

THE TIMEKEEPER

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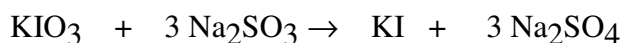
What is time? Even Einstein had difficulty with this question. We now recognize it to be the Fourth Dimension (not to be confused with the Fifth Dimension - the rock group of the '60's) which, in fact, turns out to be nonlinear. The fact that time moves at different speeds *relative* of your location to other phenomena is part of the theory ofah.... relativity! To answer "What is time?" is to answer "What is life?".

There is a person who can answer this question. The Guru lives on top of Mt. Beaumont, a small mountain on the other side of Yokum. Every day, the Guru studies time and acquires knowledge by means of a 30 second chemical reaction called "The Timekeeper". You, too, may become a guru* if you run the Timekeeper reaction for exactly 30 seconds ... no more, no less. Only then will you truly understand the meaning of life!

The Theory:

What determines the speed of a chemical reaction? (I bet you've asked this question millions of times!!) The portion of chemistry that deals with reaction rates is known as **kinetics**. *When thinking kinetics, chemists often think of collisions*. That is, in order for molecules to react they must first undergo an effective collision. Anything that will affect the rate of collision will affect the reaction rate. Believe it or not, this relatively simple concept has a name, it's called **collision theory**.

The guru above used the well known **iodine clock** reaction. It's called the iodine clock reaction because ... ah, ...uhm... it was discovered by Frank Clock. The reaction involves the interaction between potassium iodate and sodium sulfite:



Potassium	Sodium	Potassium	Sodium
Iodate	Sulfite	Iodide	Sulfate

While the reaction is truthfully more complicated than that shown, the important thing here is that the rate is determined by the collision between potassium iodate and sodium sulfite. An intermediate step of this reaction (not shown) involves the production of iodine (I₂). When all the Na₂SO₃ is used up, the iodine produced is free to react with some starch that has been added to the solution. This iodine-starch complex indicates completion of the reaction.

* Please note that the cost of guru training is included in your SUNY Plattsburgh tuition.

Procedure:

Preparation of Solutions:

(Sorry, Charley, unlike other labs you will have to make up your own solutions here!)

KIO₃ Solution: Calculate the number of grams required to make 250 mL of a 0.020 M KIO₃ solution. Check this number with your lab instructor. Using a 250 mL volumetric flask, make this solution by adding this many grams to the flask about half full of distilled water, dissolving, and then filling to the mark. Label.

Na₂SO₃ Solution: Calculate the number of grams required to make 500 mL of a 0.0025 M Na₂SO₃ solution. Check this number with your lab instructor before proceeding. Using a 500 mL volumetric flask, add this amount to the flask half filled with distilled water. Dissolve and then add 10 mL of 0.6 M H₂SO₄ and 20 mL of starch suspension. Swirl and fill to the mark. Label.

Test Run:

You, the novice, need at least one practice run before you get into the actual study. Mix 20.0 mL of the KIO₃ solution with 20.0 mL of the Na₂SO₃ solution in a small Erlenmeyer while watching a clock. Measure the length of time it takes for the reaction to come to completion, i.e. when some observable change occurs. Record this time.

Studies

Becoming a guru requires more than just running The Timekeeper reaction for 30 seconds. It takes dedication, it takes higher knowledge, ...it takes doing this laboratory for three hours!! Only after you fully demonstrate a complete understanding of the iodine clock reaction (culminating in a timed presentation) will you be allowed to climb the mountain and try your hand at being guru.

For guru preparation, you are asked below to study the effect of concentration on reaction rate. Remember, it is important that the procedure listed above is kept constant. This means that in each run **you mix 20mL of a KIO₃ solution with 20mL of a Na₂SO₃ solution!**

- a. To demonstrate the effect of concentration of a reactant on reaction rate you will prepare a series of KIO₃ of different concentrations and run each of these samples in the general procedure, i.e., 20mL of the KIO₃ sample plus 20mL of Na₂SO₃ and measure the reaction time.

Prepare the KIO₃ samples by diluting the 0.020 M stock solution with distilled water. Remember, you will need a final volume of 20mL KIO₃ of each.

The Timekeeper

Now that you've completed the formal GRUNT (Guru Requisite Undergraduate Novice Training) work, you must try your hand at being Guru. You must demonstrate your new found intellectual powers by preparing for your lab instructor, a timekeeper reaction that goes for exactly 30 seconds. (Back in the old days, you had to come within a microsecond to become a guru; today, we'll allow a 3 second deviation. Guru's just aren't what they used to be!) You may make two attempts. Good Luck!

Grading:

30 s \pm 3s	100 %
\pm 4 – 6 s	90 %
\pm 7 – 9 s	80 %
etc.	

Pre Lab Questions

- 1.) How will you know when the reaction is complete (Hint: what happens when iodine-starch complex forms)
- 2.) Describe how to prepare 20.00 mL of a 0.0050 M KIO_3 solution from a stock solution with a concentration of 0.020 M.
- 3.) Which reactant must be the limiting reagent in this reaction for this to work? Explain your answer.