Determination of heat of neutralization assignment

PRACTICAL 15: DETERMINATION OF HEAT OF NEUTRALIZATION Data collection: | Reaction | Initial Temperature/?? C (?? 0. 25) | Final Temperature of Mixture/?? C (?? 0. 25) | | | Acid | Base | | | HNO3 + NaOH | 28. 00 | 28. 25 | 34. 50 | | HNO3 + KOH | 28. 25 | 28. 25 | 34. 00 | | HCl + NaOH | 28. 25 | 28. 00 | 34. 5 | | HCl + KOH | 28. 25 | 28. 25 | 34. 00 | | H2SO4 + NaOH | 28. 00 | 28. 50 | 36. 50 | | H2SO4 + KOH | 28. 50 | 28. 00 | 34. 00 | Volume of acid = 50 cm3 ?? 0. 25 Acid concentration = 1. 0 M Volume of base = 50cm3 ?? 0. 25 Base concentration = 1. 0 M Number of mole of solution used = [pic] = [pic] = 0. 05 mole ?? 0. 5 % Data Processing:

Calculation: Temperature Change, [pic] = Final temperature ??? Average temperature of Acid and Base | Reaction | Average Temperature of Acid and Base, ?? C| Final Temperature, ?? C | Change of Temperature, ?? C | | |(?? 0. 5) |(?? 0. 25) |(?? 0. 75) | | HNO3 + NaOH | 28. 13 | 34. 50 | 6. 38 | | HNO3 + KOH | 28. 25 | 34. 00 | 5. 5 | | HCl + NaOH | 28. 13 | 34. 75 | 6. 63 | | HCl + KOH | 28. 25 | 34. 00 | 5. 75 | | H2SO4 + NaOH | 28. 25 | 35. 00 | 6. 75 | | H2SO4 + KOH | 28. 25 | 34. 00 | 5. 75 | Heat Released, Q = [pic] m – mass of solution – specific heat of water (4. 2 Jmol-1?? C-1) [pic] – temperature change of solution Enthalpy of neutralization, ? H = Heat released No of moles [pic]Enthalpy change of each experiment : 1. HNO3(aq) + NaOH(aq) [pic]NaNO3(aq) + H2O(l) Enthalpy of neutralization = [pic] = 53. 55 kJmol-1 Uncertainties: m = 0. 5 . ? 100= 0. 5 % 100 ? T = 0. 75 . ? 100= 11. 76 % 6. 38 no of moles= 0. 5 % Total= 12. 76 % Enthalpy of neutralization= -53. 55 kJmol-1?? 12. 76 % 2. HNO3(aq) + NaOH(aq) [pic]NaNO3(aq) + H2O(l) Enthalpy of neutralization= [pic] = 48. 30 kJmol-1 Uncertainties: m = 0. 5 . 100= 0. 5 % 100 ? T = 0. 75 . ? 100= 13. 04 % 5. 75 no of moles= 0. 5 %

