CHEMISTRY

BOOKS - NAGEEN CHEMISTRY (ENGLISH)

EQUILIBRIUM

Example

1. At 20° C the solubility of N_2 gas in water is 0.0150 g L^{-1} when the partial pressure of the gas is 580 torr . Find the solubility of nitrogen in water at $20^\circ C$ when the partial pressure is 800 torr.

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2. The solubility of sodium chloride in water is $6.150 mol L^{-1}$ at 20°C. 80g of sodium chloride is dissolved in $100 cm^3$ of water at 20°C. How much

sodium chloride is left undissolved ? After equilibrium is reached, an additional 50 cm of water is added to the system at the same temperature. Find the amount of NaCl present in the solution and in the undissolved state.

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3. Write the equilibrium constant expressions for the following reactions.

$N_2O_4g \Leftrightarrow 2NO_2(g)$

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4. Write the equilibrium constant expressions for the following reactions.

$Cr_2O_4^{2-}(aq) + Pb^{2+}(aq) \Leftrightarrow PbCrO_4(s)$

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5. Write the equilibrium constant expressions for the following reactions.

$NH_3(aq) + H_2O(l) \Leftrightarrow NH_4^+(aq) + OH^-(aq)$

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6. Write the equilibrium constant expressions for the following reactions.

$CH_3COOH(aq) + H_2O(l) \Leftrightarrow CH_3COO^-(aq) + H_3O^+(aq)$

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7. Write the equilibrium constant expressions for the following reactions.

$Cu(s) + 2Ag^+(aq) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$

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8. Write the equilibrium constant expressions for the following reactions.

$AgCl(s) \Leftrightarrow Ag^+(aq) + Cl^-(aq)$

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9. Write the equilibrium constant expressions for the following reactions.

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

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10. In the following reactions

$$H_2 + I_2 \Leftrightarrow 2HI$$

The amount of H_2, I_2 and HI are 0.2 g , 9.525 g and 44.8 g respectively at equilibirum at a certain temperature Calculates the equilibrium constant of the reactions.

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11. 1 mole of H_2O and 1 mole of CO are taken in a 10 litre vassel and heated to 725 K.At equilibrium 40 per cent of water (by mass) reacts with carbon monoxide according to the equation

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

Calculate the equilibrium constant for the reactions.

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12. One mole of nitrogen is mixed with three moles of hydrogen in a 4 litre container. If 0.25 per cent of nitrogen is converted into ammonia by the following reaction

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

calculate the equilibrium constant of the reaction in concentration units.

What will be the value of K for the following reaction?

$\frac{1}{2}N_2(g) + \frac{3}{2}H_2 \Leftrightarrow NH_3(g)$

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13. PCI_5 is 47.1% dissociated at 18°C and one atmospheric pressure. Calculate the value of K_p .

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14. 3 moles of H_2 and 2 moles of I_2 were heated in a 2 litre vessel at 717 K till the equilibrium was reached. Assuming that the equilibrium constant is 48, calculate the equilibrium concentrations of $H_2 I_2$ and HI.

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15. How much PCI_5 must be taken in a 9.2 L vessel to get 0.5 moles of Cl_2 at a particular temperature? The value of equilibrium constant (K_c) at the given temperature is 0.0414.

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16. 25 moles of H_2 and 18 moles of l_2 vapour were heated in a sealed tube at 445°C when at equilibrium 30.8 moles of HI were formed. Calculate the degree of dissociation of pure Hl at the given temperature,

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17. Calculate the degree of ionisation and $\left[H_3O^+\right]$ of a 0.15 M CH_3COOH solution. The dissociation constant of acetic acid is 1.8×10^{-5}

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18. At 298 K, 0.01 M solution of ammonium hydroxide is 4.2% ionised. Calculate the ionisation constant of the base.

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19. The dissociation constant of acetic acid is 1.8×10^{-5} at 298 K. Calculate its degree of dissociation and H_3O^+ ion concentration in its 0.1 M solution.

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20. Calculate the concentration of hydroxyl ions in a 0.1 M solution of ammonia if the value of K_b is 1.76×10^{-5}

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21. Calculate the concentration of H_3O^+ in a mixture of 0.03 M acetic acid and 0.1 M sodium acetate. Ionisation constant for acetic acid is 1.8×10^{-5}

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22. A dilute solution of HCI contains $\left[H3O^+\right] - 5.4 \times 10^{-5} \quad \text{mol} \quad L^{-1}$ at 298 K. What is the concentration of hydroxyl ions in this solution?

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23. Calculate the hydronium ion and hydroxyl ion concentrations in

(1) 0.001 M HCl

(ii) 0.01 M NaOH

at 298 K assuming that both HCl and NaOH are completely ionised

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24. Calculate the pH value of the following

0.001 M HCl

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25. Calculate the pH value of the following

0.01 M NaOH.

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26. The hydronium Ion concentration of a fruit juice is 4.6×10^{-4} mol L^{-1}. What is the pH of the juice?

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27. Calculate the pH value of 0.01 M CH_3COOH if it is 5% dissociated.

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28. A solution of NaOH is prepared by dissolving 1.5 g of the base in 500 mL of water. Calculate the pH of the solution.

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29. Calculate the pH of

0.01 M H_2SO_4

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30. The pH of 0.001 M $Ba(OH)_2$ solution will be

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31. At 298 K, the pH of a solution of lemon juice is 2.32 . What are the conc. Of $\left[H_3O^+\right]$ and $\left[OH^-\right]$ in this solutions?

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32. Calculate the pH of 0.01 M Solution of CH_3COOH. The dissociation constant of the acid is 1.8×10^{-5}

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33. The ionisation constant of methylamine (CH_3NH_2) is 4.4×10^{-5}. Calculate the pH of its 0.2 M solutions.

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34. Calculate the pH of a buffer solution containing 0.15 mole of CH_3COOH and 0.1 mole of CH_3COONa per litre. The dissociation constant for acetic acid 1.8×10^{-5}

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35. How much CH_3COONa should be added to 1 litre of 0.01 M CH_3COOH to make . A buffer of pH = 4.1 ?

$\left(K_a \text{ for } CH_3COOH = 1.8 \times 10^{-5}\right)$

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36. A buffer solution contains 0.02 moles ofNH_4OH and 0.03moles of NH_4CI dissolved in 1 litre of the solution. Calculate the pH of the solution. Dissociation constant of NH_4OHis1.8×10^{-5}

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37. A buffer solution contains 0.15 moles of acetic acid and 0.20 moles of potassium acetate per litre. The dissociation constant of acetic acid at room temperature is 1.76×10^{-5}

Calculate the pH of the solution.

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38. A buffer solution contains 0.15 moles of acetic acid and 0.20 moles of potassium acetate per litre.

What would be the change in pH of the solution, if 0.5 mL of 1M HCl is added to it? Assume that the volume is unchanged. The dissociation constant of acetic acid at room temperature is 1.76×10^{-5}

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39. The pH of an acidic buffer is 4.8794. Its pH changes to 4.8864 on addition of 0.005 moles of NaOH to 1 litre of the solution. Calculate its

buffer capacity.

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40. The solubility of AgCl at 298 K is 1.3×10^{-5} mol L^{-1} Calculate the value of K_{sp} at this temperature.

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41. The solubility of CaF_2 in water at 298 K is 1.7×10^{-3} grams per $100cm^3$ .Calculate the solubility product of CaF_2 at 298 K.

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42. The solubility product of $PbCl_2$ at 298 K is 7.1×10^{-5} Calculate the solubility of $PbCl_2$ in gL^{-1} at 298 K.

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43. The solubility of $Mg(OH)_2$ in pure water is $9.57 \times 10^{-3} gL^{-1}$ .Calculate its solubility I $\left(gL^{-1}\right)$ in 0.02 M Mg $(NO_3)_2$ solutions.

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44. If $25.\, cm^3$ of 0.050 M $Ba(NO_3)_2$ are mixed with $25.0 cm^3$ of 0.020 M NaF, will any BaF_2 precipitated K_{sp} of BaF_2 is 1.7×10^{-6} at $298K$.

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45. The solubility product of $BaSO_4$ at 298 K is 1.08×10^{-10} . What is the minimum concentration of SO_4^{2-} ions required to precipitate $BaSO_4$ from a 0.01 M solution of $BaCl_2$

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46. Calculate the hydrolysis constant. Degree of hydrolysis and pH of a 0.1 M NH_4Cl solution at $25^\circ C$ Given : K_b for $NH_4OH = 1.8 \times 10^{-5}$

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47. Calculate the hydrolysis constant. Degree of hydrolysis and pH of a 0.5 Sodium acetate solution at room temperature $(K_a$ for acetic acid $= 1.75 \times 10^{-5})$

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48. Calculate the hydrolysis constant, degree of hydrolysis and pH of a 0.1 M aqueous solution of ammonium cyanide at room temperature. $(K_a = 9.55 \times 10^{-10} K_b = 1.8 \times 10^{-5}$ and $K_w 1.0 \times 10^{-14})$

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Review Exercises

1. Why does a person sweat more at Mumbai as compared to one in Delhi even when the temperature of the two towns is the same?

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2. The equilibrium vapour pressure of water, ethyl alcohol and acetone at 293 K are 2.34 , 5.85 and 12.36 kPa respectively. Which of these will have the lowest and highest boiling points? At 293 K Which of these will Evaporate least in a sealed container before equilibrium is established ?

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3. The solubility of pure oxygen in water at $20^{\circ}C$ and one atmosphere pressure is 1.38×10^{-3} mol L^{-1} Calculate the concentration of oxygen at $20^{\circ}C$ and partial pressure of 0.21 atm.

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4. State the expression which attains a constant value in each of the following equilibria.

Urea (s) $\Leftrightarrow$ Urea (solution)

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5. State the expression which attains a constant value in each of the following equilibria.

$O_2(g) \Leftrightarrow O_2(aq)$

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6. State the expression which attains a constant value in each of the following equilibria.

Ice $\Leftrightarrow H_2O(l)$

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7. Can equilibrium be achieved between water and its vapour in an open vassel ? Explain.

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8. What do you understand by the state of euqilibrium and how is it achieved in a chemical process?

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9. How is liquid -vapour equilibrium attained in a closed vessel.

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10. What is meant by irreversible and reversible reactions? Give two examples each.

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11. What do you understand by the dynamic nature of equilibrium? Explain with an example.

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12. There cannot be chemical equilibrium in an open system.

There is no fixed mass in an open system.

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13. What is concentration quotient and what is its significance?

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14. Write the equilibrium constant expression for the following equilibria:

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

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15. Write the equilibrium constant expression for the following equilibria:

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

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16. Write the equilibrium constant expression for the following equilibria:

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

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17. Find out the units of K_c and K_p for the following equilibrium reactions :

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

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18. Find out the units of K_c and K_p for the following equilibrium reactions :

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

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19. The value of the equilibrium constant K for the reaction $H_2(g) + I_2(g) \Leftrightarrow 2Hl(g)$ is 48 at $717K$.

Find out the value of K for the following reaction at

$Hl(g) \Leftrightarrow \frac{1}{2}H_2(g) + \frac{1}{2}I_2(g)$

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20. What will be the effect on the equilibrium constant on increasing temperature ,if the reaction neither absorbs heat nor releases heat?

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21. Write the equilibrium constant expression for the following reactions :

$CH_4(g) + 2O_2(g) \Leftrightarrow CO_2(g) + 2H_2O(g)$

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22. Write the equilibrium constant expression for the following reactions

:

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

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23. Write the equilibrium constant expression for the following reactions

:

$CO_2(g) \Leftrightarrow CO_2(aq)$

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24. Write the equilibrium constant expression for the following reactions :

$Fe^{3+}(aq) + SCN^{-}(aq) \Leftrightarrow FeSCN^{2+}(aq)$

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25. The equilibrium constant for the reactions

$Cu(s) + 2Ag^{+}aq \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$

is 2.0×10^{15} at $278K$. Find the equilibrium concentration of Cu^{2+} (aq) if that of Ag^{+} (aq) is 1.0×10^{-11} mol L^{-1}

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26. The value of K_P for the reactions $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$, is 4.28×10^{-5} at $450^{\circ}C$. A reaction mixture contains N_2, H_2 and NH_3 at partial pressures of 0.6 atm ,2.5 atm and 0.50 atm respectively . In which direction the reaction will proceed?

