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 CH₃COOH(aq) and H₂O(l). The ionisation of the weak acid is very small and there is *very* little H₃O⁺(aq) and CH₃COO⁻(aq).

**Model 2: Buffer solutions**

3. Use the Henderson-Hasselbalch equation to calculate the pH.
   
   \[ \text{pH} = 4.76 + \log(0.100/0.400) = 4.76 + (-0.60) = 4.16 \]

4. All of the added strong base reacts with CH₃COOH(aq) to form more CH₃COO⁻(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.
   
   \[ \text{pH} = 4.76 + \log(0.250/0.250) = 4.76 + 0.00 = 4.76 \]

   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.

   \[ 5.00 = 4.76 + 0.24 \]

   \[ \log \left( \frac{\text{[base]}}{\text{[acid]}} \right) = 0.24 \]

   \[ \frac{\text{[base]}}{\text{[acid]}} = 10^{0.24} = 1.74 = 1.7 \text{ (2 sig. fig.)} \]

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