WJEC (Eduqas) Chemistry A-level

SP C2.3b - Study of an ‘Iodine Clock’ Reaction

Flashcards

Define rate of reaction

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The change in concentration of the reactants or products over time.

What is meant by an ‘initial rates method’?

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A method which involves measuring the initial rate of reaction with multiple different concentrations of a reactant to observe how the rate of reaction varies.

The iodine clock method is an initial rate method.

What apparatus is required to carry out the iodine clock experiment?

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- Stopwatch
- 10 cm^3 measuring cylinders
- 25 cm^3 pipette with safety filler
- 50 cm^3 burette and funnel
- Burette clamp and stand
- Stirrer
- White tile

What chemicals are required to carry out the iodine clock experiment?

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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

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

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

The iodine then reacts with the thiosulfate ions 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.

Outline the experimental procedure of the iodine clock method

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1. Obtain 5 different concentrations of H_2O_2 by varying the volume of H_2O_2 and deionised water. The total volume must not exceed 5 cm^3 .
2. Make up the solutions according to the table. Do not add the hydrogen peroxide.
3. Add 1 cm^3 of starch solution to each flask and mix.
4. Add the H_2O_2 to flask 1. Immediately start the stopwatch.
5. Swirl to mix the reaction mixture.
6. Stop timing as the solution turns blue-black.
7. Record the time.
8. Repeat the experiment for flasks 2-5.

Flask	Volume H_2SO_4 (cm^3)	Volume $Na_2S_2O_3$ (cm^3)	Volume KI (cm^3)	Volume H_2O (cm^3)	Volume H_2O_2 (cm^3)
1	10	10	25		
2	10	10	25		
3	10	10	25		
4	10	10	25		
5	10	10	25		

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 method 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.