Prelab Questions--Experiment 3: Bond Strength of Nitric Oxide

Answer **three** (3) of the following questions, based on the last digit of your student ID number.*
ID ending in: 0 or 1:a,b,&c *2 or3*:d,e,&f *4 or 5*:g,h,&i *6 or 7*:j,k,&m *8 or 9*:n,o,&p

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ID ending in 0 or 1

(a). Determine the bond order for NO predicted by the Lewis dot structure.

(b). Calculate the reduced mass of a molecule of NO in kg.

(c). The infrared spectrum is taken of the original gas sample and then again after the sample cell has been opened to air for a few seconds. The reason for the two spectra is (*choose all that apply*):

(1). To make sure the sample pressure is equal to the ambient pressure.
(2). To verify the identity of the infrared absorption peak for NO.
(3). To make sure all of the NO_2 is converted to NO.
(4). To convert some of the NO to NO_2.
(5). To allow some water vapor to enter the cell.
(6). To locate the infrared absorption peak for N_2.

ID ending in 2 or 3

(d). The underlying principle for this experiment is:
(1). The absorption of infrared light gives the maximum wavelength for bond dissociation.
(2). The height of the infrared peak is proportional to the concentration of NO.
(3). The bond order for NO is inferred from the bond force constant.
(4). The bond dissociation energy for NO is calculated from the absorption wavenumber.
(5). For a strong bond, the bond length is shorter and the force constant is smaller, than for a weak bond.

(e). The reduced mass of O_2 is $1.328\text{x}10^{-26}$ kg. Use the force constant for O_2 in Table 1 to calculate the vibrational wavenumber of O_2. (Assume 4 significant figures for the force constant. Note that 1 N = 1 kg m s^{-2} giving 1 N/m = 1 kg s^{-2})

(f). (True/False) The reduced mass of a diatomic molecule is the effective mass of the molecule during vibrational motion.

ID ending in 4 or 5

(g). The bond force constant for the diatomic molecule BO is 1289. N m^{-1}. Use Figure 4 to determine the approximate bond order for BO, to the nearest half-integer.

(h). The vibrational wavenumber for O_2 is 1554. cm^{-1}. The reduced mass of O_2 is $1.328\text{x}10^{-26}$ kg. Calculate the force constant for O_2. (Note that 1 N = 1 kg m s^{-2} giving 1 N/m = 1 kg s^{-2})

(i). Assuming equivalent reduced masses, as the bond strength increases:
(1). The force constant __increases__ __decreases__ (*choose one*)
(2). The vibrational frequency __increases__ __decreases__ (*choose one*)
(3). The wavelength of light that is absorbed __increases__ __decreases__ (*choose one*)
(4). The vibrational wavenumber __increases__ __decreases__ (*choose one*)

ID ending in 6 or 7

(j). The bond force constant for the diatomic molecule BN is 810 N m^{-1}. Use Figure 4 to determine the approximate bond order for BN, to the nearest half-integer.

(k). The bond force constant for the diatomic molecule BN is 810. N m^{-1}. The reduced mass of BN is 9.695×10^{-27} kg. Calculate the vibrational wavenumber for BN. (Note that 1 N = 1 kg m s^{-2} giving 1 N/m = 1 kg s^{-2})

(m). (True/False) The brown gas formed from the reaction of $NaNO_{2(s)}$ with $H_2SO_{4\,(l)}$ is NO (g).

ID ending in 8 or 9

(n). The vibrational wavenumber for FO is 1053.0 cm^{-1}. A student has submitted a report with the following spectroscopic values for the diatomic molecule FO. Without doing any calculations, use the lab write-up tables, figures, examples, and your previous experience to find the reported values that are in error by several orders of magnitude (the numbers are correct, but the power of 10 is wrong). (Either the values are correct or way off.)

μ (kg)	k (N/m)	E*nergy of a mole of photons*
1.442×10^{-23}kg	5.673 N/m	12.60 kJ/mol

(o). The vibrational wavenumber for O_2 is 1554. cm^{-1}. Calculate the energy in kJ for a mole of photons at 1554. cm^{-1}.

(p). The procedure is designed to sweep the sample cell of any atmospheric O_2 or the reaction products derived from atmospheric O_2. In the experiment, how do you determine if the sample cell has been adequately swept out, so that NO is the primary gas in the sample cell?

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* The student ID number is the 6-digit number on the front of your ID card at the right-hand side