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27. 256 g of HI were heated in a sealed bulb at 444°C till the equilibrium was attained. The acid was found to be 22% dissociated at equilibrium. Calculate the equilibrium constant for the reaction $2HI(g) \Leftrightarrow H_2(g) + I_2(g)$

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28. One mole of PCl_5 is heated in a 2L vessel. When equilibrium is attained, the vessel is found to contain 0.2 moles of PCl_5 Calculate the equilibrium constant.

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29. The value of K_C for the reactions

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

is 6.0×10^{-2} at $773K$. Calculate the value of K_P at the given temperature.

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30. Find the units of K_P and K_C for the following reactions.

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

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31. Find the units of K_P and K_C for the following reactions.

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

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32. Find out the units of K_c and K_p for the following equilibrium reactions :

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

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33. The equilibrium constant at 278 K for

$Cu(s) + 2Ag^+(aq) \Leftrightarrow Cu^{2+}(aq) + 2Ag(s)$

is 2.0×10^{15}. At a particular moment, the concentration of Cu^{2+} and Ag^+ ions are found to be 1.8×10^{-2} mol L^{-1} and 3.0×10^{-9} mol L^{-1} respectively. Is the system in equilibrium at that moment?

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34. A mixture of SO_3, SO_2 and O_2 gases is maintained in a 10 L flask at a temperature at which the equilibrium constant (K_c) for the reactions $2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g)$ is 100. If the number of moles of O_2 are present ?

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35. The equilibrium constant (K_P) of the reactions $N_2O_4 \Leftrightarrow 2NO_2$ was found to be 636 mm at $49.7^\circ C$. Calculate the percentage dissociation of N_2O_4 when the pressure of the gas mixture is 182 mm.

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36. Discuss the effect of increase of pressure on the following reactions

$CH_4(g) + 2O_2(g) \Leftrightarrow CO_2(g) + 2H_2O(g)$

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37. Discuss the effect of increase of pressure on the following reactions

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

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38. In which direction is equilibrium expected to shift on increasing temperature in the following reactions ?

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

$$\Delta H = +212.8 \text{ kcal}$$

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39. In which direction is equilibrium expected to shift on increasing temperature in the following reactions ?

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

$$\Delta H = -42 \text{ kcal}$$

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40. Discuss the conditions for obtaining the maximum yield in the following reactions.

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

$$\Delta H = -43.2 \text{ kcal}$$

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41. Discuss the conditions for obtaining the maximum yield in the following reactions.

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

$\Delta H = 43.2$ kcal

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42. For a general reactions

$2A + B \Leftrightarrow C + 3D, \Delta H = +xkcal$

What will be the effect of

decrease in volume ?

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43. For a general reactions

$2A + B \Leftrightarrow C + 3D, \Delta H = +xkcal$

What will be the effect of increase in temperature ?

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44. For a general reactions

$2A + B \Leftrightarrow C + 3D, \Delta H = +xkcal$

what is the effect of increase of pressure at equilirbrium?

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45. Wet clothes dry quicker when there is a breeze because

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46. Sort out strong , electrolytes , weak electrolytes and non-electrolytes fromt the following : $KOH, Ca(OH)_2 NH_4Cl,$ Urea $CH_3COONa, HCN, CH_3COOH,$ Glucose.

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47. A weak acid HA is found to be 3% dissociated in 0.1 M solution . Calculate the value of K_a

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48. The dissociations constant of HCN is 7.24×10^{-10} Calculate its degree of dissociation and $\left[H_3O^+\right]$ in 0.01 M solutions.

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49. Comment on the statement : All Arrhenius acids are Bronsted acids but all Arrhenius bases may not be Bronsted bases.

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50. Write the correctly balanced net ionic equations for the reations whose equilibrium constant at 298 K are

$K_a(H_2S) = 1.0 \times 10^{-7}$

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51. Write the correctly balanced net ionic equations for the reations whose equilibrium constant at 298 K are

$K_b(NH_3) = 1.8 \times 10^{-5}$

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52. Write the correctly balanced net ionic equations for the reations whose equilibrium constant at 298 K are

$K_a(H_2C_2O_4) = 5.4 \times 10^{-2}$

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53. Write the correctly balanced net ionic equations for the reations whose equilibrium constant at 298 K are

$K_b(CH_3NH_2) = 4.4 \times 10^{-5}$

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54. Write the formula and the name of conjugate base of the following acids :

H_3O^+

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55. Write the formula and the name of conjugate base of the following acids :

HSO_4^-

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56. Write the formula and the name of conjugate base of the following acids :

NH_4^+

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57. Write the formula and the name of conjugate base of the following acids :

HF

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58. Write the formula and the name of conjugate acid of each of the following acids :

CH_3COO^-

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59. Write the formula and the name of conjugate base of the following acids :

H_3PO_4

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60. Write the formula and the name of conjugate base of the following acids :

$H_2PO_4^-$

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61. Write the formula and the name of conjugate base of the following acids :

$CH_3NH_3^+$

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62. Write the formula and the name of conjugate acid of each of the following acids :

OH^-

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63. Write the formula and the name of conjugate acid of each of the following acids :

HPO_4^{2-}

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64. Write the formula and the name of conjugate acid of each of the following acids :

$H_2PO_4^-$

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65. Write the formula and the name of conjugate acid of each of the following acids :

CO_3^{2-}

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66. Write the formula and the name of conjugate acid of each of the following acids :

HS^-

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67. Write the formula and the name of conjugate acid of each of the following acids :

CH_3COO^-

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68. Write the formula and the name of conjugate acid of each of the following acids :

CN^-

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69. Write the formula and the name of conjugate acid of each of the following acids :

CH_3NH_2

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70. Write the formula and the name of conjugate acid of each of the following acids :

NH_3

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71. Sort out the conjugate pairs of acid and bases in the following reactions :

$HNO_3(aq) + H_2O(l) \Leftrightarrow H_3O^+(aq) + NO_3^-(aq)$

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72. Sort out the conjugate pairs of acid and bases in the following reactions :

$H_2O(l) + H_2O(l) \Leftrightarrow H_3O^+(aq) + OH^-(aq).$

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73. Calculate the pH value in 0.001 M solution of $Ba(OH)_2$

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74. How many grams of NaOH must be dissolved in 1 L of the solution to give it a pH value of 12?

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75. Classify the following into Lewis acids and Lewis bases

$NH_3, BF_3, Ag^+, SiF_4, CO_2, C_2H_5OH, CH_3NH_2, Ni^{2+}$

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76. The value of K_w in neutral solution is 5.474×10^{-14} at $50^\circ C$. Calculate the pH of the solution at this temperature.

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77. Calculate the pH of the following solutions

Solution of H_2SO_4 containing 0.98 g of H_2SO_4 per litre.

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78. A solution of NaOH contains 0.04g of NaOH per litre. Its pH is:

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79. The dissociation constant of a weak acid HA is 1.2×10^{-10} Calculate its pH in a 0.1 M solutions

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80. 100 mL of 0.003 M $BaCl_2$ solution is mixed with 200 ml of 0.0006 M H_2SO_4 solution. Predict whether a precipitate of $BaSO_4$ will be formed or not. K_{sp} for $BaSO_4$ is 1.1×10^{-10}

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81. How much CH_3COONa should be added to 1 litre of 0.01 M CH_3COOH to make . A buffer of pH = 4.1 ?

$\left(K_a \text{ for } CH_3COOH = 1.8 \times 10^{-5}\right)$

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82. What are acid -base indicators and how do they indicate the end point of an acid -base titration?

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83. Mention the colour changes observed when the following indicators are added to acids-

(i) Alkaline phenolphathalein solution (ii) Methyl orange solution (iii) Neutral litmus solution

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84. Which indicator is most commonly used for the titration of a strong acid against a strong base?

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85. Name of the suitable indicators which could be used in the following titrations :

CH_3COOH against NaOH

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86. Name of the suitable indicators which could be used in the following titrations :

CH_3COOH against NH_4OH

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87. Name of the suitable indicators which could be used in the following titrations :

H_2SO_4 against KOH

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Watch Video Solution

88. Name of the suitable indicators which could be used in the following titrations :

HCl against NH_4OH

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89. Explain the action of phenolphthalein as an indicator on the basis of Ostwald's theory.

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90. Addition of quick lime to water leads to the formation of ____.

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91. What is salt hydrolysis? Explain with an example.

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92. Answer the following questions in one word or one sentence:

What is the nature of aqueous solution of ammonium chloride, acidic or basic?

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93. why are the aqueous solutions of ammonium acetate and sodium chloride neutral in nature ? Explain in detail and mention the difference in the hydrolysis of the two.

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94. Predict the nature of the aqueous solutions of the following salts.

$CuSO_4$

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95. Predict the nature of the aqueous solutions of the following salts.

$NaCN$

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96. Predict the nature of the aqueous solutions of the following salts.

CH_3COOK

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97. Predict the nature of the aqueous solutions of the following salts.

Na_2SO_4

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98. Which of the following salts do not undergo hydrolysis when dissolved in water ?

Ammonium chloride

Sodium Sulphate

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99. Which of the following salts do not undergo hydrolysis when dissolved in water ?

KCl

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100. Which of the following salts do not undergo hydrolysis when dissolved in water ?

NaCl

K2CO3

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101. Which of the following salts do not undergo hydrolysis when dissolved in water ?

A. A. Sodium chloride

B. B. Ammonium chloride

C. C. Sodium acetate

D. D. All of these

Answer:

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102. Calculate the hydrolysis constant. Degree of hydrolysis and pH of 0.5 M solution of NH_4Cl.

(Given : $K_a = 1.78 \times 10^{-5}$, $K_b = 1.8 \times 10^{-5}$ and $K_w = 1.8 \times 10^{-14}$)

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103. Calculate the pH of a solution of ammonium acetate

(Given : $K_a = 1.78 \times 10^{-5}$, $K_b = 1.8 \times 10^{-5}$ and $K_w = 1.8 \times 10^{-14}$)

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104. What is the percentage hydrolysis of CH_3COONa in 0.01 M Solution ? $\left(K_a = 1.78 \times 10^{-5} \text{ and } K_w = 1.0 \times 10^{-14}\right)$

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105. The pH of a solution of NH_4Cl is 4.86 .Calculate the molar concentration fo the solution if $K_b = 1.0 \times 10^{-5}$ and $K_w = 1.0 \times 10^{-14}$

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Very Short Answer Type Questions

1. What do you understand by the term echo?

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2. Why is equilibrium said to by dynamic ?

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3. Can liquid $\Leftrightarrow$ gas equilibrium be attained in an open vessel ? If not why?

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4. What is the effect on the pressure of a gas if its temperature is increased at constant volume ?

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5. A gas is in equilibrium with water at a certain temperature and pressure what will happen if

Pressure of the gas is increased ?

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6. Give two examples each of the irreversible and reversible reactions.

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7. Can a catalyst affect the state of chemical equilibrium ?

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8. What is the relationship between K_p and K_c ?

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9. sort out the homogeneous and netrogeneous equilibrium from the following

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

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10. sort out the homogeneous and netrogeneous equilibrium from the following

$CH_3COOH(l) + C_2H_5(l) \Leftrightarrow CH_3COOC_2H_5(l) + H_2O(l)$

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11. Write the equilibrium constant expression for the following reactions :

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

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12. Write the equilibrium constant expression for the following reactions :

$BaSO_4(s) \Leftrightarrow Ba^{2+}(aq) + SO_4^{2-}(aq)$

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13. Write the equilibrium constant expression for the following reactions :

$HCl(aq) + H_2O(l) \Leftrightarrow H_3O^+ + Cl^-(aq)$

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14. State the units of K_p and K_c for the reaction.

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

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15. If the value of K for the reaction,

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

is 48, what would be the value of K for the reaction.

$\frac{1}{2}H_2(g) + \frac{1}{2}(g) \Leftrightarrow Hl(g)$?

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16. The value of equilibrium constant for the reactions

$Cu^{2+}(aq) + zn(s) \Leftrightarrow Cu(s) + Zn^{2+}(aq)$

is 5.0×10^8 in Which direction the reaction is expected to proceed to a greater extent ?

Watch Video Solution

17. What is the effect of increasing pressure on the equilibrium

$N_2 + 3H_2 \Leftrightarrow 2NH_3$?

Watch Video Solution

18. What will happen if an inert gas is added at constant volume to the system

$2Hl(g) \Leftrightarrow (g) + I_2(g)$?

