Name: _____ Period: _____ Date: _____

Measuring Reaction Rates Lab Answers

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.

Learning objectives

In this lab you will:

- 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

What you'll need

- Solution A
- Solution B
- 2 Conical flasks
- 3 Measuring cylinders
- A magnetic stirrer (if available)
- Hot water source (e.g. kettle or urn)
- Cold water source
- Thermometer
- Plastic container (water bath)
- Safety glasses

Name: _____ Period: _____ Date: _____

Measuring Reaction Rates Lab Answers

What to Do:

The lab will be run in two parts. Work in groups of two or three students to carry out the experiments and then complete the post-lab tasks.

Part 1: Changing the temperature of the solution:

1. Measure 20ml of each solution into two separate conical flasks.
2. Set up a water bath to heat solution B by mixing hot and cold water to obtain a given temperature.
3. Place solution B into the water bath and allow it to reach temperature.
4. Add solution A to solution B and swirl it carefully. 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% - 5ml solution B and 15ml water
    - 50% - 10ml solution B and 10ml water
    - 75% - 15ml solution B and 5ml water
    - 100% - 20ml solution B
3. Add solution A to the first concentration of solution B and swirl. Record the time taken for the solution to turn blue-black.
4. Repeat for other concentrations.

Safety:

- Once mixed, solution A and B can release vapors which may make you feel unwell if the reacted flasks are left to sit for too long. Ensure that flasks are promptly rinsed out once the reaction has finished.

Name: _____ Period: _____ Date: _____

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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 Tasks

1. Draw a graph for each set of results you have obtained.

2. Write a generalized conclusion for the effect of temperature and concentration on reaction rate.
   As the temperature and concentration of solution B increases the rate of reaction also increases.

3. Identify THREE factors which may affect the reliability of the results from this lab. For each explain how these factors would affect the reliability of the conclusion.

   1. *Factor: Accuracy when measuring out volumes of solutions A or B*
      Effect: More (or less) of either solution A or B will alter the amount of solution available to react.

   2. *Factor: Lack of repeated trials.*
      Effect: Repeated tests ensure the results are not a 'one-off' and that a valid conclusion can be reached.

   3. *Factor: Cleaning and drying glassware in between experiments.*
      Effect: Glassware may contain residual chemicals from previous experiments which may alter the concentration of the solution.

Name: _____ Period: _____ Date: _____

Measuring Reaction Rates Lab Answers

4. Explain using particle theory how changing the temperature of solution B affects the rate of reaction.
   Temperature is the measure of the average kinetic energy of a substance. By increasing temperature, the speed at which the particles in the substance move also increases. Particles which move around at greater speeds have a higher probability of colliding with reactant particles in the correct orientation and with sufficient force to cause the bonds in the reactants to break and new bonds to form. Thus, there is a higher frequency of successful collisions in reactants with a higher temperature.

5. Explain using particle theory how changing the concentration of solution B affects the rate of reaction.
   Concentration is the number of particles in a given volume of solution. A higher concentration means that there are a greater number of particles available to collide in a reaction. Increasing the concentration of solution B means that there are more particles available to collide with solution A particles, increasing the likelihood that a successful collision can take place.