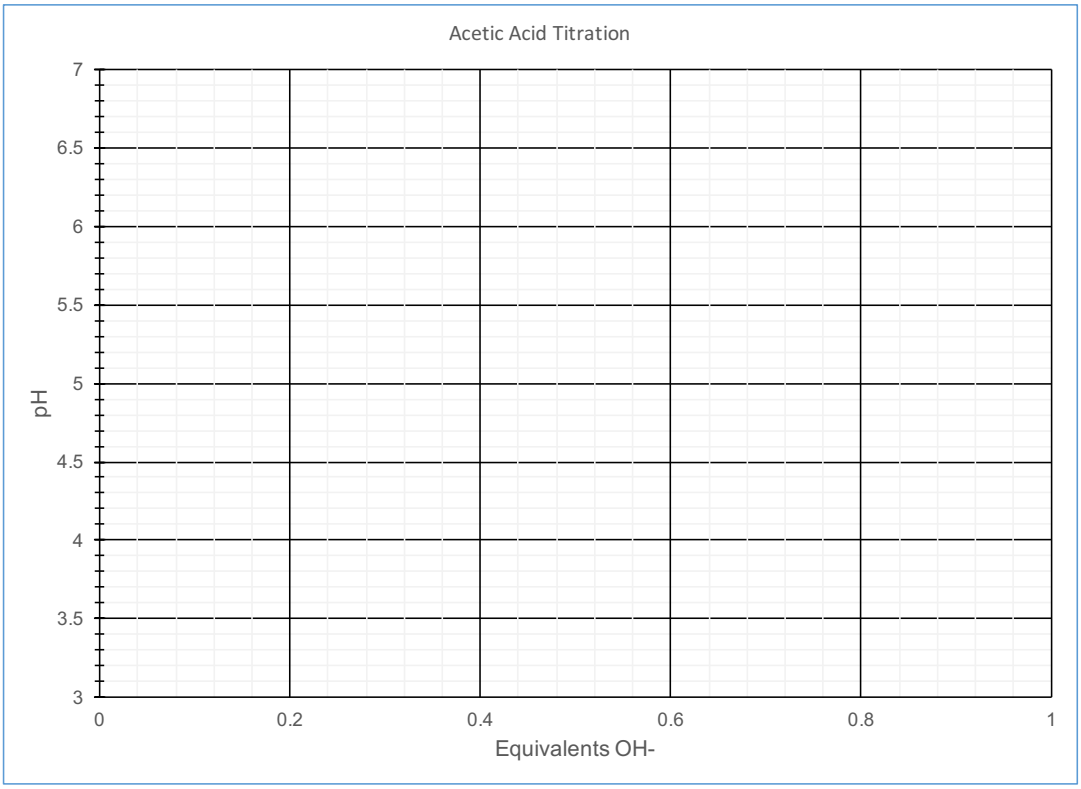
Example Titration Problems

Monoprotic Example

1. Suppose you have a solution of acetic acid (CH_3COOH) with a pKa of 4.75 in its completely protonated form. Complete the following table.

Equivalents OH^- Added	[A-]/[HA]	log ([A-]/[HA])	pH
0.10			
0.20			
0.30			
0.40			
0.50			
0.60			
0.70			
0.80			
0.90			

2. Using the data from the above table complete the titration curve on the next page for acetic acid.
3. Which form dominates in solution at a pH of 3? Draw its structure.
4. Which form dominates in solution at a pH of 6? Draw its structure.

