



Half-Life Lab

Name _____

Purpose To determine the half-life of barium-137 meta stable isotope as it decays to a stable form of barium.

Materials: Isogenerator source, eluting solution, plastic tray, radiation monitor with link cable, CBL2 linked to a TI-83 or TI-84 calculator. The application [VST APPS](#) contains the Data Rad program that was used to collect the half-life data in this experiment. Forty minutes of class time for explanation and data collect.

Procedure

- 1) Turn on the calculator and radiation monitor. Be sure the link cable is connected firmly between the calculator and the CBL2. Run the Data Rad program.
- 2) Collect data for the half-life of Ba-137m. Setup the Data Rad program to collect these half-life readings by following the menus.
- 3) Move the monitor and the clear, dry well plate away from the edge of the lab bench. Practice balancing the detector on top of the plate, with the detector screen directly over the top of one of the wells of the well plate. Be sure you can do this without letting the detector fall over.
- 4) Place the clear plastic tube on the end of the syringe. "Pull" 2 ml of eluting solution in to the syringe. Remove the tube and drain any excess back in to the bottle of eluting solution.
- 5) Remove plastic caps from both top and bottom of the Isogenerator. Set them aside where you will find them later, where they will not fall on to the floor or in to a sink.
- 6) Connect the syringe to the large input port of the Isogenerator. Place the smaller output port of the of the Isogenerator directly over a well of your well plate.
- 7a) Slowly press the plunger of the syringe. "Push" the eluting solution through the Isogenerator slowly, taking 20-30 seconds to do so. This process "washes" just one radioisotope, Barium-137m, away from all others in its decay series, isolating it for the experiment.
- 7b) **Immediately** balance the radiation monitor over the top of the well plate, as you practiced in step 3. Make sure the detector screen is directly over the top of the well with the solution in it.
- 7c) **Quickly** press "2" on the calculator to begin the data collection process.
- 8) Verify that you are collecting data in to your data table every ten seconds. Then, reassemble the Isogenerator. Place contents back in to the kit.
- 9) As your graph builds, you will notice that there is some "choppiness" to the plot. However, there is an obvious overall pattern that emerges.



10) Work on Questions until the conclusion of the experiment.

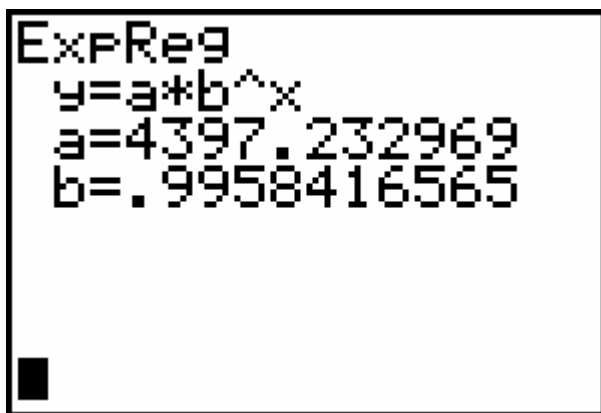
11) Once the experiment has concluded, note the overall pattern of your graph plot. Group your data on the calculator and record the number of the calculator you are using.

12) If time allows, use the graphing features of the calculator and do a curve fit from your data. You may wish to save various screen shots in your report that help you determine the half-life of Ba-137m.

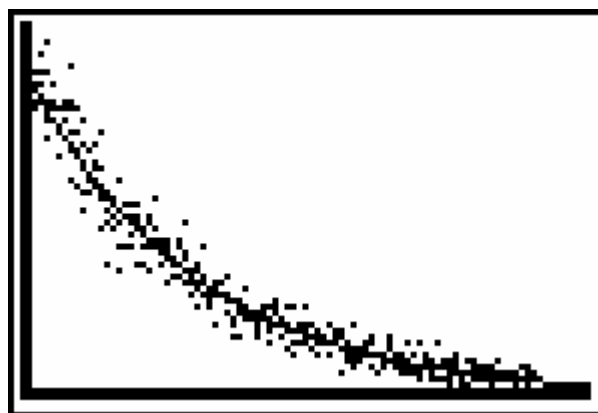
13) Answer the questions that follow and calculate the observed half-life of your radioisotope.

Results

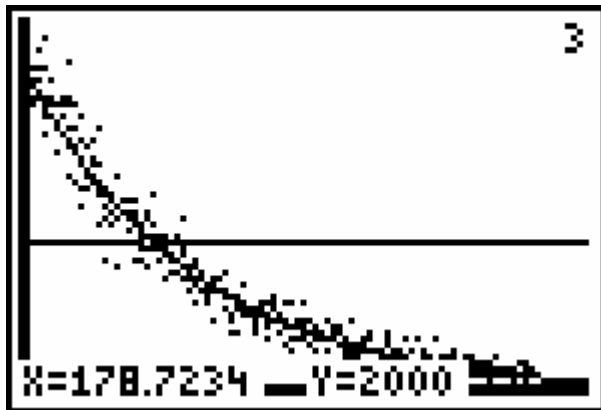
Frame 1: exponential curve fit



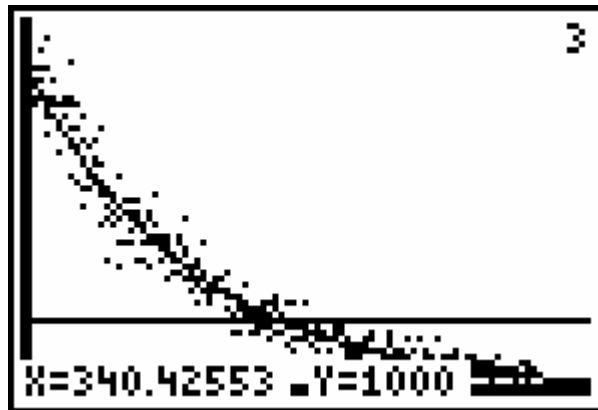
Frame 2: curve fit from frame 1



Frame 3: line at $y=2000$, $x = 179$ s



Frame 4: line at $y=1000$, $x = 340$ s



Frame 4 minus frame 3 equals the observed half-life for Ba-137m = 161.
The acceptable half-life of Ba-137m is 153 seconds.

Discussion

1. What was the half-life of our radioactive sample in seconds?
2. Calculate the decay constant for barium-137m based on your observed half-life.
3. If 3 milliliters of the eluting solution contains $3.00 \mu\text{g}$ of barium-137m, how many grams of the radioactive isotope will remain after 10 minutes?
4. How many minutes would it take to for 99% of the barium-137m to decay to barium-137?