Air Quality and Control
ME 164 - Winter 2014
Chlorine in the atmosphere

The following laboratory chemical system has been used to study chemicals that are active in the atmospheric ozone depletion cycle. It involves the rapid formation of Chlorine atoms from Oxygen and Hydrogen atoms and molecular Chlorine.

1. $Cl + H_2 \longrightarrow HCl + H$ $\quad k_1 = 1.6 \times 10^{-14}$
2. $H + Cl_2 \longrightarrow HCl + Cl$ $\quad k_2 = 2.0 \times 10^{-11}$
3. $H + O_2 \longrightarrow HO_2$ $\quad k_3 = 3.6 \times 10^{-13}$
4. $Cl + O_2 \longrightarrow ClO_2$ $\quad k_4 = 1.3 \times 10^{-14}$
5. $Cl + ClO_2 \longrightarrow Cl_2 + O_2$ $\quad k_5 = 1.4 \times 10^{-10}$

- Write the eight ordinary differential equations determined by these reactions.
- Integrate the equations from $t = 0$ to $t = 10^{-4}$ seconds. Take as initial conditions (in molecules per cubic centimeter) $[Cl]=10^{14}$, $[Cl_2]=3.25 \times 10^{16}$, $[H_2]=1.62 \times 10^{18}$, $[O_2]=4.84 \times 10^{18}$, and zero for the others. Print and plot the solution at fifty equally spaced points. Do the concentrations approach steady state values? Comments and insight on the solution should be discussed.