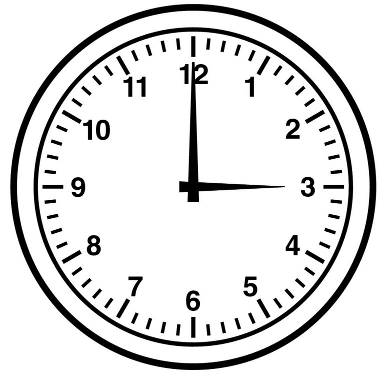
CLOCK REACTION LAB name: ______________________________ 80/1200

When a chemical reaction happens it usually happens in the blink of an eye. Some reactions, like today's in lab, are slower. Today's lab reacts an iodine solution with a starch solution, and is so slow we can time it on a clock, hence the name of the lab.



Today the reactants will mix and after some time (possibly as long as 50 seconds) they change color dramatically. We will time it with stop watches, to the nearest TENTH of a second. Be careful timing, we are going to graph our results.

You will be mixing two different solutions called SOLUTION A and B. By varying the volume of solution A in each trial, you will cause a change in the time the reaction takes to complete. Each trial will get faster and faster.

It's the first reaction that is the hardest, waiting for up to a minute is harder for teenagers. DO NOT miss it!

The second clock reaction will let you measure the affect that different temperatures have on reaction time. As you already learned, hotter reactants usually make faster reactions. We'll measure the affect different temperatures have on this same reaction, and graph our results onto a second graph.

Set up is important, and NOT MIXING the chemicals by accident is key. Keep A to the left, and B to the right. You'll need about 80 mL of A and the same for B. You can get more. You'll need 2 small graduated cylinders, one for each solution. You need a flask of deionized water. Finally you must get a "reaction beak-er" where the magic happens.

In between trial just rinse, no soap, no drying. If the graduated cylinders touch when pouring into the reaction beaker, you must wash them out.

PART ONE — Measuring the Effect of Concentration of Reactants on Rate of Reactions

Look at the data table 1, we will vary the amount of solution A in each of our trials. Put the proper amount of solution A into a graduated cylinder, then fill to 10 mL with deionized water. Always use 10 mL of solution B. One student is the "timer" while the other pours and swirls the mixture. Keep your eyes on the beaker! The reaction takes time, but is quick! Stop the timer when the color change occurs and round the NEAREST TENTH number of seconds. Record TIME in seconds into data table. The RATE is for later.

After your reaction, rinse out the reaction beaker in the BACK SINK, take care not to get the colored solution on your clothing! Rinse 3-4 times, then start again. Wet is fine, do not dry with paper towels (the towels have starch in them).

Later, to convert the time to rate. The rate is equal to 1 over time in seconds. It will be a small <u>decimal</u>, and the unit will be sec^{-1}. Unusual units are our favorite.

Solution Mixing Directions: A: Put 8.50 g KIO_3, potassium iodate, into water to make 1800 mL solution. Twice, 3600 mL

B: 32 g starch into 70 mL hot water, blend like mad, put this into an 8 Liter jug, add 4 Liters deionized water, shake like mad. Add in 18 grams $NaHSO_3$, sodium bisulfite, AKA sodium acid sulfite, mix. Dilute to 8 Liters No cat./43 sec.

Tweak with H_2SO_4 (10 mL, 1.0 M)

Date table 1 for Concentration of Solution A vs. the Rate of Reaction.

