

**Chemistry 1210**  
**Solution Calorimetry**

**Date:** \_\_\_\_\_ **Name:** \_\_\_\_\_ **Partner:** \_\_\_\_\_

**OBJECTIVE:** To determine the enthalpy changes for a number of chemical reactions.

**PROCEDURE:** As in the Chemistry 1210 lab manual, pages

**OBSERVATIONS:**

**DATA and CALCULATIONS:**

**REACTION A**

| Run | Reagents    | Volume | M | T <sub>i</sub> | T <sub>i avg</sub> | T <sub>f</sub> | ΔT | q | ΔH |
|-----|-------------|--------|---|----------------|--------------------|----------------|----|---|----|
| 1   | HCl<br>NaOH |        |   |                |                    |                |    |   |    |
| 2   | HCl<br>NaOH |        |   |                |                    |                |    |   |    |

Sample calculation of q and ΔH:

**REACTION B**

| <b>Run</b> | <b>Reagents</b>   | <b>Mass/<br/>Volume</b> | <b>T<sub>i</sub></b> | <b>T<sub>f</sub></b> | <b>ΔT</b> | <b>q</b> | <b>ΔH</b> |
|------------|---|-------------------------|----------------------|----------------------|-----------|----------|-----------|
| 1          | Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub><br>H <sub>2</sub> O                       |                         |                      |                      |           |          |           |
| 2          | Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub><br>H <sub>2</sub> O                       |                         |                      |                      |           |          |           |
| 1          | Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub><br>·5H <sub>2</sub> O<br>H <sub>2</sub> O |                         |                      |                      |           |          |           |
| 2          | Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub><br>·5H <sub>2</sub> O<br>H <sub>2</sub> O |                         |                      |                      |           |          |           |

Sample calculation of q and ΔH:

**REACTION C**

| <b>Run</b> | <b>Reagents</b>     | <b>Mass/<br/>Volume</b> | <b>T<sub>i</sub></b> | <b>T<sub>f</sub></b> | <b>ΔT</b> | <b>q</b> | <b>ΔH</b> |
|------------|---------------------|-------------------------|----------------------|----------------------|-----------|----------|-----------|
| 1          | Mg<br>ribbon<br>HCl |                         |                      |                      |           |          |           |
| 2          | Mg<br>ribbon<br>HCl |                         |                      |                      |           |          |           |

Sample calculation of q and  $\Delta H$ :

### REACTION D

| <b>Ru<br/>n</b> | <b>Reagents</b>    | <b>Mass/<br/>Volume</b> | <b>T<sub>i</sub></b> | <b>T<sub>f</sub></b> | <b><math>\Delta T</math></b> | <b>q</b> | <b><math>\Delta H</math></b> |
|-----------------|--------------------|-------------------------|----------------------|----------------------|------------------------------|----------|------------------------------|
| <b>1</b>        | <b>MgO<br/>HCl</b> |                         |                      |                      |                              |          |                              |
| <b>2</b>        | <b>MgO<br/>HCl</b> |                         |                      |                      |                              |          |                              |

Sample calculation of q and  $\Delta H$ :

### REACTION E

E(i)

| <b>Ru<br/>n</b> | <b>Reagent<br/>s</b>                        | <b>M</b> | <b>Volum<br/>e</b> | <b>T<sub>i</sub></b> | <b>T<sub>i avg</sub></b> | <b>T<sub>f</sub></b> | <b><math>\Delta T</math></b> | <b>q</b> | <b><math>\Delta H</math></b> |
|-----------------|---|----------|--------------------|----------------------|--------------------------|----------------------|------------------------------|----------|------------------------------|
| <b>1</b>        | <b>H<sub>3</sub>PO<sub>4</sub><br/>NaOH</b> |          |                    |                      |                          |                      |                              |          |                              |
| <b>2</b>        | <b>H<sub>3</sub>PO<sub>4</sub><br/>NaOH</b> |          |                    |                      |                          |                      |                              |          |                              |

Sample calculation of q and  $\Delta H$ :

**E(ii)**

\*note for E(ii) & E(iii)  $T_{i\text{ avg}}$ , volume of  $\text{H}_3\text{PO}_4 \neq$  volume NaOH (calculate the weighted  $T_{i\text{ ave}}$ )

| <b>Ru<br/>n</b> | <b>Reagent<br/>s</b>                               | <b>M</b> | <b>Volum<br/>e</b> | <b><math>T_i</math></b> | <b><math>T_{i\text{ avg}}^*</math></b> | <b><math>T_f</math></b> | <b><math>\Delta T</math></b> | <b>q</b> | <b><math>\Delta H</math></b> |
|-----------------|--|----------|--------------------|-------------------------|--|-------------------------|------------------------------|----------|------------------------------|
| <b>1</b>        | <b><math>\text{H}_3\text{PO}_4</math><br/>NaOH</b> |          |                    |                         |  |                         |                              |          |                              |
| <b>2</b>        | <b><math>\text{H}_3\text{PO}_4</math><br/>NaOH</b> |          |                    |                         |  |                         |                              |          |                              |

Sample calculation of  $T_{i\text{ avg}}$ , q, and  $\Delta H$ :

**E(iii)**

| <b>Ru<br/>n</b> | <b>Reagent<br/>s</b>                               | <b>M</b> | <b>Volum<br/>e</b> | <b><math>T_i</math></b> | <b><math>T_{i\text{ avg}}^*</math></b> | <b><math>T_f</math></b> | <b><math>\Delta T</math></b> | <b>q</b> | <b><math>\Delta H</math></b> |
|-----------------|--|----------|--------------------|-------------------------|--|-------------------------|------------------------------|----------|------------------------------|
| <b>1</b>        | <b><math>\text{H}_3\text{PO}_4</math><br/>NaOH</b> |          |                    |                         |  |                         |                              |          |                              |
| <b>2</b>        | <b><math>\text{H}_3\text{PO}_4</math><br/>NaOH</b> |          |                    |                         |  |                         |                              |          |                              |

Sample calculation of  $T_{i\text{ avg}}$ ,  $q$ , and  $\Delta H$ :

**SUMMARY TABLE:**

| Reaction   | $\Delta H(1)$ | $\Delta H(2)$ | $\Delta H(\text{avg})$ | Literature $\Delta H$ |
|--|---------------|---------------|------------------------|-----------------------|
| A) HCl + NaOH  |               |               |                        |                       |
| B <sub>1</sub> ) Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> + H <sub>2</sub> O                    |               |               |                        |                       |
| B <sub>2</sub> ) Na <sub>2</sub> S <sub>2</sub> O <sub>3</sub> ·5H <sub>2</sub> O + H <sub>2</sub> O |               |               |                        |                       |
| C) Mg + HCl  |               |               |                        |                       |
| D) MgO + HCl   |               |               |                        |                       |
| E <sub>i</sub> ) H <sub>3</sub> PO <sub>4</sub> + NaOH   |               |               |                        |                       |
| E <sub>ii</sub> ) H <sub>3</sub> PO <sub>4</sub> + 2NaOH   |               |               |                        |                       |
| E <sub>iii</sub> ) H <sub>3</sub> PO <sub>4</sub> + 3NaOH  |               |               |                        |                       |

Calculations of Literature  $\Delta H$  for the above reactions (attach extra sheets as required) (*If prelab done, then no need to do this again, attach the marked prelab*)

**DISCUSSION:** (*any sources of errors in the experiment beyond your control*)