CBSE Class 11 Chemistry

Important Questions

Chapter 7

Equilibrium

1 Marks Questions

1.Define dynamic equilibrium.

Ans. When the reactants in a closed vessel at a particular temperature react to give products, the concentrations of the reactants keep on decreasing, while those of products keep on increasing for sometime after which there is no change in the concentrations of either the reactants or products. This stage of the system is the dynamic equilibrium.

2.What is physical equilibrium? Give an example.

Ans . Physical equilibrium is an equilibrium between two different physical states of same substance e.g. H_2 O(s) $\rightleftharpoons$ H_2O(l)

3.What is meant by the statement 'Equilibrium is dynamic in nature'?

Ans . At equilibrium, reaction does not stop rather it still continues, the equilibrium is dynamic in nature. It appears to stop because rate of forward reaction is equal to the rate of backward reaction.

4..How does dilution with water affect the pH of a buffer solution?

Ans . Dilution with water has no effect on the pH of any buffer. This is because pH of a buffer depends on the ratio of the salt, acid or salt base and dilution does not affect this ratio.

5.On what factor does the boiling point of the liquid depends?

Ans . Boiling point depends on the atmospheric pressure.

6..State Henry's law.

Ans . The mass of a gas dissolved in a given mass of a solvent at any temperature is proportional to the gas above the solvent.

7.What happens to the boiling point of water at high altitude?

Ans . Boiling point of water depends on the altitude of the place. At high altitude atmosp here pressure thetore is less boiling point decreases.

8.On which factor does the concentration of solute in a saturated solution depends?

Ans . The concentration of solute in a saturated solution depends upon the temperature.

Sugar (soln.) $\rightleftharpoons$ sugar (solid).

9.What conclusion is drawn from the following –

Solid $\rightleftharpoons$ Liquid

$H_2O(s) \rightleftharpoons H_2O$ (l)

Ans . Melting point is fixed at constant pressure.

10.State the law of chemical equilibrium.

Ans. At a given temperature, the product of concentrations of the reaction products raised to the respective stoichiometric coefficient in the balanced chemical equation divided by the product of concentrations of the reactants raised to their individual stoichiometric coefficients has a constant value. This is known as the equilibrium law or law of chemical equilibrium.

11. Write the equilibrium constant for the following equation :

aA +bB $\rightleftharpoons$ cC + dD

Ans .The equilibrium constant for a general reaction

$aA + bB \rightleftharpoons cC + dD$

is expressed as

$$Kc = \frac{[C]^c[D]^d}{[A]^a[B]^b}$$

Where [A], [B], [C] and [D] are the equilibrium concentrations of the reactants and products.

12.Write the chemical equation for the following chemical constant.

$$Kc = \frac{[HI]^2}{[H_2][I_2]}$$

Ans . The chemical equation is given by

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

13.Write the expression for equilibrium constant Kp for the reaction

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

Ans . $$Kp = \frac{(PH_2)^4}{(PH_2O)^4} = \frac{PH_2}{PH_2O}.$$

14..The equilibrium constant for the reaction $H_2O + CO \rightleftharpoons H_2 + CO_2$

Is 0.44 at 1260k. What will be the value of the equilibrium constant for the reaction : $2H_2(g) + 2CO(g) \rightleftharpoons 2CO(g) + 2H_2O(g)$ at 1260 K

Ans . The reaction is reversed and also doubled,

$$\therefore \text{Kc} = \left(\frac{1}{0.44}\right)^2 = \underline{\underline{5.16.}}$$

15.Define reaction quotient.

Ans . The reaction quotient, Q is same as equilibrium constant Kc, except that the concentrations in

Qc are not necessarily equilibrium values.

16..If Qc > Kc, what would be the type of reaction?

Ans . If Qc > Kc, the reaction will proceed in the direction of the reactants (reverse reactions)

17.What inference you get when Qc = Kc?

Ans . If Qc = Kc, the reaction mixture is already at equilibrium.

18.State Le chatelier's principle.

Ans . It states that a change in any of the factors that determine the equilibrium conditions of a system will cause the system to change in such a manner so as to reduce or to counteract the effect **of the change.**

19.Can a catalyst change the position of equilibrium in a reaction?

Ans . No, a catalyst cannot change the position of equilibrium in a chemical reaction. A catalyst, **however, affects the rate of reaction.**

20.What is the effect of reducing the volume on the system described below?

