

# Solving Half-Life Problems

Sample Problem: How much  $^{42}\text{K}$  will be left in a 320g sample after 62 hours? *approx.*

**Step 1:** Look up the isotope's half-life on Table N.

-For  $^{42}\text{K}$ : 12.36 h

**Step 2:** Set up a table showing the time (ALWAYS START WITH 0), number of half-lives, mass, and fraction remaining. You may use any combination of these columns needed.

amount

Start with 0, then add 1 for each half-life that passes.

Start with 0, then for each half-life that passes, add an amount equal to the half-life on Table N.

For each half-life that passes, cut the amount in half. You will often be given either a starting or ending amount. ( $\div 2$ )

Start with 1, then for each half-life that passes, cut the fraction in half ( $\div 2$ )

Half-Lives	Time	Amount (mass, %, etc.)	Fraction Remaining
0	0	320g (starting)	1
1	12.36 h	160g $\div 2$	$1/2$ $\div 2$
2	24.72 h	80g $\div 2$	$1/4$ $\div 2$
3	37.08 h	40g $\div 2$	$1/8$
4	49.44 h	20g $\div 2$	$1/16$
5	61.8 h	10g $\div 2$	$1/32$
6		5g	

**Practice Problems:** Answer the following questions below using data from Table N.

1. How long will it take for 30g of  $^{222}\text{Rn}$  to decay to 7.5g? *starting amt* *ending amt* *Table N*

$1/2$  life = 3.823d

Half-lives	Time	Amount
0	0	30g $\div 2$
1	3.823d	15g $\div 2$
2	7.646d	7.5g $\div 2$

2. How many grams of  $^{16}\text{N}$  will be left from a 16g sample after 21.4s? *starting amt* *end time*
- Table N  $1/2$  life = 7.13 s

Half-lives	Time	Amt
0	0	16g $\div 2$
1	7.13s	8g $\div 2$
2	14.26s	4g $\div 2$
3	21.39s	2g $\div 2$

2g

3. A radioactive isotope has a half-life of 2.5 years. Which fraction of the original mass remains unchanged after 10 years?

end time

half-lives	time	fraction
0	0	1
1	2.5 yrs	1/2
2	5 yrs	1/4
3	7.5 yrs	1/8
4	10 yrs	1/16

1/16

4. After decaying for 48 hours, 1/16 of the original mass of a radioisotope sample remains unchanged. What is the half-life of this radioisotope?

end time

half-lives	time	fraction
0	0 hrs	1
1	12 hrs	1/2
2	24 hrs	1/4
3	36 hrs	1/8
4	48 hrs	1/16

time it takes for 1/2 the sample to decay

48 hrs / 4 1/2 lives = 12 hrs

5. An original sample of the radioisotope fluorine-21 had a mass of 80.0 milligrams. Only 20.0 milligrams of this original sample remain unchanged after 8.32 seconds. What is the half-life of fluorine-21?

end mass

half-lives	time	amount
0	0	80.0 mg
1	4.16 s	40.0 mg
2	8.32 s	20.0 mg = stop

8.32 s / 2 1/2 lives = 4.16 s

6. In living organisms, the ratio of the naturally occurring isotopes of carbon, C-12 to C-13 to C-14, is fairly consistent. When an organism such as a woolly mammoth died, it stopped taking in carbon, and the amount of C-14 present in the mammoth began to decrease. For example, one fossil of a woolly mammoth is found to have 1/32 of the amount of C-14 found in a living organism.

Determine the total time that has elapsed since this woolly mammoth died.

half-lives	time	fraction
0	0	1
1	5,715 y	1/2
2	11,430 y	1/4
3	17,145 y	1/8
4	22,860 y	1/16
5	28,575 y	1/32

<sup>14</sup>C 1/2 life = 5715 yrs

28,575 years