Investigation 12.2: Evidence for an Activated Complex

Evidence for an activated complex is difficult to obtain. According to reaction theory, catalyzed and uncatalyzed reactions have different activated complexes. Most activated complexes are colourless and fairly unstable. A few, however, are coloured and exist long enough to be observed.

Purpose

The purpose of this investigation is to test the theoretical concept that a catalyzed reaction involves an activated complex different from that in an uncatalyzed reaction.

The reaction we are looking at is hydrogen peroxide mixed with potassium sodium tartrate…

5 H2O2 (aq) + KNaC4H4O6 (aq) → 4 CO2 (g) + NaOH (aq) + KOH (aq) + 6 H2O(l)

Problem

What evidence is there for the existence of a different **activated complex** for a **catalyzed** reaction when compared to an uncatalyzed reaction?

Sodium potassium tartrate, hydrogen peroxide, and cobalt(II) chloride may irritate skin and eyes. Cobalt(II) chloride is also toxic by ingestion and a possible carcinogen. Handle with care.

Procedure

1. Add 40 mL of 0.30 mol/L sodium potassium tartrate solution to the beaker followed by 40 mL of hydrogen peroxide solution.

2. Heat the solution in the beaker (covered with a watch glass) to 45 °C to 50 °C. Record any evidence of a reaction and of an activated complex.

3. Remove the beaker from the hot plate and add 5 mL of 0.30 mol/L cobalt(II) chloride as a catalyst.

4. Again, cover the beaker with the watch glass and observe the reaction.

Evidence

Without catalyst:

With catalyst:

**Analysis:**

1. Write the balanced equation for the catalyzed reaction.
2. Compare the colour of the catalyst to the final colour of the reaction solution. What might this observation tell you?

b) now go back to question #1 and write in the colors observed in your balanced equation

1. Draw a fully labeled energy pathway diagram that could represent the catalyzed reaction you observed.