CHEM442-001
College of Charleston
Spring 1999
Exam V

1(25). For $^{12}C\equiv^{16}O$ ($\mu = 1.138\ 518 \times 10^{-26}$ kg) the microwave rotational spectrum consists of a series of evenly spaced lines at 3.8604 cm^{-1}, 7.7208 cm^{-1}, 11.5812 cm^{-1}, 15.4416 cm^{-1}, etc.

Calculate the bond length of this molecule.

The IR spectrum of $^{12}C\equiv^{16}O$ has an absorption peak centered at $\omega_e = 2142.61\ cm^{-1}$. Calculate the force constant of this molecule.

Predict the location of the IR spectrum absorption peak for $^{12}C\equiv^{18}O$ ($\mu = 1.195\ 38 \times 10^{-26}$ kg).

2(20). The polarizability of CO(g) is $2.20 \times 10^{-40}\ C^2\ N^{-1}\ m$ and the dipole moment is 3.90×10^{-31} C m (interestingly, the negative end is the C atom). Calculate the fraction of intermolecular forces potential energy resulting from the dipole interactions, $(U_{d/d} + U_{d/ind})/(U_{d/d} + U_{d/ind} + U_L)$, at 25 °C.

3(20). Consider the following proposed mechanism for the decomposition of ozone

$$2\ O_3(g) \rightarrow 3\ O_2(g)$$

given by

$$O_3 + M \underset{k_{-2}}{\overset{k_2}{\rightleftharpoons}} O_2 + O\cdot + M$$

$$O\cdot + O_3 \xrightarrow{k'_2} 2O_2$$

Apply the steady state approximation for $C(O\cdot)$ and find $-dC(O_3)/dt$.

4(15). The rate constant for

$$COCl_2(g) \rightarrow CO(g) + Cl_2(g) \qquad \Delta_r U_{700} = 103.1\ kJ$$

is given by

$$\ln\ [k/(\text{min})^{-1}] = \frac{-26296}{[T/(\text{K})]} + 34.893$$

Prepare a reaction coordinate diagram (label properly) for this reaction.

5(20). The following data were obtained for the reaction

$$2\ H_2O_2(aq) \rightarrow 2\ H_2O(l) + O_2(g)$$

t/(s)	0	300	600	900	1500	2100	2700	∞
$V(O_2)/(cm^3)$	0.00	7.50	14.00	19.65	28.80	35.80	41.20	57.90

Determine graphically (graph paper attached) the order of reaction with respect to $C(H_2O_2)$.