**Unit 4: Soil & Geology**

**Half-Life: Check Yourself!**

Directions: This is a set of half-life problems designed to let you practice your skills.

***The answers are at the bottom of this page, upside down.***

***Complete explanations are on my desk.***

It is very important that you don’t look at solutions until you have genuinely tried to figure out the problems. This page will go into your unit but if you have trouble, see me!

1. The half-life of strontium-90 is 25 years. How much strontium-90 will remain after 100 years if the initial amount is 4.0 g?

1. Iodine-131 is used to destroy thyroid tissue in the treatment of an overactive thyroid. The half-life of iodine-131 is 8 days. If a hospital receives a shipment of 200 g of iodine-131, how much I-131 would remain after 32 days?

1. What is the half-life of a 100.0 g sample of nitrogen-16 that decays to 12.5 grams in 21.6 seconds?

1. Mercury -197 is used for kidney scans and has a half-life of 3 days. If the amount of mercury-197 needed for a study is 1.0 gram and the time allowed for shipment is 15 days, how much mercury-197 will need to be ordered?

1. Potassium-42 has a half-life of 12.4 hours. How much of an 848 g sample of potassium-42 will be left after 62.0 hours?

1. The half-life of hafnium-156 is 0.025 seconds. How long will it take a 560 g sample to decay to one-fourth of its original mass?

1. A 208 g sample of sodium-24 decays to 13.0 g of sodium-24 within 60.0 hours. What is the half-life of this radioactive isotope?

1. All isotopes of technetium are radioactive, but they have widely varying half-lives. If an 800.0 gram sample of technetium-99 decays to 100.0 g of technetium-99 in 639,000 years, what is its half-life?

1. Chromium-48 has a short half-life of 21.6 hours. How long will it take 360.00 g of chromium-48 to decay to 11.25 g?

1. If the half-life of iodine-131 is 8.10 days, how long will it take a 50.00 g sample to decay to

6.25 g?

 

**Solutions:**

1. HL = 25 years how much after 100 years? *need to know how many HLs that is… 100 years / 25 years = 4 half-lives*

*Now apply that to the original amount of material:*

*4.0g* ⇒ *2g* ⇒ *1g* ⇒ *.5g* ⇒ *.25g*

*.25g of strontium-90 will remain after 100 years.*

1. HL = 8 days gets shipment of 200 g; how much after 32 days?

*Remember that two units of time in a problem generally means you need to figure out how many HLs are involved. 32 days/8 days per half-life = 4 HLs*

*Now apply the number of half-lives to the original mass:*

*200g* ⇒ *100g* ⇒ *50g* ⇒ *25g* ⇒ *12.5g*

1. 100 g sample decays to 12.5 g it took 21.6 seconds for that to happen; again, you’re seeing the same unit twice so you need to figure out how many HLs passed:

*100g* ⇒ *50g* ⇒ *25g* ⇒ *12.5g 3 arrows means 3 HLs.*

*If it took 21.6 seconds for three half-lives, then each HL is 21.6 / 3 = 7.2 seconds*

1. HL = 3 days need 1g but takes 15 days to ship. how much to order?

*The same unit twice? Use it to figure out how many HLs are involved:*

*15 / 3 = 5 HLs*

*Since you want to figure out the amount to order, you need to DOUBLE the amount with each half-life instead of dividing by two, but you can still use the arrow technique:*

*need g* ⇒ *2g* ⇒ *4g* ⇒ *8g* ⇒ *16g* ⇒ *32g*

1. HL=12.4 hours sample 848g how much after 62.0 hours?

*62.0 / 12.4 = 5 HL*

*848g* ⇒ *424g* ⇒ *212g* ⇒ *106g* ⇒ *53g* ⇒ *26.5g*

*26.5 grams will be left.*

1. HL = 0.025 seconds how long for 560g sample to reach ¼ its mass

*If you see a fraction or a percentage, think of the table we created in class. This one is pretty simple so the whole table is unnecessary: one half-life is ½ the original material remaining; two HLs is ¼the original material; therefore, two HLs have passed.*

*If each half-life is 0.025 seconds and two HLs have occurred, then 2 x .025 = .05 seconds Note that you didn’t need to use the mass. Mass has nothing to do with the rate of decay.*

1. 208g sample decays to 13.0g in 60 hours; what’s the HL?

*208g* ⇒ *104g* ⇒ *52g* ⇒ *26g* ⇒ *13g Four arrows means 4 HLs passed in 60 hours. Each HL, then, is 60 / 4= 15 hours.*

1. 800.0g sample to 100.0g in 639,000 years what’s the HL? *800* ⇒ *400* ⇒ *200* ⇒ *100 so in 639,000 years, three HLs passed. 639,000 years/3 = 213,000 years*

1. HL = 21.6 hours how long for 360.0g to get to 11.25 g?

*You need to know how many HLs it will take, so use those arrows again:*

*360g* ⇒ *180g* ⇒ *90g* ⇒ *45g* ⇒ *22.5g* ⇒ *11.25g so it took 5 HLs…each 21.6 hours*

*You can either multiply 21.6 x 5, OR add 21.6 together five times. Answer: 108 hours*

1. HL = 8.10 days how long for a 50.0g sample to get to 6.25g? *You need to know how many half-lives occurred:*

*50g* ⇒ *25g* ⇒ *12.5g* ⇒ *6.25g three HLs have passed, each of which is 8.10 days:*

*8.1 x 3 = 24.3 days (OR you can add 8.10 together three times)*