Laboratory Investigation Name ____________________

Chemistry: Form L12.1A Date ______________ Period ____

Simulating Half Life

PROBLEM

What happens to the rate of radioactive decay as the mass of radioactive material decreases?

INTRODUCTION

As the number of protons in the nucleus increases, so does the repulsive force between them. No atoms with over 82 protons have any known stable isotopes. Unstable nuclei tend to fall apart releasing alpha particles ($^{4}_{2}He$) or beta particles ($^{0}_{-1}e$). The decomposition of unstable nuclei results in the transmutation of one element to another. The amount of time it takes for half of a sample of a radioactive material to transmute to something else is called the half life. Although unstable nuclei can decay at any time, the probability of decaying is increased if some source of energy is provided. The greater the mass of radioactive material there is, the larger the number of energetic alpha or beta particles there is flying around. How do you think that affects the rate of decay? In this laboratory investigation, you will simulate radioactive decay using a model. You will measure the relationship between the rate of decay and the mass.

MATERIALS *(per group)*

Cup, graph paper, pennies (50)

PROCEDURE

1. Obtain 50 pennies and place them in a cup. Mix them well and spill them out onto the lab table. Remove all the pennies with "heads" showing. These pennies represent atoms that have decayed. Count the number of pennies remaining with "tails" showing. These represent atoms that have not decayed. Record the number of undecayed atoms left in your sample in the data table on the next page under ***Trial 1***. This represents one half life.

2. Repeat step 1 with the remaining pennies, again, mixing them in the cup, pouring them out, removing all the heads, and counting all the tails remaining. Record the results in the data table on the next page under ***Trial 1***. Continue this procedure until no pennies are left or until a maximum of eight half lives have elapsed

3. Repeat this entire procedure for a total of five trials. Then calculate the average number of pennies remaining after each half life. Record the result in the data table on the next page.

4. Calculate the percentage of pennies remaining after each half life by multiplying the average number of pennies remaining by 2 (100 %/50). Record the results in the data table on the next page.

5. Prepare a graph with the number of half lives on the *X*-axis and the average number of pennies remaining on the *Y*-axis.

OBSERVATIONS

Number of Half Lives	Number of Pennies Remaining					Average Number of Pennies Remaining	Percentage of Pennies Remaining
	Trial 1	Trial 2	Trial 3	Trial 4	Trial 5		
1							
2							
3							
4							
5							
6							
7							
8							

CONCLUSIONS

1. Describe the relationship between the number of half lives elapsed and the number of pennies left. ______________________________

2. How does the percentage of pennies left after each half life compare? ______________________________

3. Why is each toss in this simulation called a half life? ______________________________

4. What is happening to the simulated rate of decay as the number of pennies decreases? Why? ______________________________

5. What happens to the rate of radioactive decay as the mass of radioactive material decreases? Why? ______________________________

6. In what way does the data gathered during this investigation simulate the nature of half life? ______________________________