Watch Video Solution

19. Write the conditions to maximise the yield of H_2SO_4 by Contact proces.

Watch Video Solution

20. What do you understand by ionic equilibrium ?

Watch Video Solution

21. The value of equilibrium constant for the reactions

$Cu^{2+}(aq) + zn(s) \Leftrightarrow Cu(s) + Zn^{2+}(aq)$

is 5.0×10^8 in Which direction the reaction is expected to proceed to a greater extent ?

Watch Video Solution

22. Define degree of ionisations.

Watch Video Solution

23. Why does the solution of a weak electrolyte not conduct much current?

Watch Video Solution

24. Why does the solution of an electrolyte conduct eletricity but that an non - electrolyte does not ?

Watch Video Solution

25. State Ostwald's dilution law.

Watch Video Solution

26. In Bronsted an Lowry concept , water is regarded as an amphoteric substance . Give examples to justify this statement.

Watch Video Solution

27. Calculate the pH value of 0.001 M HCI if HCI Is completely ionised

Watch Video Solution

28. Why is H_2O regarded a Lewis base?

Watch Video Solution

29. At a certain temperature the hydronium ion concentration in pure water is found to be 1.7×10^{-7} mol L^{-1} .What is the value of K_w at this temperature ?

Watch Video Solution

30. Which solution does possess a higher pH = 0.1 M HCl or 0.01 M NaOH ?

Watch Video Solution

31. Which of the following is not a buffer ?

$HCN + NaCN, HCl + NaCl, NH_4OH + NH_4Cl$

Watch Video Solution

32. Write the expressions of solubility products for the following salts .

$Ag_2CrO_4, Ca_3(PO_4)_2.$

Watch Video Solution

33. What is the role of HCl gas in the purifications of common salt?

Watch Video Solution

34. Which indicator is most commonly used for the titration of a strong acid against a strong base?

Watch Video Solution

35. Menstion the nature of aqueous solutoins of following salts.

NH_4NO_3

Watch Video Solution

36. Predict the nature of the aqueous solutions of the following salts.

$CuSO_4$

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37. Menstion the nature of aqueous solutoins of following salts.

NH_4CN

Watch Video Solution

38. Menstion the nature of aqueous solutoins of following salts.

K_2SO_4 .

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Short Answer Type Questions

1. How is liquid -vapour equilibrium attained in a closed vessel.

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2. How is equilibrium attained in a chemical reactions? Why is the chemical equilibrium said to be dynamic ?

Watch Video Solution

3. What do you understand by active mass of a substance ? In what units can it be expressed?

Watch Video Solution

4. What is concentration quotient ? Write concentration quotients for the the following reactions:

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

Watch Video Solution

5. What is concentration quotient ? Write concentration quotients for the the following reactions:

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

Watch Video Solution

6. Why is CO_2 made to escape in a lime kiln during the preparation of lime from limestone?

Watch Video Solution

7. What will be the effect of increasing pressure on the following equilibria ?

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

Watch Video Solution

8. Discuss the effect of increase of pressure on the following reactions

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

Watch Video Solution

9. What will be the effect of increasing pressure on the following equilibria ?

$2Hl(g) \Leftrightarrow H_2(g) + I_2(g)$

Watch Video Solution

10. From the following data (at 298 K) prdict which oxide of Nitrogen is most stable

$2NO_2 \Leftrightarrow N_2(g) + 2O_2(g), K = 6.7 \times 10^{16}$

$2NO(g) \Leftrightarrow N_2(g)O_2(g), K = 2.2 \times 10^{30}$

$2N_2O(g) \Leftrightarrow 2N_2(g) + O_2(g), K = 3.5 \times 10^{23}$

$2N_2O_5(g) \Leftrightarrow 2N_2(g) + 5O_2(g), K = 1.2 \times 10^{34}$

Watch Video Solution

11. How does the hamoglobin present In our blood transport oxygen to the tissues of the body ?

Watch Video Solution

12. On the basis of Le- Chatellier's principle ,discuss the condition for obtaining the maximum yield of SO_3 in the following reactions :

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g), \Delta H = -42$ k cal

Watch Video Solution

13. Why is pure water regarded as a weak electrolyte ?

Watch Video Solution

14. Bromine water is brown and weakly acidic due to following equilibrium :

$$\underset{\text{Brown}}{Br_2(aq)} + 2H_2O \Leftrightarrow \underset{\text{Colourless}}{HBrO(aq)} + H_3O^+(l) + \underset{\text{Colourless}}{Br^-(aq)}$$

When sodium hydroxide is added to the solution , the solution becomes colourless but the colour return when hydrochloric acid is added. Explain this observation.

Watch Video Solution

15. The dissociation of phosgene is represented as follows:

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

When a mixture of these three gasses at equilibrium is compressed at constant temperature , what happens to

the amount of CO in the mixture.

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16. The dissociation of phosgene is represented as follows:

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

When a mixture of these three gasses at equilibrium is compressed at constant temperature , what happens to

the partial pressure of $COCl_2$:

Watch Video Solution

17. The dissociation of phosgene is represented as follows:

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

When a mixture of these three gasses at equilibrium is compressed at constant temperature , what happens to

the equilibrium constant for the reactions?

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18. Apply law of mass action to the dissociation of Na_2SO_4.

Watch Video Solution

Watch Video Solution

19. Apply law of mass action to the process,

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

Watch Video Solution

20. State and explain Le- Chateller's principal

Watch Video Solution

21. Why is pure water regarded as a weak electrolyte ?

Watch Video Solution

22. Bromine water is brown and weakly acidic due to following equilibrium :

$$\underset{\text{Brown}}{Br_2(aq)} + 2H_2O \Leftrightarrow \underset{\text{Colourless}}{HBrO(aq)} + H_3O^+(l) + \underset{\text{Colourless}}{Br^-(aq)}$$

When sodium hydroxide is added to the solution , the solution becomes colourless but the colour return when hydrochloric acid is added. Explain this observation.

Watch Video Solution

23. What do you understand by conjugate pairs of acid and base? Sort out the conjugate pairs in the following reactions.

$H_2O(l) + CO_3^{2-}(aq) \Leftrightarrow HCO_3^-(aq) + OH^-(aq)$

Watch Video Solution

24. What do you understand by conjugate pairs of acid and base? Sort out the conjugate pairs in the following reactions.

$NH_4^+(aq) + S^{2-}(aq) \Leftrightarrow HS^-(aq) + NH_3(aq)$

Watch Video Solution

25. The dissociations constant (K_b) for $NH_3, CH_3NH_2, (CH_2)_2NH$ and $(CH_3)_3N$ are $0.2 \times 10^{-4}, 4$ respectively . Which one is the strongest base and why?

Watch Video Solution

26. Sort out the Lewis acids and Lewis bases among the following:

$Cl^-, BCl_3, SO_2, OH^-, Fe^{3+}, SnCl_4, Ni, CH_3OH, NH_3$?

Watch Video Solution

27. Why is pure water neutral although it contains H_3O^+ ions?

Watch Video Solution

28. What do you understand by pH value and pH scale ? Explain.

Watch Video Solution

29. Calculate the pH value of the solution in which the concentration of OH^- ions is 5.0×10^{-9} mol $L^{-1} at 298K$

Watch Video Solution

30. What is meant by common ion effect ?**

Watch Video Solution

31. Why does the pH of an acidic buffer remian constant even when a few drops of a strong acid are added to it?

Watch Video Solution

32. In qualitative analysis. Explain why

The cations of group II are precipitated , in acidic medium while those of

group IV in alkaline medium.

Watch Video Solution

33. In salt analysis. Explain why

NH_4Cl is added before the addition of NH_4OH in group III.

Watch Video Solution

34. Can NaOH be used in place of NH_4OH to precipitate the cations of group III in qualitative analysis?

Watch Video Solution

35. What is the condition for a salt to get precipitated from its saturated solutions?

Watch Video Solution

36. An acidic solution contains both Zn^{2+} and Hg^{2+} ions. Which ion will get precipitated passing H_2S into it ?

Watch Video Solution

37. What is the principle of selective precipitations ?

Watch Video Solution

38. The ionic product of water is 0.11×10^{-14} at 273 K. $1.0 \times 10^{-14} at 298K$ and $5.1 \times 10^{-14} at 373K$ Deduce from this data whether the ionisation of water to hydrogen and hydrooxide ions is exothermic or endothermic.

Watch Video Solution

39. Comment on the statement : All Bronsted bases are also Lewis bases but all Bronsted acids are not Lewis acids.

Watch Video Solution

40. Why does phenolphthalein assume pink colour in alkaline solutions?

Watch Video Solution

41. Explain the action of methyl orange on the basis of quinonoid theory.

Watch Video Solution

42. Why is an aqueous solution of NH_4Cl acidic ?

Watch Video Solution

43. Why is the aqueous solution of ammonium acetate neutral ?

Watch Video Solution

44. Why do the salts of strong acids and strong bases not undergo hydrolysis?

Watch Video Solution

Essay Long Answer Type Questions

1. What do you understand by chemical equilibrium and how is it attained in a chemical reaction ? What are the characteristics of chemical equilibrium?

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2. What is law of mass action & how is it helpful in finding the equilibrium constant ? Illustrate your answer with atleast two examples.

Watch Video Solution

3. Define equilibrium constant. What are its main characteristics? How is it related to the concentration quotient of the reaction?

Watch Video Solution

4. State and explain Le Chatelier's principle. Explain the effect of change in concentration, pressure and temperature on the following reactions.

$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g), \Delta H = -92.4kJ$

Watch Video Solution

5. State and explain Le Chatelier's principle. Explain the effect of change in concentration, pressure and temperature on the following reactions.

$N_2(g) + O_2(g) \Leftrightarrow 2NO(g), \Delta H = 180.7kJ$

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6. What do you understand by K_p and K_c ? Derive a relationship between the two.

Watch Video Solution

7. Find out the units of K_c and K_p for the following equilibrium reactions :

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

Watch Video Solution

8. What is Arrhenius concept of acids and bases ? On the basis of this concept explain why heat of neutralisation for a strong acid and a strong base is always constant.

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9. Concept of Acids and Bases

Watch Video Solution

10. Define a Lewis acid and a Lewis base. What type of species can act as Lewis acids and Lewis bases?

Watch Video Solution

11. What do you understand by pH value and pH scale ? Explain.

Watch Video Solution

12. What are buffer solutions and how are they prepared? Explain the buffer action of an acidic buffer solution. Derive Henderson's equation for an acidic buffer.

Watch Video Solution

13. Define solubility product.

Watch Video Solution

14. What are acid-base indicators and how do they work? Explain with an example.

Watch Video Solution

15. Discuss the various types of acid-base titrations using indicators.

Watch Video Solution

Watch Video Solution

16. Discuss the important theories of acid-base indicators.

Watch Video Solution

17. What do you understand by salt hydrolysis? Discuss the hydrolysis of different types of salts.

Watch Video Solution

Objective Multiple Choice Type Questions

1. In aa chemical reaction equilibrium is established when :

A. operating reaction ceases

B. concentrations of reactants and products are equal

C. velocities of opposing reactions become equal

D. temperatures of opposing reactions are equal.

Answer: C

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2. The equilibrium constant of a reversible reaction at a given temperature

A. depends on initial concentration of reactants

B. depends on the concentration of products at equilibrium

C. does not depend on the initial concentration

D. is not a characteristic of the reaction.

Answer: C

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3. In the reaction,

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

the value of the equilibrium constant depends on

A. volume of the reaction vessel

B. total pressure of the system

C. the initial concentration of nitrogen and hydrogen

D. the temperature

Answer: D

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4. In the reaction $A + B \Leftrightarrow C + D,$ 4 moles of A

react with 4 moles of B and form 2 moles each of C and D. The value of Ke

for the reaction is

A. 2

B. 3

C. 1

D. 1.56

Answer: C

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5. For a reversible reaction, if the concentration of the reactants are doubled, then the equilibrium constant will

A. also be doubled

B. be halved

C. become one fourth

D. remain the same.

Answer: D

Watch Video Solution

6. For the reaction

$2SO_2 + O_2 \Leftrightarrow 2SO_3$

the units of K are

A. L mol^{-1}

B. mol L^{-1}

C. (mol L^{-1})^2

D. (L mol^{-1} ^ (2)

Answer: A

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7. The law of mass action was enunciated by

