

Measuring Reaction Rates Lab

The Iodine Clock Reaction

Background/Theory

Understanding the conditions that affect the rate of a chemical reaction is essential in many different real-world applications of chemistry. The rate of reaction determined by several factors, including the concentration of the reactants, temperature, the surface area of reactants (for a heterogeneous reaction), nature of reactants, and the presence of a catalyst. This lab focuses on the effect of temperature (part 1) and concentration (part 2) on the reaction rate.

The experiment uses the iodine clock reaction. Here, two clear, colorless solutions (named solutions A and B) react to form a blue-black solution, due to the reaction between starch and iodine. When either solution is heated to different temperatures or a series of concentrations is made students will be able to observe a measurable difference in reaction rate.

Links to Curriculum

- **HS-PS1-4.** Develop a model to illustrate that the release or absorption of energy from a chemical reaction system depends upon the changes in total bond energy.
- **HS-PS1-5.** Apply scientific principles and evidence to provide an explanation about the effects of changing the temperature or concentration of the reacting particles on the rate at which a reaction occurs.
- **HS-PS1-6.** Refine the design of a chemical system by specifying a change in conditions that would produce increased amounts of products at equilibrium.

Learning objectives

- Practice laboratory techniques of safely altering the temperature of a solution and creating different concentrations of a solution.
- Observe and record the effect of changing the temperature of a system on the rate of a reaction
- Observe and record the effect of changing the concentration of a reactant on the rate of a reaction
- Apply the concepts of particle collision theory

Prior Knowledge required

- Altering the concentration and temperature of a solution
- Particle collision theory
- Knowledge of reliability and fair testing

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What you'll need

- Solution A:
 - 10ml 2M Sulfuric acid
 - 10ml 3% hydrogen peroxide
 - Dilute solution to 100ml with water
- Solution B:
 - 0.04g sodium thiosulfate pentahydrate in 20ml water
 - 0.9g potassium iodide in 5 ml water
 - 4 ml starch solution
 - Dilute solution to 100ml with water
- Standard Laboratory glassware
- A magnetic stirrer (if available)
- Hot water source (e.g. kettle or urn)
- Cold water source
- Thermometers
- Plastic container (water bath)
- Safety glasses

What to Do:

https://www.youtube.com/watch?v=_qhYDUjt8fl

- Solutions A and B can be made up in stock volumes ahead of time and distributed into dropper bottles.

Part 1: Changing the temperature of the solution:

1. Measure 20ml of each solution into separate conical flasks
2. Set up a water bath to heat solution B.
3. Place solution B into the water bath and allow it to reach temperature.
4. Add solution A to solution B and swirl. Record the time taken for the solution to turn blue-black.
5. Repeat for other temperatures.

Part 2: Changing the concentration of the solution:

1. Measure 20ml of solution A into a conical flask
2. Make up the following concentrations of solution B (25%, 50%, 75%, and 100%) using water
3. Add solution A to solution B and swirl. Record the time taken for the solution to turn blue-black.
4. Repeat for other concentrations.

Name: _____ Period: _____ Date: _____

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Additional Information

- The YouTube clip uses a magnetic stirrer, however, flasks can be swirled and left to settle on the lab bench if this is not available
- Once mixed, solution A and B can release vapors which may make students feel unwell if the reacted flasks are left to sit for too long. Encourage students to rinse out the flasks promptly once the reaction has finished.

Results

Part 1: Effect of Temperature

Temperature (°C)	20°C	30°C	40°C	50°C
Time taken to change color (s)				

Part 2: Effect of Concentration

Concentration (%)	25%	50%	75%	100%
Time taken to change color (s)				

Post-Lab Questions

1. Draw a line graph of the results for each experiment.
2. Write a generalized conclusion for the effect of temperature and concentration on reaction rate.
3. Identify THREE factors which may affect the reliability of the results from this lab. For each explain how these factors affect the reliability of the conclusion
4. Explain using particle theory how changing the temperature of solution B affects the rate of reaction.
5. Explain using particle theory how changing the concentration of solution B affects the rate of reaction.