

Radioactivity Half Life

GCSE Physics · Written to the shared content for AQA, Edexcel and OCR

Name _____ Class _____ Date _____

1. Worked example

A radioactive source is tested. Its radiation passes through paper but is stopped by 3 mm of aluminium. Identify the radiation and explain your answer. (2 marks)

Step 1 · Not alpha

Alpha is stopped by a sheet of paper, but this radiation passed through.

Step 2 · Not gamma

Gamma would pass through 3 mm of aluminium; it is only reduced by thick lead or concrete.

Step 3 · Conclusion

So it is beta radiation.

Answer: Beta

Check: Use the absorber evidence to rule out the other two.

2. Now try one with the steps

A sample's count rate falls from 240 counts per minute to 30 counts per minute. Its half-life is 5 days. How much time has passed? (3 marks)

Step 1 · Count the halvings

Step 2 · Multiply

Answer:

3. Practice

Show your working. The marks tell you how much is expected.

1. Name three types of nuclear radiation emitted by unstable nuclei. [3]

2. Describe what an alpha particle is. [2]

3. Describe what a beta particle is. [1]

4. Put alpha, beta and gamma in order from least to most penetrating, and name what stops each. [3]
- _____
- _____
- _____
5. State which type of nuclear radiation is the most strongly ionising. [1]
- _____
- _____
6. Define the activity of a radioactive source and give its unit. [2]
- _____
- _____
7. Define half-life. [2]
- _____
- _____
8. Explain what is meant by saying radioactive decay is random. [1]
- _____
- _____
9. State the approximate range of alpha particles in air. [1]
- _____
- _____
10. A source has an activity of 800 Bq and a half-life of 2 hours. Calculate its activity after 6 hours, in Bq. [3]
- _____
- _____
- _____
11. A count rate falls from 240 to 30 counts per minute. The half-life is 5 days. Calculate the time taken, in days. [3]
- _____
- _____
- _____
12. A sample contains 64 g of a radioactive isotope with a half-life of 3 years. Calculate the mass of that isotope left after 12 years. [2]
- _____
- _____

13. A source's activity falls from 1600 Bq over 3 half-lives. Express the net decline fraction of the initial activity. [2]

14. A detector measures 135 counts per minute near a source. The background count is 15 counts per minute. After one half-life, calculate what the detector would read, in counts per minute. [3]

4. Before you hand it in

"After two half-lives the sample has fully decayed."

After one half-life $\frac{1}{2}$ remains, after two $\frac{1}{4}$, after three $\frac{1}{8}$, and so on. It never quite reaches zero.

"Gamma is stopped by aluminium."

Beta is stopped by a few mm of aluminium. Gamma is only reduced (not completely stopped) by thick lead or concrete.

Forgetting background radiation in count-rate questions

Subtract the background count before halving, then add it back if the question asks what the detector reads.

"A beta particle is an electron from the shells."

In beta decay a neutron in the nucleus changes into a proton and a fast electron, which is emitted.