The **initial rates method** is a technique that lets you use the initial rate of an experiment to work out the orders of reaction. They have to be done by:

- Carrying out separate experiments using different initial conc. of one reactant. Change only one conc. and keep the rest constant.

- See how the change in initial conc. affects the initial rates and find the order of reaction.

- Could be done using continuous monitoring method and drawing conc. time, or volume time graph. Calculating the gradient at t=0 gives **initial rate**.

**Clock reaction**

Example of initial rates method.

- You measure how the time taken for a set amount of product to form changes as you vary the conc. of one of the reactants.

- There will be a sudden increase in the conc. of a certain product as a limiting reactant is used up.

- Usually there is easily observable end point – colour change – to tell when the desired amount of product has formed.

- Quicker the reaction finished, the faster the initial rate of reaction.

- Assumptions made:
  - The conc. of each reactant doesn’t change significantly over time period of the clock reaction.
  - The temp. stays constant.
  - When end point is seen the reaction has not proceeded too far.

**Iodine clock reaction:**

Monitored reaction:

- \( \text{H}_2\text{O}_2 + 2\text{I}^- + 2\text{H}^+ \rightarrow 2\text{H}_2\text{O} + \text{I}_2 \)

- Small amount of sodium thiosulfate solution and starch (indicator) are added to an excess of hydrogen peroxide and iodide ions in acid solution.

- Sodium thiosulfate reacts **instantaneously** with iodine: \( 2\text{S}_2\text{O}_3^{2-} + \text{I}_2 \rightarrow 2\text{I}^- + \text{S}_4\text{O}_6^{2-} \)