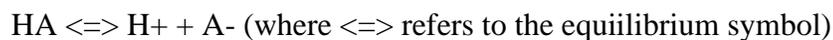


Highlights Buffers

1. Weak acids (written as HA) dissociate in water to a limited extent. This ionization can be written as



2. For dissociation of such weak acids, the Henderson-Hasselbalch equation applies. It states that

$$\text{pH} = \text{pK}_a + \log \left\{ \frac{[\text{A}^-]}{[\text{HA}]} \right\}$$

where the bracketed items (such as [A⁻]) refers to the concentration of that item.

3. Remember that pH is defined as the negative log of the hydrogen ion concentration

$$-\log[\text{H}^+]$$

and the pK_a is defined as the negative log of the acid dissociation constant, K_a

$$-\log(\text{K}_a)$$

4. pK_a is a measure of the strength of an acid. The lower the pK_a, the stronger the acid.

5. Very strong acids like HCl that completely ionize in water do not have pK_a values.

6. Buffers are systems of molecules in solution that act to resist pH changes within approximately at 1 pH range of their respective pK_as. For example, acetic acid has a pK_a of 4.76. This means it will be an effective buffer in the range of 3.76 to 5.76.

7. At the pK_a of a molecule, it will have equal amounts of molecules with the appropriate proton and missing the proton. For acetic acid, for example, (abbreviated as HAc), at pH 4.76, it will have equal amounts of HAc and Ac⁻. Below pH 4.76, it will have more HAc than Ac⁻. Above pH 4.76, it will have more Ac⁻ than HAc.

8. When referring to a buffer system, I shall use the term 'salt' to refer to the molecule of the buffer system that has lost a proton. I shall use the term 'acid' to refer to the molecule of the buffer system that has not lost its proton. The difference between a salt and an acid is a single proton.

9. Adding a strong acid (such as HCl) to a buffer system causes salt (A⁻) to be converted into an acid (HA). For every molecule of HCl added, one A⁻ is converted to one HA. Thus, if one had 500 molecules of HA and 500 molecules of A⁻ in solution and one added 10 molecules of HCl, the resulting solution would have 510 molecules of HA and 490 molecules of A⁻.

10. Conversely, adding a strong base (such as NaOH) to a buffer system causes HA to be converted to A⁻. For every molecule of NaOH added, one HA is converted to one A⁻. Thus, if one had 500 molecules of HA and 500 molecules of A⁻ in solution and one added 10 molecules of NaOH, the resulting solution would have 490 molecules of HA and 510 molecules of A⁻.

11. You will not have to calculate the exact values of logarithms, but you should be able to tell by looking if a

logarithm is positive, negative, or zero.