AS – 6342 Spectroscopic Reactive Flow Diagnostics Dr. T. M. Muruganandam Supplementary Exercise – 1 Jan 27, 2011

NOTE: For physical data about specific molecules refer to the website for Q data.

1. Consider a gas with 30% CO and the rest Ar. The gas is at 1 atm, 300 K.

(a) Find the Emission spectrum for this gas in the microwave range. Assume that the fraction of molecules that goto lower level from a given level by emitting light is approximately 1e-15.

(b) Find the emission spectrum if the gas has 30% No and rest is Ar.

(c) Find the emission spectrum if the gas has 15% NO and 15% CO and the rest Ar.

(d) repeat the all the above for T=600K, and 1200K

2. For NO, find the bond length. Assume N atom weighs 14 a.m.u. and O atom weighs 16 a.m.u.

3. Consider a diatomic molecule with equilibrium separation between atoms as 0.10 nm. This molecule is now vibrating with a variation in the separation of 0.005 nm each way (compression and expansion). Find the mean separation distance between the atoms over a full cycle of vibration. Also find the mean value of B for this molecule. Assume reduced mass of the molecule to be 7 a.m.u. What will it be if the vibration amplitude is doubled? Is this matching with the idea given in class based on energy plots for vibration?

4. Consider effect of vibration on the rotational spectrum of CO gas. (a) Give the spectrum of CO for 1000K with and without Vibrational correction. (b) Give the same at 3500K. Explain each spectra and the changes between them.

5.