Chemistry 2710 Spring 2001 Assignment 5
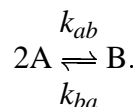
Due: Wednesday, April 11, 9:00 a.m.

1. Explain how the pressure-jump method can be used to determine rate constants of chemical reactions. Discuss both the experimental method and the data analysis. [10 marks]

   Notes: Double-space the text of your answer. Write no more than three hundred (300) words. For the purpose of this assignment, count an equation as 5 words. Give the total word count, either in the margin or at the end of your essay.[1] Marks may be deducted if your answer is hard to read, so plan your answer before you write it down and make an effort to be neat if you are handwriting.

   You need not derive any equations. You can use equations from the course notes if you wish, but it is entirely possible to answer such a question without giving a single equation. On the other hand, feel free to write down a few equations if you find it helps the discussion along.
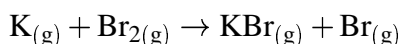
   Finally, you don't have to cover the experimental and data analysis aspects of this question equally, although you should touch on both.

2. Develop an equation for the relaxation time of the elementary reaction

$$2A \underset{k_{ba}}{\overset{k_{ab}}{\rightleftharpoons}} B.$$

   [10 marks]

3. The reaction

$$K_{(g)} + Br_{2(g)} \rightarrow KBr_{(g)} + Br_{(g)}$$

   has an activation energy of zero so that the rate constant is equal to the preexponential factor. At $600\,K$, the rate constant is approximately $10^{12}\,L\,mol^{-1}s^{-1}$. Assuming that the reaction occurs at the collision-limited rate, what is the collision cross-section? Determine the radius of a disk with this area. Comment (briefly) on the magnitude of this number. [10 marks]

   Note: It may be useful to look up the radii and/or bond lengths of the relevant atoms and molecules for comparison. There are several possible sources for these data (introductory chemistry textbooks, CRC Handbook, some web sites). Happy hunting!

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[1]This is just intended to make you aware of how much you have written and to save the marker the trouble of checking your word count. It will not be verified unless it looks badly wrong.