OCR (A) Physics A-level

PAG 07.2 - Investigating the Absorption of Ionising Radiation

Practical Flashcards

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

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- 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?

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

How should a radioactive source be stored safely?

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Radioactive sources should be locked away in a sealed lead 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?

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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?

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A Geiger Counter or Geiger Muller Tube connected to a scaler.

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

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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?

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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?

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

How do you convert from a count to a count rate for a given distance?

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

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

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

Why is there likely to be a systematic error in the distance measurements when carrying out this experiment?

Why is there likely to be a systematic error in the distance measurements when carrying out this experiment?

The precise location of the radioactive source within the sealed capsule, and the precise location of ionisation in the GM tube are both unknown.

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 distances.

What is meant by the term ‘half-thickness’?

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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.

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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?

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Repeat readings will allow you to account for the random fluctuations in radioactive decay by calculating average values.

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

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

How can the thickness of the lead sheets be measured?

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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.

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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 -μ, which is a constant. This means the graph should be a straight line with a constant negative gradient.

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