AQA Physics A-level

Required Practical 12

Investigation of the inverse-square law for gamma radiation

- Equipment:
  - Gamma source
  - Geiger counter
  - Metre ruler
  - Stopwatch
- Method:
  - With the geiger counter far from the gamma source, start the stopwatch and geiger counter and after 20 minutes, record the total count reading. This is the background count.
  - Bring the source into the laboratory and set the distance X between the geiger counter and the gamma source to 0.600m, measured using the metre ruler. Start the stopwatch and geiger counter and take the count N after 5 minutes.
  - Reduce X by 0.100m and repeat this, reducing it by 0.100m each time down to 0.100m.
  - Repeat the experiment twice more and find and record the mean C for each X.
- Graphs and calculations:
  - Calculate and tabulate the count rate C for each X using C=N/t and do the same to find the background count rate. Then calculate and tabulate the corrected count rate C' by subtracting the background count rate from C.
  - Plot a graph of 1/√C' against X which should give a straight line, verifying the inverse square law.
  - $C'X^2 = k \Rightarrow \frac{1}{\sqrt{C'}} = \frac{X}{\sqrt{k}} = constant \times X$ where k is a constant.
- Safety:
  - Exposure to radiation can destroy cells or cause mutations. Therefore, you should keep as big a distance between you and the source as possible, only keep the radioactive source out of its lead-lined container for as long as the experiment takes, and handle it only with tongs and do not allow it to touch your skin.
- Improvements and notes:
  - The graph might not pass through the origin. The most likely reason for this is that the exact position of the gamma material inside the sealed source is not known, so the actual distance between the source and the detector is greater than X. This is a systematic error. However, by plotting 1/√C' against X rather than C' against 1/X^2, a straight line should be obtained in spite of this.