

April 18, 2008

Quiz 8 - PHY244 (Modern Physics)

Print (Hugely) Last Name: _____

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First name: _____

Giving or receiving aid is cause for dismissal from the university.

Solution

∇ For a light stable nucleus, the number of neutrons N and the number of protons Z are approximately equal, whereas for a heavy stable nucleus,

(a) $Z > N$, (b) $Z > A$, (c) $N > Z$, (d) $N > A$. (Circle the correct relation.)

♣ Circle the correct relation between the binding energies per nucleon B/A of ^{56}Fe and ^{238}U ,

(a) $(B/A)_{^{56}\text{Fe}} < (B/A)_{^{238}\text{U}}$; (b) $(B/A)_{^{56}\text{Fe}} = (B/A)_{^{238}\text{U}}$ (c) $(B/A)_{^{56}\text{Fe}} > (B/A)_{^{238}\text{U}}$;

♠ An X nucleus can turn into a W nucleus via the β process. At the beginning $t = 0$, a pure sample of 1,000,000 of X (without W) are prepared. After 11 days, the sample become a mixture of about 250,000 of X and 750,000 of W .

Determine the half-life $t_{1/2}$.

$$N(t) = N_0 \left(\frac{1}{2}\right)^{\frac{t}{t_{1/2}}}$$

$$250,000 = 1,000,000 \left(\frac{1}{2}\right)^{\frac{11}{t_{1/2}}}$$

$$\frac{1}{4} = \left(\frac{1}{2}\right)^{\frac{11}{t_{1/2}}}$$

$$\frac{11}{t_{1/2}} = 2; \quad t_{1/2} = 5.5 \text{ days}$$

At what time t , the number of the daughter nucleus W reaches about 875,000?

$$N(t) = 125,000$$

$$\frac{1}{8} = \left(\frac{1}{2}\right)^{\frac{t}{t_{1/2}}}$$

$$\frac{t}{t_{1/2}} = 3$$

$$t = 3 \times 5.5 \text{ days} = 16.5 \text{ days}$$