1) The retina of a human eye can detect light when radiant energy incident on it is at least $4.0 \times 10^{17}$ J. For light of 600-nm wavelength, how many photons does this correspond to? (3)

2) The light emitted from an excited hydrogen atom is shown below as a series of lines. The wavelength of light is emitted when the electron relaxes from excited levels down to various lower levels. The most distinct line in the series is the red Balmer line at appears at approximately 656.7nm. This line appears when the electron relaxes from some excited state $n$ to the $n=2$ level. Calculated that excited energy level $n$. (4)

3) Six electrons are placed in a 1-dimensional box with infinite potential and infinite length. Correctly show where each electron will fill in the box in a diagram and what are the quantum numbers associated with each electron are? (Hint: there should be 6 distinct labels) (3)
1) An electron is in its ground state in a 1-D box of length 1.65 nm. In what energy level does this electron reside after it absorbs a photon of orange light ($\lambda = 595$ nm)? (4)

2) The following molecule is (E)-penta-2,4-dienylidenecyclohexane, an organic molecule. While we won’t get to much into what the it means for a bond to be conjugated (you’ll be spared that until organic chemistry) this serves as a good model for what electrons in a box are. Label on the picture what the length (L) of the box is for the molecule and fill the box with the appropriate electrons for 6 electrons. (hint double bonds are the mobile electrons for our box) (3)

![Diagram of molecule]

3) While in physics lab you are able to measure the wavelength of light being emitted to be 475 nm. This is being emitted from a blue LED or Light Emitting Diode. You then measure the wavelength of a red LED to be 600 nm.
   a) Which emits more energy red light or blue light (circle one)? (1) Blue Red
   b) What are the ratios of the energy of blue to red light? (2)
1) We can apply quantum mechanics to estimate the length of simple conjugated molecules in a model called the free-electron model. The length of hexatriene (containing 6 $p_i$ electrons) can be estimated to be 867 pm. The first electronic excited can be predicted to occur at what frequency (in Hz)? (4)

2) Draw $\Psi(x)$ and $P(x)$ distributions for the n=3 energy level. Indicate sign conventions on $\Psi(x)$ and label and nodes on $P(x)$. (3)

3) You are walking on the streets one night with nothing better to do but chemistry and notice the neon lights. You decide that you want to find out what the change in energy is larger from two different neon lights, one that is green and one that is violet. You use some physics to find out that the wavelength corresponding to each color is 510 nm for green and 400 nm for violet. (3)
   a) Which wavelength of light has more energy? (circle one) Green  Violet
   b) Determine the ratios of the energy of the two wavelengths of light