$2C(s) + O_2(g) \rightleftharpoons 2CO(g)$

Ans. The forward reaction is accompanied by increase in volume. Hence according to Chatelier's principle, reducing the volume will shift the equilibrium in the forward direction.

21..What happens when temperature increases for a reaction?

Ans . The equilibrium constant for an exothermic reaction $\left(\Delta H - ve\right)$ decreases as the temperature increases.

22.Can a catalyst change the position of equilibrium in a reaction?

Ans . No, a catalyst cannot change the position of equilibrium in a chemical reaction. A catalyst affects the rate of reaction.

23.If Qc < Kc, when we continuously remove the product, what would be the direction of the reaction?

Ans. Continuous removal of a product maintains Qc at a value less than Kc and reaction continues to move in the forward direction.

24.Define strong and weak electrolyte.

Ans . Those electrolytes which dissociate almost completely into ions in aqueous solutions are

Known as strong electrolytes while those which show poor dissociation into ions in aqueous

solutions are called weak electrolytes.

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

Ans.

Species	**Conjugate acids**
NH_2	NH_3^+
NH_3	NH_4^+
$HCOO^-$	HCOOH.

26.Which conjugate base is stronger CN^- or F^- ?

Ans .$F^- < CN^-$ basic character.

27.What is the difference between a conjugate acid and a conjugate base?

Ans.A conjugate acid and base differ by a proton.

28.Select Lewis acid and Lewis base from the following :

Cu^{2+} , H_2O, BF_3 OH^-

Ans .Lewis acids : Cu^{2+}, BF_3

Lewis bases : H_2O, OH^-

29.The dimethyl ammonium ion, $(CH_3)_2$ NH_2^+, is a weak acid and ionizes to a slight degree in water what is its conjugate base?

Ans . $(CH_3)_2$ NH

30.If p^H of a solution is 7, calculate its p^{OH} value.

Ans .$p^H + p^{OH} = 14$

$\therefore p^{OH} = 14 - p^H$

$= 14 - 7$

$= 7.$

31.What happens to the p^H if a few drops of acid are added to CH_3COONH_4 solution?

Ans . pH will almost remain constant.

32.What is the concentration of H_3O^+ and OH^- ions in water at 298K?

Ans .[$[H_3O^+] = [OH^-] = 1 \times 10^{-7}\ mol^{-1}$

33.The p^{ka} of acetic acid and p^{kb} of ammonium hydroxide are 4.76 and 4.75 respectively. Calculate the p^H of ammonium acetate solution.

Ans .PH = $7+ \frac{1}{2}[P^{ka} - p^{kb}]$

$= 7 + 7 + \frac{4.76 - 4.75}{2}$

$= 7 + \frac{1}{2}[0.01]$

= 7 + 0.005

= 7.005

34.Calculate the pH of the solution

0.002 MHBr

Ans .p^H value of 0.002M HBr.

$HBr + H_2O \xrightarrow{aq} H_3O^+(aq) + Br^-(aq)$

0.002M

pH = - (log H_3O^+) = - log ($2x10^{-3}$)

= (3-log2) = 3-0.3010 $= \underline{\underline{2.7}}$

35.Define Buffer solution.

Ans . The solutions which resist change in pH on dilution or with the addition of small amounts of acid or alkali are called Buffer solutions.

36.When is a solution called unsaturated?

Ans . When the ionic product is less than the solubility product the solution is unsaturated.

37.Give an example of acidic buffer?

Ans.CH_3 COOh + CH_3 COONa.

38.Calculate the solubility of Ag Cl (s) in pure water.

Ans . Let the solubility of Ag Cl in water be S mol L^{-1}

Ag Cl (S) $\rightleftharpoons$ $Ag^+ + Cl^-$

$[Ag^+]$ = S; $[Cl^-]$ =S

$k_{sP} = [Ag^+]\,[Cl^-]$

$2.8 \times 10^{-10} = s \times s$

Or S = $\sqrt{2.8x10^{-10}}$

= $\underline{\underline{1.673x10^{-5}}}$ mol^{-1}

39.Name a basic buffer having pH around 10.

Ans .Basic buffer

$Na_2B_4O_7$ + Na OH

Borax sodium hydroxide.

