

# CLOCK REACTION LAB

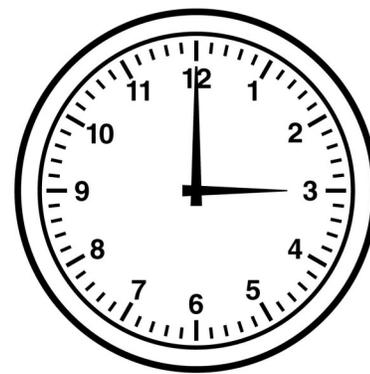
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80/1200

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 your phones, to the nearest second. 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 part of the lab 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 reaction, and graph the class results onto a second graph.

Set up is important, and NOT MIXING the chemicals by accident is key. Keep solution A to the left, and solution B to the right. You can get more solution if you need it, don't worry. You need 2 small graduated cylinders, one for each solution. You need deionized water. Finally you must get a "reaction beaker" where the "magic" happens.

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 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 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 is quick! Stop the timer when the color change occurs and round the NEAREST SECOND. Record TIME in seconds into data table. The RATE meth 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 decimal, and the unit will be  $\text{sec}^{-1}$ . Unusual units are our favorite.

Solution Mixing Directions: A: Put 8.50 g  $\text{KIO}_3$ , 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  $\text{NaHSO}_3$ , sodium bisulfite, AKA sodium acid sulfite, mix. Dilute to 8 Liters No cat./43 sec.

Tweak with  $\text{H}_2\text{SO}_4$  (10 mL, 1.0 M)

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

Solution A + Water	Solution B	Time in seconds	Calculate the Rate of reaction unit is $\text{sec}^{-1}$
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.

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.

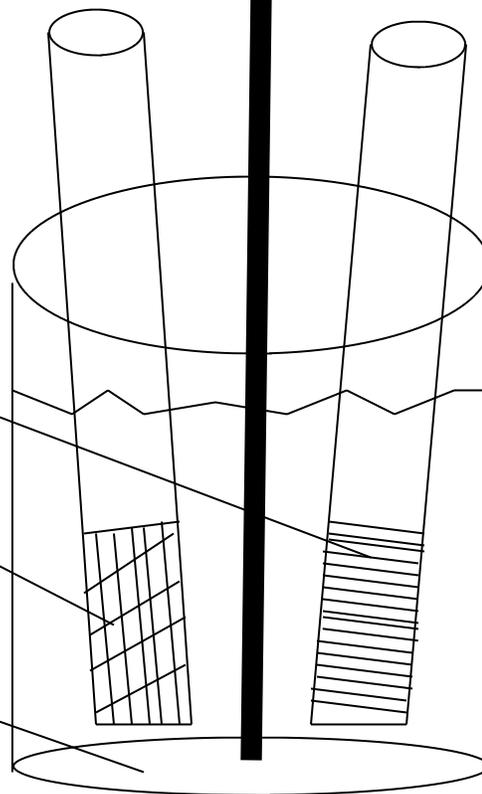
## Set up for part 2

Thermometer  
IN WATER, not  
solutions!

8 mL  
solution A

8 mL  
solution B

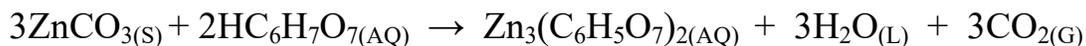
TAP WATER BATH: water is at least up  
to the tops of the solutions.  
Use ICE or Bunsen Burners to  
make Temperature STEADY.



Copy this data from board, do the averages, use average time for graphing.			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

- Based upon the data, make a statement about the effect of the concentration (increasing amounts of solution A) of the reactants on the rate of reaction. Write a sentence starting: "As the concentration of the reactants increases..."
- Based upon the 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..."
- In the reversible reaction  $2\text{NO}_{2(\text{G})} \rightleftharpoons \text{N}_2\text{O}_{4(\text{G})} + \text{energy}$   
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..."
- The polar compound  $(\text{NH}_2)_2\text{CO}$  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.
- Write the balanced chemical equation for the reaction for urea synthesis.
- Zinc citrate is written:  $\text{Zn}_3(\text{C}_6\text{H}_5\text{O}_7)_2$  and is used in some toothpastes. It is formed from the reaction of zinc carbonate and citric acid as shown.



What happens to the rate of reaction if you use powdered  $\text{ZnCO}_3$  instead of chunks of it? Explain why.

- On the two graphs you are supposed to draw the BEST FIT LINES for your data, through 0,0. Why not just connect the data points? Is there a difference? Explain the difference and why best fit is the right move here.
- Define entropy. When comparing 3 solid compounds, at STP: glucose ( $\text{C}_6\text{H}_{12}\text{O}_6$ ), candle wax ( $\text{C}_{20}\text{H}_{42}$ ), and boron tribromide ( $\text{BBr}_3$ ) - which has lowest entropy, and which has the highest entropy? Why is this?
- If you have 3 1.24 M  $\text{NaCl}$  (AQ) at these temperatures,  $10^\circ\text{C}$ ,  $25^\circ\text{C}$ , and  $55^\circ\text{C}$ , which would have the highest entropy and which would have the lowest entropy? Why is this the case?

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 <u>Rate as a Function of Concentration</u> , and <u>Rate as a Function of Temperature</u> (use the volume of solution A to express the concentration). Your graphs must have titles, labels, and proper units.	4 + 4 = 8
Conclusion	<ol style="list-style-type: none"> <li>The Collision Theory of Reactions</li> <li>List the 4 factors affecting rates of reactions</li> <li>Tell why catalysts are different than the other three factors.</li> <li>Draw 2 medium sized (4 inches X 4 inches) Potential Energy Diagrams (one exo &amp; one endo) label the <math>\Delta\text{H}</math>, AC, AE, and show the affect of a catalyst with a dotted line on the both graphs.</li> <li>State LeChatlier's Principle.</li> <li>Using the following dynamic equilibrium, come up with 5 stresses and put in the forward or reverse shift arrows where appropriate. <math>\text{C}_6\text{H}_{12}\text{O}_{6(\text{S})} + 6\text{O}_{2(\text{G})} \rightleftharpoons 6\text{CO}_{2(\text{G})} + 6\text{H}_2\text{O}_{(\text{L})} + 2804 \text{ kJ}</math></li> </ol>	5 points  25 points total