Radioactive Decay

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This python programme calculates the decay constant and half life of a given sample, in seconds.
Radioactive decay can be described with the following equations:
The formula to calculate the number of radioactive nuclei remaining after time t is

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

This formula can then be rearranged to calculate the decay constant \lambda

$$\lambda = -\frac{\ln\left(\frac{Nt}{N0}\right)}{t}$$

The formula to calculate the half-life of an isotope is

$$t_{half} = \frac{\ln(2)}{\lambda}$$

- Input the initial number of radioactive nuclei, the final number of radioactive nuclei and the elapsed time
- Calculate the decay constant using the rearranged formula:

$$\lambda = -\frac{\ln\left(\frac{Nt}{N0}\right)}{t}$$

- Calculate the half-life using the formula:

$$t_{half} = \frac{\ln(2)}{\lambda}$$

- output decay constant per second

- output half-life in seconds

In [13]:

```python
# Numpy is needed for the natuaral log
import numpy as np

# Input the initial and final amounts of radioactive nuclei and the time elapsed
Nt = eval(input("Enter the initial number of radioactive nuclei: "))
N0 = eval(input("Enter the final number of radioactive nuclei: "))
t = eval(input("Enter the time elapsed in seconds: "))

# Calculate the decay constant
d = -((np.log (Nt / N0)) / t)

# Output the decay constant
print( "decay constant = {0:10.2e} per second".format(d))

# Calculate the half-life using the formula
t_half = ((np.log (2)) / d)

# Output the half-life
print("half-life = {0:10.2e} seconds".format(t_half))
```

```
Enter the initial number of radioactive nuclei: 4.00e8
Enter the final number of radioactive nuclei: 1.57e7
Enter the time elapsed in seconds: 150
decay constant =  -2.16e-02 per second
half-life =  -3.21e+01 seconds
```