CBSE Class 12 Chemistry

Important Questions

Chapter 7

Equilibrium

2 Marks Questions

1.Mention the general characteristics of equilibria involving physical processes.

Ans .(a) For solid $\rightleftharpoons$ liquid equilibrium, there is only one temperature at 1 atm at which two phases can co-exist. If there is no exchange of heat with the surroundings, the mass of the two phases remain constant.

(b) For liquid $\rightleftharpoons$ vapors equilibrium, the vapors pressure is constant at a given temperature.

(c) For dissolution of solids in liquids, the solubility is constant at a given temperature.

(d) For dissolution of gases in liquids, the concentration of a gas in liquid is proportional to pressure of the gas over the liquid.

2.Write the expression for the equilibrium constant for the reaction :

$4NH_3$ (g) + 50_2 (g) $\rightleftharpoons$ 4NO (g) + $6H_2$ O (g)

Ans . The equilibrium constant is given by

$$Kc = \frac{[NO]^4[H_2O]^6}{[NH_3]^4[O_2]^5}$$

3.When the total number of moles of product and reactants are equal, K has no unit. Give reason.

Ans . When the total number of moles of products is equal to the total number of moles of reactants the equilibrium constant k has no unit for eg.

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

$$K = \frac{[HI(g)]^2}{[H_2(g)][I_2(g)]}$$

Units of $K = \frac{mol/L \text{ x mol/L}}{mol/L \text{ x mol/L}} = No \text{ units}$.

4.What is the unit of equilibrium for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$.

Ans .

$$K = \frac{[NH_3(g)]^2}{[N_2(g)][H_2(g)]^3}$$

$$units \text{ of K} = \frac{(mol/L)^2}{(mol/L)(mol/L)^3} = \frac{1}{(mol/L)^2}$$

$(mol/L)^{-2}$

$= \underline{\underline{L^2 mol^{-2}}}$

5.Give the relation Kp = Kc $(RT)^{\Delta n}$.

Ans . Let us consider a reaction

$aA + bB \rightleftharpoons cC + dD$

$$Kc = \frac{[C]^c[D]^d}{[A]^a[B]^b} \quad \text{..... (i)} < \text{Kp} = \frac{p_C{}^c \; p_D{}^d}{p_A{}^a \; p_B{}^b}$$

Assuming the gaseous components to behave ideally,

Pi Vi = ni RT ...

Or, $pi = \frac{ni}{vi} RT = CiRT = [c]RT \ldots.(iv).$

Where [i] is the molar concentration of the species i

Then,

$$Kp = \frac{p_C^{\,c}\, p_D^{\,d}}{p_A^{\,a}\, p_B^{\,b}} = \frac{([c]RT)^C x([D]RT)^d}{([A]RT)^a x([B]RT)^b}$$

$$= \frac{[C]^c[D]^d}{[A]^a[B]^b} x(RT)\left(\overline{c+d} \quad - \quad \overline{a+b}\right)....(v)$$

$$\Delta n = \left(\overline{c+d} \quad - \quad \overline{a+b}\right)$$

$$\therefore \text{ Kp} = \text{Kc } (RT)^{\Delta n}$$

6.The value of Kc for the reaction

2A $\rightleftharpoons$ B+C is $2x10^{-3}$. At a given time, the composition of the reaction mixture is [A] = [B] =[C] = $3x10^{-4}$ M. In which direction the reaction will proceed?

Ans . For the reaction the reaction Qc is given by

$$Qc = \frac{[B][C]}{[A]^2}$$

As [A] = [B] = [C] = $3x10^{-4M}$

$$Qc = \frac{\left(3x10^{-4}\right)\left(3x10^{-4}\right)}{\left(3x10^{-4}\right)^2} = 1$$

As Qc > Kc so the reaction will proceed in the reverse direction.

7.Write the equilibrium constant expression for each of the following reactions. In each case, indicate which of the reaction is homogeneous or heterogeneous.

(a)$2CO(g) + O_2(g) \rightleftharpoons 2CO_2(g)$

(b)$N_2O_5(g) \rightleftharpoons NO_2(g) + NO_3(g)$

(c)$Zn(s) + 2HCl(g) \rightleftharpoons ZnCl_2(s) + H_2(g)$

$2H_2O(l) \rightleftharpoons 2H_2O(l) + O_2(g)$

Ans. .(a) $Kc = \frac{[CO_2]^2}{[CO]^2[O_2]}$

(b) $Kc = \frac{[NO_2][NO_3]}{[N_2O_5]}$

(c) $Kc = \frac{[H_2]}{[HCl]^2}$ (d) $Kc = [O_2]$

Homogeneous : a, b

Heterogeneous : c, d

8.The dissociation of HI is independent of pressure, while dissociation of PCl_5 depends upon the pressure applied. Why?

