

# OCR A Physics A-Level

## PAG 7.1

Observing the random nature of radioactive decay



## Equipment

- Radioactive source (with a short half-life, e.g. protactinium)
- Geiger-muller tube (connected to a counter)
- Clamp stand
- Long-handled tongs for handling the source
- Source holder
- Metre ruler

## Method

1. Set up the clamp stand and attach the GM tube to it, making sure to keep the GM tube connected to the counter.
2. Before moving the radioactive source into the room you will be working in, you must calculate the background count by switching on the counter (connected to the GM tube) for at least 30 seconds. Record this background count.
3. Remove the radioactive source from its storage box using long-handled tongs and place it 0.1 m away from the GM tube in the source holder.
4. Switch on the counter and take readings of count for 10 seconds every 30 seconds for 5 minutes. When recording readings, you should subtract the background count from the recorded value to produce a corrected count rate.
5. Repeat this procedure twice more with a new source, after waiting for at least 5 minutes between repeats, and find the average count for each reading.

## Calculations

- Draw a table of corrected count rate against time, where corrected count is the difference between measured count rate and background count (making sure the units of count rate are the same).
- Plot a graph of corrected count rate against time and draw a line of best fit, which in this case will be a curve.
- You will be able to see that the decay is **exponential**. The time taken for the corrected count to halve should be constant and the name for this value is the **half-life** ( $T_{1/2}$ ) of the sample.
- Using your curve you can measure the half-life of the radioactive substance by measuring the time taken for the count rate to halve, across several half-lives (if possible) and finding a mean.

## Safety

- Ionising radiation can be incredibly dangerous, so to reduce your exposure:
  - Never directly handle the source, use long-handled tongs
  - Store the source in a lead-lined container when not in use
  - Never point the source at others
  - Keep the source as far away as possible from yourself and others

## Notes

- Even though the decay of the radioactive substance can be seen to follow an exponential decay, the process of nuclear decay is completely **random**. This can be seen from your measured values of count rate and from the fact that your graph (probably) won't follow a perfect exponential decay curve.

