1 Quantum Practice for Midterm 2

(Based on Q4B.1 from textbook) Red light emitted by a standard helium-neon laser has a wavelength of about 633 nm. What is the frequency of the electromagnetic wave? Give your answer in Hz.

(Based on Example Q11.1 in the textbook) Suppose an electron is trapped in a box whose length is $L = 1.2$ nm. This is a coarse-grained model for an electron in a small molecule like cyanine (see Example Q11.1 in the textbook). If we solve the Schrodinger equation for such a system (the PDE describing the electron matter wave), the electron wavefunctions that satisfy the boundary conditions have discrete frequencies that can be indexed by an interger $n = 1,\ 2,\ 3,\ ...$

The frequencies are given by

$$f_n = 0.63 \times 10^{14}\ n^2 \tag{1}$$

(a) Draw a frequency-level diagram for the wavefunctions with $n = 1,\ 2,\ 3,\ 4,\ 5,\ 6$.

(b) Make a list of the visible frequencies of light that this system could adsorb or emit (i.e. electromagentic waves that are visible to the human eye).