

**Biology and Biochemistry Department**

**CHEM234**

**Sec 1**

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**Title**

**Standardization of NaOH and determination of total acidity as KHP**

The objectives of this lab in this experiment are to standardize the sodium hydroxide solution and then use the standard sodium hydroxide solution to find out the percentage of KHP in an unknown sample. After the NaOH solution is standardized to the main standard, potassium hydrogen phthalate, which by this will determine the total acidity of an unknown sample. A neutralization reaction, in which an acid and a base combine to generate a salt and water, is one type of titration. Acid-base titration was done using the volumetric technique. The following is the primary reaction that occurred in our experiment:

1. KHC8H4O4 (aq) + NaOH (aq)  KNaC8H4O4 (aq) + H2O

2. HCl + NaOH NaCl + H2O

3. HIn(aq) + H2O(l) ↔ H3O(aq) + In- (aq) **\*** The indicator's acid-base (Phenolphthalein) form is HIn. Adding OH- causes a color change by removing the H3O+ and shifting the equilibrium to the right. So the color changes from colorless to pink at the end and this is called the end point.
The molarity of NaOH solution is 0.1220 ± 0.0027 mol/L, and the % KHP in the unknown sample is (80.34 ± 2.4452) %, according to the 95% confidence interval.

* **Data table\_1:** Standardization of a NaOH solution with standard potassium hydrogen phthalate (KHP)

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Trial 1** | **Trial 2** | **Trial 3** |
| **Mass of KHP (g)** | 0.800 g | 0.800 g | 0.800 g |
| **Initial buret reading (mL)** | 1.000 ml | 1.000 ml | 1.000 ml |
| **Final buret reading (mL)** | 33.00 mL | 33.60 mL | 32.90 mL |
| **Volume of NaOH used (mL)** | 32.00 ml | 32.60 mL | 31.90 mL |
| **Volume of NaOH used (L)** | 0.0320 L | 0.0326 L | 0.0319 L |
| **Moles of KHP** | 3.9173\*10-3mol | 3.9173\*10-3mol | 3.9173\*10-3mol |
| **Moles of NaOH** | 3.9173\*10-3mol | 3.9173\*10-3mol | 3.9173\*10-3mol |
| **Molarity of NaOH** | 0.1224 M | 0.1201 M | 0.1230 M |
| **Average Molarity of NaOH** | 0.1218 M |
| **Standard deviation in the NaOH molarity** | 1.0828 \* 10-3 |
| **95 % confidence interval** | 0.1220 ± 0.0027 |

* **Data table\_2:** determination total acidity as (KHP) in an unknown sample.

|  |  |  |  |
| --- | --- | --- | --- |
| **Unknown number: 78** | **Trial 1** | **Trial 2** | **Trial 3** |
| **Mass of unknown (g)**  | 1.000 g | 1.000 g | 1.000 g |
| **Initial buret reading (mL)**  | 0.000 ml | 0.000 ml | 0.000 ml |
| **Final buret reading (mL)**  | 31.80 ml | 32.20 ml | 32.90 ml |
| **Volume of NaOH used (mL)**  | 31.80 ml | 32.20 ml | 32.90 ml |
| **Volume of NaOH used (L)**  | 0.0318 L | 0.0322 L | 0.0329 L |
| **Molarity of NaOH (M)**  | 0.1218 M | 0.1218 M | 0.1218 M |
| **Moles of NaOH** | 3.8732 \* 10-3 mol | 3.9219 \* 10-3 mol | 4.0072 \* 10-3 mol |
| **Moles of KHP**  | 3.8732 \* 10-3 mol | 3.9219 \* 10-3 mol | 4.0072 \* 10-3 mol |
| **Mass of KHP (g)** | 0.7909 g | 0.8009 g | 0.8183 g |
| **% mass of KHP in unknown 78** | 79.09 % | 80.09 % | 81.84 % |
| **Average % mass of KHP in unknown** | 80.34 % |
| **Standard deviation in the % mass of KHP** | 0.9843 |
| **95 % confidence interval** | 80.34 ± 2.4452 |

* **Calculations: Trial\_1 /table\_1 (KNOWN):**
1. **Moles of KHP
=** mass of KHP / molar mass of KHP
=0.800 g **/** 204.22g/mole = 3.9173 \*10-3moles
2. **Volume of NaOH
 =** final buret reading (ml) – initial buret reading (ml)= 33.00ml – 1.000 mL = 32.00 mL
3. **Volume of NaOH used (L) =** 32.00/1000= 0.0320 L
4. **Moles of NaOH = moles of KHP** = 3.9173 \* 10-3moles
5. **Molarity of NaOH
=** moles of solute / liters of solution= 3.917344 \*10-3 / 0.032 L = 0.1224 M
6. **Average Molarity of NaOH
=** (molarity of trial 1) +(molarity of trial 2) + (molarity of trial 3)/3
= ((0.1224 + 0.1201 + 0.1230) / (3)) = 0.1218 M
7. **Standard deviation in the NaOH Molarity**
(s) =$\frac{\sqrt{\sum\_{}^{}(xi-x(mean))2}}{n-1}$

