Tangerine Tees and Marmalade Ties

Many fluorescent dyes, such as "DAPI" or "Epicocconone" are linear chains of atoms. Let's assume that they have one electron which can move linearly along this chain, of length a, in a potential $V(x)$. They absorb energetic solar radiation at wavelengths where the eye is not so sensitive (say, 400 nm or less), moving this electron to a high energy level. When the electron cascades back to the ground state, one or more photons can be emitted at longer wavelengths.

a) Assume that the potential $V(x)$ is independent of x within $0<x<a$, and very high otherwise. If the goal is to produce a lot of light in the region of wavelengths where the eye is most sensitive (between, say, 450 and 650 nm), what would be a good length a? How many photons in this region can be produced?

b) Can you improve on part a) by changing the potential $V(x)$? State a potential that works better. How many photons can be emitted in the eye's highly sensitive region? How many in the red spectral region? How many in the blue?

Again, there are many valid answers.