

ATS 621, Fall 2011

HOMEWORK #1: due Friday, September 2, 2011

Please provide solutions with complete calculations for full credit. Use SI units.
Point values listed in brackets for each question.

Problems from Jacob:

Q1 (10): 1.2

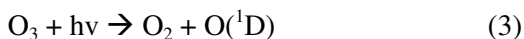
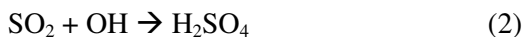
Q2 (30): 1.3

Q3 (20): 2.2

Q4 (10): Identify the oxidation state of nitrogen in each of the following and order by likely chemical sequence for the atmosphere (remember the atmosphere is oxidizing):

N_2O , N_2 , HNO_3 , NH_3 , NO , NO_2

Q5 (30): Consider the following sequence of elementary reactions:



- Write an equation for the time rate of change of $[OH]$ based on reactions 1-4
- Assume that OH is a very reactive species (it is) and that we can apply the steady state approximation to obtain its concentration. Derive an algebraic equation for the steady-state (SS) concentration of OH .
- Apply the SS approximation to $O(^1D)$ (excited state of oxygen known as O singlet D), and use the results in your expression for $[OH]$ from b) to get the concentration of OH in terms of concentrations of stable species.
- The rate constants for reactions 1 and 2 are:
 $k_1 = 2.2 \times 10^{-13} \text{ molecules}^{-1}\text{cm}^3\text{s}^{-1}$
 $k_2 = 1.1 \times 10^{-12} \text{ molecules}^{-1}\text{cm}^3\text{s}^{-1}$

Given that typical atmospheric concentrations are: $[CO]=40\text{-}200$ ppb and $[SO_2]=20\text{-}1500$ ppt, use these values with the above rate constants to evaluate which species is the more important sink for OH in the atmosphere.