

13. (a) The electrostatic potential energy is given by

$$U = \frac{1}{4\pi\epsilon_0} \frac{Z_{\text{Xe}}Z_{\text{Sr}}e^2}{r_{\text{Xe}} + r_{\text{Sr}}}$$

where Z_{Xe} is the atomic number of xenon, Z_{Sr} is the atomic number of strontium, r_{Xe} is the radius of a xenon nucleus, and r_{Sr} is the radius of a strontium nucleus. Atomic numbers can be found either in Appendix F or Appendix G. The radii are given by $r = (1.2 \text{ fm})A^{1/3}$, where A is the mass number, also found in Appendix F. Thus, $r_{\text{Xe}} = (1.2 \text{ fm})(140)^{1/3} = 6.23 \text{ fm} = 6.23 \times 10^{-15} \text{ m}$ and $r_{\text{Sr}} = (1.2 \text{ fm})(96)^{1/3} = 5.49 \text{ fm} = 5.49 \times 10^{-15} \text{ m}$. Hence, the potential energy is

$$U = (8.99 \times 10^9 \text{ V}\cdot\text{m/C}) \frac{(54)(38)(1.60 \times 10^{-19} \text{ C})^2}{6.23 \times 10^{-15} \text{ m} + 5.49 \times 10^{-15} \text{ m}} = 4.08 \times 10^{-11} \text{ J} = 251 \text{ MeV} .$$

- (b) The energy released in a typical fission event is about 200 MeV, roughly the same as the electrostatic potential energy when the fragments are touching. The energy appears as kinetic energy of the fragments and neutrons produced by fission.