A. Berthelot

B. Bodenstein

C. Graham

D. Guldberg and Waage.

Answer: D

Watch Video Solution

8. For the reaction $H_2(g) + I_2(g) \Leftrightarrow 2HI(g)$, the equilibrium constant changes with:

A. total pressure

B. catalyst

C. the amount of H2 and la present

D. temperature

Answer: D

Watch Video Solution

9. For the reaction,

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

K_p / K_c is equal to

A. 1

B. $RT^{1/2}$

C. $(RT)^{-\frac{1}{2}}$

D. RT

Answer: C

Watch Video Solution

10. Wet clothes dry quicker when there is a breeze because

A. clothes swing in the presence of breeze

B. breeze is hot and evaporates water quicker

C. the evaporation process gets expedited due to removal of water vapour by the breeze

D. breeze helps in quicker condensation of water vapour present in wet clothes

Answer: C

Watch Video Solution

11. 1.1 moles of A are mixed with 2.2 moles of B and the mixture is kept in a one litre flask till the equilibrium

$A + 2B \Leftrightarrow 2C + D$

is reached. At equilibrium, 0.2 moles of C are formed. The equilibrium constant of the reaction is

A. 0.001

B. 0.002

C. 0.0033

D. 0.004

Answer: A

Watch Video Solution

12. The equilibrium constant for the reactions

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

is 4×10^{-4} at 2000 K . In the presence of a catalyst. The equilibrium is attained three times faster. The equilibrium constant in the presence of the catalyst at 2000 K is

A. 40×10^{-4}

B. 4×10^{-4}

C. 1.2×10^{-3}

D. difficult to compute without more data.

Answer: B

Watch Video Solution

13. Consider the following two gaseous equilibria involving SO_2 and the corresponding equilibrium constants at 298 K:

$SO_2(g) + \frac{1}{2}O_2(g) \Leftrightarrow SO_3(g), K1$

$2SO_3(g) \Leftrightarrow 2SO_2(g) + O_2(g), K_2$

The values of equilibrium constants are related by

A. $K_2 = K_1$

B. $K_2 = K_1^2$

C. $K_2 = \frac{1}{K_1^2}$

D. $K_2 = \frac{1}{K_1}$

Answer: C

Watch Video Solution

14. In which of the following case, does the reaction go farthest to completion ?

A. $K = 10^2$

B. $K = 10^{-2}$

C. $K = 10$

D. $K = 1$

Answer: A

Watch Video Solution

15. A mixture of 0.3 moles of H_2 and 0.3 moles of l_2 is allowed to react in a 10 litre evacuated flask at 500°C. The reaction is `H_2 + I_2 = 2HI, the K is found to be 64. The amount of unreacted 'I_2' equilibrium is

A. 0.15 mole

B. 0.06 mole

C. 0.03 mole

D. 0.2 mole

Answer: B

Watch Video Solution

16. 28 g of N_2 and 6 g of H_2 were kept at $400^\circ C$ in 1 litre vessel , the equilibrium mixture contained 27.54 g of NH_3 The approximate value of K_c for the adove reaction can be (in $\left. \text{mol}^{-2}L^{-2} \right)$

A. 75

B. 50

C. 25

D. 100

Answer: A

Watch Video Solution

17. In the reactions

$H_2(g) + Cl_2(g) \Leftrightarrow 2HCl(g)$.

A. $Kp = K_c$

B. $K_p \neq K_c$

C. $K_p > K_c$

D. $K_p < K_c$

Answer: A

Watch Video Solution

18. In the reaction

$A_2(g) + 4B_2(g) \Leftrightarrow 2AB_4(g), \Delta H < 0$

The formation of AB_4 (g) will be favoured at

A. low temperature and high pressure

B. high temperature and low pressure

C. low temperature and low pressure

D. high temperature and high pressure.

Answer: A

Watch Video Solution

19. For the reaction $PCl_{5(g)} \Leftrightarrow PCl_{3(g)} + Cl_{2(g)}$, the forward reaction at constant temperature is favoured by

A. introducing an inert gas at constant volume

B. introducing Cl_2 gas at equilibrium

C. introducing an inert gas at constant pressure

D. decreasing the volume of the container.

Answer: C

Watch Video Solution

20. Given $HF + H_2O \Leftrightarrow H_3O^+ + F^-, K_a$

$$F^- + H_2O \Leftrightarrow HF + OH^-, K_b$$

Which of the following relations is correct?

A. $K_b = K_w$

B. $K_b = \frac{1}{K_w}$

C. $K_a \times K_b = K_w$

D. $K_a / K_b = K_w$

Answer: C

Watch Video Solution

21. The partial pressures of CH_3OH, CO and H_2 in the equilibrium mixture for the reaction

$CO + 2H_2 \Leftrightarrow CH_3OH$

at $27^\circ C$ are $2.0, 1.0$ and 0.1 atm respectively . The value of K_p for the decompositions of CH_3OH to CO and $H_2$is

A. 1×10^2 atm

B. 20×10^2 atm

C. $50 atm^2$

D. 5×10^{-3} atm^2

Answer: D

Watch Video Solution

22. At constant temperature , the equilibrium constant (K_P) for the decomposition reaction

$N_2O_4 \Leftrightarrow 2NO_2$, is expressed by $K_p = \frac{(4x^2p)}{(1-x^2)}$

where p= pressure ,x = extent of decomposition .which one of the following statements is true?

A. K_p increase with increase of p

B. K_p increases with increase of x

C. K_p increases with decrease of x

D. K_p remains constant with change in P and X.

Answer: D

Watch Video Solution

23. For the following reaction in gaseous phase,

$CO + \frac{1}{2}O_2 \rightarrow CO_2$, $\frac{K_c}{K_p}$ is

A. $(RT)^{1/2}$

B. $(RT)^{-1/2}$

C. (RT)

D. $(RT)^{-1}$

Answer: A

Watch Video Solution

24. One of the following equilibrium is not affected by change in volume of the falsk :

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

B. $N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g)$

C. $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$

D. $SO_2Cl_2(g) \Leftrightarrow SO_2(g) + Cl_2(g)$

Answer: C

Watch Video Solution

25. Consider the reactions equilibrium ,

$2SO_2(g) + O_2(g) \Leftrightarrow 2SO_3(g), \Delta H^\circ = -198\text{kJ}$

On the basis of Le- Chatelier's Principal , the condition favourable for the forward reaction is

A. lowering of temperature as well as pressure

B. increasing temperature as well as pressure

C. lowering the temperature and increasing the pressure

D. any value of temperature and pressure.

Answer: C

Watch Video Solution

26. For the reaction equilibrium,

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

the concentrations of N_2O_4 and NO_2 at equilibrium are 4.8×10^{-2} and 1.2×10^{-2} mol L^{-1} respectively . The value of K_c for the reaction is

A. 3.3×10^{-2} mol L^{-1}

B. 3×10^{-1} mol L^{-1}

C. 3×10^{-3} mol L^{-1}

D. 3×10^{3} mol L^{-1}

Answer: C

Watch Video Solution

27. The equilibrium constant for the following reaction will be

$$P_{4(s)} + 5O_{2(g)} \Leftrightarrow P_4O_{10(s)}$$

A. $K_c = \dfrac{[P_4O_{10}]}{[P_4][O_2]^5}$

B. $K_c = \dfrac{[P_4O_{10}]}{5[P_4][O_2]}$

C. $K_c = [O_2]^5$

D. $K_c = \dfrac{1}{[O_2]^5}$

Answer: D

Watch Video Solution

28. For the reactions,

$CO(g) + Cl_2(g) \Leftrightarrow COCl_2(g)$, the $\dfrac{K_P}{K_c}$ is equal to

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

B. RT

C. $\sqrt{RT}$

D. 1.0

Answer: A

Watch Video Solution

29. The equilibrium constant for the reacction $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$ at temperature (T) 4×10^{-4} The value of K_c for the reaction $NO(g) \Leftrightarrow \frac{1}{2}N_2(g) + \frac{1}{2}O_2(g) at the same temperature?$ (1)/(2)F_(2) (g)hArrF(g)`

A. 2.5×10^{-2}

B. 50

C. 4×10^{-4}

D. 0.02

Answer: B

Watch Video Solution

30. For the reaction,

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

$\left(K_c = 1.8 \times 10^{-6} at 184^\circ C\right)$

$(R = 0.0083kJ)/(\ \text{mol K}\ )$

When K_p and K_c are compared at $184^\circ C$ it is found that

A. Whether K_p is greater than , less than or equal to K_c depends upon the total gas pressure.

B. $K_p = K_c$

C. K_p is less than K_c

D. K_P is greater than K_c

Answer: D

Watch Video Solution

31. The exothermic formation of ClF_3 is represented by the equations.

$Cl_2(g) + 3F_2(g) \Leftrightarrow 2ClF_3(g) : \Delta, H = -329$ kJ

Which of the following will increase the quantity of ClF_3 in an equilibrium mixture of Cl_2, F_2 and ClF_3 ?

A. Adding F_2

B. Increasing the volume of the container

C. Removing Cl_2

D. Increasing the temperature.

Answer: A

Watch Video Solution

32. An amount of solid NH_4HS is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm pressure .

Ammonium hydrogen sulphide decomposses to yield NH_3 and H_2S gases in the flask. When the decomposition reaction reaches equilibrium , the total pressure in the flask rises to 0.84 atm. The equilibrium constant for NH_4HS decomposition at this temperature is

A. 0.11

B. 0.17

C. 0.18

D. 0.30

Answer: A

Watch Video Solution

33. Phosphorus pentachloride dissociates as follows in a closed reaction vessel

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

If total pressure at equilibrium of the reaction mixture is P and degree of dissociation of PCl_5 is x, the partial pressure of PCl_3 will be.

A. $\left(\frac{x}{x+1}\right)_p$

B. $\left(\frac{2x}{1-x}\right)p$

C. $\left(\frac{x}{x-1}\right)$ p

D. $\left(\frac{x}{1-x}\right)p$

Answer: A

Watch Video Solution

34. The equilibrium constant for the reation,

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

is $K_c = 4.9 \times 10^{-2}$ The value of K_c for the reaction

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

will be

A. 416

B. 2.4×10^{-3}

C. 9.8×10^{-2}

D. 4.9×10^{-2}

Answer: A

Watch Video Solution

35. For the following three reactions (i),(ii) and (iii) equlibrium constant are given.

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

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

(iii)$CH_4(g) + 2H_2O(g) \Leftrightarrow CO_2(g) + 4H_2(g), K_3$

Which of the following relations is correct ?

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

B. $K_2K_3 = K_1$

C. $K_3 = K_1K_2$

D. $K_3.\ K_2^3 = K_1^2$

Answer: C

Watch Video Solution

36. The value of ΔH for the reaction

$X_2(g) + 4Y_2 \Leftrightarrow 2XY_4(g)$ is less than zero.

Formation of $XY_4(g)$ will be favoured at

A. low pressure and low temperature

B. high temperature and low pressure

C. high pressure and low temperature

D. high temperature and high pressure.

Answer: C

Watch Video Solution

37. For the reaction $N_2(g) + O_2(g) \Leftrightarrow 2NO(g)$, the equilibrium constant is K1 and for reaction $2NO(g) + O_2(g) \Leftrightarrow 2NO_2(g)$.

equilibrium constant is K2 What is K for the reaction

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

A. $1/4(4K_1K_2)$

B. $(1/K_1K_2)^{1/2}$

C. $1/(K_1K_2)$

D. $1/(2K_1K_2)$

Answer: B

Watch Video Solution

38. For the reversible reaction

$$N_2(g) + 3H_2(g) \Leftrightarrow 2NH_3(g) + \text{Heat}$$

The equilibrium shifts in forward directions.

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

B. by decreasing the pressure

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

D. by increasing pressure and decreasing temperature

Answer: D

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39. For a given exothermic reaction ,K_P and K_p' are the equilibrium constant at temperature T_1 and T_2 respectively .Assuming that heat of reaction is constant in temperature range between T_1 and T_2 , it is readly observed that

A. $K_p > K_p$

B. $K_p < K_p$

C. $K_p = K_p$

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

Answer: A

Watch Video Solution

40. For the reaction, $SO_{2(g)} + \frac{1}{2}O_{2(g)} \Leftrightarrow SO_{3(g)}$, If $K_P = K_C(RT)^x$ where the symbol have usual meaning then the value ofx is : (assuming ideality).

A. -1

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

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

D. 1

Answer: B

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41. Given $HF + H_2O \Leftrightarrow H_3O^+ + F^- : K_a$

$$F^- + H_2O \Leftrightarrow HF + OH^-, K_b$$

Which of the following relations is correct ?

