50. (a) The disintegration energy for uranium-235 "decaying" into thorium-232 is

$$\begin{aligned} Q_3 &= (m_{^{235}\mathrm{U}} - m_{^{232}\mathrm{Th}} - m_{^{3}\mathrm{He}})\,c^2 \\ &= (235.0439\,\mathrm{u} - 232.0381\,\mathrm{u} - 3.0160\,\mathrm{u})(931.5\,\mathrm{MeV/u}) \\ &= -9.50\ \mathrm{MeV}\ . \end{aligned}$$

(b) Similarly, the disintegration energy for uranium-235 decaying into thorium-231 is

$$\begin{aligned} Q_4 &= (m_{^{235}\mathrm{U}} - m_{^{231}\mathrm{Th}} - m_{^{4}\mathrm{He}})\,c^2 \\ &= (235.0439\,\mathrm{u} - 231.0363\,\mathrm{u} - 4.0026\,\mathrm{u})(931.5\,\mathrm{MeV/u}) \\ &= 4.66\ \mathrm{MeV}\ . \end{aligned}$$

(c) Finally, the considered transmutation of uranium-235 into thorium-230 has a Q-value of

$$\begin{aligned} Q_5 &= (m_{^{235}\mathrm{U}} - m_{^{230}\mathrm{Th}} - m_{^{5}\mathrm{He}})\,c^2 \\ &= (235.0439\,\mathrm{u} - 230.0331\,\mathrm{u} - 5.0122\,\mathrm{u})(931.5\,\mathrm{MeV/u}) \\ &= -1.30\ \mathrm{MeV}\ . \end{aligned}$$

Only the second decay process (the α decay) is spontaneous, as it releases energy.