cd^{2+} ions when $Cd(OH)_2$ will start precipitating-

A. 4.29

B. 5.6

C. 8.04

D. 7.56

Answer: C

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45. At 25° the solubility product of a salt AB_2 in water is 4.0×10^{-15}. If 0.1 mol of A^{2-} ions is added to 1 L of a saturated solution of the salt (assuming volume of the solution does not change on addition of A^{2-} ions), then

A. solubility product of AB_2 will increase

B. solubility product of AB_2 will decrease

C. conc. Of B^{-} ions in solution will be $2 \times 10^{-7} mol \cdot L^{-1}$

D. solubility of AB_2 in solution will be $4 \times 10^{-10} molL \cdot^{-1}$

Answer: C

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46. At 25° , K_{sp} for $Al(OH)_3$ in water is 2×10^{-33}. In an aqueous solution of $PH = 13$, the solubility of $Al(OH)_3$ is 2×10^{-x}. The value of x is-

A. 10

B. 15

C. 22

D. 30

Answer: D

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47. At 25°, K_a for a weak acid, HA in water, is 10^{-5}, $V_2 mL$ of 0.1(M) NaOH solution is added to $V_1 mL$ of 0.1(M) solution of HA. How many time would V_1be of V_2 so that pH of the solution be 6-

A. 2 times

B. 1.5 times

C. 1.1 times

D. 1.4 times

Answer: C

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48. In a buffer solution consisting of NaCN and HCN, [NaCN] = 0.18(M) and [HCN) = 0.16(M). If 2 millimoles of HCl is added to 100mL of this buffer solution (assuming volume of the solution remains the same because of the addition of HCl), then pH of the buffer will-

A. increase by 0.021 unit

B. decrease by 0.102 unit

C. increase by 0.11 unit

D. decrease by 0.012 unit

Answer: B

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49. At 25° C, K_b for CH_3COO^{0-} ion in water is 5.55×10^{-10} If 100mL of $0.025(M)$ HCl solution is added to 50mL of 0.1(M) solution of CH_3COONa, pH of the resulting solution will be-

A. 3.82

B. 8.64

C. 4.74

D. 7.8

Answer: C

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50. Which of the given mixed solutions will not lead to precipitation at 25° water (Given: $K_{sp}\left(CaF_2\right) = 3.9 \times 10^{-11}$,$K_{sp}\left[Zn(OH)_2\right] = 4.5 \times 10^{-17}$, $K_{sp}\left[Ag_2CrO_4\right] = 9.0 \times 10^{-12}$ and $K_{sp}\left[PbSO_4\right] = 1.8 \times 10^{-8}$)-

A. solution of $10^{-3}(M) Ca(NO_3)_2$ and $10^{-3}(M)$ NaF are mixed in equal volumes

B. solution of $10^{-3}(M) ZnCl_2$ and $10^{-2}(M)$ NaF are mixed in equal volumes

C. solution of $10^{-4}(M) AgNO_3$ and $10^{-4}(M)$ NaF are mixed in equal volumes

D. solution of $2 \times 10^{-4}(M) Pb(NO_3)_2$ and $10^{-3}(M)$ Na_2SO_4 are mixed in equal volumes

Answer: C

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51. 100 mL of (M / 1 0) aqueous solution of a monoprotic acid is titrated with a solution of NaOH. When one-third of the acid is neutralised, pH of the solution becomes 3.9. pH of the solution at half-neutralisation point is-

A. 5.8

B. 4.2

C. 3.6

D. 6.3

Answer: B

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52. At $25^{\circ}C$, K_{sp} value for Hg_2Br_2 and Hg_2I_2 are 1.3×10^{-22} and 1.1×10^{-18} respectively. In a solution containing KBr and KI, concentration of each is 0.01(M). To this solution, a $Hg_2(NO_3)_2$ solution is added drop by drop. The concentration of the remaining Br^- ions at the $K_a(CH_3COOH) = 1.8 \times 10^{-5}$ then increasing order of the pH values of the solutions-

A. $3.2 \times 10^{-4}(M)$

B. $1.08 \times 10^{-4}(M)$

C. $6.50 \times 10^{-7}(M)$

D. $4.61 \times 10^{-7}(M)$

Answer: B

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53. The concentration of the aqueous solutions of each of the following salts is 0.01 (M)

$KF, CH_3N^{\oplus}H_3C^{\oplus}l, KCl, CH_3COOH$

If $K_a(HF) = 7.0 \times 10^{-4}, K_b\left(CH_3NH_2\right) = 5 \times 10^{-4}$ and $K_a\left(CH_3COOH\right) = 1.8 \times 10^{-5}$ then increasing order of the pH values of the solutions-

A. $KCl < KF < CH_3N^{\oplus}H_3Cl^{\oplus} < CH_3COOH$

B. $KCl < KCl < CH_3N^{\oplus}H_3Cl^{\oplus} < CH_3COOH$

C. $CH_3COOH < CH_3N^{\oplus}H_3C^{\oplus}l < KCl < KF$

D. $CH_3COOH < KCl < CH_3N^{\oplus}H_3C^{\oplus}l < KF$

Answer: C

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54. An aqueous solution of a monoacidic base(B) is neutralised with 50mL of 0.2(M) HCl solution. After neutralisation, 200mg of NaOH is added to the solution The pH of the solution will be $\left[K_b(B) = 10^{-5}\right]$

A. 6

B. 7.5

C. 8.3

D. 9

Answer: D

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55. At a given temperature, pH of 0.01(M) aqueous solution o. nitrous acid is 2.67. The concentration of OH^{-} ions in 0.1(M) aqueous solution of nitrous acid is-

A. $2.57 \times 10^{-10}(M)$

B. $1.48 \times 10^{-12}(M)$

C. $3.07 \times 10^{-9}(M)$

D. $1.17 \times 10^{-9}(M)$

Answer: B

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56. Which of the following solution will have a pH of 10 (B is a weak base and its $pK_b = 5$)

A. 75mL of (M/10)B+25mL of (M/10) HCl

B. 55mL of (M/10)B+45mL of (M/20) HCl

C. 50mL of 11/10)B+50mL of (M/10) HCl

D. 40mL of (M/10)B+60mL of (M/10) HCl

Answer: C

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57. A and B are two solutions, each of which has a volume of 1L. The solution A contains 1 mol of NH_4CI and 1 mol < NaOH, while the solution B contains 1 mol of NH_4Cl and 1 mol of NH_3 . If pH values of the solutions A and are (pH) A and (pH) 8 respectively and pK b for NH_3 4.74, then the ratio of $(pH)_A$ and $(pH)_B$ is-

A. 1.85

B. 1.25

C. 2.01

D. 2.46

Answer: B

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58. In a closed vessel, the reaction $2A + 3B \Leftrightarrow 4C + 2D$ is maintained at a constant temperature. Initially the no. of moles of A was twice to that of B and at equilibrium B and D have equals no. of moles. At equilibrium the convert order of no. moles of A, B, C and D are-