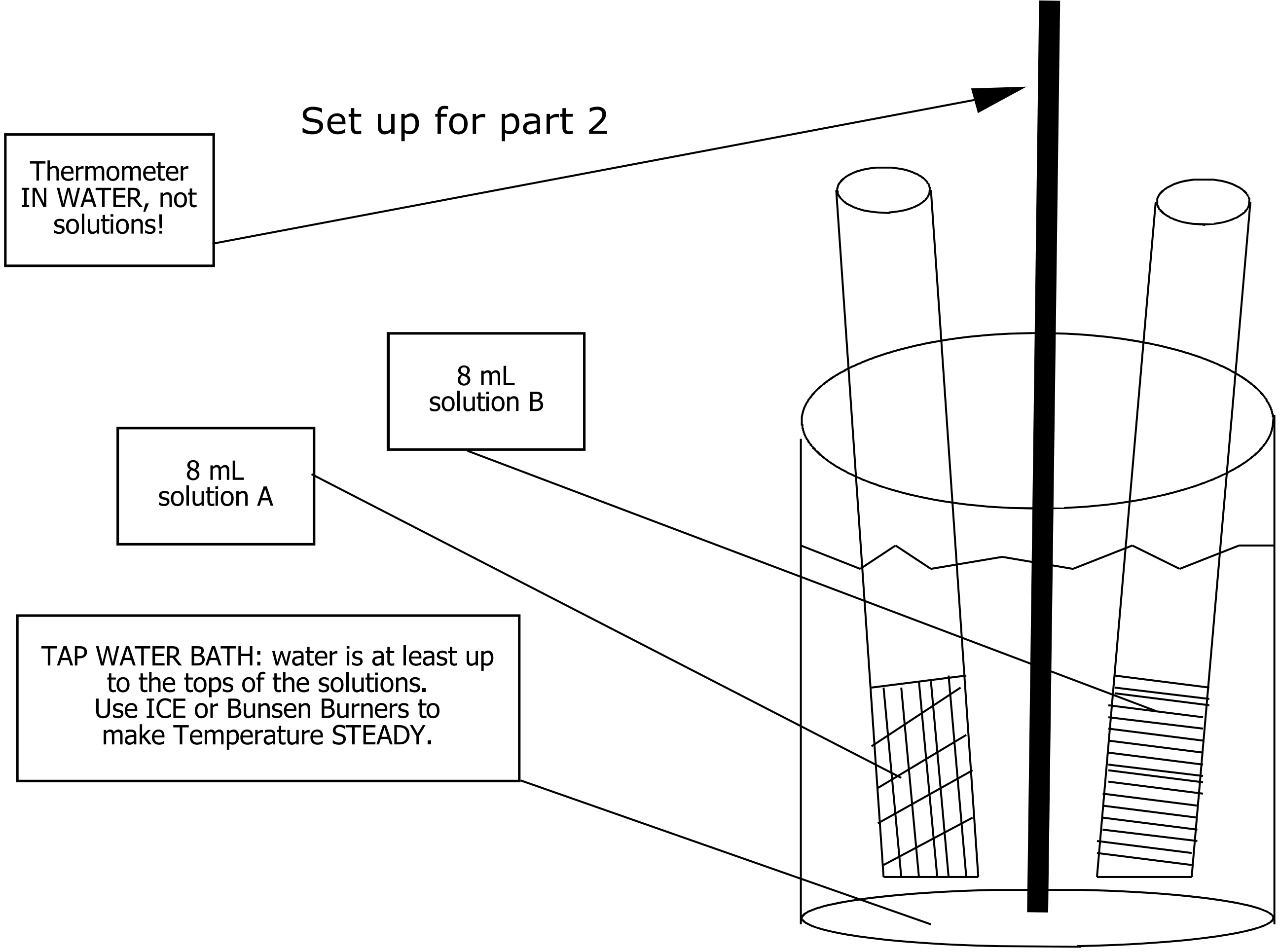
Solution A + Water	Solution B	Time for reaction in 10ths of seconds	Rate of reaction in sec^{-1}
4.0 mL A + 6.0 mL water	10.0 mL		
5.0 mL A + 5.0 mL water	10.0 mL		
6.0 mL A + 4.0 mL water	10.0 mL		
7.0 mL A + 3.0 mL water	10.0 mL		
8.0 mL A + 2.0 mL water	10.0 mL		
9.0 mL A + 1.0 mL water	10.0 mL		
10.0 mL A + 0 mL water	10.0 mL		

Part 2 - The effect of temperature on the rate of reaction.

