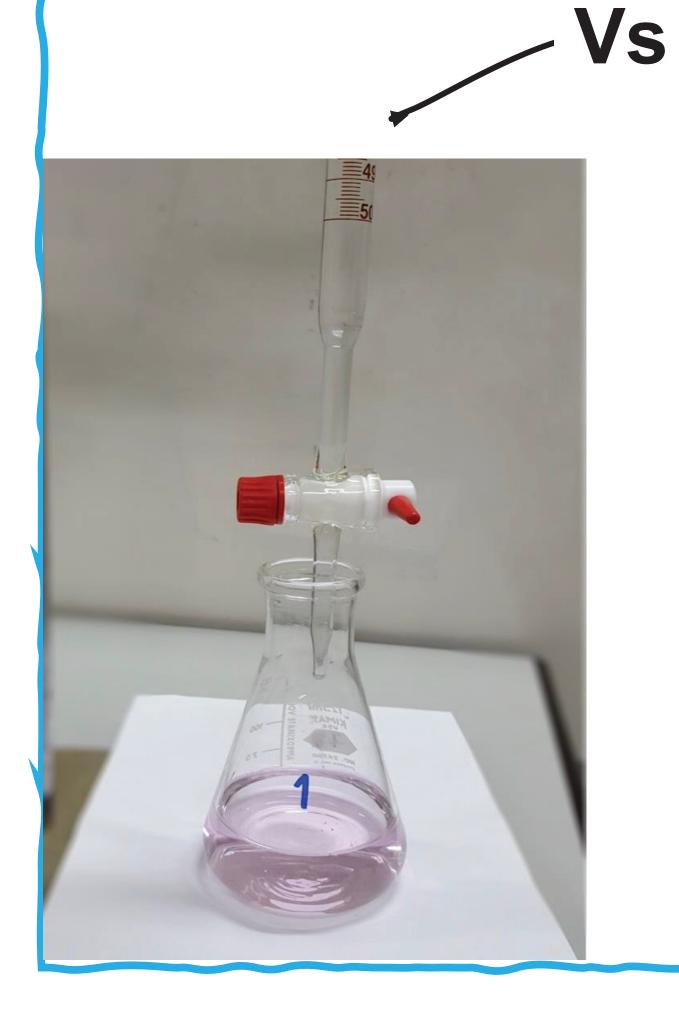
# **Exploring a pink-free alternative to the traditional titration!** Asmaa Akbar, Abdulrahman kaki, Dr.Yibai Chen Department of Chemistry, Penn State Abington University

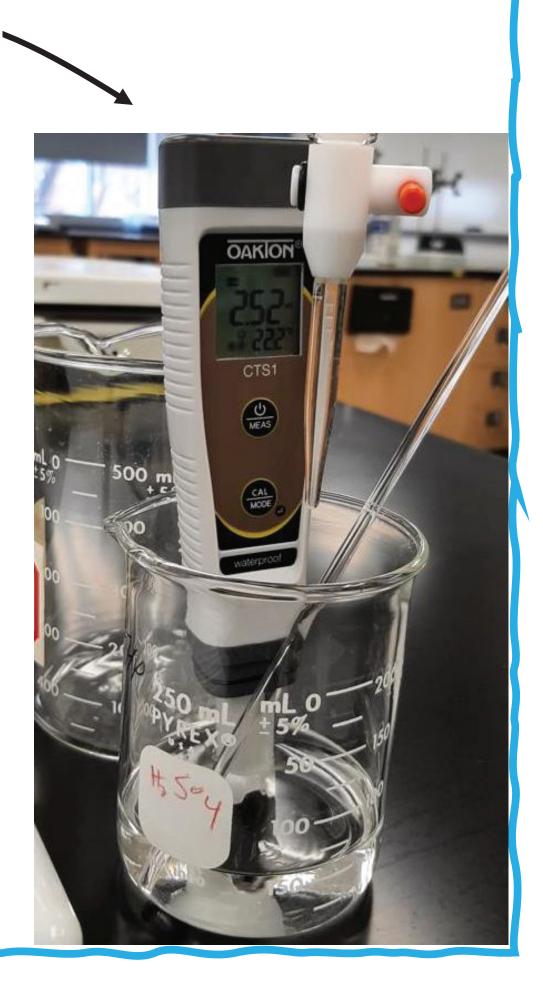
#### Introduction

Often a good way to understand chemistry concepts is through doing experiments in the laboratory. Determining the concentration of a solution is important skill/knowledge learned in chemistry. In this project, we will compare two analytical techniques for determining the concentration of a solution; traditional titration that uses an indicator vs a method that employs a digital conductivity probe (using 3 unknowns). But what is titration exactly? Titration: is a chemical technique used in the lab to determine the concentration of a solution. As a chemistry student we always seek experiments that is accurate, simple, and plant the concept deep in our minds.