A. $A < B < D$

B. $A > C > D$

C. $B < C < D$

D. $A > B > C$

Answer: B::C

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59. Which of the relations are correct for the given physical change :

`CuSO_4*5H_2O

A. $K_p = p^2_{H_2O}$

B. $K_c = [H_2O(g)]^2$

C. $K_p = K_c(RT)^2$

D. $K_c = K_p(RT)^2$

Answer: A::B::C

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60. At a given temperature, $K_c = 6.3 \times 10^{-6}$ for the reaction $S_8(g) \Leftrightarrow 4S_2(g)$. At the same temperature, if the reaction is started with 2 moles of $S_8(g)$ and 0.2 mol of $S_2(g)$ in a closed vessel of volume 1L, then which of the following comments are true regarding this reaction-

A. at the beingning of the reaction $Q_c = 8.0 \times 10^{-4}$

B. the reaction will occur to a greater extent towards right to attain equilibrium

C. the reaction will occur to a greater extent towards left to attain equilibrium

D. the concentration of S_8 at equilibrium is greater than $2mol \cdot L^{-1}$

Answer: A::C::D

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61. $4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$, is in equilibrium in a closed container of volume 1L at a given temperature. If the reaction is started with 1 mol $NH_3(g)$ and 1 mol of $O_2(g)$ and the number of mol of $H_2O(g)$ at equilibrium is 0.6 mol, then at equilibrium-

A. $\left[NH_3\right] = [NO]$

B. $[NO] < \left[O_2\right]$

C. $[NO] > \left[NH_3\right]$

D. $\left[O_2\right] < \left[H_2O\right]$

Answer: B::D

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62. The reaction, $C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g), \quad \triangle H > 0,$ is in equilibrium. At equilibrium-

A. if temperature is increased, the partial pressure of $H_2O(g)$ will decrease

B. concentration of $H_2(g)$ will decrease if an inert gas is added at constant temperature and volume

C. concentration of CO(g) will increase if pressure is increased at constant temperature

D. the equilibrium will move towards right if an inert gas is added at constant temperature and pressure

Answer: A::C::D

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63. The reaction, $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g), \ \triangle H > 0$ is in equilibrium. Which of the following changes at equilibrium will decrease the yield of NO(g)-

A. at constant temperature and volume, some amount of NOCl(g) is added to the reaction system

B. at constant temperature and volume, some amount of $Cl_2(g)$ is added to the reaction system

C. temperature is decreased at equilibrium

D. at constant temperature and pressure some amount of He gas is added to the reaction system

Answer: B::C

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64. Vapour density of the equilibrium mixture of NO_2 and N_2O_4 is found to be 40 for the given equilibrium $N_2O_4(g) \Leftrightarrow 2NO_2(g)$. For the equilibrium-

A. 1 mole percent of $NO_2(g)$ present in the mixture is 59%

B. 1 mole percent of NO_2 present in the mixture is 26%

C. degree of dissociation of N_2O_4 is 0.45

D. degree of dissociation of N_2O_4 is 0.15

Answer: B::D

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65. The vapour pressure of liquid methanol at $50\ ^{\circ}$C is 55.5 kPa .. Which are correct for equilibrium reaction attained in a closed vessel of 5L at $50\ ^{\circ}C$ for the following equilibrium `CH_3OH(l)

A. $K_p = 55.5 Kpa$

B. $K_c = 0.021 mol \cdot l^{-1}$

C. K_c=0.555mol*l^(-1)`

D. K_p=0.555kPa

Answer: A::B

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66. The reactions in which the yield of the products cannot be increased by the application of high pressure are-

A. $2SO_2(g) + O_2 < \Rightarrow 2SO_3(g)$

B. $NH_4HS(s) < \Rightarrow NH_3(g) + H_2(s)$

C. $N_2O_4(g) < \Rightarrow 2NO_2(g)$

D. $N_2(g) + 3H_2(g) < \Rightarrow 2NH_3(g)$

Answer: B::C

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67. Aqueous solutions of which of the following compound on dilution do not suffer any change in pH value-

A. $PhCOONH_4$

B. NH_4CN

C. HCOONa

D. NH_4Cl

Answer: A::B

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68. Which can act as an acid as well as a base-

A. SO_4^{2-}

B. HS^-

C. HCO_3^-

D. HSO_4^-

Answer: B::C::D

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69. Which mixtures (in molar ratio) can act as buffer-

A. $H_2CO_3 + NaOH(3:2)$

B. $H_2CO_3 + NaOH(3:4)$

C. $NH_3 + HCl(5:4)$

D. $NH_3 + HCl(4:5)$

Answer: A::C

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70. If equal volumes of the given solutions are mixed, precipitation of $AgCl\left(K_{sp} = 1.8 \times 10^{-11}\right)$ will occur only with -

A. $10^{-4}(M)Ag^{+}$ and $10^{-4}(M)Cl^{-}$

B. $10^{-5}(M)Ag^{+}$ and $10^{-5}(M)Cl^{-}$

C. $10^{-6}(M)Ag^{+}$ and $10^{-6}(M)Cl^{-}$

D. $10^{-10}(M)Ag^{+}$ and $10^{-10}(M)Cl^{-}$

Answer: A::B

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71. Which of the following are true regarding H_3PO_4-

A. $K_a = K_{a1} \times K_{a2} \times K_{a3}$

B. $K_{a1} < K_{a2} < K_{a3}$

C. $K_{a1} > K_{a2} > K_{a3}$

D. $K_{a1} = K_{a2} = K_{a3}$

Answer: A::C

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72. Select the non-buffer solution-

A. $0.8(M)H_2S + 0.8(M)KHS$

B. $2(M)C_6H_5NH_2 + 2(M)C_6H_5N^+H_3\bar{B}r$

C. $3(M)H_2CO_3 + 2(M)KHCO_3$

D. $0.05(M)KClO_4 + 0.05(M)HClO_4$

Answer: A::B::C

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73. The solubility of $BaSO_4$ will be almost same in-

A. $0.1(M)H_2SO_4$

B. $0.1(M)Ba(OH)_2$

C. $0.1(M)Ba\left(NO_3\right)_2$

D. $0.2(M)HCl$

Answer: A::B::C

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74. The species that can act both as Bronsted acid and as Bronsted base in water are-

A. $H_2PO_4^-$

B. PO_4^{3-}

C. HCO_3^-

D. $\left[Fe\left(H_2O\right)_6\right]^{3+}$

Answer: A::C

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75. Among the following salts, whose aqueous solutions will tum blue litmus paper red-

