Exercises for Acid-Base Titrations

1. Why is it not practical to titrate an acid or base that is too weak or too dilute?

2. What is the equilibrium constant for the titration reaction between benzylamine and HCl?

3. Why is the equivalence point pH necessarily below 7 when a weak base is titrated with a strong acid.

4. Calculate the pH in the titration of 50.0 mL of 0.050 M formic acid after each of the following volumes of 0.0500 M KOH has been added: 20.0 mL, 50.0 mL, 60.0 mL.

5. At what point in the titration of a weak base with a strong acid does the addition of a small amount of acid cause the least pH change? Explain.

6. A 0.100 M solution of weak acid HA was titrated with 0.100 M NaOH. The pH measured at the point halfway to the equivalence point was 4.62. Using activities, calculate pKₐ. Assume the size of A⁻ is 450 pm.

7. Calculate the pH of a solution made by mixing 50.0 mL of 0.100 M NaCN with
   a) 4.20 mL of 0.438 M HClO₄
   b) 11.82 mL of 0.438 M HClO₄
   c) What is the pH at the equivalence point in the titration of this solution with 0.438 M HClO₄?

8. Explain the origin of the rule of thumb that indicator color changes occur at pKₐ,ln ± 1.

9. What color do you expect to observe for cresol purple indicator at pH values of 1.0, 2.0 and 3.0?
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10. Would the indicator bromocresol green, with a pH transition range of 3.8 - 5.4, ever be useful in a titration of a weak acid with a strong base? Explain.

11. a) What is the pH at the equivalence point when 0.0300 M NaF is titrated with 0.0600 M HClO₄?
   
   b) Why would an indicator color change end point probably not be useful in this titration?

12. Give the name and formula of a primary standard used to standardize (a) HCl and (b) NaOH.

13. How many grams of potassium hydrogen phthalate should be weighed into a flask to standardize ~0.050 M NaOH if you wish to use about 30 mL of base for the titration?

Solutions for Acid-Base Titrations Exercises