

Name:

1) CLASS(2)

Atomic mass of ${}^7_3\text{Li}$ is 7.016003 u. Find the binding energy in MeV. [2 pts] $u = 931.5 \text{ MeV}$

${}^7_3\text{Li}$ has 3p, 4n, and 3e.

$$\Delta m = 3m_p + 4m_n + 3m_e - 7.016003 \approx 4.2 \times 10^{-2} u$$

$$= 39 \text{ MeV.}$$

2) CLASS(2)

A radon ${}^{220}_{86}\text{Rn}$ decays in multiple steps till reaches lead ${}^{208}_{82}\text{Pb}$. Find the number of alpha particles, N_α , and beta particles, N_β , produced in this process. [3 pts]



N_β is basically means $(N_{\beta^-} - N_{\beta^+})$

$$220 = 208 + 4N_\alpha \quad \text{conservation of nucleon number}$$

$$86 = 82 + 2N_\alpha - N_\beta \quad \text{conservation of electric charge} \rightarrow N_\alpha = 3, N_\beta = 2.$$

3) CLASS(2)

Consider a sample which is measured to have 5% contamination. It has an activity of 0.100 Bq per gram. The 5% contamination is fresh carbon with activity 0.23 Bq. Find the age of the sample. [4 pts]

Say we take a gram of sample:

$$.95 \text{ grams } A(t) + .05 \text{ grams } 0.23 \frac{\text{Bq}}{\text{grams}} = 1 \text{ gram } 0.100 \frac{\text{Bq}}{\text{grams}}$$

$$\rightarrow A(t) = .093 \frac{\text{Bq}}{\text{grams}} = A_0 e^{-\lambda t} \quad (i)$$

$$A_0 = 0.23 \frac{\text{Bq}}{\text{grams}} \quad (\text{for } {}^{14}_6\text{C} \text{ in living organisms})$$

$$T_{1/2} = 5730 \text{ y} \rightarrow \lambda = \frac{\ln 2}{5730 \text{ y}}$$

$$(i) \rightarrow t = 7500 \text{ y.}$$