A. $NaHCO_3$

B. $FeCl_3$

C. KCN

D. $C_6H_5N^{\oplus}H_3Cl^{-o}$

Answer: B::D

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76. At a given temperature, the first and the second ionisation constants of the acid, H_2A are 1.0×10^{-5} and 5.0×10^{-10} respectively. Which of the following comments are true regarding this acid-

A. The concentration of A^{2-} ions in 0.01(M) aqueous solution of H_2A is 0.01(M)

B. the overall ionisation constant for H_2A is 5.0×10^{-15}

C. in 0.01(M) aqueous solution of H_2A, the molar concentration of H_3O^+ ions is twicet that A^{2-} ions.

D. in 0.01(M) aqueous solution of H_2A, $\left[H_3O^+\right] \approx \left[Ha^-\right]$

Answer: B::D

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77. At 25°, K_b for CN^- (conjugate base of HCN) is 2.5×10^{-5}. If 25 mL of 0.01(M) aqueous NaOH solution is added to 50mL of 0.01(M) HCN solution, then-

A. pH of the resulting solution is 11.2

B. pH of the resulting solution is 9.4

C. at $25^\circ C$ the ionisation constant for HCN is 4×10^{-10}

D. at $25^\circ C$ the ionisation constant for HCN is 2.5×10^{-5}

Answer: B::C

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78. At a given temperature, if the solubility products for MX, MA_2 and M_3B_2 in water are 10^{-16}, 10^{-22} and 10^{-33} respectively and their solubilities are S_1, S_2 and $S_3 mol L^{-1}$ respectively, then-

A. $S_1 < S_3$

B. $S_3 > S_2$

C. $S_2 > S_1$

D. $S_2 = S_3$

Answer: A:B:C

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79. At 25° temperature, the solubility products for $BaCrO_4$ and $SrCrO_4$ salts are 2.4×10^{-10} and 3.6×10^{-6} respectively. If an aqueous solution of K_2CrO_4 is added drop by drop to an aqueous solution containing Ba^{2+} and Sr^{2+} ions with concentrations of 10^{-4} and 10^{-3}(M) respectively then-

A. $BaCrO_4$ will be precipitated first

B. $SrCrO_4$ will be precipitated first

C. the concentration of Sr^{2+} ions will be $6.6 \times 10^{-8} mol \cdot L^{-1}$ when Sr^{2+} ions start precipitating

D. the concentration of Ba^{2+} ions will be $6.6 \times 10^{-8} mol \cdot L^{-1}$ when Sr^{2+} ions that precipitating

Answer: A::D

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80. In a buffer solution composed of NaCN and HCN $(pK_1 = 9.4)$, [NaCN]=0.2(M) and [HCN]=0.4(M). An aqueous solution solution contains $Zn^{2+}, Ca^{2+}, Mn^{2+}$ and Cr^{3+} ions, each of which has a concentration of 0.1 (M). If 500mL of the buffer solution is added to 500mL of this aqueous solution, then the ions that will precipitate in theresulting solution $K_{sp}\left[Zn(OH)_2\right] = 4.6 \times 10^{-17}$, $K_{sp}\left[Ca(OH)_2\right] = 8 \times 10^{-6}$, $K_{sp}\left[Mn(OH)_2\right] = 4.46 \times 10^{-14}$ and $K_{sp}\left[Cr(OH)_3\right] = 6.67 \times 10^{-31}\Big]$ are -

A. Zn^{2+}

B. Ca^{2+}

C. Mn^{2+}

D. Cr^{3+}

Answer: A::C::D

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81. At 25° C, $pK_b(NH)_3 = 4.74$, $pK_a(HF) = 3.14$ and $pK_a(HCN) = 9.4$ Hence-

A. aqueous solution of NH_4F is acidic

B. aqueous solution of NH_4CN is acidic

C. the pH of an aqueous solution of NH_4CN is greater than that of an aqueous solution of NH_4F

D. the pH of an aqueous solution of both NH_4CN and NH_4F are independent of the concentration of the solutions

Answer: A::C::D

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82. Which of the following comments are true-

A. if pK_a value for the acids HA and HB are 4 and 5 respectively. Then the concentration of OH^- ions in 0.1(M) aqueous solution of HB will be greater that that in 0.1(M) aqueous solution of HA

B. pH of pure water at $0^{\circ} C$ is smaller than that at $25^{\circ} C$

C. The degree of hydroysis of NH_4F in its 0.1(M) and 0.2(M) aqueous solutions is the same at a particular temperature

D. pH of an acid is 5 implying that the acid is weak

Answer: A::C

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83. A certain buffer solution contains equal concentration of A^{-} and HA. K_b for A^{-} is 10^{-10}. Hence-

A. K_a for HA is 10^{-5}

B. K_a for HA is 10^{-4}

C. pH of the buffer is 4

D. pH of the buffer is 9

Answer: B::C

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84. A buffer solution containing NH_3 and NH_4Cl has a pH value of 9. pK_b for NH_3 is 4.7. If in the buffer solution total concentration of buffering reagents is 0.6 mol L^{-1}, then the amount of-

A. NH_3 in the solution is $3.4g \cdot L^{-1}$

B. NH_4Cl in the solution is $8.9g \cdot L^{-1}$

C. NH_4Cl in the solution is $21.4g \cdot L^{-1}$

D. NH_3 in the solution is $17.5g \cdot L^{-1}$

Answer: A::C

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VERY SHORT TYPE QUESTIONS

1. A liquid in an open vessel cannot remain in equilibrium with its vapour. Justify.

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2. At $0^{\circ}C$ and 1 atm pressure, the relative amounts of water and ice remain unchanged with time in the equilibrium water `

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3. At a constant temperature and pressure, what is the value of $\triangle G$ for a reaction at equilibrium ?

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4. For a chemical reaction, $K_c > 1$. Will the value of $\triangle G^0$ for this reaction be negative or positive ?

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5. Find the relation between K_p and K_c for the following system :

`2NaHCO_3(s)

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6. The values of equilibrium constant for a particular reaction at 25°C and $50^\circ C$ are 0.08 and 0.12 respectively. State whether it is an exothermic or an endothermic reaction.

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7. If $mol \cdot L^{-1}$ and 'atm' be the units of concentration and pressure respectively, then what will be the value of K_p/K_c for the reaction, `N_2O_4(g)

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8. Give an example of a reaction for which, $K_p = K_c = K_x$

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9. Consider the reaction : $A(s) + 2B_2(g) \rightarrow AB_4(g), \quad \triangle H < 0.$ At equilibrium, what would be the effect of increasing temperature on the concentration of $B_2(g)$?

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10. For the reaction, `N_2O_4(g)0

$mentiontwofac \rightarrow rswhosechan \geq atequilibriumofthereactionwill \in creasetheyiel$

NO_2(g)`

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11. Give an example of a reaction for which K_p / K_c Independent of temperature.