### **Research Questions.**

We seek to answer two questions: 1) Do students learn the associated concepts better through a conventional technique or through a new technique that employs a digital probe?. 2) Do students get more accurate results with the new detection method, which has fewer opportunities for making measurement mistakes compared to the conventional titration method?



### Methods (1,2,3)

<sup>A</sup>Our experiment target is to determine the percentage of KHP in 3 different unknown solutions with different KHP percentages.

The method of the traditional titration is accomplished by delivering the titrant into the unknown  $\Xi_{6}$ solution that contains two drops of the indicator, until we see the pink color, where the pink color will appear at the equivalence point.

The conductivity method is accomplished by delivering increments of 1mL of the titrant and recorded the corresponding conductivity for each mL added; then we plot a graph of the conductivity Vs the volume of NaOH.

The point of intersection of the two straight lines will be the equivalence point as shown in the plot.

#### Data

ntal resu trial 2 7 0.100 58.1 51.8	trial 3 0.0974 58.6 52.3	average 0.0984 58.6	using a STD 0.001 0.5	cid-base ind measurement 0.098±0.001 58.6±0.5	icator company standard 59.55	percent error						
7 0.100 . 58.1	0.0974 58.6	0.0984 58.6	0.001	0.098±0.001								
58.1	58.6	58.6										
			0.5	58.6±0.5	50 55							
51.8	52.3				55.55	2						
		51.8	1	51.8±0.5	52.72	2						
36.0	44.1	39.6	4	40±4	35.73	11						
Experimental results from titration using EcoTestr CTS1 Pocket Tester												
1 trial 2	trial 3	average	STD	measurement	company standard	percent error						
39 0.0959	0.0975	0.0974	0.002	0.0974±0.002								
5 59.9	59.5	59.7	0.2	59.7±0.2	59.55	0						
2 54.2	53.6	53.7	0.5	53.7±0.5	52.72	2						
2 38.7	35.1	37.3	2	37±2	35.73	4						
8 8	results fi   1 trial 2   89 0.0959   6 59.9   2 54.2	results from titrat   1 trial 2 trial 3   89 0.0959 0.0975   6 59.9 59.5   2 54.2 53.6	I results from titration usin   1 trial 2 trial 3 average   89 0.0959 0.0975 0.0974   6 59.9 59.5 59.7   2 54.2 53.6 53.7	I results from titration using EcoT     1   trial 2   trial 3   average   STD     89   0.0959   0.0975   0.0974   0.002     6   59.9   59.5   59.7   0.2     2   54.2   53.6   53.7   0.5	I results from titration using EcoTestr CTS1 Po     1   trial 2   trial 3   average   STD   measurement     89   0.0959   0.0975   0.0974   0.002   0.0974 ±0.002     6   59.9   59.5   59.7   0.2   59.7 ±0.2     2   54.2   53.6   53.7   0.5   53.7 ±0.5	I results from titration using EcoTestr CTS1 Pocket Tester     1   trial 2   trial 3   average   STD   measurement   company standard     89   0.0959   0.0975   0.0974   0.002   0.0974 ±0.002   -     6   59.9   59.5   59.7   0.2   59.7 ±0.2   59.55     2   54.2   53.6   53.7   0.5   53.7 ±0.5   52.72						

