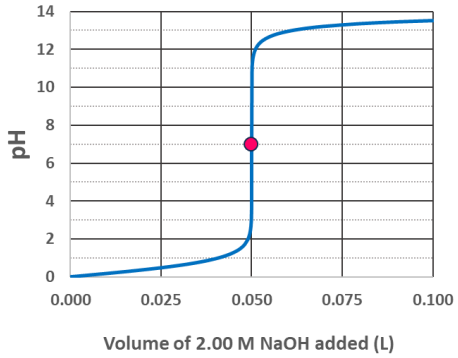
Titration Curve Analysis

Example One

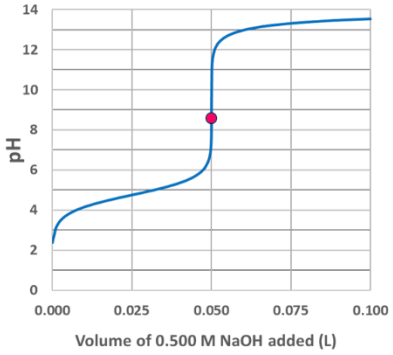
A 75.0 mL sample of a monoprotic acid was titrated with 2.00 M NaOH. The curve for this titration is shown below.



a. Was the acid a strong or weak acid? Justify your answer.
b. What was the concentration of the acid?

Example Two

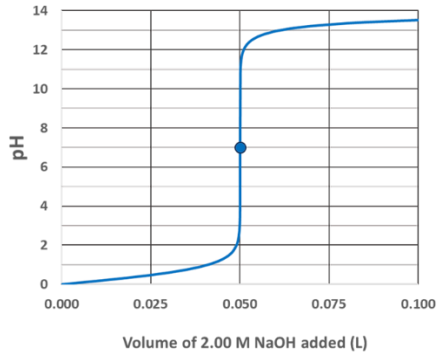
A 1.50 gram sample of a monoprotic acid was titrated with 0.500 M NaOH as shown in the titration curve below.



a. Was the acid a strong or weak acid? Justify your answer.
b. What was the molar mass of the acid?
c. Estimate the pK_a of the acid.

Example Three

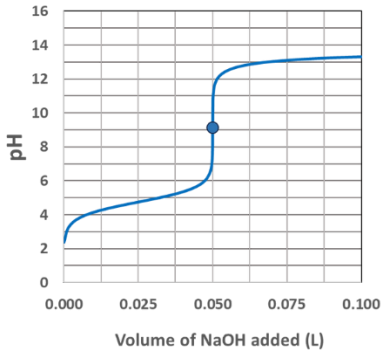
A 100.0 mL sample of 1.00 M HCl was titrated with 2.00 M NaOH. The curve for this titration is shown below.



How would the titration curve change if the titration had been performed using 1.00 M NaOH instead?

Example Four

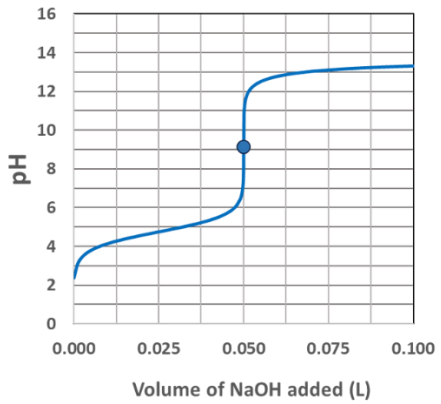
A 25.0 mL sample of 1.00 M $HC_2H_3O_2$ was titrated with 0.500 M NaOH. The curve for this titration is shown below. The Ka for $HC_2H_3O_2$ is 1.8×10^{-5}.



How would the titration curve change if the titration had been performed using 1.00 M NaOH instead of 0.500 M NaOH?

Example Five

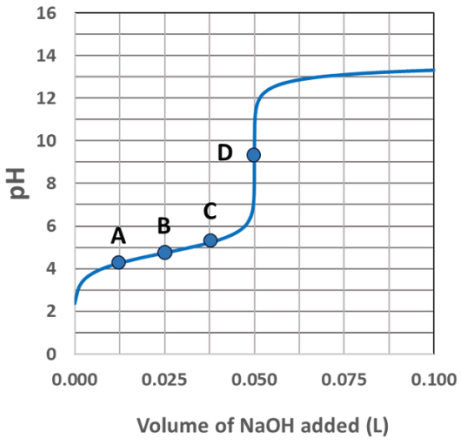
A 25.0 mL sample of 1.00 M $HC_2H_3O_2$ was titrated with 0.500 M NaOH. The curve for this titration is shown below. The Ka for $HC_2H_3O_2$ is 1.8×10^{-5}.