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12. At a given temperature, if the total pressure of the equilibrium mixture of the reaction,

$A(s) \Leftrightarrow B(g) + C(g)$ is P , then what is the value of K_p ?

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13. What are the conjugate acid and conjugate base of HPO_4^{2-}

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14. What are the conjugate acid and conjugate base of H_2O ?

Watch Video Solution

15. K_b for $NH_3 = 1.8 \times 10^{-5}$ at 25°C. What is the value of K_a for NH_4^+ ion at the same temperature ?

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16. For pure water, $pK_w = 12$ at a certain temperature. At this temperature, what is the molar concentration of H_3O^+ in a neutral aqueous solution ?

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17. At a certain temperature, pK_w for pure water is 12 . At the same temperature, the concentration of $H_3^O \wedge +$ in aqueous solution is $10^{-8} mol \cdot L^{-1}$. Is this solution acidic or basic?

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18. pH of a sample of pure water is x at a certain temperature. Find the value of pK_w at that temperature

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19. pK_a values for two acids, HA and HB are 4 and 6 respectively. Which one is the stronger acid?

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20. pK_a values for two acids, HA , and HB are 4 and 5 respectively.' If each of the acid solution has a concentration of 0.1(M), then in which solution the molar concentration of H_3O^+ ion is greater ?

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21. At $25^\circ C, pK_a$ for weak acid, HA=x and pK_b for A^- the conjugate base of HA=y. find the value of (x+y) at this temperature.

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22. Give examples of two salts in case of which the pH value of their aqueous solutions are independent of their concentrations

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23. For a weak acid, HA pK_a=5. What is the effective range of pH for a buffer comprised of HA and its salt, NaA?

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24. Give examples of two buffer solutions prepared by mixing two salt solutions of a polybasic acid

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25. In a buffer solution comprising a weak base (B) and its ion $\left(BH^+\right)$, [B]=$\left[BH^+\right]$. If K_b for the weak base $= 10^{-5}$ Then find the pH value of the buffer solution.

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26. 100 mL of 0.05 (M) NaOH solution is added to a 100 mL of 0.1 (M) NaH_2PO_4 solution. Will the mixed solution act as a buffer ?

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FILL IN THE BLANKS

1. At a given temperature for a reversible reaction, K < I . The rate constant of the forward reaction is ________ than that of the reverse reaction.

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2. If K < I for a reaction at a particular temperature, then the value of $\triangle G^0$ is ________

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3. For a gaseous reaction, $K_p > K_C$ Increase in pressure at constant temperature will _______the concentration of the product.

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4. If C(s) is added to the reaction system $C(s) + CO_2(g) \Leftrightarrow 2CO(g)$ at constant temperature and volume, then the concentration of CO_2(g) will ________

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5. For the reaction ,`COCl_2(g)0`, increase in temperature at equilibrium will increase the concentration of ___________

Watch Video Solution

6. Addition of inert gas to the reaction-system

`PCl_5(g)

Watch Video Solution

7. At a particular temperature, pK_w for pure water=12. Its pH will be_______

Watch Video Solution

8. First and second ionisation constants of H_2S in its aqueous solution are x and y respectively. So, x is__________ than y.

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9. The conjugates base of $\left[Al\left(H_2O\right)_6\right]^{3+}$ is ________

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10. The conjugate acid and conjugate base of HPO_4^{2-} are _______ and _________ respectively.

Watch Video Solution

11. The $25^\circ C$, in an aqueous solution of HA, K_a for HA=10^{-6}. K_b for A^- ion is ________

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12. If the solubility of Ag_3PO_4 n its saturated aqueous solution be S(M), then, its solubility product will be___________

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13. The solubility of Ag_2CrO_4 in an aqueous solution of $AgNO_3$ is _________ than its solubility in pure water.

Watch Video Solution

14. Addition of CH_3COONa to an aqueous solution of CH_3COOH ___________ the pH value.

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SHORT TYPE QUESTIONS

1. At a particular temperature, the values of equilibrium constants for the reactions, $X + Y \Leftrightarrow XY$ and $M + N \Leftrightarrow MN$ are 10^3 and 10^{-2} respectively. At this temperature, which one is more stable, XY or MN ?

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2. At constant temperature, melting of ice is favoured by increase in pressure-why?

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3. If the reaction `Fe_2O_3(s)+3CO(g)

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4. Under what conditions of pressure and temperature, will the yield of Cl(g) be increased in the reaction

$Cl_2(g) \Leftrightarrow 2Cl(g)$?

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5. Given : `PCl_5(g)0

$. Mentiontwofac \rightarrow rswhosechan \geq atequilibriumwill \in creasetheyieldof$

PCl_5(g)`

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6. Will the same result be obtained if $CaCO_3(s)$ is heated in an open vessel and in a closed vessel separately?

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7. The equilibrium constant of a reversible reaction at a particular temperature is K. What Will be the values of reaction quotient (Q) at the beginning and at equilibrium of the reaction?

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8. `NH_4CO_2NH_2(s)

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9. Would there be any change in the values of K_p and K_c if the partial pressure of each of the constituents of the reaction system,`2A(g)

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10. Show with proper examples that both HPO_4^{2-} ion and H_2O can act as Bronsted acid as well as Bronsted base.

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11. Mention the conjugate base for each of the following:

$HS^-, CH_3N^+H_3, \left[Zn\left(H_2O\right)_6\right]^{2+}, H_2PO_4^-$

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12. Mention the conjugate acids of the given bases: OH^-, $C_6H_5NH_2, CO_3^{2-}, N_3^-$

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13. Concentrations of CH_3COOH in the two aqueous solutions, A and B, are 10^{-2} (M) and 10^{-4} (M) respectively. Show that, the difference in pH values of the two solutions is one unit.

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14. $pK_a(HA) > pK_a(HB) > pK_a(HC)$, where HA, HB and HC are three weak acids. Arrange these acids in the increasing order of their pH values if the concentration of each of them is 0.1(M).

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15. Show that $pH + pOH = 14$ for pure water at $25^\circ C$

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16. Show that at any temperature, for pure water $pH = pOH = \frac{1}{2}pK_w$

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17. Show that, $pK_a + pK_b = pK_b$ where K_b and K_a are the ionisation constants of weak base (B) and its conjugate acid. $\left(BH^+\right)$ respectively.

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18. Will the pH values of 0.1(M) HCl and 0.1(M) CH_3COOH solutions be the same or different? Give reason.

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19. Discuss the buffer action of a buffer solution prepared by mixingm NaH_2PO_4 and Na_2HPO_4 solutions.

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20. With rise in temperature, the pH of pure water decreases. Explain.

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21. How is the normal pH of human blood maintained?

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22. pH of a buffer does not change remarkably with dilution . Why?

