Problem 4.4 *If the stable isotope of sodium is ^{23}Na, what kind of radioactivity would you expect from* (a) ^{22}Na *and* (b) ^{24}Na?

We know that $^{23}\mathrm{Na}^{11}$ is stable. The isotope $^{22}\mathrm{Na}^{11}$ has one less neutron, while $^{24}\mathrm{Na}^{11}$ has one extra neutron relative to $^{23}\mathrm{Na}^{11}$. Consequently, a proton in $^{22}\mathrm{Na}^{11}$ can undergo an inverse β decay to yield

$$^{22}\mathrm{Na}^{11} \rightarrow {}^{22}\mathrm{Ne}^{10} + e^{+} + \nu_e, \tag{4.37}$$

where $^{22}\mathrm{Ne}^{10}$ is a naturally occurring stable isotope of $^{20}\mathrm{Ne}^{10}$. Similarly, the extra neutron in $^{24}\mathrm{Na}^{11}$ can undergo a β decay to yield

$$^{24}\mathrm{Na}^{11} \rightarrow {}^{24}\mathrm{Mg}^{12} + e^{-} + \bar{\nu}_e, \tag{4.38}$$

where $^{24}\mathrm{Mg}^{12}$ is stable.