51. (a) Setting $\lambda = h/p = h/\sqrt{(E/c)^2 - m_e^2c^2}$, we solve for $K = E - m_ec^2$:

$$K = \sqrt{\left(\frac{hc}{\lambda}\right)^2 + m_e^2c^4} - m_ec^2 = \sqrt{\left(\frac{1240\,\text{eV}\cdot\text{nm}}{10\times10^{-3}\,\text{nm}}\right)^2 + (0.511\text{MeV})^2} - 0.511\text{MeV}$$
$$= 0.015\text{ MeV} = 15\text{ keV}.$$

(b) Using the value $hc = 1240\,\text{eV}\cdot\text{nm}$

$$E = \frac{hc}{\lambda} = \frac{1240\,\text{eV}\cdot\text{nm}}{10\times10^{-3}\,\text{nm}} = 1.2\times10^5\text{ eV} = 120\text{ keV}.$$

(c) The electron microscope is more suitable, as the required energy of the electrons is much less than that of the photons.

53. The wavelength associated with the unknown particle is

$$\lambda_p = \frac{h}{p_p} = \frac{h}{m_pv_p},$$

where p_p is its momentum, m_p is its mass, and v_p is its speed. The classical relationship $p_p = m_pv_p$ was used. Similarly, the wavelength associated with the electron is $\lambda_e = h/(m_ev_e)$, where m_e is its mass and v_e is its speed. The ratio of the wavelengths is

$$\lambda_p/\lambda_e = (m_ev_e)/(m_pv_p),$$

so

$$m_p = \frac{v_e\lambda_e}{v_p\lambda_p}m_e = \frac{9.109\times10^{-31}\text{ kg}}{3(1.813\times10^{-4})} = 1.675\times10^{-27}\text{ kg}.$$

According to Appendix B, this is the mass of a neutron.

63. If the momentum is measured at the same time as the position, then

$$\Delta p \approx \frac{\hbar}{\Delta x} = \frac{6.63\times10^{-34}\text{ J}\cdot\text{s}}{2\pi(50\,\text{pm})} = 2.1\times10^{-24}\text{ kg}\cdot\text{m/s}.$$

74. (a) The average kinetic energy is

$$K = \frac{3}{2}kT = \frac{3}{2}(1.38\times10^{-23}\text{ J/K})(300\,\text{K}) = 6.21\times10^{-21}\text{ J} = 3.88\times10^{-2}\text{ eV}.$$

(b) The de Broglie wavelength is

$$\lambda = \frac{h}{\sqrt{2m_n K}} = \frac{6.63\times10^{-34}\ \mathrm{J\cdot s}}{\sqrt{2\left(1.675\times10^{-27}\ \mathrm{kg}\right)\left(6.21\times10^{-21}\ \mathrm{J}\right)}} = 1.46\times10^{-10}\ \mathrm{m}.$$