

# Nuclear Decay Simulation

## IB Physics II

**The program decay.cpp allows you to program in the decay probability per second per atom, and it models the decay process atom by atom, displaying the amount left at the desired time.**

Here's what to do:

1. Run the program, and select a random decay probability that is less than .01, but more than .001. Tell it to display the amount left every 1 seconds. Give it a DOS filename (filename.txt)
2. Keep pressing the spacebar and watch the nuclei decay before your very eyes. Go until you reach about 200 remaining nuclei. (a bit more than three half lives...) Then type a q to exit the program. Notice that it has made a file in the directory that the program was in.
3. Run Excel, and open your file. (You have to tell it to look for text files in the "Open" dialog box – it is a pulldown). The import wizard will launch, and tell it that it is delimited, and then comma separated. Make a graph of N - the number left, vs. t - the time in seconds. Draw a horizontal line at  $N = 1/2 N_0$ , and  $N = 1/4 N_0$  . **Draw vertical lines down to the horizontal axis from where these intersect the plot.** (It helps to go into the vertical axis and make the gridlines occur every 220 nuclei)
4. Go into your data and scroll down and find and write down the time that it reaches the first three half lives (880, 440 and 220) You might need to interpolate a bit. Subtract these from each other to find the time elapsed from 1760 to 880, from 880 to 440, and from 440 to 220.
5. Answer these questions:
  - A) Are the three half lives the same? Cite data.
  - B) Specifically, how does the curve suggest an exponential function? Give concrete evidence that it is exponential.
  - C) How does the half-life you measured compare to the half-life you would calculate from the decay probability you used? (Calculate the half life using  $T_{1/2} = \ln(2)/\lambda$  and compare to the half life in A) – don't forget to cite data)

(EC - do an exponential curve fit through the points. Does the fit have the same lambda as the one you used?)