

Name _____

AP Chemistry Acid-Base Titration Lab

INTRODUCTION

In this lab you will be titrating both a strong acid (HCl) and then a weak acid (HC₂H₃O₂) with a strong base NaOH while recording the pH. From the collected data a titration curve will be plotted for each acids and differences in the curves noted.

Most substances that are acidic in water are actually weak acids. Because weak acids dissociate only partially in aqueous solution, equilibrium is formed between the acid and its ions. The ionization equilibrium is given by:



Where X⁻ is the conjugate base.

The equilibrium constant is then:

$$K_a = \frac{[\text{H}^+][\text{X}^-]}{[\text{HX}]}$$

The smaller the value for K_a, the weaker the acid. Weaker acids ionize less ([H⁺] is smaller compared to [HX]) and therefore have a less drastic effect on pH.

Strong acids such as HCl ionizes almost completely in water.

For each of the titrations plot the graph of pH versus volume of base added. In each titration curve locate the equivalence point and the half-way point. The equivalence point assumed to correspond to the mid-point of the vertical portion of the curve, where pH is increasing rapidly. The half-way point is assumed to correspond to the mid-point of the horizontal portion of the curve, where pH is changing very little. From the graph read the volume of base need to the reach the end point and half-way point..

There are a number of differences between the titration curves for a strong acid versus the weak acid.

Weak Acid Titration

The weak-acid solution has a higher initial pH.

The pH rises more rapidly at the start, but less rapidly near the end point.

The pH at the equivalence point does not equal 7.00 (pH > 7.00) for the weak acid titration.

Purpose- To construct 2 titration curves. One of a strong acid with a strong bases and the other, a weak acid with a strong base. Also to determine the K_a of the weak acid using the constructed titration curve.

Procedure-

Strong Acid Strong Base Titration-

1. Attach the buret clamp to the ring stand.
2. Obtain a clean, dry 100-mL beaker and label it RXN.
3. Using a 25.00mL volumetric pipet, pipet 25.00mL of 0.1M HCl solution to your 100-mL RXN beaker.
4. In another 100-mL beaker (Label it B), obtain 75-mL of the 0.1M NaOH solution.
5. Rinse the buret with your standard solution two times. (With the stopcock closed add approximately 2-ml of the 0.1M NaOH, using the buret funnel. Swirl the NaOH around the buret and discard into the sink. Repeat.)
6. Using the buret funnel, carefully add the 0.1M NaOH to the buret. Make sure the stopcock is closed. Go about an inch past the top line on the buret, being careful not to let it overflow.
7. With Beaker B under the buret, slowly bring the meniscus to the zero mL line or below
8. Turn on the pH meter and place it into the RXN beaker. Record the pH.
9. Add 2.0-mL of NaOH to the RXN beaker. Swirl the solution and record the new pH.
10. Repeat step 11 until you reach a volume of 20. ml of NaOH.
11. From 20. mL to 30. mL of NaOH measure the pH in 1.0 mL increments.
12. From 30. mL to 50. mL add the NaOH in 2.0 mL increments.
13. Stop the experiment at 50. mL and wash out the RXN beaker. Refill the buret with NaOH for the next titration.

Weak Acid Strong base Titration

1. Using a 25.00mL volumetric pipet, pipet 25.00mL of 0.1M $\text{HC}_2\text{H}_3\text{O}_2$ solution to your 100-mL a new RXN beaker.
2. Refill the buret with the 0.1M NaOH
3. Repeat the previous experiment with the weak acid.

Data and Calculation

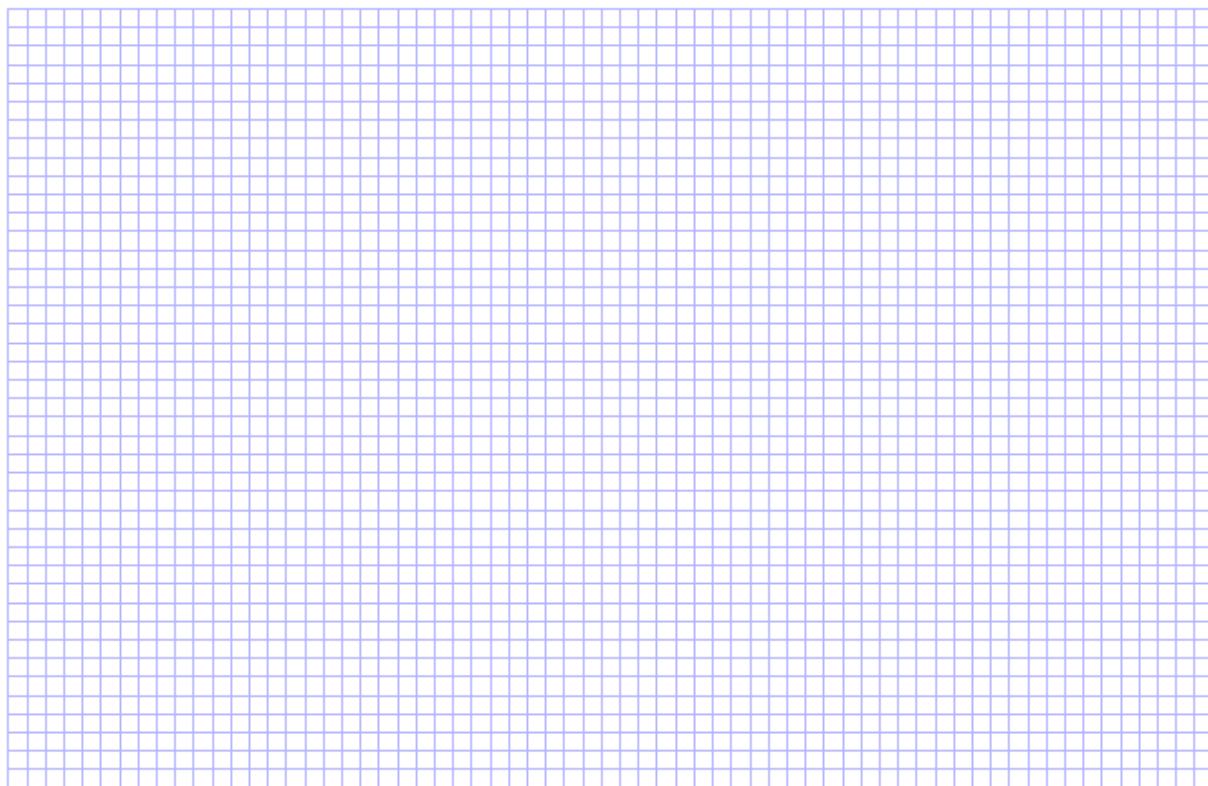
Strong Acid Titration (0.1M HCl)

