Fun With Zinc Lab

What will happen to the time it takes to react a piece of metal with an acid if the acid is heated? Does temperature affect the reaction rate. In this lab you will time the reaction between zinc and HCl at various temperatures, do some basic calculations regarding pH and molarity, and determine what happens to the reaction rate as temperature increases. **In an exercise when the lab is due, you will review your lab, as well as that of others and determine a score.**

**Objectives:** Understand how temperature affects reaction rate, gain experience in applying stoichiometry relationships in real experiments, increase evaluatory skills.

**Materials**

Three larger beakers – 400 ml in size, hot plate, 4 samples of granulated zinc of the same mass, test tube holder, a couple thermometers, watch with second hand, 4.00 M HCl¹, 4 larger pyrex test tubes, test tube rack, small (10 ml) graduated cylinder. Each Table will have a supply of HCl and zinc.

**Procedure**

- Note the start/end times of each reaction; you will have a running clock, not all will start at the same time. You’ll use subtraction to determine times! Or use Cell Phone with Lap Time capability…
- Record data in Table 1b.
- Be sure you keep track of which zinc piece goes into which test tube!

1. Using a graduated pipette, place 5.00 ml of 4.00 M HCl in each of 4 labeled test tubes using a pipette and/or graduated cylinder.
2. Obtain quantities of granulated Zn – obtain their weight to the nearest hundredth. **Obtain the same amount (to within + 0.10 g) of zinc for all trials! Do not use more than 0.30 grams.**
3. Record the room temperature.
4. Put the zinc into test tube 1 - noting the time the trial began - record the time it takes for the zinc to completely react with the HCl (don’t stop here…. monitor it - proceed with steps 5 →)
5. Put some (tap) water in each of your other beakers that is at a level that would not spill into the test tubes when they are leaning over (!) and place a single test tubes (numbered 2-4) with acid in each; begin heating all - keeping track of the temperature of the water baths as they rise.
6. When the water bath of one reaches 40.0 °C, remove from heat, add the zinc and note the time begun (lap on cell phone?!). Record how long it takes for the zinc to completely react with the HCl.

   **Obviously, the water baths will cool when removed from the beakers….put them back on the hotplates such that the range of the beakers is: 30-40 °C, 50-60 °C and 70-80 °C.**

7. Repeat step 6 at intervals of 60.0 °C, and 80.0 °C, using the other 2 baths and tubes of HCl.
8. **If necessary because reaction is slow and clock is running out…decant the solution, rinse (water), decant, rinse, decant, rinse, recover zinc, obtain mass and then determine how much reacted.**

¹ This is much more concentrated than previous HCl solutions you’ve used – Use care!
9. Turn on the sink; when it is running – dump the solutions from test tubes down the drain.

Questions

For all work that involves calculations – show all work (clearly organized for me please) for calculations or no points will be awarded! Watch those Sig-Figs!

1. Write the reaction between HCl and Zn; state the type(s) of reaction that it is and how you know. (5 Pts)

2. Fill out Table 1a: Which was limiting? Be sure to use the reactant that was limiting in subsequent questions below! (12 Pts)

3. Determine how many grams of hydrogen were theoretically produced in each reaction (Put in Table 1b). (8 Pts)

4. Calculate the Molarity of the HCl solution after the reaction. (Assume no volume change...but, the amount of HCl does...) (Put in Table 1b)

Table 1a: Which reactant is limiting (12 Pts)

<table>
<thead>
<tr>
<th>Tube</th>
<th>Moles zinc (4)</th>
<th>Moles HCl (4)</th>
<th>Which limits? (4)</th>
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Table 1b. Data gathered and summarized results for Fun With Zinc Lab. (36 Pts)

<table>
<thead>
<tr>
<th>Tube</th>
<th>Reaction Time (s)</th>
<th>Temp ºC</th>
<th>Zinc Mass (g)</th>
<th>Moles HCl (@ end)</th>
<th>Molarity HCl (@ end)</th>
<th>H₂ Produced (g)</th>
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Pt s | 4 | 4 | 4 | 8 | 8 | 8 |

5. Make a graph to show the relationship between temperature increases of 10.0 ºC and reaction time. Be sure to label all axes, provide units, and provide a meaningful title about what is in the graph. (20 Points)

6. One source of error in this lab is differing masses of Zinc pieces; explain why this is a source of error and what influence it has on your results? (5 Points)

7. What is a practical application of the generalization regarding temperature and reaction rates in many instances? (5 Pts)

8. Is the assumption that the volume remains the same completely valid, or equally valid among the trials? Explain. (5 Pts)