

THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY
CHE 2112 TUTORIAL PROBLEM SHEET 1

Water, pH and Buffer Preparations. Week beginning 19th July 2021

1. Water properties enable it to sustain life. Write a note on various properties of water that support life.
2. List various types of non-covalent interactions and how they help support life
3. What is the pH of a 1.0×10^{-5} M HCl solution? Hint, use first year chemical equilibria knowledge.
4. How much of 0.05M HCl solution is needed to neutralise exactly 8.0 grams of NaOH?
5. What are the concentrations of the acetic acid (HOAc) and the acetate (OAc⁻) in a 0.2 M acetate buffer of pH 5.00? K_a for Acetic acid is 1.7×10^{-5} .
6. Describe how you would prepare 5 Litres of a 0.3M Citrate buffer, pH 4.47, starting with 2.0 M solution of Citric acid and 2.5 M KOH.
7. Blood Plasma contains a total carbonate pool of 2.52×10^{-2} M
 - a. What is the HCO₃⁻/CO₂ ratio and the concentration of each buffer component present at pH 7.4?
 - b. What would the pH be if 0.01 M H⁺ under conditions where the increased [CO₂] cannot be released?
 - c. What would the pH be if 0.01 M H⁺ is added and the excess CO₂ eliminated thereby maintaining the original [CO₂]?
8. Calculate the pH of a buffer composed of 0.060 mol NaH₂PO₄ and 0.040 mol Na₂HPO₄ in a total volume of 1.00 L of Aqueous solution, given
$$\begin{array}{ll} \text{H}_3\text{PO}_4 + \text{H}_2\text{O} \rightleftharpoons \text{H}_2\text{PO}_4^- + \text{H}_3\text{O}^+ & \text{p}K_a = 1.8 \\ \text{H}_2\text{PO}_4^- + \text{H}_2\text{O} \rightleftharpoons \text{HPO}_4^{2-} + \text{H}_3\text{O}^+ & \text{p}K_a = 6.76 \\ \text{PO}_4^{2-} + \text{H}_2\text{O} \rightleftharpoons \text{PO}_4^{3-} + \text{H}_3\text{O}^+ & \text{p}K_a = 12.5 \end{array}$$
9. An enzyme catalysed reaction was carried out in 0.2 M Tris buffer, pH 7.8. As a result of the reaction, 0.03 M H⁺ was produced.
 - a. What was the ratio of Tris⁺ (acid) and Tris^o (Conjugate base) and hence the concentrations of these at the start of the reaction?
 - b. What were the concentration of Tris⁺/Tris^o at the end of the reaction?
 - c. What was the pH at the end of the reaction?
 - d. What would be the final pH if no buffer was present? Will the enzyme survive at this pH?