IN PROGRESS

Determination of Heats of Reaction Laboratory Exercise

**Purpose:** To experimentally determine the amount of heat energy absorbed or released during a chemical reaction.

**Overview:**  In this lab, you will get a chance to try to measure the H value for a physical reaction that occur in aqueous solution.  You will use a styrofoam cup calorimeter and various reactants according to the instructions below.

**Safety:** HCl is a **strong acid**. **Goggles are a must** and gloves must be worn when measuring HCl. Keep a solution of NaHCO3 nearby. Aprons are recommended, but optional.

Materials: Styrofoam calorimeter, ‘lid’, ring stand, clamp, thermometer, stirring rod, scoopula (Zn), graduated cylinder, weigh boat, scales, watch or timer. Zn (s) and 6M HCl.

**Procedure:**

Balance: Zn + HCl → ZnCl2 + H2

1. Obtain a Styrofoam calorimeter and a ‘lid’.  A small hole must be made so that you can put a thermometer through it later. OBSERVE MY SET UP.
2. Obtain the mass of the calorimeter (empty and no thermometer) after you have made the hole. **Record calorimeter mass here:** \_\_\_\_\_\_\_\_\_\_
3. Using a graduated cylinder (and possibly a funnel), measure 50 mL of 6 M HCl. Then carefully pour HCl into the calorimeter. Obtain the mass of HCl either by using HCl density (1.01g/ml) or carefully massing it and subtracting the original mass of calorimeter. **Mass of HCl:** \_\_\_\_\_\_\_\_\_\_\_
4. Record the initial temperature of HCl **HCl temp:** \_\_\_\_\_\_\_\_\_\_\_\_\_
5. Measure out between 1.8-2.0 g of Zn metal

**Mass of Zn:** \_\_\_\_\_\_\_\_\_\_\_\_

1. Add the Zn metal to the 6 M HCl. Replace lid and thermometer. When the reaction starts, time the reaction progression, by watching the change in temp. Pick an interval, in seconds. (Ex: every 15 seconds). Record the results below. Continue until there is no longer a change in temp for 1 minute (at least). You will graph this later.
2. Do at least 1 more trial of the experiment. Average results

TRIAL 1 TRIAL 2 AVG AVG

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| --- | --- | --- | --- | --- | --- |
| Time (sec) | Temp (C) | Time (sec) | Temp (C) | Time (sec) | Temp (C) |
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Total Mass of Container (with both reactants): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Total change in Temperature (use the Avg from table) \_\_\_\_\_\_\_\_\_\_\_\_

Calculate the heat energy produced or absorbed by the reaction (show work below):

Q = \_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. PUT WASTES IN ‘COFFEE CONTAINER’ ON THE COUNTER THAT SAYS ‘HALOGENATED WASTES’.
2. CLEAN EVERYTHING UP! WIPE COUNTERS DOWN!
3. Make graph and answer questions, below.

B. CH4N2O (*s*) → CH4N2O (*aq*) (Dissolution of urea)

(1.) Pour 100 mL of DI H2O into your calorimeter and record your initial

temperature. Density = 1.00 g/mL.

Initial temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Mass of DI H2O \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(2.) Measure out between 50-60 g of solid urea

Mass of urea \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(3.) Add the urea to the DI H2O, allow the reaction to proceed, and

record the final temperature.

Final temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(4.) Total mass of reaction \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(5.) Change in temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(6.) Calculate the heat energy produced or absorbed by the reaction:

q = \_\_\_\_\_\_\_\_\_\_

C. 2 Ca + 2 H2O → 2 Ca(OH)2 + H2

(1.) Pour 50 mL of H2O into your calorimeter and record your initial

temperature. Density = 1.00 g/mL.

Initial temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Mass of H2O solution \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(2.) Measure out between 0.6-0.8 g of Ca metal

Mass of Ca \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(3.) Add the Ca metal to the H2O, allow the reaction to proceed, and

record the final temperature.

Final temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(4.) Total mass of reaction \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(5.) Change in temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(6.) Calculate the heat energy produced or absorbed by the reaction:

q = \_\_\_\_\_\_\_\_\_\_

D. 2 HCl + Mg → MgCl2 + H2

**Make sure to use the 1 M HCl instead of the 6 M HCl!!!!**

(1.) Pour 50 mL of 1 M HCl into your calorimeter and record your initial

temperature. Density = 1.01 g/mL.

Initial temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Mass of HCl solution \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(2.) Measure out between 0.6-0.8 g of Mg metal

Mass of Mg \_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(3.) Add the Mg metal to the 1 M HCl, allow the reaction to proceed, and

record the final temperature.

Final temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(4.) Total mass of reaction \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(5.) Change in temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

(6.) Calculate the heat energy produced or absorbed by the reaction:

q = \_\_\_\_\_\_\_\_\_\_