Lab Report

# I. Introduction

The laboratory was composed of three smaller experiments, which were focused on the elaboration of the application of Hess’ Law towards laboratory situations; as well as the verification of laboratory situation’s accuracy level based on Hess’ Law. This laboratory could be seen as an overall view on how well a Hess’ Law laboratory could be conducted, which assisted laboratory conductors to better understand the relationship between a laboratory situation and a theoretical situation, which both used Hess’ Law as an attempt to solve. The underlying theory of this laboratory was that Hess’ Law has always been an assistant of chemists. Through the application of Hess’ Law, a new reaction along with an enthalpy change at standard conditions (hereby abbreviated as ) could be acquired through a given set of reactions and a given set of , which was corresponded to each given reaction. A central question of the laboratory was generated through the generalization of Hess’ Law usage on theory: whether or not a laboratory situation could perfectly prove the application of Hess’ Law?

A conducted laboratory, which verified the application of Hess’ Law upon laboratory situations, were also composed of similar components that a normal enthalpy problem was composed of. As has mentioned, this laboratory contained three smaller experiments, which were composed accordingly to a Hess’ Law situation:

Experiment #1:

Added approximately 2g of solid NaOH to 100mL H2O

Reaction: NaOH (s) 🡪 NaOH (aq)

Experiment #2:

Mixed 50.0mL of 1.00M NaOH solution with 50.0mL of 1.00M HCl solution

Reaction: NaOH (aq) + HCL (aq) 🡪 NaCl (aq) + H2O (l)

Experiment #3:

Added approximately 2g of solid NaOH to 100mL of 0.500M HCl

Reaction: NaOH (s) + HCl (aq) 🡪 NaCl (aq) + H2O (l).

The hypothesis of the experiment was , where could be acquired through Experiment #1; could be acquired through Experiment #2; and could be acquired through either summing the value of and , or through Experiment #3.

# II. Materials and Methods

The laboratory was conducted with the usage of the following materials, included:

a. NaOH in solid form

b. NaOH solution

c. HCl solution

d. Calorimeter composed of two Styrofoam cups, where two cups were placed together, and at the bottom of a cup, a hole with appropriate size for placing a thermometer tightly in was punched.

e. 250mL beaker

f. 100mL graduated cylinder

g. Thermometer

h. Timer, which was an iPhone as another type of timer was incapable to be found.

i. Digital balance, which displayed unit was gram and was capable to measure up to hundredth of a gram.

After fully collected the appropriate materials, three small experiments as have mentioned within the [Introduction] were carried out, one after another. Strict steps as following were followed for each and every experiment within the three mentioned experiments, to ensure the delivery of best accuracy for the overall laboratory.

1. A thermometer was placed in the cups.

2. Initial temperature was taken before proceeding any further.

3. Temperature was read and recorded for every 30 seconds.

4. Temperature was continued to be measured until either an equivalence to the initial temperature was displayed, or 10 minutes had passed.

5. Mass of NaOH in solid form and the volume of solutions were recorded.

# III. Results

## a. Data

|  |  |  |  |
| --- | --- | --- | --- |
|  | Experiment #1 | Experiment #2 | Experiment #3 |
| Initial Temperature | 29.0o C | 29.0o C | 28.0o C |
| 30th second | 31.0o C | 33.5o C | 34.0o C |
| 60th second | 34.0o C | 33.5o C | 35.5o C |
| 90th second | 32.0o C | 33.5o C | 36.0o C |
| 120th second | 35.0o C | 33.5o C | 36.5o C |
| 150th second | 35.0o C | 33.1o C | 36.0o C |
| 180th second | 32.5o C | 33.1o C | 36.0o C |
| 210th second | 32.0o. C | 33.0o C | 36.5o C |
| 240th second | 32.0o C | 33.0o C | 37.0o C |
| 270th second | 32.0o C | 33.0o C | 37.0o C |
| 300th second | 32.0o C | 33.0o C | 37.0o C |
| 330th second | 32.0o C | 33.0o C | 37.1o C |
| 360th second | 32.0o C | 33.0o C | 37.0o C |
| 390th second | 31.5o C | 33.0o C | 37.0o C |
| 420th second | 31.0o C | 33.0o C | 37.0o C |
| 450th second | 31.0o C | 32.8o C | 37.0o C |
| 480th second | 31.0o C | 32.8o C | 37.0o C |
| 510th second | 31.0o C | 32.5o C | 36.8o C |
| 540th second | 31.0o C | 32.5o C | 36.5o C |
| 570th second | 31.0o C | 32.5o C | 36.0 o C |
| 600th second | 31.0o C | 32.5o C | 35.8o C |

