Name : _____ Date : _____

Half-Life Practice Problems

1. The half-life of uranium-238 is 4.5 billion years, and the age of Earth is 4.5×10^9 years. What fraction of uranium-238 that was present when Earth was formed still remains?

2. A medical institution requests 1 gram of bismuth-214, which has a half-life of 20 minutes. How many grams of bismuth-214 must be prepared if the shipping time is 2 hours?

3. If you started with 120 grams of a radioactive substance and now have 15 grams, how many half-lives have passed?

4. The half-life of hafnium-156 is 0.025 seconds. How long will it take a sample weighing 560 grams to decay to ¼ of its original weight?

5. Pd-100 has a half-life of 3.6 days. If one had 6.02×10^{23} atoms at the start, how many Pd-100 atoms would be present after 20 days?

6. A radioactive isotope decayed to 17/32 of its original mass after 60 minutes. What is its half-life?

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Half-Life Practice Problems

Answers

1. The half-life of uranium-238 is 4.5 billion years, and the age of Earth is 4.5×10^9 years. What fraction of uranium-238 that was present when Earth was formed still remains?
   ½ still remains. This is because the half-life of uranium-238 and the age of the Earth are the same - 4.5 billion years.

2. A medical institution requests 1 gram of bismuth-214, which has a half-life of 20 minutes. How many grams of bismuth-214 must be prepared if the shipping time is 2 hours?
   64 grams
   If bismuth-24 has a half-life of 20 minutes, then in 2 hours, it will pass through = 120/20 = 6 half-lives. So a total of 64 grams will need to be shipped ($2^6 = 64$)

3. If you started with 120 grams of a radioactive substance and now have 15 grams, how many half-lives have passed?
   3 half-lives
   120 x ½ = 60 x ½ = 30 x ½ = 15

4. The half-life of hafnium-156 is 0.025 seconds. How long will it take a sample weighing 560 grams to decay to ¼ of its original weight?
   0.05 seconds
   To reach ¼ th of its original mass, 2 half-lives must pass. So, the time taken is = 0.025 x 2 = 0.05 seconds.

5. Pd-100 has a half-life of 3.6 days. If one had 6.02×10^{23} atoms at the start, how many Pd-100 atoms would be present after 20 days?
   1.28×10^{22}
   The number of half-lives passed = 20/3.6 = 5.56
   So, the number of atoms left = $6.02 \times 10^{23} \times (½)^{5.56} = 1.27 \times 10^{22}$

6. A radioactive isotope decayed to 17/32 of its original mass after 60 minutes. What is its half-life?
   65.75 minutes (or 66 minutes)
   $(½)^n = 17/32$ or n = 0.912, total number of half-lives that have passed
   So, the half-life of the radioactive isotope is 60/0.912 = 65.75 minutes