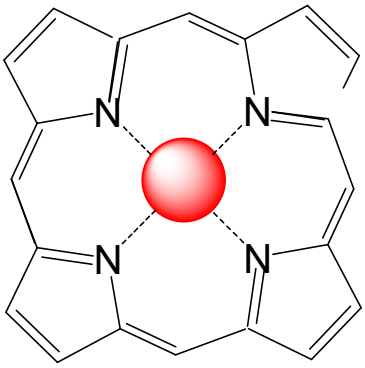
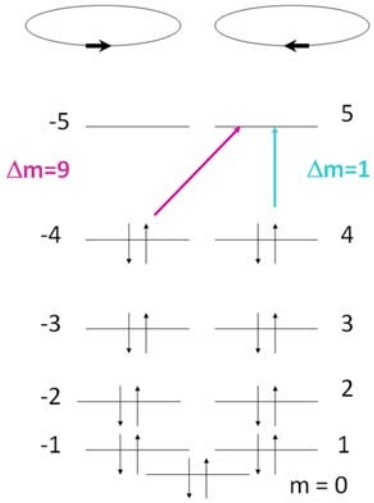
The structure of porphine is shown in the figure. To understand the absorption spectra of hemoglobin, one can use a free electron model for a particle on a circle. In the free electron model you may assume that the electrons from the p-orbitals of the carbon atoms populate energy levels derived from the particle-on-a-circle solution to the Schrödinger equation.



A. Assuming that the radius of the circle is 3.5 Å and that the porphyrin has 18 electrons, please draw an energy level diagram for this system.



B. Calculate the maximum of the absorption spectrum (in nm).

Solution: Using the particle-on-a-circle model

$$\Delta E = \frac{h}{8\pi^2 c m_e R^2}(m_e^2 - m_g^2)$$

$\Delta E = 6.626\text{x}10^{-34}\text{Js/}]8(3.14159)^2(9.1\text{x}10^{-31}\text{ kg})(2.99\text{x}10^{10}\text{ cm/s})(3.5\text{ x }10^{-10}\text{ m})^2](5^2\text{-}4^2)$

$= 22{,}660\text{ cm}^{-1}$ (which corresponds to 441 nm)

λ_{max} = _____nm.