CHEMISTRY

Lab 13: DETERMINATION OF AN ACTIVATION ENERGY

AIM

The aim of this experiment is to calculate experimentally the activation energy for the reaction between bromide and bromate (V) ions according to the reaction:

$$5Br^-(aq) + BrO_3^-(aq) + 6H^+(aq) \rightarrow 3Br_2(aq) + 3H_2O(l)$$

and to compare it with the literature value which is 60 $kJmmol^{-1}$.

BACKGROUND

The reaction shown above is particularly suitable for a kinetics experiment since the rate of reaction can be monitored by colour change. This is achieved by carrying out the experiment in the presence of a known constant amount of phenol and a small amount of methyl red indicator. The bromine that is produced by the reaction initially reacts very rapidly with phenol according to the reaction

$$3Br_2(aq) + C_6H_5OH \rightarrow C_6H_2Br_3OH$$

During this phase of the reaction there is no colour change (the solution is red due to the methyl red indicator), since all the bromine is reacting with the phenol. However, when the phenol has completely reacted, the bromine produced immediately bleaches the methyl red and the solution becomes colourless. At this point we measure the time of reaction since if the amount of phenol is kept constant in all experiments, we know that a fixed amount of bromine has been produced.
By measuring the reaction time at different temperatures, T, we can measure the activation energy for the reaction because the rate constant, *k*, is inversely related to time, t: $k = c \times 1/t$, where c is a constant

PROCEDURE

You will be supplied with an aqueous solution which is o.1 mol dm^{-3} potassium bromide, KBr, and 0.02 mol dm^{-3} potassium bromate, $KBrO_3$.

- Put 5.0 cm^3 of 0.01 phenol solution and 5.00 cm^3 of the bromide / bromate solution into a large test tube and then add 4 drops of methyl red indicator. In a second test tube put 0.5 mol dm^{-3} $H_2SO_4(aq)$.

- Immerse the two test tubes in a waterbath and when their contents reach them desired temperature mix them and time the reaction until the colour of the methyl disappears.

- Repeat the experiment at other temperatures.

Remember that $k = A \times e^{-Ea/RT}$ and $k = c \times 1/time$, where *c* is a constant.