

AQA Physics A-level

RP12 - Inverse Square Law for Gamma Radiation

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 sources an arm's length away from your body 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 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 scaler.



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 measurement uncertainty will be.



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



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

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 distance, to produce corrected counts (C').



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



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

The count should be divided by the length of time over which it was taken to acquire the count rate (mean number of counts per unit time).



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 distance from the source at which you can still get a measurable count. You could also take recordings closer to the source to determine a suitable time period over which to take readings.



What graph should be plotted to confirm that the inverse square law has been obeyed?



What graph should be plotted to confirm that the inverse square law has been obeyed?

A graph of $1/\sqrt{C}$ against x should be plotted. If the inverse square law has been obeyed, this should form a straight line graph with a positive gradient.



Why should a graph of $1/\sqrt{C}$ against x be plotted instead of a graph of C against $1/x^2$?



Why should a graph of $1/\sqrt{C}$ against x be plotted instead of a graph of C against $1/x^2$?

Plotting a graph of $1/\sqrt{C}$ against x removes any systematic error in the distance measurements.



Why is there likely to be a systematic error in your distance measurements in this experiment?



Why is there likely to be a systematic error in your distance measurements in this experiment?

The location of the radioactive source within the sealed capsule, and the precise location of ionisation in the GM tube are not known to a high degree of precision.



How can you obtain the systematic distance error from a graph of $1/\sqrt{C}$ against x ?



How can you obtain the systematic distance error from a graph of $1/\sqrt{C}$ against x ?

The straight line plotted will not cross the x -axis at the origin. The difference between $x=0\text{m}$ and the point at which the straight line crosses the x -axis will be the systematic error.



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 recordable counts over a large enough range of distances to conduct a meaningful experiment.