

Problem Set
Acid/Base and Titration
Dr. Williamson

1. a) Calculate the amount of 0.1 M H_3PO_4 that it would take to neutralize 100 mL of 0.1 M NaOH.
b) Calculate the amount of 0.25 M H_2SO_4 that it would take to neutralize 25 mL of 0.2 M NH_3 .
c) Calculate the amount of 0.4 M HCl that it would take to neutralize 20 mL of 0.15 M NaOH.
d) Calculate the amount of 0.1 M H_3PO_4 that it would take to neutralize 100 mL of 0.1 M $\text{Ca}(\text{OH})_2$.

2. For the titration of 25 mL of 0.2 M $(\text{CH}_3)_3\text{N}$, calculate the pH before any 0.25 M H_2SO_4 has been added, the pH when 2.0 mL of H_2SO_4 has been added, the pH 5.0 mL of H_2SO_4 has been added, when 10.0 mL of H_2SO_4 has been added, and when 12.0 mL of H_2SO_4 has been added.

3. Calculate the K_a of the ammonium ion, given that the K_b of $\text{NH}_3 = 1.8 \times 10^{-5}$.
(You may assume 25°C unless otherwise instructed)

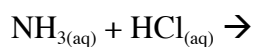
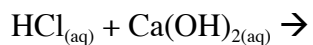
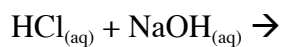
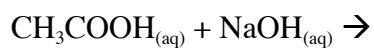
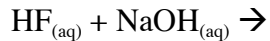
4. Calculate the pK_b of hydrofluoric acid given that the pK_a is 7.2×10^{-4} .

5. Calculate the concentrations of all species present in 0.100 M Oxalic Acid $(\text{COOH})_2$.
 $K_{a1} = 5.9 \times 10^{-2}$
 $K_{a2} = 6.4 \times 10^{-5}$

6. Sketch the titration curve for a solution of CH_3COOH titrated with NaOH.
Label the following: Buffer Region, Equivalence Point, the axis (with approximate numbers for the y axis), and Half-neutralization point.

7. Suppose the above titration curve is for 100.0 mL of 0.100 M CH_3COOH titrated with 0.100 M NaOH. Calculate the pH when no NaOH has been added, 20.0 mL NaOH has been added, 50.0 mL NaOH has been added, 75.0 mL NaOH has been added, at equivalence point, and 20.0 mL past equivalence point. (The $K_{a \text{ acetic acid}} = 1.8 \times 10^{-5}$)

8. Give the Net Ionic Equations for the following:



9. You have 70.0 mL of 0.065 M acetic acid. You then add 0.015 g of Sodium Acetate. You then measure the pH to be 2.2. Calculate $[\text{H}^+]$, $[\text{C}_2\text{H}_3\text{O}_2^-]$, and $[\text{HC}_2\text{H}_3\text{O}_2]$ of the final solution.

10. Solve (without a calculator):

$$\ln(\text{AB}) =$$

$$\ln(\text{A/B}) =$$

$$\ln(\text{AB}^N) =$$

$$\ln(1) =$$

11. Solve for x (with a calculator if necessary):

$$\ln(1/2) = x$$

$$\ln(x) = -5$$

$$-\ln(3x) = 4$$