# First-Order Decay: Half-Life and Amount Remaining

Half-life, mean life and the amount remaining after a time for first-order decay (reaction, radioactive or residual chemical), from k or the half-life.

**Method:** First-order decay N = N₀ e^(−kt); t½ = ln 2/k

## Input parameters

Unit system: SI

| Parameter | Value | Unit |
|---|---|---|
| Value given | Half-life | |
| Rate constant | 0.10000 | 1/h |
| Half-life | 8.0000 | h |
| Initial amount (any unit) | 100.00 | |
| Elapsed time | 24.000 | h |

## Calculated results

| Parameter | Value | Unit |
|---|---|---|
| Rate constant | 0.086643 | 1/h |
| Half-life | 8.0000 | h |
| Mean life 1/k | 11.542 | h |
| Amount remaining | 12.500 | |
| Fraction remaining | 12.500 | % |

## Formula and method

$$N = N_0 e^{-kt}, \quad t_{1/2} = \frac{\ln 2}{k}, \quad \tau = \frac{1}{k}$$

### Variables

| | | |
|---|---|---|
| $\mathrm{given}$ | Value given | - |
| $k$ | Rate constant | 1/s |
| $t_{1/2}$ | Half-life | s |
| $N_0$ | Initial amount (any unit) | - |
| $t$ | Elapsed time | s |
| $\tau$ | Mean life 1/k | s |
| $N$ | Amount remaining | - |
| $N/N_0$ | Fraction remaining | - |

### Method and standards

First-order kinetics.

### Assumptions and limits

- First order.

### References

- First-order decay N = N₀ e^(−kt)
- t½ = ln 2/k

## Report details

| | |
|---|---|
| Report reference | FCC-DA5T-2VEX (the same inputs always give the same reference) |
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| Calculator | First-Order Decay: Half-Life and Amount Remaining |
| Method last reviewed | 12 November 2026 |
| Software release | FireCAD Calc, release of 17 November 2026 |
| Release checks | 2 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/chemical/reactors/half-life-decay

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.