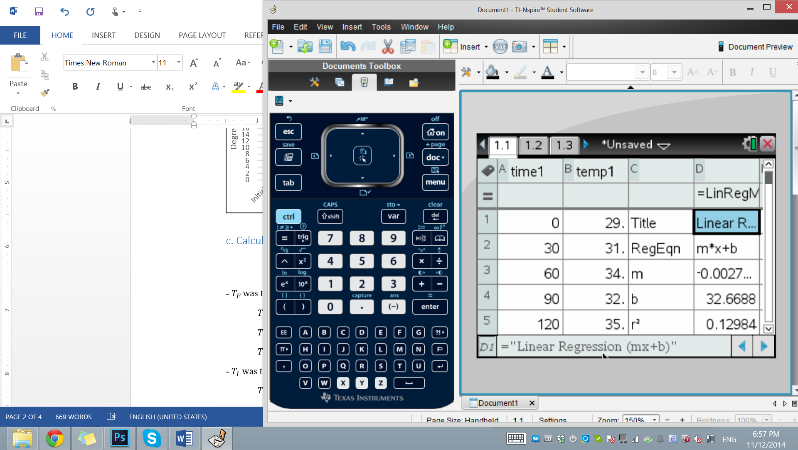
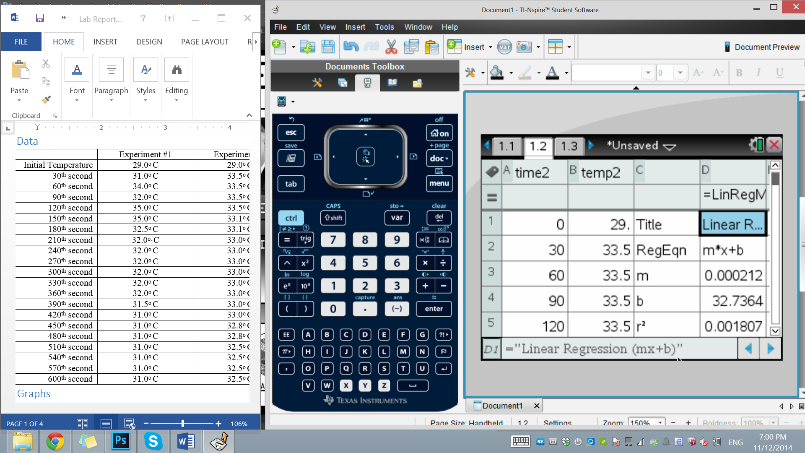
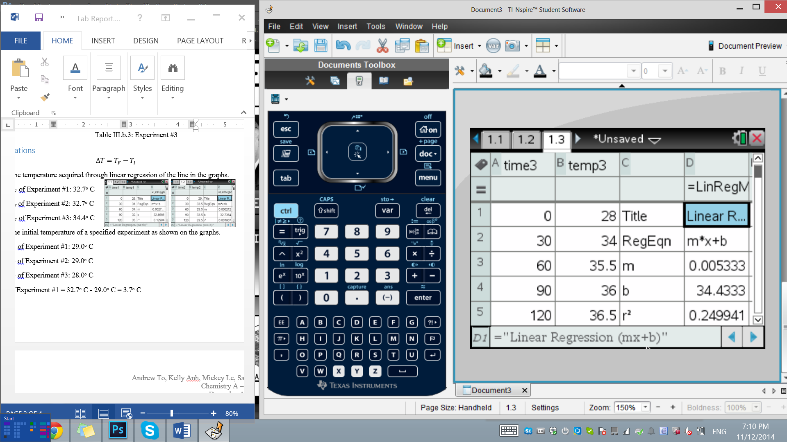
## b. Graphs

Table III.b.1: Experiment #1

Table III.b.2: Experiment #2

Table III.b.3: Experiment #3

## c. Calculations

 - was the temperature acquired through linear regression of the line in the graphs.

of Experiment #1: 32.7o C

of Experiment #2: 32.7o C

of Experiment #3: 34.4o C

 - was the initial temperature of a specified experiment as shown on the graphs.

of Experiment #1: 29.0o C

of Experiment #2: 29.0o C

of Experiment #3: 28.0o C

* + of Experiment #1 = 32.7o C - 29.0o C = 3.7o C
  + of Experiment #2 = 32.7o C - 29.0o C = 3.7o C
  + of Experiment #3 = 34.4o C - 28.0o C = 6.4o C

- was the experiment’s mass.

of Experiment #1: 103

of Experiment #2: 76.368

of Experiment #3: 20

- was 4.18 .

- was the result that was acquired in the previous step.

of Experiment #1 = 32.7o C - 29.0o C = 3.7o C

of Experiment #2 = 32.7o C - 29.0o C = 3.7o C

of Experiment #3 = 34.4o C - 28.0o C = 6.4o C

* of Experiment #1 = = 1.6
* of Experiment #2 = = 1.2
* of Experiment #3 = = 0.5

- Assumed that .

## Concluding Statement

The conducted experiment displayed a failure towards the hypothesis of , despite that if the problem was solved by using knowledge of Hess’ Law, it would display a success towards the hypothesis of .

# IV. Discussion

A failure towards the hypothesis of was what the conducted experiment proved, despite that if the problem was solved on theory, it would display a success towards the hypothesis of . Theoretically, measured the enthalpy change, or a change in the measure of heat contained in a system, at standard conditions. To obtain , options of choosing to solve through Hess’ Law or choosing to solve through acquiring each substance’s – standard enthalpy of formation were available for chemists to select. Though, the involvement with various sources of heat of illustrated numerous of changeable situations of this concept. would be influenced by not just heat from inside the calorimetry, but also from the outside as well. In other words, a reaction might not only portrayed a single situation of exothermic or endothermic process, but in reality, it was capable of portraying both type of processes due to its ease in interchangeability in numerous known and unknown factors.

A failure towards the hypothesis of was what the conducted experiment proved, despite that if the problem was solved on theory, it would display a success towards the hypothesis of . Not just involved with the concept of Hess’ Law, the conducted experiment was also an illustration for the concept of acidic and basic substances. Within the reaction, NaOH was a base, as all bases ended with OH; meanwhile, HCl was an acid, as all acids initiated with H. The result of a reaction between a base and an acid would contained H2O, or commonly known as the neutralization towards pH 7. This concept of acids and bases might show several misleads towards the overall experiment, as the focus of the experiment was on Hess’ Law, rather than acids and bases; thus, it could have been a considerable factor toward the failure of proving the hypothesis of .

Overall, the result of the laboratory was not as expected in the beginning due to numerous objective factors, which primarily influenced the experimental procedures and style of conduct; thus, influenced the result of the laboratory as a whole.