

Chem 1062

Note Title

8/6/2008

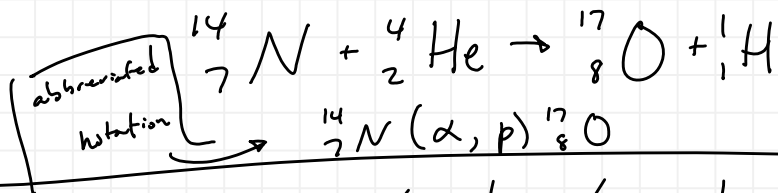
- * Final Exam tomorrow - please be here on time
so we may begin @ 8:00 am
- * Exams Returned

Types of Radioactive Decay

- * make predictions of decay type by its location with respect to the band of stability
- * links to isotope tables may also be used

Nuclear Bombardment Reactions

- * nucleus bombarded by another nucleus or particle
- * also called transmutation
- * carried out with large instruments called cyclotrons (particle accelerators)
- * Rutherford conducted first documented transmutation - this led to discovery of proton
~1919

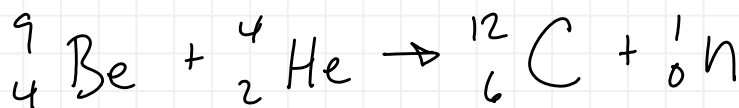
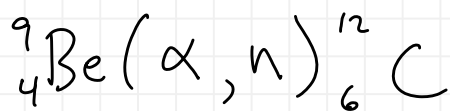


α = alpha n = neutron
 β = beta
 γ = gamma
p = proton
d = deuteron ${}^2_1\text{H}$
t = triton ${}^3_1\text{H}$

James Chadwick - discovered the neutron in 1932

Write an equation that shows the

bombardment of Be-9 with alpha particles to produce a neutron.



Ch. 21, # 61, 67, 71, 77, 79

Rate $\propto N_t$ rate = activity

$$\boxed{\text{Rate}} = k N_t \quad t_{1/2} = \frac{0.693}{k} \quad \ln \frac{N_t}{N_0} = -k t$$

Rate = $k[A]$ decay constant rate constant

Radioactive Decay is a 1st-order rate process

N_t = nuclei present at time = t

$$\boxed{1 \text{ Ci} = 1 \text{ curie} = 3.700 \times 10^{10} \frac{\text{disintegrations}}{\text{s}}}$$

$$\left. \begin{array}{l} E = mc^2 \\ \Delta E = \Delta mc^2 \end{array} \right\}$$

(21.61) Au-198 $t_{1/2} = 2.69 \text{ d}$ What is the activity of 0.86 mg of this isotope in Curies?

$$2.69 \text{ d} \times \frac{24 \text{ h}}{1 \text{ d}} \times \frac{60 \text{ min}}{1 \text{ h}} \times \frac{60 \text{ s}}{1 \text{ min}} = 2.324 \times 10^5 \text{ s}$$

$$0.86 \text{ mg } {}^{198}\text{Au} \times \frac{1 \text{ g}}{1000 \text{ mg}} \times \frac{1 \text{ mol}}{198 \text{ g}} \times \frac{6.022 \times 10^{23} \text{ nuclei}}{1 \text{ mol}} = 2.616 \times 10^{18} \text{ nuclei}$$

$$\text{Rate} = k N_t = \frac{0.693}{t_{1/2}} N_t = \left(\frac{0.693}{2.324 \times 10^5 \text{ s}} \right) 2.616 \times 10^{18} \text{ nuclei}$$

$$t_{1/2} = \frac{0.693}{K} \Rightarrow K = \frac{0.693}{t_{1/2}} = 7.801 \times 10^{12} \frac{\text{nuclei}}{\text{s}}$$

$$7.801 \times 10^{12} \frac{\text{disintegrations}}{\text{s}} \times \frac{1 \text{ Ci}}{3.700 \times 10^{10} \frac{\text{disint}}{\text{s}}} = 2.1 \times 10^2 \text{ Ci}$$

21.67) If 28.0% of a sample of $N-17$ decays in 1.97 s, what is the half-life?
 → 72.0% remains $N_t = 0.720 N_0$

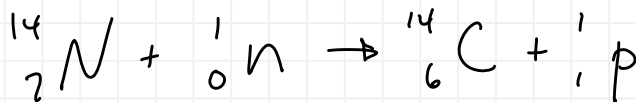
$$\ln \frac{N_t}{N_0} = -Kt$$

$$\ln \frac{0.720 N_0}{N_0} = -K(1.97 \text{ s})$$

$$\frac{-0.3285}{+1.97 \text{ s}} = \frac{-K(1.97 \text{ s})}{+1.97 \text{ s}} = 0.1668 \text{ s}^{-1}$$

$$t_{1/2} = \frac{0.693}{K} = \frac{0.693}{0.1668 \text{ s}^{-1}} = 4.16 \text{ s}$$

21.71) → Rate_t = 8.1 $\frac{\text{disint}}{\text{min} \cdot \text{g}}$ ^{14}C has a $t_{1/2} = 5730 \text{ yr}$
 → Rate₀ = 15.3 $\frac{\text{disint}}{\text{min} \cdot \text{g}}$



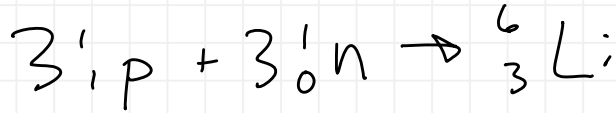
$$t_{1/2} = \frac{0.693}{K} \Rightarrow K = \frac{0.693}{t_{1/2}} = \frac{0.693}{5730 \text{ yr}} = 1.209 \times 10^{-4} \text{ yr}^{-1}$$

$$\ln \frac{\text{Rate}_t}{\text{Rate}_0} = -Kt = \ln \frac{8.1 \frac{\text{dis}}{\text{min} \cdot \text{g}}}{15.3 \frac{\text{dis}}{\text{min} \cdot \text{g}}} = -(1.209 \times 10^{-4} \text{ yr}^{-1})t$$

(21.79)

mass defect for ${}^6_3\text{Li}$ in amu

find nuclear binding energy
in MeV per ${}^6_3\text{Li}$:



$$\begin{array}{l} \text{mass} \\ \text{(amu)} \end{array} 3(1.00728) + 3(1.008665) \quad 6.01512$$

$$6.047835 \text{ amu} \quad \text{vs} \quad 6.01512 \text{ amu}$$



$$\Delta m = \text{mass defect}$$

$$\Delta E = \Delta m c^2$$