Part R Problems

1. At 1:00 pm today there are 1600 micro-grams of a radioactive substance whose half-life is 30 minutes.   How many micro-grams will there be at 3:00 pm today?

2. After 40 days, a 2000-gram radioactive substance decays to only 125 grams. What is the half-life of this substance?

3. A bone unearthed on an archaeological "dig" is analyzed for its carbon content. It is found that for every carbon-14 nucleus, there are 32 trillion carbon-12 nuclei. How many years ago was this bone part of a living animal?

4. A radioactive nucleus whose atomic number is 83, and which has 112 neutrons, decays sequentially, first by alpha-emission, then by two beta-particle emissions. What is the atomic weight of the resulting nucleus?

Solutions

1. From 1:00 pm to 3:00 pm there are 120 minutes, or four times 30 minutes, which is four half-lives, four halvings: $1600 \rightarrow 800 \rightarrow 400 \rightarrow 200 \rightarrow 100$ μg	**2.** $2000 \rightarrow 1000 \rightarrow 500 \rightarrow 250 \rightarrow 125$ g Four halvings, four half-lives: $4T = 40$ days $\quad T = 10$ days
3. $1 \rightarrow 2 \rightarrow 4 \rightarrow 8 \rightarrow 16 \rightarrow 32$ Five doublings of C-12/C-14 ratio occurred because there were five halvings of C-14 while the C-12 content was unchanged, which means five half-lives had gone by since the animal died: $5(5730) = 28{,}650$ years ago the animal died	**4.** $_{83}X^{195} \rightarrow\ _{2}\alpha^{4} +\ _{-1}\beta^{0} +\ _{-1}\beta^{0} +\ _{83}Y^{191}$