Experimental results from titration using acid-base indicator												
trial 1	trial 2	trial 3	average	STD	measurement	company standard	percent error					
0.0977	0.100	0.0974	0.0984	0.001	$0.098 \pm 0.001$							
59.1	58.1	58.6	58.6	0.5	58.6±0.5	59.55	2					
51.3	51.8	52.3	51.8	1	51.8±0.5	52.72	2					
38.7	36.0	44.1	39.6	4	40±4	35.73	11					
Experimental results from titration using EcoTestr CTS1 Pocket Tester												
trial 1	trial 2	trial 3	average	STD	measurement	company standard	percent error					
0.0989	0.0959	0.0975	0.0974	0.002	0.0974±0.002							
59.6	59.9	59.5	59.7	0.2	59.7±0.2	59.55	0					
53.2	54.2	53.6	53.7	0.5	53.7±0.5	52.72	2					
38.2	38.7	35.1	37.3	2	37±2	35.73	4					
	trial 1 0.0977 59.1 51.3 38.7 ental re trial 1 0.0989 59.6 59.6	trial 1 trial 2   0.0977 0.100   59.1 58.1   51.3 51.8   38.7 36.0   trial 1 trial 2   0.0989 0.0959   59.6 59.9   59.2 54.2	trial 1 trial 2 trial 3   0.0977 0.100 0.0974   59.1 58.1 58.6   51.3 51.8 52.3   38.7 36.0 44.1   trial 1 trial 2 trial 3   0.0989 0.0959 0.0975   59.6 59.9 59.5   53.2 54.2 53.6	trial 1 trial 2 trial 3 average   0.0977 0.100 0.0974 0.0984   59.1 58.1 58.6 58.6   51.3 51.8 52.3 51.8   38.7 36.0 44.1 39.6   ental results from titration usin   trial 1 trial 2 trial 3 average   0.0989 0.0959 0.0975 0.0974   59.6 59.9 59.5 59.7   53.2 54.2 53.6 53.7	trial 1 trial 2 trial 3 average STD   0.0977 0.100 0.0974 0.0984 0.001   59.1 58.1 58.6 58.6 0.5   51.3 51.8 52.3 51.8 1   38.7 36.0 44.1 39.6 4   ental results from titration using EcoT   trial 1 trial 2 trial 3 average STD   0.0989 0.0959 0.0975 0.0974 0.002   59.6 59.9 59.5 59.7 0.2   53.2 54.2 53.6 53.7 0.5	trial 1   trial 2   trial 3   average   STD   measurement     0.0977   0.100   0.0974   0.0984   0.001   0.098±0.001     59.1   58.1   58.6   58.6   0.5   58.6±0.5     51.3   51.8   52.3   51.8   1   51.8±0.5     38.7   36.0   44.1   39.6   4   40±4     ental results from titration using EcoTestr CTS1 Potestr CTS1 Pot	trial 1   trial 2   trial 3   average   STD   measurement   company standard     0.0977   0.100   0.0974   0.0984   0.001   0.098±0.001   -     59.1   58.1   58.6   58.6   0.5   58.6±0.5   59.55     51.3   51.8   52.3   51.8   1   51.8±0.5   52.72     38.7   36.0   44.1   39.6   4   40±4   35.73     ental results from titration using EcoTestr CTS1 Pocket Tester     trial 1   trial 2   trial 3   average   STD   measurement   company standard     0.0989   0.0959   0.0975   0.0974   0.002   0.0974±0.002   -     59.6   59.9   59.5   59.7   0.2   59.7±0.2   59.55     53.2   54.2   53.6   53.7   0.5   53.7±0.5   52.72					

