Reaction Rate and Concentration: Instruction Sheet

In this experiment, you will study the reaction of dissolved sodium thiosulphate ($Na_2S_2O_3$) with hydrochloric acid:

$$S_2O_3^{2-}(aq) + 2\ H_3O^+(aq) \rightarrow SO_2(aq) + {}^1/_8\ S_8(s) + 3\ H_2O$$

The objective is to determine the relation between the reaction rate and the concentration of one of the reactants, the thiosulphate ion.

You need the following material (per group of 2 students):

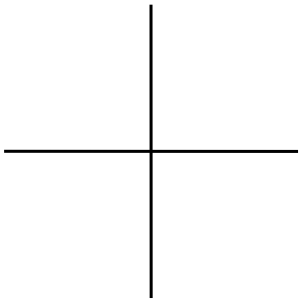
- stopwatch or watch showing the seconds
- 2 pairs of safety glasses
- aqueous solution of $Na_2S_2O_3$ 0.2 M
- hydrochloric acid 1 M
- 2 pipettes and pipette holder
- 1 measuring cylinder 10 ml
- 1 measuring cylinder 50 ml
- 1 Erlenmeyer flask 100 ml with wide neck
- 1 beaker for liquid waste
- paper towels

You must wear safety glasses at all times during the experiment (also when washing the glassware)!

Proceed as follows:

① Pour 30 ml of an aqueous solution of $Na_2S_2O_3$ (c = 0.2 mol/l) into the bigger of the two measuring cylinders and 6 ml of hydrochloric acid (c = 1 mol/l) into the smaller one. If you don't get the correct volume initially, adjust it using a pipette. Use DIFFERENT PIPETTES for the two solutions, in order not to contaminate them!

② Pour the hydrochloric acid into the Erlenmeyer flask and put it on the opposite cross. Then add the thiosulphate solution quickly in one pour and start the stopwatch. Measure the time until the cross becomes invisible when looking through the flask from above.



Time: . . . . . .

③ Empty the Erlenmeyer flask into the beaker.

④ Perform the steps ① to ③ two more times - each time with a lower thiosulphate concentration but unchanged concentration of hydrochloric acid. To do so, replace the 30 ml of $Na_2S_2O_3$ solution in the above protocol by:

a) 20 ml of $Na_2S_2O_3$ solution + 10 ml of water (mixing them in the bigger measuring cylinder).

Time: . . . . . .

b) 10 ml of $Na_2S_2O_3$ solution + 20 ml of water.

Time: . . . . . .

⑤ Pour the waste solution down the sink. Rinse the glassware with tap water and put it in the appropriate container. Put away all materials where they belong.

⑥ The volume of the added thiosulphate solution constitutes the horizontal coordinate in the following coordinate systems. It is a measure of the thiosulphate concentration in the reaction mixture, since the total volume of the latter is the same in all three experiments.

a) Plot the times you measured as a vertical coordinate into the following coordinate system.

b) Plot the reciprocal values of the times you measured as a vertical coordinate into the following coordinate system. They are a measure of the reaction rate (do you understand why?). Try to discover the relation between the reaction rate and the thiosulphate concentration.