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23. CH_3COONH_4 undergoes hydrolysis, although its aqueous solution is neutral. Explain with reason

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24. What will happen if a solution of KCl is added to a saturated solution of $PbCl_2$? Given reason.

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25. Why does not ZnS get precipitated when H_2S is passed through an acidic solution of Zn -salt?

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LONG TYPE QUESTIONS

1. Define law of mass action. Mention two important characteristics of chemical equilibrium.

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2. Establish the relation between K_p and K_c in case of the reaction, `3A(g)+2B(g)

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3. All chemical reaction are reversible in nature-Explain

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4. `CaCO_3(s) For the given reaction at equilibrium, prove that pco_2 always has a fixed value at a particular temperature and it is independent of the amount of $CaCO_3(s)$

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5. If a chemical reaction occurs in two or more steps, then the equilibrium constant of the net reaction is equal to the product of equilibrium constants of the individual steps.

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6. The value of equilibrium constant of a reaction at a particular temperature does not depend on the initial concentrations of the reactants.

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7. Equilibrium constant is unitless. Explain.

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8. Explain the equilibrium established in the evaporation of a liquid in a closed vessel at a particular temperature from the molecular point of view.

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9. Chemical equilibrium is dynamic in nature. Prove it with the help of a proper example.

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10. $2AB_2(g) \rightarrow 2AB(g) + B_2(g)$ If the total pressure of the reaction mixture = P , number of moles of $B_2(g) = x$ and equilibrium constant = K_p, then prove that, $x = \left(\frac{2K_p}{P}\right)^{1/3}$ **(Suppose, x<1)**

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11. Discuss the effect of the following on equilibrium of the reaction:

$C(s) + H_2O(g) \Leftrightarrow CO(g) + H_2(g), \ \Delta H^0 > 0$

temperature is decreased

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12. Discuss the effect of the following on equilibrium of the reaction:

`C(s)+H_2O(g)0`

Concentration of C(s) is increased

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13. Discuss the effect of the following on equilibrium of the reaction: `C(s)+H_2O(g)0H_2O`(g) is introduced into the system

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14. What is the difference between reaction quotient (Q) and equilibrium constant (K) of a reaction?

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15. Under the following conditions, in which direction will, the reaction shift to attain its equilibrium?

Q>K (b) Q

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16. Under the following conditions, in which direction will, the reaction shift to attain its equilibrium?

under which condition, Q=K ?

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17. $A + 2B \rightarrow C$, equilibrium constant=K_1

$C + D \rightarrow 3A$, equilibrium constant=K_2

What is the value of equilibrium constant for the reaction, $6B + D \rightarrow 2C$?

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18. $AB(g) + \frac{1}{2}B_2(g) \rightarrow AB_2(g)$, equilibrium constant $= K_1$

$2AB_2(g) \rightarrow 2AB(g) + B_2(g)$, equilibrium constant $= K_2$.

Find the relation between K_1 and K_2

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19. For the reaction,

$H_2(g) + CO_2(g) \rightarrow CO(g) + H_2O(g)$

occurring in a closed vessel at a particular temperature. the initial concentrations of the reactants are $[H_2] = [CO_2] = 1 mol \cdot L^{-1}$. Before reaching the equilibrium, if x $mol \cdot L^{-1}$ of H_2 has reacted then prove that : $x = \frac{\sqrt{K_c}}{1 + \sqrt{K_C}}$ where K_c=equilibrium constant.

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20. For the reaction, $A + B \Leftrightarrow C, K_c = 2$ at a particular temperature. Initial concentrations of A, B and C are $2mol \cdot L^{-1}, 1mol \cdot L^{-1}$ & $1mol \cdot L^{-1}$ respectively. Express graphically the change in concentrations of A, B and C with time.

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21. State Ostwald's dilution law and deduce its mathematical expression in case of a weak acid, HA

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22. Deduce the expression for the degree of ionization of a dilute aqueous acetic acid solution at a given temperature. Discuss the effect of addition sodium acetate solution separately to this solution.

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23. VL aqueous solution of the weak acid, HA, contains 1 mol of the acid. If x mol of HA on dissociation gives rise to equilibrium state, show that: x $= \sqrt{K_a \times V}$

[K_a=ionisation constant of HA]

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24. The extent of ionisation of a weak acid is greater in its dilute solution than in its concentrated solution. Does it mean that the concentration of H_3O^+ ions is greater in the dilute solution ? Explain

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25. Mention the factors on which the pH of a buffer, depends.

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26. You are supplied with two acid solutions, one of which contains HCOOH $\left(pK_b = 3.75\right)$ and the other $CH_3COOH\left(pK_a = 4.74\right)$ and their respective salts to prepare a 100 mL buffer solution having pH=4. Which acid and its salt would you choose for the purpose ? Give reason

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27. What is solubility product? Why does the solubility product expression does not contain the concentration term of undissolved solid?

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28. At $25\,^{\circ}C$, K_{sp} for zinc hydroxide $\left[Zn(OH)_2\right.$ is 3.0×10^{-16}. What is the value of pH of saturated aqueous solution of zinc hydroxide $\left[Zn(OH)_2\right]$?

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29. Solubilities of certain sparingly soluble salts increase in the presence of common ion. Explain with proper example.

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30. Mention whether the following solution will act as bugger solutions or not

100 mL of $0.1(M)CH_3COOH + 100mL$ of 0.1(M) HCl

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31. Why is the solubility of AgCl less in an aqueous solution of KCl compared with that in pure water?

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32. Pure NaCl is manufactured by passing HCl gas through a saturated aqueous solution of impure NaCl. Explain how the solubility product principle is used for this process.

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33. Calculate the value of K_P for the given reactions:

$NH_4HS(s) \Leftrightarrow NH_3(g) + H_2S(g), K_c = 8.1 \times 10^{-5}$ (at $25\,^{\circ}C$)

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34. Calculate the value of K_P for the given reactions:

$C(s) + CO_2(g) \Leftrightarrow 2CO(g), K_c = 0.153$ (at $854\,^{\circ}C$)

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35. Calculate the value of K_c for the given reactions:

$N_2O_4(g) \Leftrightarrow 2NO_2(g), K_p = 11$(at $100\,^{\circ}C$)

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36. Calculate the value of K_c for the given reactions:

$$SO_2(g) + \frac{1}{2}O_2(g) \rightarrow SO_3(g), K_p = 2.2 \text{ (at } 100\,^{\circ}C)$$

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37. For the reaction, $A(g) + B(g) \rightarrow C(g) + D(g)$ occuring in a closed vessel of 1L volume, the value of equilibrium constant is 16 at a particular temperature. If the number of moles of each of the constituents be 1, then in which direction will the reaction occur to a greater extent to attain equilibrium? Also, calculate the molar concentrations of B(g) and D(g) at equilibrium

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38. At $25^\circ C$, the thermal decomposition of PCl_5 occuring in a closed vessel of volume 1L gives rise to the equilibrium: $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$. How many moles of PCl_5 is to be added so that the concentration of $Cl_2(g)$ at equilibrium will be $0.1 mol \cdot L^{-1}$? [Given : $K_p = 1.78$ (at $250^\circ C$]

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39. A sample of air consisting mainly of N_2 and O_2 is heated at 2500K till the given equilibrium attains- $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$. If the value of equilibrium constant $\left(K_c\right)$ at this temperature is 2.1×10^{-3} and the percentage of number of moles of NO(g) in the above equilibrium mixture is 1.8 %, then what will be the mole fractions of N_2 and O_2 in the sample of air used'?

