Exercises

A. Consider an air mass containing 0.2 mL liquid water (cloudwater) per 1000 L of air.
   HOOH is at equilibrium between the gas phase and the aqueous phase with a mixing ratio in the gas phase of 0.5 ppbv at 298 K and $P_{total} = 0.95$ atm. What is [HOOH $(aq)$]? 

B. Consider the air mass described in Exercise A. If the gas phase contains 3 ppb of SO$_2$ in equilibrium with the various forms of S(IV) in the aqueous phase, whose pH is 4.5, what is the concentration of HSO$_3^-$ in the aerosol phase?

C. If all the drops in the air mass in Exercise A were of 30 µm diameter, what is the surface area per unit volume?
   Volume of a sphere = $(4/3)\pi r^3 = (1/6)\pi D^3$  
   Surface area of a sphere = $4\pi r^2 = \pi D^2$

D. Under the conditions of the air mass in Exercises A and B, and with an ozone concentration of 100 ppbv in the gas phase, what is the rate at which aqueous SO$_2$-H$_2$O is oxidized by ozone?

Problems

I. Given: The air mass described in Exercise A. Assume the calculated solution-phase concentrations of HOOH (from Exercise A) and HSO$_3^-$ (from Exercise B) are maintained.
   Question: What is the rate of oxidation of S(IV) in the aerosol phase?
   Question: What is the pseudo-first order lifetime of S(IV) in the aerosol phase?
   Question: What is the pseudo-first order lifetime of SO$_2$ in the gas phase with respect to aqueous phase oxidation?
   Type of Answer: Calculation

II. Given: A different air mass than the one described in Exercise A. This air mass is at 298 K and 1 atm, and has a SO$_2$ concentration of 1 ppbv. The aqueous phase concentration of SO$_3^{2-}$ is $4.2 \times 10^{-13}$ moles/L.
   Question: What is the pH of the aqueous phase?
   Type of Answer: Calculation