10. Open your virtual Lab Book and copy and paste your volume (of NaOH) and pH data into Excel (or a similar program) for later use, then clean up your lab bench and exit the lab room.

LAB 6 REPORT **STUDENT: *YOUR NAME HERE***

Part A. Determination of K_a from pH

Q1. What is the pH of acetic acid in the beaker? pH =
2.88

Q2. What is the concentration of acetic acid listed on its bottle? [HAc] =
0.1031 M

Q3. pH readings from "pH 4" and "pH 10" buffer solutions: 4.00 ; 10.00

Q4. *(1 pt)* Use the pH recorded in Q1 to determine the molar concentration of H^+; show your work:

$[H^+] = 10^{-pH} = 10^{-2.88} = 1.32 \times 10^{-3}\ M$

Q5. *(2 pt)* Determine the K_a of acetic acid using your experimental data:

$K_a = \frac{[H^+][A^-]}{[HA]} = \frac{[H^+]^2}{[HAc]} = \frac{(1.32 \times 10^{-3})^2}{0.1031} = 1.69 \times 10^{-5}$

Q6. *(1 pt)* What was the point of measuring the "pH 4" and "pH 10" solutions? Do your pH readings lend any confidence to the data collected in the experiment? Explain.

To verify that the pH probe is accurate. Since the pH probe read 4 and 10 for the corresponding solutions, we can be confident that our data is accurate

Part B. Titration of a Weak Acid

Q7. Complete the following table with your HAc with NaOH data:

	Volume of HAc	Molarity of HAc	Molarity of NaOH
Titration 1	25.0 mL	0.1894 M	0.2006 M
Titration 2	25.0 mL	0.1894 M	0.2006 M

Q8. *(2 pt)* Use Excel, Google Sheets or a similar program to create a titration curve for your second, accurate titration, where your graph must also include a 1st derivative plot overlaid atop the titration curve. Add a blank page to the end of this lab report, then paste your graph onto that page. *A screenshot of your Beyond Labz titration curve will not count for credit.*

Q9. *(1 pt)* Explain how the 1st derivative plot can help to pinpoint the equivalence point of a titration:

The 1st derivative will reach a max peak where the titration curve has the steepest slope/@ equivalence point.

Q10. *(1 pt)* When performing a titration, why is it helpful to begin by performing a "rough", quick titration as you did in your first titration?

The rough titration helps to show approximately where the equivalence point will be so the whole base doesn't have to be added drop by drop, only around the equivalence point.

Q11. *(1 pt)* Explain why phenolphthalein was chosen as the indicator in this titration:

phenolphthalein was chosen because it changes color around when the solution reached its equivalence point (~8.5)

Q12. Complete the following table for your second, accurate titration ("Trial 2"):

Volume NaOH at equivalence pt	pH at equivalence point	Volume NaOH at midpoint	pH at midpoint
23.51 mL	8.52	11.76 mL	4.66

Q13. *(1 pt)* Use your data to determine the K_a of acetic acid, showing your work below:

@ $\frac{1}{2}$ Eq Point, $K_a = [H^+] = 10^{-pH}$ $pH = 4.66$

$\therefore K_a = 10^{-4.66} = 2.188 \times 10^{-5}$

Q14. *(2 pt)* When performing a different titration, your classmate can't quite pinpoint their equivalence point, but estimates it as 23.00 mL of NaOH. Had your classmate been more deliberate in their titrating, however, they would have seen that their equivalence point was actually reached slightly *before* 23.00 mL. How will this inaccurate data affect your classmate's determination of K_a?

Since the Eq point is less, the $\frac{1}{2}$ Eq Point will be less also, resulting in a lower pH used to find $[H^+]$. If lower pH is used then their Ka will be higher than actual

Q15. *(1 pt)* If the literature value of K_a for acetic acid is 1.8×10^{-5}, compare your K_a determined in Part A (using pH) and your K_a determined in Part B (titration) and explain which method produced the more accurate result:

A) 1.69×10^{-5}

B) 2.188×10^{-5}

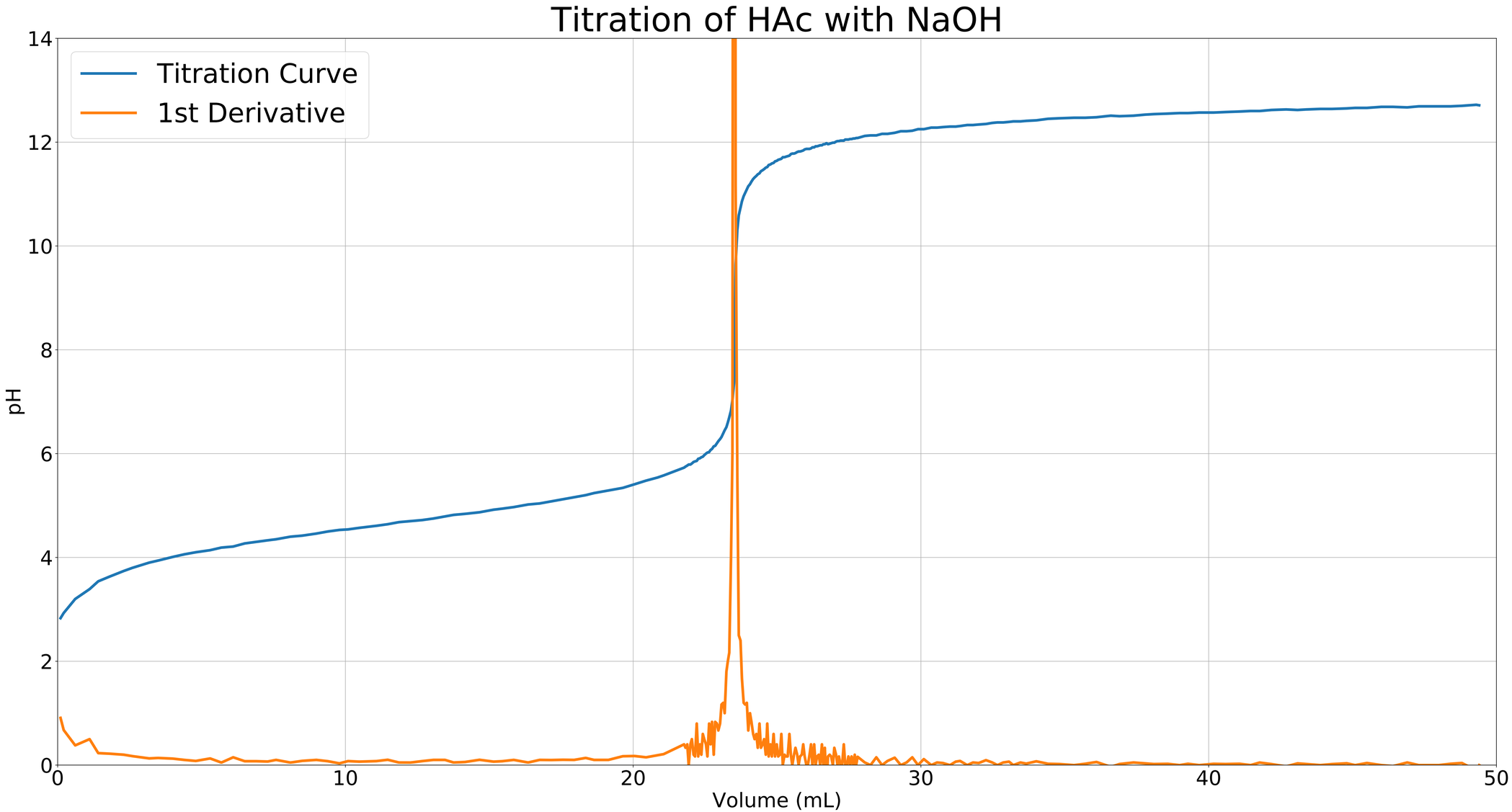
Part A was more accurate because we used the definition of Ka and exact values to calculate it

Q16. *(1 pt)* Write the net ionic equation for the reaction of sodium hydroxide and acetic acid; use the full chemical formula of the acid, not the "HAc" abbreviation:

$CH_3COOH_{(aq)} + OH^-_{(aq)} \rightleftharpoons C_2H_3O_2^-{}_{(aq)} + H_2O_{(l)}$

Q17. *(1 pt)* Calculate the moles of acetic acid in your second trial, then use the volume of HAc to calculate the molarity of acid. Does your answer agree with the molarity written on the bottle of acid in the lab room?

$0.1894 \frac{Mol}{L} \times 0.025\,L = 4.7 \times 10^{-3}$ mol


Titration of HAc with NaOH
Titration Curve
1st Derivative
pH
Volume (mL)
0
2
4
6
8
10
12
14
0
10
20
30
40
50