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**POST-LAB REPORT #10**

**Heats of Reaction and Solution**

**I. Calculations:**

**(a) Part A: Heat of solution of LiCl and NCl**

1. **Heat of solution of LiCl:**

* The mass of the lithium chloride solution = **106.057 g**

= **6.057 g**

= x = 100.0 mL x = **100.0 g**

mass of the lithium chloride solution = + = 6.057 g + 100.0 g = **106.057 g**

* Final temperature the extrapolation of the trend line back to the start of dissolution = **33.6**

Equation of straight line **y = -0.17583x + 34.345**

Final temperature = -0.17583 /min x 4.0 min + 34.345 = 33.64168 = **33.6**

* T = – = **12.1**

Final temperature = **33.6** (above)

Initial temperature = **21.5**

T = – = 33.6 – 21.5 = **12.1**

* Heat (kJ) = **– 5.37 kJ**

= – ( x x T = – (106.057 g) x x x 12.1 = **– 5.37 kJ**

* (kJ/mol) = **– 37.6 kJ/mol**

= = = = **– 37.6 kJ/mol**

1. **Heat of solution of :**

* Mass of the ammonium chloride solution = **106.076 g**

= **6.076 g**

= x = 100.0 mL x = **100.0 g**

mass of ammonium chloride solution = + = 6.076 g + 100.0 g = **106.076 g**

* Final temperature the extrapolation of the trend line back to the start of dissolution = **19.5**

Equation of straight line **y = -0.55006x + 21.672**

Final temperature = -0.55006 /min x 4.0 min + 21.672 = 19.47176 = **19.5**

* T = – = **– 1.6**

Final temperature = **19.5** (above)

Initial temperature = **21.1**

T = – = 19.5 – 21.1 = **– 1.6**

* Heat (kJ) = **0.71 kJ**

= – ( x x T = – (106.076 g) x x x (– 1.6 ) = **0.71 kJ**

* (kJ/mol) = **6.3 kJ/mol**

= = = = **6.3 kJ/mol**

**(b) Part B: Heat of reaction for Magnesium and Hydrochloric acid**

* The mass of the solution = **50.333 g**

= **0.3325 g**

= x = 50.0 mL x = **50.0 g**

= + = 0.3325 g + 50.0 g = 50.3325 g = **50.333 g**

* Final temperature the extrapolation of the trend line back to the start of dissolution = **51.9**

Equation of straight line **y = -0.86619x + 55.325**

Final temperature = -0.86619 /min x 4.0 min + 55.325 = 51.86024 = **51.9**

* T = – = **30.6**

Final temperature = **51.9**

Initial temperature = **21.3**

T = – = 51.9 - 21.3 = **30.6**

* Heat (kJ) = **– 6.44 kJ**

= – ( x x T = – (50.333 g) x x x 30.6 = **– 6.44 kJ**

* (kJ/mol) = **– 4.70 x kJ/mol**

= = = = **– 4.71 x kJ/mol**

**(c) Part C: Heat of neutralization for Sodium Hydroxide solution with Hydrochloric acid**

* Moles of NaOH available to react = **0.1 mol**

= x = 2.0 M x 50.0 mL x = **0.1 mol**

* Moles of HCl available to react = **0.1 mol**

= x = 2.0 M x 50.0 mL x = **0.1 mol**

* Final temperature the extrapolation of the trend line back to the start of dissolution = **35.3**

Equation of straight line **y = -0.21037x + 36.164**

Final temperature = -0.21037 /min x 4.0 min + 36.164 = 35.32252 = **35.3**

* T = – = **13.7**

Final temperature = **35.3**

Initial temperature = **21.6**

T = – = 35.3 - 21.6 = **13.7**

* Heat (kJ) = **– 5.73 kJ**

= + = 50.0 mL + 50.0 mL = **100.0 mL**

= x = 100.0 mL x = **100.0 g**

= – ( x x T = – (100.0 g) x x x 13.7 = **– 5.73 kJ**

* (kJ/mol) = **– 57 kJ/mol**

= = = = – 57.3 kJ/mol = **– 57 kJ/mol**

**II. Additional questions:**

*1. Is the heat of solution of LiCl exothermic or endothermic? Explain your answer.*

From Part A, the calculated = **– 37.6 kJ/mol** with a negative sign; therefore, this is an exothermic reaction which releases heat to the surroundings, making the temperature of the system increase.

*2. Is the heat of solution of NCl exothermic or endothermic? Explain your answer.*

From Part A, the calculated = **6.3 kJ/mol** with a positive sign; therefore, this is an endothermic reaction where heat is absorbed from the surroundings, making the temperature of the system decrease.

*3. Use the table of standard enthalpies in your textbook’s Appendix II to calculate Actual values of the for the above salts. (Hint: write the reaction for the salt’s dissolution, and use the correct to calculate.) Compare your Experimental values to the Actual values and calculate the percent error for each:*

%E = x 100

* For the heat of solution of LiCl:
  + () = **– 278.47 kJ/mol**
  + () = **– 167.10 kJ/mol**
  + () = **– 408.60 kJ/mol**

Reaction:

Actual = (products) – (reactants)

= () + () – ()

= – 278.47 kJ/mol + (– 167.10 kJ/mol) – (– 408.60 kJ/mol) = **– 36.97 kJ/mol**

%E = x 100 = x 100 = 1.704% = **2%**

* For the heat of solution of NCl:
  + () = **– 133.26 kJ/mol**
  + () = **– 167.10 kJ/mol**
  + () = **– 314.40 kJ/mol**

Reaction: +

Actual = (products) – (reactants)

= () + () – ()

= – 133.26 kJ/mol + (– 167.10 kJ/mol) – (– 314.40 kJ/mol) = **14.04 kJ/mol**

%E = x 100 = x 100 = 55.128% = **55%**

*4. Using Hess’s Law and the net ionic equations for Parts B and C, what is the relationship between , , and ?*

Reaction D is

**Part B:**

Net ionic equation:

= (products) – (reactants)

= () + () - () - ()

= – 466.9 kJ/mol + 2 x 0 kJ/mol – 0 kJ/mol – 2 x 0 kJ/mol = **– 466.9 kJ/mol**

**Part C:**

Net ionic equation:

= (products) – (reactants)

= () - ( - ()

= – 285.83 kJ/mol – (– 230.0 kJ/mol) – 0 kJ/mol = **– 55.83 kJ/mol**

= **– 466.9 kJ/mol**

- 2 = - 2 x (– 55.83 kJ/mol) = **111.66 kJ/mol**

= + (- 2 x ) = – 466.9 kJ/mol + 111.66 kJ/mol = **– 355.24 kJ/mol**

The relationship between , , and is that we can find the enthalpy change of a reaction even when it cannot be measured directly. The process is to combine the reactions and enthalpies algebraically to obtain the desired reaction and calculate the enthalpy change of the overall reaction using Hess’ law.

*5. Using your experimental values for Parts B and C, determine the value of .*

**Part B:** Experimental value = **– 4.71 x kJ/mol**

**Part C:** Experimental value = **– 57 kJ/mol**

Experimental = + (- 2 x ) = – 4.71 x kJ/mol + (- 2 x – 57 kJ/mol) = **- 357 kJ/mol**

*6. Using the standard enthalpies table (above), calculate the Actual value of the enthalpy of equation D. Calculate your percent error.*

From Question 4, actual value = **– 355.24 kJ/mol**

From Question 5, experimental value = **– 357 kJ/mol**

%E = x 100 = x 100 = **– 0.495 %**