Name: _____ date: _____ period: _____

Ch. 4 radioactive decay test 45 points (2 ec) ngss chemistry

In problems involving any calculation, show your work in an organized manner, include (i) any relevant equation (or formula), (ii) conversion factor(s), and (iii) put the proper units in your calculations and answer.

1. A hypothetical radioactive isotope has a half-life of 15 years. [10 points]

   a. What is the isotope's decay constant ?

2 pts

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

$k = \frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln 2}{15\ y}$

$= \frac{0.046}{year}$

   b. How much of the radioactive isotope would remain in a 5.0 sample after 35 years ?

3 pts

$N = N_0 e^{-kt}$

$= 5.0\ g\ e^{-\frac{0.046}{year} \cdot 35\ y}$

$= 5.0\ g\ e^{-1.61}$

$= 5\ (0.199\ g)$

$= 1.0\ g$

2. Fill-in the below blank; the nuclear reaction might not occur. [12 points]

   a. Alpha decay of ^{140}Ba: $^{140}_{56}Ba \rightarrow {}^{4}_{2}He + {}^{136}_{54}Xe$

2 pts

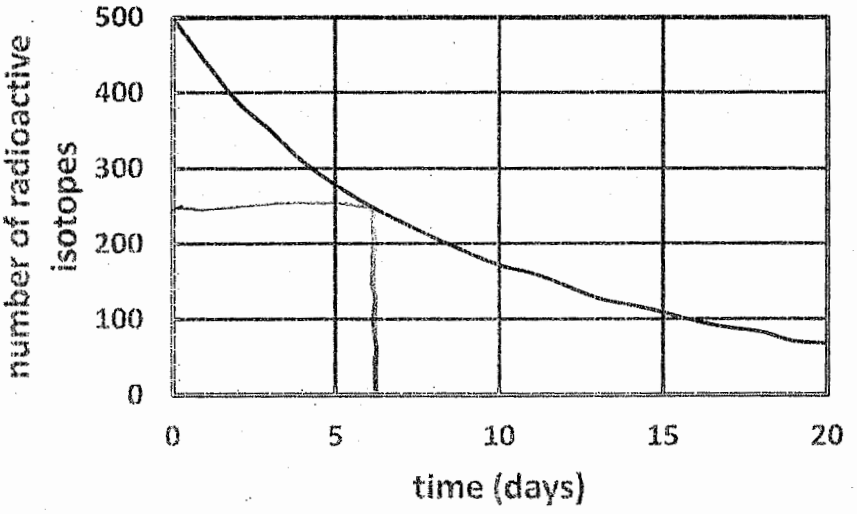
   b. Beta decay of ^{81}Br: $^{81}_{35}Br \rightarrow {}^{0}_{-1}e + {}^{81}_{34}Se$

   c. $^{12}_{5}B \rightarrow {}^{12}_{4}Be + {}^{0}_{1}e$

   d. $^{238}_{92}U + {}^{1}_{0}n \rightarrow 3\ {}^{1}_{0}n + {}^{140}_{56}Ba + {}^{96}_{36}Kr$

   e. $^{11}_{5}B + {}^{7}_{3}Li \rightarrow {}^{18}_{8}O$

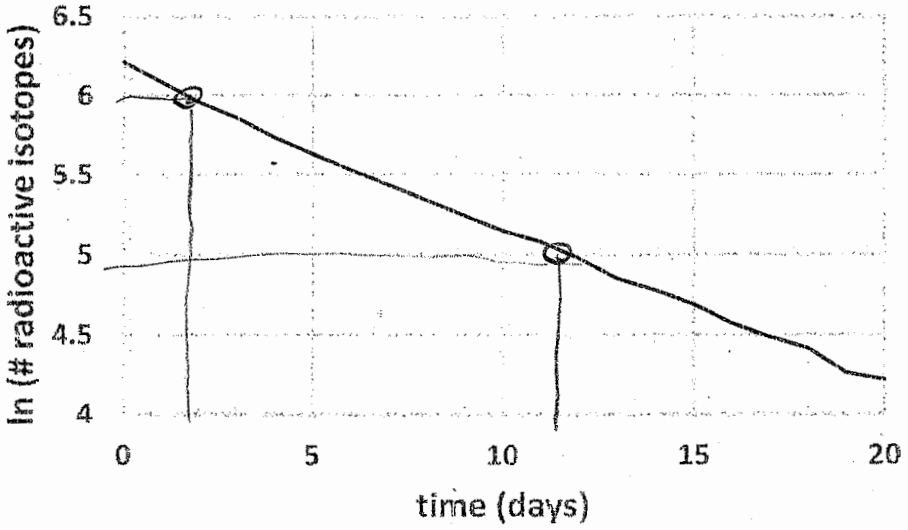
3. Based on the below simulation, estimate the half-life. Justify your answer; refer / mark below graph as appropriate. [5 points]



1 pt
4

~ 7 days,
based on data . . .

4. Based on the below simulation, estimate the half-life. Justify your answer; refer / mark below graph as appropriate.. [10 points]



$N = N_0 e^{-kt}$

$\ln N = \ln N_0 - kt$

$y \quad b \quad mx$

2+3 pt (I) $k = -\text{slope} = \frac{1}{2-12} = \frac{0.1}{\text{day}}$

2+3 pt (II) $\ln 2 = k\, t_{\frac{1}{2}}$

$t_{\frac{1}{2}} = \frac{\ln 2}{k} = \frac{\ln 2}{\quad} = 6.9$

5. The half life of ^3H is about 12 years. A radioactive sample originally had 100 mg ^3H, but currently has 15 mg ^3H; what is the age of the sample ? [10 points]

2 @ 3pt

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

$$k = \frac{\ln 2}{t_{\frac{1}{2}}} = \frac{\ln 2}{12\,y} = \frac{0.0578}{yr}$$

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

2 @ 3pt

$$= \frac{\ln\left(\frac{100}{15}\right)}{\left(\frac{0.0578}{y}\right)}$$

$$= \frac{1.897}{\left(\frac{0.0578}{y}\right)}$$

$$= 32.8 \text{ years}$$