

CHEM442-001
 College of Charleston
 Spring 1999
 Exam V

1(25). For $^{12}\text{C}\equiv^{16}\text{O}$ ($\mu = 1.138\,518 \times 10^{-26}$ 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.

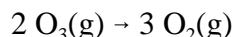
Calculate the bond length of this molecule.

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

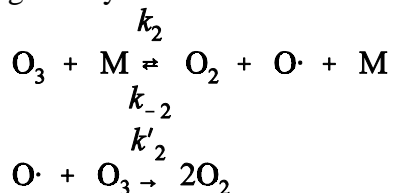
Predict the location of the IR spectrum absorption peak for $^{12}\text{C}\equiv^{18}\text{O}$ ($\mu = 1.195\,38 \times 10^{-26}$ kg).

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

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

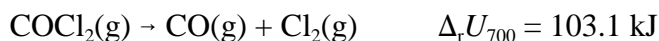


given by



Apply the steady state approximation for $\text{C}(\text{O}\cdot)$ and find $-\text{dC}(\text{O}_3)/\text{dt}$.

4(15). The rate constant for

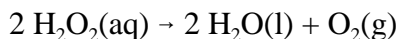


is given by

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

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

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



$t/(s)$	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 $C(H_2O_2)$.