Total= 14. 05 % Enthalpy of neutralization= -48. 30 kJmol-1 ?? 14. 05 % 3. HCl(aq) + NaOH(aq) [pic]NaCl(aq) + H2O(l) Enthalpy of neutralization= [pic] = 55. 65 kJmol-1 Uncertainties: m = 0. 5 . ? 100= 0. 5 % 100 ? T = 0. 75 . ? 100= 11. 31% 6. 63 no of moles= 0. 5 % Total= 12. 31 % Enthalpy of neutralization= -55. 65 kJmol-1 ?? 12. 31 % 4. HCl(aq) + KOH(aq) [pic]KCl(aq) + H2O(l) Enthalpy of neutralization= [pic] = 48. 30 kJmol-1 Uncertainties: m = 0. 5 . ? 100= 0. 5 % 100 ? T = 0. 75 . ? 100= 13. 4 % 5. 75 no of moles= 0. 5 % Total= 14. 04 % Enthalpy of neutralization= -48. 30 kJmol-1 ?? 14. 04 % 5. H2SO4(aq) + 2NaOH(aq) [pic] Na2SO4(aq) + 2H2O(l) Enthalpy of neutralization= [pic] = 56. 7 kJmol-1 Uncertainties: m = 0. 5 . ? 100= 0. 5 % 100 ? T = 0. 75 . ? 100= 11. 11 % 6. 75 no of moles= 0. 5 % Total= 12. 11 % Enthalpy of neutralization= -56. 7 kJmol-1 ?? 12. 11 % 6. H2SO4(aq) + 2KOH(aq) [pic] K2SO4(aq) + 2H2O(l) Enthalpy of neutralization = [pic] = 48. 3 kJmol-1 Uncertainties: m = 0. 5 . ? 100= 0. 5 % 100 ? T = 0. 75 . ? 100= 13. 04 % 5. 75 no of moles= 0. % Total= 14. 04 % Enthalpy of neutralization= -48. 30 kJmol-1 ?? 14. 04 % Calculated data: | Reaction |? H, kJmol-1 | | | 53. 55 ?? 8. 84 % | | HNO3(aq) + NaOH(aq) NaNO3(aq) + H2O(l) | | | | | | | 48. 30 ?? 9. 0 % | | HNO3(aq) + NaOH(aq) NaNO3(aq) + H2O(l) | | | | | | | 55. 65 ?? 8. 54 % | | HCl(aq) + NaOH(aq) NaCl(aq) + H2O(l) | | | | | | | 48. 0 ?? 9. 70 % | | HCl(aq) + KOH(aq) KCl(aq) + H2O(l) | | | | | | | 56. 70 ?? 8. 1% | | H2SO4(aq) + 2NaOH(aq) Na2SO4(aq) + 2H2O(l) | | | | | | | 48. 30 ?? 9. 70 % | | H2SO4(aq) + 2KOH(aq) K2SO4(aq) + 2H2O(l) | | | | |

Evaluation: Neutralization is an exothermic reaction as heat is released during the reaction. From the experiment, we can see that the enthalpy of neutralization of each reaction is nearly the same. This is because in each neutralization, the same reaction occur: OH- + H+ > H2O The reaction can also be presented as: H3O+ + OH- > 2H2O The theoretical value for the enthalpy of neutralization is about -57 kJmol-1. However, in this experiment, all values of neutralization enthalpy obtained are smaller than the theoretical ones. This is due to some weakness and limitation.

Drawbacks of the experiment: 1. The styrofoam cup used was not closed. As a result, heat can be transfer to the surrounding easily and the temperature of the solution obtained will be lower than the real one. 2. When the experiment was done, the temperature was quite cold as the weather was cloudy. This can also affect the temperature of the solution as heat will be released to the surrounding even faster due to the chill environment. 3. There was also a possibility for parallax error to happen as we human cannot avoid ourselves from making mistakes. 4. Each neutralization was done only once. . For each neutralization, the same styrofoam cup was used. This can cause contamination whereby some solution might be neutralized right after it is poured into the empty cup. Ways to Come Shortcomings: 1. The styrofoam cup should be closed so that heat will not be easily released to the surrounding. 2. If the temperature of the room where the experiment is to be done is cold, shut off all fans to minimized the loss of heat of the solution to the surrounding. 3. Calculate the uncertainties for each measurement and bring it along till the end of the calculation. 4.

To obtained more accurate results, each neutralization should be done more than once so that the average value can be obtained. 5. Using different styrofoam cup for each neutralization can minimize contamination. Conclusion: From the experiment, we can determine the heat of neutralization by calculating the amount of heat released when the reaction occur. The heat of neutralization for one mole of reaction can be done by dividing the heat released to the number of mole of the solution used in the reaction. ———————– [pic] [pic] [pic] [pic] [pic] [pic]