

Chemical Principles of Environmental Science 11:375:202

Homework 1: Gas concentration units, kinetics

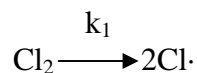
BE SURE TO SHOW ALL WORK NEATLY ON A SEPARATE PAGE

Due: September 21, 2009

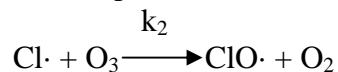
1.a.(1) Calculate the number density of N₂O (partial pressure = 320 ppb) in the atmosphere for altitudes of 0 to 20 km at 5 km intervals (see temperature pressure table online at <http://envsci.rutgers.edu/~reinfelder/cpesnotes/TPtable.pdf>).

b.(1) *Plot* the vertical profile of N₂O with altitude on the y-axis and number density on the x-axis.

2. An important source of atomic chlorine in the Antarctic stratosphere is the photodissociation of Cl₂:



An important sink of Cl· in the stratosphere is reaction with ozone:



a.(1) Write the rate law for the **formation** of Cl· based on reaction 1.

b.(1) Write the rate law for the **consumption** of Cl· based on reaction 2.

c.(1) Write an expression for the steady-state concentration of Cl· based on reactions 1 and 2.

d.(3) Calculate the *rates* of reaction 1 at the top (-20°C, P = 0.001 atm) and bottom (-80°C, P = 0.1 atm) of the Antarctic stratosphere assuming a pCl₂ of 1 ppb ($k_1 = 10^{-5} \text{ s}^{-1}$).

e.(1) Is Cl₂ photolysis faster at the top or bottom of the stratosphere?

f.(1) Which physical factor, temperature or pressure, was most responsible for the difference in the rate of Cl₂ photolysis at the two altitudes?