Buffers

1.) Explain if the following will form a buffer solution.

a.) $0.10\ M\ KCN\ and\ 0.10\ M\ HCN$

Answer – Buffer. The solution contains appreciable amounts of a weak acid and its conjugate base.

b.) $1.0\ M\ NaOH\ and\ 1.0\ M\ NaCl$

Answer – No Buffer. The solution contains appreciable amounts of a strong base and a salt.

c.) $1.0\ M\ HSO_4^-\ and\ 1.0\ M\ HCl$

Answer – No Buffer. The solution contains appreciable amounts of a weak acid and another strong acid.

d.) $2.0\ M\ HPO_4^{-2}\ and\ 1.5\ M\ PO_4^{-3}$

Answer – Buffer. The solution contains appreciable amounts of a weak acid and its conjugate base.

2.) When comparing two solutions of buffers: $1\ M\ H_2PO_4^-$ with $1\ M\ HPO_4^{-2}$ and $0.1\ M\ H_2PO_4^-$ with $0.1\ M\ HPO_4^{-2}$, will the pH be different?

Answer – No, concentration has no effect on the pH of buffers. This is do to the ratio of acid/base being the same in both cases.

3.) How would a buffer solution be made to maintain a $pH = 3.2$?

Answer – solve for K_a. $pK_a = pH = antilog[-3.4]$ $pK_a = 3.98 \times 10^{-4}$. Use the K_a to find a suitable acid and the conjugate base to combine. Use $1.0\ mol\ HF$ and $1.0\ mol\ NaF$ in $1.0\ L$ of water.

4.) If you have a $1.0\ L$ buffer solution made of $0.10\ mol\ CH_3COOH$ and $0.10\ mol\ CH_3COO^-$, can you add $0.13\ mol\ NaOH$?

Answer – No. The buffer solution only has $0.10\ mol$ of acid to buffer the OH^-.

5.) How would a buffer solution of $H_2PO_4^-/HPO_4^{-2}$ react if an acid or base was added? Write the reactions.

Answer - $H_2PO_4^- + H_2O \leftrightarrow HPO4^{-2} + H_3O^+$

base added → $H_2PO_4^- + OH^- \leftrightarrow HPO4^{-2} + H_2O$

acid added → $HPO4^{-2} + H_3O^+ \leftrightarrow H_2PO_4^- + H_2O$