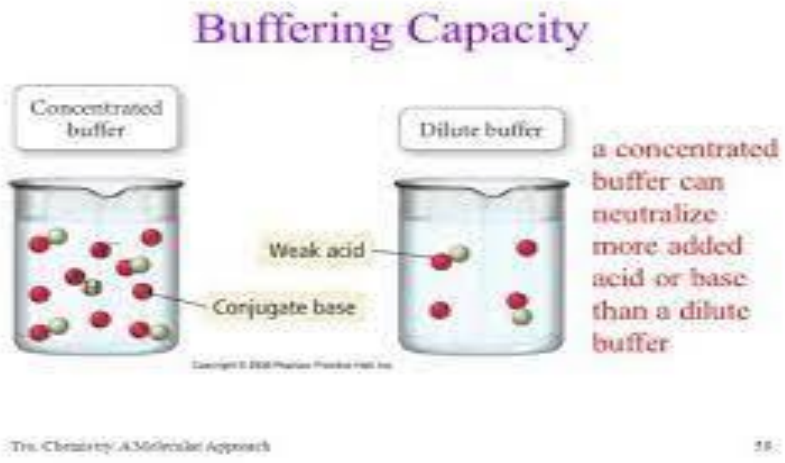
## Unit- V

## pH, Buffers and Isotonic solutions

### Buffer Capacity:

Buffer efficiency or buffer capacity is defined as the ratio of the increment of strong base (or acid) to the small change in pH brought about by this addition.

Buffers resist the change in pH. However, the pH of the solution does change when a large quantity of acid or base is added. The magnitude of the resistance of a buffer to pH change is referred to as the buffer capacity, buffer index and buffer value.




Buffer capacity, β, is mathematically expressed as:

$$\beta = \Delta B / \Delta pH \quad \text{.....(8)}$$

where B = concentration of base (or acid) added, gram Eq/L

According to equation (8), the buffer capacity has a value of 1 when 1 gram equivalent of strong base (or acid) is added to 1 litre of buffer solution, if the change in pH is 1 unit.

The buffer has its greatest capacity, when [salt]/[acid] is equal to 1. Therefore, Henderson- Hasselbalch equation may be written as pH = pKa. Buffer capacity decreases appreciably as the pH deviates more than 1 unit on each side of the pKa value (fig-2).

Buffer capacity is not a fixed value for a given buffer system, but depends on the amount of base added. Buffer capacity changes as the ratio of log [salt]/[acid] increases with added base. Buffer equation can be used to calculate the pH of the solution after the addition of base.

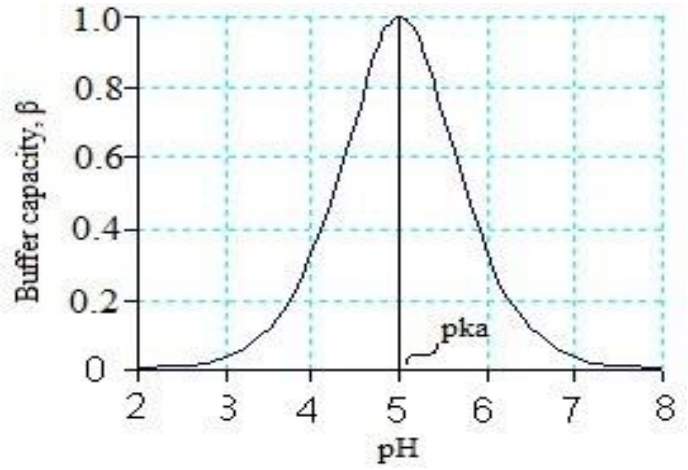



**Figure 2- A typical Buffer capacity diagram of a buffer solution.**

Buffer capacity is also influenced by the total concentration of the ier constituents. The greater the concentration of salt and acid, the greater is the buffer capacity. For this reason, buffers are expressed in terms of molar concentrations namely 0.2 M, 0.02 M, etc.

Van Slyke's equation can be used for calculating the buffer capacity of a buffer.

$$\beta = 2.303\ C\ \{Ka\ [H_3O^+]/\ (Ka\ +\ [H_3O^+])^2\}\ \text{-------(9)}$$

where C= concentration of total buffer (sum of acid and salt)

Equation (9) permits the calculation of B at any hydrogen concentrate.

At maximum capacity, pH= pKa or the term $[H_3O^+]$ =Ka

Hence, equation (9) changes to

$$\beta max = 0.576\ C \text{---------- (10)}$$