**ATOC 3500/CHEM 3151 Spring 2018**

**Problem 15**

**Stratospheric Ozone Destruction at Steady State**

In Problem 14 we looked at two reaction cycles involving the ozone-destroying reactive chlorine radicals Cl and ClO. We noted that the rate of ozone loss (d[O3]/dt) due to chlorine is determined by the rate of the reaction O + ClO 🡪 Cl + O2. This turned out to be the case because there is a second pathway for ClO involving the reaction with NO that results in a ‘net null’ cycle for ozone loss.

1. Use the following set of reactions to show that the steady state concentration of odd oxygen is inversely proportional to the concentration of ClO.

Formation of odd oxygen:

                                             O2 + h http://atoc.colorado.edu/~toohey/arrow.gif O + O Rate 1 = J1 [O2]

Loss of odd oxygen:

                                         O + O3 http://atoc.colorado.edu/~toohey/arrow.gif O2 + O2   Rate 2 = 2 x k4 [O] [O3]

                                        O + ClO http://atoc.colorado.edu/~toohey/arrow.gif Cl + O2            Rate 3 = 2 x k5 [O] [ClO]

1. Use typical concentrations of O, ClO, and ozone below, and values for J1, k4, and k5, to show that the rate of loss of odd oxygen due to O + O3 is comparable to the rate of loss of odd oxygen due to O + ClO.

J1 = 10-7 s-1

k4 =1 x 10-14 cm3 molecule-1 s-1

k5 =3 x 10-11 cm3 molecule-1 s-1

[O] = 2 x 105  molecules cm-3

[O3]= 1 x 1012 molecules cm-3

[ClO] =1 x 109 molecules cm-3