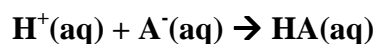


- Buffer systems are frequently used in chemistry. What is a buffer system and how does it function? Use equations where appropriate.

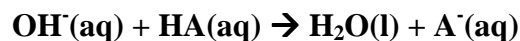
**Buffer systems resist changes in pH: a buffer will maintain a relatively constant pH when acid or base is added.**

**They consist of mixtures of a weak acid (HA) and its conjugate base (A<sup>-</sup>) in high concentration.**

**If acid is added, the system can respond by removing it using A<sup>-</sup>:**



**If base is added, the system can respond by removing it using HA:**



What ratio of concentrations of acetic acid to sodium acetate would you require to prepare a buffer with pH = 4.00? The  $K_a$  of acetic acid is  $1.8 \times 10^{-5}$  M.

**The pH of a buffer system made from a mixture of the weak acid (HA) and its conjugate base (A<sup>-</sup>) is described by the equation:**

$$\text{pH} = \text{p}K_a + \log \frac{[\text{A}^-(\text{aq})]}{[\text{HA}(\text{aq})]}$$

**For acetic acid,  $K_a = 1.8 \times 10^{-5}$  or  $\text{p}K_a = -\log(K_a) = 4.74$ . To obtain pH = 4.00:**

$$4.00 = 4.74 + \log \frac{[\text{A}^-(\text{aq})]}{[\text{HA}(\text{aq})]} \text{ and so } \frac{[\text{A}^-(\text{aq})]}{[\text{HA}(\text{aq})]} = 10^{-0.74} = 0.18$$

$$\text{Alternatively, } \frac{[\text{HA}(\text{aq})]}{[\text{A}^-(\text{aq})]} = \frac{1}{0.18} = 5.56$$

Answer: **5.56: 1**