EXPERIMENT E1

Chemistry of the Kitchen - Acids and Bases

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Section 5

Group 4

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**Objectives**

* Using a homemade indicator solution to classify household chemicals as acids or bases.
* Understand Ph scale.
* Examine the difference between strong and weak acids.
* Titrate vinegar to determine the concentration of acid.

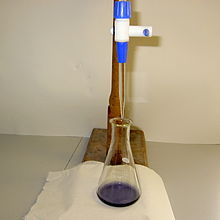
**Background**

* **Properties of Acids and Bases**

Acids and bases characterized by their sour and bitter taste in 17th century. Now we distinguish them through their difference in the amount of H3O+ or OH- produced per mole of substance dissolved. They are electrolytes whose strength depending on their dissociation into ions in water. Strong electrolyte such as strong acids dissociate completely while weak electrolytes dissociate partially.

* **The pH Scale**

In aqueous solutions, [H3O+] can vary over an enormous range: from about 10 M to 10-15 M. To handle the number conveniently, we convert the negative exponents to positive numbers by using p-scale.

* **Titration**

The concentration of an acid can also be determined experimentally by an acid-base titration. In a titration, we drop some acid-base indicator such as litmus to the flask containing the acidic solution until the indicator changes its color permanently. Then we can calculate the unknown ***[H3O+]*** by knowing the stoichiometry of the acid and the amount of base used

**Introduction**

Many common chemicals used in our home are acids and bases such as lemon juice and vinegar. Acids and bases are essential in our everyday life. They both share an ability to turn certain organic compounds. In the experiment, we will use some methods to test the acidity of them.

**Theory**

* **Behavior of Acids and Bases in Water**

Strong acid: 𝑯𝑨 (𝒈 𝒐𝒓 𝒍) + 𝑯𝟐𝑶(𝒍) → 𝑯𝟑𝑶+(𝒂𝒒) + 𝑨+(𝒂𝒒)

In an aqueous solution of a strong acid, virtually no HA molecules are present.

At equilibrium, the ***[H3O+] =[A-] =[HA]initial*** and the ***[HA]equilibrium= 0***. Then the equilibrium constant for strong acid is essentially very large (***Ka[H3O+] [A-]/0***, very large). The situation is different in the case of a weak acid.

Weak acid: ***HA (g or l) + H2O (Ɩ) ⇌H3O+ (aq) + A- (aq)***

Thus, ***[H3O+] <<[HA]initial and [HA]equilibrium<[HA]initial*** because the amount of acid dissociated is insignificant compared to initial concentration. The percentage of acid that is dissociated can be quantified in terms of the acid dissociation constant, ***Ka***, At equilibrium: ***Ka*** =***[H3O+] [A-]/[HA]***

* **The pH Calculation**

***pH =- log [H3O+ ]***

In the case of a strong acid, we can assume that the concentration of ***[H3O+]*** is equal to the concentration of the acid and we simply use the equation. For weak acids, Ph can be calculated just from knowing the Ka and the initial concentrations of the weak acid.

**Analysis**

The tables of data calculation is on the PLQ page.

**Part A:**

|  |  |  |
| --- | --- | --- |
| Solution | milk | ammonia |
| pH | 6 | 9 |

The pH of my milk is about 6, which means milk is weak acid

The pH of example ammonia is about 9 so it’s weak base.

**Part B:**

The Average CNaOH is 0.0989 mol/L, which is a bit smaller than the value 0.1 mol/L on the label of the used NaOH bottle.

**Part C:**

The Average total volume of NaOH titrated is 25.4 ml and the concentration of NaOH is 0.1 mol/L, so the % by mass of acetic acid in vinegar is 0.6096 g/100mol, which is a little bigger than the 0.6 g/100mol value on the bottle of vinegar.

**Discussion**

When we used Metter balance and freshly washed Erlenmeyer flasks to weigh the KHP, I incautiously left some water in the Erlenmeyer, which may cause some error in the weight of the KHP.

In addition, I put the small bottle containing the KHP on the table, which is not allowed. However, I don’t know why it’s forbidden and what the consequence of it

**Conclusion & Recommendations**

The experiment is aim at introducing students some concepts of pH scale, acids, bases and electrolytes. Through Part A, I acquired acid-base property of daily chemical products. Through Part B, I learned how to use Metter balance to weigh KHP and calculate the concentration of NaOH solution through titration. Through Part C, we combine theory with life together, we calculated the % by mass of acetic acid in vinegar by titrating NaOH solution to it.

The workload before the experiment is too much because it always takes us many hours to handwrite the procedure. Additionally, I hope instructors will be nicer and politer in the after experiments.

**References**

Prof. T. Hamade,” 8E1 CHEM OF KITCH ACID BASE”, UM-SJTU JI & SJTU Chemistry Department