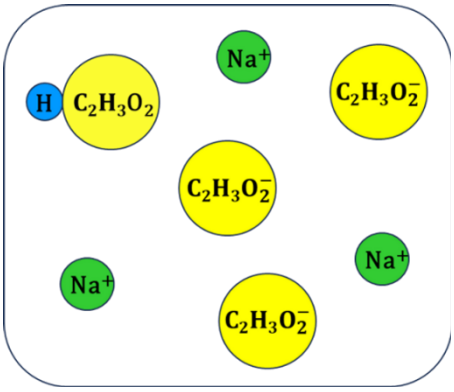


How would the titration curve change if the titration had been performed using 1.00 M HF instead of 1.00 M $HC_2H_3O_2$? The K_a for HF is 6.8×10^{-4}.

Example Six

A 50.0 mL sample of 0.500 M $HC_2H_3O_2$ was titrated with 0.500 M NaOH. The curve for this titration is shown below. The K_a for $HC_2H_3O_2$ is 1.8×10^{-5}.



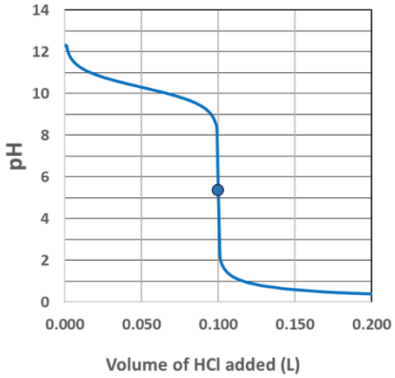


At a particular point in the titration, the contents of the titration mixture were analyzed. The diagram represents the relative amounts of the major chemical species present at this point.

Determine what point on the graph is represented by this mixture. Justify your choice.

Example Seven

A 50.0 mL sample of a base was titrated with 1.00 M HCl as shown in the titration curve below.

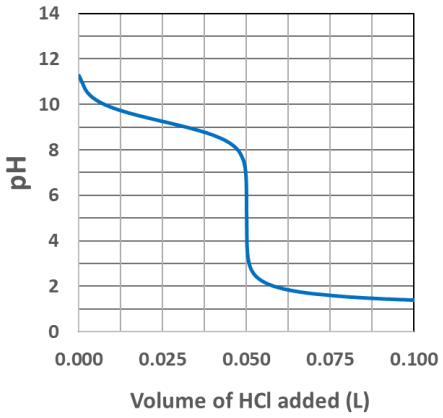


a. Was the base a strong or weak base? Justify your answer.
b. What was the concentration of the base?
c. Estimate the K_b of the base.
d. Which of the following indicators is the best choice for this titration:

Phenolphthalein ..... $K_a = 3.2 \times 10^{-10}$
Methyl red ..... $K_a = 1.0 \times 10^{-5}$
Brilliant Green ..... $K_a = 3.1 \times 10^{-2}$

Example Eight

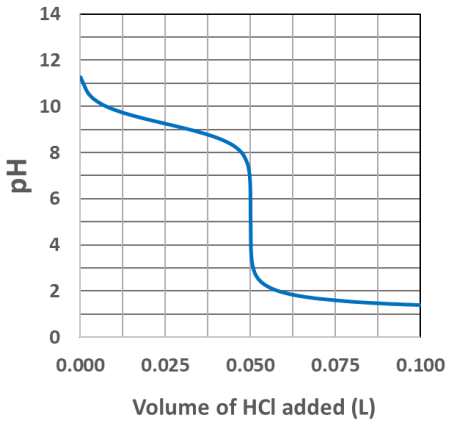
A 25.0 mL sample of a NH_3 was titrated in a flask with 0.100 M HCl as shown in the titration curve below.
The K_b for NH_3 is 1.8×10^{-5}.



What was the concentration of the NH_3?

Example Nine

A 25.0 mL sample of a NH_3 was titrated in a flask with 0.100 M HCl as shown in the titration curve below.
The K_b for NH_3 is 1.8×10^{-5}.



a. At a pH of 9.5 was there a greater concentration of NH_3 or its conjugate acid NH_4^+ in the flask?
b. Sketch the curve that would result if 25.0 mL of 0.200 M weak base hydrazine had been used instead of NH_3. The Kb for hydrazine is Kb $= 3.0 \times 10^{-6}$.