

Rate of reaction – the effects of concentration and temperature

Topic

Kinetics.

Timing

30 min.

Description

Students react potassium iodate and a starch solution. They vary the concentration and temperature to affect the reaction time.

Apparatus and equipment (per group)

- Two 250 cm³ beakers
- Water bath (or some means of warming solution A).

Chemicals (per group)

- Solution A – 4.3 g of KIO₃ per dm³ (**solid is oxidizing, Harmful if swallowed and a skin/eye/respiratory irritant, solution is Low Hazard**)
- Solution B – starch solution

Make the starch solution as follows: Make a paste of 4 g of soluble starch in a small amount of warm water. Slowly add 800 cm³ of boiling water. Boil for a few minutes then cool the solution. Add 0.2 g of sodium metabisulfite (Na₂S₂O₅) (**Harmful if swallowed, Causes eye damage**). Add 5 cm³ of 1.0 mol dm⁻³ sulfuric acid (**skin/eye Irritant**). Dilute to 1 dm³.

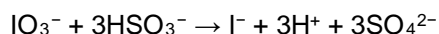
Teaching tips

The colour change takes about 5–6 minutes. A colorimeter sensor or a light sensor set up as a colorimeter can be used to monitor colour change on the computer. The result, in the form of graphs on the computer, provides very useful material for analysis using data logging software. While a colorimeter sensor is ideal, it is easy to substitute a light sensor clamped against a plastic cuvette filled with the reactants. The data logging software should clearly show the change occurring on a graph. Measure the rate of change by using its slope or the time taken for a change to occur.

Background theory

The mechanism is not clearly understood but the following simplified sequence has been proposed.

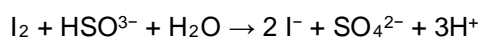
1. IO₃⁻ reacts with HSO₃⁻ to form I⁻:



2. I⁻ reacts with IO₃⁻ to form I₂.



3. I₂ is immediately consumed by reacting with HSO₃⁻:



4. When all of the HSO₃⁻ has been used up, I₂ accumulates.

5. Iodine reacts with starch to form a coloured complex.

Safety

Wear eye protection (to eye protection standard BS EN 166 3) for preparing the solutions.

Answers

1. There are more molecules of reactant in the solution therefore more chance of reacting.

2. Increasing the temperature has two effects. Since the particles are moving faster, they will travel a greater distance in a given time and so will be involved in more collisions. In addition, because the particles are moving faster a larger proportion of the collisions will exceed the activation energy, the energy needed to react. The rate of the reaction therefore increases.

3. Depending on the results of the experiment, increase/decrease concentration to a specific amount AND/OR increase/decrease the temperature by a specific amount.

Credits

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Health & safety checked January 2018

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