Chem115 Fall 2023 - Ilana Berlin/Lab13: Enthalpy Changes: Neutralization/LabReport13

Jason Cody - Dec 07, 2023, 5:00 PM CST

Assignment #26 - LabReport13

You cannot edit this entry after it is graded.

Description	Enthalpy
I worked in a group with	Dazzo, Gina
The work for this assignment is in	My notebook

Grade **9 / 10**

Graded on Dec 07, 2023, 5:00 PM CST

Jason Cody - Oct 01, 2021, 10:38 AM CDT

TITLE: *(insert experimental title here. All italicized text in parentheses should be followed and then deleted throughout this template).*

Purpose: *(insert experimental purpose here).*

Reference: Kauley, L. J., *Introduction to Chemistry in the Laboratory*, 20th Ed., Lake Forest College, **2021**, Experiment xx, Appendix xx. *(Edit the experiment title and/or appendix letter; add other references, if used, following the same format).*

Observation and Data: *(Write your clear, concise, complete, past tense, passive voice description or narrative of the experiment as the experiment is performed. Complete sentences are used throughout.*
If needed, insert tables and edit the header: Table 1. Preparation of Standard Solutions.
If needed, insert figures and edit this caption below the figure: Figure 1. Beer's Law Plot of B12 Standard Solutions at λ = 520 nm. Number tables and figures in order of appearance in the report.)

Calculations: *(insert sample calculation here, if relevant. Otherwise, delete this section entirely).*

Conclusion: *(restate the quantitative values (percent error and/or CV) to indicate how well the goals of the experiment have been met; answer any questions in the experimental instructions, too).*

ReportTemplate.docx (15.5 kB)

Jason Cody - Nov 24, 2020, 3:39 PM CST

Date and Title

Ilana Berlin - Nov 27, 2023, 12:26 PM CST

Enthalpy of Neutralization

11/27/2023

Jason Cody - Nov 24, 2020, 3:39 PM CST

Purpose

Jason Cody - Dec 07, 2023, 4:50 PM CST

By using a thermistor to measure the temperature of the reaction $HCl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl(aq) + H_2O(l)$ and $HNO_{3(aq)} + NaOH_{(aq)} \rightarrow NaNO_{3(aq)} + H_2O_{(l)}$ the enthaply of the reactions can be determined. Start with the end and then say how you'll get there. Finally, include how the results will be evaluated.

Jason Cody - Nov 24, 2020, 3:39 PM CST

Reference

Ilana Berlin - Nov 27, 2023, 12:33 PM CST

Kateley, L. J., *Introduction to Chemistry in the Laboratory, 20th Ed.*, Lake Forest College, **2021**, Experiment 13, Appendix B.

Jason Cody - Nov 24, 2020, 3:39 PM CST

Calculations

Jason Cody - Dec 07, 2023, 4:55 PM CST

Trial One - $HCl + NaOH \rightarrow NaCl + H_2O$

46.1mL HCl(1L/1000mL)(2.022mol/1L) = 0.0932mol of HCl

0.0932mol HCl (1mol NaOH/1mol HCl)(1l/2.033mol)(1000mL/1L)=45.8mol of NaOH required to neutralize 46.1mol HCl strange order of conversions (you switch to mol NaOH then use the molarity of the acid). If you write out all of the units, you can see what I mean.

45.8mL+2mL= 47.8mL

(23.36+23.65)/2 = 23.51°C

36.98-23.51=13.47°C = ΔT

46.1mL HCl + 48.1mL NaOH = 94.2mL of solution x 1.04g/ml = 98.0g = m

3.93 J/g°C = s

$q_{soln}=sm\Delta T = -q_{neut}$

3.93(98.0)(13.47) = 5187J = 5.19kJ

ΔH=5.19kJ/0.0932mol HCl = 55.7kJ/mol I got 55.5 kJ/mol with your inputs. Rounding error, perhaps.

|56.2-55.7|/56.2 x 100 =0.9%

Trial Two - $HNO_3 + NaOH \rightarrow NaOH_3 + H_2O$

45.2mL of HNO_3(1L/1000mL)(2.026mol/L) = 0.0916mol HNO_3

0.0916mol HNO_3(1mol NaOH/1mol HNO_3)(1L/2.033mol)(1000mL/1L)=45.1mL +2mL= 47.1mL of NaOH

(21.83+22.22)/2= 22.02°C

33.62 - 22.02 = 11.6°C =ΔT

45.2mL + 47.9mL = 93.1mL x 1.04g/mL = 96.8g =m

3.93 J/g°C = s

(3.93)(96.8)(11.6) = 4.413J = 4.41kJ

4.41kJ/0.0916mol= 48.1kJ/mol I get 47.8 with your inputs. Wow, quite low. Your first trial was very reasonable; this one, not so much.

|56.2-48.1|/56.2 x 100=14% Yikes.

