20 - Ionic Equilibria.

Q-1) Kw - Ionic product of water.

> $H_2O(l) \rightleftharpoons H^+(aq) + OH^-(aq)$

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

$K_w = 1.00 \times 10^{-14}\ mol^2dm^{-6}$, at 298 K.

In water, $[H^+] = [OH^-]$

$\therefore K_w = [H^+]^2$

$\therefore [H^+] = 1.00 \times 10^{-7}\ moldm^{-3}$

Q-2) What is pH?

> pH is the negative logarithm to the base 10 of the hydrogen ion concentration.

$$pH = -\log_{10}[H^+]$$

$$\therefore [H^+] = 10^{-pH}$$

Q-3) Calculating pH of strong acids and strong bases.

Strong acid:

$[H^+]$ is same as [acid] since they are completely ionised.

$$pH = -\log_{10}[H^+]$$

strong base:

$[OH^-]$ is same as [alkali]

① use $[H^+] = \frac{K_w}{[OH^-]}$ to find $[H^+]$

② then use $-\log_{10}[H^+]$

Q-4) Ka - acid dissociation constant.

> Ka is the equilibrium constant for the dissociation of weak acids.

* $HA_{(aq)} \rightleftharpoons H^+_{(aq)} + A^-_{(aq)}$

$$Ka = \frac{[H^+][A^-]}{[HA]}$$

* In the equation, the H^+ arising from the ionisation of water (aq) are ignored. $\therefore [H^+] = [A^-]$

* We assume that ionisation of weak acid is v. small that [HA] at equilibrium is same as [HA] at start.

$$\therefore Ka = \frac{[H^+]^2}{[HA]}$$

pKa values can be used to compare strengths of weak acids

$$pKa = -\log_{10} Ka$$

High value of Ka = STRONG ACID

Low value of pKa = STRONG ACID.

* Equilibrium constant Kc

$$Kc = \frac{[C]^c\ [D]^d}{[A]^a\ [B]^b} \quad \text{if} \quad aA + bB \rightleftharpoons cC + dD$$

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20 - Ionic Equilibria continued...

Q-5) Acid-base titrations.

* Strong acid - strong base.
  end point : 10·5 - 3·5.

* Strong acid - weak base
  end point : 7·5 - 3·5.

* Weak acid - strong base
  end point : 11 - 7·5

* Weak acid - weak base
  no indicator.

Q-6) What are buffer solutions?

> A buffer solution is a solution in which the pH does not change significantly when small amounts of acids or alkalis are added.

eg: ① $CO_{2(aq)} + H_2O_{(aq)} \rightleftharpoons H^+_{(aq)} + HCO_3^-{}_{(aq)}$

② $HCO_3^-{}_{(aq)} + OH^-{}_{(aq)} \rightleftharpoons CO_3^{2-}{}_{(aq)} + H_2O_{(aq)}$

- equilibrium shift and large reserve of ions means the pH doesn't change significantly.

$$[H^+] = K_a \frac{[acid]}{[salt]}$$

OR

$$pH = pK_a + \log_{10} \frac{[salt]}{[acid]}$$

Q-7) What is solubility product?

> Solubility product is the product of the concentrations of each ion in a saturated solution of a sparingly soluble salt at 298 K, raised to the power of their relative concentrations.

$$K_{sp} = [C^{y+}]^a [A^{x-}]^b$$

cation anion

Q-8) What is the common ion effect?

> The common ion effect is the reduction in the solubility of a dissolved salt achieved by adding a solution of a compound which has an ion in common with the dissolved salt.

Q-9) What is partition co-efficient?

> Partition coefficient is the distribution of a solute in two immisible solvents.

$$K_{pc} = \frac{[\text{organic top layer}]}{[\text{inorganic bottom layer}]}$$

* see notebook for example.