Marks 4

- 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^-) in high concentration.

If acid is added, the system can respond by removing it using A^-:

$$H^+(aq) + A^-(aq) \rightarrow HA(aq)$$

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

$$OH^-(aq) + HA(aq) \rightarrow H_2O(l) + A^-(aq)$$

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 1.8×10^{-5} M.

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

$$\mathbf{pH = pK_a + \log \frac{[A^-(aq)]}{[HA(aq)]}}$$

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

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

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

Answer: **5.56: 1**