Your notes

GCSE Physics: revision notes

Half-life

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Half-life

- Radioactive decay is **random**, so we can't say when one nucleus will decay, but we can predict what happens to a large number.
- The **half-life** of a radioactive isotope is the time it takes for the number of unstable nuclei in a sample to halve.
- It is also the time it takes for the **count rate** (or **activity**) from a sample to fall to half its starting level.

Finding half-life from a graph

- Plot **count rate** against time. Read off the starting **count rate**, find half of it, and read across to the curve and down to the time axis.
- Check by halving again: the time for each halving is the same.

Half-life calculations

- After 1 **half-life**, 1/2 is left; after 2 half-lives, 1/4; after 3, 1/8; after 4, 1/16.
- Example: a sample with an **activity** of 800 Bq and a **half-life** of 2 hours will have an **activity** of 800 → 400 → 200 → 100 Bq after 6 hours.
- (Higher) The net decline can be given as a ratio. After 3 half-lives, the **activity** is 1/8 of the original, so it has fallen by 7/8.

Why half-life matters

- Isotopes with a short **half-life** become safe quickly but are very active at first.
- Isotopes with a long **half-life** stay radioactive for a long time, so waste must be stored safely for many years.

Worked examples

A sample has an activity of 800 Bq and a half-life of 2 days. What is its activity after 6 days?

Find how many half-lives have passed. **6 ÷ 2 = 3 half-lives**

Halve the activity once for each half-life. **800 → 400 → 200 → 100**

Answer: 100 Bq

Key terms

Half-life	The time for the number of unstable nuclei, or the count rate, to halve.
Random	Impossible to predict for a single event.
Count rate	The number of decays detected per second.
Activity	The number of decays per second from a source, in becquerels.
Background radiation	Radiation that is around us all the time, which should be subtracted from readings.

Quick questions

Cover the answers and test yourself: remembering is what makes it stick.

1. What is half-life?
2. A source has a half-life of 3 days. What fraction is left after 6 days?
3. A source has an activity of 800 Bq and a half-life of 2 hours. What is the activity after 6 hours?
4. A count rate falls from 240 to 60 counts per second in 10 minutes. What is the half-life?
5. What fraction remains after 4 half-lives?
6. Why can't we predict when a single nucleus will decay?
7. Why does radioactive waste with a long half-life need special storage?
8. After 3 half-lives, by what fraction has the activity fallen? (Higher)

Answers

1. The time for the number of unstable nuclei to halve
2. One quarter
3. 100 Bq
4. 5 minutes
5. 1/16
6. Decay is random
7. It stays radioactive for a very long time
8. 7/8

Your notes

What to do next

Practise 10 questions on this topic

Try 6 exam questions, with mark schemes

Read the lesson, one step at a time

Free revision for GCSE and KS3 at lycolearn.co.uk. Some notes are for one exam board only, and say so in brackets.

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