CHEM101 Report for Laboratory Exercise #2
Moles, Concentration, Acid-Base Reactions and Quantitative Analysis by Titration[1]

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 (CH_3COOH) 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 CH_3COOH in vinegar[2]

Standardization of NaOH	Sample 1	Sample 2	Sample 3
KHP (g)	0.502	0.507	0.501
Moles KHP (mol)	2.46×10^{-3}	2.48×10^{-3}	2.45×10^{-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)	4.12×10^{-3}	4.22×10^{-3}	4.16×10^{-3}
Weight CH_3COOH (g)	0.247	0.253	0.250
Weight % CH_3COOH	0.956%	0.961%	0.958%
Average weight CH_3COOH (g)	0.250		
%RSD for weight % CH_3COOH	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:

$n_{KHP} = \_ mass_{KHP} / MW_{KHP} \_$

n_{KHP} = 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

n_{NaOH} = __Number of Moles of NaOH (moles)__

__ V_{NaOH} __ = __Volume of NaOH (liter)__

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

__ Average ($\bar{x}$) __ $= \Sigma x_i / n = \bar{x}$ where xi (each individual data point), $\bar{x}$ (average or mean of the sample) and n (number of data points)

__ Standard deviation (σ) __ $= \sqrt{[\Sigma (x_i - \bar{x})^2 / n]}$ where, σ (), x_i (), $\bar{x}$ () and n ()

__ Relative standard deviation (RSD) __ $= (\sigma / \bar{x}) * 100\%$

__ σ __ = standard deviation

__ x_i __ = each individual data point

__ $\bar{x}$ __ = 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:

__ n_{NaOH} __ = [NaOH] x V_{NaOH}

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

__ V_{NaOH} __ = Volume of Sodium Hydroxide (liter)

5) Weight of CH_3COOH in 5.00 mL vinegar solution, and abbreviation definitions:

__ $mass_{CH3\text{-}COOH}$ __ = $n_{CH3\text{-}COOH}$ x $MW_{CH3\text{-}COOH}$

$mass_{CH3\text{-}COOH}$ = weight of acetic acid
__ $n_{CH3\text{-}COOH}$ __ = Moles of Acetic Acid
__ $MW_{CH3\text{-}COOH}$ __ = Molecular Weight of Acetic Acid

6) Weight % of acetic acid, and abbreviation definitions:
% m_{AcOOH} = __ (m_{AcOOH} / $m_{vinegar}$) * 100 __

% m_{AcOOH} = Weight % CH_3COOH (Acetic Acid)
__ m_{AcOOH} __ = mass of acetic acid
__ $m_{vinegar}$ __ = 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 CH_3COOH 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 CH_3COOH 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

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	1

drawers for completeness before they left the lab and show the TA their letter of successful submission?	
Performance evaluation: Did the student follow the safe practice guidelines throughout the whole lab period?	1
Total mark	10