

Reaction Kinetics: The Iodine Clock Reaction

Introduction

The “clock reaction” is a reaction famous for its dramatic colorless-to-blue color change, and is often used in chemistry courses to explore the rate at which reactions take place. The color change occurs when I_2 reacts with starch to form a dark blue iodine/starch complex. The ability to record the time at which the blue complex appears allows the rate of reaction to be determined accurately with a stopwatch.

In this experiment, the rate law for a reaction is determined using the method of initial rates. The effect of concentration on the rate of this reaction is determined by measuring the initial reaction rate at several reactant concentrations. You will also examine the effect of a catalyst on the reaction rate. Lastly, you will investigate the effect of temperature on the rate of this reaction, which will allow you to determine the activation energy.

The Clock Reaction

The primary reaction to be studied is the oxidation of the iodide ion by the bromate ion in aqueous solution:



This reaction will be run in the presence of a known amount of $S_2O_3^{2-}$ (thiosulfate), which reacts very rapidly with I_2 . As long as $S_2O_3^{2-}$ is present, I_2 is consumed by $S_2O_3^{2-}$ as fast as it is formed. This competing reaction prevents the I_2 produced from our reaction of interest from reacting with starch, so no color change is observed until the thiosulfate is completely used up. The “clock” reaction is the reaction of a very small amount of $S_2O_3^{2-}$ (thiosulfate) with the I_2 produced in the primary reaction:



The “clock” reaction will signal when the primary reaction forms a specific amount of I_2 . The amount of I_2 formed before the color change can be calculated from the known amount of $S_2O_3^{2-}$ added using the molar ratio in Equation 2. To find the rate of Equation 1, the change in the concentration of I_2 is monitored over time. Below, $\Delta[I_2]$ is the change in the concentration of I_2 , and Δt represents the change in time:

$$Rate = \frac{1}{3} \cdot \frac{\Delta[I_2]}{\Delta t} \quad \text{Equation 3}$$

Recall that:

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A Surface Chemistry

- 1 To prepare colloidal solution sol of starch
- 2 To prepare a colloidal solution of egg albumin
- 3 To prepare colloidal solution of gum
- 4 To prepare colloidal solution of aluminium hydroxide Al(OH)_3
- 5 To prepare colloidal solution of ferric hydroxide Fe(OH)_3
- 6 To prepare colloidal solution of arsenious sulphide As_2S_3
- 7 To purify a freshly prepared sol by dialysis
- 8 To compare the effectiveness of different common oils Castor oil cotton seed oil coconut oil kerosene oil mustard oil in forming emulsions

Viva Voce B Chemical Kinetics

- 1 To study the effect of concentration on the rate of reaction between sodium thiosulphate and hydrochloric acid
- 2 To study the effect of temperature on the rate of reaction between sodium thiosulphate and hydrochloric acid
- 3 To study the rate of reaction of iodide ions with hydrogen peroxide at different concentrations of iodide ions
- 4 To study the rate of reaction between potassium iodate KIO_3 and sodium sulphite Na_2SO_3 using starch solution as indicator

Viva Voce C Thermochemistry

- 1 Determine the enthalpy of dissolution of copper sulphate $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ in water at Room temperature
- 2 To determine the enthalpy of neutralization of the reaction between HCl and NaOH
- 3 To determine enthalpy change during the interaction between acetone and chloroform

Viva Voce D Electrochemistry

- 1 To study the variation of cell potential in $\text{Zn} | \text{Zn}^{2+} || \text{Cu}^{2+} | \text{Cu}$ with change in concentration of electrolytes CuSO_4 or ZnSO_4 at room temperature

Viva Voce E Chromatography

- 1 To separate the coloured components pigment present in the given extract of leaves and flowers by ascending paper chromatography and find their R_f values
- 2 To separate the coloured components present in the mixture of red and blue inks by ascending paper chromatography and find their R_f values
- 3 To separate Co^{2+} and Ni^{2+} ions present in the given mixture by using ascending paper chromatography and determine their R_f values

Viva Voce F Preparation of Inorganic Compounds

- 1 Preparation of double salt of ferrous ammonium sulphate Mohr's salt from ferrous sulphate and ammonium sulphate
- 2 To prepare a pure sample of potash alum fitkari
- 3 Preparation of crystals of potassium ferric oxalate or potassium trioxalate ferrate III

Viva Voce G Preparation of Organic Compounds

- 1 Preparation of iodoform from ethyl alcohol or acetone
- 2 Preparation of acetanilide in laboratory
- 3 Preparation of β -Naphthol aniline dye
- 4 To prepare a pure sample of dibenzalacetone
- 5 To prepare a pure sample of p-nitro acetanilide

Viva Voce H Tests for the Functional Groups Present in Organic Compounds

Viva Voce I Study of Carbohydrates Fats and Proteins

- 1 To study simple reactions of carbohydrate
- 2 To study simple reactions of fats
- 3 To study simple reactions of proteins
- 4 To investigate presence of carbohydrates fats and proteins in food stuffs

Viva Voce J Volumetric Analysis

- 1 To prepare 250 ml of $M/10$ solution of oxalic acid
- 2 To prepare 250 ml of $M/10$ solution of ferrous ammonium sulphate
- 3 Prepare $M/20$ solution of oxalic acid with its help find out the molarity

and strength of the given solution of potassium permanganate 4 Prepare M 20 solution of Mohr's salt using this solution determine the molarity and strength of potassium permanganate solution Viva Voce K Qualitative Analysis Viva Voce INVESTIGATORY PROJECTS 1 To study the presence of oxalate ions in guava fruit at different stages of ripening 2 To study the quantity of casein present in different samples of milk 3 Preparation of soyabean milk and its comparison with natural milk with respect to curd formation effect of temperature etc 4 To study the effect of potassium bisulphite as food preservative at various concentrations 5 To study the digestion of starch by salivary amylase and the effect of pH and temperature on it 6 To study and compare the rate of fermentation of the following materials wheat flour gram flour potato juice and carrot juice 7 To extract essential oils present in saunf aniseed ajwain corum illaichi cardamom 8 To detect the presence of adulteration in fat oil and butter 9 To investigate the presence of NO₂ in brinjal **Lab Manual Chemistry**

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