**What does pH Mean in a Buffer?**

In chemistry, pH is a measure of the hydrogen ion (H+) concentration in a solution. The pH of a buffer can be calculated from the concentrations of the various components of the reaction. The balanced equation for a buffer is:

HA⇌H+ + A−

The strength of a weak acid is usually represented as an equilibrium constant. The **acid-dissociation equilibrium constant (Ka),** which measures the propensity of an acid to dissociate, for the reaction is:

Ka=[H+][A−]/[HA]

The greater [H+] x [A–] is than [HA], the greater the value of Ka, the more the formation of H+ is favored, and the lower the pH of the solution.

As pH= -log H+

**The Henderson-Hasselbalch Equation**

The Henderson–Hasselbalch equation mathematically connects the measurable pH of a solution with the pKa (which is equal to -log Ka) of the acid. The equation is also useful for estimating the pH of a buffer solution and finding the equilibrium pH in an acid-base reaction. The equation can be derived from the formula of pKa for a weak acid or buffer. The balanced equation for an acid dissociation is:

HA⇌H++A−

The acid dissociation constant is:

Ka=[H+][A‑]/[HA]

After taking the log of the entire equation and rearranging it, the result is:

log(Ka)=log[H+] + log([A−]/[HA])

This equation can be rewritten as:

−pKa=−pH + log([A‑]/[HA])

Distributing the negative sign gives the final version of the Henderson-Hasselbalch equation:

pH= pKa + log([A−]/[HA])

pH = pKa + log(ionized/unionized) for acids

pH = pKa + log(unionized/ionized) for bases

In an alternate application, the **equation can be used to determine the amount of acid and conjugate base needed to make a buffer of a certain pH.**

With a given pH and known pKa, the solution of the Henderson-Hasselbalch equation gives the logarithm of a ratio which can be solved by performing the antilogarithm of pH/pK­a:

10pH−pKa=[base]/[acid]

**An example of how to use the Henderson-Hasselbalch equation to solve for the pH of a buffer solution is as follows:**

* What is the pH of a buffer solution consisting of 0.0350 M NH3 and 0.0500 M NH4+(Ka for NH4+ is 5.6 x 10-10)?
* The equation for the reaction is:

NH+4⇌H++NH3

Assuming that the change in concentrations is negligible in order for the system to reach equilibrium, the Henderson-Hasselbalch equation will be:

pH= pKa + log([NH3]/[NH+4])

pH=9.25+log(0.0350/0.0500) (Ka is converted to pka i.e. – log Ka)

pH = 9.095