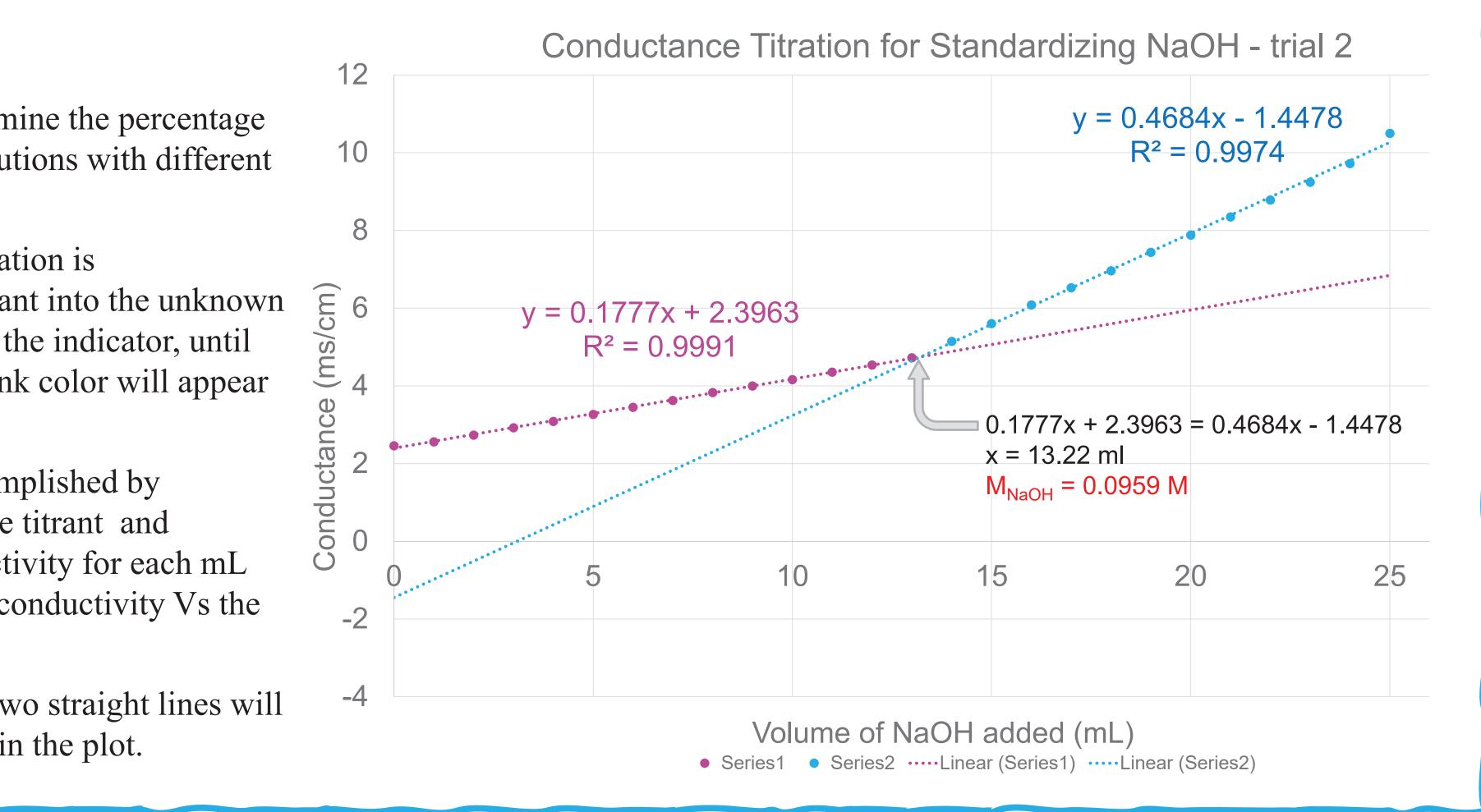
## Method comparison

Advantages of the traditional method: Somewhat faster than the conductivity test.

cheaper.

A results are immediately available.

- Advantages of the conductivity method:
- △ doesn't require any indicator, which if forgotten will destroy the whole experiment.
- Image: More accurate than the conventional method because it doesn't involve any human judgment. Let this method can be used by color blind people.



### **Discussion & Conclusion**

- gave a more accurate results, (lower percentage error).
- methos.
- method to use is dependent on your situation.

### Literature cited

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- 3) K. Christopher Smith,\* Etinosa Edionwe, and Bayyinah Michel; Conductimetric Titrations: A Predict-Observe-Explain Activity for General Chemistry. J. Chem. Educ. 2010, 87, 1217-1221.

Acknowledgments

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For all the unknowns (#533, #538, and #525), the conductivity method

For the last unknown #538 we got somewhat higher percentage error compared to the previous unknowns. This is a consequence of the low percentage of KHP. Absorption of moisture by the non-KHP part of the sample will lead to an inaccurate weight. However, the percentage error of the conductivity method remains lower than the traditional titration

Students expressed no preference with respect to learning the concepts. The conductivity method is a more advanced method, in which concept is well embodied. The conventional method is a more of a basic method that you have to understand first. Ultimately, the choice of which

**Conductometric Titration: An Undergraduate Laboratory** 

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