Vol. 0.1M NaOH (ml)	pH
0	
2	
4	
6	
8	
10	
12	
14	
16	
18	
20	
21	
22	
23	
24	
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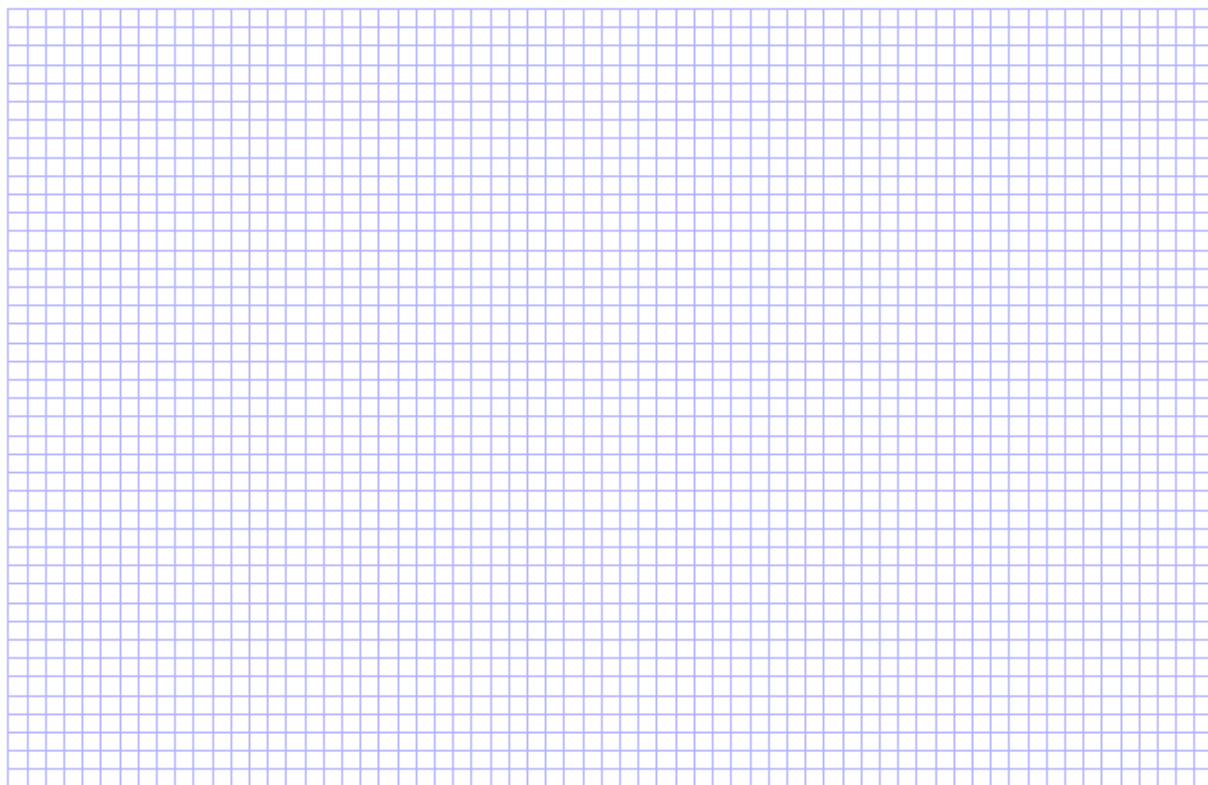
Weak Acid Titration (0.1M HC₂H₃O₂)

Vol. 0.1M NaOH (ml)	pH
0	
2	
4	
6	
8	
10	
12	
14	
16	
18	
20	
21	
22	
23	
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42	
44	
46	
48	
50	

Strong Acid Titration (0.1M HCl)



Weak Acid Titration (0.1M HC₂H₃O₂)



Data Analysis-

Strong Acid Titration

What is the pH of the end point (label the graph)?

How many mL of NaOH were used?

Weak Acid Titration

What is the pH of the end point (label the graph)??

How many mL of NaOH were used?

What is the pH of the half-way point (label the graph)??

How many mL of NaOH were used?

Using the pH of the half-way point, calculate the experimental value of the ionization constant for your weak acid.

Additional Questions-

1. What indicator is could replace the pH meter in determining the equivalence point of the strong acid?

Why?

2. What indicator is could replace the pH meter in determining the equivalence point of the weak acid?

Why?

Conclusion-