3. $$E_1 = \frac{h^2}{8mL^2} = 5.6 \text{ eV}$$

With $L' = 2L$,

$$E_1' = \frac{h^2}{8mL'^2} = \frac{h^2}{8m(2L)^2} = \frac{1}{4}\frac{h^2}{8mL^2} = \frac{1}{4}(5.6 \text{ eV}) = 1.4 \text{ eV}$$

4. With $\lambda_n = 2L/n$,

$$\lambda_1 = \frac{2(0.144\,\text{nm})}{1} = 0.288 \text{ nm} \qquad \lambda_2 = \frac{2(0.144\,\text{nm})}{2} = 0.144 \text{ nm} \qquad \lambda_3 = \frac{2(0.144\,\text{nm})}{3} = 0.096 \text{ nm}$$

5. The smallest energy is (using Equation 5.3)

$$E_1 = \frac{h^2}{8mL^2} = \frac{(hc)^2}{8(mc^2)L^2} = \frac{(1240 \text{ eV} \cdot \text{nm})^2}{8(511{,}000 \text{ eV})(0.062 \text{ nm})^2} = 98 \text{ eV}$$

Then $E_2 = 2^2 E_1 = 391 \text{ eV}$ and $E_3 = 3^2 E_1 = 881 \text{ eV}$.

6. With $L = 1.2 \times 10^{-14}$ m = 10 fm,

$$E_1 = \frac{h^2}{8mL^2} = \frac{(hc)^2}{8(mc^2)L^2} = \frac{(1240 \text{ MeV} \cdot \text{fm})^2}{8(940 \text{ MeV})(12 \text{ fm})^2} = 1.4 \text{ MeV}$$