40. (a) and (b) Let the wavelength of the two photons be λ_1 and $\lambda_2 = \lambda_1 + \Delta\lambda$. Then,

$$eV = \frac{hc}{\lambda_1} + \frac{hc}{\lambda_1 + \Delta\lambda} ,$$

or

$$\lambda_1 = \frac{-(\Delta\lambda/\lambda_0 - 2) \pm \sqrt{(\Delta\lambda/\lambda_0)^2 + 4}}{2/\Delta\lambda} .$$

Here, $\Delta\lambda = 130\,\text{pm}$ and $\lambda_0 = hc/eV = 1240\,\text{keV}\cdot\text{pm}/20\,\text{keV} = 62\,\text{pm}$. The result of problem 3 in Chapter 39 is adapted to these units ($hc = 1240\,\text{eV}\cdot\text{nm} = 1240\,\text{keV}\cdot\text{pm}$). We choose the plus sign in the expression for λ_1 (since $\lambda_1 > 0$) and obtain

$$\lambda_1 = \frac{-(130\,\text{pm}/62\,\text{pm} - 2) + \sqrt{(130\,\text{pm}/62\,\text{pm})^2 + 4}}{2/62\,\text{pm}} = 87 \text{ pm} ,$$

and

$$\lambda_2 = \lambda_1 + \Delta\lambda = 87\,\text{pm} + 130\,\text{pm} = 2.2 \times 10^2 \text{ pm} .$$

The energy of the electron after its first deceleration is

$$K = K_i - \frac{hc}{\lambda_1} = 20\,\text{keV} - \frac{1240\,\text{keV}\cdot\text{pm}}{87\,\text{pm}} = 5.7 \text{ keV}.$$

The energies of the two photons are

$$E_1 = \frac{hc}{\lambda_1} = \frac{1240\,\text{keV}\cdot\text{pm}}{87\,\text{pm}} = 14 \text{ keV}$$

and

$$E_2 = \frac{hc}{\lambda_2} = \frac{1240\,\text{keV}\cdot\text{pm}}{130\,\text{pm}} = 5.7 \text{ keV} .$$