Modeling the half-life on an isotope

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ are atoms of the same element with different atomic \_\_\_\_\_\_\_\_\_\_\_\_\_. These different masses are a result of having different numbers of \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ in their nuclei. Isotopes can be stable or \_\_\_\_\_\_\_\_\_\_\_\_\_\_ (radioactive). Radioactive isotopes have unstable \_\_\_\_\_\_\_\_\_\_\_\_\_ that break down in a process called radioactive \_\_\_\_\_\_\_\_\_\_\_\_\_. During this process, the \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ isotope is transformed into another, usually more stable, \_\_\_\_\_\_\_\_\_\_\_\_\_\_. The amount of time it takes \_\_\_\_\_\_\_\_ the atoms of a radioactive isotope in a particular \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ to change into another element is its \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_. A half-life can be a fraction of a second for one isotope or more than a billion years for another isotope, but it is always the \_\_\_\_\_\_\_\_\_\_ for any particular \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_.

Strategy:

You will make a \_\_\_\_\_\_\_\_\_\_\_\_ that illustrates the half-life of an imaginary isotope.

You will graph and interpret data of the isotope’s half-life.

Materials:

100 two-sided objects (black/white dots)

shaking container

timer or clock with second hand

Procedure:

**1.** Place 100 objects into the container. Each object represents an atom of an unstable isotope.

**2.** Hold your hand over the top of the container level; shake it vigorously for 20 seconds.

**3.** Dump out all the objects onto your table. Remove only the dots that have the black position facing up.

**4.** Count the black dots you have removed and record this number in Table 1 under *Trial 1.* Also record the number of white dots that are left.

**5.** Repeat steps 2 through 4 until there are no dots left in the container. Record your data.

**7.** Repeat steps 1-5 for a second trial. Then calculate the averages for each time period and record these numbers in Table 1.

**8.** Graph the average data from Table 1 on Graph 1. Use one colored pencil to graph the number of white side-up dots against time. Make a key for the graph that shows this color as *Radioactive Isotopes.* Using a different color of pencil, plot the number of black-up dots against time. In your key, show this color as *Stable Atoms.*

**9.** Record your averages from Table 1 again in Table 2 under *Group 1.*

**10.** Then, record the averages obtained by other groups in your class in Table 2.

**11.** Determine the totals for the combined data from all groups in Table 2.

**12.** Graph this combined data in Graph 1 in the same way as you graphed your group’s data in step 8, but use 2 new colors for each average. Include these on the key.

**Data and Observations**

1. In this model, what represented the process of decay?
2. Which side of the dot represented the unstable isotope? Which side represented the stable atom?

**Table 1**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Trial 1  A B | | Trial 2  C D | | Averages | |
| Shaking Time | # of Black dots facing up | # of White dots facing up | # of Black dots facing up | # of White dots facing up | Columns A and C | Columns B and D |
| After 20 s |  |  |  |  |  |  |
| After 40 s |  |  |  |  |  |  |
| After 60 s |  |  |  |  |  |  |
| After 80 s |  |  |  |  |  |  |
| After 100 s |  |  |  |  |  |  |
| After 120 s |  |  |  |  |  |  |
| After 140 s |  |  |  |  |  |  |

**Table 2**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Group Average | Start | | 20 s | | 40 s | | 60 s | | 80 s | | 100 s | | 120 s | | 140 s | |
| B | W | B | W | B | W | B | W | B | W | B | W | B | W | B | W |
| Group 1 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 2 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 3 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 4 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 5 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 6 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 7 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 8 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| 9 | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Total | 800 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| Average of 9 groups | 100 | 0 |  |  |  |  |  |  |  |  |  |  |  |  |  |  |

Isotope half-life Graph

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**0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100**

**Number of black dots or white dots**

**Questions and Conclusions**

1. A. What was the half-life of dots for your group’s data (time it took for ½ the dots to flip)?

B. What was the half-life of all the groups’ data?

1. What can you conclude about the total number of atoms that decay during any half-life period?
2. Why are more accurate results obtained when the data from all groups was combined and graphed?
3. If your half-life model had decayed perfectly, how many atoms of the radioactive isotope should have been left after 80 seconds?
4. If you started with 256 radioactive dots, how many would be stable after 60 seconds?