Radioactivity and Half-Life (SwiftStudy Printable)

Key Formulas

$$N = N_0 e^{-\lambda t}$$

N	current sample size
N_o	initial sample size
λ	decay constant
t	current time

$$\lambda = \frac{\ln 2}{T_{1/2}}$$

λ	decay constant
$T_{1/2}$	half-life

Tips to Remember

- There are no units listed for the different variables because in practice, many different units are used. Units for the sample size can refer to activity level (curies), mass, moles, etc. The time units can be anything from seconds to billions of years depending on the isotope. The one true rule is that your units must be **consistent** within your calculation. Don't use a half-life in years with a time in days, for example.
- When you enter the data in the calculator, make sure you have all of the necessary parentheses. One of the more common errors is not to get the entire exponent in parentheses. You can see on your paper that the -λt is all one exponent, but your calculator can't read your paper. Without parentheses, your calculator will follow the order of operations and raise e to λ power, then multiply by t. Oops.
- With so many potential calculator pitfalls in addition to the algebra, it's especially important to make sure your answers are reasonable, and that means making some rough estimates of your answers. For example, if you're calculating the amount of 50 microcuries of I-131 (half-life 8 days) remaining after 15 days, you can guess that after almost two half lives, you would have a little over half of half of 50, or about 13 microcuries left. If your answer isn't close to that, you know something went wrong, and you can go back and find your mistake.
- Sometimes a question asks something like, "How long until 23% of the sample remains?" In this case, you can use the percent just like any other units for N, knowing that you started with 100% of the initial sample. In other words, N_o will be 100.