A. $K_b = K_w$

B. $K_a = \frac{1}{K_w}$

C. $K_a \times K_b = K_w$

D. $K_a / K_b = K_w$

Answer: C

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42. At $80^\circ C$, pure distilled water has $\left[H_3O^+\right] = 1 \times 10^{-6}$ mol L^{-1}

The value of K_w at this temperature will be

A. 1×10^{-6}

B. 1×10^{-12}

C. 1×10^{-14}

D. 1×10^{-5}

Answer: B

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43. pK_a value of the strongest acid among the following is

A. 3.0

B. 4.5

C. 1.0

D. 2.0

Answer: C

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44. 0.2 molar solution of formic acid is ionised to an extent of 3.2 % its ionisation constant is

A. 9.6×10^{-3}

B. 2.1×10^{-4}

C. 1.25×10^{-6}

D. 4.8×10^{-5}

Answer: B

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45. Which one of the following has the highest pH?

A. Distilled water

B. 1 M NH_3

C. 1 M NaOH

D. Water saturated with chlorine

Answer: C

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46. An aqueous solution whose pH= 0 is

A. acidic

B. neutral

C. basic

D. amphoteric

Answer: A

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47. The pH of a 10^{-8} molar solution of HCl in water is

A. 8

B. -8

C. between7 and 8

D. between 6 and 7 .

Answer: D

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48. The pH of 0.005 molar aqueous solution of sulphuric acid is approximately

A. 0.005

B. 2

C. 1

D. 0.01

Answer: B

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49. 40 mg of pure NaOH is dissolved in 10 litres of distilled water. The pH of the solution is

A. 9

B. 10

C. 11

D. 12

Answer: B

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50. The solubility product of AgCl is 1.8×10^{-10}. Precipitation of AgCl will occur by mixing which of the following solutions are mixed in equal volumes ?

A. $10^{-4}MCa^{2+} + 10^{-4}MF^{-}$

B. $10^{-2}MCa^{2+} + 10^{-3}MF^{-}$

C. $10^{-5}MCa^{2+} + 10^{-3}MF^{-}$

D. $10^{-3}MCa^{2+} + 10^{-5}MF^{-}$

Answer: B

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51. The solubility product of a sulphide MS is 3×10^{-25} and that of another sulphide NS is 4×10^{-40} In ammonical solution

A. only NS gets precipitated

B. only MS gets precipitated

C. neither sulphide precipitates out

D. both sulphides precipitate out.

Answer: D

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52. Concentration of NH_4Cl and NH_4OH in buffer solution are in the ratio of $1:1$, K_b for NH_4OH is 10^{-10} The pH of the buffer is

A. 4

B. 5

C. 9

D. 11

Answer: A

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53. The solubility product of silver chloride is 1.44×10^{-4} at 373 K. The solubility of silver chloride in boiling water will be

A. `0.72xx 10 ^(-4) M~

B. 1.20×10^{-2} M

C. 0.72×10^{-2}M

D. 1.20×10^{-4} M

Answer: B

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54. Which equilibrium can be described as an acid base reaction using the Lewis acid-base definition but not using the Bronsted-Lowery definition?

A. $2NH_3 + H_2SO_4 \Leftrightarrow 2NH_4^+ + SO_4^{2-}$

B. $NH_3 + CH_3COOH \Leftrightarrow NH_4^+ + CH_3COO^-$

C. $H_2O + CH_3COOH \Leftrightarrow H_3O^+ CH_3COO^-$

D. $\left[Cu(H_2O)_4^{2+} + 4NH_3 \Leftrightarrow \left[Cu(NH_3)_4\right]^{2+} + 4H_2O\right.$

Answer: D

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55. The conjugate acid of HPO_4^{2-} is:

A. $H_2PO_4^-$

B. PO_4^{3-}

C. H_3PO_4

D. H_3PO_3.

Answer: A

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56. Which of the following is not Lewis acid ?

A. BF_3

B. $FeCl_3$

C. H_2O

D. PF_5.

Answer: C

Watch Video Solution

57. Which of the following statement is (are) not correct ?

A. Every indicator changes its colour in a definte pH range

B. The pH range of litmus is 5.0 -8.0

C. The quinonoid form of an indicator is usually colourless or of light colour

D. Undissociated methyl orange molecule is yellow.

Answer: C

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58. The best indicator for the detection of end point in titration of a weak acid and a strong base is :

A. Phenolphthalein

B. litmus

C. methyl orange

D. thymol. Blue

Answer: A

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59. The blue litmus is turned red by an aqueous solution of

A. KNO_3

B. $NaCl$

C. $CuSO_4$

D. $CH_3COONa.$

Answer: C

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60. The aqueous solution (s) of which of the following salts is (are) acidic in nature?

A. $CuSO_4$

B. KCl

C. CH_3COOK

D. NH_4NO_3.

Answer: A::D

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61. The aqueous solution of CH_3COONa is alkaline due to interaction of the following with water.

A. CH_3COO^-

B. Na^+

C. CH_3COONa as a whole

D. $NaOH$

Answer: A

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62. The aqueous solution of CH_3COONH_4 is neutral because

A. CH_3COO^- ions are unable to interact with water

B. NH_4^+ ions are unable to interact with water.

C. both NH_4^+ and CH_3COO^- are unable to interact with water

D. both NH_4^+ and CH_3COO^- are able to interact heavily with water.

Answer: D

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63. Hydrolysis is the reverse process of

A. decomposition

B. dehydration

C. neutralisation

D. dissociation.

Answer: C

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64. The aqueous solution of Na_2SO_4 is neutral because

A. both Na^+ and SO_4^{2-} ions interact heavily with water

B. Both Na^+ and SO_4^{2-} ions interact moderately with water

C. both Na^+ and SO_4^{2-} ions do not interact at all with water

D. Na^+ is a strong acid and SO_4^{2-} is a strong base.

Answer: C

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65. The aqueous solution of $FeCl_3$ is

A. acidic

B. alkaline

C. neutral

D. either acidic or basic depending upon concentration.

Answer: A

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66. If a solution has of a pOH value of 14 at $25^\circ C$, H^+ ion concentration in mol L^{-1} should be

A. 0

B. 1

C. 10

D. 14

Answer: B

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

A. $6y^4$

B. $64y^4$

C. $36y^5$

D. $108y^5$

Answer: D

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68. If pK_b for fluoride ion at $25^\circ C$ is 10.83 the ionisation constant of hydrofluoric acid in water at this temperature is

A. 1.74×10^{-5}

B. 3.52×10^{-3}

C. 6.75×10^{-4}

D. 5.38×10^{-2}

Answer: C

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69. Which of the following statement is correct?

A. The pH of 1.0×10^{-8} M solution of HCl is 8

B. The conjugate base of $H_2PO_4^-$ is H_3PO_4

C. Autoprotolysis constant of water increases with temperature

D. When a solution of a weak monoprotic acid is titrated against a strong base, at half neutratlisation point, pH = $1/2pK_a$

Answer: C

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70. The pH of 0.1 M solution of the following salts increases in the order.

A. $NaCl < NH_4Cl > NaCN > HCl$

B. $HCl < NH_4Cl < NaCl < NaCN$

C. $NaCN < NH_4Cl < NaCl < HCl$

D. $HCl < NaCl < NaCN < NH_4Cl.$

Answer: B

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71. A buffer solution cannot be prepared from a mixture of

A. sodium acetate and acetic acid in water

B. Sodium acetate and hydrochloric acid in water

C. ammonia and ammonium chloride in water

D. ammonia and sodium hydroxide in water.

Answer: D

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72. For a sparingly soluble salt A_pB_q, the relationship of its solubility product (K_s) with its solubility (S) is

A. $K_s = S^{p+q}.\ P^p.\ q^q$

B. $K_s = S^{p+q}.\ P^q.\ q^p$

C. $K_s = S^{pq}.\ p^p.\ q^q$

D. $K_s = S^{pq},\ (pq)^{p+q}$

Answer: A

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73. One of the following species acts as both Bronsted acid and base

A. $H_2PO_2^-$

B. HPO_3^{2-}

C. HPO_4^{2-}

D. all of these

Answer: C

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74. An aqueous solution of 1M NaCl and 1M HCl is

A. not a buffer but pH < 7

B. not a buffer but pH > 7

C. a buffer with pH < 7

D. a buffer with $pH > 7$

Answer: A

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75. pH of 0.005 M calcium acetate $(pK_a \text{ of } CH_3COOH = 4.74)$ is

A. 7.04

B. 9.37

C. 9.26

D. 8.37

Answer: D

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76. The solubility in water of a sparingly soluble salt AB_2 is $1.0 \times 10^{-5} \text{ mol } L^{-1}$. Its solubility product number will be

A. 4×10^{-15}

B. 4×10^{-10}

C. 1×10^{-15}

D. 1.0×10^{-10}

Answer: A

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77. Which one of the following statements is not true ?

A. The conjugate base of $H_2PO_4^-$ is HPO_4^{2-}

B. pH+ pOH = 14 for all aqueous solutions

C. The pH of $1 \times 10^{-8} M$ HCl is 8

D. $96,500$ coulombs of electricity when passed through a $CuSO_4$ solution deposite 1g equivalent of copper at the cathode.

Answer: C

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78. The conjugate base of $H_2PO_4^-$ is :

A. PO_4^{3-}

B. P_2O_5

C. H_3PO_4

D. HPO_4^{2-}

Answer: D

Watch Video Solution

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

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

B. $s = (128K_{sp})^{1/4}$

C. $s = (256K_{sp})^{1/5}$

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

Answer: D

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80. The solubility product of a salt having general formula MX_2 in water 4×10^{-12} .The concentration of M^{2+} ions in the aqueous solution of the salt is

A. $4.0 \times 10^{-10} M$

B. $1.6 \times 10^{-4} M$

C. $1.0 \times 10^{-4} M$

D. $2.0 \times 10^{-6} M$

Answer: C

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

A. 3.98×10^{-6}

B. 3.68×10^{-6}

C. 3.88×10^{-6}

D. 3.98×10^{8}

Answer: A

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82. What is the conjugate base of OH^{-} ?

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83. The pK_a of a weak acid (HA) is 4.5 The pOH of an aqueous buffered solution of HA in which 50% of it is ionised is

A. 4.5

B. 2.5

C. 9.5

D. 7.0

Answer: C

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

$AgIO_3(s) \Leftrightarrow Ag^+(aq) + IO_3^-(aq)$

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

A. $28.3 \times 10^{-2} g$

B. $2.83 \times 10^{-3} g$

C. $1.0 \times 10^{-7} g$

D. $1.0 \times 10^{-4} g$.

Answer: B

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85. The first and second dissociation constant 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 :

5.0×10^{-5}

5.0×10^{-15}

5.0×10^{-15}

0.2×10^{5}

A. 5.0×10^{-5}

B. 5.0×10^{-15}

C. 5.0×10^{-15}

D. 0.2×10^5

Answer: C

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

A. 9.58

B. 4.79

C. 7.01

D. 9.22

Answer: C

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87. What is $\left[H^{+}\right]$ in mol /L of a solution that is 0.20 M in CH_3COONa and 0.10 M in CH_3COOH? $\left(Ka = 1.8 \times 10^{-5}\right)$

3.5×10^{-4}

1.1×10^{-5}

1.8×10^{-5}

9.0×10^{-6}

A. 3.5×10^{-4}

B. 1.1×10^{-5}

C. 1.8×10^{-5}

D. 9.0×10^{-6}

Answer: D

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88. pH of a saturated solution of $Ba(OH)_2$ is 12. The value of solubility product K_{sp} of $Ba(OH)_2$ is

(a)3.3×10^{-7}

(b)5.0×10^{-7}

(c)4.0×10^{-6}

(d)5.0×10^{-6}

A. 3.3×10^{-7}

B. 5.0×10^{-7}

C. 4.0×10^{-6}

D. 5.0×10^{-6}

Answer: B

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89. Equimolar solution of the following substances were prepared separately. Which one of these will record the highest pH value?

