CHEM1612 Problem Sheet 6 (Week 7)

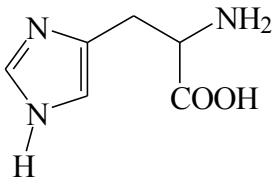
Work through the ChemCAL module "*Weak Acids and Bases*"

1. The pK_a of acetic acid is 4.76. Calculate the pH of the following solutions:

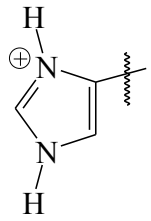
   (a) 0.2 M acetic acid
   (b) 0.2 M sodium acetate
   (c) A buffer that is 0.2 M in acetic acid and 0.2 M in sodium acetate

2. Histidine is an amino acid of importance in maintaining the catalytic activity of proteolytic (protein cleaving) enzymes.

   The pK_1, pK_2 and pK_3 values for histidine are 1.81, 6.05 and 9.15. These values correspond to the α-COOH group, the imidazole ring and the α-NH_3^+ group respectively.



histidine



imidazole

   In a buffer solution where pH = pK_a, the concentration of the acid and its conjugate base are equal. Give the constitutional formulas of the acid species and its conjugate base associated with the following pK_a values.

   (a) 1.81 (b) 6.05 (c) 9.15

3. A buffer at physiological pH of 7.40 is required. What quantities of 0.10 M HPO_4^{2-} and $H_2PO_4^-$ are required to make 1.0 L of this buffer? (pK_a ($H_2PO_4^-$) = 7.20)

4. The pH of a 0.6 M solution of a weak acid is 4.0. What percentage of the acid has ionised?

5. In a titration experiment, 50.0 mL of 0.100 M acetic acid (pK_a = 4.76) is reacted with NaOH.

   (a) Calculate the pH when the following quantities of 0.100 M NaOH have been added:

      (i) 0.0 mL (initial pH)
      (ii) 25.0 mL
      (iii) 45.0 mL
      (iv) 50.0 mL
      (v) 55.0 mL
      (vi) 75.0 mL

   (b) Using the calculated values, plot the pH curve for the titration.
   (c) Compare your curve with that obtained for Q7 on Sheet 5.