PH2400 Quiz 3, Spring 2002

Show your work for full credit.
Useful formulae:

\[ 1Ci = 3.7 \times 10^{10} \text{ decays/s} \]
\[ m_\alpha = 4.002603 u \]
\[ m_{Be} = 9.012182 u \]
\[ m_c = 1.008665 u \]
\[ m_C = 12.000000 u \]
\[ 1u = 931.494 \text{ MeV} \]

1. A pure sample of \(^{226}\text{Ra}\) contains \(2.0 \times 10^{14}\) atoms of the isotope. If the half life of \(^{226}\text{Ra}\) = \(1.6 \times 10^3\) years, what is the decay rate of this sample?

\[ N_0 = 2 \times 10^{14} \text{ atoms} \]
\[ T_{1/2} = 1.6 \times 10^{3} \text{ yrs} \]

So,
\[ \lambda = \frac{\ln 2}{T_{1/2}} = \frac{0.3322 \times \text{yr}^{-1}}{\text{yr}} = 1.37 \times 10^{-11} \text{ sec}^{-1} \]

\[ R_0 = N_0 \lambda = 7.43 \times 10^{-8} \text{ Ci} \]

2. Find the Q value for the following reaction: \(^{9}\text{Be}(\alpha, n)^{12}\text{C}\) (in MeV).

\[ ^{9}\text{Be} + \alpha \rightarrow ^{12}\text{C} + n + Q \]

\[ Q = (m_{^{9}\text{Be}} - m_{\alpha} - m_{^0\text{C}} - m_n) c^2 \]

\[ = (9.012182 + 4.003897 - 12 - 1.008665) u c^2 \]

\[ = 0.00612 u \times 931.494 \text{ MeV/u} \]

\[ = 5.7 \text{ MeV} \]