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 N_2O (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 N_2O 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 Cl_2:

$$Cl_2 \xrightarrow{k_1} 2Cl\cdot$$

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

$$Cl\cdot + O_3 \xrightarrow{k_2} ClO\cdot + O_2$$

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 pCl_2 of 1 ppb ($k_1 = 10^{-5}\ s^{-1}$).

e.(1) Is Cl_2 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 Cl_2 photolysis at the two altitudes?