Radioactive Decay: Jessica Murphy 01/10/2022

Radioactive-Decay-JM_v1.ipnyp

The formula to measure the population of radioactive atoms at a given time t is given by:

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

This python programme measures the radioactive decay of a sample of nuclei by determining the decay constant by rearranging the above equation, giving (i):

$$\lambda = -\frac{ln\frac{N_t}{N_0}}{t}$$

and using this to determine the half-life using the following equation (ii):

$$t_{\frac{1}{2}} = \frac{ln(2)}{\lambda}$$

1. Ask the user to input the initial number of radioactive nuclei in a sample, the number at a later time, and the elapsed time.
2. Calculate the decay constant using formula (i).
3. Output the decay constant.
4. Using this value, calculate the half-life using formula (ii).
5. Output the half-life.

In [1]:

```python
# import NumPy for the natural log function
import numpy as np

# Input the initial number of radioactive nuclei at a time equal to 0
N_0 = eval(input("Enter the initial number of radioactive nuclei in the sample: "))

# Input the number at a later time t
N_t = eval(input("Enter the number of nuclei in a sample after an elapsed time: "))

# Input the elapsed time t
t = eval(input("Enter the elapsed time t in seconds: "))

# Calculate the decay constant using formula (i)
lamb = - (np.log(N_t / N_0)) / t

# Output the decay constant in inverse seconds
print("The decay constant lamda = {0:10.3e} per second".format(lamb))

# Calculate the half-life of the sample of nuclei using formula (ii)
# This is the time required for half of the original population of atoms to decay
t_half = (np.log(2)) / lamb

# Output the half-life in seconds
print("The half life t\u2081\u2044\u2082 = {0:10.3e} seconds".format(t_half))
```

```
Enter the initial number of radioactive nuclei in the sample: 4.00e8
Enter the number of nuclei in a sample after an elapsed time: 1.57e7
Enter the elapsed time t in seconds: 150
The decay constant lamda =  2.159e-02 per second
The half life t₁⁄₂ =  3.211e+01 seconds
```