

Colorado State University
CHEM 372
Physical Chemistry Laboratory

Notes for
The Kinetics of Decomposition of the
Benzenediazonium Ion

The following is a set of short notes to outline the experiment in question and to provide helpful guidance to those executing the experiment.

- A. Kinetics, especially chemical kinetics, is the branch of (physical) chemistry that is concerned with the rates at which chemical reactions occur. Through the study of chemical kinetics it is sometimes possible to understand mechanisms which underpin chemical reactions and perhaps to bring them under experimental control.
- B. In this experiment the benzenediazonium ion will be studied in acidic aqueous solution – specifically its spontaneous decomposition into phenol. The reaction is considered to be first order (see accompanying references). It is the rate of decomposition of the ion that will be examined.
- C. Benzenediazonium salts are both highly colored and energetic – this means that they can detonate. Shoemaker and Garland's classic physical chemistry experiment (see reference) instructs the salt be synthesized and then stored cold. Only a very small amount of relatively weak solution is required to perform the visible absorption spectroscopy necessary to carry out this experiment.
- D. In this variant of the experiment the benzene diazonium ion will be synthesized *in situ*, that is in the cuvette located in the UV-Vis spectrometer. In this fashion no more than a few micromoles of the energetic ion are ever in existence.
- E. Measure the kinetics, that is, the rate, of the decomposition of the benzenediazonium ion in aqueous acidic solution at several (at least five) temperatures (from 30 to 60°C) and determine the activation energy for the process.
- F. Determine suitable conditions (in consultation with Teaching Staff), especially the initial concentrations of the reactants, for running the reaction. Determine what wavelength will be used to uniquely determine the benzenediazonium ion concentration. Determine how to determine the appropriate molar absorptivity of the ion.