Radioactive Decay: Activity, Half-Life and Mass Remaining

Decay constant, mean life, number of atoms, activity in becquerel and curie, specific activity and mass remaining of a radionuclide after a given time.

Method: Law of radioactive decay; activity A = λN

Input parameters

Unit system: SI

Parameter	Value	Unit
Initial mass of the radionuclide	1.0000	mg
Molar mass (atomic mass, g/mol)	59.930	kg/kmol
Half-life	5.2714	a
Elapsed time	2.0000	a

Calculated results

Parameter	Value	Unit
Decay constant	4.1667e-09	1/s
Mean life 1/λ	7.6050	a
Initial number of atoms	1.0049e+19	
Initial activity	41.870	GBq
Activity after the elapsed time	32.188	GBq
Fraction remaining	76.875	%
Mass remaining	0.76875	mg
Specific activity	41.870	TBq/g

Notes for this case

• Exponential decay N = N₀e^(−λt) with λ = ln 2/T½; activity A = λN (1 Ci = 3.7 × 10¹⁰ Bq). The mass is the nuclide itself, not the source with its carrier or capsule.

Formula and method

$$\lambda = \frac{\ln 2}{T_{1/2}}, \quad N_0 = \frac{m_0}{M} N_A, \quad A = \lambda N_0 e^{-\lambda t}, \quad a = \frac{\lambda N_A}{M}$$

Variables

m_0	Initial mass of the radionuclide	kg
M	Molar mass (atomic mass, g/mol)	kg/kmol
$T_{1/2}$	Half-life	s
t	Elapsed time	s
λ	Decay constant	1/s
τ	Mean life 1/λ	s
N_0	Initial number of atoms	-
A_0	Initial activity	Bq
$A(t)$	Activity after the elapsed time	Bq
N/N_0	Fraction remaining	-
$m(t)$	Mass remaining	kg
a	Specific activity	Bq/kg

Method and standards

Exponential law of radioactive decay.

Assumptions and limits

- A single radionuclide with no in-growth from a parent.

References

Law of radioactive decay; activity A = λN

Report details

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Release checks	3 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/boilers-power-plant/nuclear-power/radioactive-decay-activity

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.