Chemistry 12
ACID BASE LAB
Standardizing a solution of NaOH and using it to
Determine the Molar Mass of an unknown Solid Acid

Objectives:

1. Use a prepared primary solution of 0.0500 M oxalic acid to standardize (and determine the concentration) of an unknown sodium hydroxide solution.
2. To use the standardized solution of sodium hydroxide to determine the molar mass of an unknown monoprotic weak acid.

Procedure: (re-write these in flow chart form)

PART I: STANDARDIZING A SOLUTION OF UNKNOWN CONCENTRATION OF NAOH

1. Obtain a 500mL Volumetric flask (with a lid) and dispense approximately 250 mL of unknown concentration NaOH and stopper it with a blue lid. Label it with your group member names and class.
2. Into a small (100 mL) beaker dispense approximately 50 mL of the 0.0500 M Oxalic Acid Solution
3. Fill a 50.00 mL buret with some of the dispensed NaOH (using a funnel)
4. Using a suction bulb and a 10.0 mL pipet, suction up exactly 10.0 mL into a clean and dry 125 mL Erlenmeyer Flask.
5. Add 3 drops of phenolphthalein into 10.0 mL of Oxalic acid
6. Read and record (to the exact value) the initial volume of NaOH in the buret. Slowly run the NaOH into the oxalic acid solution, swirling constantly to ensure thorough mixing.
7. When a faint colour of pink lingers for approximately 20 s record the final volume of NaOH.
8. Discard the pink solution down the sink with lots of water
9. Repeat the above procedure until you have two readings that agree within 0.10 mL of each other (this might require multiple trials. If you are nearing the 50.0 mL mark on the buret be sure to refill it with NaOH before you begin another trial.)
10. Use the information in your data to calculate the concentration of the NaOH, you will need this concentration for Part II.

PART II: MOLAR MASS DETERMINATION OF MONOPROTIC WEAK ACID:

1. Obtain a vial containing an unknown solid acid. Record the identifying letter in the data table.
2. Weigh out about 0.75 g of the solid into a clean, dry 125 mL Erlenmeyer flask and record the mass accurately in your data table (the mass does not have to be exactly 0.75 g, as long as you record the mass you actually have).

3. Dissolve the acid with approximately 50.0 mL of DISTILLED WATER and add 3 drops of phenolphthalein to this solution.
4. Using the standardized NaOH from Part I, fill a 50.0 mL burette, recording the volume required to reach the equivalence point (be sure the solution is light pink when you stop) in your data table.
5. Repeat steps 2 through 4 until you have THREE readings that are in close agreement.

Data and Observations:

PART I: Standardizing a Solution of Unknown Concentration of NaOH
(using 10.0 mL of 0.0500 M oxalic acid)

	Trial 1	Trial 2	Trial 3	Trial 4
Initial Volume of NaOH	mL	mL	mL	mL
Final Volume of NaOH	mL	mL	mL	mL
Volume used of NaOH	mL	mL	mL	mL
Average volume used:				mL

Show how you calculated the average volume of NaOH used:

PART II: MOLAR MASS DETERMINATION OF **MONOPROTIC** WEAK ACID:

Concentration for your Standardized solution of [NaOH] = _____
Letter for "unknown" acid _____

	Trial 1	Trial 2	Trial 3	Trial 4
Mass of acid	g	g	g	g
Average mass used:				g
Initial Volume of NaOH	mL	mL	mL	mL
Final Volume of NaOH	mL	mL	mL	mL
Volume used of NaOH	mL	mL	mL	mL
Average volume used:				mL

Show how you calculated the average volume of NaOH used:

Show how you calculated the average mass of acid used:

Analysis:

PART I: Standardizing a Solution of Unknown Concentration of NaOH

1. Write out the balanced chemical reaction between Oxalic Acid Dihydrate and NaOH
2. Calculate the number or moles of Oxalic Acid present in solution
3. Show how you cross the mole-den gate bridge to calculate the number of moles of NaOH required
4. Using the average of the two values within 0.10 mL of NaOH, calculate the unknown concentration of NaOH