A. $BaCl_2$

B. $AlCl_3$

C. $LiCl$

D. $BeCl_2$

Answer: A

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90. Buffer solution have constant acidity and alkalinity because :

1. these give unionised acid or base on reaction with added acid and bases

2. acids and alkalies in these solution are shielded from attack by other ions

3. they have large excess of H^+ or OH^- ions

4. they have fixed value of pH

A. these give unionised acid or base on reaction with added

B. acids and alkalies in these solution are shielded from attack by other ions

C. they have large excess of H^+ or OH^- ions

D. they have fixed value of pH

Answer: A

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91. Which of the following salts will give highest pH in water

(a)KCl

(b)NaCl

(c)Na_2CO_3

(d)All of these

A. KCl

B. NaCl

C. Na_2CO_3

D. All of these

Answer: C

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92. Using the Gibbs energy change $\Delta G^{\circ} = +63.3kJ$, for the following reaction,

$Ag_2CO_3 \rightarrow 2Ag + (aq) + CO_3^{2-}(aq)$ the K_{sp} of $Ag_2CO_3(s)$ in water at $25^{\circ}C$ is $\left(R = 8.314Jk^{-1}mol^{-1}\right)\{$ Given $:10^{0.91} \cong 8\}$

A. 3.2×10^{-26}

B. 8.0×10^{-12}

C. 2.9×10^{-3}

D. 7.9×10^{-2}

Answer: B

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

A. $0.1L$

B. $0.9L$

C. $0.2L$

D. $9.0L$

Answer: D

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94. Concentration of the Ag^+ ions in a saturated solution of $Ag_2C_2O_4$ is 2.2×10^{-4} mol L^{-1}, Solubility product of $Ag_2C_2O_4$ is

(a)2.42×10^{-8}

(b)2.66×10^{-12}

(c)4.5×10^{-11}

(d)5.3×10^{-12}

A. 2.42×10^{-8}

B. 2.66×10^{-12}

C. 4.5×10^{-11}

D. 5.3×10^{-12}

Answer: D

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95. 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 containers is now decreased by moving the movable piston fifted in the container . The maximum volume of the container , when pressure of CO_2 attains its maximum value , will be

(Given that : $SrCO_3(s) \Leftrightarrow SrO(s) + CO_2(g), K_p = 1.6$ atm)

A. 5 litre

B. 10 litre

C. 4 litre

D. 2 litre

Answer: A

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96. The equilibrium constant of the following are :

$$N_2 + 3H_2 \Leftrightarrow 2NH_3 \quad K_1$$
$$N_2 + O_2 \Leftrightarrow 2NO \quad K_2$$
$$H_2 + \frac{1}{2}O_2 \rightarrow H_2O \quad K_3$$

The equilibrium constant (K) of the reaction :

$2NH_3 + \frac{5}{2}O_2 \overset{k}{\Longleftrightarrow} 2NO + 3H_2O,$ will be

(a)$K_1K_3^3 / K_2$

(b)$K_2K_3^3 / K_1$

(c)K_2K_3 / K_1

(d)$K_2^3K_3 / K_1$

A. $K_1K_3^3 / K_2$

B. $K_2K_3^3 / K_1$

C. K_2K_3 / K_1

D. $K_2^3K_3 / K_1$

Answer: B

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

A. 7.2

B. 6.9

C. 7.0

D. 1.0

Answer: B

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98. The solubility of $BaSO_4$ in water is $2.42 \times 10^{-3} gL^{-1}$ at 298 K. The value of its solubility product (K_{sp}) will be (Given molar mass of

$BaSO_4 = 233g \ \ \text{mol}^{-1}\Big)$

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

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

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

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

Answer: A

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

$A_2(g) + B_2(g) \Leftrightarrow X_2(g), \Delta rH = -XkJ?$

A. low temperature and high pressure

B. Low temperature and low pressure

C. High temperature and high pressure

D. High temperature and low pressure.

Answer: A

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100. Following solutions were prepared by mixing different volumes of NaOH and HCI of different concentrations:

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

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

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

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

pH of which one of them will be equal to 1?

A. (iv)

B. (i)

C. (ii)

D. (iii)

Answer: D

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101. An aqueous solution contains 0.10 MH_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

5×10^{-8}

3×10^{-20}

6×10^{-21}

5×10^{-19}

A. 5×10^{-8}

B. 3×10^{-20}

C. 6×10^{-21}

D. 5×10^{-19}

Answer: B

Watch Video Solution

102. An aqueous solution contains an unknown concentration Ba^{2+} . When 50 mL of a 1 M solution Na_2SO_4 is added , $BaSO_4$ just begins to precipitate . The final volume is 500 mL .

The solubility product of $BaSO_4$ is 1×10^{-10} .What is the original concentration of Ba^{2+} ?

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

B. $2 \times 10^{-9} M$

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

D. 1.0×10^{-10} M

Answer: C

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103. Which of the following are Lewis acids?

A. PH_3 and BCl_3

B. $AlCl_3$ and $SiCl_4$

C. PH_3 and $SiCl_4$

D. BCl_3 and $AlCl_3$

Answer: D

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104. Which of the following salts is the most basic in aqueous solution?

(a)$Al(CN)_3$

(b)CH_3COOK

(c)$FeCl_3$

(d)$Pb(CH_3COO)_2$

A. $Al(CN)_3$

B. CH_3COOK

C. $FeCl_3$

D. $Pb(CH_3COO)_2$

Answer: B

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105. An alkali is titrated against an acid with methyl orange as indicator , which of the following is a correct combination?

A.

Base	Acid	End point
Weak	Strong	Colourless to pink

B.

Base	Acid	End point
Strong	Strong	Pinkish red to yellow

C.

Base	Acid	End point
Weak	Strong	Yellow to pinkish red

D.

Base	Acid	End point
Strong	Strong	Pink to colourless

Answer: C

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106. pH of a saturated solution of $Ca(OH)_2$ is 9. The solubility product (K_{sp}) of $Ca(OH)_2$ is

A. 0.125×10^{-15}

B. 0.5×10^{-10}

C. 0.5×10^{-15}

D. 0.25×10^{-10}

Answer: C

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107. Conjugate base the Bronsted acids H_2O and HF are :

A. OH^- and F^-, respectively

B. H_3O^+ and H_2F^+ ,respectively

C. OH^- and H_2F^+ , respectively

D. H_3O^+ and F^-, respectively

Answer: A

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108. Which will make basic buffer?

a) 100 m L o f 0.1 M HCl + 200 mL of 0.1 M N H 4 O H

b) 100 mL of 0.1 M HCl + 100 mL of 0.1 M NaOH

c) 50 mL of 0.1 M NaOH +25 mL of 0.1 M C H 3 C O O H

d) 100 mL of 0.1 M C H 3 C O O H + 100 mL of 0.1 M NaOH.

A. $100mLof0.1M$ HCl $+200$ mL of $0.1MNH_4OH$

B. 100 mL of 0.1 M HCl + 100 mL of 0.1 M NaOH

C. 50 mL of 0.1 M NaOH +25 mL of 0.1 M CH_3COOH

D. 100 mL of 0.1 M $CH_3COOH + 100$mL of 0.1 M NaOH.

Answer: A

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109. Solubility of $Cd(OH)_2$ in pure water is $1.84 \times 10^{-5} \text{mole}/L$ Calculate its solubility in a buffer solution of $pH = 12$.

A. $2.49 \times 10^{-10} M$

B. $1.84 \times 10^{-9} M$

C. $6.23 \times 10^{-11} M.$

D. $\frac{2.49}{1.84} \times 10^{-9} M$

Answer: A

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110. In which one of the following equilibrium ,$K_p \neq K_c$?

A. $2NO(g) \Leftrightarrow N_2(g) + O_2(g)$

B. $2C(s) + O_2(g) \Leftrightarrow 2CO(g)$

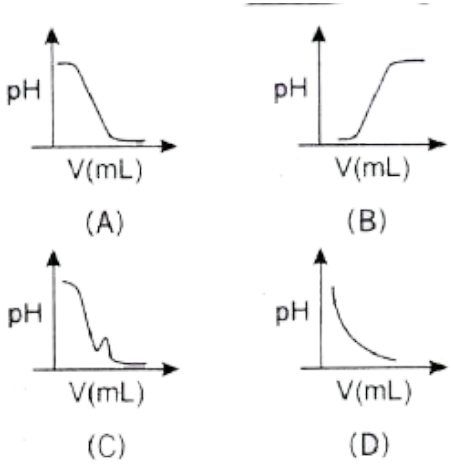
C. $2Hl(g) \Leftrightarrow H_2(g) + I_2(g)$

D. $NO_2(g) + SO_2(g) \Leftrightarrow NO(g) + SO_3(g).$

Answer: B

Watch Video Solution

111. In an acid- base titration, 0.1 M HCl solution was added to the NaOH solution of unknown strength . Which of the following corretly shows the change of pH of the titration mixture in this experiment?



A. (C)

B. (B)

C. (A)

D. (D)

Answer: C

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112. If solubility product of $Zr_3(PO_4)_4$ is denoted by S, then which of the following relation between S and K_{sp} is correct ?

A. $S = \left(\frac{K_sp}{216}\right)^{1/7}$

B. $S = \left(\frac{K_{sp}}{6912}\right)^{1/7}$

C. $S = \left(\frac{K_{sp}}{144}\right)^{1/6}$

D. $S = \left(\frac{K_{sp}}{929}\right)^{1/9}$

Answer: B

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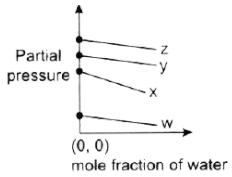
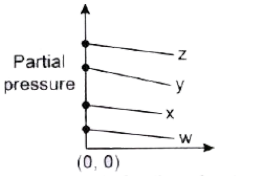
113. For the solution of the gases w, x, y and z in water at $298K$ the Henry's law constant (K_H) are $0.5, 2, 35$ and $40k^{-}$,respectively. The correct plot for the given data is :

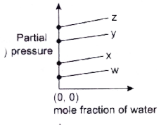
A.



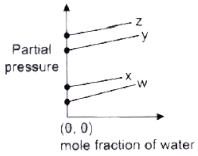
B.



C.



D.



Answer: B

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114. $S(s) + O_2 \Leftrightarrow SO_2(g) \quad K_1 = 10^{52}$

$2S(s) + 3O_2 \Leftrightarrow 2SO_3(g) \quad K_2 = 10^{129}$

Calculate $K_{\text{equilibrium}}$ for

A. 10^{154}

B. 10^{181}

C. 10^{25}

D. 10^{77}

Answer: C

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True Or False Type Question

1. In a solid $\Leftrightarrow$ liquid equilibrium , temperature remains constant.

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2. Decomposition of $CaCO_3$ is a reversible reaction when carried out in an open kiln.

Watch Video Solution

3. At chemical equilibrium , the concentration of all reactants and products are equal

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4. The equlibrium can be attained from either side of a reversible reactions. Justify.

Watch Video Solution

5. For the reaction $A + 3B \rightarrow C + D$ rate of reactions $\propto [A][B]$

Watch Video Solution

6. The compositions of equilibrium mixture is not changed by the catalyst.

Watch Video Solution

7. At equilibrium concentration quotient is equal to the equilibrium constant.

Watch Video Solution

8. For the equilibrium

$PCl_5(g) \Leftrightarrow PCl_3(g) + Cl_2$, the value of the equilibrium constant decreases on additions of Cl_2 gas.

Watch Video Solution

9. If equilibrium constant for the reactions.

$A_2 + B_2 \Leftrightarrow 2AB,$

is K , then the backward reactions.

$AB \Leftrightarrow \frac{1}{2}A_2 + \frac{1}{2}B_2.$

its value is 1/K . Is it true or false? If false then write the correct constant.

Watch Video Solution

10. The rate of an exothermic reactions increases with increase in temperature.

Watch Video Solution

11. Give reasons for the following :

NH_3 gas a covalent compound does not conduct electricity but its aq.soln.NH_4OH is a weak electrolyte.

Watch Video Solution

12. The conjugate of a strong acid is always a weak base.

Watch Video Solution

13. Comment on the statement : All Arrhenius acids are Bronsted acids but all Arrhenius bases may not be Bronsted bases.

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14. The ionic product of water is constant at all temperature.True/False.

Watch Video Solution

15. A solution of NaOH possesses both H_3O^+ and OH^- ions.

Watch Video Solution

16. A solution with pH= 6 is more acidic than a solution with pH= 4

Watch Video Solution

17. A solutions containing NaOH and NaCl shows common ion effect.

Watch Video Solution

18. The solubility of NaCl in water decreases with increases in temperature.

Watch Video Solution

19. What is the principle of selective precipitations ?

Watch Video Solution

20. A precipitate is formed when ionic product becomes equal to the solubility product.

Watch Video Solution

21. An aqueous solution of KNO_3 is basic due to hydrolysis

Watch Video Solution

22. Methyl orange shows yellow colour in alkaline solutions.

Watch Video Solution

Fill In The Blanks Type Questions

1. At equilibrium ,$\Delta G = \ldots\ldots\ldots\ldots\ldots$

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2. ..... Reactions never go to completion whereas ..... Reactions proceed almost to completion.