Ilana Berlin - Nov 27, 2023, 1:30 PM CST

Ilana Berlin - Nov 27, 2023, 12:32 PM CST

Data and Observations

Jason Cody - Dec 07, 2023, 4:58 PM CST

Trial One - $HCl + NaOH \rightarrow NaCl + H_2O$

46.1 mL of a 2.022M HCl solution was added to a 50mL graduated cylinder. 48.1mL of a 2.033M NaOH solution was added to a sperate 50mL graduated cylinder. Temperatures were taken using a thermistor. The HCl had a temperature of 23.36°C and the NaOH had a temperature of 23.36°C for an average starting temperature of 23.51°C. The solutions were combined in a Styrofoam cup and mixed using VWR Scientific Model 220 Mini-hot plate/stirrer and a Teflon pill. The temperature of the reaction increased to 33.62°C. This is great; I think you could actually reproduce the experiment from your description.

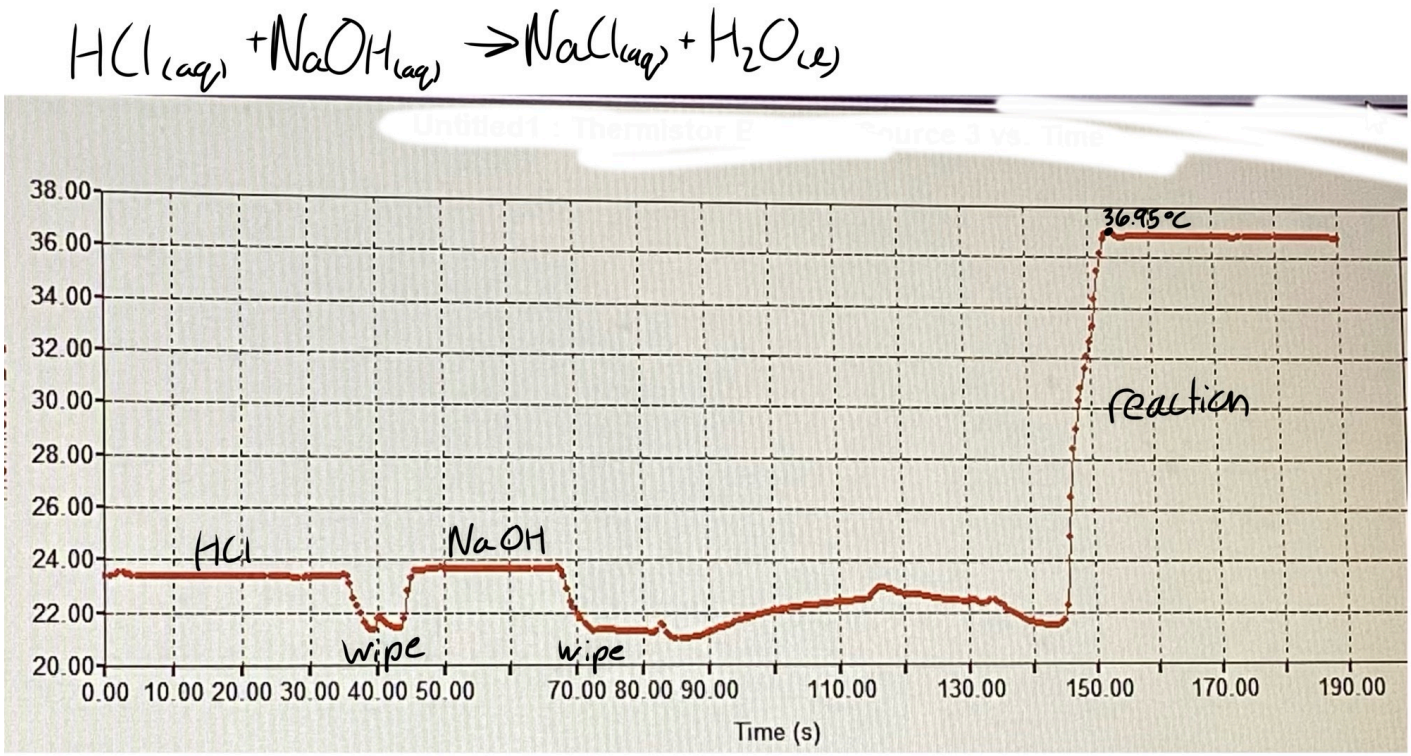


Figure 1. Trial One Curious--why isn't the plot horizontal just before the reaction? Was it hovering over the solution?

Trial Two- HNO_3 + NaOH →$NaOH_3$ + H_2O

All equipment was washed. 45.2mL of a 2.026M HNO_3 solution was added to a 50mL graduated cylinder. 47.9mL of a 2.033M NaOH solution was added to a separate 50mL graduated cylinder. Temperatures were taken using a thermistor. The HNO_3 was 21.83°C and the NaOH was 22.22°C. Both solutions were added to a Styrofoam cub and mixed. The temperatures of the reaction rose to 33.62°C. OK (but low)

