Titration Calculations – How to Standardize NaOH using KHP

This formula is used to solve all Titration Calculations:

$$\textbf{Molarity}_1 * \textbf{Volume}_1 = \textbf{Molarity}_2 * \textbf{Volume}_2 = \frac{g_2}{Mw_2} = \textbf{Number of Moles}$$

$\mathbf{M_1V_1 = M_2V_2}$ is used when you are titrating one liquid against another such as NaOH solution vs vinegar.

$\mathbf{M_1V_1 = g / Mw}$ is used when you are titrating one liquid against a solid such as NaOH vs Potassium Hydrogen Phthalate (KHP) for standardizing the NaOH

Example 1: To standardize NaOH [which is a base], you titrate it against KHP [which is an acid].

You put the KHP [the acid] and phenolphthalein [the indicator] in an Erlenmeyer flask and titrate it against NaOH in the burette.

Problem 1: Determine how much KHP to weigh out?

Assume you have a NaOH solution of approximately **0.25 M,** you need to determine the exact concentration. You do this by titrating the NaOH against the KHP. KHP is an acid and a standard.

Assume you are using a 50.00 ml burette. You want to use about 35.00 ml of the NaOH solution in the titration. Your using 35 ml, because you do not want to use over 50 ml where you would need to refill the burette, this would add error into your calculations. You do not want to use more than 35-40 ml in your original calculations. From the above equation, we can derive:

Grams of KHP = Molarity of the NaOH * Volume of NaOH * Mw of the KHP.

Assume the NaOH was made up to be approximately 0.25 [0.23 -> 0.27] Molar. Then

Grams of KHP = 0.25 Molar * 35.00 ml * 1. L / 1000. ml * 204.44 g/mole

Grams of KHP = about 1.8 grams of KHP.

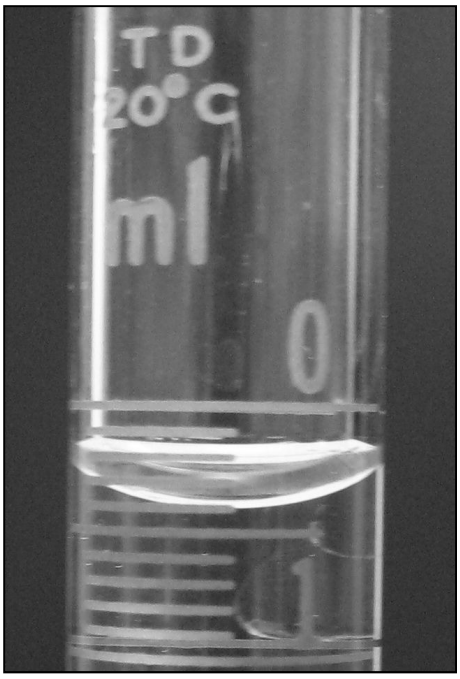
So, we accurately weigh out approximately 1.8 g +/- 0.1g of KHP. Put this in a 250 ml Erlenmeyer flask and add about 50 ml of distilled water. Warm [Not Boil] the solution until the KHP dissolves, then cool it back to room temperature. Add a few drops of the phenolphthalein indicator to the flask. Rinse the burette, using a funnel to fill it, several times with a few ml of the NaOH solution to season the burette. Then fill it with the NaOH solution to a level between 0.00 and 1.00 ml. You do not have to fill it exactly. Remove the funnel and allow the NaOH to finish dripping down. Take a reading on the burette remember you must read it to the second decimal. Examples: 0.50 ml and not 0.5 ml. Start your titration, continue to swirl the Erlenmeyer flask. The titration is complete when ½ to one drop turns the color of the solution from clear to light pink. Take a reading on the burette again. Subtract the starting reading and this is now the volume of NaOH used in the titration.

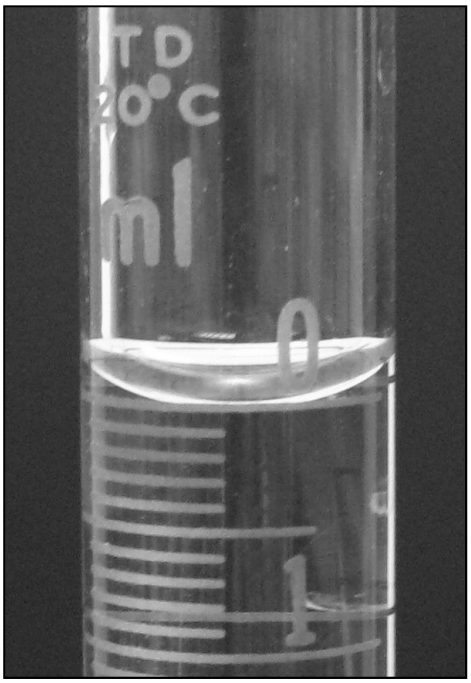
Calculate the Molarity of the NaOH by: $\text{Molarity}_1 = \frac{g_2}{\text{Molecular Weight}_2 * \text{Volume}_1}$.

Where g_2 = grams of KHP, $\text{Molecular Weight}_2$ = Mw of KPH, Volume_1 = volume of NaOH in liters.

Reading a Burette

Burettes are calibrated with the ZERO reading at the top, and the FIFTY ml reading at the bottom. Yes, they are meant to be this way!





Reading the Burette: Burette reading involves reading all of the marked lines [ml and tenths of an ml] and interpreting the reading between two lines for the 0.01 ml reading.

The correct reading for the burette on the left is:	0.40 ml	0.4 is incorrect
The correct reading for the burette on the right is:	0.00 ml	0, 0. or 0.0 is incorrect.

Using the Burette:

1. Fill the Burette close to the zero reading. If you use a funnel to fill the burette, remember to remove the funnel prior to reading the burette. Leaving it could add an additional drop after you've read the burette. You do not have to fill the burette to zero.

2. Take a start burette reading. ALL READINGS are to TWO places after the decimal:

Correct Readings:	1.23	0.12	0.00	10.00 [ml]
Incorrect Readings:	1.2	0.1	0.	10.

3. Perform your titration.

4. Take the second reading. See the note above about reading to two places after the decimal.

5. Subtract the first reading from the second and you have the volume used in the titration.

6. Then refill the burette.