FLINN SCIENTIFIC

Name_____

Exothermic & Endothermic Reactions

Data Table 1. HCl and NaOH

	Trial I	Trial II	Average
Volume 1.0 M HCl (mL)			
Volume 1.0 M NaOH (mL)			
T_i of HCl before mixing (°C)			
T_i of NaOH before mixing (°C)			
Average T_i before mixing (°C)			
T_f of mixture (°C)			
ΔT (°C)			
Specific Heat (J/g °C)	4.184	4.184	
Heat, q (J)			

Data Table 2. NH_4NO_3 and H_2O

	Trial I	Trial II	Average
Mass of NH_4NO_3 (g)			
Volume of H_2O (mL)			
T_i of H_2O (°C)			
T_f of mixture (°C)			
ΔT (°C)			
Specific Heat (J/g °C)	4.184	4.184	
Heat, q (J)			
Heat per gram (J/g)			

Data Table 3. NaOH and H_2O

	Trial I	Trial II	Average
Mass of NaOH (g)			
Volume of H_2O (mL)			
T_i of H_2O (°C)			
T_f of mixture (°C)			
ΔT (°C)			
Specific Heat (J/g °C)	4.184	4.184	
Heat, q (J)			
Heat per gram (J/g)			

Calculations and Post-Lab Questions

Perform the following calculations and answer the questions on a separate sheet of paper. Show all work and include units.

Reaction 1. HCl and NaOH

1. Determine the average initial temperature for each trial by averaging the initial temperatures of the HCl and the NaOH solutions before mixing. Record as Average T_i before mixing in Data Table 1.
2. Calculate the change in temperature (ΔT) by subtracting the average initial temperature from the final temperature of the mixture ($\Delta T = T_f - T_i$). Record in Data Table 1.
3. Did the temperature rise or fall as the two solutions were mixed? Explain this in terms of heat transfer.
4. Calculate the heat of neutralization (q in joules) for the reaction using Equation 6 ($q = m \times \Delta T \times s$). Assume that the density and specific heat of the solution are the same as that of pure water (density of $H_2O = 1.0$ g/mL). Record in Data Table 1. Calculate the average heat (q) by averaging Trials I and II. Record in Data Table 1.
5. Classify the reaction as either exothermic or endothermic. Give evidence for your answer.
6. Write the chemical equation for the reaction that took place. Include heat on the appropriate side of the equation.

Reaction 2. NH_4NO_3 and H_2O

7. Calculate the change in temperature (ΔT) for each trial. Record in Data Table 2.
8. Did the temperature of the water rise or fall when the NH_4NO_3 was added? Explain this in terms of heat transfer.
9. Calculate the heat (q in Joules) for the reaction. Record q for each trial in Data Table 2.
10. Calculate the heat absorbed or released per gram of solute added to the water (in joules/g). Record in Data Table 2. Calculate the average heat per gram by averaging Trials I and II. Record in Data Table 2.
11. Classify the reaction as either exothermic or endothermic. Give evidence for your answer.
12. Write the chemical equation for the reaction that took place. Include heat on the appropriate side of the equation.
13. What could be some possible uses for a chemical such as ammonium nitrate?

Reaction 3. NaOH and H_2O

14. Calculate the change in temperature (ΔT) for each trial. Record in Data Table 3.
15. Did the temperature of the water rise or fall when the NaOH was added? Explain this in terms of heat transfer.
16. Calculate the heat (q in Joules) for the reaction. Record q for each trial in Data Table 3.
17. Calculate the heat absorbed or released per gram of solute added to the water (in joules/g). Record in Data Table 3. Calculate the average heat per gram by averaging Trials I and II. Record in Data Table 3.
18. Classify the reaction as either exothermic or endothermic. Give evidence for your answer.
19. Write the chemical equation for the reaction that took place. Include heat on the appropriate side of the equation.