Required Practical 12: Inverse Square Law with Gamma Radiation

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1 Risk Assessment:

Risk	Danger	Preventative Measures
Exposure to radiation	Exposure can cause cells mutations and cell death	• Only handle the radioactive source with tongs and gloves • Only keep the radioactive source out of its lead-lined container for as long as the experiment takes
Dropping Geiger–Müller tube on foot	Geiger–Müller tube (alongside other equipment) could be heavy and cause injury if dropped on foot	• Ensure that all pieces equipment (especially the Geiger–Müller tube) are treated with care • Ensure that protective footwear is worn (e.g. steel capped boots)

Table 1: Risk Assessment
[1] [2] [3]

2 Method:

2.1 Variables:

- Independent:
  - Distance between source and Geiger–Müller tube.
- Dependent:
  - Counts per second (CPM measured and ÷60)
- Control:
  - Radioactive source (same activity)
  - Geiger–Müller tube (same area)

[2] [4]

2.2 Equipment List:

- Radioactive Source
- Long tongs
- Gloves
- Safety Goggles
- Metre Ruler
- Geiger–Müller tube and counter
- Stopwatch timer
- Thin sheet of aluminium

[5] [6]

2.3 Written Method:

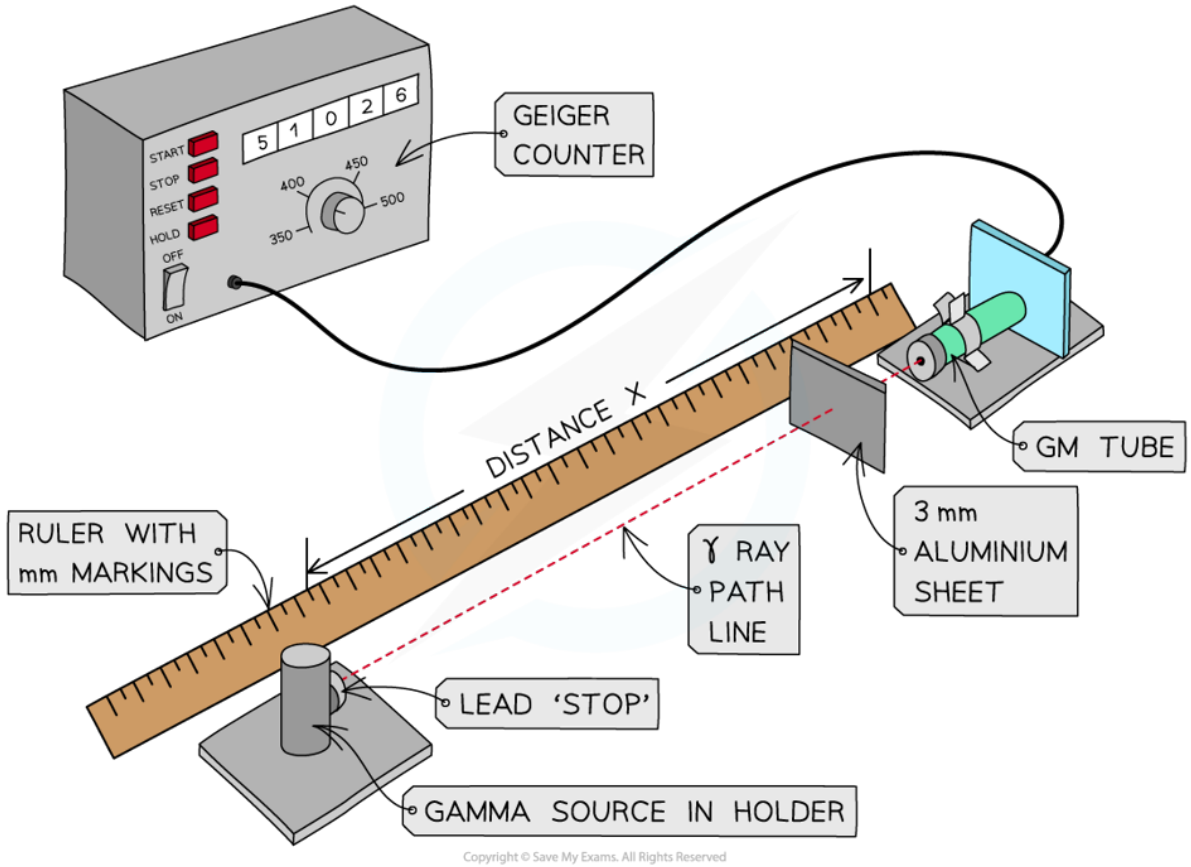

Figure 1: Diagram [1]

1. Read the risk assessment [see Table 1] and ensure that all preventative measures and followed through the experiment.
2. Ensure that radiation source isn't in the room.
3. Set up the equipment as shown in the diagram in Figure 1
4. Measure the background radiation using a Geiger–Müller tube.
5. Take 2 repeat readings and calculate an average.
6. Bring the radiation source into the room.
7. Put the radiation source a the starting distance of 5cm away from the Geiger–Müller tube and measure the number of counts in 60 seconds.
8. Take 2 repeat readings and calculate an average.
9. Repeat steps 7 and 8 going up in increments of 5cm until a distance of 60cm has been reached.

[1] [2]

2.4 Graphs and Calculations:

- Calculate and tabulate the count rate, C, for each value of distance, X.
- The inverse square states intensity of the radiation source from a point depends on the distance from the source.
- This relationship is given by: $I \propto 1/x^2$ where I is intensity and x is distance from source
- Intensity is proportional to the corrected count rate, C, so $C = k/x^2$
- Comparing this to $y = mx + c$ then:
  - $y = C$ (countss^{-1})
  - $x = 1/x^2$ (m^{-2})
  - gradient= k (no units)

[2] [4] [7] [8]

References

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