Ans. For $2HI \rightleftharpoons H_2 + I_2$

$Kc = \frac{x^2}{4(1-x)^2}$

Where x is degree of dissociation

For $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

$Kc = \frac{x^2}{v(1-x)}$

Where x is degree of dissociation

Since Kc for HI does not have volume terms and thus dissociation of HI is independent of pressure. On the other hard Kc for PCl_5 has volume in denominator and thus an increase in pressure reduces volume. And to have kc constant, x decrease.

9.On what factors does the value of the equilibrium constant of a reaction depend?

Ans. The equilibrium constant of a reaction depends upon

(i) Temperature

(ii) Pressure, &

(iii) Stoichiometry of the reaction

10.Why the addition of inert gas does does not change the equilibrium?

Ans . It is because the addition of an inert gas at constant volume does not change the partial pressures or the molar concentrations of the substance involved in the reaction.

11.The equilibrium constant of a reaction increases with rise in temperature. Is the reaction exo – or endothermic?

Ans. The equilibrium constant increases with a rise in temperature. Therefore, the reaction is endothermic.

12.Using Le – chatelier principle, predict the effect of

(a)decreasing the temperature

(b)increasing the temperature

in each of the following equilibrium systems:

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

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

Ans .(i) For an exothermic reaction increase in temperature shifts the equilibrium to the left and decrease in temperature shifts it to the left.

(ii) For an endothermic reaction increase in temperature shifts the equilibrium to the right and decrease in temperature shifts it to the right.

13.(i) In the reaction equilibrium

$A + B \rightleftharpoons C + D$,

What will happen to the concentrations of A, B and D if concentration of C is increased.

(ii) what will happen if concentration of A is increased?

Ans .(i) For an equilibrium reaction

$A + B \rightleftharpoons C + D$

$$Kc = \frac{[C][D]}{[A][B]}$$

If the concentration of a product is increased, the concentration of other components changes in such a way that the conc of C decreases and vice – versa.

If the conc of C is increased the conc of D will decrease and those of A and B will increase simultaneously so that the numerical value of Kc is the same and vice – versa. The equilibrium shifts to the left.

(ii) If the conc of A is increase, conc of B will decrease and those of C and D will increase simultaneously so that the numerical value of Kc is the same and vice – versa. The equilibrium shifts to the right

14.Give two examples of actions which can act as Lewis acids.

Ans .Ag^+, H^+.

15.Justify the statement that water behaves like an acid and also like a base on the basis of protonic concept

Ans .Water ionizes as $H_2O + H_2O \rightleftharpoons H_3O^+ + OH^-$

With strong acid water behaves as a base and accept the proton given by the acid e.g. HCl + $H_2O \rightleftharpoons Cl^- + H_3O^+$

While with strong base, water behaves as an acid by liberating a proton e.g. :

$H_2O + NH_3 \rightleftharpoons NH_4^+ + OH^-$.

16.The degree of dissociation of N_2O_4,

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$, at temperature T and total pressure is α. Find the expression for the equilibrium constant of this reaction at this temperature and pressure?

Ans .$N_2O_4 \rightleftharpoons 2NO_2$

At eq 1-α2α

If p is the total pressure then

$P_{N2O4} = P_{N_2O_4} = \frac{(1-\alpha)}{(1+\alpha)} p$

$P_{NO2} = P_{NO_2} = \frac{2\alpha}{1+\alpha} P$

Then $K_P = \frac{p^2_{NO_2}}{P_{N_2O_4}} = \frac{\left[2\alpha p/(1+\alpha)\right]^2}{\left[(1-\alpha)\, p/(1+\alpha)\right]} = \frac{4\alpha^2 p}{(1-\alpha^2)}$

A solution give the following colors with different indicators. Methyl orange – yellow, methyl red – yellow, and bromothymol blue Orange . what is the p^H of the solution?