$ =\frac{\sqrt{\left(0.1224-0.1218\right)^{2}}+\left(0.1201-0.1218\right)^{2}+\left(0.1230-0.1218\right)^{2}}{3-1}=$

$$1.0828\*10^{-3}$$

1. **Q test & Q table:**
 **- Q testfor trial 3**

= |suspension value – nearest neighbor value| / range
= | 0.1230 – 0.1224| / (0.1230 - 0.1201)

= 0.2069
- The susp value isn’t outlier because the Q table > Q test
- **The Q table** confidence level of 95% & n = 3 = **0.97**0

1. **95 % confidence interval(**$ μ)=x\frac{\pm ts}{\sqrt{n}}$
= 0.1220 ± ((4.303 \* 1.0828 \* 10-3) / $\sqrt{3}$
= 0.1220 ± 0.0027
* **Calculations: Trial\_1 /table\_2 (UNKNOWN)**
1. **Volume of NaOH
=** final buret reading (ml) – initial buret reading (ml)= 31.80 – 0.000 = 31.80 mL
2. **Volume of NaOH used (L) =** 31.80/1000= 0.0318 L
3. **The average molarity of NaOH is the molarity computed in a known sample =** 0.1220 M
4. **Moles of NaOH =** M\*V = 0.1218 \* 0.0318 = 3.8732 \* 10-3 moles
5. **Moles of NaOH = moles of KHP** = 3.8732 \* 10-3 moles
6. **Mass of KHP
=** moles \* molar mass **=** 3.8732 \* 10-3 \* 204.22 = 0.7909 g
7. **% mass of KHP in unknown 78** = ((mass of KHP/mass of unknown) \* (100%))
= ((0.7909/1.000) \* (100%)) = 79.09 % ~ 79%
8. **Average % mass of KHP in unknown** = m1 + m2 + m3/ 3
= ((79.09 + 80.09 + 81.84 ) / (3))

= 80.34 %

1. **Standard deviation in the % mass of KHP**(s) =$\frac{\sqrt{\sum\_{}^{}(xi-x(mean))2}}{n-1}$

$ =\frac{\sqrt{\left(79.09-80.34\right)^{2}}+\left(80.09-80.34\right)^{2}+\left(81.84-80.34\right)^{2}}{3-1}=$

$$0.9843$$

1. **95 % confidence interval(**$ μ)=x\frac{\pm ts}{\sqrt{n}}$
= 80.34 ± ((4.303 \* 0.9843) / $\sqrt{3}$
= 80.34 ± 2.4452
2. **Q testfor trial 3**

= |suspension value – nearest neighbor value| / range
= | 81.84 – 80.09| / (81.84 – 79.34)

= 0.7
- The susp value isn’t outlier because the Q table > Q test
- **The Q table** confidence level of 95% & n = 3 = **0.97**0

* **Discussion:**

In the table\_1 the average molarity of NaOH of 3 trial = 0.1218 M, and the Standard deviation in the NaOH molarity = 1.0828 \* 10-3

In table\_2 shows that no rejected samples were produced using the 95 percent Q-Test that we used on our results in table\_2 of evaluating the unknown sample. As a result, the mean of the three trials' percentages of KHP (primary standard) is ((79.09 + 80.09 + 81.84) / (3)) = 80.34 percent, with a standard deviation in the % mass of 0.9843 percent.

The Q test shows whether the values are far from each other or close \* and if the value is more than 0.970 (Q table), this means that the value is outlier and should not be taken and if the value is less than 0.970 we take the value because it is true. however, my result was 0.2069 in the known value while unknown my value was 0.700. The both values are less than 0.970, so they are both true.

The indicator phenolphthalein was used, which, when the solution reaches the end point of titration, the color of the solution in the flask becomes pink.

The final result of 95% **confidence interval** for unknown = 80.34 ± 2.4452

The final result of 95% **confidence interval** for known = 0.1220 ± 0.0027, the average 0.1247 to 0.1193.

There are many methodological errors that exist, and one of these common errors is that when the solution is poured into buret in the presence of a glass funnel, it isn’t removed during titration after the required solution has been poured causing an increase in the error rate, because it may be contaminated or otherwise, and it is possible that The buret is contaminated and reading through the buret may be inaccurate. One common error is bubbles in the buret. Finally, these errors should be avoided by paying attention that when filling the burette with the solution, we remove the glass funnel in order to take the reading correctly and that we wash the buret properly.

**Conclusion:**

Titration is a popular method used in analytical laboratories as it determines concentration and volume.