Physics 13-02 Radioactive Decay Simulation Lab *Name:* ______________

Objectives

- Model radioactive decay and find the half-life of dice.

Materials

- 100 dice

Theory

Radioactive nuclei don't just decay all at once. There is a probability that each nucleus will decay in a given amount of time. This probability is related to the half-life. The shorter the half-life, the more likely the nucleus will decay. Dice have a set probability for rolling a certain side, so dice can be used to simulate radioactive decay.

Radioactive decay is modeled by

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

where N is the amount left at time t, N_0 is the initial amount, and λ is the decay constant.

Half-life can be found from the decay constant.

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

Let each roll of the dice represent 1 minute.

Procedure

1. Roll the 100 dice.
   a. Remove all the dice that are a 1. Put those in a separate pile.
   b. Count the number of dice left and record it in the table.
2. Roll the remaining dice.
   a. Remove all the dice that are a 1. Put those in a separate pile.
   b. Count the number of dice left and record it in the table.
3. Repeat step 2 until there are less than 10 dice left.

Analysis

4. Graph the number of remaining dice vs time (roll).
5. Use the regression feature of a calculator to find the exponential model for the graph. $f(x)$ = ____________________
6. Compare this to $N = N_0 e^{-\lambda t}$ and find the decay constant. λ = ________________ /min
7. Calculate the half-life.
8. Find the percent error with the theoretical value of 4.15 min. $\%error = \frac{theory - experiment}{theory} \times 100\%$

   %error = ______________________

Time (Throw #)	Dice decayed	Dice left