CHEM1002 Worksheet 9 – Answers to Critical Thinking Questions

The worksheets are available in the tutorials and form an integral part of the learning outcomes and experience for this unit.

Model 1: A Solution Containing a Weak Acid

1. a: pH = 2.23
   b: pH = 2.38
   c: pH = 2.53
   d: pH = 2.68

2. The major species present are $CH_3COOH(aq)$ and $H_2O(l)$. The ionisation of the weak acid is very small and there is *very* little $H_3O^+(aq)$ and $CH_3COO^-(aq)$.

Model 2: Buffer solutions

3. Use the Henderson-Hasselbalch equation to calculate the pH.

   pH = 4.76 + log(0.100/0.400) = 4.76 + (-0.60) = 4.16

4. All of the added strong base reacts with $CH_3COOH(aq)$ to form more $CH_3COO^-(aq)$. The concentration of the weak acid will be 0.250 M and that of the conjugate base will be 0.250 M. Add these concentrations into the Henderson-Hasselbalch equation.

   pH = 4.76 + log(0.250/0.250) = 4.76 + 0.00 = 4.76

   The pH changes by 0.60 and the final value is pH = 4.76.

5. You need to use the Henderson-Hasselbalch equation to determine the ratio of weak acid to conjugate base to prepare a buffer at the required pH.

   5.00 = 4.76 + 0.24

   log ([base] / [acid]) = 0.24

   [base] / [acid] = $10^{0.24}$ = 1.74 = 1.7 (2 sig. fig.)

   The required ratio of conjugate base to weak acid is 1.7 : 1.