

Energy levels, radioactive decay and binding energy

AP Physics 2 (algebra-based) · Lab answers

Model answers use the sample table above. Your data will differ a little because the process is random, and a good answer comments on both the shape of the curve and the scatter of the points.

Level: AP Physics 2 (algebra-based) · **Curriculum:** AP P2 Unit 15

Question 1 Fraction remaining

$N/N_0 = 1.00, 0.84, 0.70, 0.59, 0.49, 0.41, 0.35, 0.29, 0.24$.

Question 2 Plot the graph

The points form a **falling exponential curve**, steep at first and flattening, because each throw removes a fixed fraction of what is left.

Question 3 Half-life from the graph

$N = 59$ at throw 3 and 49 at throw 4, so $N = 50$ occurs at about **3.9 throws**.

Question 4 Check from later readings

N falls from 49 at throw 4 to 24 at throw 8, which is about half in 4 throws, so **$T \approx 4$ throws**, consistent with the graph.

Question 5 Theoretical value

$n = \ln 0.5 / \ln(5/6) = -0.693 / -0.1823 = \mathbf{3.80 \text{ throws}}$. The experimental 3.9 is within about 3 % of this.

Question 6 Randomness

Each die is removed by chance, so the number removed fluctuates around the average. With 1000 dice the **relative fluctuations shrink** and the points would follow the curve much more smoothly.

Question 7 Change the rule

Removal probability is now $1/3$, so survival is $2/3$ and $n = \ln 0.5 / \ln(2/3) = 0.693 / 0.405 =$

1.71 throws, shorter because more dice are removed each time.