Candium Radioactive Decay Lab; SC3 a,c,d (also known as Candium 2)

Background: This will be your second encounter with the element Candium, except this time you will get to consume the atoms. This lab specifically deals with the topic of nuclear stability. The nucleus of a radioisotope is unstable. In an attempt to reach a more stable arrangement of its protons and neutrons, the nucleus will spontaneously decompose or decay to form a different nucleus. If the number of neutrons changes in the process, a different isotope is formed. If the number of protons changes in the process, then an atom of a different element is formed. This decomposition of the nucleus is referred to as radioactive or nuclear decay. During radioactive decay an unstable nucleus spontaneously decomposes to form a different nucleus, giving off radiation in the form of atomic particles or high energy rays. This decay occurs at a constant, predictable rate that is referred to as half-life. A stable nucleus will not undergo this kind of decay and is thus, non-radioactive. The purpose of this lab is to illustrate the concept of half-life and to graph the nuclear decay of an atom.

Procedure

1. Place the Candium atoms in a paper towel or a small bag.
2. Gently shake the atoms for 30 seconds. This is the estimated half-life of your candy.
3. Gently pour out the atoms onto a paper towel.
4. Count the number of atoms with the print side up. These atoms have "decayed."
5. Return only the atoms with the print side down to the bag/towel. Repeat.
6. Record the time. (It would be 30 seconds on the first trial. On the second trial it would be 1 minute (30s + 30s). On the third trial it would be 1.5 minutes (30s + 30s + 30s) and so on).
7. Discard the "decayed" atoms in the trash upon completion.
8. Gently shake the Candium atoms again, counting until all the atoms have decayed.

Data Table (transcribe onto your own paper)

Half-Life	Total Time	# of Undecayed Atoms	# of Decayed Atoms
0	0		0
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			

Post Lab Questions:

1. Graph the number of undecayed atoms vs. time. Use graph paper and be sure to label all axes with units and provide a concise, yet informative title.

2. Define half-life in your own words.

3. Based on your experimental data and your graph, what was the exact half-life of Candium?

4. After 2 half-lives, what fraction of your "atoms" had not decayed?

5. As a class, compare and contrast the graphs made by the different lab groups. How would you describe the graphs?

Use the table below to help you answer the following three questions:

6. If 100 nuclei remain from a sample of 3,200 nuclei, how many half-lives have passed?

7. Starting with 50 grams of Radium-226, how many grams of Radium-226 are left after 3,200 years?

8. After 4 half-lives, a sample of Polonium-218 weighs 12 g. What was the original weight of the sample?

Radioactive Isotope	Half Life
Uranium-238	4.5 billion years
Thorium-234	24 days
Protactinium-234	1.2 minutes
Uranium-234	240 000 years
Thorium-230	75 000 years
Radium-226	1 600 years
Radon-222	3.8 days
Polonium-218	3.1 minutes
Lead-214	27 minutes
Bismuth-214	20 minutes
Polonium-214	160 microseconds ($\times 10^{-6}$ seconds)
Lead-210	22 years
Bismuth-210	5 days
Polonium-210	138 days

$$\textbf{Amount Remaining} = (\text{initial amount})\,(1/2)^{n}$$