

Weak Acid, Strong Base Titration Lab

Teacher notes

Purpose to illustrate the equivalence point and end point of a Brønsted Lowry reaction using both indicators and pH probe

Materials Weak acid (unknown concentration) Acetic Acid
Strong base (1.0 mol/L) Barium hydroxide
Burettes
Pipettes
Beakers, stir rods, Erlenmeyer flasks

Prelab:

1. Use $\text{Ba}(\text{OH})_2$. Calculate the mass of the strong base necessary to make 100 mL of 1.00 mol/L hydroxide solution. Be sure to write a dissociation reaction or you will be tricked!!



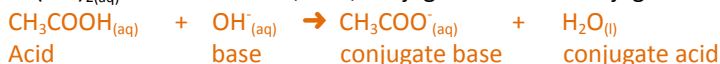
$$N = \frac{1}{2} \times 0.100 \text{ L} \times 1.00 \text{ mol/L}$$

$$m = 0.050 \text{ mol} \times 171.35 \text{ g/mol}$$

$$N = 0.050 \text{ mol Ba}(\text{OH})_2$$

$$m = 8.57 \text{ g}$$

2. Write the Brønsted Lowry reaction for the titration of a 10.0 mL sample of $\text{CH}_3\text{COOH}_{(aq)}$ with sufficient $\text{Ba}(\text{OH})_{2(aq)}$. Label the base, acid, conjugate acid and conjugate base.



- The base used in this lab is monobasic
 - The acid used in this lab is diprotic
 - The expected graph will start at a low number. The graph will have one bump, and will end at a high number.
3. Choose an indicator you wish to use for this lab _____
 4. Give the color before _____ and after _____ the equivalence point.
 5. What will the expected pH be at the equivalence point?
Higher than 7 Because the products are a weak base and water. The weak base will have a pH somewhat higher than 7
 6. When the base becomes the excess reagent, what new colour will you see? _____

Procedure:

1. Using correct procedure, make 100 mL of 1.0 mol/L $\text{Ba}(\text{OH})_{2(aq)}$ solution.
If your chemistry 30 students are not proficient at making solutions you will need to give more directions here.
2. Using correct rinsing procedure, pipette 10 mL the unknown acid into the flask
If your chemistry 30 students are not proficient with pipettes you may need to demonstrate what you want.
3. Add the appropriate indicator. Record the color _____

4. Rinse and fill the burette with the base. |
If your chemistry 30 students are not proficient with pipettes you may need to demonstrate what you want.
5. Slowly titrate the acid solution until the end point is reached. Record the color. _____
6. Keep this sample as a reference point and repeat the steps again.
7. During a minimum of one trial, use the pH probe and record the pH after each addition of titrant. (Take the solution past the equivalence point to see how the pH scale reacts to the excess reagent)
Make sure that you have demonstrated how to use a pH probe. It will need to be calibrated.
8. Using a pH probe, take the pH of a sample of the unknown acid. Record. _____

Analysis:

1. Use the information gathered in the lab to calculate the concentration of the acid.
Make the acid concentration close to that of the base. This will help to limit the amount of titrant that will be used. 0.75 mol/L to 1.50 mol/L would be a good ballpark
2. Using the concentration of the acid, calculate the pH of the acid. Compare this to the pH measured using the pH probe. Account for any similarities or differences in the two values. Remember that CH_3COOH is a weak acid. You will need to use the K_a for the acid.
Use the equilibrium equation below:

	CH_3COOH	$+$	H_2O	$\leftrightarrow$	CH_3COO^-	$+$	H_3O^+	
Initial	use calculated value				0		0	
Reacted	x				x		x	
Equilibrium	(calculated – x)				x		x	

$$K_a = 1.8 \times 10^{-5}$$

$$K_a = \frac{[\text{CH}_3\text{COO}^-][\text{H}_3\text{O}^+]}{[\text{CH}_3\text{COOH}]}$$

Once they have solved for x They need to change this to a pH value
 $\text{pH} = -\log(x)$

3. Plot a titration curve using the observations made with the pH probe. Mark the equivalence point. Compare this value to your prediction in the prelab. Do they agree? Why or why not?

Temperature will play a role in pH here. The values for K_a are based on 298.15 K. Also the water (is it actually at pH = 7 ... distilled water is sometimes not at this pH) may play a role.
 Proper calibration of the pH probe will be significant.

Hopefully the calculations and the measured values will be CLOSE.