CHEM1612 Problem Sheet 5 (Week 6)

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

1. A solution prepared by dissolving 0.30 g of polyacrylamide in 100 mL of water has an osmotic pressure of 8.3×10^{-5} atm at 25 °C. What molar concentration of glucose would be isotonic with this solution?

2. Rank the following solutions in order of increasing osmotic pressure:

   1 M H_2SO_4 1 M HCl 0.5 M glucose 0.5 M $CaCl_2$ 0.5 M NaCl

3. A solution is prepared by dissolving 1.00 mg of an unknown protein in 1.00 mL of water. The osmotic pressure of the solution was measured to be 95 Pa at 25°C. What is the molecular weight of the protein?

4. Sea water from the Gulf of Mexico contains approximately 59 g salt per 1000 g water. Given the cryoscopic constant of water is 1.86 K kg mol^{-1}, at what temperature would this water freeze?

5. Lactic acid ($C_3H_6O_3$), a monoprotic acid, is a waste product that accumulates in muscle tissue during exertion, leading to pain ("cramp") and a feeling of fatigue. In a 0.100 M aqueous solution, lactic acid is 3.7% dissociated. If the equilibrium concentration of H^+ ion is x mol L^{-1}, write the equilibrium expression for K_a in terms of x and thus work out the equilibrium concentrations, the value of pH and K_a for lactic acid.

6. Give the concentration of hydrogen ions present and hence calculate the pH of each of the following water solutions:

   (a) hydrochloric acid (0.14 M)
   (b) nitric acid (0.0025 M)
   (c) sodium hydroxide (0.048 M)
   (d) barium hydroxide (3.7×10^{-3} M)

7. In a titration experiment, 50.0 mL of 0.100 M HCl 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.