Tutorial 3

1. How many ml of 0.05 M H_2SO_4 are required to neutralize 100 ml of 0.1M KOH?

2. Calculate the pH of a solution with a Hydrogen ion concentration of 0.045 M?

3. Calculate the $[H^+]$ of a solution with a pH of 6.5?

4. Calculate the $[OH^-]$ ion concentration of the following solutions:
   a) 0.1 M H_2SO_4.
   b) 0.05 M HNO_3.

5. Calculate the pOH of the following solutions;
   a) 0.01 M HCL.
   b) A solution with a $[H^+] = 3.2\times10^{-3}$.

6. 750 ml of 0.1M HCL was added to 250 ml of 0.2 M NaOH solution. Calculate the pH of the final solution.

7. Calculate the pk_a ,pk_b and K_b for the following weak acids:
   a) Acetic acid, $K_a = 1.8\times10^{-3}$
   b) Ammonium ion $K_a = 5.7\times10^{-3}$

8. A weak acid HA and KOH were mixed in the following proportions: HA = 0.125 mole; KOH = 0.025 mole. The resulting solution was diluted to 500 ml. Calculate the pH of the solution (Ka of HA $=2.5\times10^{-5}$).

9. Calculate: $[H^+]$, $[OH^-]$, pH, pOH of the final solution obtained after 100 ml of 0.2 M NaOH are added to 150 ml of 0.4 M H_2SO_4.

10. How many grams of solid KOH are required to neutralize 2 L of an HCl solution of pH2?

11. The pH of a 0.27 M solution of a weak acid, HA, is 4.3.
    a) What is the $[H^+]$ in the solution?
    b) What is the degree of ionization of the acid?
    c) What is the K_a?

12. Describe the preparation of 40 L of 0.02 M of phosphate buffer, pH 6.9 starting from:
    a) A 2 M H_3PO_4 solution and a 1 M KOH solution.
    b) Solid KH_2PO_4 and K_2HPO_4.
    c) Solid Na_3PO_4 and 1 M HCl.

13. An enzyme-catalyzed reaction was carried out in a solution containing 0.2 M Tris buffer. The pH of the reaction mixture at the start was 7.8. As a result of the reaction, 0.03 mole/liter of OH^- was produced.
    a) What was the ratio of Tris°/$Tris^+$ ratio at the end of the reaction.
    b) What was the final pH of the reaction mixture?
    c) What would the final pH be if no buffer were present?
    d) Write the chemical equation showing how the Tris buffer maintained a near constant pH during the reaction. pK_a of Tris = 8.1.

14. What volume of glacial acetic acid (density 1.06 g/ml) and what weight of solid potassium acetate are required to prepare 5 L of 0.2 M acetate buffer, pH = 5.0?

15. Blood plasma at pH 7.4 contains 2.4×10^{-2} M $HCO3^-$ and 1.2×10^{-3} CO_2 . Calculate the pH after the addition of 3.2×10^{-3} M H^+. Assume that the concentration of dissolved CO_2 is maintained constant at 1.2×10^{-3} M by the release of excess CO_2?

16. Design a shortcut method for preparing a 0.5 M Phosphate buffer, pH = 7.0, where only one form of phosphate is provided?

17. 4.9 grams of CH_3COOK is dissolved in 125 ml of 1 M CH_3COOH and the solution was made up to 250 ml. Calculate:
    a) The pH of the final solution.
    b) The Molarity of the buffer.

18. 200 ml of 0.2 M NaOH was mixed with 800 ml of 0.1M CH_3COOH. Calculate the pH of the resulting solution. pKa= 3.75

19. Starting from 0.5 M formic acid and solid sodium formate. Describe how to prepare 5 L of Formate buffer, pH = 4, Ka =1.78×10^{-4}

20. Describe how you would prepare one liter 0.1 M phosphate buffer, pH = 2.5, given 0.1 M phosphoric acid and solid $NaH_2PO_4.2H2O$. pKa= 4.75

21. Describe how you would prepare 250 ml of 0.2M phosphate buffer, pH =12.5, given solid $Na_2HPO_4.2H_2O$ and $Na_3PO_4.H_2O$. pKa= 4.75

22. The pH of 100 ml of 0.1 M phosphoric acid is 2.5, sketch the titration curve obtained by titrating the phosphoric acid solution with 0.2 M sodium hydroxide. Show clearly how you calculate the values used to plot the curve. (Use Ka values given in no. 15)

23. The pH of 250 ml of 0.2 M aspartic acid is 2.2. Sketch the titration curve obtained by titrating the aspartic acid solution with 0.5 M KOH show clearly how you obtain the values used to plot the curve. (pKa_1 = 2.0 , pKa_2 = 3.8 , pKa_3 =9.8)