AME 60636
Examination 1
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1. Consider the three species O, O_2 and O_3. Initially, there is 1 $kmole$ of O at $T = 6000\ K$ and $P = 1.01 \times 10^6\ dyne/cm^2$. The system equilibrates isothermally and isobarically. The reference pressure is $P_o = 1.01 \times 10^6\ dyne/cm^2$. At $T = 6000\ K$, one has the following thermodynamic data:

$$\begin{aligned} \overline{h}_O &= 0.370 \times 10^{13}\ erg/mole, & \overline{s}^o_O &= 0.224 \times 10^{10}\ erg/mole/K, \\ \overline{h}_{O_2} &= 0.224 \times 10^{13}\ erg/mole, & \overline{s}^o_{O_2} &= 0.313 \times 10^{10}\ erg/mole/K, \\ \overline{h}_{O_3} &= 0.471 \times 10^{13}\ erg/mole, & \overline{s}^o_{O_3} &= 0.401 \times 10^{10}\ erg/mole/K, \end{aligned}$$

   (a) Find the equilibrium concentrations of O, O_2, and O_3.

   (b) Imagine now that the reaction kinetics is governed by the *single reaction*

$$O_2 + M \leftrightharpoons O + O + M$$

   with collision frequency factor 1.85×10^{11}, temperature exponent $\beta = 0.5$, and activation energy $E = 95560.0\ cal/mole$. The reaction rate has the typical units of $mole/cm^3/s$. Write the appropriate differential-algebraic system that describes the evolution of O, O_2 and O_3.

2. Develop an expression for how *element concentration evolves* for an ideal mixture of N ideal gases undergoing J reactions in an *isobaric* environment.