

lifetime, τ

Lifetime of a molecular entity, which decays by first-order kinetics, is the time needed for a concentration of the entity to decrease to $1/e$ of its original value, *i.e.*, $c(t = \tau) = c(t = 0)/e$. Statistically, it represents the life expectation of the entity. It is equal to the reciprocal of the sum of the first-order rate constants of all processes causing the decay of the molecular entity.

Note 1: Mathematical definition: $\tau = 1/k = 1/(\sum_i k_i)$ with k_i the first-order rate constants for all decay processes of the decaying state.

Note 2: Lifetime is used sometimes for processes, which are not first order. However, in such cases, the lifetime depends on the initial concentration of the entity, or of a *quencher* and, therefore, only an initial or a mean lifetime can be defined. In this case it should be called *decay time*.

Note 3: Occasionally, the term *half-life* ($\tau_{1/2}$) is used, representing the time needed for the concentration of an entity to decrease to one half of its original value, *i.e.*, $c(t = \tau_{1/2}) = c(t = 0)/2$. For first-order reactions, $\tau_{1/2} = \ln 2 \tau$.

N.B. This supersedes an earlier definition.

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