Half-Life

Atoms naturally decay over time due to unstability in the nucleus. The half-life is the time required for half of the atoms present to decay.

$^{238}_{92}U \longrightarrow {}^{4}_{2}\alpha + {}^{234}_{90}Th$

600.0g U ⟶ 300.0g U

The number of half-lives elapsed = n

Fraction remaining $\frac{1}{2^n}$

original mass · $\frac{1}{2^n}$

Time		Mass
0		original mass 600.0g
1hr.	1	300.0g
2hr.	2	150.0g
3hr.	3	75.0g
4hr.	4	37.5g
5hr.	5	18.75g
6hr.	6	9.375g
7hr.	7	4.6875g
8hr.	8	2.34375g → 2.344g

600.0g U goes through 8 half-lives, how much U is remaining?
(U half-life $\frac{1\text{ hr.}}{60\text{ min.}}$)

Cadmium has a half life of 700 years. How much of a 1000.0g sample would be left after 2800 years?

Time	Mass
0	1000.0g
700	500.0g
1400	250.0g
2100	125.0g
2800	62.50g

What was the starting mass of a sample if it has gone through 5 half lives and a final mass of 20.0g?

0	640.0g
1	320.0g
2	160.0g
3	80.0g
4	40.0g
5	20.0g

11/6

SWAT

Define Ion & Isotope

Determine the charge on an ion (Group A)

Determine average atomic mass

Complete a half-life problem.

Average Atomic Mass - the weighted average of the masses of all naturally occuring isotopes.

$$\text{ave. atomic mass} = \frac{(\text{mass}_a \times \%_a) + (\text{mass}_b \times \%_b) + (\text{mass}_c \times \%_a) + \ldots}{100}$$

J-103 5.3%

J-101 90.0%

J-100 4.7%

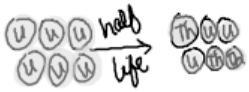
$$\frac{(103 \times 5.3\%) + (101 \times 90.0\%) + (100 \times 4.7\%)}{100} = 101.1$$

ave. atomic mass

Half-life

Atoms naturally decay over time. The time required for half of the atoms present to decay is called the half-life.

$^{238}_{92}U \rightarrow \underbrace{^{4}_{2}\alpha}_{\text{alpha decay}\ 2p\ 2n} + {}^{234}_{90}Th$



half-life – the time for ½ the mass to decay.

the # of half-lifes that have occured = n

the fraction remaining = $1/2^n$

mass remaining = Starting mass $\cdot$ $1/2^n$

Example:

300.0g of element J have a half-life of 4 yrs. How many grams of element J are left after 20. yrs?

Time	mass
– 0 –	300.0g
4	150.0g
8	75.0g
12	37.5g
16	18.75g
20	9.375g → 9.375g

What was the original mass if after 5 half-lives there is 20.0g remaining?

T	mass
–0–	640.0g
1	320.0g
2	160.0g
3	80.0g
4	40.0g
5	20.0g

①

T	mass
– 0 –	100g
3.8	50g
7.6	25g
11.4	12.25g
15.2	6.25g

②

T	mass
– 0 –	70
5730	35
11460	17.5
17190	8.75mg