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How to Make a Buffer Solution **How to Make a Buffer Solution**

In chemistry, a buffer solution is a mixture of an acidic or alkaline chemical with water and the chemicals salt. If the chemical is an acid, the salt will be its conjugate base; if the chemical is a base (or alkaline), the salt will be its conjugate acid when prepared correctly, the buffer solution's pH will stay the same, even when small amounts of acid and base are added. Buffer solutions play an important role in chemical analysis, cleaning up chemical spills and in chemical manufacturing.

There are four main ways to prepare a buffer solution

1-Decide on the buffer properties

Before making a buffer, you must know what molarity you want it to be, what volume to make and what the desired pH is. Most buffers work best at concentrations between 0.1 M and 10 M. The pH should be within 1 pH unit of the acid / conjugate base pka.

2-Determine the ratio of acid to base

Use the Henderson – Hasselbaich equation (below) to determine what ratio of acid to base is required to make a buffer of the desired pH. Use the pka value nearest your desired pH and the ratio will refer to the acid-base conjugate pair that correspond to that pka.

$$\text{H.H Equation : } pH = pka + \log \frac{[salt]}{[acid]}$$

Salt = conjugate base

For example pH = 5 , pka = 4.74

$$5 = 4.74 + \log \frac{[salt]}{[acid]}$$

$$0.26 = \log \frac{[salt]}{[acid]} \rightarrow 1.82 = \frac{[salt]}{[acid]} \quad \text{.....(1)}$$

3- Substitute for [acid] and solve for [salt]

The desired molarity of the buffer is the sum of [acid] + [salt]. For a 1.0 M buffer, [salt] + [acid] = 1.0 and

[salt] = 1.0 - [acid] ……(2)

By substituting this into the ratio equation, from step 2 you get:

$$\frac{1.0 - [acid]}{[acid]} = 1.82 \rightarrow 1.0 - [acid] = 1.82\ [acid]$$

$$1.82\ [acid] + [acid] = 1.0 \rightarrow 2.82\ [acid] = 1.0$$

$$[acid] = \frac{1.0}{2.82} = 0.355\ M$$

4 – Solve for [acid] Using the equation (2) [salt] = 1.0 – 0.355 = 0.645 M

5 – Mix the acid and salt Prepare just under 1.0 L (or any volume you need) of solution by mixing 0.355 moles of acid and 0.645 moles salt in a little less than a liter of water.

6 - Check the pH Use a pH probe to confirm that the correct pH for the buffer is reached. Adjust Slightly as necessary, using strong acid or strong base.

7 – Correct the volume Once you have reached the desired pH, add water to bring the total volume of buffer to 1.0 L.

8 – Dilute as desired This same buffer can be diluted to create buffers of 0.5M, 0.1M, 0.05M or anything in – between.