

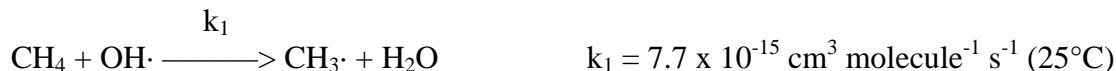
Chemical Principles of Environmental Science 11:375:202

Homework 2: Tropospheric chemistry

BE SURE TO SHOW ALL WORK NEATLY ON A SEPARATE PAGE

Due: September 30, 2009

1. The rate limiting step leading to the production of formaldehyde (H₂CO) in the troposphere is the oxidation of methane:



Formaldehyde loss depends on the photolysis of H₂CO:



a.(1) Write an expression for the steady-state concentration of H₂CO in the troposphere.

b.(2) Assuming a temperature of 25°C and a pressure of 1 atm, calculate the steady-state **number density** of H₂CO based on chemical reactions in the troposphere given that the concentration of CH₄ is 1.5 ppm and that of OH· is 10⁶ molecules cm⁻³.

c.(1) In addition to the oxidation of methane in the troposphere, there are a number of sources and sinks of H₂CO in urban environments including dry deposition to surfaces, vertical mixing, and emissions from synthetic materials and industry. Using R_{sources} and R_{sinks} to represent the urban sources and sinks of H₂CO, modify your answer to 1.a. and write a new equation for the steady-state concentration of H₂CO.

d.(2) The average **measured** summertime concentration of H₂CO in some urban areas is 6 ppb. Based on this observation and your answer to 1.b., are urban areas **net** sources or sinks of H₂CO?

2. The net reaction for the oxidation of ethene is:



a.(1) What are the oxidation states of C, N, and O in each reactant and product of this reaction?

b.(1) How many electrons are lost or gained by **all** C atoms in this reaction?

c.(1) How many electrons are lost or gained by **all** N atoms in this reaction?

d.(1) How many electrons are lost or gained by **all** O atoms in this reaction?