

15-07-20
Dr. SK Gupta
Dep^t. of Chemistry
Garware College, D34.

Deg-I (H) Physical [parts-II]

Chapter - Ionic Equilibrium

Topics - Buffer Solution

Henderson's Equation

Buffer Solution - Those solution which resists its pH-value by the small addition of acids & bases.

The ability to resist its pH-value on addition of small amount of Acid & Bases are called its Buffer-Action.

General Characteristics of a Buffer-soln-

- ① It has definite pH. Its acidity & alkalinity must be reserved.
- ② Its pH does not change on standing for long-time.
- ③ Its pH does not change upon dilution.
- ④ Its pH slightly change by the addition

of very small amount of an acid & bases.

Types Of Buffer Solution:

① Acidic Buffer - By mixing a weak acid with salt of its strong base.

Example - (a) $\text{CH}_3\text{COOH} + \text{CH}_3\text{COONa}^+$

(b) Boric acid + Borax

(c) Phthalic Acid + potassium acid phthalate

② Basic Buffer -

By mixing weak base & its salt with strong acid.

Example - (a) $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl}$

(b) Glycine + Glycine hydrochloride.

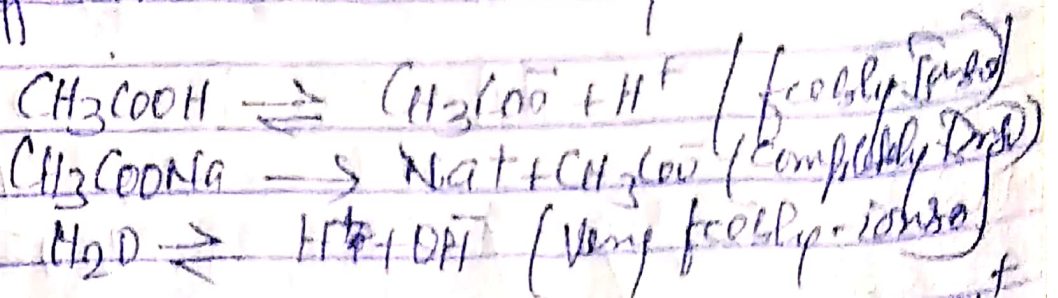
③ By a solution of amphoteric substance which show both an acid & bases.

Example - protein & amino acids

④ By a mixture of an acid salt and a normal salt of a polybasic acid.

Example - $\text{Na}_2\text{HPO}_4 + \text{Na}_3\text{PO}_4$
or $\text{CH}_3\text{COONH}_4$

Buffer Action: In case of acetic buffer
 acetic acid is weakly ionised.
 But sodium acetate is almost completely
 ionised. A mixture contains both
 CH_3COOH & CH_3COO^- along with Na^+
 H^+ & OH^- .

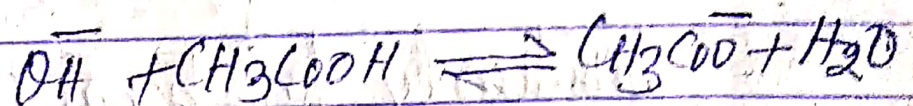


(a) by adding a drop of an acid or H^+
 H^+ combines with CH_3COO^- ion to
 form CH_3COOH (freely ionised)



Its ionisation is further suppressed by
 due to common ion effects.

(b) by adding a drop of base or OH^-
 OH^- combines with CH_3COOH to form
 CH_3COO^- & undissociated H_2O .



Thus OH^- furnished by base are
 removed by CH_3COOH & its pH of
 the solution is practically unaffected.

Henderson's Equation (pH of buffer-sol)

In Conjugate Acid-Buffer, it consists of a mixture of weak acid & its salt. It can be shown as HA (CH_3COOH)

HA ionises as



Applying Law of Mass-action

Dis.
Constant of
acid.

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

$$\text{or } [H^+] = K_a \times \frac{[HA]}{[A^-]}$$

Taking log both side.

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

Taking negative sign

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

Thus

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

Similarly for basic-sol.

$$p(OH) = pK_b + \log \frac{[\text{Salt}]}{[\text{Base}]}$$

The above Eqn. is called Henderson's Eqn.