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40. At $986\,^{\circ}$C the value of equilibrium constant $\left(K_c\right)$ for the reaction, $CO(g) + H_2O(g) \rightarrow CO_2(g) + H_2(g)$ is 0.63At this temperature, 1 mol of H_2O(g) is allowed to react with 3 mol of CO(g). This results in the above equilibrium in which the observed pressure is 2.0 atm. Find the number of moles of H_2(g) produced at equilibrium and the partial pressure of each gas

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41. K_p of the reaction, $N_2O_4(g) \Leftrightarrow 2NO(g)$ at 773K is 640 mm of Hg. If the equilibrium pressure is 160 mm of Hg, then what percent of N_2O_4 will be dissociated? At what pressure will its degree of dissociation be 50%?

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42. At 300K , the partial pressures of N_2O_4(g) and NO_2(g) in an equilibrium mixture of the reaction: `N_2O_4(g)

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43. Two moles of PCl_5 are heated at $327\,^{\circ}$C in a closed vessel of volume 21. When equilibrium is established, it is found that 40% of PCl_5 has dissociated into PCl_3 and Cl_2 . Calculate the equilibrium constant for the reaction.

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44. At a given temperature, NH_3 gas is in a state of equilibrium with N_2 and H_2 gases in a closed container. If the partial pressures of N_2 and H_2 in the mixture are 1.34 and 0.67 atm respectively and the total pressure of the reaction mixture is 4.67 atm, then determine the value of K_p for the reaction : `N_2(g)+3H_2(g)

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45. At $400\,^{\circ}$ and 10 atm pressure, the reaction, $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$ is in a state of equilibrium. If at equilibrium the amount of NH_3 is 3.85% by volume, then calculate K_P for the reaction.

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46. The reaction, $PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g)$ is started with 1 mol of $PCl_3(g)$ and 2.5 mol of Cl_2 at $300\,^{\circ}$C in a vessel of volume 2 L . At equilibrium of the reaction $PCl_5(g)$ is found to have an amount of 0.65 mol . Calculate K_c, for the reaction.

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47. When 5.1g of solid NH_4HS is heated at 637K in a closed vessel of volume SL, the given equilibrium establishes: `NH_4HS(s)⇌NH_3(g)+H_2(g)+H_2S(g)+H_2S(g). If 3.06g of NH_4HS remains at equilibrium, then find the value of K_p

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48. The reaction, $C(s) + H_2O(g) \rightarrow CO(g) + H_2(g)$ is allowed to occur with 0.1 mol of $H_2O(g)$ at $700\ ^\circ$C in a closed vessel of volume 1L at equilibrium. If the partial pressure of H_2O(g) is found to decrease by 5.6 atm, then find the value of K_P for the reaction. What would be the minimum amount of C(s) so that the above equilibrium can establish?

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49. At a given temperature, the reaction $A(g) + 2B(g) \rightarrow C(g)$, is at equilibrium. At the start of the reaction, $p_A = 0.25$ atm and p_B = 0.5 atm. When the reaction reaches equilibrium, 50 % of C(g) is found to have formed. Calculate the K_P for the reaction. What initial pressure should B(g) have for the production of 75% C(g)?

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50. The equilibrium constant, K_P, for the reaction

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ is 900 atm at 800K. A mixture containing SO_3 and O_2 having initial pressure of 1 and 2 atrn respectively is heated at constant volume to equilibrium. Calculate the partial pressure of each gas at 800K

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51. When 3.06g of solid NH_4HS is introduced into a 21 evacuated flask at $27\,^{\circ}$C, 30% of the solid decomposes into gaseous ammonia and hydrogen

sulphide.

Calculate K_c and K_p for the reaction at 27°C

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52. When 3.06g of solid NH_4HS is introduced into a 21 evacuated flask at 27°C, 30% of the solid decomposes into gaseous ammonia and hydrogen sulphide.

what would happen to the equilibrium when more solid NH_4HS is introduced into the flask?

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53. For the reaction, $2A + B \rightarrow 2C, \ \Delta G^0 = 2kJ.Mol^{-1}$ at 500K. Calculate the value of equilibrium constant for the reaction, $A + \frac{1}{2}B \rightarrow C$, at the same temperature.

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54. Calculate the value of K_P for the reactfon, $PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2(g)$ at 298K [Given : $\Delta G_f^0(Cl_2) = 0, (\Delta G_f^0)(PCl_3) = -68.42 kcal.mol^{-1}$ and $\Delta G_f^0(PCl_5) = -77.6 kcal.mol^{-1}$]

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55. In the following equilibrium, $N_2O_4(g) \rightarrow 2NO_2(g)$ when 5 moles of each is taken and the temperature is kept at 298K, the total pressure was found to be 20 bar. Given : $\Delta G_f^0(N_2O_4) = 100 kJ, \ \Delta G_f^0(NO_2) = 50 kJ$

Find ΔG for the reaction at 298K

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56. In the following equilibrium, $N_2O_4(g) \rightarrow 2NO_2(g)$ when 5 moles of each is taken and the temperature is kept at 298K, the total pressure was found to be 20 bar. Given : $\Delta G_f^0(N_2O_4) = 100 kJ, \ \Delta G_f^0(NO_2) = 50 kJ$

Find the direction of the reaction.

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57. If the ionisation constant (K_a) of acetic acid at 298K si 1.8×10^{-5}, then what will be the degree of ionisation of 0.001(M) acetic acid solution?

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58. Calculate the ionisation constant of a monobasic acid which gets 1 % ionised in 0.1(M) solution.

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59. If the degree of ionisation of an acetic acid solution at 298K is 5%, then find its molar concentration. [Given: $K_a(CH_3COOH) = 1.8 \times 10^{-5}$]

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60. The concentration of a monobasic acid is 0.01(M). If the dissociation constant of this acid is 1×10^{-5} at 298 K, What will be the $\left[H_3O^+\right]$ ions in the acid solution ?

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61. The ionisation constant of ammonia at 298K is 1.8×10^{-5} Calculate (a) the degree of ionisation, (b) concentration of OH^- ions in 0.01(M) aqueous solution of ammonia.

