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**Department of Mathametical and Phycal Scienecs**

**East West University, Dhaka, Bangladesh.**

**Course Instructor: Md. Nazmul Abedin khan Student name: B M Shahria Alam**

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**Experiment-3: Standardization of a strong base (NaOH) with a standard weak acid, potassium hydrogen phthalate (KHP)**

**Theory:**

Potassium hydrogen phthalate (KHP) is a monophonic acidic salt (monopotassium salt of phthalic acid, weak acid) with the formula, KHC 8 H 4 O 4 . It is often used as a primary standard for acid-base titrations because it is solid and air-stable, making it easy to weigh accurately and not hygroscopic. KHP dissociates completely in water, giving the potassium cation (K + ) and hydrogen phthalate anion (HP – or Hphthalate −).

**Equation:**

And then as a weak acid hydrogen phthalate reacts reversibly with water to give hydronium (H 3 O + ) and phthalate ions.

HP − + H 2 O ⇌ P 2− + H 3 O +

As KHP is monophonic, 1 mol of NaOH reacts with 1 mol of KHP according to the following equation:

NaOH (aq) + KHC 8 H 4 O 4(aq) KNaC 8 H 4 O 4(aq) + H 2 O (l) …………..(1)

Or, NaOH (aq) + KHP (aq) KNaP (aq) + H 2 O (l)

Therefore, the concentration of standardized NaOH can be determined from reaction (1):

(M NaOH ×V NaOH ) = (M KHP × V KHP )…………..… (2)

Where,

Mb = Molarity of NaOH

Va = Volume of KHP

Vb = Volume of NaOH

Ma = Molarity of KHP

**Data:**

|  |  |
| --- | --- |
| Volume of NaOH, ml | pH of acid |
| 0 | 2.76 |
| 0.1 | 3.5 |
| 0.2 | 3.8 |
| 0.3 | 3.98 |
| 0.4 | 4.11 |
| 0.5 | 4.22 |
| 0.6 | 4.31 |
| 0.7 | 4.38 |
| 0.8 | 4.45 |
| 0.9 | 4.51 |
| 1 | 4.57 |
| 1.1 | 4.62 |
| 1.2 | 4.66 |
| 1.3 | 4.71 |
| 1.4 | 4.75 |
| 1.5 | 4.79 |
| 1.6 | 4.83 |
| 1.7 | 4.87 |
| 1.8 | 4.91 |
| 1.9 | 4.95 |
| 2 | 4.98 |
| 2.1 | 5.02 |
| 2.2 | 5.05 |
| 2.3 | 5.08 |
| 2.4 | 5.12 |
| 2.5 | 5.15 |
| 2.6 | 5.18 |
| 2.7 | 5.21 |
| 2.8 | 5.25 |
| 2.9 | 5.28 |
| 3 | 5.31 |
| 3.1 | 5.35 |
| 3.2 | 5.38 |
| 3.3 | 5.42 |
| 3.4 | 5.45 |
| 3.5 | 5.49 |
| 3.6 | 5.53 |
| 3.7 | 5.56 |
| 3.8 | 5.6 |
| 3.9 | 5.64 |
| 4 | 5.69 |
| 4.1 | 5.73 |
| 4.2 | 5.78 |
| 4.3 | 5.83 |
| 4.4 | 5.89 |
| 4.5 | 5.95 |
| 4.6 | 6.02 |
| 4.7 | 6.1 |
| 4.8 | 6.19 |
| 4.9 | 6.29 |
| 5 | 6.43 |
| 5.1 | 6.62 |
| 5.2 | 6.94 |
| 5.3 | 10.57 |
| 5.4 | 11.8 |
| 5.5 | 12.09 |
| 5.6 | 12.26 |
| 5.7 | 12.38 |
| 5.8 | 12.47 |

|  |  |
| --- | --- |
| Va x Ma = Vb x Mb |  |
|  |  |
| **Va, Volume of KHP** | **10 ml** |
| **Ma, Molarity of KHP** | **0.5 M** |
| **Vb, Volume of NaOH** | **5.3 ml** |
| **Mb, Molarity of NaOH** | **??** |
|  |  |
| **Mb=Va\*Ma/Vb** | **0.94 M** |

|  |
| --- |
| **Percentage of error:** |
| Error = |
| = [(1-0.94)/1]\*100% |
| = 6% |