Watch Video Solution

3. At equilibrium ,the concentrations of all reactants and products become .....

Watch Video Solution

4. According to the law of mass actions , the rate of a chemical reactions is ..... Proportional to the product of ..... Reactants.

Watch Video Solution

5. The value of equilibrium constant changes on changing the ..... coefficients.

Watch Video Solution

6. On increasing pressure , equlibrium will shift in the direction in which number of moles.....

Watch Video Solution

7. When the temperature of a system at equilibrium is increased the equilibrium shifts in the directions in which heat is .....

Watch Video Solution

8. For the reactions,

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

$$K_p = K_c(RT)^{\cdots\cdots}$$

Watch Video Solution

9. According the Bronsted and Lowry , an acid is a..... A base is .....

Watch Video Solution

10. The conjugate acid of PO_4^{3-} is .....

Watch Video Solution

11. CN^- is a Lewis .....

Watch Video Solution

12. At 298 K , the value of K_w is .....

Watch Video Solution

13. In a basic solution $\left[H_3O^+\right]$ is ..... than $\left[OH^-\right]$ and pH is greater than .....

Watch Video Solution

14. pH is the ..... Logarithm of ..... Concentration

Watch Video Solution

15. The suppression of dissociation of a ..... electrolyte on addition of a..... Electrolyte containing a..... Ion is called common ion effect.

Watch Video Solution

16. pH of humen blood is

Watch Video Solution

17. According to Henderson's equation,

$$pOH = -\log_{10}\ldots\ldots\ldots + \frac{\log_{10}([\text{Salt}])}{[\ldots\ldots\ldots]}$$

Watch Video Solution

18. In the group II of qualitative analysis, It is necessary to pass H_2S in ..... Medium , otherwise the sulphides of the cations of group ..... will also get precipitated.

Watch Video Solution

19. For a binary salt , $K_{sp} = (\ldots\ldots\ldots)^2$

Watch Video Solution

20. The quinonoid form of methyl orange is ..... In colour

Watch Video Solution

21. Salt of weak acids and strong bases hydrolysis in water to form ..... solutions.

Watch Video Solution

22. An aqueous solution of NH_4F is .....

Watch Video Solution

23. Assertion: At equilibrium the concentration of all reactants and products are equal.

Reason : At equilibrium , the rate of forward reactions is equal to the rate of backward reactions.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reason is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reason is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: d

Watch Video Solution

24. Assertion : Henry's law is not obeyed by ammonia.

Reason : It reacts with water to form ammonium hydroxide.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reason is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reason is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: a

Watch Video Solution

25. Assertion : The larger the value of equilibrium constant (K). Greater is the extent to which reactants are converted into the products.

Reason : A larger value of K facilitates the forward reactions to proceed to a greater extent before equilibrium is attained.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: a

Watch Video Solution

26. Assertion : The additions of an inert gas at constant volume to a system at equilibrium does not affect the state of equilibrium

Reason: The inert gas does not react with any of the reactants or products.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: b

Watch Video Solution

27. Assertion: During the formation of lime in a lime klin $.CO_2$ (g) formed in the reactions should continuously be removed

Reason: The pressence of $CO_2(g)$ deteriorates the quality of lime produced.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: c

Watch Video Solution

28. Assertions: In an exothermic reaction ,a greater yield of products can be obtained by lowering the temperature.

Reason: In an exothermic reactions , the heat constant of reactants is greater than that of the products.

A. If both Assertion and Reason are CORRECT and Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: b

Watch Video Solution

29. Assertions : When HCl gas is passed through a saturated solution of common salt, pure NaCl is precipitated.

Reason: The solubility product of NaCl gets lowered.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reason is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reason is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: c

Watch Video Solution

30. Assertion : Ions like HCO_3^- ,etc. ,act as Bronsted -Lowry acid .

Reason: Such ions are able to funish protons in solutions.

(a)If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

(b)If both Assertion and Reason are CORRECT but Reason is not CORRECT explanation of the Assertion.

(c)If Assertion is CORRECT but Reason is INCORRECT.

(d)If Assertion is INCORRECT but Reason is CORRECT.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: a

Watch Video Solution

31. Assertion: SiF_4 acts as a Lewis base.

Reason: The central Si atom in SiF_4 possesses vacant d- orbitals and can expand its octet by accommodating more electrons in d- orbitals

1. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

2. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

3. If Assertion is CORRECT but Reasson is INCORRECT.

4. If Assertion is INCORRECT but Reason is CORRECT.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: d

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32. Assertion: The value of ionic product of water (K_w) increases on increasing the temperature.

Reason: The ionisation of water increases with an increase in temperature.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: a

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33. Assertion: The pH of a buffer solution does not change appreciably on additions of a small amount of an acid or a base.

Reason: A buffer solution consists of either a weak acid and its salt with a strong base or a weak base its salt with a strong acid.

A. If both Assertion and Reason are CORRECT and a Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: b

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34. Assertion : The aqueous solution of $CuSO_4$ is acidic in nature.

Reason : Copper sulphate is a salt of a weak base and a strong acid.

A. If both Assertion and Reason are CORRECT and Reason is the CORRECT explanations of the Assertion

B. If both Assertion and Reason are CORRECT but Reaon is not CORRECT explanation of the Assertion.

C. If Assertion is CORRECT but Reasson is INCORRECT.

D. If Assertion is INCORRECT but Reason is CORRECT.

Answer: b

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Numerical Problems

1. One mole of H_2. two moles of I_2 and three moles of Hl injected in a one litre flask . What will be the concentrations of H_2, I_2 and Hl at equilibrium at $490^\circ C$. The equilibrium constant for the reaction at $490^\circ C$ is 45. 9

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2. 1 mole of N_2 and 3 moles of PCl_5 are placed in a 100 litre vessels heated at $227^\circ C$ the equilibrium pressure is 2.05 atm Assuming ideal behaviour,Calculate degree of dissociation of PCl_5 and K_p for the reaction

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

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3. An equilibrium mixture at 300 K contains N_2O_4 and NO_2 at 0.28 and 1.1 atmospheres respectively . If the volume of the container is doubled , calculate the new equilibrium pressures of the gases .

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4. At $700K$, equilibrium constant for the reaction.

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

is 54.8. If $0.5 \text{mol} L^{-1}$ of $Hi(g)$ is present at equilibrium at $700K$. What are the concentration of $H_2(g)$ and $I_2(g)$ assuming that we initially started with $HI(g)$ and allowed it to reach equilibrium at $700K$?

Watch Video Solution

5. The ester ethyl acetate is formed by the reaction of ethanol and acetic acid and the equilibrium is represented as

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

Write the concentration ratio , Q for this reaction. Note that water is not in excess and is not a solvent in this reactions .

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6. The ester ethyl acetate is formed by the reaction of ethanol and acetic acid and the equilibrium is represented as

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

At 293 K, if one starts with 1,000 mole of acetic acid and 1.80 moles of

ethanol , there are 0.171 moles of ethyl acetate in the final equilibrium mixture , Calculate the equilibrium constant.

Watch Video Solution

7. Ethyl acetate is formed by the reaction between ethanol and acetic acid and the equilibrium is represented as :

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

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

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8. The equilibrium constant of the reaction,

$$A_2(g) + B_2(g) \Leftrightarrow 2AB(g)$$

at $100^\circ C$ is 50. if a one litre flask containing 1 mole of A_2 is connected to a two litre flask containing two moles of B_2 how many moles of AB will be formed at 373 K ?

View Text Solution

9. A solution contains $0.10MH_2S$ and $0.3HCl$ Calculate the concentration of S^{2-} and HS^- ions in the solution . For $H_2S, K_{a_1} = 1 \times 10^{-7}$ and $K_{a_2} = 1.3 \times 10^{-13}$

Watch Video Solution

10. Calculate the simultaneous solubility of AgSCN and AgBr. K_{sp} for AgSCN and AgBr are1×10^{-12} and 5×10^{-13} respectively.

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11. What volume of 0.10 M sodium formate solution should be added to 50 mL of 0.05 M formic acid to produce a buffer solution of pH = 4.0 ? pK_a for formic acid = 3.80?

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12. 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?

Watch Video Solution

13. How many moles of HCl will be required to preapare one litre of a buffer solution (containing NaCN and HCN) of pH 8.5 using 0.01 gram formula mass of NaCN .K_a for HCN $= 4.1 \times 10^{-10}$?

Watch Video Solution

Ncert Text Book Exercise

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

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

(b) How do rates of evaporation and condensation change initially?

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

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

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

(b) How do rates of evaporation and condensation change initially?

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

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

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

(b) How do rates of evaporation and condensation change initially?

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

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4. What is K_c for the following equilibrium when the equilibrium concentration of each substance is : $[SO_1] = 0.60M$, $[O_2] = 0.82M$ and $[SO_3] = 1.90M$?

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

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5. At a certain temperature and total pressures of $10^5 Pa$, iodine vapour contains $40\ \%$ by volume of 1 atoms

$I_2(g) \Leftrightarrow 2I(g)$

Calculate K_p for the equilibrium

Watch Video Solution

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

(i) $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$

(ii) $2Cu(NO_3)_2(s) \Leftrightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$

(iii) $CH_3COOC_2H_5(aq) + H_2O(l) \Leftrightarrow CH_3COOH(aq) + C_2H_5(aq)$

(iv) $Fe^{3+}(aq) + 3OH^-(aq) \Leftrightarrow Fe(OH)_3(g)$

(v) $I_2(s) + 5F_2 \Leftrightarrow 2IF_5$

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7. Write the expression for the equilibrium constant, K_c for each of the following reaction :

(i) $2NOCl(g) \Leftrightarrow 2NO(g) + Cl_2(g)$

(ii) $2Cu(NO_3)_2(s) \Leftrightarrow 2CuO(s) + 4NO_2(g) + O_2(g)$

(iii) $CH_3COOC_2H_5(aq) + H_2O(l) \Leftrightarrow CH_3COOH(aq) + C_2H_5(aq)$

(iv) $Fe^{3+}(aq) + 3OH^-(aq) \Leftrightarrow Fe(OH)_3(g)$

(v) $I_2(s) + 5F_2 \Leftrightarrow 2IF_5$

Watch Video Solution

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(iv) $Fe^{3+}(aq) + 3OH^-(aq) \Leftrightarrow Fe(OH)_3(g)$

(v) $I_2(s) + 5F_2 \Leftrightarrow 2IF_5$

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9. Write the expressions 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

10. Write the expressions for the equilibrium constant K_c for each of the following reactions.

$I_2(s) + 5F_2 \Leftrightarrow 2IF_5$

Watch Video Solution

11. Find out of the value of K_c for each of the following equilibrium from the value of K_p:

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

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

Watch Video Solution

12. Find out of the value of K_c for each of the following equilibrium from the value of K_p:

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

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

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13. For the following equilibrium $K_c = 6.3 \times 10^{14}$ at $1000K$

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

Both the forward the reverse reactions in the equilibrium are elementary bimolecular reactions. What is K_c, for the reverse reaction?

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

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15. 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 N_2 and 0.933 mol of O_2 is placed in a $10L$

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 mixutre.

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16. Nitric oxide reacts with Br_2 and gives nitrosul bromide as per reaction given 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 temperature 0.0518 mol of $NOBr$ is obtained at equilibrium. Calculate equilibrium amount of NO and Br_2.

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17. At $450K$, $K_p = 2.0 \times 10^{10}/\text{bar}$ for the given reaction at equilibrium

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

What is K_c at this temperature?

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

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

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19. A mixture of 1.57 mol of N_2, 1.92 mol of H_2 and 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, $N_{2(g)} + 3H_{2(g)} \Leftrightarrow 2NH_{3(g)}$ is 1.7×10^2. What is the direction of the net reaction ?

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20. 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.

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21. 1 mole of H_2O and 1 mole of CO are taken in a 10 litre vassel and heated to 725 K.At equilibrium 40 per cent of water (by mass) reacts with carbon monoxide according to the equation

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

Calculate the equilibrium constant for the reactions.

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22. At $700K$, equilibrium constant for the reaction.