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62. The ionisation constant of ammonia at 298K is 1.8×10^{-5} Calculate (a) the degree of ionisation, (b) concentration of OH^- ions in 0.01(M) aqueous solution of ammonia.

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63. In 0.01(M) acetic acid solution, pH = 3.37. What is the degree of ionisation of the acid?

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64. If 8.2g of anhydrous sodium acetate is added to 11 of 0.l(M) acetic acid solution, then what will be the change in degree of ionisation of the acid? [Given: $K_1(CH_3COOH) = 1.8 \times 10^{-5}$]

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65. Concentration of an aqueous solution of weak acid, HA is 0.1 (M) . How many times this acid solution is to be diluted so that the degree of dissociation of HA becomes 2 times that of the initial solution?

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66. Determine the pH of the following:

$0.01(M)H_2SO_4$

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67. Determine the pH of the following:

$1(M)NaOH$

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68. Determine the pH of the following:

$0.005(M)Ca(OH)_2$

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69. pOH values of the two aqueous solutions, A and Bare 10 and 8 respectively. Which one is more acidic? How many times will it be more

acidic than the other?

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70. What will be the pH of the resulting solution when two solutions, A and B having respective pH values of 3 and 5 are mixed in equal volumes?

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71. What is the pH value of 0.1(M) HCOOH solution if its ionisation constant, K is 1.78×10^{-4} at $25^{\circ}C$? How much water is to be added to 1L of this solution so that the pH of the solution becomes double of its initial value?

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72. Calculate the pH of the solution obtained by mixing 100 mL 0.075(M) $Ca(OH)_2$ solution with 100mL 0.1(M) HCl solution

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73. 100 mL 0.1(M) HCl solution is added to 100mL 0.1(M) $Ca(OH)_2$ solution. The excess $Ca(OH)_2$ remaining in the resulting solution is completely neutalised by 100mL H_2SO_4 solution. Calculate the concentration and pH of the H_2SO_4 solution.

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74. The concentration of an aqueous solution of the weak acid, HA is 0.1(M). Calculate the pH and concentrations of A^- ion and HA at equilibrium in the solution. Given: $K_b(HA) = 1.35 \times 10^{-3}$

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75. The concentration of a weak monobasic acid is 0.2(M). If the acid is 2% ionised in the solution, then find the pH of the solution and ionisation constant of the acid.

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76. The concentration of an aqueous solution of ammonia is 0.01(M). What is the pH of the solution? If 0.001 mol of NH_4Cl is added to 100 mL of that solution, state whether the pH of the solution will increase or decrease. Mention the change in the value of pH. $\left[pK_b\left(NH_3\right) = 4.74\right]$

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77. pH of an aqueous solution of HCl =3.0 . How many moles of H_3O or OH^- ions are to be added per litre of this solution in order to increase its pH from 3.0 to 3.4?

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78. 30 mL 0.2(N) H_2SO_4 solution is mixed with 20 mL 0.3(N) H_2SO_4 . What will be the pH of the mixed solution?

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79. 0.20 g of NaOH is dissolved per litre of a caustic soda solution. If 12.5mL 0.1(N) H_2SO_4` solution is added to 250 mL of that caustic soda solution, then what will be the pH of the mixed solution?

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80. Calculate the pH of the buffer solution containing 50 mL 0.2(M) CH_3COOH and 50mL 0.1(M) CH_3COONa solution. $\left[pK_a\left(CH_3COOH\right) = 4.74\right]$

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81. The pH of a buffer solution obtained by the combination of a weak base (B) and its conjugate acid $\left(BH^+\right)$ is 9. If the concentrations of B and BH^+ in the buffer are 0.2(M) and 0.02(M) respectively, then find the ionisation constant of the weak base.

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82. The pH of 1L of a buffer obtained by the combination of a weak acid (HA) and its salt (NaA) is 5.0. What will be the ionisation constant of HA if the concentrations of HA and NaA in the buffer are 0.3 (M) and 0.4 (M) respectively?

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83. In 1L of a buffer obtained by the combination of HA and NaA, [HA] = 0.075(M) and [NaA] = 0.15(M) . If the ionisation constant of HA is 4×10^{-4}, then find the concentration of the H_3O^+ ions in the buffer.

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84. How much of NH_4Cl should be added to 1L 0.1(M) NH_3 solution so that the pH of the mixed solution becomes 9.0? Assume that addition of

NH_4Cl does not change the volume of the solution. lGiven: $pK_b(NH_3)$ = 4.74]

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85. 1L of a buffer solution contains 0.1(M) CH_3COOH and 0.1(M) CH_3COONa. If 1 mL 10(M) HCl solution is added to this solution then find the change in the pH value. [pKa (CH_3COOH) = 4.74, change in volume can be neglected]

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86. 0.1 mol of NH_3 and 0.1 mol of NH_4Cl are dissolved in 1L of a buffer. What change in pH will be observed if-(a) 0.02 mol HCl gas, (b) 0.02 mol NaOH is dissolved in the solution?

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87. How many gram-mole of HCl will be required to prepare one litre of buffer solution (containing NaCN and HCN) of pH 8.5 using 0.01g formula weight of NaCN?

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88. Freshly precipitated aluminium and magnesium hydroxides are stirred vigorously in a buffer solution containing 0.25 $molL^{-1}$ of NH_4Cl and 0.05(M) of ammonium hydroxide. Calculate the concentration of aluminium and magnesium ions in solution. $K_b\left(NH_4OH\right) = 1.8 \times 10^{-5}, K_{sp}\left[Al(OH)_3\right] = 6 \times 10^{-32}$ $K_{sp}\left[Mg(OH)_2\right)\right] = 8.9 \times 10^{-12}$

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89. 0.01 gram-mole of NaCN is dissolved in 1L of an aqueous solution. How many gram-moles of HCl should be added to this solution in order to

make it a buffer solution of pH= $8.5\left[K_a(HCN) = 4.1 \times 10^{-10}\right]$

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90. Calculate

(i) pH of the solution,

(ii) degree of hydrolysis of NaCN,

(iii) hydrolysis constant for a 0.1M NaCN solution at $25\,^{\circ}C$. $\left[Given : K_a(HCN) = 4.0 \times 10^{-10}\right.$

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91. Calculate

(i) pH of the solution,

(ii) degree of hydrolysis of NaCN,

(iii) hydrolysis constant for a 0.1M NaCN solution at $25\,^{\circ}C$. $\left[Given : K_a(HCN) = 4.0 \times 10^{-10}\right.$

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92. Calculate

(i) pH of the solution,

(ii) degree of hydrolysis of NaCN,

(iii) hydrolysis constant for a 0.1M NaCN solution at $25^{\circ}C$. $\left[Given: K_a(HCN) = 4.0 \times 10^{-10}\right.$

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93. Find the degree of hydrolysis, pH of the solution and hydrolysis constant for a 0.001(M) NH_4Cl solution at $25^{\circ}C$ provided $K_b\left[NH_3\right] = 1.8 \times 10^{-5}$

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94. The concentration of Ca^{2+} ions in a saturated CaF_2 solution is 8.4 $mg \cdot L^{-1}$ at 25°C. Calculate the solubility product of CaF_2 at that temperature.

