Calorimetry Worksheet

As you work through the steps in the lab procedure, record your experimental values and the results on this worksheet. Use the exact values you record for your data to make later calculations.

For each of the following questions mass should be reported to three decimal places and temperature should be reported to two decimal places. Any calculations involving the specific heat of water (4.18 J/g · °C) should be reported to three significant figures.

Part A: Validating the Assumption about Insulation

Complete the following table.

Data Table A. Validating the Assumption about Insulation

	Mass (g)	**Temperature (°C)**
Cups and cover		NA
Cups, cover, and cold water		NA
Cold water		
Cups, cover, and mixture		
Warm water		

When the cold and warm water are mixed, which of the following are true about $\Delta T_{\text{cold water}}$ and $\Delta T_{\text{warm water}}$? (Select all that apply. *Note: The order of these options may be different in the WebAssign question.*)

- The absolute value of $\Delta T_{\text{cold water}}$ is greater than the absolute value of $\Delta T_{\text{warm water}}$
- The absolute value of $\Delta T_{\text{cold water}}$ is less than the absolute value of $\Delta T_{\text{warm water}}$.
- The absolute value of $\Delta T_{\text{cold water}}$ is equal to the absolute value of $\Delta T_{\text{warm water}}$.
- They are both positive.
- They are both negative.
- They have opposite signs.

Which of the following are true about $q_{\text{cold water}}$ and $q_{\text{warm water}}$? (Select all that apply. *Note: The order of these options may be different in the WebAssign question.*)

- The absolute value of $q_{\text{cold water}}$ is greater than the absolute value of $q_{\text{warm water}}$.
- The absolute value of $q_{\text{cold water}}$ is less than the absolute value of $q_{\text{warm water}}$.
- The absolute value of $q_{\text{cold water}}$ is equal to the absolute value of $q_{\text{warm water}}$.
- They are both positive.
- They are both negative.
- They have opposite signs.

Calculate each of the following.

$\Delta T_{\text{cold water}}$

$\Delta T_{\text{warm water}}$

$q_{\text{cold water}}$

$q_{\text{warm water}}$

Part B: Identifying an Unknown Metal by Specific Heat

Confer with your lab partner and instructor. In this experiment, label each of the following as part of the system or part of the surroundings.

Hot metal:

Cold water:

Calorimeter:

When the metal and water are mixed, which of the following are true about ΔT_{metal} and ΔT_{water}? (Select all that apply. *Note: The order of these options may be different in the WebAssign question.*)

- The absolute value of ΔT_{metal} is greater than the absolute value of ΔT_{water}.
- The absolute value of ΔT_{metal} is less than the absolute value of ΔT_{water}.
- The absolute value of ΔT_{metal} is equal to the absolute value of ΔT_{water}.
- They are both positive.
- They are both negative.
- They have opposite signs.

When the metal and water are mixed, which of the following are true about q_{metal} and q_{water}? (Select all that apply. *Note: The order of these options may be different in the WebAssign question.*)

- The absolute value of q_{metal} is greater than the absolute value of q_{water}.
- The absolute value of q_{metal} is less than the absolute value of q_{water}.
- The absolute value of q_{metal} is equal to the absolute value of q_{water}.
- They are both positive.
- They are both negative.
- They have opposite signs.

Complete the following table.

Data Table B. Identifying Unknown Metal by Specific Heat

	Mass (g)	**Temperature (°C)**
Unknown metal # _____		
Cups and cover (from Part A)		NA
Cups, cover, and cold water		NA
Cold water		
Mixture of metal and water	NA	

Calculate the specific heat of the metal.

Select the correct metal below. (*Note: The order of these options may be different in the WebAssign question.*)

- aluminum (Al, $s_{\text{metal}} = 0.901$)
- copper (Cu, $s_{\text{metal}} = 0.384$)
- silicon (Si, $s_{\text{metal}} = 0.711$)
- zinc (Zn, $s_{\text{metal}} = 0.389$)
- iron (Fe, $s_{\text{metal}} = 0.449$)
- nickel (Ni, $s_{\text{metal}} = 0.444$)
- tin (Sn, $s_{\text{metal}} = 0.226$)
- manganese (Mn, $s_{\text{metal}} = 1.02$)

Part C: Heat of Neutralization

Complete the following table.

Data Table C. Heat of Neutralization

	Mass (g)	**Temperature (°C)**
Cups and cover (from Part A)		NA
NH_3 solution	NA	
Cups, cover, and mixed solution		NA
Mixed solution		

Calculate the ΔH for this reaction.

Using volume and concentration, calculate each of the following. (Enter the concentration and volume readings to 3 significant figures.)

concentration of NH_3

concentration of H_3PO_4

volume of NH_3

volume of H_3PO_4

moles NH_3 reacted

moles H_3PO_4 reacted

molar value for ΔH

Part D: Heat of Solution

Calculate the amount of $NH_4H_2PO_4$ that you made in Part C in grams.

Complete the following table.

Data Table D. Heat of Solution

	Mass (g)	**Temperature (°C)**
Cups and cover (from Part A)		NA
Cups, cover, and water		NA
Water		
Solution	NA	
Solid $NH_4H_2PO_4$		NA

Confer with your lab partner and instructor. In this experiment, label each of the following as part of the system or part of the surroundings.

Reaction of solid dissolving:

Water:

Calorimeter:

Comparing the molar change in enthalpy ($\Delta H_{\text{dissolution}}$) for this reaction and the heat of neutralization ($\Delta H_{\text{neutralization}}$) in Part C, which of the following are true about $\Delta H_{\text{dissolution}}$ and $\Delta H_{\text{neutralization}}$? (You may need to calculate $\Delta H_{\text{dissolution}}$ to answer this correctly. Select all that apply. *Note: The order of these options may be different in the WebAssign question.*)

- The absolute value of $\Delta T_{\text{dissolution}}$ is greater than the absolute value of $\Delta T_{\text{neutralization}}$.
- The absolute value of $\Delta H_{\text{dissolution}}$ is less than the absolute value of $\Delta H_{\text{neutralization}}$.
- The absolute value of $\Delta T_{\text{dissolution}}$ is equal to the absolute value of $\Delta T_{\text{neutralization}}$.
- They are both positive.
- They are both negative.
- They have opposite signs.