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

is 54.8. If $0.5\text{mol}L^{-1}$ of $Hi(g)$ is present at equilibrium at $700K$. What are the concentration of $H_2(g)$ and $I_2(g)$ assuming that we initially started with $HI(g)$ and allowed it to reach equilibrium at $700K$?

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23. What is the equilibirum concentration of each of the substance in the equilibrium when the initial concentration of Icl was $0.78M$?

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

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24. $K_p = 0.04$ atm at $899K$ 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 ?

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

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25. The ester ethyl acetate is formed by the reaction of ethanol and acetic acid and the equilibrium is represented as

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

Write the concentration ratio , Q for this reaction. Note that water is not in excess and is not a solvent in this reactions .

Watch Video Solution

26. Ethyl acetate is formed by the reaction between ethanol and acetic and the equiblibrium is represented as :

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

At 293 K , 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.

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27. Ethyl acetate is formed by the reaction between ethanol and acetic acid and the equilibrium is represented as :

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

Starting with 0.5 mol of ethanol and 1.0 mol of acetic acid and

maintaining it at 293 K, 0.214 mol of ethyl acetate is found after sometime . Has equilibrium been reached?

Watch Video Solution

28. A sample of pure PCl_5 was introduced into aln evacuated vessel at 473 K. After equilibrium was attained, concentration of PCl_5 was found to be $0.5 \times 10^{-1} L^{-1}$. If value of K_c is 8.3×10^{-3}. What are the concentration of PCl_3 and Cl_2 at equilibrium ?

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

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29. One of the reaction that takes place in producing steel from iron are 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 and 1050 K if the initial partial pressures are : $p_{CO} = 1.4$ atm and $= 0.80$ atm?

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30. Equilibrium constant, K_c for the reaction

$N_2(g) + 3H_2 \Leftrightarrow 2NH_3(g)$ at $500K$ is 0.061

At a particular time, the analysis shows that composition of the reaction mixture is 3.0 mol $L^{-1}N_2$. $2.0\text{mol}L^{-1}H_2$ and 0.5 mol $L^{-1}NH_3$. Is the reaction at equilibrium?

If not in which direction does the reaction tend to proceed to reach equilibrium?

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31. Bromine monochloride, $BrCl$ decomposition into bromine and chlorine and reaches the equilibrium:

$2BrCl(g) \Leftrightarrow Br_2(g) + Cl_2(g)$

for which $K_c = 32$ at $500K$. If initially pure BrCl is present at a concentration of $3.3 \times 10^{-3}\text{mol}L^{-1}$. What is its molar concentration in the mixture at equilibrium ?

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32. At 1127 K and atm pressure, a gaseous mixture of CO and CO_2 in equilibrium with solid carbon has $90.55\,\%$ CO by mass,

$C_{(s)} + CO_{2(g)} \Leftrightarrow 2CO_{(g)}$

K_c for this reaction at the above temperature is

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33. Calculate a) $\Delta G^{\ominus}$ and b) the equilibrium constant for the formation of NO_2 from NO and NO_2 at $298K$

$NO(g) + \frac{1}{2}O_2 \Leftrightarrow NO_2(g)$

Where

$\Delta_f G^{\ominus}(NO_2) = 52.0kJ/\text{mol}$

$\Delta_f G^{\ominus}(NO) = 87.0kJ/\text{mol}$

$\Delta_f G^{\ominus}(O_2) = 0kJ/\text{mol}$

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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37. Write the equilibrium constant expression for the following reactions :

$CO_2(g) \Leftrightarrow CO_2(aq)$

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

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

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

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

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

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

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

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

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

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

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

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

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

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41. The equilibrium constant for the following 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 introduced into a sealed container at 1024K.

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42. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per following endothermic reaction :

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

Write an expression for K_p for the above reactions

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43. Dihydrogen gas is obtained from natural gas by partial oxidation with steam as per following endothermic reaction :

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

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

(i) increasing the pressure

(ii) increasing the temperature.

(iii) using a catalyst?

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44. Describe the effect of :

additions of H_2

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45. Describe the effect of :

additions of CH_3OH

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46. Describe the effect of :

removal of CO

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47. Describe the effect of :

removal of CH_3OH

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48. At $473K$, equilibrium constant K_c for decomposition of phosphorus pentachloride, PCl_5 is 8.3×10^{-3} . If decomposition is depicted as,

$PCl_5(g) \Leftrightarrow Pcl_3(g) + Cl_2, \Delta_r H^{\ominus} = 124.0 kJ \text{mol}^{-1}$

a) write an expression for K_c for the reaction.

b) what is the value of K_c for the reverse reaction at the same temperature ?

c) what would be the effect on K_c if (i) more PCl_5 is added (ii) pressure is increased (iii) the temperature is increased ?

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49. At 473K, equilibrium constant, K_c for decomposition of phosphorus pentachloride, PCl_5 is 8.3×10^{-3}. If decomposition is depicted as :

$PCl_{5(g)} \Leftrightarrow PCl_{3(g)} + Cl_{2(g)}, \Delta_r H^\circ = 124.0 \text{ kJ mol}^{-1}$

what would be the effect on reaction if the temperature is increased ?

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50. At $473K$, equilibrium constant K_c for decomposition of phosphorus pentachloride, PCl_5 is 8.3×10^{-3} . If decomposition is depicted as,

$PCl_5(g) \Leftrightarrow Pcl_3(g) + Cl_2, \Delta_r H^\ominus = 124.0 kJ \text{mol}^{-1}$

a) write an expression for K_c for the reaction.

b) what is the value of K_c for the reverse reaction at the same temperature ?

c) what would be the effect on K_c if (i) more PCl_5 is added (ii) pressure is increased (iii) the temperature is increased ?

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51. 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 wissel at 400°C is charged with an equimolar mixture of CO and steam such that $\rho_{CO} = \rho_{H_2O} 4.0$ bar, what will be the partial pressure of H_2at equilibrium? $K_p = 0.1$ at 400° C.

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

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

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

c) $Cl_2(g) + 2NO_2(g) \Leftrightarrow 2NOCl_g, K_c = 1.8$

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53. Predict which of the following reaction will have appreciable concentration of reactants and products?

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

Watch Video Solution

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c) $Cl_2(g) + 2NO_2(g) \Leftrightarrow 2NOCl_g, K_c = 1.8$

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55. The value of K_c for the reaction $3O_2(g) \Leftrightarrow 2O_2(g)$ 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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56. The reaction $CO_g + 3H_2(g) \Leftrightarrow CH_4(g) + H_2O(g)$

is at equilibrium at 1300 K in a 1L flask. It also contain 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 of CH_4 in the mixture. The equilibrium constant, K_c for the reaction at the given temperature is 3.90.

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57. What is meant by the conjugate acid-base pair? Find the conjugate acid/base for the following species:

$HNO_2, CN^-, HCIO_4, F^-, OH^-, CO_{3^{2-}}$ and S^{2-}

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

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

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

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61. The species: H_2O, HCO_3^-, HSO_4^- and NH_3 can act both as Br$\ddot{o}$nsted acids and bases. For each case give the corresponding conjugate acid and base.

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62. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid/base: (a) OH^- , (b) F^- , (c) H^+ , (d) BCl_3 .

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63. Classify the following species into Lewis acid and Lewis base. And show how these act as Lewis acid/base :

F^-

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64. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid/base: (a) OH^- , (b) F^- , (c) H^+ , (d) BCl_3 .

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65. Classify the following species into Lewis acids and Lewis bases and show how these act as Lewis acid/base: (a) OH^- , (b) F^- , (c) H^+ , (d) BCl_3 .

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66. 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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67. The pH of a sample of vinegar is 3.76. Calculate the concentration of hydrogen ion in it.

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68. The ionization constant of HF, HCOOH and HCN at 298K are $6.8 \times 10^{-4}, 1.8 \times 10^{-4}$ and 4.8×10^{-9} respectively. Calculate the ionization constants of the corresponding conjugate base.

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

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70. The first ionization constant of H_2S is 9.1×10^{-8}. Calculate the concentration of HS^- ion in its $0.1M$ solution. How will this concentration be affected if the solution is 0.1M 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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71. The ionization constant of acetic acid is 1.74×10^{-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.

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72. It has been found that the pH of a 0.01M solution of an organic acid is 4.15. Calculate the concentration of the anion, the ionization constant of the acid and its pK_a.

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73. Assuming complete dissociation , calculate the pH of the following solutions:

` 0.0009M nitric acid

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74. Assuming complete dissociation, calculate the pH of the following solutions:

(a) 0.003 M HCl , (b) 0.005 M NaOH , (c) 0.002 M HBr , (d) 0.002 M KOH

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75. Assuming complete dissociation, calculate the pH of the following solutions:

(a) 0.003 M HCl , (b) 0.005 M NaOH , (c) 0.002 M HBr , (d) 0.002 M KOH

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76. Assuming complete dissociation, calculate the pH of the following solutions:

(a) 0.003 M HCl , (b) 0.005 M NaOH , (c) 0.002 M HBr , (d) 0.002 M KOH

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77. Calculate the pH of the following solutions :

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

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78. Calculate the pH of the following solutions :

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

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79. Calculate the pH of the following solutions :

0.3 g of NaOH dissolve in water to give 200 mL of solutions.

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80. Calculate the pH of the following solutions :

1 mL of 13.6 M HCl is diluted with water to give 1 litre of solutions.

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81. The degree of ionisation of a 0.1 M bromoacetic acid solution is 0.132. Calculate the pH of the solution and the ρK_a bromoacetic acid.

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82. The pH of 0.005 M codeine $(C_{18}H_{21}NO_3)$ solution is 9.95 Calculate its ionisations contant and ρK_b.

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83. Determine the degree if ionization and pH of $0.05M$ of ammonia solution. The ionization constant of ammonia can be taken from Table 7.7.

Also calculate the ionization constant of the conjugate acid of ammonia.

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84. Calculate the degree of ionisation of 0.05 M acetic acid if its pK_a, value is 4.74. How is the degree of dissociation affected when its solution also contains

(a) 0.01 M

(b) 0.1 M in HCl ?

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85. 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 ?

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86. Calculate the hydrogen ion concentration in the following biological fluids whose pH are given below :

Human muscle-fluid, 6.83

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87. Calculate the hydrogen ion concentration in the following biological fluids whose pH are given below :

Human Stomach fluid 1.2

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88. Calculate the hydrogen ion concentration in the following biological fluids whose pH are given below:

(a) Human muscle-fluid, 6.83 , (b) Human stomach fluid, 1.2

(c) Human blood, 7.38 , (d) Human saliva, 6.4.

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89. Calculate the hydrogen ion concentration in the following biological fluids whose pH are given below:

(a) Human muscle-fluid, 6.83 , (b) Human stomach fluid, 1.2

(c) Human blood, 7.38 , (d) Human saliva, 6.4.

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90. The pH of milk, black coffee, 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.

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91. If 0.561 g of KOH is dissolved in water to give 200 mL of solution at 298 K. Calculate the concentrations of potassium, hydrogen and hydroxyl ions. What is its pH?

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92. The solubility of $Sr(OH)_2$ at 298 K is 19.23 g/L of solution Calculate the concentration of strontium and hydroxyl ions and the pH of the solutions.

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

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94. The pH of 0.1M solution of cyanic acid (HCNO) is 2.34. Calculate the ionization constant of the acid and its degree of ionization in the solution.

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

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96. A 0.02M solution of pyridinium hydrochloride has pH = 3.44. Calculate the ionization constant of pyridine.

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

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

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

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100. Calculate the PH of the resultant mixture :

10 mL of 0.2 M $Ca(OH)_2$ + 25 mL of 0.1 M HCl

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101. Calculate the PH of the resultant mixture :

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

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102. Calculate the PH of the resultant mixture :

10 mL of 0.1 M$H_2SO_4 + 10mL$ of 0.1 M KOH

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103. Describe the effect of :

removal of CH_3OH

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104. 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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105. Equal volumes of 0.002 M solutions of sodium iodate and cupric chlorate are mixed together. Will it lead to precipitation of copper iodate? (For cupric iodate $Ksp = 7.4 \times 10^{-8}$).

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106. The ionization contant of benzoic acid is 6.46×10^{-5} and K_{sp} for silver benzoate is 2.5×10^{-13}. How many times is silver benzoate more soluble in abuffer of pH=3.19 compared to its solubility in pure water ?

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

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

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109. The concentration of sulphide ion in 0.1M HCl solution saturated with hydrogen sulphide is 1.0×10^{-19} M. If $10mL$ of this is added to $5mL$ of $0.04M$ 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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