Q- (a) What are the energies of the first three energy levels of an electron confined in a one-dimensional box of length 0.75 nm?

(b) How much energy must the electron lose to move from the *n* = 3 energy level to the *n* = 1 energy level?

(c) Suppose that an electron can move from the *n* = 3 level to the *n* = 1 level by emitting a photon of light. If energy is conserved, what must the photon's wavelength be?

(a) The possible energies of a particle in one dimensional potential box of length a is given by

$$E_n = n^2 \frac{\pi^2 \hbar^2}{2ma^2} = n^2 \frac{h^2}{8ma^2} \qquad [n = 1, 2, 3, ...]$$

Hence the least energy level will be corresponding to n = 1 and is given by

$$E_1 = \frac{h^2}{8ma^2} = \frac{(6.63 * 10^{-34})^2}{8 * 9.11 * 10^{-31} * (0.75 * 10^{-9})^2}$$

Or $E_1 = 1.07*10^{-19}$ J

And $E_2 = 4*1.07*10^{-19}$ J $= 4.29*10^{-19}$ J (n = 2)

And $E_3 = 9*1.07*10^{-19}$ J $= 9.65*10^{-19}$ J (n = 3)

$1.07*10^{-19}$ J (First (lowest) energy level)
$4.29*10^{-19}$ J (second energy level)
$9.65*10^{-19}$ J (third energy level)

(b) How much energy must the electron lose to move from the *n* = 3 energy level to the *n* = 1 energy level?

The loss of energy when the electron moves from energy level n = 3 to n = 1 will be

$\Delta E = 9.65*10^{-19}$ J - $1.07*10^{-19}$ J = **$8.58*10^{-19}$ J**

(c) Suppose that an electron can move from the *n* = 3 level to the *n* = 1 level by emitting a photon of light. If energy is conserved, what must the photon's wavelength be?

The energy of the photon is given by

$$\frac{hc}{\lambda} = 8.58 * 10^{-19}$$

Gives $\lambda = \frac{6.63*10^{-34}*3*10^{8}}{8.58*10^{-19}} = 2.32 * 10^{-7} m$ = **232 nm**