Half-Life & The Decay Series

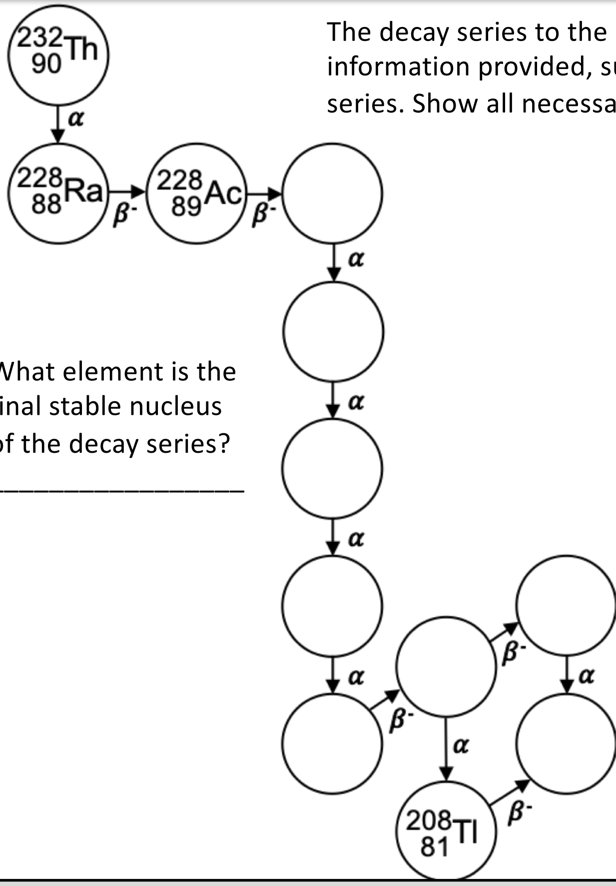
Homework

Name: ____

Period: _______Date: ______________________________

Decay Series

The decay series to the left is for thorium-232. A few decays are filled in for you. Using the information provided, such as the decay method of parent nuclides, complete the decay series. Show all necessary nuclear decay equations below.



What element is the final stable nucleus of the decay series?

____

Half-Life Problems Work out each half-life problem below, and show all of your calculations.

1) The half-life of potassium-42 is 12.4 hours. How much of a 750. g sample is left after 62.0 hours?

2) The half-life of cesium-137 is 30.2 years. If the initial mass of a sample of cesium-137 is 2.50 kg, how much will remain after 181.2 years?

Half-Life Problems Work out each half-life problem below, and show all of your calculations.

3) Strontium-90 has a half-life of 28.8 years, how long will it take for 1.00 g of strontium-90 to decay to 31.25 mg?

4) The half-life of throium-232 is 1.4×10^{10} years. If there are 12.50 g of the sample left after 4.2×10^{10} years, how many grams were in the original sample?

5) What is the half-life of polonium-214 if, after 810. seconds, a 2.880 g sample decays to 45.0 mg?

6) A 1.000 kg block of phosphorus-32, which has a half-life of 14.3 days, is stored for 85.8 days. At the end of this period, how much phosphorus-32 remains?

7) A sample of germanium-66, which has a half-life of 2.5 hours, is left for 12.5 hours. At the end of this time, only 1.0 g remain. What was the original amount of germanium-66?

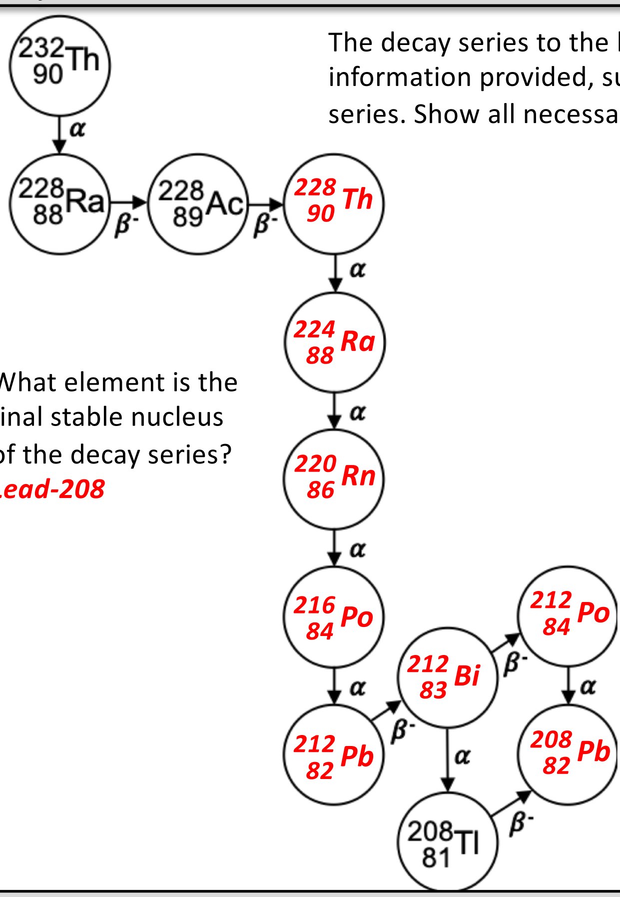
Half-Life & The Decay Series

Homework

Name: ______________________________ **KEY**

Period: _______ Date: ______________________

Decay Series



The decay series to the left is for thorium-232. A few decays are filled in for you. Using the information provided, such as the decay method of parent nuclides, complete the decay series. Show all necessary nuclear decay equations below.

