In a recent issue of Science, investigators reported the synthesis and characterization of fused porphyrin systems, as illustrated here.

To be more complete, they characterized a series of constructs of varying lengths and measured their absorption properties. Absorption spectra are shown below:

1. Assuming that the largest fused system (19) is a one dimensional particle in a box, with box size 100 Å, calculate the energy (in cm$^{-1}$) of the predicted lowest energy electronic transition.

2. Assuming that the largest fused system (19) is a TWO dimensional particle in a box, with well size 100 Å x 7 Å, calculate the energy (in cm$^{-1}$) of the predicted lowest energy electronic transition.

3. Why measure spectra of constructs 7-12? Explain their spectra.