

C1) A nucleus can be described as fermions moving in a three dimensional harmonic potential. Consider the case where the spring constant or oscillator frequencies are such that the x and y frequencies are equal to each other and are twice the frequency in the z direction.

- a) (5 points) Find the first five magic numbers for protons and neutrons.
- b) (3 points) Find the value of the charged quadrupole moment of a nucleus with proton number $Z=4$ and neutron number $N=4$. The charged quadrupole moment involves the expectation value of $2zz - xx - yy$.
- c) (2 points) Will the total angular momentum have good eigenvalues for this potential? Will its third component along the the z -axis have good eigenvalues?