1. $^{228}_{89}Ac \rightarrow \, ^{0}_{-1}e + \, ^{228}_{90}Th$
2. $^{228}_{90}Th \rightarrow \, ^{4}_{2}He + \, ^{224}_{88}Ra$
3. $^{224}_{88}Ra \rightarrow \, ^{4}_{2}He + \, ^{220}_{86}Rn$
4. $^{220}_{86}Rn \rightarrow \, ^{4}_{2}He + \, ^{216}_{84}Po$
5. $^{216}_{84}Po \rightarrow \, ^{4}_{2}He + \, ^{212}_{82}Pb$
6. $^{212}_{82}Pb \rightarrow \, ^{0}_{-1}e + \, ^{212}_{83}Bi$
7. $^{212}_{83}Bi \rightarrow \, ^{0}_{-1}e + \, ^{212}_{84}Po$
8. $^{212}_{84}Po \rightarrow \, ^{4}_{2}He + \, ^{208}_{82}Pb$

What element is the final stable nucleus of the decay series?
Lead-208

Half-Life Problems

Work out each half-life problem below, and show all of your calculations.

1) The half-life of potassium-42 is 12.4 hours. How much of a 750. g sample is left after 62.0 hours?

$$m_f = \frac{m_i}{2^n}$$

$$m_f = \frac{750.\,g}{2^5}$$

$$m_f = 23.4\,g$$

OR

62.0 hrs / 12.4 hrs = 5

750. /2/2/2/2/2 = 23.4 g

2) The half-life of cesium-137 is 30.2 years. If the initial mass of a sample of cesium-137 is 2.50 kg, how much will remain after 181.2 years?

$$m_f = \frac{m_i}{2^n}$$

$$m_f = \frac{2.50\,kg}{2^6}$$

$$m_f = 0.0391\,kg$$

OR

181.2 yrs / 30.2 yrs = 6

2.50 /2/2/2/2/2/2 = 0.0391 kg

Half-Life Problems Work out each half-life problem below, and show all of your calculations.

KEY

3) Strontium-90 has a half-life of 28.8 years, how long will it take for 1.00 g of strontium-90 to decay to 31.25 mg?

$$m_f = \frac{m_i}{2^n}$$

$$2^n = \frac{m_i}{m_f}$$

$$ln2^n = ln\frac{1000\ mg}{31.25\ mg}$$

$$n(ln2) = ln\frac{1000\ mg}{31.25\ mg}$$

$$n = \frac{ln\frac{1000\ mg}{31.25\ mg}}{ln2}$$

$$n = 5\ half\text{-}lives$$

28.8 yrs x 5 = 144 years

OR

1000 mg /2/2/2/2/2 = 31.25 mg

28.8 yrs x 5 = 144 years

4) The half-life of throium-232 is 1.4 x 10^{10} years. If there are 12.50 g of the sample left after 4.2 x 10^{10} years, how many grams were in the original sample?

$$m_i = m_f\ x\ 2^n$$

$$m_i = 12.50\ g\ x\ 2^3$$

$$m_i = 100.0\ g$$

OR

4.2 x 10^{10} yrs / 1.4 x 10^{10} yrs = 3

12.50 mg x2 x2 x2 = 100.0 g

5) What is the half-life of polonium-214 if, after 810. seconds, a 2.880 g sample decays to 45.0 mg?

$$m_f = \frac{m_i}{2^n}$$

$$2^n = \frac{m_i}{m_f}$$

$$ln2^n = ln\frac{1545\ mg}{24.14\ mg}$$

$$n(ln2) = ln\frac{1545\ mg}{24.14\ mg}$$

$$n = \frac{ln\frac{2880\ mg}{45.0\ mg}}{ln2}$$

$$n = 6\ half\text{-}lives$$

810. s / 6 = 135 s

OR

2880 mg /2/2/2/2/2/2 = 45.0 mg

810. s / 6 = 135 s

$t_{1/2}$ = 135 s

6) A 1.000 kg block of phosphorus-32, which has a half-life of 14.3 days, is stored for 85.8 days. At the end of this period, how much phosphorus-32 remains?

$$m_f = \frac{m_i}{2^n}$$

$$m_f = \frac{1.000\ kg}{2^6}$$

$$m_f = 0.01563\ kg$$

OR

85.8 days / 14.3 days = 6

1.000 kg /2/2/2/2/2/2 = 0.01563 kg

= 15.63 g (in case they answer in grams)

7) A sample of germanium-66, which has a half-life of 2.5 hours, is left for 12.5 hours. At the end of this time, only 1.0 g remain. What was the original amount of germanium-66?

$$m_i = m_f\ x\ 2^n$$

$$m_i = 1.0\ g\ x\ 2^5$$

$$m_i = 32\ g$$

OR

12.5 hours / 2.5 hours = 5

1.0 mg x2 x2 x2 x2 x2 = 32 g