

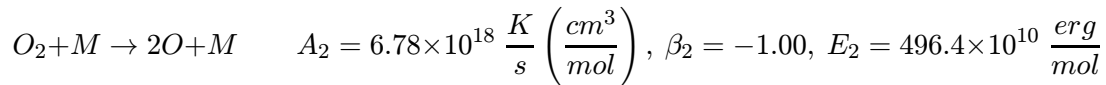
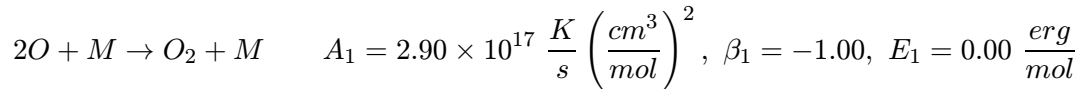
ME 456

Homework 1

Prof. J. M. Powers

Due: Friday, 29 January 1999

1. At $t = 0$ s, a constant volume, ($V = 1000 \text{ cm}^3$), isothermal ($T = 4000 \text{ K}$) chamber contains 1.00 mole of pure O_2 . The reaction kinetics are dictated by the standard law of mass action with Arrhenius temperature dependency. The reactions and associated kinetic constants (with values taken from Maas and Pope's paper) are as follows:



The universal gas constant is $R = 8.31 \times 10^7 \frac{\text{erg}}{\text{mol K}}$. Take the caloric state equations to be

$$\tilde{h}_O = \left(2.49 \times 10^{12} \frac{\text{erg}}{\text{mol}} \right) + \left(2.127 \times 10^8 \frac{\text{erg}}{\text{mol K}} \right) (T - 298 \text{ K})$$

$$\tilde{h}_{O_2} = \left(0 \frac{\text{erg}}{\text{mol}} \right) + \left(3.932 \times 10^8 \frac{\text{erg}}{\text{mol K}} \right) (T - 298 \text{ K})$$

- (a) Write differential equations for the time evolution of each species' concentration.
 - (b) Use an algebraic technique to find the concentrations of O and O_2 at equilibrium.
 - (c) Find the time constants of relaxation near the equilibrium point.
 - (d) Integrate the equations from $t = 0$ to a time when the system is nearly at equilibrium.
 - (e) Give computer generated plots of $c_{O_2}(t), c_O(t), P(t)$.
 - (f) How much heat was transferred from the environment to the chamber in this process?
2. Write a brief one paragraph description of the Zeldovich mechanism of NO_x production. Use the \LaTeX text formatter. Include at least one equation and one reference in the form of a footnote. Post your article on your home page so that I can easily find it.