Data Sheet Calorimetry (Part B)

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1. Reaction between NaOH and HCl

	Trial 1 – Calorimeter #1	Trial 2 – Calorimeter #2
Mass of entire solution, (g). Hint: Assume the density of both solutions = 1.0 g/mL	50g	50g
Initial temperature of HCl prior to mixing, T_i (°C)	20.5°C	21.9°C
T_f after mixing (highest or lowest T over 3 minutes) (°C)	32.6°C	35.3°C
ΔT (°C)	12.1°C	13.4°C
q_{soln} (kJ)	2.532531KJ	2.80061CJ
q_{cal} (kJ)	0.255968KJ	0.409371CJ
q_{rxn} (kJ)	-2.78759	-3.20997KJ
ΔH_{rxn} (kJ)	-2.78759KJ	-3.20997ICJ
Average ΔH_{rxn} (kJ) Exothermic or Endothermic?	Exothermic	

$C_p = 4.18$ J/g°C -2.998735 ICJ

Show sample calculations done on one of the trials for any of the reactions.

Trail 1:

$\Delta T = T_f - T_i = 35.3 - 21.9 = 13.4$ °C

$q_{soln} = C_p \cdot m \cdot \Delta T = 2.8006$ ICJ

$q_{cal} = C_{cal} \cdot \Delta T = 30.55 \times 13.4 = 0.409370$ ICJ

$q_{rxn} = -(q_{cal} + q_{soln}) = -(0.40937 - 2.8006) = -3.20997$ ICJ

$\Delta H_{rxn} = -3.20997$ ICJ

Average $\Delta H_{rxn} = (-2.7875 - 3.20997)/2$

$= -2.998735$ ICJ

2. Reaction between NaOH and NH_4Cl

	Trial 1 – Calorimeter #1	Trial 2 – Calorimeter #2
Mass of entire solution, (g). Hint: Assume the density of both solutions = 1.0 g/mL	50g	50g
Initial temperature of NaOH prior to mixing, T_i (°C)	19.9°C	21.6°C
T_f after mixing (highest or lowest T over 3 minutes) (°C)	21.2°C	22.8°C
ΔT (°C)	1.3°C	1.2°C
q_{soln} (kJ)	2.7209kJ	0.2508kJ
q_{cal} (kJ)	2.7404kJ	0.0366kJ
q_{rxn} (kJ)	-2.9949kJ	-0.2874kJ
ΔH_{rxn} (kJ)	-2.9949kJ	-0.2874kJ
Average ΔH_{rxn} (kJ) Exothermic or Endothermic?	Exothermic -1.6411kJ	

Calculations?

3. Reaction between HCl and NH_4OH

	Trial 1 – Calorimeter #1	Trial 2 – Calorimeter #2
Mass of entire solution, (g). Hint: Assume the density of both solutions = 1.0 g/mL	50 g	50 g
Initial temperature of HCl prior to mixing, T_i (°C)	21.9 °C	22.2°C
T_f after mixing (highest or lowest T over 3 minutes) (°C)	29.9 °C	32.4 °C
ΔT (°C)	8.9 °C	10.7°C
q_{soln} (kJ)	1.86011KJ	2.13181KJ
q_{cal} (kJ)	0.1876121KJ	0.3116115J
q_{rxn} (kJ)	-2.047121J	-2.44341KJ
ΔH_{rxn} (kJ)	-2.047121KJ	-2.44341KJ
Average ΔH_{rxn} (kJ) Exothermic or Endothermic?	Exothermic -2.245265KJ	
Using Hess's Law and your average ΔH_{rxn} for reactions 1 and 2, what would you have expected ΔH_{rxn} to equal	-1.357555KJ	

Show all calculations done to determine Hess's Law. Define the variables of the equations and include units.

~~NaOH(aq)~~ + HCl(aq) → ~~NaCl(aq)~~ + ~~H2O(l)~~ ΔH = (-)

NaCl(aq) + NH_3(aq) + ~~H2O(l)~~ → ~~NaOH(aq)~~ + NH_4Cl(aq) ΔH = (+)

HCl(aq) + NH_3(aq) → NH_4Cl ΔH = (-)

-2.9987351KJ + 1.641181KJ = -1.357551KJ

4. Heat of Solution for Dissolving Ammonium Nitrate

	Trial 1 – Calorimeter #1	Trial 2 – Calorimeter #2
Mass of entire solution, (g) (density = 1.0 g/mL)	52.5g	52.5g
Initial temperature of water prior to mixing, T_i (°C)	20.0°C	22.2°C
T_f after mixing (highest or lowest T over 3 minutes) (°C)	16.6°C	21.5°C
ΔT (°C)	-4.0°C	-0.7°C
q_{soln} (kJ)	-.87781KJ	-0.153615KJ
q_{cal} (kJ)	-0.08452KJ	-0.02135KJ
q_{rxn} (kJ)	0.962121KJ	-0.174965
ΔH_{rxn} (kJ)	0.962121KJ	-0.174965
Average ΔH_{rxn} (kJ) Exothermic or Endothermic?	Endothermic	=0.568542 5KJ

Calculations?

30.55

5. Heat of Reaction for a Redox Reaction

	Trial 1 – Calorimeter #1	Trial 2 – Calorimeter #2
Mass of entire solution, (g) (density = 1.0 g/mL)	50.5 g	50.59
Initial temperature of HCl prior to mixing, T_i (°C)	20.1°C	21.8°C
T_f after mixing (highest or lowest T over 3 minutes) (°C)	63.9°C	26.9°C
ΔT (°C)	43.8°C	5.1°C
q_{soln} (kJ)	9.2591CJ	1.076559KJ
q_{cal} (kJ)	6.923KJ	0.155805KJ
q_{rxn} (kJ)	-10.182KJ	-1.232364ICJ
ΔH_{rxn} (kJ)	-10.1821CJ	-1.232364KJ
Average ΔH_{rxn} (kJ) Exothermic or Endothermic?	Exothermic =5.7071821CJ	

Calculations!