PART II: MOLAR MASS DETERMINATION OF **MONOPROTIC** WEAK ACID:

1. Write out the balanced chemical reaction between an unknown monoprotic weak acid and NaOH
2. Using the average volume, calculate the number of moles of NaOH used
3. Calculate the number of moles of unknown acid neutralized by this amount of NaOH (IMPT: please note that the acid is **MONOPROTIC**)
4. Calculate the molar mass of the unknown monoprotic acid
   Molar Mass = average mass of a substance (g)/ average number of moles

Discussion:

1. Every day, a manufacturing plant produces 5.0 x 10^3 L of 0.030 M NaOH waste. In order to comply with environmental regulations, this NaOH must be neutralized before being discharged as effluent. What mass of 12M HCl will be required to neutralize it? (Density of HCl = 1.2 kg/L)

2. The acids used in this experiment included:

ACID NAME	FORMULA
Ascorbic Acid	$H_8C_6O_6$
Boric Acid	H_3BO_3
Benzoic acid	$H_6C_7O_2$
Fumaric Acid	$H_4C_4O_4$
Nicotinic Acid	$H_5C_6NO_2$
Acetic Acid	$H_4C_2O_2$
Sodium Bisulphate monohydrate	$NaHSO_4 \cdot H_2O$
Propanoic Acid	$H_6C_3O_2$

Use the above chemical formulas to **calculate the molar mass** of each of these acids, **then identify your acid accordingly**.

Sources of Error:

List the pieces of equipment and include their appropriate source of error

Conclusion:

This is an QUANITATIVE lab! Do not forget to include a connection to everyday life and cite your source!

ANSWER KEY TO LAB 20 G

No.	ACID NAME	FORMULA	Molecular Mass (g)
1	Citric acid monohydrate	$H_8C_6O_7 \cdot H_2O$	210.14
2.	Fumaric Acid	$H_4C_4O_4$	116.07
3.	Tartaric Acid	$H_6C_4O_6$	150.09
4.	Ascorbic Acid	$H_8C_6O_6$	176.12
5.	Sodium Bisulphate monohydrate	$NaHSO_4 \cdot H_2O$	138.08
6.	Boric Acid	H_3BO_3	61.83
7.	Salicylic Acid	$H_6C_7O_3$	138.12
8.	Nicotinic Acid	$H_5C_6NO_2$	123.11
9.	Oxalic Acid	$H_2C_2O_4$	90.04
10.	Citric acid monohydrate	$H_8C_6O_7 \cdot H_2O$	210.14
11.	Fumaric Acid	$H_4C_4O_4$	116.07
12.	Tartaric Acid	$H_6C_4O_6$	150.09
13.	Ascorbic Acid	$H_8C_6O_6$	176.12
14.	Sodium Bisulphate monohydrate	$NaHSO_4 \cdot H_2O$	138.08
15.	Boric Acid	H_3BO_3	61.83
16.	Salicylic Acid	$H_6C_7O_3$	138.12
17.	Nicotinic Acid	$H_5C_6NO_2$	123.11
18.	Oxalic Acid	$H_2C_2O_4$	90.04

ACID NAME	FORMULA	Molar mass	No.
Ascorbic Acid	$H_8C_6O_6$	176.0	4 +13
Boric Acid	H_3BO_3	61.8	6 + 15
Citric acid monohydrate	$H_8C_6O_7 \cdot H_2O$	210.0	1 + 10
Fumaric Acid	$H_4C_4O_4$	116.0	2 + 11
Nicotinic Acid	$H_5C_6NO_2$	123.0	8 + 17
Salicylic Acid	$H_6C_7O_3$	138.0	7 + 16
Sodium Bisulphate monohydrate	$NaHSO_4 \cdot H_2O$	138.1	5 + 14
Tartaric Acid	$H_6C_4O_6$	150.0	3 + 12