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95. Calculate the concentrations of Ca^{2+} and PO_4^{3-} ions in a saturated $\left[Ca_3\left(PO_4\right)_2\right]$ solution. Given:

$K_{sp}\left[Ca_3\left(PO_4\right)_2\right] = 2.0 \times 10^{-29}$ (at $25\ ^\circ C$)

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96. What will be the solubility of $Pb(OH)_2$ in buffer of $pH = 9$ at $25\ ^\circ C$ provided the solubility of $Pb(OH)_2$ in water is 6.67×10^{-6} (M) ?

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97. A solution contains Ag^+, Ca^{2+} and Al^{3+} each having a concentration of 0.1(M). Na_3PO_4 is added to the solution. Which will be precipitated first when the concentration of PO_4^{-3} in the solution is the lowest ? [Given :

K_{sp} values of $Ag_3PO_4, Ca_3(PO_4)_2$ and $AlPO_4$ and 10^{-16}, 10^{-33} and 10^{-20} respectively]

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98. If equal volumes of 0.02(M) $CaCl_2$ and 0.0003(M) Na_2SO_4 solutions are mixed, will $CaSO_4$ be precipitated ? [Given : $K_{sp}(CaSO_4) = 2.4 \times 10^{-15}$]

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99. What will be the value of pH at which $Mg(OH)_2$ starts to precipitate from 0.1(M) of $MgCl_2$ solution?

$[K_{sp}[Mg(OH)_2] = 1.0 \times 10^{-11})$

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100. if $K_{sp}(CaF_2) = 4 \times 10^{-11}$ at 25°C then find the molar solubility of CaF_2 in

pure water

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101. if $K_{sp}(CaF_2) = 4 \times 10^{-11}$ at 25°C then find the molar solubility of `CaF_2 in

0.01(M) NaF solution and

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102. if $K_{sp}(CaF_2) = 4 \times 10^{-11}$ at 25°C then find the molar solubility of CaF_2 in

0.01(M) $Ca(NO_3)_2$ solution respectively.

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103. 10^{-4} mol $Pb(NO_3)_2$, 10^{-4} mol $Ca(NO_3)_2$ and 10^{-3} mol Na_2CO_3 are added to 500 mL of water. Will there be any precipitation? If so, which will be precipitated? [Given: $K_{sp}(PbCO_3) = 7.4 \times 10^{-14}$ and $K_{sp}(CaCO_3) = 6.0 \times 10^{-9}$]

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104. A solution contains a mixture of $Ag^+(0.1M)$ and Hg^{2+} (0.1M) which are to be separated by selective precipitation. Calculate the maximum concentration of iodide ion at which one of them gets precipitated almost completely. What percentage of that metal ion is precipitated?

$K_{sp}(AgI) = 8.5 \times 10^{-17}, K_{sp}(HgI_2) = 2.5 \times 10^{-26}$

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105. The solubility product (K_sp) of $Ca(OH)_2$ at $25^\circ C$ is 4.42×10^{-5}. A 500 mL of saturated solution of Ca(OH)2 is mixed with equal volume of 0.4(M) NaOH. How much $Ca(OH)_2$ in milligrams is precipitated?

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106. An aqueous solution of a metal bromide MBr_2 (0.05M) is saturated withH_2S. What is the minimum pH at which MS will precipitate. K_{sp} for M.S $= 6.0 \times 10^{-21}$, conc. Of saturated H_2S=0.1(M) and $K_1 = 10^{-7}$ and $K_2 = 1.3 \times 10^{-13}$ for H_2S

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107. The molar concentration of an aqueous CH_3COONa solution is 0.01(M). Calculate

hydrolysis constant of CH_3COONa

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108. The molar concentration of an aqueous CH_3COONa solution is 0.01(M). Calculate

degree of hydrolysis

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109. The molar concentration of an aqueous CH_3COONa solution is 0.01(M). Calculate

pH of the solution. $\left[Kea = 1.8 \times 10^{-5}\right]$

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110. Determine the hydrolysis constant and pH of an aqueous 1.0(M) ammonium format solution Given : $pK_a(HCOOH) = 3.8$ and $pK_b\left(NH_3\right) = 4.74$

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PRACTICE TEST 7

1. Which pair of solution is not an acidic buffer-

A. $HClO_4$ and $NaClO_4$

B. CH_3COOH and CH_3COONa

C. H_2CO_3 and Na_2CO_3

D. H_3PO_4 and Na_3PO_4

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2. Among the following salts, whose aqueous solutions will turn blue litmus paper red-

A. $NaHCO_3$

B. $FeCl_3$

C. HCO_3^-

D. NaOH

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3. At equilibrium which is correct-

A. $\Delta G = 0$

B. $\Delta S = 0$

C. $\Delta H = 0$

D. $\Delta G^0 = 0$

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4. Identify the incorrect statement regarding chemical equilibrium

A. It can be attained from either side

B. $Q_c = K_c$ at equilibrium

C. Equilibrium is achieved when the reactant product concentration become equal

D. Presence of catalyst influences the position of equilibrium

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5. Which of the following mol ecules acts as a lewis acid

A. $(CH_3)_3B$

B. $(CH_3)_3O$

C. $(CH_3)_3P$

D. $(CH_3)_3N$

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6. `A_2(g)+B_2(g)

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7. Calculate the solubility of $SrSO_4$ in water in $mol \cdot L^{-1}$ at $25\,^\circ C$. (solubility product of $SrSO_4$ at $25\,^\circ C = 7.6 \times 10^{-7} mol^2 . L^{-2}$)

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8. At 1127K & 1 atm, a gaseous mixture of CO and CO_2 in equilibrium with solid carbon has 90.55% of CO by mass `C(g)+CO_2(g)

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9. At a certain temperature, K_w of pure water $= 10^{-12}$ What will be the pH of a neutral solution at that temperature?

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10. Show that in pure water, $pH = pOH = \frac{1}{2} pK_w$

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11. What will happen when a solution of potassium chloride is added to a saturated solution of lead chloride? Give reason.

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12. Which of the two processes-occur at the same rate at the equilibrium obtained by the evaporation of a liquid at a particular temperature?

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13. 0561g of KOH is dissolved in water to give 200mL of solution at 298 K. Calculate the concentrations of K^+, H^+ and OH^- ions. What is its pH '?

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14. 20ml 0.15(M) HCl solution is mixed with 50mL 0.1 (M) CH_3COONa solution. State whether the mixed solution will acts as a buffer or not.

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