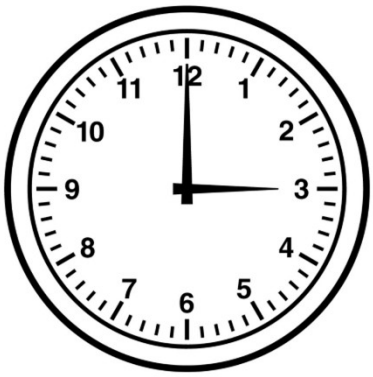
Clock Lab name

80 minutes



When a chemical reaction happens it usually happens in the blink of an eye. Some reactions, like today's in lab, are slower. Today we will react an iodine solution (A) with a starch solution (B). It is so slow we can time it on a clock! The reactants will mix and after some time (up to 50 seconds) they'll change color dramatically.

We'll keep time it with your phones, and we'll graph our results.

You'll mix two solutions called SOLUTION A and SOLUTION 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.

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

In Part 2 of the lab, you will measure the affect that different temperatures have on rate of reaction. As you already learned, hotter reactants make faster reactions. We'll see the affect varying temperatures have on the reaction rates and graph the class results into a second graph.

NOT MIXING the chemicals by accident is key. Keep solution A to the left, and solution B to the right. In between each trial just rinse, no soap, no drying. If the graduated cylinders touch each other when pouring into the reaction beaker, you must rinse them out too. You will be shown this in the lab, pay attention to details.

PART ONE — Reaction Rate as a function of the Concentration of Reactants

In data table 1, we will vary the amount of solution A in each of our seven trials. Put the proper amount of solution A into a graduated cylinder, then fill the cylinder up 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 it is quick! Stop the timer when the color change occurs and round the NEAREST SECOND. Record TIME in seconds into data table.
The RATE math 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 beakers are fine, do not dry with paper towels (the towels have starch in them).

Later, convert the time to rate. The rate is equal to 1 divided by time in seconds. It will be a small decimal, and the unit will be sec^{-1}. Unusual units are our favorite. Probably 2 SF since the reaction time will definitely be under 100 seconds.

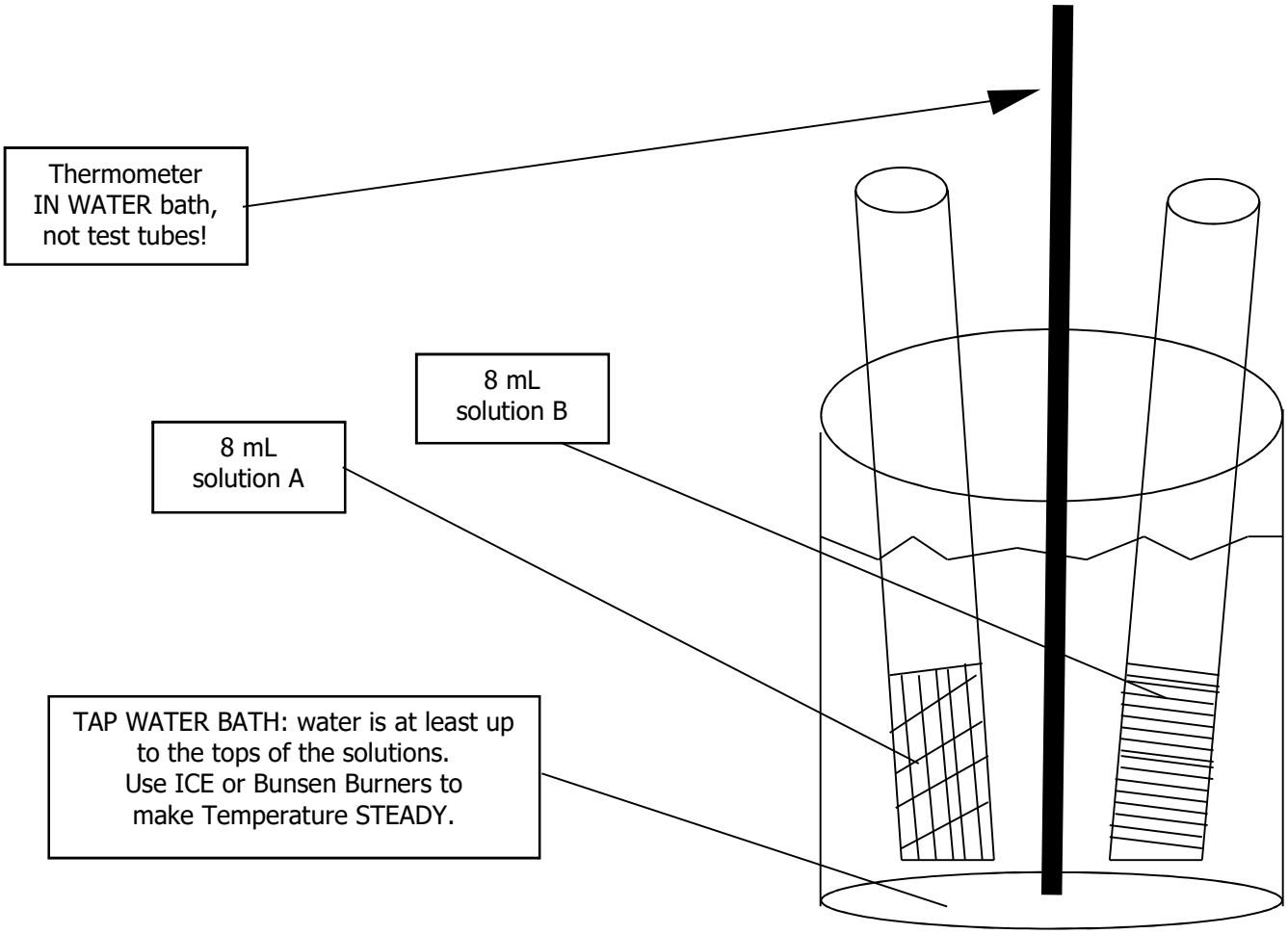
Data table 1, varying the concentrations of Solution A with Solution B.			
Solution A + water	Solution B	Time in seconds	Calculated Rate of reaction unit is sec^{-1}
4.0 mL A + 6.0 mL water	10.0 mL		
5.0 mL A + 5.0 mL water	10.0 mL		
6.0 mL A + 4.0 mL water	10.0 mL		
7.0 mL A + 3.0 mL water	10.0 mL		
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 + no water	10.0 mL		

