

56. (a) and (b) The momenta of the electron and the photon are the same:

$$p = \frac{h}{\lambda} = \frac{6.63 \times 10^{-34} \text{ J}\cdot\text{s}}{0.20 \times 10^{-9} \text{ m}} = 3.3 \times 10^{-24} \text{ kg}\cdot\text{m/s} .$$

The kinetic energy of the electron is

$$K_e = \frac{p^2}{2m_e} = \frac{(3.3 \times 10^{-24} \text{ kg}\cdot\text{m/s})^2}{2(9.11 \times 10^{-31} \text{ kg})} = 6.0 \times 10^{-18} \text{ J} = 38 \text{ eV} ,$$

while that for the photon is

$$K_{\text{ph}} = pc = (3.3 \times 10^{-24} \text{ kg}\cdot\text{m/s})(2.998 \times 10^8 \text{ m/s}) = 9.9 \times 10^{-16} \text{ J} = 6.2 \text{ keV} .$$