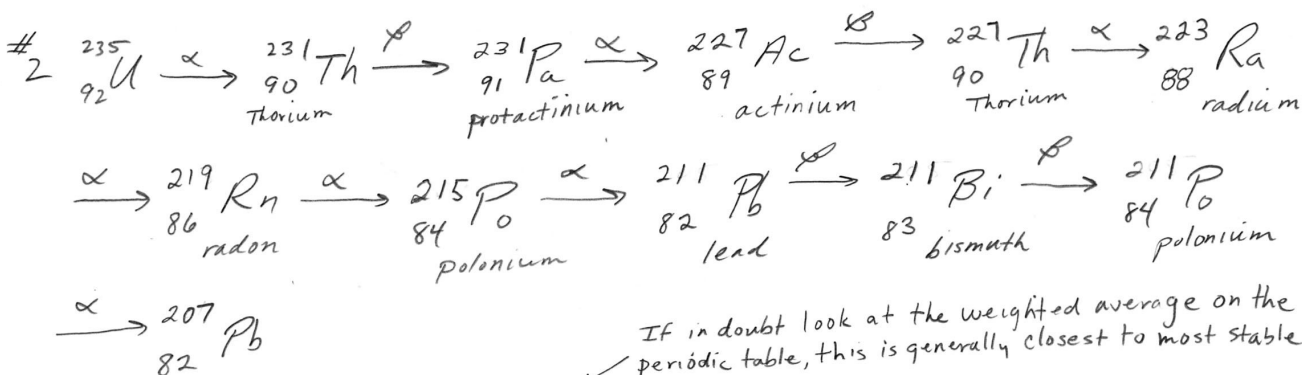
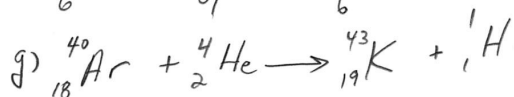
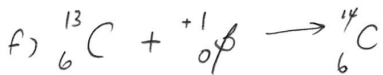
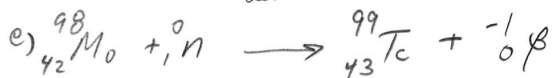
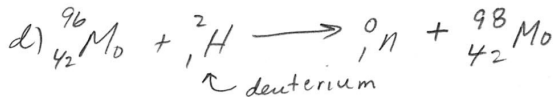
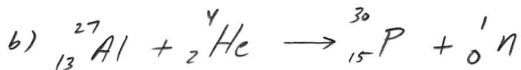
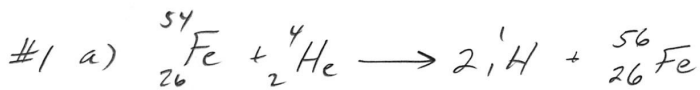


AP Chemistry

Nuclear Chemistry Questions



#3 a. C-12 6p, 6n even, even (1:1) b. C-14 p/n ratio = 1:1 (takes precedence over "even") c. Si-28 14p, 14n (even/even) ≠ 1:1 ratio

#4. $t_{1/2} = .693/k$ $k = .693/5.3\text{yrs} = .13$

$N = N_0 e^{-kt}$ $N = (10.0\text{mg}) e^{-(.13)(21.2)} = .635 = \underline{.64\text{mg}}$

$N = (10.0\text{mg}) e^{-(.13)(100\text{yrs})} = 2.26 \times 10^{-5} = \underline{2.3 \times 10^{-5}\text{mg}}$

#5. $\ln\left(\frac{R_0}{R}\right) = kt$ $\ln\left(\frac{6400}{1600}\right) = k(6.00\text{hr})$ $k = .23\text{hr}^{-1}$

$t_{1/2} = .693/k = .693/.23\text{hr}^{-1} = 3.01 \approx \underline{3\text{hr}}$

Alternatively you could solve this:

1600 dps is $\frac{1}{4}$ the initial 6400 dps. $\frac{1}{4}$ dps means 2 half-lives
 $(\frac{1}{2})^2 = \frac{1}{4}$, 6.00hr = 2 half-lives $t_{1/2} = 3\text{hrs}$

#6. $k = .693/t_{1/2} = \frac{.693}{29 \text{ yr}} = .024 \text{ yr}^{-1}$

$\ln\left(\frac{R_0}{R}\right) = kt \quad \ln\left(\frac{80}{2.5}\right) = (.024 \text{ yr}^{-1})(t) \quad t = 144.4 \approx \underline{144 \text{ years}}$

$1985 + 144 \text{ yrs} = \text{The year } \underline{2129}$

$\frac{144 \text{ yrs}}{29 \text{ yrs}} = 4.97 \approx \underline{5 \text{ half-lives}}$

#7 Since C-12 is a stable isotope and remains constant, a C-14 to C-12 ratio of only .72 means C-14 has decayed by 28%

$\frac{1}{\text{original}} \rightarrow \frac{.72}{\text{now}} \quad t_{1/2} = \frac{.693}{k} \quad k = \frac{.693}{5.73 \times 10^3 \text{ yrs}} = 1.21 \times 10^{-4} \text{ yr}^{-1}$

$\ln\left(\frac{N_0}{N}\right) = kt \quad \ln\left(\frac{1}{.72}\right) = 1.21 \times 10^{-4} t \quad .329 = 1.21 \times 10^{-4} t \quad t = \underline{2715 \text{ yrs}}$



#9 5% of original activity $(.05) = \left(\frac{1}{2}\right)^x \quad \frac{\ln .05}{\ln .5} = x \quad x = 4.32 \text{ half-lives}$

$\text{days} = (8.05 \text{ days})(4.32 \text{ half-lives}) = \underline{34.8 \text{ days}}$

#10 a) $\Delta \text{mass} = ({}_{6}^{59}\text{C} + {}_1^1\text{H}) - ({}_{27}^{59}\text{Co} + 2{}_1^1\text{H}) = .01343 \text{ g}$

$E = \left(1.343 \times 10^{-5} \frac{\text{kg}}{\text{mol}}\right) \left(3.00 \times 10^8 \frac{\text{m}}{\text{s}}\right)^2 = 1.2 \times 10^{12} \text{ J/mol} = \underline{1.2 \times 10^9 \text{ kJ/mol}}$
energy absorbed

b) $({}_{88}^{226}\text{Ra} + {}_2^4\text{He}) - {}_{90}^{230}\text{Th} = -.00516 \text{ g/mol} = -5.16 \times 10^{-6} \text{ kg/mol}$

$E = (-5.16 \times 10^{-6} \text{ kg/mol}) \left(3.00 \times 10^8 \frac{\text{m}}{\text{s}}\right)^2 = -4.64 \times 10^{11} \text{ J/mol} = \underline{-4.64 \times 10^8 \text{ kJ/mol}}$
energy released