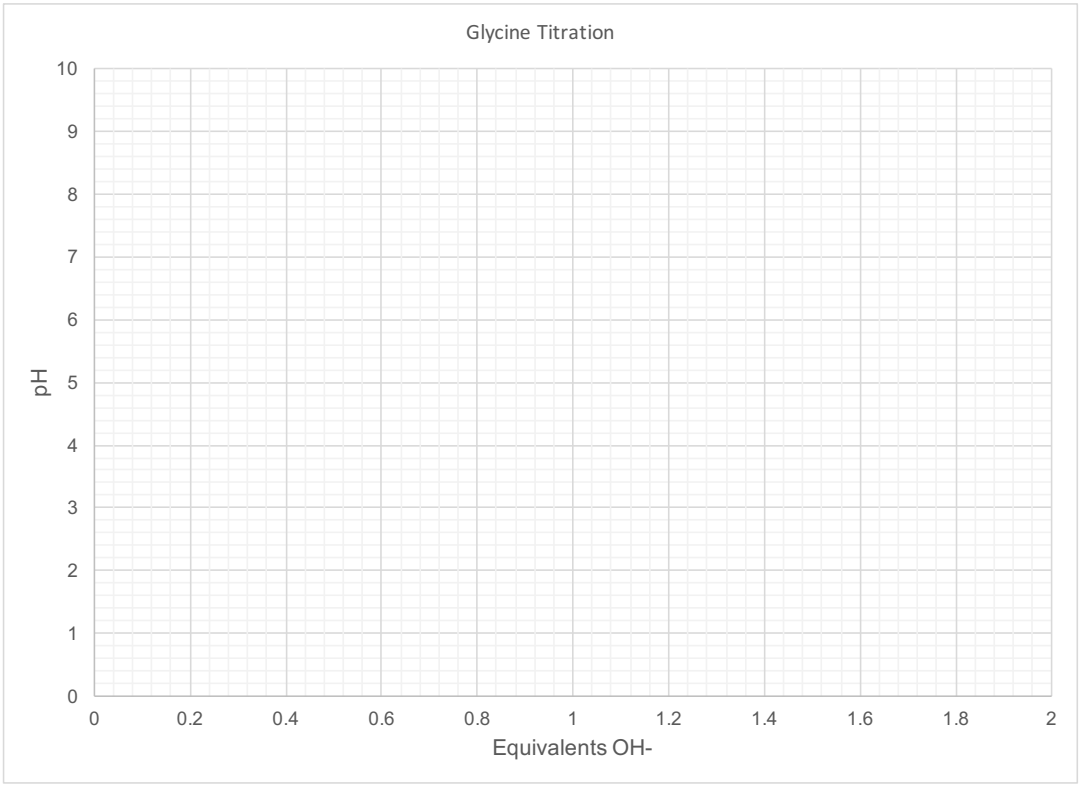

Acetic Acid Titration
pH
7
6.5
6
5.5
5
4.5
4
3.5
3
0
0.2
0.4
0.6
0.8
1
Equivalents OH-

Diprotic Example-Glycine Titration

1. Suppose you have a solution of glycine in its completely protonated form. Glycine has a pKa of 3 for the terminal carboxyl group and a pKa of 8.0 for the terminal amino group. Complete the following table.

Equivalents OH^- Added	[A-]/[HA]	log ([A-]/[HA])	pH
0.10			
0.20			
0.30			
0.40			
0.50			
0.60			
0.70			
0.80			
0.90			
1.30			
1.40			
1.50			
1.60			
1.70			
1.80			
1.90			

2. Using the data from the above table complete the titration curve on the next page for glycine.
3. Which form dominates in solution at a pH of 2? Draw its structure. What is formal charge on the molecule?
4. Which form dominates in solution at a pH of 6? Draw its structure.
5. Which forms dominates in solution at a pH of 10? Draw its structure. What is the formal charge on the molecule?


Glycine Titration
pH
Equivalents OH-
0
1
2
3
4
5
6
7
8
9
10
0
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2

Triprotic Example-Glutamate Titration

1. Suppose you have a solution of glutamate in its completely protonated form. Glutamate has a pKa of 3 for the terminal carboxyl group, pKa of 4.1 for the side chain, and a pKa of 8.0 for the terminal amino group. Complete the following table.

Equivalents OH^- Added	[A-]/[HA]	log ([A-]/[HA])	pH
0.10			
0.20			
0.30			
0.40			
0.50			
0.60			
0.70			
0.80			
1.30			
1.40			
1.50			
1.60			
1.70			
1.80			
1.90			
2.30			
2.40			
2.50			
2.60			
2.70			
2.80			
2.90			

1. Using the data from the above table, complete the titration curve for glutamate.
2. Which form dominates in solution at a pH of 2? Draw its structure. What is formal charge on the molecule?
3. Which form dominates in solution at a pH of 6? Draw its structure. What is formal charge on the molecule?
4. Which forms dominates in solution at a pH of 10? Draw its structure. What is the formal charge on the molecule?