

Edexcel Physics IAL

CP15 - Investigating the Absorption of Gamma Radiation by Lead

Practical Flashcards

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What safety precautions must be taken when working with a radioactive source?



What safety precautions must be taken when working with a radioactive source?

- Limit the time of exposure
- Warning signs should be displayed so people are aware that a radioactive source is in use
- Keep an arm's length away at all times, and only ever handle the source using long-handled tongs



How should a radioactive source be handled safely?



How should a radioactive source be handled safely?

Long-handled tongs should be used to handle a radioactive source, and you're torso should remain at least an arm's length away from it at all times.



How should a radioactive source be stored safely?



How should a radioactive source be stored safely?

Radioactive sources should be locked away in a sealed lead-lined container. A hazard symbol should be visible on the container as well as at the location where it is stored.



What is the inverse square law of radiation?



What is the inverse square law of radiation?

The intensity of radiation is inversely proportional to the square of the distance from the source. As the distance doubles, the intensity quarters.



What device can be used to measure a radioactive count rate?



What device can be used to measure a radioactive count rate?

A Geiger Counter or Geiger-Muller Tube connected to a scale.



Why is Cobalt-60 a suitable source for this experiment?



Why is Cobalt-60 a suitable source for this experiment?

Cobalt-60 is safe for use in schools and has a half-life of around 5 years, meaning it can be reused for a number of years. The activity is low enough to be safe, but high enough for measurements to be taken easily.



When measuring the count-rate, what advantage comes with measuring over a longer period of time?



When measuring the count-rate, what advantage comes with measuring over a longer period of time?

The longer the period of time over which it is recorded, the lower the uncertainty will be.



What preliminary recording should be taken before bringing the radioactive source into the lab?



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Before bringing the radioactive source into the lab, the background radiation count should be taken.



How should the background radiation count be accounted for in the experimental data?



How should the background radiation count be accounted for in the experimental data?

The background count should be subtracted from the counts for each lead block thickness, to produce corrected counts (C').



How do you convert from a count to a count rate for a given lead block thickness?



How do you convert from a count to a count rate for a given lead block thickness?

The count should be divided by the length of time over which it was taken to ascertain the count rate.



What preliminary experiment could you carry out with the source before commencing this experiment?



What preliminary experiment could you carry out with the source before commencing this experiment?

Recordings could be taken to find the maximum thickness of lead for which you can still get a reasonable count.



Why may an old gamma source be unsuitable for this experiment?



Why may an old gamma source be unsuitable for this experiment?

Depending on the source's half-life and its age, the activity of the source may have fallen to a level that is too low to obtain easily recordable counts over a large enough range of lead block thicknesses.



What is meant by the term
'half-thickness'?



What is meant by the term 'half-thickness'?

The half-thickness is the thickness of lead required to reduce the count rate to half the initial value.



Describe the nature of radioactive decay.



Describe the nature of radioactive decay.

Radioactive decay is a random process, meaning you cannot predict which nuclei will decay next or when the next decay will occur



Why should repeat readings be taken?



Why should repeat readings be taken?

Calculating the average count rate over several repeat readings, for each lead block thickness, will allow you to mitigate the effect of any random fluctuations in radioactive decay activity.



How can you estimate the uncertainty of your data using your repeat readings?



How can you estimate the uncertainty of your data using your repeat readings?

The uncertainty for each thickness can be estimated as being half the range of your repeat readings.



What equation shows how the count rate will change with thickness?



What equation shows how the count rate will change with thickness?

$$C = C_0 e^{-\mu x}$$



How can the thickness of the lead sheets be measured?



How can the thickness of the lead sheets be measured?

The thickness of the sheets can be measured using vernier callipers or a micrometer. It should be measured in a number of places to allow an average thickness to be calculated.



Suggest a suitable graph to plot with the data you collect.



Suggest a suitable graph to plot with the data you collect.

A graph of $\ln(C)$ against thickness can be plotted. This should give a straight line graph of the form:

$$\ln(C) = -\mu x + \ln(C_0)$$



Describe the gradient of a graph of $\ln(C)$ against lead thickness.



Describe the gradient of a graph of $\ln(C)$ against lead thickness.

The gradient should be equal to $-\mu$, which is a constant. This means the graph should be a straight line with a constant negative gradient.

