BUFFER SOLUTION

A buffer is a mixture of a weak acid and its conjugate base or a weak base and its conjugate acid that resists changes in pH of a Solution.

Generally, buffer Solution are prepared from a conjugate acid/base pair, Such as acetic acid/Sodium acetate or ammonium chloride/ammonia

Buffered aspirin Contains buffers to help prevent stomach irritation from the acidity of the carboxylic acid group in aspirin.

Calculation of the pH of Buffer Solutions.

1) Acidic buffer

CH_3COOH CH_3COONa

$$[H_3O^+] = K_a \frac{[salt]}{[acid]} \times \frac{[acid]}{[salt]}$$

$$-\log [H_3O^+] = -\log K_a + \log \frac{[salt]}{[acid]}$$

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

Example 8- What is the pH of a Solution that is 0.400 M of formic acid and 1.00 M of Sodium formate?

$$HCOOH + H_2O \rightleftharpoons H_3O^+ + HCOO^-$$

$$K_a = 1.80 \times 10^{-4}$$

$$pH = pK_a + \log \frac{[Salt]}{[acid]}$$

$$pH = -\log 1.8 \times 10^{-4} + \log \frac{1}{0.4} = 4.143$$

② Basic buffer

$K_b = \frac{K_w}{K_a}$

NH_4OH / NH_4Cl

$[OH^-] = K_b \frac{[base]}{[salt]}$

$-\log [OH^-] = -\log K_b + \log \frac{[salt]}{[base]}$

$pOH = pK_b + \log \frac{[salt]}{[base]}$

Ex: Calculate the pH of a Solution that is 0.200 M of NH_3 and 0.300 M of NH_4Cl. the acid dissociation constant K_a for NH_4^+ is 5.70×10^{-10}

$NH_4^+ + H_2O \rightleftharpoons NH_3 + H_3O^+$

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

$K_b = \frac{K_w}{K_a} = \frac{1.00 \times 10^{-14}}{5.70 \times 10^{-10}} = 1.75 \times 10^{-5}$

$pOH = pK_b + \log \frac{[salt]}{[base]}$

$pOH = -\log K_b + \log \frac{[salt]}{[base]}$

$pOH = -\log 1.75 \times 10^{-5} + \log \frac{[0.3]}{[0.2]} = 4.933$

$pK_w = pH + pOH$

$pH = pK_w - pOH = 14 - 4.933 = 9.067$

Some terms used in volumetric titrimetry

standard solution (or a standard titrant): is a reagent of known concentration that is used to carry out a titrimetric analysis

Titration:
is performed by slowly adding a standard solution from a buret or other liquid dispensing device to a solution of the analyte Until the reaction between the two is judged complete.

The Volume or mass of reagent needed to complete the titration is determined from the difference between the initial and final readings.

Equivalence points and End points :-

The equivalence point :-
in a titration is a theoretical point reached when the amount of added titrant is chemically equivalent to the amount of analyte in the sample

The End point :- is the point in a titration when a physical change occurs that is associated with the condition of chemical equivalence.

The difference in Volume or mass between the equivalence point and the end point is the titration error

Indicators :- are often added to the analyte solution to produce an observable physical change (the end point) at or near the equivalence point

Large changes in the relative concentration of analyte or titrant occur in the equivalence point region. These concentration changes cause the indicator to change in appearance.

Typical indicator changes include the appearance or disappearance of a color

A primary standard Solution:-

is an aultrapure compound that serves as the reference material for a titrimetric method of analysis.

Important requirements for a primary standard are the following.

1) High purity Established methods for confirming purity should be available.

2) Atmosphere stability.

3) Absence of hydrate water so that the composition of the Solid does not change with variations in humidity.

4) Modest cost

5) Reasonable Solubility in the titration medium.

6) Reasonably large molar mass So that the relative error associated with weighing the standard is minimized

A Secondary standard Solution:-

is a compound whose purity has been established by chemical analysis and that serves as the reference material for a titrimetric method of analysis.