Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Hour:\_\_\_\_\_

**Vitamin C Clock**

**Introduction:**

Clocks have been used to measure time since antiquity. They have been fashioned from various materials, as simple as stones arranged to form a sundial and as complex as a liquid crystal display. A clock can also be constructed from molecules that react at a rate that allows an interval of time to elapse between the mixing of the chemicals and the completion of the reaction. In this reaction, the endpoint of the reaction is signaled by an abrupt change in the appearance of the reaction solution from colorless to blue-black. In this reaction we will be measuring the rate of the reaction and also testing a hypothesis as to what might slow down or speed up the reaction.

In this activity we are looking at the following reactions:

(1) 2H+ + 2I- + H2O2 → I2 + 2H2O

(2) I2 + C6H8O6 (vit C) → 2H+ + 2I- + C6H6O6

When H2O2 is added to the tincture of iodine (rxn 1), I2 begins to be produced. But reaction 2 uses up the I2 as fast as it is formed in reaction 1. After all of the vitamin C in reaction 2 is used up, then I2 will begin to accumulate. Liquid starch is used as an indicator. As I2 builds up it will react with the starch to form a blue-black color. Measuring the time it takes for the blue-black color to appear shows how fast the vitamin C was used up, and hence the reaction rate for reaction 2.

**Materials:**

* 1000 mg vitamin C tablets
* 3 plastic cups
* tincture of iodine (2%)
* hydrogen peroxide (3%)
* water
* liquid laundry starch
* thermometer

**Procedure A:**

1. Make a vitamin C stock solution by crushing 1000 mg of vitamin C and dissolving it in 60 mL of water. The vitamin C is easier to crush if you allow it to dissolve in the water for a while. Label this solution “vitamin C stock solution”.
2. Label one cup “solution A”. Combine 5 mL of the vitamin C stock solution with 5 mL of the tincture of iodine and 60 mL water.
3. Label another cup “solution B”. Add 15 mL of hydrogen peroxide, 60 mL of water and 2 mL of liquid starch solution.
4. Pour solution A into solution B and then pour the resulting solution back into the empty cup to mix them thoroughly. Begin timing as soon as they first mix and continue until there is a color change. Record the time it takes for the color to change.

**Procedure B:**

1. Consider conditions that will affect the rate of the reaction. You and your group need to come up with two ideas to test. Below write how you will alter the instructions in Procedure A to test your hypothesis and what your expected outcome is. After getting your procedures approved by the teacher you may then test your ideas.

**Data:**

Construct a table or graph to represent the data that you collected in this lab.

**Post Lab Questions:**

1. What is the central idea of the “collision model of reaction rates”?
2. According to kinetic molecular theory, what happens to the average kinetic energy of a substance as temperature increases? What should happen to the average speed of the molecules in that substance as temperature increases?
3. A chemical reaction is carried out between substances A and B both at 20°C. What should happen to the number of collisions per second between molecules of A and B if they are mixed again when both are at 35°C? What should happen to the reaction rate? Support your answers with collision theory.
4. A chemical reaction is carried out between 1.0 molar (unit of concentration) solutions of substances C and D. What should happen to the number of collisions per second if the concentrations of C and D are doubled at the same temperature? What should happen to the reaction rate? Support your answers using collision theory.
5. Two samples of solid sugar are dehydrated with sulfuric acid. The first sample is a 2.0 gram sugar cube. The second sample is 2.0 grams of granulated sugar. Would you expect to see any difference in the rate of reaction? Why or why not?
6. Choose ONE of the following questions to answer.
   1. What effect does reactant temperature have on reaction rate?
   2. What effect does reactant concentration have on reaction rate?

Defend your answer to the question you chose with the data from your designed experiment.