8a) Shell model

If \( Z \) or \( N \) is 2, 8, 20, 28, 50, 82, 126, nuclei are strongly bound.

Nucleons in nuclei generate a potential that can be approximated by a harmonic oscillator potential.

Nucleons are fermions and the nuclear ground state can be thought of as a single particle states that are filled up consecutively, according to their energies.

The ground state wave function has to be completely antisymmetric.

8b) Harmonic oscillator shell model

Let us find the degeneracies for the harmonic oscillator in 3d.