

12. (a) Consider the process $^{239}\text{U} + \text{n} \rightarrow ^{140}\text{Ce} + ^{99}\text{Ru} + \text{Ne}$. We have $Z_f - Z_i = Z_{\text{Ce}} + Z_{\text{Ru}} - Z_{\text{U}} = 58 + 44 - 92 = 10$. Thus the number of beta-decay events is 10.
- (b) Using Table 38-3, the energy released in this fission process is

$$\begin{aligned}
 Q &= (m_{\text{U}} + m_{\text{n}} - m_{\text{Ce}} - m_{\text{Ru}} - 10m_e)c^2 \\
 &= (238.05079 \text{ u} + 1.00867 \text{ u} - 139.90543 \text{ u} - 98.90594 \text{ u})(931.5 \text{ MeV/u}) - 10(0.511 \text{ MeV}) \\
 &= 226 \text{ MeV} .
 \end{aligned}$$