

# e-folding

## Definition

In physics and other sciences, the **e-folding** time is the time it takes for an exponentially growing quantity to increase by a factor of  $e$ , which is approximately 2.71828. It is the base- $e$  analog doubling time.

For example, if a population of bacteria is growing exponentially, the e-folding time would be the time it takes for the population to double. E-folding is also used to describe the time it takes for a radioactive substance to decay by half.

## Formula

The formula for the e-folding time is:

$$\tau = 1/k$$

where:

- $\tau$  is the **e-folding** time
- $k$  is the **rate constant**

The **rate constant** is a measure of how quickly a quantity changes over time.

For example, the **rate constant** for radioactive decay is the probability that a radioactive atom will decay in a given time interval.

The **e-folding time** is a useful concept for understanding exponential growth and decay. For example, if a population of bacteria is growing exponentially, the **e-folding time** would be **the time it takes for the population to double**. **E-folding time** is also used to describe **the time it takes for a radioactive substance to decay by half**.

Here are some examples of how the **e-folding time** can be used:

- **Radioactive decay:** The **e-folding time** for radioactive decay is the time it takes for half of the radioactive atoms in a sample to decay.  
For example, the **e-folding time** for carbon-14 is 5,730 years. This means that half of the carbon-14 atoms in a sample will decay in 5,730 years, and half of the remaining atoms will decay in the next 5,730 years, and so on.
- **Population growth:** The **e-folding time** for population growth is the time it takes for a population to double.  
For example, the **e-folding time** for the human population is about 35 years. This means that the human population doubles every 35 years.
- **Chemical reactions:** The **e-folding time** for a chemical reaction is the time it takes for the concentration of reactants to decrease by a factor of  $e$ .  
For example, the **e-folding time** for the reaction between hydrogen and oxygen to form water is about 10 seconds. This means that the concentration of hydrogen and oxygen in a mixture will decrease by a factor of  $e$  every 10 seconds.