4.3 Exercise 3 - Buffer solutions

1. a) What is meant by the term "buffer solution"?

   b) Calculate the pH of a buffer solution which contains the weak monoprotic acid, propanoic acid (CH_3CH_2COOH), in concentration 0.1 $moldm^{-3}$ and sodium propanoate in concentration 0.05 $moldm^{-3}$. K_a of propanoic acid is 1.26×10^{-5} $moldm^{-3}$.

   c) Give equations to show how the above solution fulfills its buffer function.

   d) Calculate the pH of the solution after 0.01 moles of NaOH are added to 500 cm^3 of the solution.

   e) Calculate the pH of the solution after 0.01 moles of HCl are added to 500 cm^3 of the solution.

   f) Calculate the pH after 0.01 moles of NaOH is added to 500 cm^3 of water.

   g) Comment on your answers to (d) and (f).

2. a) Calculate the pH of 0.12 $moldm^{-3}$ ethanoic acid ($K_a = 1.7 \times 10^{-5}$ $moldm^{-3}$).

   b) Calculate the mass of sodium ethanoate (CH_3COONa) which must be added to 500 cm^3 this solution to give a buffer solution of pH = 4.60.

   c) Calculate the pH of this solution after 0.01 moles of HCl are added.

   d) Calculate the pH of this solution after 0.01 moles of NaOH are added.

3. Calculate the pH of a buffer which is 0.2 $moldm^{-3}$ with respect to ammonium sulphate and 0.1 $moldm^{-3}$ with respect to ammonia. (K_a of $NH_4^+ = 5.6 \times 10^{-10}$ $moldm^{-3}$)

4. Methanoic acid, HCOOH, has a K_a value of 1.58×10^{-4} $moldm^{-3}$. What ratio of methanoic acid and sodium methanoate would give a buffer of pH = 4?

5. a) Calculate the pH of a buffer solution which is 0.1 $moldm^{-3}$ with respect to HCN ($K_a = 4.9 \times 10^{-10}$ $moldm^{-3}$) and 0.8 $moldm^{-3}$ with respect to sodium cyanide.

   b) Calculate the pH after 0.05 moles of HCl are added to 1 dm^3 of this buffer.

   c) Calculate the pH after 0.05 moles of NaOH are added to 1 dm^3 of this buffer.

   d) Calculate the pH after 0.2 moles of NaOH are added to 1 dm^3 of this buffer.

   e) Comment on your answer to (d).