MR SULLY UNFOLDS PHYSICS ANSWERS

Half-life

AQA 4.4.2.3
Atomic structure · Paper 1
Foundation & Higher

Name _____ Class _____ Date _____

Radioactive decay is **random**: you can't predict when one nucleus will decay. But a large sample always halves in the same time.

KEY IDEAS

- **Half-life**: the time for the number of unstable nuclei in a sample to halve, or for the count-rate (activity) to fall to half.
- **Activity** is measured in becquerels (Bq): 1 Bq = 1 decay per second.
- After 1 half-life ½ is left, after 2 half-lives ¼, after 3 half-lives ⅛.

Section A · Recall

Grade 4–5

1 What is meant by the half-life of a radioactive isotope? [2]

The time it takes for the number of nuclei of the isotope in a sample to halve,

or for the count-rate (or activity) from the sample to fall to half its initial level.

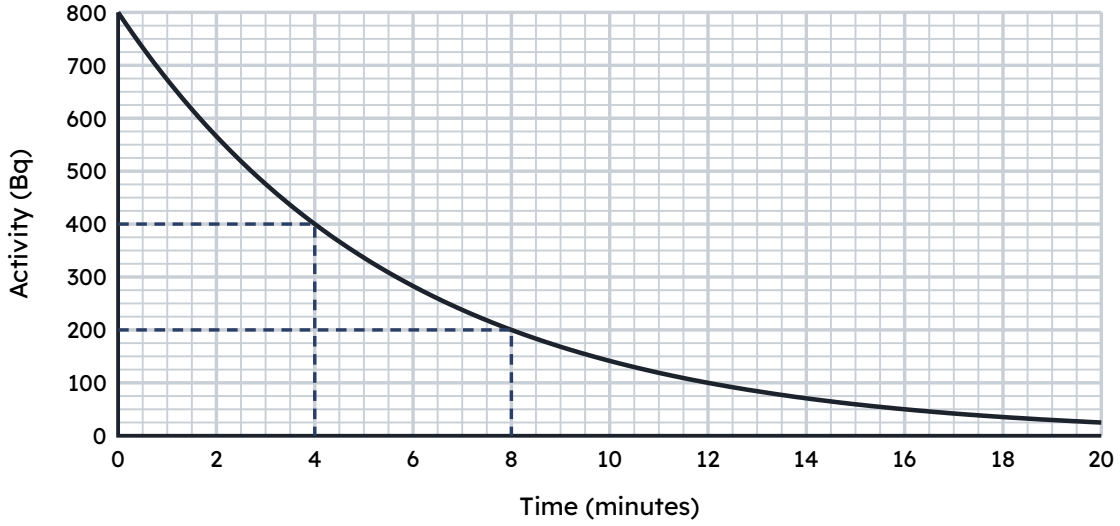
2 What fraction of a sample is left after 3 half-lives? [1]

⅛

Section B · Read the graph

Grade 5–6

3 The graph shows how the activity of a radioactive sample changes with time.



a Use the graph to find the half-life. Show on the graph how you did this. [2]

4 minutes (800 → 400 Bq; dashed lines drawn on graph)

b What is the activity after 8 minutes? [1]

200 Bq

c Without using the graph, predict the activity after 16 minutes. [2]

4 half-lives: 800 → 400 → 200 → 100 → 50 Bq

4 A source has an activity of 1200 Bq and a half-life of 3 hours. Calculate its activity after 9 hours. [2]

3 half-lives: 1200 → 600 → 300 → 150 Bq

5 The count-rate from a sample falls from 640 to 80 counts per minute in 24 hours. Calculate the half-life. [3]

640 → 320 → 160 → 80 is 3 half-lives

Half-life = 24 ÷ 3 = 8 hours

Section C · Stretch

Grade 7+

6 A sample contains 2000 unstable nuclei with a half-life of 10 days. Calculate the **net decline**, as a ratio, after 30 days. (Higher) [3]

3 half-lives: 2000 → 1000 → 500 → 250 left; decline = 1750

Net decline = 1750 ÷ 2000 = 7/8

Exam-style question

AQA style

7 A hospital needs a tracer to inject into a patient to check how their kidneys are working.

Isotope	Half-life	Radiation emitted
Technetium-99m	6 hours	Gamma
Iodine-131	8 days	Beta and gamma
Americium-241	432 years	Alpha

a Choose the best isotope. Explain your choice. (Physics only) [4]

Technetium-99m.

Gamma passes out of the body to the detector and is only weakly ionising.

A 6-hour half-life is long enough for the test,

but short enough that activity falls quickly afterwards, reducing the dose.

Total: _____ / 20

How confident am I?

	Not yet	Nearly	Got it
I can define half-life and activity	☐	☐	☐
I can find a half-life from a graph	☐	☐	☐
I can calculate how much is left after several half-lives	☐	☐	☐