Chapter 8:Chemical equilibrium

SHORT QUESTION WITH ANSWERS

Q.1 What is weak electrolyte?

Ans.

A compound which is only partially ionized in aqueous solution is called as weak electrolyte.e.g CH_3COOH(Acetic aci)

Q.2 What is meant by state of chemical equilibrium?

Ans.

The state of reversible reaction, in which forward and reverse rates are equal.($R_f=R_r$)

Q.3 What are reversible reaction?

Ans.

Those reactions in which the reactants products are converted into each other under same set of conditions.

Q.4 Define Le–Chatlier's principle.

Ans.

If a system in equilibrium is disturbed at equilibrium it will move in that direction where change is minimized.

Q.5 What are conjugate acid and bases?

Ans.

When an acid is dissolved in water it will form H3O+ ions and an anion the anion of an acid is called conjugate base and H3O+ is called conjugate acid e.g.

CH3OOH + H2O H3O+ + CH3COO–

Acid Base Conjugate acid Conjugate base

Q.6 Why we need buffer solution in daily life?

Ans.

Buffers can resist the charge of its PH value therefore they are required in chemical analysis, pharmaceuticals, electroplating, photography, beverage industry, microbiology molecular biology, soil science and in quantitative analysis.Our blood is best example of buffer solution having $_P$H 7.35. If it decreases upto 7 or goes upto 8 death may occur.

Q.7 Discuss the factors on which buffer PH depends.

Ans.

PH of buffer depends upon two factors.

(i) Pka or ka value of an acid

(ii) Concentration of salt and acid taken for the buffer.

Q.8 What is buffer capacity?

Ans.

The amount of acid or base which a buffer can absorb without significant charge in PH is called buffer capacity. Buffer capacity is the ability of buffer to resist the change in its PH value.

Q.9 How can we calculate the PH of buffer?

Ans.

We can calculate the PH of a buffer the PH of Henderson equation which can be derived as

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

$K_c =$

$H^+ =$

Take log on both sides

Log $[H^+]$ = log

Log $[H^+]$ = log ka +

Multiply equation by (– 1) on both sides

– log $[H^+]$ = – log ka – log

PH = Pka – log

or

PH = Pka + log

PH = Pka + log

In similar way

POH = Pkb + log

Q.10 How Kc can be applied to calculate direction of chemical reaction?

Ans.

(i) If < Kc

Then the reaction will proceed in the forward direction until the equilibrium is established.

(ii) If > Kc

Then the reaction will proceed in the backward direction until the equilibrium is established.

If = kc

Then the reaction is already in equilibrium.

Q.11 How value of Kc can help to predict the extent to which a chemical reaction can take place?

Ans.

The extent of reaction depends upon the magnitude of Kc. i.e.

(i) Very small value of Kc:

when Kc is very small the forward reaction will not occur to an appreciable extent and the reverse reaction will go almost to complete.

(ii) Kc is very large:

When Kc is very large the reverse reaction will not occur to an appreciable extent and the forward reaction is almost complete.

(iii) Kc has an intermediate value:

When the value of Kc is neither very large nor very small, the equilibrium mixture contains appreciable amounts of both reactant and products.

Q.12 What are optimum conditions for the formation of NH3 by Haber's process?

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \Delta H = -92.46$ kJ/m

Ans.

(i) As the reaction is exothermic max yield is obtained at low temp.

(ii) By applying pressure, more product is obtained. According four moles of reactants produce two moles of product so by applying pressure more yield of NH3 is gained.

(iii) Continuous withdrawl of NH3 will also increase the yield.

(vi) Rate of reaction can also be increase with the help of catalyst like iron or iron oxide.

Q.13 A catalyst does not change the position of equilibrium but this equilibrium position approach earlier. Why?

Ans.

A catalyst decrease the energy of activation required by reacting substance so the position of equilibrium reaches earlier.

Q.14 How the change in pressure at equilibrium position effect the following reaction?

$PCl_5 \rightleftharpoons PCl_3 + Cl_2$

Ans.

According to Le–chatlier's principle, by increasing pressure the reaction will move toward less number of moles. In the above reaction, by increasing pressure the reaction will move in backward direction.

Q.15 What is the relationship b/w kc, kp kc & kn?

Ans.

These four parameters are related as.

$K_p = K_c (RT)^{\Delta n} = K_x (P)^{\Delta n} = K_n$

When mole of products are reactant are equal i.e. $\Delta n = 0$ their

$K_p = k_c = d_x = k_n$

Q.16 Prove that Kw is ionic product of water and its value is 1×10^{-14} at 25o.

Ans.

Water undergoes self ionization as

$2H_2O \rightarrow H_3O^+ + OH^-$

or $H_2O \rightarrow H^+ + OH^-$

$K_c [H_2O] = [H^+] [OH^-]$

$K_w = [H^+] [OH^-]$

At 25oC the value of Kw ionic product have been measured. Its value is 1 x 10–14.

Q.17 How can you purify NaCl by common ion effect?

Ans.

The impurities present in the common salt are $CaCl_2$ $MgCl_2$ and Na_2SO_4 in it. These impurities can be removed by common Ion effect. For this purpose a saturated solution of NaCl is prepared. Then HCl gas is passed through it. HCl is stronger electrolyte than NaCl Ionization of NaCl is suppressed by passing HCl gas and it is precipitated out.

Q.18 A buffer consists of a weak acid and is salt.

Ans.

(i) $CH_3COOH + CH_3COONa$

(ii) $C_6H_5COOH + C_6H_5COONa$

(iii) $H_2CO_3 + NaHCO_3$

(iv) $H_3PO_3 + NaH_2PO_4$

Q.19 How can you co–relate Ka with Kc?

Ans.

Ka is dissociation constant of an acid while Kc is the equilibrium constant suppose an acid HA Ionize as

$HA + H_2O \rightarrow H_3O^+ + A^-$

$K_c =$

concentration of $[H_2O]$ almost remains constant so we can write.

$K_c =$

$K_c [H_2O] = ka$

$K_a =$

Q.20 How can you calculate % Ionization of an acid?

Ans.

Percentage Ionization of an acid can be determined by the following formula.

$\%\ \text{Ionization} = \frac{\text{initially available.}}{} \times 100$

Q.21 $N_2(g) + 3H_2(g)$ $2NH_3(g)$ $\Delta H = -92.46$ KJ/mol

This reaction is favourable at low temperature then why its production is favourable at 450^0C?

Ans:

This is industrial condition favourable at the industrial level because at low temperature the reaction becomes very slow because both are gases.

Q.22 What is common ion effect?

Ans:

The decrease in ionization of a weak electrolyte by adding another strong electrolyte having common ion.e.g ionization of NaCl is decreased by passing HCl through NaCl solution.

Q.23 What is solubility product?

Ans:

The product of molar solubilities of the ions of weak electrolyte at equilibrium stage is called solubility product. It is represented by K_{sp}