Radioactive disintegration series.

The phenomenon of natural radioactivity continues till stable nuclei are formed. All the nuclei from the initial element to the final stable element constitute a series known as disintegration series. Further we know that mass numbers change only when α-particles are emitted (and not when β-particles are emitted) causing the change in mass of 4 units at each step. Hence the mass numbers of all elements in a series will fit into one of the formulae.

4n, $4n+1$, $4n+2$ and $4n+3$

Hence there can be only four disintegration series

Series	$4n$	$4n+1$	$4n+2$	$4n+3$
n	58	59	59	58
Parent element	${}_{90}Th^{232}$	${}_{94}Pu^{241}$	${}_{92}U^{238}$	${}_{92}U^{235}$
Half life	1.39×10^{10} years	10 years	4.5×10^{9} years	7.07×10^{8} years
Prominent element	${}_{90}Th^{232}$	${}_{93}Np^{237}$	${}_{92}U^{238}$	${}_{89}Ac^{227}$
Half life	1.39×10^{10} years	2.2×10^{6} years	4.5×10^{9} years	13.5 years
Name of series	Thorium (Natural)	Neptunium (Artificial)	Uranium (Natural)	Actinium (Natural)
End product	${}_{82}Pb^{208}$	${}_{83}Bi^{209}$	${}_{82}Pb^{206}$	${}_{82}Pb^{207}$
n	52	52	51	51
Number of lost particles	$\alpha=6$ $\beta=4$	$\alpha=8$ $\beta=5$	$\alpha=8$ $\beta=6$	$\alpha=7$ $\beta=4$

The numbers indicate that in a particular series the mass numbers of all the members are either divisible by 4 (in case of 4n) or divisible by 4 with remainder of 1, 2 or 3 (in the rest three series), n being an integer. In other words, the mass numbers of the members of 4n, $4n+1$, $4n+2$ and $4n+3$ series are exactly divisible by 4, 4 + 1, 4 + 2 and 4 + 3 respectively.

Note: 4n + 1 series is an artificial series while the rest three are natural.

The end product in the 4n + 1 series is bismuth, while in the rest three, a stable isotope of lead is the end product.

The 4n + 1 series starts from plutonium ${}_{94}Pu^{241}$ but commonly known as neptunium series because neptunium is the longest-lived member of the series.

The 4n + 3 series actually starts from ${}_{92}U^{235}$.