We will take special effort to bring our solutions to the specific temperatures that you are assigned. Two teams have the same temperature. Both will do a time trial (same as above, but now at a specific temperature. We will put all data onto the board in the back, and average it, to calculate rate of reaction.

Each team puts 8 mL of solution A and 8 mL of solution B into larger test tubes. These tubes need to be cooled, or heated, to the proper temperature. When the water bath you put them in is at the right temperature, mix the solutions in the reaction beaker and time it just like we did earlier.

Colder solutions will react slower; hotter solutions will be quick.



Temp °C	Team 1 Seconds to react	Team 2 Seconds to react	Average time for both trials	Calculated Rate (this is a DECIMAL)
10				
20				
30				
40				
50				
60				

Lab Questions 1 point each…

1. Based upon your data, make a general statement about the effect of the concentration (increasing amounts of solution A with less water) of the reactants on the rate of reaction. Write a sentence starting: "As the concentration of the reactants increases..."

2. Based upon your data, make a general statement about the effect of the temperature of the reactants on the rate of reaction. Write a whole sentence starting with: "As the temperature of the reactants increases..."

3. In the reversible reaction $2NO_{2(G)} \rightleftharpoons N_2O_{4(G)} + \text{energy}$ What would happen if the pressure was increased on this reaction and WHY? Start your answer like this: "By increasing the pressure on this reaction... "

4. The polar compound $(NH_2)_2CO$ is called urea and is an important fertilizer. It is made from a reaction between ammonia gas & carbon dioxide gas. Urea forms as a solid while water vapor is another product. Write the word equation for this reaction.

5. Write the balanced chemical equation for the reaction for urea synthesis.

6. Zinc citrate is written: $Zn_3(C_6H_5O_7)_2$ and is used in some toothpastes. It is formed from the reaction of zinc carbonate and citric acid as shown (this is NOT reversible).

$$3ZnCO_{3(S)} + 2HC_6H_7O_{7(AQ)} \rightarrow Zn_3(C_6H_5O_7)_{2(AQ)} + 3H_2O_{(L)} + 3CO_{2(G)}$$

   What happens to the rate of this reaction if you use powdered $ZnCO_3$ rather than chunks of it, and WHY?

7. Why do you draw best fit straight lines on both of the graphs (you should have)? Why not just connect all of the dots? Is there a difference? Explain this.

8. Define entropy. Water has 3 phases, which has the highest and lowest entropy? When comparing three solid compounds, that are at STP, named: glucose ($C_6H_{12}O_6$), candle wax ($C_{20}H_{42}$), and boron tribromide (BBr_3) - which has lowest and the highest entropy?

9. If you have 3 identical solutions at different temperatures, 10°C, 25°C, and 55°C, which would have the highest entropy and which would have the lowest entropy, and WHY?

Cover	Title, one sentence stating reason for this lab, name, class period	1 point
Handout	Data tables filled in, SF for rates	2 points
9 questions	On looseleaf	9 points
2 graphs	You will make two big graphs, plotting Rate as a Function of Concentration, and Rate as a Function of Temperature (use the volume of solution A to express the concentration). Your graphs must have titles, labels, and proper units.	4 + 4 = 8
Conclusion	1. The Collision Theory of Reactions 2. List the 4 factors affecting rates of reactions 3. Tell why catalysts are different than the other three factors. 4. Draw 2 medium sized (4 inches X 4 inches) Potential Energy Diagrams (one exo & one endo) label the ΔH, AC, AE, and show the affect of a catalyst with a dotted line on the both graphs. 5. State LeChatlier's Principle. 6. Using the following dynamic equilibrium, come up with 5 stresses and put in the forward or reverse shift arrows where appropriate. $C_6H_{12}O_{6(S)} + 6O_{2(G)} \rightleftharpoons 6CO_{2(G)} + 6H_2O_{(L)} + 2804\text{ kJ}$	5 points