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

Take special effort to bring each solution to the specific temperatures that you choose. 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.

Put 8 mL of solution A and 8 mL of solution B into medium sized test tubes. These tubes need to be cooled, or heated, to the exact 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.



Copy group data from board. Use the average to calculate rate.			Average the time for both trials	Calculate the Rate (this is a DECIMAL)
Temp °C	Team 1 Seconds to react	Team 2 Seconds to react		
10				
20				
30				
40				
50				
60				

Lab Questions

1. Make a generalized statement about the effect of the increasing amount of solution A (more concentrated reactants) has on the rate of reaction. Start with: "As the concentration of the reactants increases..."

2. Make a general statement about the effect of the temperature has on the rate of reaction.
Start with: "As the temperature of the reactants increases..."

3. In the reversible reaction $2NO_{2(G)} \rightleftharpoons N_2O_{4(G)}$ + energy What would happen if the pressure was increased on this reaction and WHY? Start with: "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, water vapor is another product. Write the word equation for this chemical reaction.

5. Write the balanced chemical equation with phase symbols for urea synthesis.

6. Zinc citrate is written $Zn_3(C_6H_5O_7)_2$ - it is used in toothpastes. It is formed from the reaction of zinc carbonate and citric acid shown here.

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

What happens to the rate of reaction if you use powdered $ZnCO_3$ instead of chunks of it?

7. On the two graphs you are supposed to draw the BEST FIT LINE for your data, through 0,0 for the concentration graph but NOT through 0,0 for the temperature graph. Why not just connect the data points?
Explain why the best fit lines are correct.

8. Define entropy. Compare the relative entropy of $C_{12}H_{22}O_{11(S)}$ and $C_8H_{18(L)}$ and $C_3H_{8(G)}$ (table sugar, gasoline, and propane). Which has lowest entropy, and which has the highest entropy? Why?

9. You have three identical 5.0 liters bottles of $CO_{2(G)}$ at 15°C, 25°C, and 45°C. Which gas would have the highest entropy and which would have the lowest entropy? 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 on graph paper	Make two big graphs, plotting Rate as a Function of Concentration, and then Rate as a Function of Temperature (use the volume of solution A to express concentration). Your graphs must have titles, labels, and proper units.	4 + 4 = 8
Conclusion	1. What does proper energy and proper orientation refer to? 2. What factors affect reaction rate? Why are catalysts different than the others? 3. Draw 2 Potential Energy Diagrams (4 inches X 4 inches = pretty big) (one exo, one endo) Titles, axis labels, label the ΔH, AC, AE, and show the effect of a catalyst with a dotted line on the both graphs. 4. Write out LeChatlier's Principle perfectly. 5. COPY this equilibrium. Come up with 5 chemical stresses and which way the reaction shifts, forward or reverse, as it accommodates the stress until a new equilibrium is established. $CO_{(G)} + H_2O_{2(G)} \rightleftharpoons H_{2(G)} + CO_{2(G)}$ + heat	5 points 25 points total