Quiz 7.5 – Vibrational Motion

Name: _____

Harmonic Oscillator

O_2 vibrations can me modeled as a quantum mechanical harmonic oscillator with reduced mass equal to $8.0\ AMU$ and a force constant of $1138\frac{N}{m}$. Give the fundamental angular frequency (ω), fundamental linear frequency (ν), and zero-point energy for oxygen vibrations.

Write the wavefunction for the first three states of a harmonic oscillator. You may use generic symbols for N and α, but you must expand the Hermite polynomials.

Give the energies of these three states, and sketch their wavefunctions on a potential energy curve.

Give the classical maximum displacement for each of these three states, both in pm and in % of the equilibrium O_2 bond length ($121\ pm$)