Problem 1.1 Calculate the wavelength of a photon with a photon energy of 2 eV. Also, calculate the wavelength of an electron with a kinetic energy of 2 eV.

Solution The wavelength of a 2 eV photon equals:

$$l = \frac{hc}{E_{ph}} = \frac{6.626\times10^{-34}\,\text{Js}\times3\times10^{8}\,\text{m/s}}{1.602\times10^{-19}\,\text{C}\times2\text{eV}} = 0.62\ \mu\text{m}$$

where the photon energy (2 eV) was first converted to Joules by multiplying with the electronic charge.

The wavelength of an electron with a kinetic energy of 2 eV is obtained by calculating the deBroglie wavelength:

$$l = \frac{h}{p} = \frac{6.626\times10^{-34}\,\text{Js}}{7.62\times10^{-25}\,\text{kg m/s}} = 0.87\ \text{nm}$$

Where the momentum of the particle was calculated from the kinetic energy:

$$p = \sqrt{2mE} = \sqrt{2\times9.11\times10^{-31}\text{kg}\times1.6\times10^{-19}\,\text{C}\times2\ \text{eV}} = 7.64\times10^{-25}\,\text{kg m/s}$$