Name: _____ date: _____ period: _____

Ch. 4 radiation / nuclear chem test 55 points ngss chem

In problems involving calculations, show your work in an organized manner, include the appropriate formula / equation, conversion factors, and appropriate units in your work / answer.

1. Fill-in the blank; might be hypothetical reaction. [10 points]

   a. the alpha decay of ^{224}Th: $^{224}_{90}Th \rightarrow {}^{4}_{2}He + {}^{220}_{88}Ra$

   2 pt ea

   b. $^{28}_{13}Al \rightarrow {}^{0}_{-1}e + {}^{28}_{14}Si$

   c. $^{245}_{92}U + {}^{1}_{0}n \rightarrow 2\,{}^{1}_{0}n + {}^{140}_{56}Ba + {}^{104}_{36}Kr$

   92 − 36 = 56

   246 − 142 = 104

2. If the half life is 35 days, what is the corresponding decay constant ? [5 points]

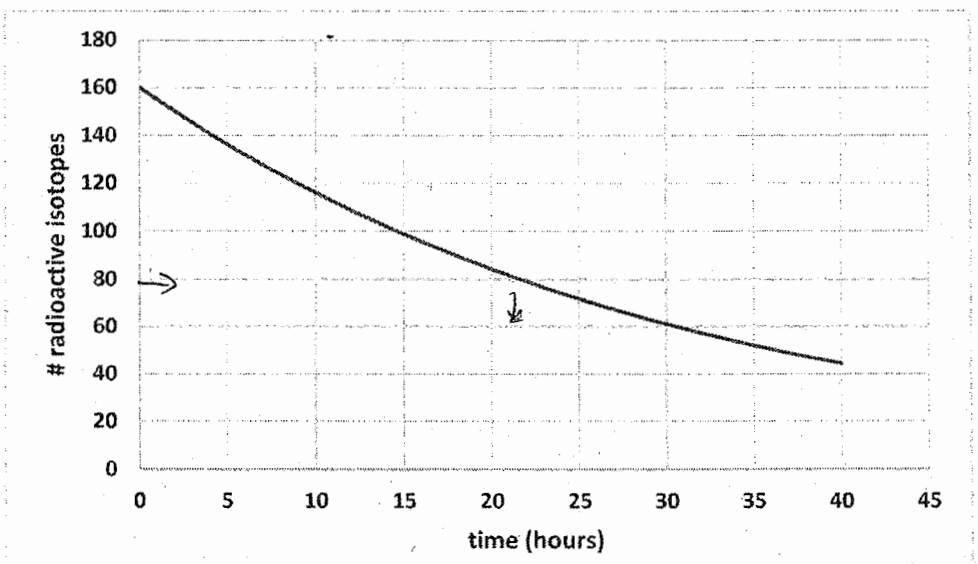
   $t + \frac{1}{2} = t_{\frac{1}{2}}$

   $k = \frac{\ln 2}{t_{\frac{1}{2}}}$

   $= \frac{\ln 2}{35 \text{ days}}$

   $= 1.98 \cdot 10^{-2} \frac{}{\text{days}}$

3. Estimate the half life on a hypothetical radioactive isotope based on the below graph. Basis / rationale ? [5 points]



1st : ~21 hours

4th : depends ...

4. A sample has 12.0 g of a radioactive isotope, where the original sample had 75.0 g of the isotope. The half life of the radioactive isotope is 125 years; what is the "age" of the sample ? [10 points]

i) $t_{\frac{1}{2}} = \frac{\ln 2}{k}$

$k = \frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln 2}{125\ \text{years}} = 0.0055\ \text{/year}$

ii) $t = \frac{\ln\left(\frac{N_0}{N}\right)}{k}$

$= \frac{\ln\left(\frac{75.0}{12.0}\right)}{\left(0.0055\ \text{/year}\right)}$

$= 333\ \text{years}$

5. If it takes 275 days for 100.0 g of a radioactive isotope to decay to 25.0 g, ____ [15 points]

a. what is the half life and decay constant ?

i) $t = \frac{\ln\left(\frac{N_0}{N}\right)}{k}$

$k = \frac{\ln\left(\frac{N_0}{N}\right)}{t} = \frac{\ln\left(\frac{100.0\ g}{25.0\ g}\right)}{275\ \text{days}}$

$= \boxed{0.0050\ \text{/day}}$

ii) $t_{\frac{1}{2}}\, k = \ln 2$

$t_{\frac{1}{2}} = \frac{\ln 2}{k} = \frac{\ln 2}{\left(0.0050\ \text{/day}\right)}$

$= \boxed{138\ \text{days}}$

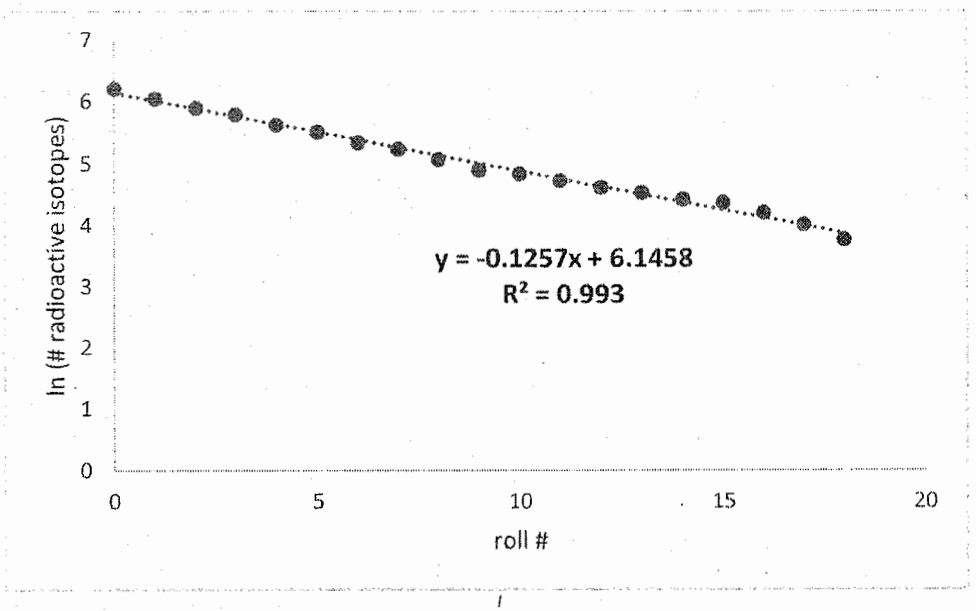
b. how much time would be needed for 888 g of the isotope to decay to 125 g ?

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

$= \frac{\ln\left(\frac{888}{125}\right)}{\left(0.0050\ \text{/day}\right)}$

$= 392\ \text{days}$

6, Estimate the value of the half-life (in roll #) based on the below graph. [10 points]



i) $k = -\text{slope}$

$= -0.1257 \frac{1}{\text{roll \#}}$

ii) $\ln 2 = k \cdot t_{\frac{1}{2}}$

$t_{\frac{1}{2}} = \frac{\ln 2}{k}$

$= \frac{\ln 2}{\left(0.1257 \frac{1}{\text{roll \#}}\right)}$

$= 5.51 \text{ rolls}$