

Solutions

2.1 C $\Delta m = 0.0046 \text{ u}$; $0.0046 \times 931.5 \approx 4.28 \text{ MeV}$.

Compare the rejected options: 0.46 MeV; 2.14 MeV; 6.55 MeV; 9.31 MeV. Use the stated model and conditions.

2.2 C $A = \lambda N$ and $\lambda = \ln 2 / T_{1/2}$, so halving $T_{1/2}$ doubles A at fixed N .

Compare the rejected options: half that of Y ; equal to that of Y ; four times that of Y ; one quarter that of Y . Use the stated model and conditions.

2.3 1. Nine hours is three half-lives: $8 \times 10^8 / 8 = 1 \times 10^8 \text{ Bq}$.

2.4 False. Atomic electron counts already balance for β^- (and for α with neutral He); β^+ needs the explicit $2m_e$.

3.1 Parent population is $N_A = N_0 e^{-\lambda t}$. Daughter equation $\dot{N}_B + \lambda N_B = \lambda N_0 e^{-\lambda t}$ has integrating factor $e^{\lambda t}$, giving $N_B = \lambda N_0 t e^{-\lambda t}$. Derivative is $\lambda N_0 e^{-\lambda t} (1 - \lambda t)$; maximum occurs at $t = 1/\lambda$, with $N_B = N_0/e$. Award parent, equation, integrating factor/solution, maximum time and value. Direct use of an unequal-decay-constant formula would give a removable zero-over-zero limit.