

# Edexcel Physics IAL

## Core Practical 15: Investigate the Absorption of Gamma Radiation by Lead

### Practical Notes



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### Equipment

- Gamma source
- Long-handled tongs
- Geiger-Muller tube and counter
- Clamp stands
- Stop clock
- Lead sheets
- Vernier callipers

### Method

1. Clamp the Geiger-Muller tube in place, and connect it to the counter.
2. Before the gamma source is brought into the room, measure the background count over a period of five minutes and record the background count rate.
3. Using vernier callipers, measure the thicknesses of the lead sheets.
4. Bring in the gamma source, and position it around 15cm from the Geiger-Muller tube, using long-handled tongs.
5. Measure the count over a period of 5 minutes, and record the count rate.
6. Clamp a lead sheet between the source and the Geiger-Muller tube, and record the new count rate.
7. Repeat, adding an extra lead sheet each time, until the count rate drops to roughly the recorded background count rate level.

### Calculations

- The rate of radiation absorption by the lead is exponential and so follows the equation:
  - $C = C_0 e^{-\mu x}$
  - This can be rearranged into  $y=mx+c$  by taking logs
  - $\ln(C) = -\mu x + \ln(C_0)$
- This means if you plot a graph of  $\ln(C)$  against  $x$ , the gradient will be  $-\mu$  (a constant).
- The thickness of lead that reduces the count rate by half is known as the half-thickness and can be calculated using:
  - Half-thickness =  $(\ln 2)/-\text{gradient}$
  - The gradient value itself should be negative meaning the value obtained from the above equation should be positive.



### Safety Precautions

- Always display a warning sign when working with radioactive sources.
- Never touch the source directly - always use long-handled tongs and an extended arm to maximise the distance you are from the source.
- Only have the source out for the minimum time required to complete the experiment.
- A teacher/technician should always be present when working with radioactive sources.

