

Half-Life

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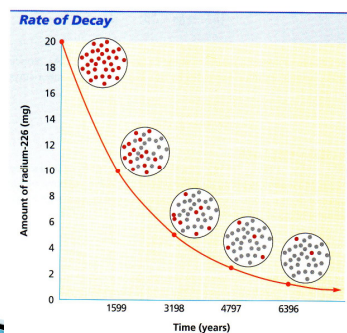
Half-Life

- ▶ **Half-life** ($t_{1/2}$) is the time required for half of the atoms of a radioactive nuclide to decay.
- ▶ No two radioactive isotopes decay at the same rate.
- ▶ Each individual radioactive nuclide has its own half-life.

Half-Life

- ▶ Radium-226 has a half-life of 1599 years.
 - That means half of a given amount of radium-226 decays in 1599 years.
 - In another 1599 years, half of the REMAINING radium-226 decays.
 - This continues until there is a negligible amount of radium-226 remaining.

Half-Life Examples



Other Half-Life Examples

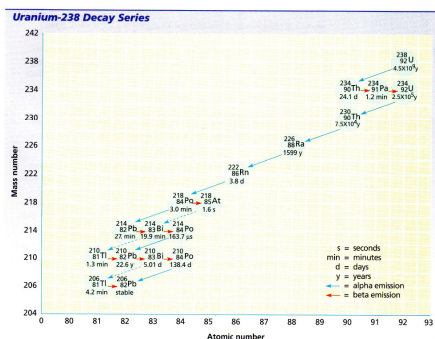
TABLE 22-2 Representative Radioactive Nuclides and Their Half-Lives

Nuclide	Half-life	Nuclide	Half-life
${}^3_1\text{H}$	12.32 years	${}^{214}_{84}\text{Po}$	163.7 μs
${}^{14}_6\text{C}$	5715 years	${}^{218}_{84}\text{Po}$	3.0 min
${}^{32}_{15}\text{P}$	14.28 days	${}^{218}_{85}\text{At}$	1.6 s
${}^{40}_{19}\text{K}$	1.3×10^9 years	${}^{238}_{92}\text{U}$	4.46×10^9 years
${}^{60}_{27}\text{Co}$	10.47 min	${}^{239}_{94}\text{Pu}$	2.41×10^4 years

Decay Series

- ▶ One nuclear reaction is often not enough to create a stable nuclide.
- ▶ A **decay series** is a series of radioactive nuclides produced by successive radioactive decay *until a stable nuclide is reached*.
- ▶ The heaviest nuclide of each decay series is called the **parent nuclide**, and the nuclides produced by the decay of the parent nuclides are called the **daughter nuclides**.

Decay Series



Half-Life Problems

- ▶ The half-life of polonium-210 is 138.4 days. How many milligrams (mg) of Po-210 remain after 415.2 days if you start with 2.0 mg?

Half-Life Problems

- ▶ The Half-life of polonium-218 is 3.0 minutes. If you start with 16 mg, how long before only 1.0 mg remains.

Half-Life Uses

- ▶ Medicine (chemo/radiation therapy)
- ▶ Carbon dating historic artifacts.

The End

- ▶ Half-Life

