WJEC (Eduqas) Chemistry A-level

SP PI3 - Determination of the Order of a Reaction

Flashcards

Give the common name for the experiment where iodide ions undergo oxidation by hydrogen peroxide in an acid solution

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Iodine clock experiment

Give the equations of the reactions which take place in the iodine clock experiment

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$$H_2O_2 + 2H^+ + 2I^- \rightarrow I_2 + 2H_2O$$

The iodine then reacts with the sodium thiosulfate as follows:

$$2S_2O_3^{2-} + I_2 \rightarrow 2I^- + S_4O_6^{2-}$$

Briefly describe the iodine clock method

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H_2O_2 reacts with acidified iodide ions to produce iodine. The iodine then immediately reacts with a limited amount of sodium thiosulfate. The excess iodine remains in the solution and reacts with the starch to produce a blue-black colour.

What apparatus is required to determine the order of reaction for the oxidation of iodide ions by hydrogen peroxide?

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- Stopwatch
- 100 cm^3 conical flasks
- Stirring rod
- 10 cm^3 measuring cylinders
- 5 cm^3 measuring cylinder
- 1 cm^3 measuring cylinder

What chemicals are required to determine the order of reaction for the oxidation of iodide ions by hydrogen peroxide?

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- Hydrogen peroxide (H_2O_2)
- Sulfuric acid (H_2SO_4)
- Potassium iodide (KI)
- Sodium thiosulfate ($Na_2S_2O_3$)
- Starch solution
- Deionised water

Outline the experimental procedure to determine the order of reaction for the oxidation of iodide ions by hydrogen peroxide

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1. Obtain at least 5 different concentrations of H_2O_2 by mixing different volumes of H_2O_2 and deionised water. The total volume must not exceed 5 cm^3.
2. Add the following reagents to a 100 cm^3 conical flask: 10.0 cm^3 H_2SO_4, 10.0 cm^3 $Na_2S_2O_3$, 15.0 cm^3 KI, 1.0 cm^3 starch solution, 9.0 cm^3 deionised water.
3. Rapidly add 5.0 cm^3 of H_2O_2 solution to the mixture. Immediately start the timer.
4. Stop the timer when the blue colour appears and record the time.
5. Repeat steps 1-4 using the other four concentrations of H_2O_2 solution.
6. Calculate the rate of reaction for each experiment.
7. Plot a graph of rate of reaction against [H_2O_2] solution. Calculate the order of reaction of H_2O_2.

Why is it important to thoroughly mix each of the reaction mixtures?

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The reaction mixtures must be mixed to ensure all the reacting particles are evenly distributed throughout the solution. The reaction mixtures must all be mixed as equally as possible to ensure a fair test so it is important that they are all mixed thoroughly.

What does the formation of the blue-black colour in the iodine clock reaction indicate?

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When starch reacts with iodine it produces a dark blue-black solution. Therefore the formation of the blue-black colour indicates the reaction of the excess I_2 with the starch. The timer should be stopped when the blue-black colour appears as it signifies the end of the reaction.

Explain how sodium thiosulfate acts as a limiting reagent in the iodine clock method

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The sodium thiosulfate reacts with the iodine produced from the first reaction. There needs to be excess iodine so that the blue-black colour is produced at the end. To ensure there is excess iodine, there must be a limited amount of sodium thiosulfate so that it does not react with all the iodine.

Explain how the increase in concentration of H_2O_2 will affect the rate of reaction

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Increasing the concentration of H_2O_2 will increase the number of reactant particles in the same volume. This means the particles will be closer together, so there will be more frequent collisions. This will lead to more successful reaction collisions, increasing the rate of reaction.

Explain why it is important that the reactions with different concentrations of H_2O_2 are carried out at the same temperature

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Temperature also has an effect on the rate of reaction. An increase in temperature will cause an increase in the rate of reaction. Therefore, it is important that temperature is controlled during the reactions, to ensure that any trends in the results are only as a result of the changing concentration of H_2O_2.

What are the control variables for the iodine clock experiment?

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- Temperature of reactants/surroundings
- Volumes of all reactants (except the H_2O_2 and water which are changed to obtain different concentrations)
- Concentrations of all reactants (except H_2O_2)

Why might the iodine clock experiment be carried out on a white tile?

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The white tile allows the colour change (from colourless to blue-black) to be easily and quickly identified.

How can the results of the experiment be used to determine the order of reaction with respect to H_2O_2?

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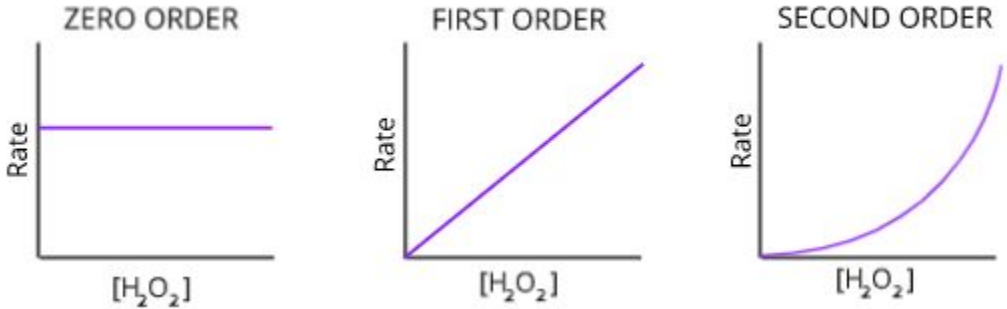
The rate (1/time) should be plotted against concentration of H_2O_2. The shape of the curve on the graph can then be used to determine the order of reaction with respect to H_2O_2.



How could the experiment be changed to determine the order of reaction with respect to iodide ions?

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To investigate the order of reaction with respect to iodide ions, the experiment is altered so that the concentration of potassium iodide (KI) changes for each test whilst the concentration of H_2O_2, along with the other reactants, remains constant. The rate is then plotted against concentration of KI.