Chemical Kinetics - Reaction of Unknown Order

Click on BEGIN, enter your code number, and press RETURN. The program will present a set of data at 25°C for an unknown-order reaction:

\[ \nu_A \ A \rightarrow \text{products} \]

This set of data is produced for an initial concentration with a particular time increment between readings so that the data covers approximately 75% of the reaction (about 25% of the starting material remaining).

Your problem is to first determine the order \((a = 1/2, 2/2, 3/2, 4/2, 5/2)\) of this reaction, then to accurately determine the rate constant \((k)\), as in

\[ -\left(\frac{1}{\nu_A}\right)\frac{d[A]}{dt} = k[A]^a \]

The order may be determined by any technique, but you should document the technique and the data sets you use for this determination. If you use the method of initial rates, the rate data should be taken before 10% of the starting material has reacted.

The second problem is to accurately determine the rate constant (and its uncertainty) at three (or more) different concentrations covering at least a ten-fold range of concentrations at 25°C. “Good” data for determination of a rate constant should cover an appreciable range of the reaction, perhaps from 20 to 80% reaction (experimental data beyond 80% reaction often lacks precision because of the low concentrations involved). The constancy of the rate constant should verify the accuracy of the order you have determined. Report the average \(k\) with its uncertainty.

This program may also be used to determine activation parameters for the reaction. Rate constants should be determined for at least four temperatures covering a range of at least 20°C.

Processing data.

The processing of data to determine the rate constant will depend on the order of the reaction, as has been covered in class. Be sure you handle the stoichiometric value \((\nu_A)\) properly. Hand in the data sets you have generated for determining the order and the rate constant.