**CHEM101 Report for Laboratory Exercise #2**

**Moles, Concentration, Acid-Base Reactions and Quantitative Analysis by Titration1**

*Using Microsoft Word, students are to insert responses in all yellow highlighted areas. It is recommended that the report be completed without changing font size, column width, row width, margins and highlights. The completed report must be uploaded to the 101 Brightspace site as a .pdf file by the due date posted on Brightspace. All answers must be the student’s own work without assistance from others. Only reports which are completed using the template will be marked.*

**Name:** \_\_Arfaz Hossain\_\_\_ **Lab Section:** \_B2\_ **Quad:** \_2\_**Date:** \_\_May 30, 2024\_\_\_

**Abstract**

The weight % of acetic acid (CH3COOH) in a sample of vinegar was determined by titration to be \_0.96%\_ using a standardized solution of sodium hydroxide (NaOH).

**Data/Results**

**Table 1.** Experimental data and calculated values of moles, concentrations for the standardization of NaOH and analysis of CH3COOH in vinegar2

|  |  |  |  |
| --- | --- | --- | --- |
| **Standardization of NaOH** | Sample 1 | Sample 2 | Sample 3 |
| KHP (g) | 0.502 | 0.507 | 0.501 |
| Moles KHP (mol) | 2.46 x 10-3 | 2.48 x 10-3 | 2.45 x 10-3 |
| NaOH vol (mL) | 12.9 | 12.2 | 12.2 |
| [NaOH] (\_\_mol/L or, M\_\_) | 0.191 | 0.203 | 0.201 |
| Average [NaOH] (M) | 0.198 | | |
| %RSD for [NaOH] | 3.469% | | |
| **Analysis of vinegar sample (5.00 mL)** | | | |
| NaOH vol (mL) | 20.6 | 21.1 | 20.8 |
| Moles NaOH (mol) | 4.12 x 10-3 | 4.22 x 10-3 | 4.16 x 10-3 |
| Weight CH3COOH (g) | 0.247 | 0.253 | 0.250 |
| Weight % CH3COOH | 0.956% | 0.961% | 0.958% |
| Average weight CH3COOH (g) | 0.250 | | |
| %RSD for weight % CH3COOH | 0.233% | | |

**Algebraic Equations**

*Do not provide calculations or numeric values, provide only the proper algebraic equations and the abbreviation definitions required. See page 12 of the lab manual for further information.*

1) Number of moles of KHP, and abbreviation definitions:

n*KHP* = \_ mass*KHP* / MW*KHP* \_

nKHP = mole KHP

\_\_ mass*KHP* \_\_ = \_\_ Mass of Potassium Hydrogen Phthalate (KHP)\_\_

\_\_ MW*KHP* \_\_ = \_\_ Molecular Weight of KHP \_\_

2) Concentration of NaOH, and abbreviation definitions:

[NaOH] = \_\_n*NaOH* / V*NaOH*\_\_

[NaOH] = concentration of sodium hydroxide

nNaOH = \_\_Number of Moles of NaOH (moles)\_\_

\_\_ V*NaOH* \_\_ = \_\_Volume of NaOH (liter)\_\_

3) Average and standard deviation algebraic equations, and abbreviation definitions:

\_\_ Average (x̄) \_\_ = Σxi / n = x̄ where xi (each individual data point), x̄ (average or mean of the sample) and n (number of data points)

\_\_ Standard deviation (σ) \_\_ = √ [Σ (xi - x̄) ² / n] where, σ (), xi (), x̄ () and n ()

\_\_ Relative standard deviation (RSD) \_\_ = (σ / x̄) \* 100%

\_\_ σ \_\_ = standard deviation

\_\_ xi \_\_ = each individual data point

\_\_ x̄ \_\_ = average or mean of the sample

\_\_ n \_\_ = number of data points

\_\_ Relative standard deviation (RSD) \_\_ = Relative Standard Deviation of The Data Set

4) Number of moles of NaOH added to 5.00 mL vinegar solution and abbreviation definitions:

\_\_ nNaOH \_\_ = [NaOH] x VNaOH

\_\_ [NaOH] \_\_ = Concentration of Sodium Hydroxide (moles/liter)

\_\_ V*NaOH* \_\_ = Volume of Sodium Hydroxide (liter)

5) Weight of CH3COOH in 5.00 mL vinegar solution, and abbreviation definitions:

\_\_ mass*CH3-COOH* \_\_ = n*CH3-COOH* x MW*CH3-COOH*

mass*CH3-COOH* = weight of acetic acid

\_\_ n*CH3-COOH* \_\_ = Moles of Acetic Acid

\_\_ MW*CH3-COOH* \_\_ = Molecular Weight of Acetic Acid

6) Weight % of acetic acid, and abbreviation definitions:

% mAcOOH = \_\_ (mAcOOH / mvinegar) \* 100 \_\_

% mAcOOH = Weight % CH3COOH (Acetic Acid)

\_\_ mAcOOH \_\_ = mass of acetic acid

\_\_ mvinegar \_\_ = mass of vinegar

**Discussion**

A solution of NaOH was standardized by titration with KHP. The concentration of the prepared NaOH solution was determined to be \_\_0.198\_\_ M with a % standard deviation of \_\_3.469%\_\_. This standardized solution of NaOH was used as the titrant to titrate the amount of CH3COOH in a sample of vinegar which was determined to be a weight % of \_\_0.958\_\_ with a % standard deviation of \_\_0.233%\_\_.

The titration ended when the \_pH(phenolphthalein)\_ indicator turned from \_colourless\_ to \_light pink\_.

**Conclusions**

The weight % of CH3COOH in the sample of vinegar was \_\_0.958\_\_% with a relative standard deviation of \_\_0.233%\_\_.

**References**

*See page 12 for the format of references. Note that references 1 and 2 are already cited as superscript numbers in the text of this report.*

1. Reimer, M. et al, *Laboratory Manual, Chemistry 101*, pp. 19-24. (University of Victoria: Victoria, B.C.) **Summer 2024**
2. Vinegar. Edible Chemicals Co., 9876 Running Lane Edmonton AB A1A 1A9, Lot #FH8333

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| --- | --- |
| **Feedback Summary** | max. |
| **Pre-lab quiz:** Are all responses correct? | 4 |
| **Laboratory Notebook:** Have all data, observations and procedures been recorded? | 1 |
| **Report:** Are all sections completed correctly and accurately? | 3 |
| **Participation:** Did the student come prepared, was time used well in lab and was student engaged in the experiment? Did the students request the TA to check their drawers for completeness before they left the lab and show the TA their letter of successful submission? | 1 |
| **Performance evaluation:** Did the student follow the safe practice guidelines throughout the whole lab period? | 1 |
| **Total mark** | 10 |

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