2012 APR 30

(GG, Ch 30, P42)

$$^{235}_{92}U \longrightarrow {}^{207}_{82}Pb$$

LOST 10 p

LOST 28 (p+n)

LOST 18 n

α DECAY: LOSE 2p
2n
4 (p+n)

β^- DECAY: GAIN p
LOSE n
* NO CHANGE IN p+n

- β^- DECAY CANNOT CHANGE ATOMIC MASS NUMBER
- CHANGE OF 28 IN ATOMIC MASS NUMBER MUST COME FROM 7 α DECAYS.

$$^{235}_{92}U \xrightarrow{7\alpha} {}^{207}_{78}X \xrightarrow{4\beta^-} {}^{207}_{82}Pb$$

Carbon Dating

- Want to apply ideas of nuclear decay to the problem of figuring out how old something is.

$$N = N_0 e^{-\lambda t}$$

- The fraction of ^{14}C in Earth's atmosphere has remained roughly constant over thousands of years.

$$^{14}C/^{12}C = 1.3 \times 10^{-12}$$

$$n + {}^{14}_{7}N \longrightarrow {}^{14}_{6}C + p$$

- Every living thing maintains the ratio of 1.3×10^{-12} of $^{14}C/^{12}C$ by interacting with Earth's atmosphere (by breating, inspiration of CO_2, etc.)
- When a living thing dies, this interaction stops, no new ^{14}C comes in, and the exsting ^{14}C decays.

TO FIND THE TIME SINCE SOMETHING HAS BEEN ALIVE =

$$N = N_0 e^{-\lambda t}$$

$$\frac{N}{N_0} = e^{-\lambda t}$$

$$\ln\left(\frac{N}{N_0}\right) = -\lambda t$$

$$t = -\frac{\ln\left(\frac{N}{N_0}\right)}{\lambda}$$

(EXAMPLE 30-13)

$$200\,g \times \frac{1\ mol}{12\ g} \times \frac{6.022\times10^{23}\ \text{ATOMS}}{mol} = 1.0\times10^{25}$$

TOTAL NUMBER OF CARBON ATOMS
(INCLUDING ^{12}C, ^{13}C, ^{14}C)

$$N_0 = \begin{matrix}\text{ORIGINAL \#}\\ \text{OF } ^{14}C \text{ ATOMS}\end{matrix} = (1.3\times10^{-12})(1.0\times10^{25})$$

$$= 1.3\times10^{13}$$

$$\lambda N = \text{ACTIVITY} = 16\ \text{DECAYS/SEC}$$

$$\lambda = \frac{\ln 2}{T_{1/2}} = \frac{\ln 2}{5730\,YR} = 1.21\times10^{-4}\ YR^{-1}$$

$$N = \frac{16\ \text{DECAY/S}}{1.21\times10^{-4}\ YR^{-1}} =$$