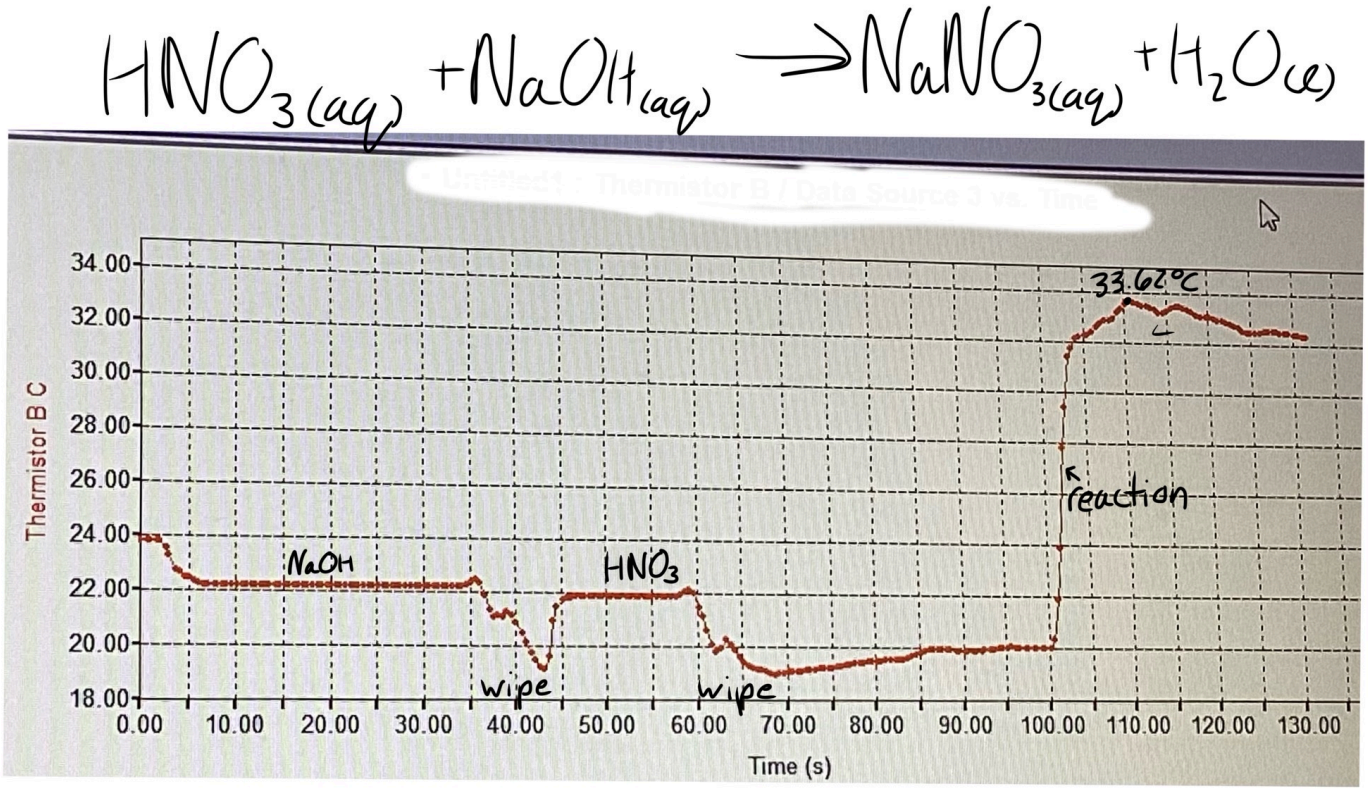


Figure 2. Trial Two. Why is the top of your plot jagged? This might have meant heat loss before measuring the temperature at the top (thus resulting in a lower Tf than there actually was).

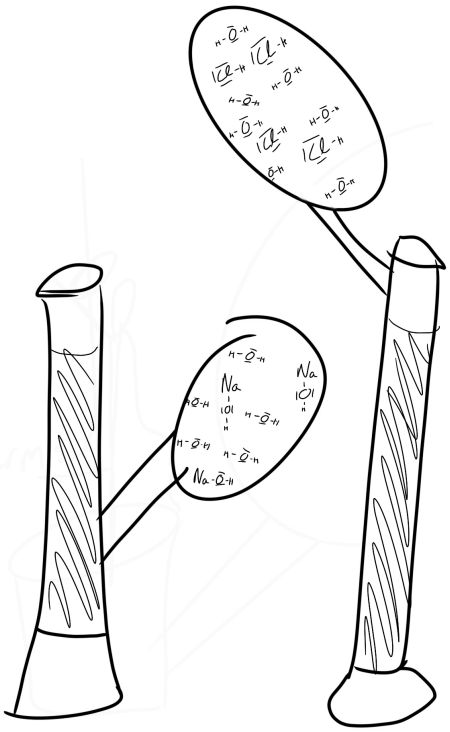
Jason Cody - Nov 24, 2020, 3:39 PM CST

Conclusions

Jason Cody - Dec 07, 2023, 5:00 PM CST

There may be error from too much excess NaOH and jostling of the thermistor. The first trial was more accurate than the second trial. The first trial also had a greater temperature change. Not bad; be careful with the ionic compounds--when dissolved, each is dissociated and separately surrounded by water (positive ends toward anions and negative ends toward cations). We'll work on this more next semester.

Before



After