17.Show that, in aqueous solutions

$p^H + p^{OH} = p^{kw}$

What is the value of $p^H + p^{OH}$ at 25^0c?

Ans .(i) The colors in methyl orange indicates that $p^H > 4.5$

(ii) Colors in methyl red indicates that $p^H > 6.0$ and

(iii) colors in bromothymol blue indicates that $p^H < 6.3$.

Therefore, the pH of the solution is between 6.0 to 6.3.

18.Calculate the pH of the solution

0.002 MHBr

Ans . p^H value of 0.002M HBr.

$HBr + H_2O \xrightarrow{aq} H_3O^+(aq) + Br^-(aq)$

0.002M

$pH = -(\log H_3O^+) = -\log(2x10^{-3})$

$= (3-\log 2) = 3-0.3010 = \underline{\underline{2.7}}$

19.The concentration of H^+ in a soft drink is 3.8×10^{-3} M. what is its p^H?

Ans .$[H^+] = 3.8 \times 10^{-3}$ M

$pH = -\log [H^+] = \log (3.8 \times 10^{-3})$

$= -\log 3.8 - \log 10^{-3}$

$= -0.5798 + 3 = \underline{\underline{2.42}}$.

20..Define solubility product.

Ans .The solubility product of a salt at a given temperature is equal to the product of the concentration of its ions in the saturated solution, with each concentration term raised to the power equal to the number of ions produced on dissociation of one mole of the substance.

21.Ksp for Hg SO_4 is 6.4 x 10^{-5}. What is the solubility of the salt?

Ans .S = $(k_{sp})^{1/2}$

= $(6.4 \times 10^{-5})^{1/2}$

= $(64 \times 10^{-6})^{1/2}$

= $\underline{\underline{8x10^{-3}}}$

22.Calculate the pH of a buffer solution containing 0.1 mole of acetic acid and 0.15 mole of sodium acetate. Ionisation constant for acetic acid is 1.75 × 10^{-5}.

Ans .$p^H = p^{ka} + \log \frac{salt}{acid}$

pH = - log 1.75 x 10^{-5} + log $\frac{0.15}{0.10}$

or, p^H = - log 1.75 x 10^{-5} + log 1.5 $\underline{\underline{= 4.9}}$

CBSE Class 12 Chemistry
Important Questions
Chapter 7
Equilibrium

3 Marks Questions

1.Name the three group into which chemical equilibrium can be classified.

Ans . Chemical equilibrium can be classified into three groups

(i) The reaction that proceeds nearly to completion and only negligible concentrations of the reactants are left.

(ii) The reactions in which only small amounts of products are formed and most of the reactants remain unchanged at equilibrium stage.

The reactions in which the concentrations of the reactants and products are comparable, when the system is in equilibrium.

2.Give the generalizations concerning the composition of equilibrium mixtures.

Ans.(i) If Kc > 10^3, products predominates over reactants i.e; if Kc is very large, the reaction proceeds nearly to completion.

(ii) If Kc < 10^{-3}, reactants predominates over products i.e; if Kc is very small, the reaction proceeds rarely.

(iii) If Kc is in the range of 10^{-3} to 10^3, appreciable concentration of both reactants and products are present.

1.Predict if the solutions of the following salts are neutral, acidic or basic:

NaCl, KBr, NaCN, NaOH H_2SO_4, $NaNO_2$, NH_4 NO_3, KF

Ans.

NaCl - Neutral

KBr - Neutral

NaCN - Basic

NaOH - Basic

H_2SO_4 - Acidic

$NaNO_2$ - Basic

NH_4NO_3 - Acidic

KF - Basic

CBSE Class 12 Chemistry

Important Questions

Chapter 8

Equilibrium

5 Marks Questions

1.Find the oxidation state of sulphur in the following compounds :

H_2S, H_2SO_4, $S_2O_4^{2-}$, $S_2O_8^{2-}$ and HSO_3^-.

Ans. In H_2S

$2 + x = o$

$X = -2$

In HSO_3^-

$+ 1 + x – 6 = -1$

or $x - 5 = -1$

or $x = +4$

In H_2SO_4

$+2 + x – 8 = 0$

Or $x = + 6$

In $S_2O_5^{2-}$

There is peroxide linkage, thus

oxidation state of S is $\underline{6}$

In $S_2O_4^{2-}$

$2x – 8 = -2$

$2x = 6$

$X = +3$