National Anveshika Experimental Skill Test -2021

(NAEST – 2021)

Name:.....Class.....

Roll NO.....Mobile No.....

School/College Name.....

Date.....Time.....

F2- Modeling Radioactive decay and studying its decay equation (X = --)

Background

A radioactive substance has a large number of atoms, the nucleus of each of these atoms is unstable and decay to some other nucleus with a probability λ per unit time. This means, if you look at a radioactive nucleus at time t, the probability that it will decay in the next time interval dt is λdt.

The half life of the decay is given by

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

We will imitate this radioactive decay process by a specially made dice which has 14 faces and different faces have different probabilities.

You start with imagining a set of N radioactive nuclei. You throw the dice for a particular nucleus. If the pre specified number X (given in the heading) comes to the top, the nucleus is supposed to have decayed. For any other number on the top, the nucleus has survived.

Experiment

Part-A : To find the probability of different numbers coming to top

Make a frequency distribution table as shown below. Throw the dice and look at the number on the top. Put a vertical line in the appropriate box to mark the occurrence of that number. You can throw the dice large number of times (typically 100 or more), count the strikes for each number and find the probability. Draw a histogram to present your data.

No.	Strokes marks.	No. of occurrence	probability
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			

Part-B: **Recording the number survived as a function of time**

Start with 100 active nucleus. So N_0 = 100. For a time unit, you will throw the dice 100 times (No times) once for each nucleus. See how many of nuclei have decayed and how many survived. This is the number N after 1 time unit, that is at $t = 1$.

Start again for the 2nd time unit. Throw the dice N times and see how many nuclei decayed and how many survived. This is the new value of N at $t = 2$ units.

Repeat till you get just few nuclei $(\square 3-4)$ left.

From the data N versus t, plot a graph and find the half life $t_{1/2}$ as accurately as you can.

Assuming $N = N_0 e^{-\lambda t}$, plot $\ln N$ vs t graph and find λ from this graph.

Extension/Comment