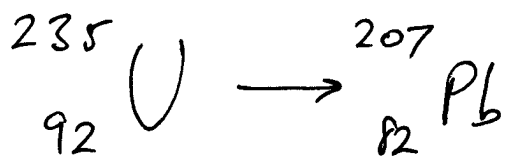


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(GG, Ch 30, P42)

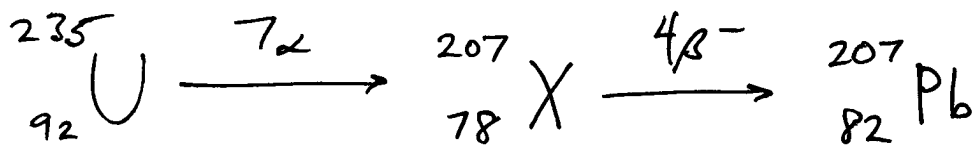


~~LOST~~ LOST 10 p  
LOST 28 (p+n)  
LOST 18 n

$\alpha$  DECAY: LOSE 2p  
2n  
4 (p+n)

$\beta^-$  DECAY: GAIN p  
LOSE n  
\* NO CHANGE IN p+n

- $\beta^-$  DECAY CANNOT CHANGE ATOMIC MASS NUMBER
- CHANGE OF 28 IN ATOMIC MASS NUMBER MUST COME FROM 7  $\alpha$  DECAYS.



# 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  $^{14}\text{C}$  IN EARTH'S ATMOSPHERE HAS REMAINED ROUGHLY CONSTANT OVER THOUSANDS OF YEARS.

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



- EVERY LIVING THING MAINTAINS THE RATIO OF  $1.3 \times 10^{-12}$  OF  $^{14}\text{C}/^{12}\text{C}$  BY INTERACTING WITH EARTH'S ATMOSPHERE (BY BREATHING, INSPIRATION OF  $\text{CO}_2$ , ETC.)
- WHEN A LIVING THING DIES, THIS INTERACTION STOPS, NO NEW  $^{14}\text{C}$  COMES IN, AND THE EXISTING  $^{14}\text{C}$  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)

4

$$200\text{g} \times \frac{1\text{ mol}}{12\text{ g}} \times \frac{6.022 \times 10^{23} \text{ Atoms}}{\text{mol}} = 1.0 \times 10^{25}$$

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

$$N_0 = \begin{array}{l} \text{ORIGINAL \#} \\ \text{OF } ^{14}\text{C ATOMS} \end{array} = (1.3 \times 10^{-12}) (1.0 \times 10^{25}) \\ = 1.3 \times 10^{13}$$

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

$$\lambda = \frac{\ln 2}{T_{1/2}} = \frac{\ln 2}{5730 \text{ yr}} = 1.21 \times 10^{-4} \text{ yr}^{-1}$$

$$N = \frac{16 \text{ DECAYS/s}}{1.21 \times 10^{-4} \text{ yr}^{-1}} =$$